MODERN GUNSMITHING

A Manual of Firearms Design, Construction and Remodeling, for Amateurs and Professionals

by

CLYDE BAKER

SECOND EDITION, 1933

SMALL-ARMS TECHNICAL PUBLISHING COMPANY
Plantersville, South Carolina
U. S. A.

THE AMERICAN RIFLEMAN

JUNE, NINETEEN FORTY-THREE

Clyde Baker

One of the most popular contributors to RIFLEMAN pages, Clyde Baker, author of many home gunsmithing articles, died April 8, 1943. In ill health for some time he entered Oak Noll Naval Hospital on March 22 and passed away following an operation.

Mr. Baker was born at Cowgill, Missouri, March 26, 1894, but received most of his schooling at Kansas City, Missouri, where his family moved.

At the outbreak of World War I he enlisted in the Marine Corps and had nine months service in France. Upon returning to the United States and his home he went in for the hobby he always loved—guns, gunsmithing and repairing.

In 1922 he married Edna N. Mengel and then, in his own home, established a gun repair shop where he remodeled, rebuilt, repaired and restocked guns of all types in his spare time. His occupation was advertising. It was during this time he wrote his book, "Modern Gunsmithing," which became one of the most enthusiastically received writings of that subject. He was a lover of the outdoors and hunting came to him naturally. That and his gunsmithing hobby provided the material for the many articles he wrote for THE AMERICAN RIFLEMAN, *Sports Afield*, *Mechanix Illustrated*, *Outdoor Life* and others.

After Pearl Harbor Mr. Baker answered the Navy's call for men with specialized trades. Then being in the gun business entirely, he enlisted and soon was assigned to

instruction on the subject of "Guns and Gunnery" at San Diego. In July, 1942, he was assigned to special duty at the U. S. Naval Base at Oakland, Calif., where he worked in a small arms repair unit. Everywhere his fine work and gunsmithing ability was recognized and he was made Gunners Mate 1st Class last February.

Clyde Baker will live long in the memories of those who loved the outdoors, fine firearms and expert worksmanship.

CONTENTS

INTRODUCTION

SOMETHING over a year ago, in writing to Dr. Paul B. Jenkins, then shooting editor of Outdoor Recreation, I made the statement that there were a number of points I should like to have seen discussed in Whelen's "Amateur Gunsmithing" which were not covered therein. Apparently Dr. Jenkins was impressed with the outline of features which I thought would be of value to the gun crank as well as the professional gunsmith, for he sent my letter to Colonel Whelen without more ado.

Now the Colonel, being the most agreeable of men, frankly stated that "Amateur Gunsmithing" was not as complete as he should like to have made it, being the first work on the subject, and requiring original investigation, for which time was limited. And in further evidence of his devotion to a good cause, he cordially invited me to write the kind of gunsmithing book I was talking about, generously offering me any or all of the original material in his book, and his personal cooperation in the new enterprise as well.

If at first I felt flattered by the invitation, the feeling was quickly dispelled by the realization of what a big mouthful I had bitten off for myself; I was pretty much in the same situation of the nigger who caught a wild-cat by the tail—"couldn't hang on, an' dassent let loose!" But as all things must eventually have an ending, the last line was finally written, the last photograph made; and from the heart of the continent there sounded one long drawn sigh of relief.

It is evident that a book of this character cannot in the nature of things be entirely the work of one man. In the field of gunsmithing, as elsewhere, we unconsciously lean toward specialization, doing more of the work we like best, and less of the work we do not understand so well, or for which we are not so well equipped. In "Modern Gunsmithing," therefore, my work has been quite as much that of a compiler as of an author; the meager results of personal experience have been enlarged by adding the experience and knowledge of others, with a view to placing in the hands of gunsmiths and gunowners the greatest amount of useful material and information, regardless of its source.

There seemed to be a definite desire on the part of a large number of shooters for a textbook of gunsmithing practice, and every effort has been made to incorporate in "Modern Gunsmithing" detailed instructions covering those jobs most often required by the gun-crank.

There are some who will scoff at this suggestion, pointing out that the high degree of skill acquired by expert gunsmiths was not acquired by reading a book, but through long apprenticeship to the trade; and pointing out also the elaborate and costly machinery necessitated in the manufacture of modern firearms. All this is true; and it would be not only futile, but silly, to claim that this or any other text book would place the amateur workman or the gun-crank on a par with the expert of long experience, or enable him to perform all the intricate mechanical operations possible only in the well equipped factory shops.

It has been our purpose, therefore, to cover as thoroughly as possible those jobs which can be considered practicable for the amateur workman, and for the gunsmith with a small shop and limited equipment, and to show not only the possibilities, but also the limitations of amateur gunsmithing. And while some of the jobs described may prove to be beyond the ability of some workmen, they will, it is hoped, serve a useful purpose in bringing to the gunowner a greater appreciation of the guns he owns—of the skill and material which enter into their makeup—at the same time showing the fallacy, perhaps, of some of the things which shooters demand of the factories—things which are clearly impossible or impracticable once the subject is better understood.

It is hoped also, that our work may serve another useful purpose, in the way of a warning against a type of gunmaker who sneers at the work of our great arms factories and offers, in some mysterious manner which he carefully conceals from the trusting customer, to do things which the factories, with all their experience and costly equipment, do not claim to do.

We are tempted at times, of course, to take exception to the attitude of our large factories, when they refuse to give us something which we think we want—which refusal is always necessitated by the fact that the factories are lined up for regular production, and cannot, in the nature of things, go into custom work without involving more expense than the job would bring. But before we start cussing them let us remember that the products of our old established factories, while they may not always suit us in certain minor details, are pretty certain to be dependable, accurate, and to live up to the very modest claims of the makers. Which is a blamed sight more than the products of some custom shops will do, despite the gold dogs, the flubdubs, an the furbelows with which they are embellished.

A large portion of the credit for "Modern Gunsmithing" belongs to Lt. Colonel Townsend Whelen, without whose untiring energy and splendid cooperation the work would not have been possible, and would not have been attempted. In fact, though he modestly refuses to have his name attached as co-author, he wrote the chapters on barrel work and cartridge design and construction. I wanted these chapters to be absolutely authoritative, and I know of no man so well qualified as he is to cover the subjects.

I wish to acknowledge also the very valuable assistance rendered by Major Julian S. Hatcher, Mr. James V. Howe, Mr. Frank J. Kahrs, Mr. Lou Smith, Captain Edward C. Crossman, the Lyman Gunsight Corporation, the Marble Arms & Equipment Company, Remington Arms Company, Hunter Arms Company, Parker Gun Company, Fox Gun Company, Ithaca Gun Company, and other firms and individuals who have been so generous in the matter of supplying needed data or illustrations; and I am most grateful also to the several individual shooters, some of whom I have never met, who have come to the front with interesting illustrations of their own handiwork, besides their many valuable suggestions.

Last but not least I am indebted to the publishers for the many constructive criticisms, chapter by chapter, which have prevented the possible omission of much important data that might easily have been overlooked, and whose assistance in the matter of securing the cooperation and aid of leading firearms manufacturers, has proven invaluable.

The preparation of this book has taught me that the best way to really learn something about a given subject is to attempt to write a book on it!—and if the reader acquires half as much new information from reading "Modern Gunsmithing" as the author acquired in the writing of it, he will find, I hope, that his effort has not been entirely wasted.

Kansas City, Mo. CLYDE BAKER.
July, 1928

1

CHAPTER I

HOME GUNSMITHING

"HELLO, Bill!"

"Howdy, Frank! C'min."

"Believe the weather's coolin' off a bit, ain't it?—for heck sake, whatcha doin' there—makin' a gun?"

And Bill smiles. "Well, not exactly. Just a new stock for one of my old ones."

"One of 'em! How many you got, anyhow?"

"Oh, not many, I guess. Four rifles, my old Parker 12 that I use for ducks and a 20 gauge Smith for birds, and four or five pistols—not counting a coupla target pistols I made out of .22 rifles."

"My Gawd! You figurin' on startin' a revolution or something."

"Nope. Just like to shoot, and fool with guns. What did I do with that other file?"—and Bill rummages among the odds and ends on the bench. Frank watches him a moment.

"Say, ain't that some kind of an old army rifle?—that thing sticking out on the side looks like the ones we had at Funston during the war. Boy, I sure was glad to get rid of mine!"

"Well, this isn't an old army rifle, exactly, though it is a Springfield barrel and action. This is the 'Sporter' model sold by the Director of Civilian Marksmanship to members of the National Rifle Association."

Frank inspects the gun with a knowing air. "Um-m huh! Thirty-thirty, ain't it! Boy!—how far will that thing shoot?"

"Can't say. Depends on how high you hold it. I'll sight it in for a hundred yards for hunting."

"Aw hell—I bet that thing 'ud carry clear over into the next county! Wha'd'ya want with a thing like that around here for anyhow—can't use it in this country can you?"

2

By this time Bill is becoming somewhat nettled. "You can if you're not crippled! I get out for a little shooting on the range most every Saturday and Sunday. Don't have much time through the week. Now and then I get down along the river and throw a few at the driftwood, and such, as it floats down. Great sport, that—good practice for game-shooting, too."

"Game shooting—shucks—there ain't no game 'round here."

"No, not right out here in the yard. But I don't have to go far to find rabbits and squirrels, and usually get my share of birds and ducks in season. And last fall I got a prime elk and a nice bear out in Wyoming—and this fall I'm going up in Idaho with a friend of mine whose brother owns a ranch there. There's plenty of shooting if you know where to find it—and besides there's no closed season on targets, tin cans, chunks of driftwood. Yeah, I reckon I'll get my share of shooting, as long as they make powder!"

Frank gapes, open mouthed. "My gosh! I didn't know you was such a hunter. Lemme see one o' them bullets. Wow! That thing'd tear right through an elephant an' keep on goin', wouldn't it? Looka' that steel jacket—that's what we used in the army."

Bill keeps right on filing, unimpressed. "No, I don't reckon that would tear through many elephants. You see, Frank, that isn't a 'steel jacket' as you call it. It's just a hard cast alloy bullet for small game—that cartridge in your hand—which you call a 'bullet'—is a reduced load I use on squirrels, and the like. Shoots only a little harder than a twenty-two. Gives me a chance to get acquainted with my big game rifle outside the hunting season."

"Heck, that'd be too much gun for me—twenty-two's big enough for anything around here. I've got a peach of a twenty-two. Cost eight-fifty—knocks 'em dead far as you can see 'em—hardest shootin' twenty-two I ever saw. Say, Bill, that reminds me, they's some rust or something in that barrel—I told my kid brother to clean it up last summer, but I s'pose he forgot it. I had it out on a fishin' trip, but hadn't shot it more'n a dozen times. Smokeless, too—I always use smokeless ca'tridges. I'll bring it over an' you can clean it up.

"Thanks!" grunts Bill. "Move around just a little, will you, Frank, so I can get elbow room?"

"Sure! Say what are you doing to that stock anyhow?"

"I'm shaping it up right now."

"Wasn't the shape all right when you got it?"

"Didn't 'get' it—I made it."

"Made it! You mean to tell me you made that stock yourself?"

"Sure, why not?"

"What'd ya make it out of?"

"Piece of walnut like that blank over there in the corner."

"You mean to tell me you carved that out of a chunk of wood like this?"

"Nothing different."

3

"Well howd'ja get it that shape?—huh? Howd'ja get that groove cut in for the barrel? Howd'ja get all them other holes cut to fit? Say, boy! You've got more time to waste than I have."

Bill lays down his rasp and turns from the bench. "Frank, you're a pretty good guy—in spots—maybe. But you've a lot to learn. You're missing a lot of fun. Guess you're interested or you wouldn't be asking so many questions. I'll make you a proposition. Our rifle and pistol club meets at the Armory tomorrow night. Come on out with me—meet a bunch of good scouts—learn to shoot a rifle. You'll get just as much fun out of the game as I do—maybe more."

"Nothin' doin' old timer—not for me. Learn to shoot?—hell! I bet I can shoot better'n most of them birds right now;—an' besides I gotta date with a keen frail at the Play-Mor tomorrow night—boy, y'oughta see her. Some rib! Gosh, it must cost you a pile of jack to do all that shootin', don't it? Well, gotta beat it—see you later. Say, Bill—lend me five, will you—I'll pay you Saturday. Thanks! Well, so long!"

And Bill turns back to the bench with a sigh of relief.

• • • • • •

There's the picture—and it isn't exaggerated. In city, town, and country, there are legions of "Franks." We find them everywhere. Slowly, but surely, our male citizenry is becoming emasculated to the point of utter helplessness. Sliding along, content in their weakness, glorying in their inability to do things. Proud of the fact that they've never been taught to use their hands—and blind also, to the fact that they know mighty little about using their heads.

Work—honest, decent labor, skill of fingers, accuracy of eye,—somehow it seems to be beneath the present generation. The business man in his office sticks out his chest, holds "conferences," frowns and looks wise, preening himself on that thing he calls "ability." Then he sharpens his pencil by sticking it into a little machine and turning a crank—or more likely screws down the point of an automatic gold one; has his finger nails cleaned by the blonde in the barber shop; calls a service man to change a tire on his car; wears a little useless penknife on his watch chain and sends it to a grinding shop to be whetted!—yes, he does just that. We've been pampered now to the point of helplessness—and if we don't watch our step, we'll find ourselves at the point of uselessness.

The average man who owns a gun—I said the *average*—takes it to the gunsmith to be cleaned—usually two or three weeks after using it. But the average man of today doesn't own a gun—knows nothing about a gun—and brags about his ignorance. "Reform" has done wonders—in the way of making us a race of saps. Not that lack of gun knowledge, or a liking for firearms constitutes a man a sap—but the general trend of the times is doing this

4

very thing, and the supercilious attitude of the general public toward those things on which our forefathers builded the nation, is but one of the visible evidences of it.

Back in the hills, or on the farms, conditions are better. Living close to nature gives man a better viewpoint, a keener appreciation of the fundamentals. People are judged more by their ability than by their appearance or their social accomplishments. The man in the far places is not easily fooled by honeyed words of so called "reformers" who seek to take away our God-given rights; he promptly places him in his proper classification—and in so doing he doesn't call a spade an agricultural implement.

The pioneer of yesterday saw, thought, and acted clearly—with understanding. Having no one else to depend on, he learned to do things for himself. He built his cabin, fenced his fields, cultivated them with home-made tools, and filled his larder with game which he shot himself—sometimes with a rifle made with his own hands, or by the hands of a neighboring smith, with the crudest of home-made equipment. Civilization, as we know it today, was not essential in his scheme of things.

Since the inception of our nation, the love of firearms has been a natural instinct of the American. Not as a means of slaughter, except in defense of life and property, or to provide food for the table. This heritage has been passed down to us, to be received by some, and rejected by many. Civilization has in some unaccountable manner, twisted our brains.

The pioneer loved his long rifle, and gave it all the care and attention given by the true gun-crank of today—for the pioneer instinct is not entirely extinct. Thanks to the efforts of the National Rifle Association of America, each year finds a greater number who have learned of the wholesome sport awaiting them on the range, and in the woods; while the call of the bob-white and the honk of incoming geese is a perpetual inspiration to those who have inherited a love for the smooth tubes. And try as they may, the sob-sister element will probably never succeed in wholly depriving us of our love for the sport of shooting—for what is bred in the bone is born in the flesh. The male American who scoffs at the sport is either an alien by nature, or else is deliberately perverting his natural ideas.

The arms of the pioneer expressed his individuality—and each was, perforce, a custom built arm. For there were no great factories as there are today, equipped to turn out quantity production. The man who wanted a gun told the smith how he wanted it built, and the smith built it that way. Each gun embodied the pet ideas of the owner—ideas evolved from the necessities of the day and of the locality. As time went on, the private gunmaker was gradually replaced by the factories—and firearms began to lose their individuality. Living costs advanced, and with them the cost of material and labor. The machine-made factory rifles were acceptable be-

5

cause they were both good, and cheap in price—costing far less than the hand-made muzzle loader—and possessed the advantages of greater speed of fire, greater facility of loading, more compact construction, besides greater power and range.

* * * * * *

Yet in his acceptance of this new arm, the shooter never entirely lost his desire for expression of his personality in his weapons. The evidence is found in the several fancy grades of factory guns still supplied, and which usually are merely stock guns with added engraving and other decoration.

With the growing scarcity of our big game the need for more powerful hunting arms has grown apace, and hunters have learned that the military type of arm, being more highly developed, is now the best adapted to their requirements. So there has come into the field, not a new industry, but the revival of an old one—the building of special arms to the ideas of the individual, on modern actions adapted to the load he desires to use. This industry has been further aided by those, who while still clinging to the traditions surrounding the old "standbys," yet desired certain changes and refinements. Special stocks designed to fit, buttplates with trap for cleaning materials, pistol grips that serve a definite purpose instead of being a mere wart under the shooter's elbow, sights adapted to his eyes, barrels of gilt-edge accuracy, trigger pulls sweet and crisp, instead of reminding one of opening a cash register—these are some of the many things the custom-gunmaker of today is called upon to supply, by shooters who have learned what they want and who can afford to pay for it.

But for every shooter able to buy the gun of his dreams there are hundreds who must count their cash more carefully. And they,—like the pioneer who having plenty of time and little cash, mined and smelted his own iron, felled his rock-maple tree, and built his flintlock,—will retire to their improvised workshop, and with such tools as are available, produce the weapons they want. For failure is not written for the true gun-crank.

* * * * * *

Does home gunsmithing pay? That all depends. It pays Bill, but it may not pay Frank. The man who has the skill, or the patience to acquire the skill, necessary to turn out a job of repairing or remodeling in a workmanlike manner, will be far more proud of his gun than if it were the work of a high priced maker. Then there is the other man located far from factories and gunsmiths—the man to whom a reliable firearm is a daily necessity. A little knowledge of the more common repairs may prove immensely valuable to him, eliminating tiresome weeks of delay with the gun sent to the factory for repairs or alteration, or in saving the price of the job at a time when dollars are few.

6

The gunsmith, for some reason or other, has always surrounded himself with an aura of mystery; leading the shooter to believe that his craft was a gift from the gods, not to be encroached upon by ordinary mortals. True, gunsmithing is a highly specialized trade—but there's no black magic about it. It requires mechanical skill, and an understanding of principles, just like any other mechanical trade. Sawing off the end of a stock isn't so very different from sawing off a piece of oak flooring—both require a sharp saw, and ability to follow the line. It's no harder to file a spring or a hammer than it is to file a door latch—and either one may be ruined if you fail to stop in time. The jeweler makes a ring of silver, and oxidizes it—but he thinks the bluing of a gun is a deep dark secret. The dentist makes a gold crown and puts it on a tooth—why shouldn't he also make a gold bead sight and fit it to his rifle?

Many, if not most, of the so-called "trade-secrets" of firearms manufacturers are wide open secrets. The trouble has been that the factories had no reason for telling their customers how to do their own work, and the small amount of data available has been in most cases the work of amateur gunsmiths who, meeting the necessity as it has arisen, have worked out fairly good methods, but not necessarily the best methods by any means.

The man who prides himself on his inability to sharpen a lead pencil may well gasp at the sight of another man—perhaps one who is not a mechanic by trade—making and fitting and checking and finishing a rifle or shotgun stock; or spending long hours filing out some small part that "quantity production" methods would complete in a few minutes; or in bluing a barrel when there are factories better equipped to do it. "Does it pay?" he will ask. Of course not!—not as he would figure it. The gunowner cannot count his time at so much per hour and come out ahead on the job. But, in using his non-productive time to do work that perhaps he could not afford to buy, he acquires beautiful, well fitted and finished and smooth working arms that are a constant source of pride and satisfaction, because products of his own handiwork—expressing his own individuality. So of course it pays him to do it.

Gunsmithing is not child's play. It is hard, slow, painstaking WORK, calling for reasonable skill, the proper tools (many of which may be home made), and a whole lot of patience and attention to small detail. Yet it is perhaps the most fascinating pastime in which a shooter can indulge, next to the actual use of his weapons in the woods or on the range, affording him the opportunity of having exactly what he wants, at a price he can afford.

* * * * * *

Yes—home gunsmithing pays; it pays in more ways than one.

7

Chapter 2

THE GUN-CRANK'S WORKSHOP

THIS chapter is not intended for the professional gunsmith. It is written mainly for the sportsman who is desirous of providing a place wherein he may tinker when he pleases and as he pleases, with a view to steering him in the right direction. The man who tries to do his gun tinkering on a corner of the kitchen table is placing himself under a handicap right at the beginning; and while the "cliff dwellers" residing in city apartments may be forced to do thus, the man who has a bit of space to spare in his house will find it pays big returns in satisfaction and convenience to rig up a regular shop.

But in consideration for those not so fortunate, we had better consider their needs for a moment. Because a man "batches" in a furnished room, or lives in a kitchenette is no reason for depriving him of all the pleasure which the true gun-crank derives from working over his pets. A few simple tools with a compact chest or drawer to keep them in will give him many an hour of profitable pleasure.

THE "TABLE" LAYOUT. The first tool or piece of equipment to be considered in any case, is the vise. Without a good vise even the best mechanic is pretty helpless. The man who must do his work on the kitchen cabinet or library table must use a vise that can be clamped on or removed at will; and it should be a good one, with accurate steel jaws—none of the two-bit cast iron affairs found at the local department store, although even this kind is better than none. The Goodell-Pratt bench vise No. 161 has 2 inch jaws, opening 2 inches, and weighs 3 3/8 pounds, costing $2.60 list. It clamps firmly to any table top by a strong wing nut. The local hardware dealer or your favorite mail order house either has it or can get it fon you on special order. It is a real vise made for fine small work. Another which will be even more useful at times is the little Yankee toolmaker's vise with swivel base, No. 1992. The

8

jaws are 2 inches wide and 1 1/4 inches deep, opening 1 15/16 inches. The vise may be turned around to any position or angle and firmly locked in position. The jaws are straight, of hardened steel, with extra false jaws notched for holding round and irregularly shaped stock. The base of this vise fastens to the table with screws, but it may also be fastened to a small piece of hardwood which can be fastened to the table with hand clamps. This vise costs $7.50 and is worth it. A smaller size may be had at $5.00.

In addition to the vise or vises, you should have a good sized piece of board that can be placed on the table to work on. Both housewives and landlords are averse to having the furniture marred up with tools.

The Starrett No. 166-B pin vise is a handy thing for holding small rods and pin stock for filing. It has a small close fitting chuck, and is held in the hand while in use. It takes any size rod from .030 to .062 inch, and costs seventy-five cents. The No. 166-A is the same price, taking all sizes from 0 to .040 inch.

A hacksaw with 12 inch blades, and a few files, two or three pairs of good long nosed pliers, stones for lightening trigger pulls, and half a dozen screw-drivers will enable the table worker to do a lot of tinkering when the evenings are long and the story of the latest murder is missing from the evening paper. Under such circumstances heavy work such as making stocks is of course out of the question, but there is nothing to stop one from refinishing his stocks. A man might even be able to do a job of checking, by clamping the checking cradle to the table top. (See Chapter 12 for description of checking cradle.)

THE WORKSHOP. Now for the real home workshop, possible for the man who lives in a house, or in some cases for the apart ment dweller who can arrange for a little basement space. Somehow it seems the natural thing to put the workshop in the basement—yet this is the worst place for it, and should only be used in event no other space is available. Basements are seldom well lighted, and are often damp. Constant watchfulness is necessary to prevent tools, guns and parts from rusting. Cement workers have preparations for damp-proofing basements which are very effective, and it will usually pay to have this done; or one can buy the material and apply it to the walls himself. Select a spot having as much daylight as possible, and with good ventilation. North light is best in any shop; but since much of the work will probably be done at night, good artificial light is also essential. Acetylene or one of the powerful gasoline lamps or lanterns provides an excellent light in the country where other means of lighting are not available. If one has electric light, one or two drops should be placed directly over the bench in position that will eliminate shadows on the work, and 75 watt "daylight" mazda lamps should be used. These give a very brilliant light that is easy on the eyes.

6

The attic often presents splendid possibilities for the home workshop, and its only drawback is that most attics are insufferably hot in summer. But for that matter most of us prefer to spend our summer evenings otherwise than working. The long winter evenings afford the best times for tinkering. The garage or woodshed or other outbuilding may often be converted into an excellent workshop. The cracks should be well battened to keep out cold, and the roof put in good repair. It doesn't pay to let rain drip on high grade tools. A dirt or cement floor is usually damp and uncomfortable—a substantial wood floor is the best of all. It should be solid, well supported underneath, and without gaps and cracks to catch dirt. Be sure there is plenty of light and ventilation, and some means of heating in cold weather. Kerosene or gasoline heaters are inexpensive and may be purchased from the mail order houses at small cost. The Sunshine Lamp Company of Wichita, Kansas, makes a splendid low-priced gasoline pressure heater which is safe to use, and economical in fuel consumption. An old wood or coal stove is the best, provided there is room for it, but a discarded kitchen range, if in usable condition, is probably the best of all. For in addition to providing heat, it is also excellent for melting bullet metal if one happens to be a handloader, and by taking off the top lids it can also be used for the bluing tank or the nitre pot. If one expects to do much bluing in the home shop, it will often pay to install a three or four burner oil or gasoline range for heating the tank, in case city gas is not available.

If oil or gas is used for heating, be sure to have good ventilation in event there is no flue connection in the shop, for these heaters use up oxygen very rapidly making the air foul and unhealthy to breathe. If the shop has a good flue, and you can afford the cost, by all means install a small portable forge and anvil. It will pay for itself many times over in the making of tools, bending of parts in making alterations, in brazing, welding, and countless other operations. You need not be a blacksmith to use a forge to good advantage. Small portable forges and anvils, with necessary tools, can be purchased from the mail order houses all ready to set up. The forge should by all means have a metal hood over it to carry off gas and chemical fumes. A cheap castiron anvil will answer for much of the work—most of it, in fact—although of course a good steel faced anvil is best if you can afford it.

The very best shop of all, provided one desires to do bench work only, is the unused room found in most large homes. Usually this is a small room not convenient or well adapted to other uses, and the purchase of a new dress or hat for friend wife will often effect the arrangement without difficulty. Here may be built in, a gun cabinet, with shelves and cabinets for loading materials and supplies, and all the paraphernalia which the crank usually has kicking about. A room right in the house is likely to be well lighted and warm and

10

comfortable, and if the shavings, etc., are religiously swept up and carried out after each seance at the bench, the likelihood of domestic storms is reduced to a minimum.

Having everything else decided and arranged, the most important consideration of all comes next—THE WORK BENCH. It may be built, or purchased ready made—but it must, first of all, be substantial. A flimsy, wobbly bench is as bad as no bench at all. The top should be at least 1 3/4 inches in thickness, and the legs heavy enough to support it firmly. The legs must be firmly braced underneath to prevent wobbling and the entire bench must be heavy enough so that it will not shake under heavy sawing or draw-knife work.

From four and one-half to six feet is the best length; eighteen to twenty-four inches is plenty of width, and the height may be from 30 to 36 inches, or even higher, depending on your build and whether you use the bench mostly sitting or standing. My own choice is unusually high—39 inches; and my height is five feet seven; but I like to have the work up in front of me so I can handle it without strain on neck and back. Even with a rather high vise mounted on top of the bench I do not find this height too great. Most of my work is necessarily done standing, and a 36 inch stool provides a comfortable seat when the nature of the work permits. If one is interested only in very small work, such as making sight parts, or something of that sort, a very low bench—28 to 30 inches high—with a small low vise should be selected. Then a good comfortable chair with a back, and away you go. Such an arrangement is usually found in shops where much assembling of small parts is done.

An excellent home-made bench may be built from 2 inch pine lumber, using the Hallowell Steel Bench Legs sold for this purpose. A set of these legs for a bench 33 1/2 inches high and 28 1/2 inches wide will weigh 30 pounds, and cost about $6.75, complete with bolts, screws, etc., ready for assembling to the home-made top. Two or three dollars worth of lumber, a set of these legs, and three or four hours' work will result in a bench that cannot be surpassed for strength and rigidity. There are no drawers for tools, but these can be made and fitted by anyone handy with carpenter tools at small additional cost. Steel brackets for attaching a backboard to be used as a tool rack can be had for 35 cents each. These legs can be purchased from the Ellfeldt Hardware and Machinist's Supply Company, Kansas City, or from any larger dealer or jobber, most of whom either catalog them or carry them in stock.

The manual training benches carried by Hammacher, Schlemmer & Company, New York City, are rigidly built, with thick maple top, and fitted with a quick-acting cabinet maker's vise. A good bench of this type with drawers for tools and supplies will cost in the neighborhood of fifty dollars, and it is worth the cost if you plan to use it a great deal.

11.

The frontispiece shows a special bench which I had built in a mill at a cost of about fifty dollars. The upper tool drawers have sliding compartments for small tools, parts and supplies, while the sloping rack on top places the chisels, screwdrivers, and other tools used most frequently, in convenient reach. When doing stock work it is essential that the chisels are all within reach, as one is using first one, then another. Each size and shape should have its own location, and should be put back in the rack when another is taken. Thus there is no delay from misplaced tools. A simpler arrangement almost equally effective is a backboard eight or ten inches high, with a leather strap nailed on in loops for the different tools. Each should have its particular place, and be kept in that place at all times when not actually in your hands.

STORAGE OF SUPPLIES. Back of the bench, or conveniently located at one side, there should be shelves or cabinet for supplies, tools and materials. The important thing is to have a definite place for everything you use, and keep things in their places at all times. Tools should be kept where they are readily accessible—either on the tool rack, in drawers or shelves, or hanging on the wall above the bench. Don't "bury" things. The old-fashioned tool cabinet or chest in which the tools are packed and piled is a most infernal nuisance. Keep everything in plain sight as far as possible, and what can't be kept in view should be in containers that are plainly labeled.

For example, screws. The usual plan is to keep them in boxes stored away in shelves or cabinets, and the worker generally has to open a dozen or so boxes before finding what he wants. I use the small screw-top glass jars in which salad dressing is sold by grocers. Dump an entire box of screws into the jar—one jar for each size and kind—stand the jars in rows on narrow shelves, and you can put your hand on the right one instantly. A small sticker pasted on each jar also gives the size and thread.

This stunt is especially useful for special screws for sights. A few extra sight screws can be put into the jar, with a label showing the sights the screws are intended for. The drills and taps for these screws are kept right in the jar with them, hence always at hand when wanted—no hunting. Sights, springs and other small parts can also be kept in jars and plainly labeled to show what they are.

Besides tools, which will be discussed in the following chapter, there are two other essentials to the well ordered home workshop. These are a good bench brush and a broom. Keep the place cleaned up! A litter of shavings and dust on bench top and floor is not only unhealthful, it is conducive to accidental fires, and worst of all, a screw or other part dropped into the litter is almost sure to be lost—often resulting in weeks of delay while another is secured from the factory. And if it happens to be a part of an obsolete gun for which parts are no longer available—wow! It's a lot cheaper

12

to sweep out occasionally than to pay a machine shop $1.50 to make a screw.

SHOP LAYOUT. Arrange things in the shop in the most convenient manner possible. Saving of steps means more and better work in less time. The cabinet maker's vise, if one is used, should be placed at the extreme left end of the bench. Most gunwork, however, requires a regular machinist's or iron worker's vise—and the best place for it is near the right end. By all means, if you are right handed, have the left end of the bench in the clear. If necessary to set it in a corner, let the right hand end be inaccessible rather than the left. If you go in for a drill press, lathe, forge, or similar equipment, get them clear of the bench—on the other side of the shop if possible. Five or six feet of floor space in front of the bench will be needed, and the same amount at the left end.

Bluing equipment should be in a separate room, away from the tools if possible. Bluing is a rusting process, and the steam and vapors are hard on tools. If your shop is in the basement, set the bench and tools in one corner, and the bluing layout as far away as possible—and always have plenty of ventilation when bluing to carry off steam, fumes, and moisture.

Finally, arrange to keep others away from your shop and tools. If in a separate shed or outbuilding, put bars on the windows, and good locks on both windows or doors. If in a basement, it will pay you to partition off the shop with framing covered with heavy wire, and a good padlock for the door. This of course will not keep out a burglar, but it will prevent the sponging neighbor who never has a tool of his own from borrowing from friend wife while you're away, or the gas-meter man from picking up your micrometer,—and it will also keep the lady of the family from helping herself to your hacksaw to cut a ham bone, or using your favorite chisel to chip ice for dinner, or driving a nail to hang a picture with your pet Pope bullet mold. I happen to know how these things go!

If there are children in the family it is essential to keep them away from tools and other equipment during your absence. A small boy who is inclined that way can wreak untold damage in a few minutes time—leaving tools about the yard, or losing them about the neighborhood. Moreover, if you keep powder and primers on hand, the locked door is a necessary precaution.

All this work and fuss and equipment may sound like a large order to the chap who never takes the trouble to tighten up a sagging screen door; but an investment in a small home shop, with good dependable tools, will pay big dividends in satisfaction and pleasure to the true gun crank, besides providing a sure means of keeping the kids in off the streets as they grow up and begin to take an interest in the "old man's" playthings.

13

Chapter 3

TOOLING UP

HAVING prepared a place to work, whether in basement, attic, or out-building, the next consideration of the gun-crank is tools and equipment. It is possible for the amateur gunsmith to accumulate several hundred dollars worth of tools in a few years without realizing it, simply buying this or that item as needed to complete a job; and when expensive tools are bought, used once, then laid away and forgotten, one's hobby can easily become a gross extravagance. Unless you expect to use a tool frequently enough to make the investment pay, better look for a way to do without it, and use its cost for a more practical purpose—such as buying ammunition or loading supplies. I do not mean by this that a man should hesitate about buying first class tools whenever needed, and whenever they are of a type to serve a real need. It is poor economy, for example, to pay $1.40 for a counterbore reamer to cut a hole for some particular screw head on an obsolete gun; the screw is probably a bastard size which will never be encountered again. Rather, adapt another screw, or if this cannot be done, spend a few minutes making a flat reamer which will cost you nothing but your work, and which will do one or even several jobs successfully.

This economy may of course be carried to the opposite extreme. No man deserves credit for sponging or borrowing tools from his neighbor, nor for using some nearly worthless makeshift and cobbling up his job. Every job should be turned out in the most careful, painstaking manner of which you are capable—and most men are capable of better work than they think they are. The difference between a good job and a poor one quite often depends on knowledge of some simple "kink" to obtain desired results. A man may scratch his head and study for hours on some simple mechanical problem, when the answer is right before him. Learn to do things right; learn

14

the tools needed for each job; and if the job is likely to recur frequently, the purchase of the tools will always prove a good investment.

A large initial outlay is not necessary for the gun crank starting a home workshop. A few simple tools, of best possible quality, will do to begin with; others may be added, or perhaps made, as the need arises. Thus in the course of time your equipment becomes more complete, and many a job that would have stumped you in the beginning will seem like child's play, because you are tooled up for it.

FILES. If I were forced to start a shop with but one tool, that tool would certainly be a file, provided I had my choice. I consider the file the most important of all mechanical implements; with it many other tools can be manufactured, and in a pinch it could be made to serve, after a fashion, in lieu of other tools.

Next to a tool with which to work, a method of holding the work is most important—so a first class vise becomes a secondary consideration. With a good file and a good vise, a "fair to middlin'" mechanic need not be afraid of many jobs. So we will first consider files—both wood and metal—and vises at some length, after which we will discuss other tools likely to be needed by both the amateur and professional gunsmith.

The file in one form or another can be traced back almost to the beginning of time. While its development probably followed that of the saw, its greater scope of usefulness entitles it to a higher place in the history of civilization. Abrading instruments date back many centuries prior to the Christian era, and like most other man-made tools, had their origin in nature. The following, quoted from "The File in History," published by Henry Disston & Sons—a little book which every mechanic should have and read, by the way—is interesting:

"There is a type of mollusc having a rough tongue with which it rubs or files through the shells of other molluscs on which it feeds. The wasp, also, has a rasp-like organ with which it abrades dry wood, afterwards mixing the dust with a glutinous saliva to form the paper with which it builds its nest. The cat's tongue, and that of the cow, are familiar examples of abrading organs in the animal kingdom.

"Prehistoric man made handles for his weapons by sawing or splitting wood, rough shaping the pieces as well as he could by primitive methods, and finally finishing and polishing them by means of the particular abrasive material found in his vicinity. * * * To abrade, or file, ancient man used sand, grit, coral, bone, fish skins, and gritty woods—also stone of varying hardness in connection with sand or water.

"The Egyptians of the Light Dynasty, about 1200 to 1000 B. C., made small rasps of bronze, as several specimens have been found which could be more or less accurately connected with that time. * * * That there were iron files in Solomon's time may be inferred from his statement: 'Iron sharpeneth iron; so a man sharpeneth the countenance of his friend,' but the first historical mention of artificial files that can be definitely identified as referring to such implements as are now understood by this term is found in I Samuel: xiii; 21, which is supposed to relate to about the year 1093 B. C.

15

"'They had a file for the mattocks, and for the colters, and for the forks, and for the axes, and to sharpen the goads.'

"Files are also mentioned in Homer's Odyssey. They were doubtless very crude in form and inefficient in operation as compared to present day files, but the fact that they were mentioned in these early writings is proof that they were held in high esteem by workmen of ancient times."

And by workmen of today also, I might add. Your real mechanic prizes his files, and gives them good care. He doesn't throw them loose together in a drawer, to blunt and break the teeth, but lays them carefully on the bottom of drawer so they cannot rub together.

Until comparatively recent times, files were made entirely by hand. The workman held a chisel above the soft annealed blank at the proper angle and struck it repeatedly with a mallet, cutting and raising the teeth as required. On some of the old handmade files the spacing is almost as even and perfect as on the best modern machine made files. Even to-day there are Swiss file makers who still use the old method of hand cutting, and their files are world famous for their quality and temper.

The three best brands of files in this country to-day are the American Swiss, the Nicholson, and the Henry Disston. Every file turned out by either of these firms may be considered a good file; if used for the purpose intended. Of the three, I find the American Swiss most useful in gun work—not that the quality is any better, perhaps, but because this firm produces a larger variety of special shapes and sizes than either of the others. All three makes can be procured through any first-class dealer or jobber, and it will pay the aspiring gunsmith to secure the factory catalogs of all three companies and study them,—it is surprising how many shapes will be found that one did not know existed. Files—even the best of them—are comparatively cheap in price; it pays to have plenty on hand—plenty of shapes, plenty of sizes, and plenty of different cuts. By "cut" we mean the size and formation of the teeth.

Files are usually divided into three general classes—single cut, double cut, and rasp cut. The single cut has straight single teeth running at a slight angle across the blade. The files are called, according to the size of these teeth, "Rough," "Middle," "Between Middle and Bastard," "Bastard," "Second Cut," and "Smooth."

The double-cut file is cut in the same manner, but has another set of straight teeth cut diagonally across the first, resulting in short pointed teeth. All double-cut files are usually referred to in the shop as "bastard" files whereas the term really applies to the size of the teeth, whether of single, double, or rasp cut.

The rasp tooth is cut in a different manner from the other two. Each tooth is cut separately by a blow from a pointed chisel. The commercial names for the different size teeth are: "Horse," "Rough," "Middle," "Bastard," "Second Cut," and "Smooth."

Files and rasps are further subdivided and named according to

16

their shapes and uses. Figure 1 shows the sectional shapes of several of the most commonly used.

These are but a few of the many special shapes available for special classes of work. In addition to files and rasps there are "rifflers"—very small steel handles with specially shaped and curved ends with teeth only on the ends used by die-sinkers and silversmiths, and also wood rifflers, called "wood carver's rasps," but made similar to the smaller rifflers, except for the size and teeth. I would consider the following a sufficient file assortment for the amateur gunsmith to begin with—later, as he comes to appreciate the many uses of files, he will study the makers' catalogs and select others as needed:

1	Cabinet rasp, rough or middle, for roughing out stocks,	14 inch
1	Cabinet file, double-cut bastard, for final shaping, half round,	14 inch
1	Half round, double-cut bastard file (for metal),	14 inch
1	Half round, double-cut bastard file (for metal),	10 inch
2	Vixen files,	12 inch
1	Single cut mill file, second cut,	12 inch
1	Single cut mill file, smooth,	12 inch
1	Single cut mill file, smooth,	8 inch
3	Single cut mill files, smooth,	6 inch
1	American Swiss Finishing or Stripping file, No. 4 cut	12 inch
1	American Swiss Pillar file, Nos. 2, 3, or 4 cut	12 inch
1	American Swiss Pillar file, No. 2 cut, narrow,	3/8 by 8 inch
1	American Swiss Pillar file, No. 2 cut, extra narrow	5/16 by 8 inch
1	American Swiss Pillar file, No. 4 cut, extra narrow,	5/16 by 8 inch
1	American Swiss Crossing file, No. 2 cut,	8 inch
1	American Swiss Crossing file, No. 4 cut,	6 inch
1	Screw slotting file.	
1	Double-cut rattail file,	3/8 by 12 inch
1	Double-cut rattail file,	1/2 by 12 inch
1	Double-cut rattail file,	1/4 by 8 inch
1	Straight round file, No. 2 cut, (Am. Swiss),	3/16 by 6 inch
1	Straight round file, No. 2 cut, (Am. Swiss),	5/16 by 8 inch
1	each of the following die-sinker's needle files, 6 inch: Round, Square, Knife, Flat, Three-square, Crossing, Half round, Barrett	
3	each die-sinker's needle files as follows, 4 inch: Round, Knife	
6	3-square Escapement files, No. 2 cut,	5-1/2 inch
1	each die-sinker's rifflers, Nos. 1, 3, 4, 5, 11, 16, 18.	
1	each Hammacher-Schlemmer Co.'s. wood carver's rasps Nos. 140, 142, 146, 148, 152.	

This sounds like a pretty large order; yet the entire layout need not be bought at one time, and even if it is, it will not run into a great many dollars; and every tool in the lot is extremely useful—many being absolutely necessary. Where several sizes of the same kind of file are listed, it is advisable to buy only the one size needed for the particular job in hand, adding the others as needed. With such an assortment, or even half of it, a man will be pretty well equipped to turn out any kind of filing job required for the alteration or manufacture of any gun part that can be made by hand. The rifflers and wood carver's rasps can be passed up if desired—they are extremely useful, but not always essential. All of the larger files will be needed frequently, and most of the die-sinkers. The finishing or stripping file and the large pillar file will be found indispensable for

17

striking barrels, and should be used for no other purpose. Various others are mentioned from time to time in connection with special jobs described throughout this book.

Having the files, the next thing needed is a file card—a brush with short hard steel bristles with which to brush out the filings that stick in the teeth. A clogged or "pinned" file is very quickly ruined, and a 40 cent card will add months or years to the life of all your files.

THE VISE comes next. The most useful of all vises in the gun shop is the Prentiss Ironworker's Vise No. 19. This vise costs about $15.00. and is the best investment you can make if you

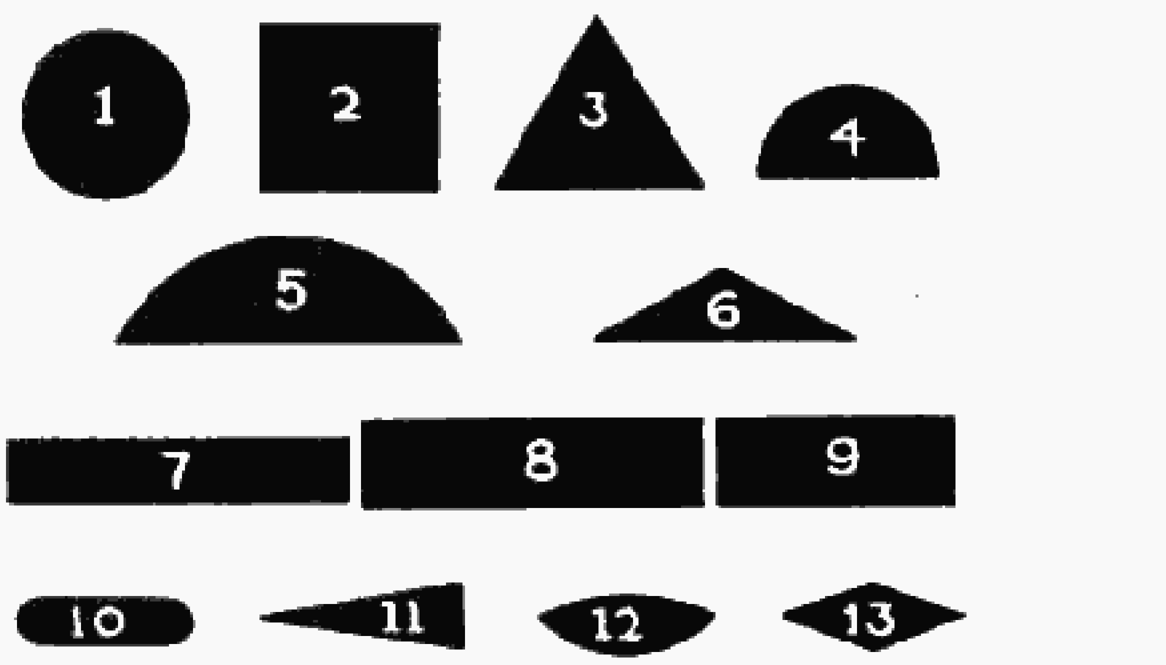


Fig. 1. Various sectional shapes of useful files, and their names: 1, Round; rattail; mousetail; (according to size) made in both taper and parallel. 2, Square; Taper and parallel. 3 Three-square; Taper and parallel. 4, Pit-saw; really half round in section, but not so named. 5, Half round. 6, Cant or lightning. Same shape as a Barrett file except the latter is slightly thinner, and smooth on the angled sides. 7, Mill. 8, Flat. 9, Pillar. 10, Round edge joint. 11, Knife. 12, Crossing. 13, Slitting; lozenge.

plan to do much work. Both the base and one jaw are swiveled, enabling the worker to swing the vise to any position or angle, and to grip tapered stock, barrels, gunstocks, etc., firmly. The jaws are 3½ inches wide and open 4¼ inches, fitting together very accurately when closed. If you do not care to put this much money in a vise, then get a heavy, cheaper iron one of about the same size—they can be had as low as five or six dollars, and often can be picked up second hand for half that amount.

For a second vise it is well to consider one of the rapid-acting cabinet makers' vises which attach under the bench, the jaws coming flush with the top. These open and close by a quarter turn of the handle, and are fine for planing and draw-knife work, but are no good for heavy work on metal. They can be had from any hardware or mail order house and cost around $5.00.

For a third vise, consider the little Yankee No. 1992 toolmaker's vise mentioned in Chapter 2. It is worth its weight in gold for small jobs on sights, springs, pins, etc., and has the advantage of being

18

detachable from its base, so that, with small work in the jaws, it may be clamped at any desired angle in the larger vise. Any of the Goodell-Pratt hand vises, and a G-P or a Starrett Pin Vise will also prove useful occasionally.

SAWS AND PLANES. Now we need a few wood working tools. Some of these will—or should be—found about every well ordered household, so they need not be charged against gunsmithing. First a rip-saw and a cut-off saw, of either Disston or Atkins Silver-Steel make—it pays to buy nothing but the best saws. A ten or twelve inch back saw for use in the mitre box for sawing off butts, and other accurate work will prove valuable, but may be dispensed with. Same with the mitre box. A good Stanley or Langdon iron mitre box is worth its weight in gold—when you need it; you don't need it often. A common wood mitre box such as every carpenter makes for himself in a few minutes, will serve nearly as well.

You should have three good planes—jack, smooth and block. If you want to buy only two, cut out the smooth. Stanley's Bailey pattern iron planes are the best ever sold and well worth the difference in their cost over cheaper ones. Such tools as planes, saws, etc., will find many uses other than in the gun shop, so there is economy in buying good ones. For a jack plane the Bailey No. 5 1/4 at $4.50 will answer your purpose nicely; the No. 1 smooth plane at $3.55 will also be handy for smoothing up the sides of stock blanks, but the jack will answer nearly as well; for the block plane, give first choice to the Stanley No. 65 at $3.40, second choice the Stanley No. 65 1/2 at $2.80, and last, the Stanley No. 110 at $1.25.

Many stockmakers use A DRAWKNIFE for the first shaping of a stock, working it down almost to size before using the rasp. I have a drawknife which I seldom use; nor do I often recommend it to the amateur stocker. Most of my stocks are made from curley or figured wood which will not shave worth a cent, and it is nearly as quick to use the round side of the cabinet rasp, which takes off the surplus in a surprisingly short time. Moreover, nobody ever split a stock or took off wood unintentionally with a rasp. Occasionally I find a drawknife helpful on a straight grained piece for roughing off the corners, but I could get along nicely without it.

The same applies to THE SPOKE-SHAVE or shake-shave. If the wood is perfectly straight grained, this is a mighty handy tool for shaping up following the drawknife. Yet a good rasp will do the work quicker and easier, for me at least, and my spoke-shave usually rests comfortably in the drawer with the drawknife. No objection whatever to using one if you are familiar with it and like it—only, remember it leaves flats on the stock which must be removed later with the cabinet file and sandpaper.

One tool which I have never used that might have saved me a little time, is a rabbet plane or a router plane. Such a tool is handy for roughing out the barrel channel in a stock, provided you keep at

19

least 1-16 inch from the sides and bottom. The barrel channel is seldom or never a straight groove—most barrels being tapered or having some special formation. Perhaps one reason I have never used the rabbet plane is because so many stock blanks are twisted or warped out of shape in the drying so that the channel is seldom cut parallel with the sides, but is centered on a line which likely as not runs at a slight angle with the piece. Use a rabbet plane to hasten the job if you want to—but leave plenty of wood to be finished out with the chisels as described in Chapter 10. These planes are made

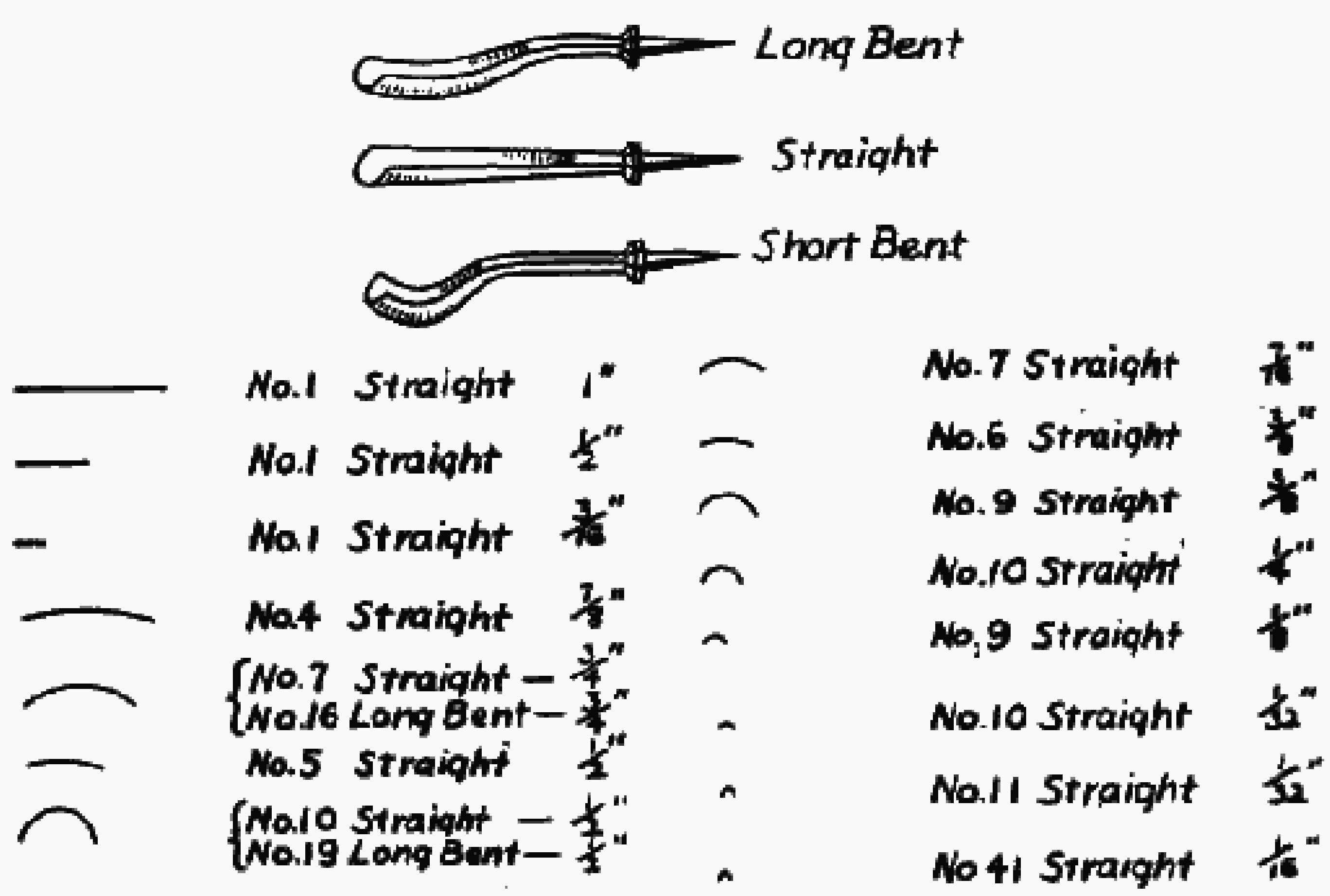


Fig. 2

by Stanley, and are listed in all hardware catalogs, also handled by the large mail order houses.

CHISELS. The most important tools used by the stockmaker are his chisels. Without good chisels he is helpless. And while the ordinary socket firmer chisels and deep thick gouges used by carpenters may be used for inletting a stock, their work is crude and proceeds very slowly compared with the work of the thin, keen carving chisels, which are made in a wide variety of shapes and sizes.

The very best carving chisels in the world are those made by J. B. Addis and Sons, of London. They are as far ahead of common chisels as a Packard is ahead of a 1913 flivver. They are thin and springy, made of fine Sheffield steel, forged entirely by hand—they are *real tools*. Addis chisels are sold in this country by Hammacher, Schlemmer & Co., New York City, who publish a tool catalog that should be in the hands of every gun-crank, and in this catalog they list a large number of shapes and sizes in which these chisels are sup-

20

plied. Figure 2 shows the three shapes of blade—straight, short bent and long bent; also the edge shapes and sizes that will prove most useful to the stocker. These chisels do not cost a great deal more than the ordinary kind. They should be ordered with hexagonal maple handles already fitted.

When you get the chisels they will be ground on one side, but not sharpened on a whetstone. This you must do yourself, and instructions for sharpening will be found in Chapter 7.

For your first attempt at stocking a gun you can limit your purchase to two or three chisels, choosing the shapes that seem to fit the cuts in the old stock best. Later, you will want to add to your chisel collection. Never try to use a hollow chisel that is the full size of the channel to be cut—the chisel should invariably be a size or two smaller.

Saws, planes, drawknife, chisels, rasps and files—these are the essentials of the stock maker. Many others will come handy at times, and can be added when and if required. Don't blow all your cash on tools with which to make the gun, and have none left for "shootin' money."

I have not mentioned the mallet in connection with the chisels, for the very good reason that the mallet may very nicely be dispensed with. Use it if you like, but use it seldom. Stocks are not inletted by hammering or driving in the chisels. Wood carving chisels are held in the hands, and a mallet blow is seldom or never required. The tools must be kept so sharp that they will cut across the grain of hard walnut readily without hammering. An occasional light blow with mallet or side of hammer may be excused when cutting the magazine mortice, but nowhere else. The stock maker trims out the wood in shavings instead of gouging it out in chunks like a carpenter morticing in a door lock. There's quite a difference.

Carving chisels are "chisels" and not "gouges" whether they are curved or flat, and their sole purpose is *cutting*. Select your chisels by number and shape of edge—and do not be led into buying a "set" of carving tools put up in a box. Most of them will be useless for gun work, and the box is a nuisance anyhow. Get the chisels up in a tool rack where you can get at them.

BRACES, BITS AND DRILLS: A good brace and a few bits will be required for boring holes. The principal use of augur bits is in roughing out wood in magazine mortices, and in boring out the butt recesses under a butt plate trap. Augur bits are not expensive, and it will pay to invest in a set of high grade ones, graduated from ¼ inch to 1 inch by sixteenths. An expansive bit may be needed now and then, but there is no need of buying it until the need arises.

Forstner bits are very useful in gun work. Unlike augur bits they have no spur in the center, being guided by a sharp outer rim or cutting edge, and making a hole with a smooth level bottom.

21

These are very convenient for cutting down into the ends of lock recesses in side lock shotgun stocks, and elsewhere, but since they cost two or three times as much as augur bits, it is advisable to purchase them one at a time as needed. These bits are often incorrectly called "Foster" bits, so it is well to know both names in case the hardware man doesn't know what you're talking about.

A Yankee push-drill with an assortment of small bits in the handle is a handy tool around the house—but about the only thing you will ever use it for is to drill screw holes in the butt of a stock, and for this purpose a hand drill or breast drill is better. Though generally used for metal work, these often come in handy for woodwork as well. They should be selected with care, and the cheap ones avoided, as they are not accurately aligned, nor can the chucks be depended upon to hold the drills. The hand drill chuck should be capable of taking drill shanks up to 3/16 inch in size, while the breast drill should take them up to 1/2 inch. Any of the Yankee, Goodell-Pratt, or Millers Falls drills are good—select the model you like best and you will make no mistake.

MEASURING TOOLS: A good boxwood marking gauge will be needed for running the center line around stocks—provided the sides of stock are planted perfectly straight. Otherwise the gauge will have to be replaced by a pencil and long straightedge. A narrow bar of flat hardened tool steel makes the best straightedge of all. The other measuring and marking tools you will need are: a 12 inch steel scale, a folding wood or steel rule 3 feet or longer, sharp pointed dividers, inside and outside calipers. A pair of hermaphrodite calipers will pay dividends on many a job. These have one leg pointed and adjustable for length; the other leg is bent, and the hinge joint has no stop so that the bent leg can be used on inside or outside measuring, while the pointed leg is used for marking.

Thus far I have mentioned no machinery. The average man does not care to go to the expense of it for a little home tinkering, nor does he have the amount of work to warrant such expenditure. The only time any sort of machine is really essential to the home tinkerer, is when he has fitted a recoil pad to a stock. The only way the pad can be dressed down even with the stock is on a flat sandpaper wheel. For this purpose I use a Van Dorn motor grinder of 1/4 h. p. with the grinder wheel on one end of shaft replaced by a 7-inch wood wheel 1/2 inch thick, on which is glued a sheet of garnet cloth. This motor runs at 3600 r. p. m. which is really faster than a sandpaper wheel should run—2500 would be a better speed and easier to handle. The high speed is of value when using a coarse grinding wheel to rough off metal, instead of filing or milling it off.

A small wood turning lathe, while not a liability, is seldom needed by the stocker. Now and then it would help on some small job, such as turning up dowells, or something of that sort—but don't

22

put your money in a wood turning lathe until you have everything else you ever expect to need.

The tools for metal work of the amateur or the professional gunsmith are far greater in number than the woodworking tools. After the vise and the files, the most important are perhaps the SCREW-DRIVERS. I doubt if any tool is more often abused, or more grossly misunderstood than the humble screwdriver. The average man tries to get along with one or two, when he needs a dozen. Gun screws are often set in very tightly at the factories, and their removal necessitates a driver that exactly fits the head slot both in width and thickness. Unless it does so fit, the attempt to remove it usually results in a badly marred screw head—maybe one that is engraved and color-hardened, and must be sent to the factory for replacement. A poorly fitting driver may even split off half the head—then the fun begins! As soon as the air clears it is necessary to drill out the screw, which commonly results in ruining the threads in the hole also.

It doesn't make much difference what make screwdrivers you buy—they all have to be shaped up after you get them. I like Yankee drivers best, but probably this is just a habit. Select sizes a trifle larger than the screw slots most commonly encountered. File the end of blade off perfectly square, then thin it down on the sides, *without beveling*, until it is just an easy fit in the slot. File to correct width, and round the side edges slightly at the point. Leave the "business end" square and sharp, unless you run into a screw having a milled slot rounded on the bottom from side to side—then round the edge of driver slightly to fit it.

For removing the tang screws from Springfield and other bolt action rifles, I have a screwdriver with a large heavy handle from which the blade projects only two inches. This little devil gets right down to business and takes 'em out! The handle is thick enough for a good grip, and the hand is brought so close to the work that there is no danger of slipping. An extra large long blade will be needed for getting at the stock screw that is put in through a hole in the butt as in the '99 model Savage and the Lee Enfield. Between these two you will require various sizes that may be purchased or made as required. The main thing is to have the right size for the screw in every case, and don't try to make the wrong size do. Either make a new one outright, or grind down another to fit—and be sure the point is well hardened, but not too brittle.

Screwdrivers are easy to make. A few pieces of drill rod should be on hand at all times for this purpose. Heat the end of rod and forge it flat, then file to shape, or grind; then harden and temper as described in Chapter 21. If you have no drill rod or other tool steel, make the blade of cold rolled steel and caseharden in cyanide—

some of the best screwdrivers I have are made thusly—and this is a good remedy also for the cheap "store" ones that prove too soft.

23

The sides of most screwdriver blades are tapered slightly toward the point. This is O. K. provided the blade does not have to reach into a hole for the screw—in that case grind off the taper so that the blade is slightly wider at the extreme point.

A small jeweler's screwdriver with revolving head should be on hand for removing the smallest sight screws, and the little all steel screwdrivers packed with Colt revolvers are also excellent. When making very small screwdrivers, use drill rod and shape the point as shown in Figure 3, using a rattail file for the purpose. This is the strongest possible shape for a small blade. When made of

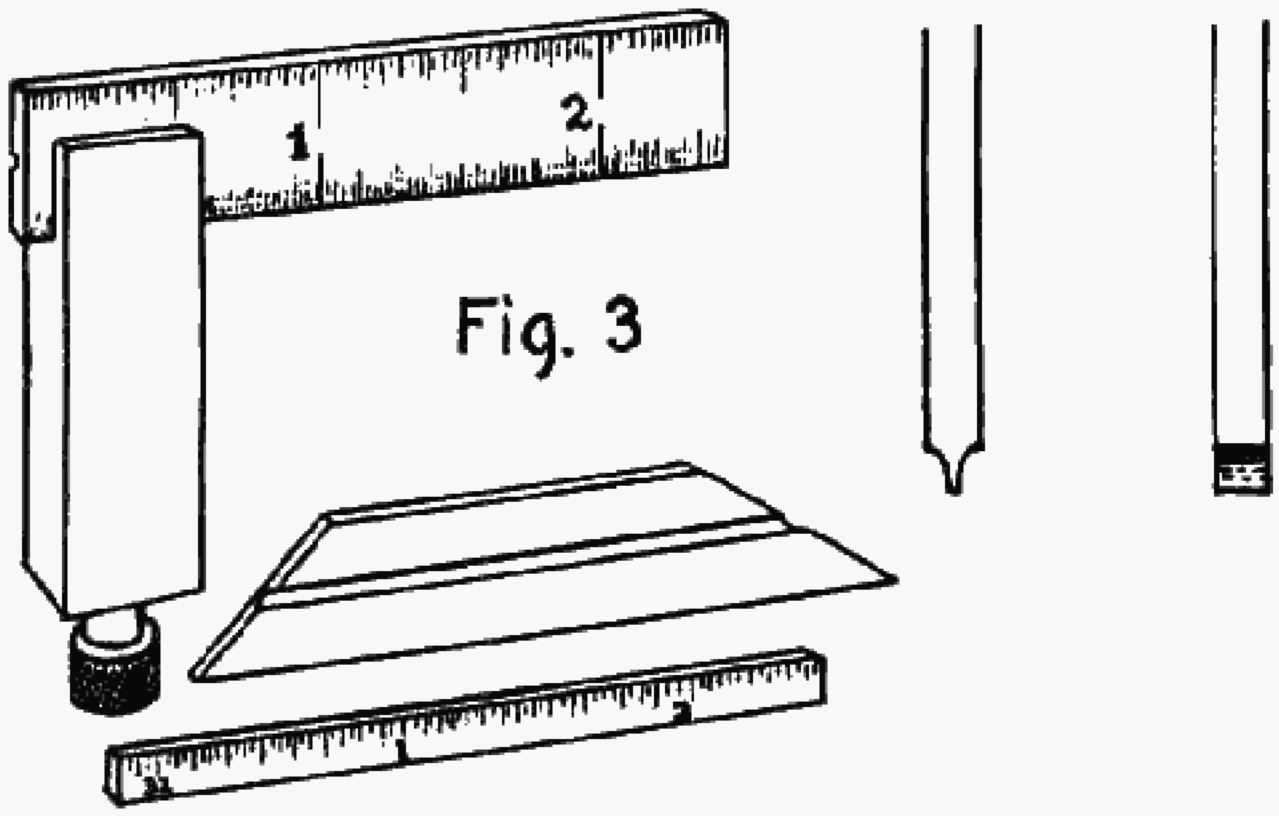


Fig. 3

tool steel without heating or forging, it is seldom necessary to harden or temper the point.

BENCH DRILLS: Hand drills and breast drills have already been mentioned. A small drill press is useful, but hardly worth the cost in the home shop. The gunsmith should have one, motor driven, taking drills up to one-half inch in size, or larger if his work requires it. A good bench drill is exceedingly useful, and some models cost little more than a high grade breast drill. The Goodell-Pratt No. 8 1/2 drill takes up to 1/4 inch drills in the chuck; it is hand driven and hand fed, and is equipped with a special vise which can be used in place of the table for holding work. The price is $11.55 list. The same drill without the special vise is known as the No. 8 and lists at $8.50.

The No. 9 drill of the same makers takes up to 3/8 inch drills and has a table adjustable for height. It is also hand operated, and lists at $12.70 without the vise, and $16.00 with vise—the latter being known as the No. 9 1/2.

There is also a splendid line of Yankee bench drills considerably

24

higher in price than the Goodell-Pratt. They are, however, heavier in construction and should stand up to more accurate work. They are supplied both in hand and power drive.

The beginner may be tempted into the purchase of one of the portable electric drills, often supplied with a rack on which they may be mounted to serve as a bench drill. I would strongly advise against such an arrangement. These drills are noisy, and have lots of play due to the gearing. They are fine to throw around under cars in a garage, and will do a splendid job of drilling bolt holes for attaching license plates to the flivver—but they have no place in a gun shop where precision is the order of the day. Let the garage man follow his own methods, if any.

DRILL BITS AND GAUGES: It may be O. K. to buy screwdrivers and chisels one at a time as needed, but when it comes to drills (drill bits) it pays to buy the whole set. The different sizes vary by only a few thousandths, and without a full set one is apt to find the required size missing when badly needed. Twist drills are inexpensive in the small sizes, and in addition to a complete set, there should be two or three extras in the sizes most commonly used—then if one is broken, the work is not stopped.

The Starrett No. 185 Time Saver Drill and Wire Gauge Chart is a very necessary tool to have. It will pay every gun owner to buy one of these which lists at $2.40. It is a hardened steel plate, with holes drilled in it to fit drill sizes Nos. 1 to 60 inclusive. In addition to being used as a gauge it also gives exact diameter of drill and shows drills to be used in drilling for standard taps.

A complete set of these 60 drills will cost in the neighborhood of eleven dollars, complete with a stand in which the drills are held vertically in plain view. The stand is also numbered with the size of the drill opposite each hole. I have found Cleveland regular carbon steel drills the best for all round work. The Cleveland Cle-Forge High Speed drills or their Mezzo Super-Carbon drills cannot be beaten for hard tough steel, such as high power rifle receivers. In addition to the 1 to 60 wire gauge sizes, it is advisable to have another set from 1/4 to 1/2 inch by 64ths. Then you are prepared for any job likely to come up which can be done by hand.

The next thing needed is a screw thread gauge. The one needed by the gunsmith, amateur or professional, is the Starrett No. 473, giving thread pitch from 6 to 60 per inch. It doesn't pay to guess at the pitch of a thread—some gunsmiths do this, which is the reason Lyman sights occasionally drop off. After you have ascertained the *exact* thread use a screw tap of the right size and *none other*.

A few TAPS will be needed, but it is not necessary to carry a great number on hand. Those found most generally useful are 7/32 x 32, 10 x 32, 8 x 32, 6 x 32, 4 x 36, 3 x 48, and 2 x 56. For the benefit of those who do not understand how screw taps are

25

numbered, the first figure refers either to the diameter of the screw in fractions of an inch, or to its numbered size; the second figure refers to the number of threads per inch. Thus a 7/32 x 32 screw is 7/32 inch diameter, and has 32 threads per inch; an 8 x 32 is a No. 8 size machine screw, with 32 threads per inch; a 2 x 56 is a number 2 screw with 56 threads per inch. Screw sizes are not the same as wire gauge sizes—hence the value of the Starrett gauge, which in addition to showing the drill sizes, shows what screws and taps they should be used for.

Most special sights have special sized screws supplied for attaching to the gun, the threads being finer than are considered standard. Thus the Lyman 48 sight uses screws 1/8 x 48, and the gunsmith who uses a tap cutting only 40 threads per inch is botching up the job in fine shape. Someday that screw is going to loosen and come out, and Mr. Lyman gets the blame! Why didn't they use standard screws, dern their hides! No—why didn't the gunsmith use a Lyman tap, blast his measly carcass! The finer thread is designed to hold more tightly, and the correct tap could easily have been secured. *Always*, when ordering sights, enclose an extra fifty cents and tell the maker to send you the correct tap and drill. It is a mighty fine plan also to spend a few cents more for some extra screws, and an additional tap or so. Then if an accident happens, you're ready for it. Keep the special tap in a glass jar with the extra screws, plainly labeled, and there's no guess work.

Measuring tools are of prime importance in all branches of gunsmithing. We have already mentioned inside and outside and hermaphrodite calipers in connection with wood working tools; the same calipers will be useful in working metal. However, since calipers cost little, it is well to have at least two pairs of each style, as it is very often a big help to be able to leave the calipers set for some given dimension, while using another pair for general measurements.

A good MICROMETER CALIPER is essential. Mikes can be purchased for as low as four or five dollars, but there is no economy in a cheap tool of this sort. A miss is as good as a mile when taking measurements in thousandths of an inch or less. By all means select either a Brown & Sharpe or a Starrett micrometer. There is no difference in quality, some mechanics preferring one make, some the other. The shape and size will largely influence your choice. For gun work I find the Starrett No. 231 the most useful. This instrument has a measuring range of 1 inch by thousandths on the sleeve and thimble scales, with a vernier scale also on the sleeve by which you can take readings in ten-thousandths of an inch. It also has a small thumbpiece on the end, which is provided with a click, and by setting up the instrument by means of this stem, it is always set at correct and uniform tension. While many mechanics pride themselves on having a touch so sensitive

26

that the click is unnecessary, the beginner will find it a very good thing—and in my opinion the work of a lot of old timers would be improved if they would use it.

A good 1 inch micrometer should cost around ten or eleven dollars. Never borrow a micrometer, and never lend one. Have your own, or do without. It is too delicate an instrument to be handled as some people would handle them, and unless it is absolutely accurate, it is entirely worthless.

Larger calipers measuring up to three or four inches can be had, but are not needed in gunsmithing. A two-inch mike might be handy occasionally, but these have a range of only one inch—that is, measuring from 1 inch to two inches, instead of from zero to 2 inches. Some of them have an extension anvil permitting measurements from zero to 2 inches, but are probably less accurate when the extension is used than a straight zero to 1 inch mike.

Few shops will have use for an inside mike. They are quite expensive, and cannot be used in small holes, as a rifle bore, for example. A star-gauge, or the lead slug method described elsewhere in this book, is the proper ticket for taking bore measurements. An inside mike might be useful for measuring shotgun bores and chokes, but I know of none long enough for this purpose, which requires reaching into the barrel several inches. Special long legged calipers can be used for this, the measurement from their points being read by means of an outside mike.

The Starrett No. 269 TAPER GAUGE is convenient for taking inside measurements at end of holes, and will give the bore and groove diameter of a barrel at the muzzle by simply inserting one of the blades and taking the reading at the point reached by the extreme edge of muzzle. It is graduated only by thousandths but a good pair of eyes find no difficulty in reading it pretty accurately to a quarter-thousandth. This tool lists at $5.50, with 8 leaves reading from 1/10 to 1/2 inch by thousandths.

A pair of hardened and ground V-BLOCKS WITH CLAMPS are essential in gun work, for holding round stock while drilling through the side, for holding barrels, while fitting scope blocks, lining up sights, and many other uses. The Starrett No. 278 and the Brown & Sharpe No. 750 are almost identical in size and design, and both list at $6.75 per set of two blocks and two clamps. The Starrett No. 271 drill blocks are convenient for drilling scope block screw holes in barrels also. These blocks are mounted to slide on a rod, with a clamp on one block to hold the barrel or other round stock. List price for set complete, $3.30. Unless you have an accurate drill press, the drill blocks are largely useless. If you have to drill with a hand or breast drill, line it up by eye the best you can—which is about as good a way as any after you have the holes properly located.

SCALES: Two or three high grade steel measuring scales

should be in every shop. For most work 6-inch scales are long enough; of course there should be a long folding rule for measuring barrels, stocks, etc. One scale graduated to 64ths and another to 100ths will take care of your jobs in good shape.

SQUARES: Besides a good carpenter's iron try-square, you should have two or three small ones. The particular toolmaker uses a small "standard" square for testing others that are used on the work—and the "standard" is never used on the work itself. These small squares, hardened and ground to absolute 90 degree angles, are very expensive. The Starrett No. 20, with 2 inch blade and 1 7/8 inch beam is well worth the $3.90 it costs. For general work of lining up sights, leveling barrels in V-blocks, etc., my choice is the Starrett No. 60 with 4 inch blade and 2 5/16 inch beam, costing $1.50. Two of these squares is a good investment in any shop. The Brown & Sharpe Adjustable Square No. 554 is well worth having around also. This tool has three removable blades—one for right angles which is graduated; one gives 30 and 45 degree angles, and is not graduated; the third blade is narrow—also graduated—and is adjusted to any angle within a limited range. This blade is useful in squaring off the end of a barrel that has been cut off, and similar work.

A centering square is almost a necessity in the gun shop, and is just as necessary to the amateur as to the professional. With it one can lay out an exact center line across the end of any round stock, such as a barrel, piece of tubing, etc. It is impossible to make an accurate layout for a barrel band with sight base, without a centering square. The Starrett No. 33 combination square has two heads, interchangeable. One gives a right angle and 45 degrees, according to which side is used. The other is a centering head. The blade slides to any desired position, and is held tight in the head by a knurled finger screw. In the square head is a small spirit level, so that a barrel or other work can be placed absolutely vertical in the vise if necessary. This square, with 6 inch blade, and both heads, lists at $3.90 complete.

A set of THICKNESS OR "FEELER GAUGES" reading from .004 to .025 inch will occasionally prove useful; but since the cost is $2.50, would not recommend its purchase until needed. The Starrett No. 72 and the Brown & Sharpe No. 640 are equally satisfactory.

Several small CLAMPS, both parallels and C type, should be on hand at all times for use in lining up and holding scope blocks, etc., while fitting. C clamps are also used for holding on ramps and other parts while soldering or brazing. They must be of best quality malleable iron, or they will break under the heat.

The shop should also have several PLIERS with different shaped jaws, and a number of wrenches. Get them as needed.

At least two pairs of sharp pointed, accurate DIVIDERS with

screw adjustment, should be on hand; also a good sharp pocket scriber, with hardened point.

CENTER PUNCHES, PRICK PUNCHES AND DRIFT PUNCHES: By all means include with your shop equipment a Starrett No. 18A automatic adjustable stroke center punch. List, $2.40, and worth ten times that. Looks like any other center punch, but the handle is a little larger, and the upper end is a sliding sleeve, with a coiled spring and trip inside, adjustable for tension. Place this punch on the mark, push down on sleeve, and it trips, striking a quick sharp blow and driving the point in for a perfect impression for starting the drill. No hammer is needed, nor should one be used. The punch never jumps off the mark, and the point is hard enough to make a clean impression even on fairly hard steel.

You will also need several common center punches from 1/8 to 3/8 inch in size. Be sure they are HARD. Nothing is more disgusting than a soft punch that turns or flattens its point on the work. Buy the highest priced punch you can find, and hope for the best. If they prove soft, try to harden the points. If common tempering methods do not get results, harden them in cyanide. Keep the points ground very sharp at all times.

Three or four small prick punches should also be on hand. These cost but fifteen or twenty cents each, and even the best standard makes may prove soft. Harden them also, and keep them ground sharp—some with slender points, some with points more blunt. You will need all kinds now and then.

For forty cents you can get a set of three small drift punches—1/16, 3/32, and ⅛ inch. Keep these in your apron pocket at all times—they will probably be lost anywhere else. Other sizes, both larger and smaller, from 1/32 or less, up to ¼ inch. If you can't buy the sizes needed, get the nearest size and have a machinist turn them down on the lathe with a file. They should be annealed first, then re-hardened. Drift punches need not be as hard as center and prick punches, or they will break. Draw the temper at blue color, in oil.

A splendid drift for very small sight pins is an old de-capping punch. The point is a small piece of drill rod set into a larger piece of steel with a setscrew. Points of various sizes may be cut and set in the tool as required. The point should not be longer than necessary, to avoid bending,—¼ inch is usually long enough.

Secure a number of ten cent nail sets of different sizes. These have the points cupped, and are excellent drifts for finished pins the ends of which show on the gun. Anneal them, chuck them in a lathe, and turn the point straight for a length of about one inch. Polish out the cupped end with crocus cloth, and there will be little if any marring on ends of drift pins. The punch should fit the pin exactly, so have them made as needed, to the sizes required.

Finally, keep a small pin vise such as the Starrett No. 162A, and special sizes of drill rod up to .040 inch diameter can be cut and placed in the chuck as needed, making a small universal drift punch of it.

A good accurate hardened steel BENCH BLOCK, while not a necessity, is a mighty convenient little tool. It provides a convenient rest for parts while punching out pins, while drilling, and for many other hand operations. It also makes a splendid block for riveting. The Starrett No. 129 block is hardened and ground, lapped and polished; it has a groove across the top, and holes of various sizes through which pins may be punched without damage, or through which the drill may pass at the end of a cut. Lists at $2.00.

REAMERS: Under this head come straight and tapered reamers, rose countersinks, taper pin reamers, spiral reamers, both straight and tapered, expanding reamers, countersinks and counterbores, and sight aperture reamers—and possibly others. You never know until you get into the job what reamer will be required—and the one you need is usually the one you do not have at hand. Buy them only as needed, at least the larger ones. They quickly run into money.

Sooner or later you will need taper-pin reamers from 3/0 to 5 in size. The Cleveland standard reamers are excellent, but high in price, listing from $1.50 to $2.00 each in above sizes. I once found a lot of these in the five and ten cent store for a dime each, and by using the mike in picking them out, got a good set in standard sizes for a song. The floor walker gave me several dirty looks, and I had traffic blocked at the hardware counter, but I got away with my reamers before he called the cops. A small tap wrench with four jaw chuck will be needed to hold the reamers; also for holding small taps.

A rose countersink will come handy for lightly roughing out a muzzle before lapping to crown—and that's about all you will use it for. A better tool for this purpose is the Cleveland bit stock countersink No. 115C, size 5/8 inch, 82 degree point, list 75 cents.

Straight reamers, and reamers with very slight taper will often be wanted for sizing barrel bands, sight base bands, etc. Barrel tapers vary and it will usually be found that many of the tapered reamers have too much taper; while straight reamers do not give any taper. Hence, few if any tapered reamers will be suitable for this work, the best plan being to ream the hole in block or tubing straight, then shape the band roughly and peen it to size and taper on the barrel—or, better, on an old barrel having the same size and taper. For this work a few Critchley expanding reamers will set you right up in business. I use the 6 blade reamers which have less tendency to chatter than those having 5 blades. These blades have adjustment by means of a tapered bearing surface on the shank,

on which the blades rest, being held at each end by a screw collar. Screwing the collars back on the shank sets the blades on a higher point on their bearing surfaces, enlarging the cut. The reamers have no taper except for a short distance at the point, for relief in starting into the hole. The following table gives catalog numbers, sizes, and list prices on those likely to be needed:

Catalog No.	*Expansion, Inches*	*Price of Reamer*	*Useful for:—*
19	27/64 to 29/64	$4.50	
20	7/16 to 1/2	4.50	
21	1/2 to 9/16	4.50	Sight ramps and small swivel bands.
22	9/16 to 5/8	4.50	
23	5/8 to 11/16	4.75	
24	11/16 to 3/4	4.75	Medium bands and larger ramps; sight base bands.
25	3/4 to 13/16	5.00	
26	13/16 to 7/8	5.00	Sight base or large swivel bands.
27	7/8 to 1	5.50	Sight base bands, Krag or Spr.
28	1 to 1-1/8	5.80	Sight base bands, Springfield.

WOW! Yep, it costs money for a gunsmith to tool up—and how some folks do kick when he charges them a little profit on the job, trying to get back some of his investment.

Counterbores for flat head and filister head screws will be needed occasionally, as, for example, when changing the position of a tang screw in a rifle, or when putting on a welded false tang. These have round shanks, for use in breast drill or drill press. A counterbore is really a small end mill with a pilot to fit the screw hole. In ninety-nine cases out of a hundred—and maybe more than that—it will be found there is no standard counterbore bit to fit the particular screw. In that case you must discard the bastard screw originally used, or else turn the head down to size to fit the counterbore—or else make a flat drill with a pilot, as described in the next chapter, which will usually stand up all right on one or two jobs. Considering their small size, counterbores are expensive—better buy them only as needed.

DIES AND DIE HOLDER: Usually the gunsmith will be able to use standard machine screws to a great extent, or else screws obtainable from the factories. When a screw has to be made it is a lathe job, and the thread can be cut more accurately on the lathe than in a thread die. It is doubtful, therefore, if a set of dies will pay dividends even in the professional's shop. If you decide to buy a set for use at home, consult your hardware dealer, and select from his wholesale catalogs those sizes that you are going to require.

CHISELS: Depending on the work you go in for, you may sooner or later require cold chisels, cape chisels, and "diamond point" chisels. Start out with a good 1/4 inch cold chisel, and another 1/2 inch; add other sizes when and if needed. Cape chisels and diamond points may prove handy for roughing off stock where there is considerable to cut away; and this also applies to round nose chisels. Sizes from 1/8 to 1/2 inch in the various styles will

probably covered all requirements. The Hargrave line of chisels for iron and steel is hard to beat, and most good dealers have them or can get them from jobbers. Most gunsmiths keep a few pieces of hexagon tool steel and make chisels of the size and shape wanted.

HACKSAW FRAME AND BLADES: Get a "pistol grip" hacksaw by all means—for what sawing you do will often be done to take the place of some milling or planer operation, which means lots of sawing. A Disston, Atkins, Starrett or other standard make costs but little more than some "off" brand, and is stronger and more rigid. You will want fine tooth blades for thin stock and thin tubing, and coarser ones for heavier work, roughing off stock, etc. After using all kinds of blades, I have concluded there is but one kind for me—the Universal all hard Tungsten Steel blades. The 12 inch length is most convenient. A shorter blade than this is a nuisance, while a longer one is a little too springy for fast work. Use 18 teeth to the inch for roughing cuts and heavy stock; 24 teeth for smoother, more accurate cuts and lighter jobs; and 32 teeth for thin tubing.

HAMMERS: It pays to get good ones, even though you do not use them a great deal in gun work. My own choice is a Maydole ball peen machinist's hammer of 36 ounces; another of 24 ounces; and another of 3 ounces; also a Maydole 6 ounce riveting hammer. The manufacturer's numbers on these are, respectively, 121, 123, 129, and 265. Also, a Goodell-Pratt brass hammer, No. 93, weighing 8 ounces, and a solid copper hammer of 1½ pounds weight. Lead hammers can be cast as needed using a hollow wood cylinder for a mould, with a hole in one side through which a plug is inserted to form the hole for handle. A rawhide mallet is nice but I have a plain wooden one which I seldon or never find use for.

Some means of heating a SOLDERING IRON will be necessary, also the iron, or "copper" as it is more correctly called. Buy the best soldering copper you can find, weighing from 1½ to 2 pounds. A small one from the five and ten cent store will come in handy also for tinning the inside of ramps and bands, or one can be made from a piece of round copper rod. A good blowtorch will cost from $3.50 to seven or eight or ten dollars, and it seems like one is just about as good as another. The Turner and the Clayton and Lambert torches have the reputation.

BENCH KNIFE: A good strong sharp blade is indispensable and in this day of helpless critters who can't appreciate a pocket knife with hardened steel in it, the best we can get in pocket knives are so soft that the edge will not stand up even to ordinary work. The Swedish steel bench knives sold by Hammacher, Schlemmer & Company, New York, cost only 35 or 40 cents, and beat any pocket knife costing two or three times their price. It pays to have two of these knives, keeping one very keen and the other for rougher work, scraping, etc.

SHARPENING STONES: Several of these will be needed. The first should be a Carborundum combination stone, 8 x 2 x 1 inch in size, coarse on one side, smooth on the other. This will be used for dressing edges and first whetting of chisels, plane bits, etc. Specify stone No. 108. Next, a Lily White Washita, about 6 x 2 x 1 inch for final whetting of wood cutting tools. Then a No. 186 Carborundum slip stone, 4 inches long and 1 inch wide, with edges rounded, 7/16 and 3/16 inch thick respectively, for inside of carving chisels; this is used only for the first whetting. Use a similar stone of Lily White Washita for finishing.

Carborundum and aloxite sticks may be had in square, triangular, half round and round cross section, and in fine, medium and coarse grits, at prices from 60 cents to $1.50 each. They are useful for dressing up and reshaping hardened parts that cannot be filed, and should be bought as needed. Pike India Oil Stones can be had in many odd sizes and shapes, and should be bought as required, the purchaser selecting them from illustrations in any large tool house catalog. The No. 27 stone, known as a "point" is round in section, 3 inches long, 5/16 inch diameter, and tapering to a very sharp point. It is indispensable for getting into small corners and grooves, when a file will not cut. The No. 58 is larger, being 4 inches long, ½ inch diameter at one end and ¼ inch at the other. A very useful stone in reshaping parts of sears, triggers, etc., when the file will not cut. Last but not least, the stones for easing trigger-pulls. There are two kinds of Arkansas stone, known as "Hard Arkansas" and "Soft Arkansas." Specify the hard and refuse the soft. Slip stones for trigger work should be about two inches long, 3/16 inch thick at one edge and tapering to a knife edge on opposite side. This material is also available in round, square and triangular "sticks" the last two shapes being most useful. Buy them only as the need arises.

I hesitate to bring this chapter to a close. Already it has taken more than its rightful share of space, and has named so many tools, etc., that the reader may have gained the impression that even a small tinkering shop is beyond his financial statement. Time after time I have checked over my own tool equipment, in an effort to miss nothing essential, nor to include nothing that might not be definitely useful or necessary. My own work has covered a wider field, perhaps, than the average amateur will cover in a few years of tinkering his guns; and he should therefore discard at once the idea that it is necessary for him to have everything mentioned or to be mentioned later before he can restock his pet rifle or put on a new sight. Far from it! Start with the fewest possible number of tools—you'll be surprised how rapidly they will accumulate, as your hobby grows and develops.

Chapter 4

SPECIAL AND HOME-MADE TOOLS AND EQUIPMENT

HAVING rigged up a place to work, and assembled a few of the most essential tools, the amateur gunsmith will next consider certain other equipment, some of which is necessary to certain jobs, while other items may be dispensed with, but will nevertheless add both to the pleasure, speed and convenience of the work. For the gunsmithing trade calls at times for tools not regularly listed or manufactured, and which if ordered specially from a tool maker, would cost a great deal. Fortunately, most of them can be easily made by the amateur.

Before going into details of these special tools, let's consider a few of the non-essential but worth while ones.

The first is a high grade MOTOR GRINDER. When I first started tinkering with guns I had no grinder—and now I wouldn't know how to get along without one. Many long hours of filing have been reduced to a pleasant few minutes work; to say nothing of the advantage of being able to buff and polish parts quickly and more perfectly than by hand.

There are three well known makes of grinders of the type I am going to recommend—the Black & Decker, the U. S. Electric Company, and the Van Dorn. Possibly there are others I have not seen. Of the three named, I believe one to be about as good as another. The first two are somewhat heavier, and might stand up better under long hard usage. They cost about $60 and $50 respectively, while the Van Dorn, a trifle lighter machine, costs about $40. All three are ball bearing, with an automatic built-in starting rheostat, rubber covered connection cable, and socket plug, operating on any ordinary lighting circuit. The grinder is small and compact, and sets conveniently on the bench, or may be had with a cast iron floor pedestal at an additional cost. The shaft is 1/2 inch diameter, and has a

6 inch Aloxite wheel 1/2 inch thick on each end—one coarse, and one fine. Other wheels of various sizes, shapes and thicknesses not exceeding these dimensions may be added as needed. The wheels have removable guards and tool rests adjustable for height and cutting angle. With the wheels removed, you can use wire or cloth buffers, wood wheels faced with abrasive cloth, sandpaper wheels for dressing down butt pads—new uses will be continually occurring to the owner of one of these splendid machines. By using Aloxite wheels with thin, rounded or beveled edge you can get into places in shaping up parts that would ordinarily call for a milling machine or shaper. Hours of filing can be saved when making barrel bands, sight bases, ramps, and similar jobs. Tools can be sharpened—although these wheels are too hard and fast (3000 to 3600 R.P.M.) for carving chisels and plane bits which are best ground on an old fashioned grindstone.

Soft steel wire buffers are splendid for carding off the rust during the bluing process, and, with light pressure, for burnishing a barrel after it is blued. A separate wire buffer should be kept for carding off rust, and this must be boiled in lye or sal soda to remove all grease, then rinsed in clean boiling water. If the bristles should rust a bit, that is the best evidence that there is no grease or oil on them to spoil the bluing job.

You will want two or three cloth buffing wheels 4 inches in diameter, and two or three 6 inch ones. These are not much good until worn down to an even surface on the edge. Start the motor and hold a sharp chisel against the cloth until all loose edges, threads, etc., are worn off and the surface is smooth and compact.

Keep one cloth wheel clean and dry, for final polishing; keep another for use with Tripoli rouge; another, perhaps, for fine jeweler's rouge. Others may be surfaced with a little fine emery or carborundum in heavy grease for preliminary polishing of parts.

Wood wheels can be made as needed. Scribe a circle the required size with dividers on a piece of clear soft pine; bore a half inch hole through the center for the shaft, and saw and file the wheel to shape on the outline. Set it on the shaft, tighten up the nut to hold it, then start the motor and turn the wheel true by holding a slightly curved very sharp chisel against it, then finish with sandpaper.

Coat the edges of these wheels lightly with glue or very thick shellac, then roll them in fine emery, carborundum, pumice, etc., as needed. On some, glue thick felt weather-stripping to the edge, letting the ends of felt meet evenly. The felt may be used dry for final polishing, or may be coated, either dry or with heavy grease, with various abrasives.

Make, or have made, some hardwood (preferably maple) spindles which will screw onto the end of motor shaft instead of the nut, and projecting from two to four inches beyond the end of shaft. The projecting ends may be shaped as desired, to reach through trigger

guards and other places for inside polishing. Coat them with glue and wrap on felt to hold the abrasives.

Special wheels of compressed felt are fine for polishing, but very expensive. If you can afford a few of them they will make a hard job easy. They are used both dry, and with abrasive pastes.

Very fine polishing wheels are made by cementing together several thicknesses of heavy leather—sole leather or saddle skirting. Bore the shaft hole and saw them round with a coping or scroll saw, then turn them true on the shaft with a chisel. Edges may be made square, round, V-shaped or beveled as needed. Rub valve grinding compound on some and keep others for use dry in final polishing.

You can get a drill grinding attachment for use with your grinder for about $12.00. Many mechanics scoff at these attachments, considering themselves competent to hold the drill in their fingers and grind it true. Grinding a drill is about the most particular job you will find, and one of the hardest to learn. The attachment will soon pay for itself in drills saved or reclaimed—for be it known that a dull drill, or one ground off center is useless. Off center grinding of the point causes a drill to cut a hole larger than itself—a serious matter when a certain screw is to be tapped into the hole. Accurate grinding of very small drills is almost impossible without the attachment.

Another useful accessory is a chuck, made to either screw on end of motor shaft instead of the nut, or else to be slipped on and held by a set-screw. Drills may be held in the chuck for boring; small pieces of drill rod may be turned to size for pins by holding a file against the rod while motor is running; often a new firing pin can be turned out with only this chuck and a file for a tool. Round parts may be chucked for cutting down slightly, or for polishing. Finally, a pully may be placed on one end of the motor shaft, and belted to a bench drill, small bench lathe, drill press, or to another grinder, in case you want one slower running than the motor itself.

The best substitute for a small motor grinder, is a GRINDING HEAD which can be purchased from the mail order houses for four to ten dollars. This can be belted up to a 1/4 h.p. motor, a fan motor, gas engine, or even the old flivver. The lad on the farm, where electricity is not available, will connect up his grinder to the tractor, milking machine, log saw or washing machine. Leave it to him—he'll get power to it. A grinding head, belted for a speed of 1500 to 2500 R.P.M. is better for some work than the high speed grinder—but the latter is supreme when roughing off a lot of surplus metal in making parts from rough stock.

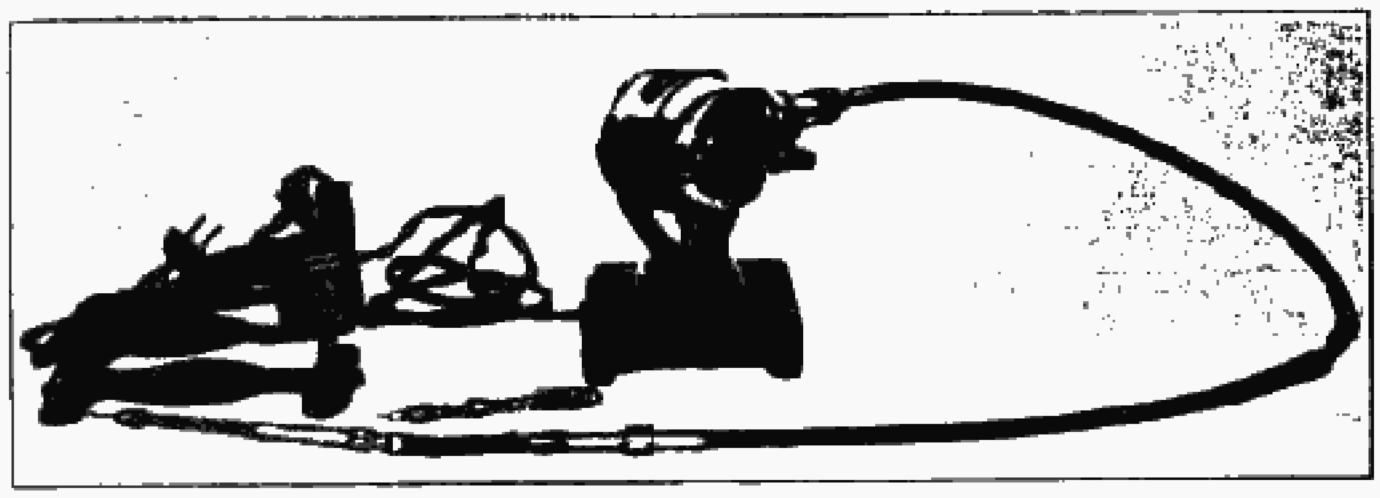
The amateur gunsmith should manage if possible to have some kind of a motor, even if nothing better than a fan motor is available. Small cloth and steel wire buffers are almost indispensable at times, any investment you make in this direction will quickly pay for itself.

36

THE DENTAL ENGINE. Now for another suggestion, for which I am deeply indebted to the dental fraternity. This will not be new to some people, but will be to many. When you sit in the dentist's chair inwardly cursing the fiend as he drills into the old molars with such keen delight, probably you paid little attention to the makeup of the principal tools he was using. Yet if you had that "dental engine" of his in your shop, you would find a million and one uses for it on every job, big and little.

Dentistry and gunsmithing are two widely separated professions but the professional gunsmith will do well to investigate this piece of dental apparatus and learn of its daily application to his business.

The old time dentist used a villainous arrangement on a tall stand, with wheels and string belts, operated by a treadle which he worked with his foot. From this ran a flexible or jointed shaft to the drill head with which he did the dirty work. The modern dental engine

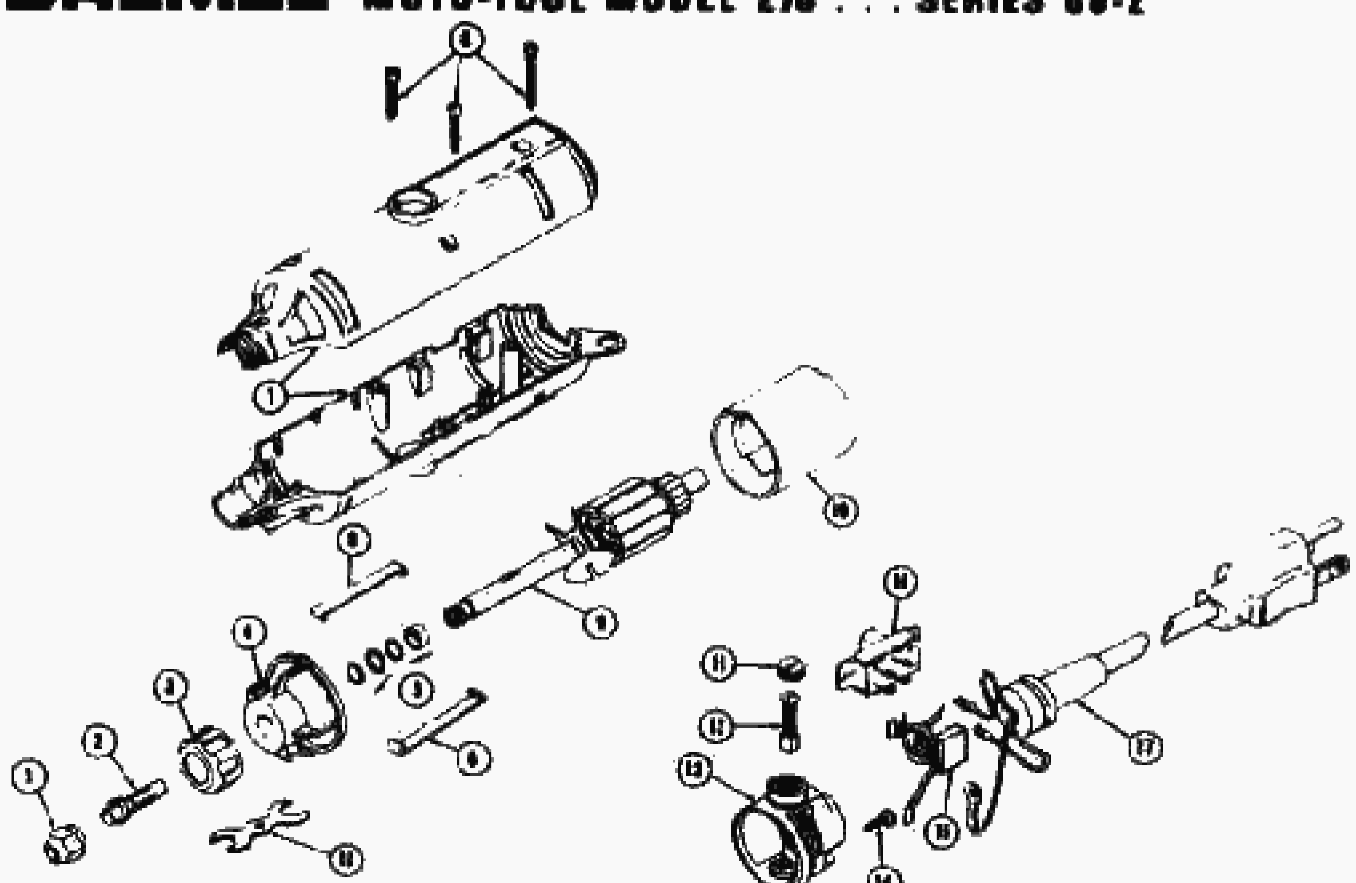


THE DENTAL ENGINE

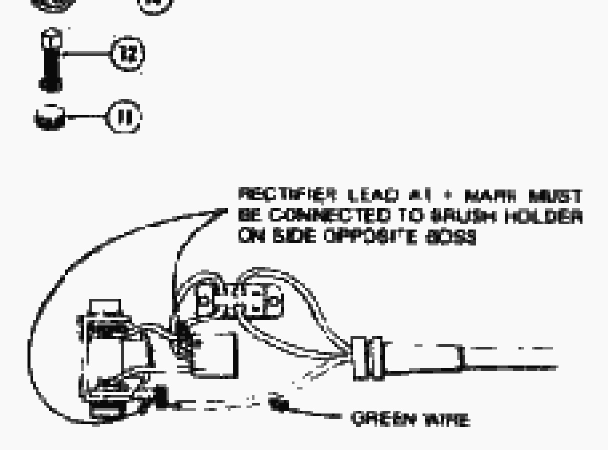
consists of a small and compact motor all nickled and shiny, and with about six feet of rubber covered flexible shaft; the business end of the shaft is attached to a nickeled tool about ten inches long which serves as a handle. In the end of this is a small chuck in which Doc holds his burrs, drills, carborundum wheels, and other implements of torture designed for proselyting Christian Scientists from the true faith. The chuck is arranged so that the burrs and wheels may be mounted at right angles to the handle if desired. Now this chuck is removable, and in its place may be inserted another chuck with a head which converts the rotary motion to a hammer motion—in other words, converts the gadget into a miniature riveting machine. After this brief explanation, consider the following suggestion: Next time you call on your dentist, control your feelings and temper if you can; but if he tortures you beyond human endurance, then slay him with the jaw-bone of an ass or whatever is handy—and don't leave the place empty handed. Steal his dental engine and as many of his tools as you can stuff in your pockets. Also loot the body of any spare change you may find.

(Rather than bothering about a dentist's drill, go to any hobby shop, a well-stocked hardware store, Sears etc. and buy a Dremel Moto-tool or its equivalent. All or most of the burrs, wheels, etc., are stocked).

DREMEL® MOTO-TOOL MODEL 270 . . . SERIES 66-2



Qty.	Code No.	Part No.	Description
	1	880113	Chuck Cap
	2	.480	1/8 Collet
		481	3/32 Collet
		482	1/16 Collet
		483	1/32 Collet
	3	880217	Housing Cap Screw
	4	880136	Front Brg. Bracket (Comp.)
	5	990516	Thrust Washer Assortment
	6	880806	Bearing Bracket Clips (Pr.)
	7	990132	Housing Comp.
	8	990515	Housing Sc. 1 long 2 short



WRITE FOR CURRENT PRICES - NO C.O.D.'S

UNITED STATES
Dremel Service Center, P.O. Box 954 Racine, WI 53405

OUTSIDE OF CONTINENTAL UNITED STATES
See your local distributor or write to Dremel Mfg. Co. 4915 Twenty-first St., Racine, Wis. 53406

EASTERN CANADA
Giles Tool Agencies, 47 Granger Ave., Scarborough Ont CANADA M1K 3L1

WESTERN CANADA
Totem Tools & Eq., Ltd., 3851 Main St., Vancouver, B.C., CANADA V5V-3P1

DREMEL® MFG. DIVISION 4915 21st STREET RACINE, WISCONSIN 53406 U.S.A
EMERSON ELECTRIC CO.
Form 880108 12/76
PRINTED IN U.S.A.

37

If you hesitate to pursue such a course, then your best bet is to make your peace with your local tooth puller and tell him your troubles. If he happens to be a gun-crank,—and a lot of them are, for some reason—he'll understand at once. If he hasn't an old obsolete engine that you can talk him out of for a song, he will be glad to help you select the type you need, and will probably order it for you from his supply house. And his experience with the various tools and attachments will enable him to offer many helpful suggestions—moreover, he will likely make you a present of a double handful of old burrs, too worn for use on teeth, but fine for metal. And you

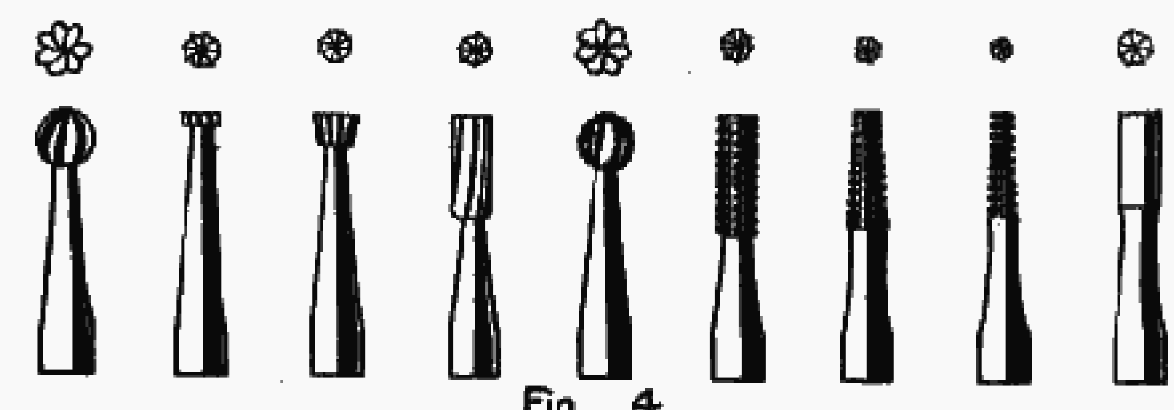


Fig. 4
A B C D E F G H I

can buy others as you need them, for the cost, barring the cost of a new dental engine, is surprisingly low. As this is written I am advised that the S. S. White Dental Mfg. Co. are putting on the market an engine to sell at $25.00—lacking the motor. The shaft is made to attach to any small motor, with suitable connections.

Figure 4 shows a number of dental burrs (they are always called "burrs" and not "drills") useful to the gunsmith. These come in sizes from No. 1/2 to No. 11, ranging from about .023 inch diameter. The No. 6 measures .067. This is a handy size for countersinking rear sight apertures, or for straight drilling where a very small hole is wanted—the pin hole in a front sight blade, for example. A number 3 or 4 round burr makes a splendid center punch. Figure 5.

It will not slip and slide off the mark even on hard surfaces. The hole may be started with a small burr, and enlarged to exactly fit the drill to be used later. Spot annealing is unnecessary, for these burrs are made to cut the hardest material.

Another advantage of using burrs is that they will cut on the side as readily as the point, hence need not be held perpendicularly. Hold them at an angle as you hold a pen in writing— the tool never hides the work and you always see what you are doing.

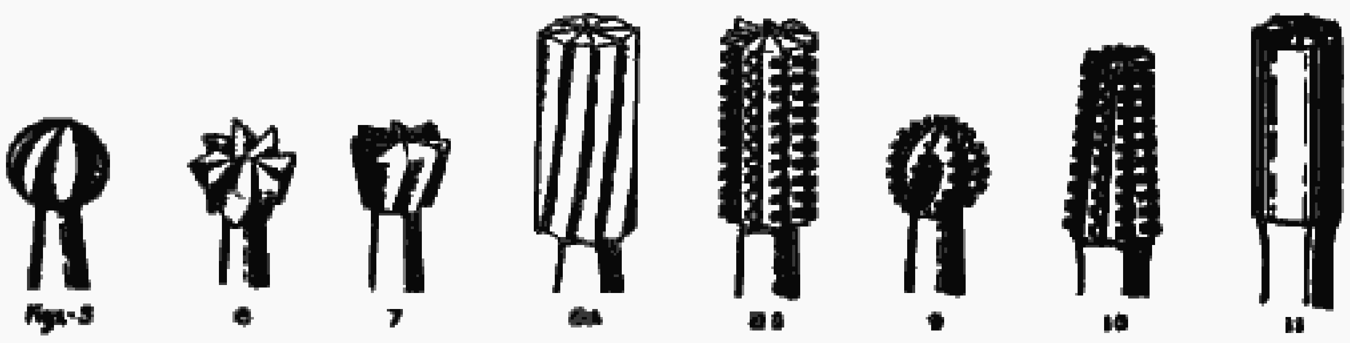
The Wheel burr, Figure 6, is really a small milling cutter—excellent for getting into difficult corners and uneven spots. Uses numbers 11 1/2 to 22.

The Inverted Cone, Figure 7, is used as a straight drill for small holes—cuts very fast in all sizes. Use numbers 33 1/2 to 44—they

38

make excellent milling cutters in all sizes, even an old discarded one cutting through case hardening easily.

The Fissure burr, Figure 8, is one of the handiest of the lot. "A" is a plain burr, while "B" is a cross-cut Fissure. The sizes most commonly needed will be Nos. 557 to 562. Use it, for example, instead of a "mouse-tail" file for cutting the half round groove in a Springfield barrel through which the fixed stud pin is inserted. Cutting



on the end as well as on the side, this type of burr is especially valuable in small "tight" jobs.

Figure 9, shows a cross-cut Cherry. This is similar to the round burr in Figure 4, but cuts faster.

Figure 10, shows a tapered fissure burr known as an "inlay fissure"—not particularly useful to the gunsmith, but might be used occasionally.

Figure 11, is an end cutting fissure, used for bottoming out a hole or slot without cutting the sides. Better than an end mill or any other machine tool for cutting square bottom holes in barrels for scope block screws.

Twist drills, reamers and extra large diamond point drills may be had for the handpiece of the dental engine, from dental supply houses: but the discarded drills of the dental practitioner's office will keep the amateur or professional gunsmith supplied for years and save him many hours of time.

Vulcanite burrs (similar to those already described, but made for drilling and cutting vulcanite) are very handy for use on wood; also large size surgical burrs. What a convenience for some small, nearly inaccessible cut when inletting a stock, or fitting a small inlay!

Besides the burrs, there are the mandrels and mounted carborundum stones and wheels—all extremely useful. The various carborundum mounted points and wheels are shown in Figure 12. No need to mention their uses in gunsmithing—you've wished for just such a thing many and many a time! Knock off the case-hardening where you wish to drill a hole—level off projecting ends of screws in a receiver after fitting a Noske scope mount or a Lyman 48 sight, trim and smooth out angles and corners in parts that have been welded—there's no end to what you can do with these points and wheels; new uses will be found on every job.

39

The Maxfield Mandrel, Figure 13, is a quick acting holder for paper discs of assorted thickness and sizes which are covered on one side of the stiff paper with sandpaper, garnet, carborundum and cuttlefish in all different size grits. These can be used for polishing out corners, small screw heads, sights and other small parts before bluing; also for removing rust and pits and uneven places, doing a wonderfully quick and thorough job. By cutting the paper disc as shown at "b," Figure 13, it can be forced into a hole for rounding and polishing the edges. The natural spring of the paper and the centrifugal force keeps the paper in tight contact with walls and edges, and rust, pits or dirt is removed in an instant, or a mirror like surface can be put on with fine carborundum or cuttlefish discs.

Fig. 13 B

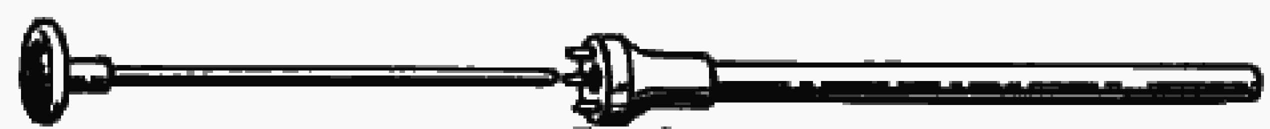


Fig. 13

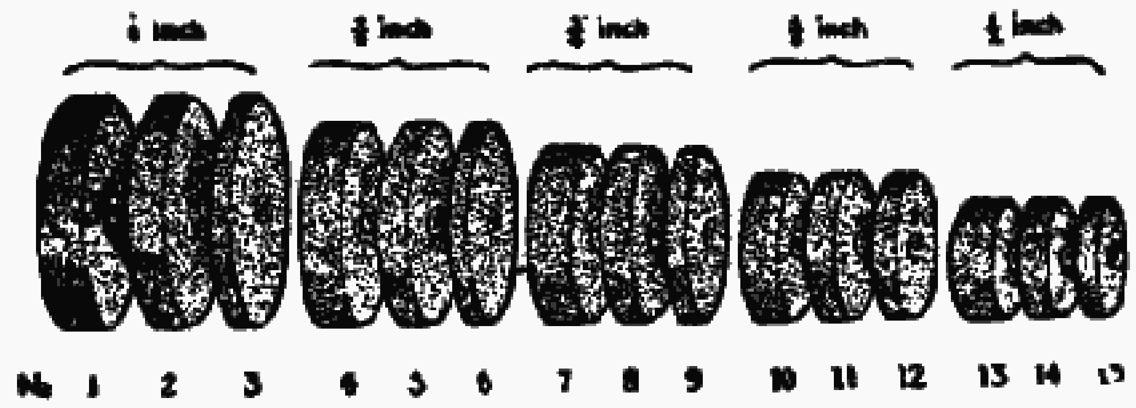


Fig. 14 B

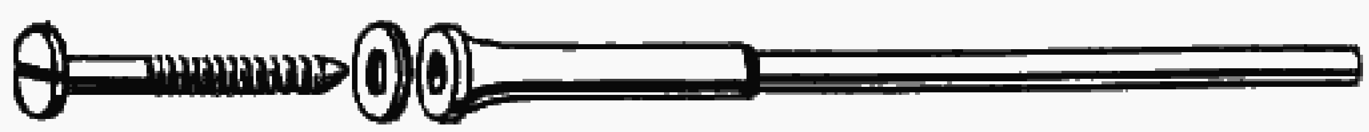


Fig. 14

Figure 14 is a mandrel for circular stones and hard rubber discs. There are solid carborundum and hard Arkansas stones of all sizes, thicknesses and grits. These small wheels are fine for sharpening cutting and boring tools of all kinds, doing more accurate work than can be done by any other means. Sharpening hand reamers, for example is a job only for the expert grinder with a lot of special

40

equipment; but the amateur gunsmith can use these wheels to sharpen his reamers several times before a trip to the grinding shop is necessary. Being under full hand control at all times they can be used right up to the cutting edge.

This mandrel also holds both circular and cup shaped stiff brushes which used with a little pumice or other fine abrasive will quickly polish any odd shaped piece, getting into corners and grooves not reached otherwise.

These are but a few of the many uses to which the gunsmith can

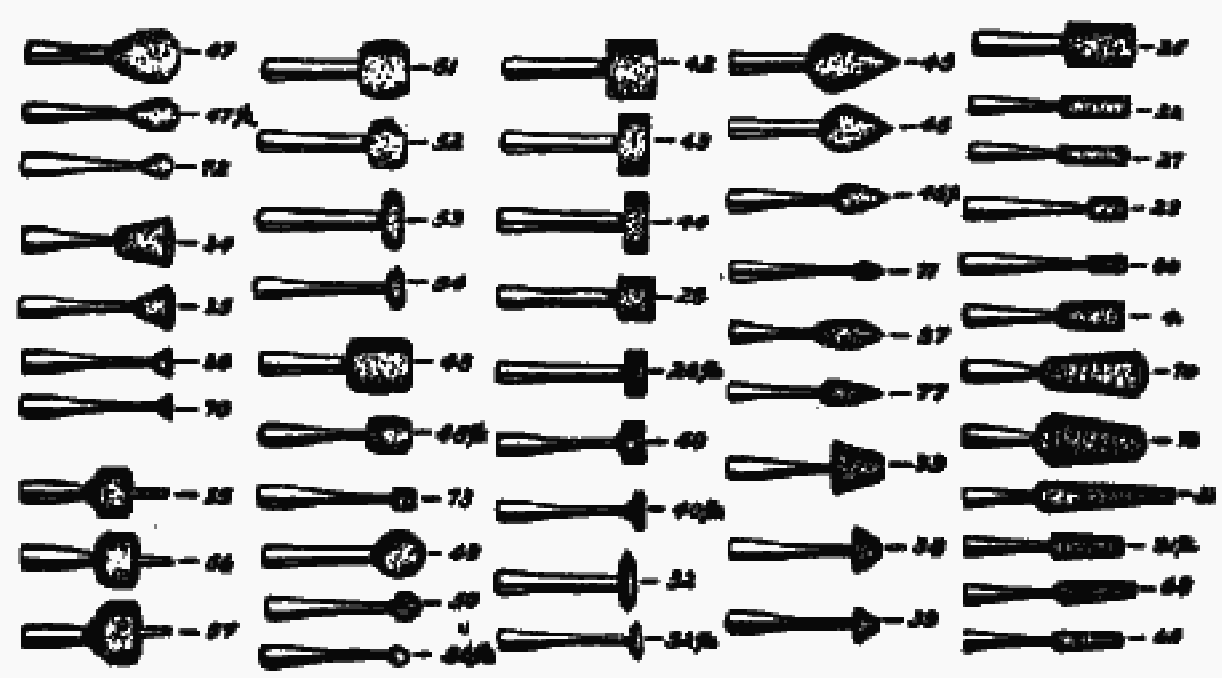


FIG. 12

put dental instruments. How often have you wondered about the shape and finish of the locking lug shoulders in a rifle receiver?—a magnifying mouth mirror costing about a dollar would have showed it to you instantly, as well as many other undercuts and "out of sight" places! A pair of cotton pliers (what the proletariat call "tweezers") is invaluable for picking up small screws, pins, and springs. A head mirror with a hole in the center will enable you to look into portions of a gun's internal economy you never expected to see—you can look down the barrel from the muzzle with the breech closed if you wish. Get the light in front of you, reflecting it down the barrel with the mirror as you peek through the hole. Drill a hole in any small mirror and try this.

A small carborundum stone or a cherry burr will forever eliminate spot annealing—you're ready for the drill in about thirty seconds. Figure 15 illustrates cutting a screwdriver slot in a broken off screw—takes only a minute to do and the screw is then turned out "easy as pie." Figure 16 shows a .22 calibre barrel being crowned with bud-shaped carborundum and Arkansas mounted points.

The hammer motion of the special head before mentioned is useful in a variety of ways—for light riveting of pins, peening screws used

41

to fill up holes in barrels, etc., and a thousand and one others. One of its most important uses is that of producing a beautifully matted surface on sight ramp, top of barrel, or even on receiver. This is described in a later chapter.

It would be possible to go on almost indefinitely naming the uses of dental instruments in gunsmithing—but one must stop sometime. For a good while I used the dental engine principally for matting,

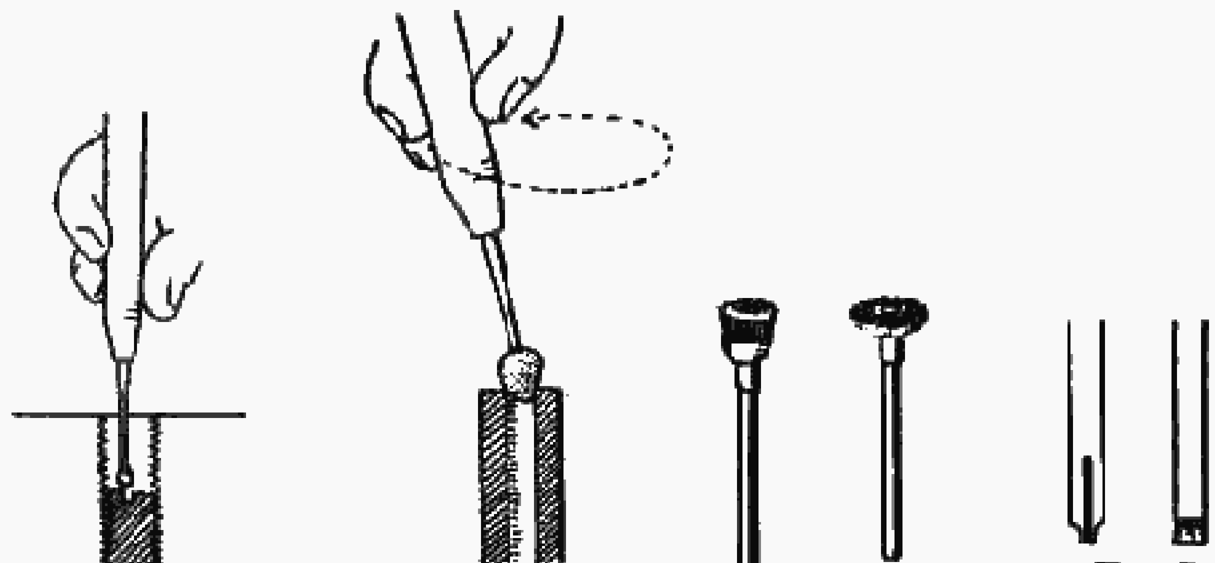


Fig 15 Fig. 16 Fig. 17

and for drilling small holes, and I am indebted to Dr. E. W. Harper, of Watertown, S. D., for introducing me to its greater possibilities. Dentistry is one of the highest branches of scientific mechanics, and the man at the bench may, by using his head, learn much from the man in the laboratory.

SPECIAL HOME MADE TOOLS: The gunsmith, requiring a tool not regularly made and sold, usually makes what he needs for the job at hand. There are, moreover, numerous tools used almost constantly that he will have to make or do without. Among these may be mentioned split screwdrivers. Make these as shown in Figure 17. Eight inches is a convenient length, and handles are not necessary, neither need they be hardened and tempered, as they are used only for holding the screw while starting it into a hole that cannot be reached by the fingers. Make them up in several sizes to fit most screws used in guns, selecting drill rod of the nearest size for each one. Make the split about 1 1/4 inches long with a hacksaw blade having the "set" ground off the sides of teeth. Shape point as shown with the rattail file. Half a dozen split screwdrivers in a box that is easily accessible are a real convenience.

CHECKING TOOLS: The amateur gunsmith will require at least two tools, while the professional will want half a dozen or more in various sizes and cuts. So many different patterns have been described in outdoor magazines in recent years that one is puzzled as to which type to select and learn to use. For be it known that none of them will do even passing good work for the rank, raw be-

42

ginner. Checking is an art, just like sculpture, or rolling Bull Durham, or running over pedestrians. It has to be learned. Given the finest checking tools ever made the amateur will find them as awkward as his first pair of skates, and will swear to high heaven the tools are worthless.

And right here I want to digress for a moment. This thing of blaming one's lack of skill on the tools is why a lot of folks never learn to shoot. There never was a gun turned out by any reliable factory that wouldn't hit somewhere in the neighborhood of where it was held. There is a type of individual who is of a nervous temperament, and who cannot be suited. I have a friend who is a pistol and revolver fan. Neither Colt nor Smith & Wesson ever made a gun that was exactly right, for him. One time the gun will be shooting low; another time high; again ignition is poor. Always there is a perfect alibi in the gun, to account for the poor shooting. Another may take the same gun and make good scores with it—makes no difference—the damn gun is no good.

Trapshooters are also prone to blame it on the gun. Either the stock is too straight or too crooked, or it has too much pitch or not enough. They wear out their guns with continual alterations—"raising the pattern" and similar superstitions; they bankrupt themselves buying new guns, and immediately selling them at a heavy loss; yet they never learn to shoot. The man who is so constituted that he will break right down and admit that maybe the man who built the gun knew just a little something about gunmaking, is very likely to take most any gun out and bust his share of bluerocks, or bag his share of furred or feathered game. Practice is essential to good shooting. The man who practices constantly with a poor gun, or an ill-fitting gun will be a far better shot than the one who tries out and discards a dozen or so a year, though the latter may burn more powder. The fact is a man has to handle and shoot a gun a good while before he can really say whether it fits or not—and about ninety-nine per cent. of the birds who bellyache about their guns don't use them long enough to get acquainted with their good or bad points.

So it is with checking tools, or any other tools requiring reasonable skill to use. The amount of time you spend learning to use them makes a lot more difference than the type of tools you have. Chapter 12 of this book is intended as a complete course in the essentials of checking; and if you will follow the instructions given therein you may later design any kind of tool you please, and you'll be able to use it. What you know about checking is what counts most.

The tools I shall describe were introduced to my attention by John Dubeil who used to make stocks in the Hoffman plant—and a better stockmaker, or a more painstaking workman than John, I never expect to find. These tools have given the best results of any in my hands. Maybe they won't in yours. But as I have tried about every kind I have ever heard of, my best advice is that you make up this

43

type of tool and LEARN TO USE IT—then, if you find better tools, there's nothing on earth to stop you from changing. Your skill won't leave you on that account.

Figure 18, shows three tools and a bent escapement file. "A" is the line spacer; "B" is the V-tool or deepening tool with which the diamonds are pointed up; "C" is a border cutter—seldom necessary but sometimes used; and "D" is the file for finishing up the diamonds.

All these tools but the file may be made of 5/32 inch drill rod. The V-tool may be made of 3/16 inch rod if preferred.

Cut a piece of rod about 8 inches long, heat the end cherry red and forge it flat, then bend to the angle shown. Shape it up carefully

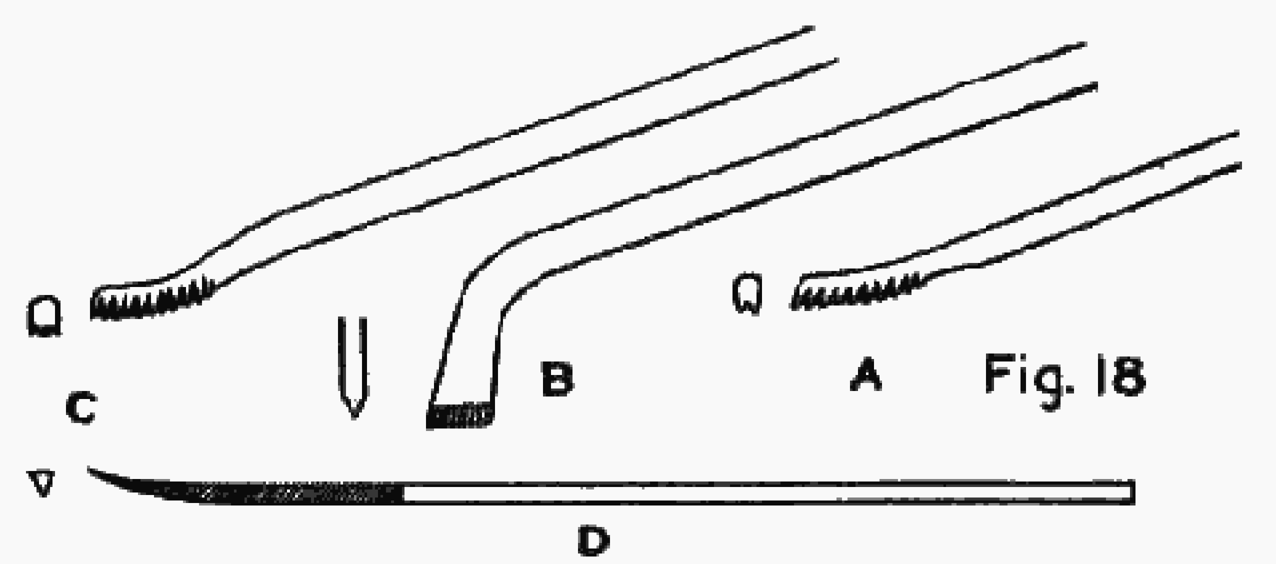


Fig. 18

with a file; cut the groove in underside very deep, using a die-sinker's knife edge needle file. Use a 3-square escapement file to cut the teeth, and note that these are cut on the sides of the tool, and not across the bottom. Each of the two edges of the line spacer is sharp, so that the file, being turned in slightly during the cutting, the teeth take form both on sides and bottom edge. The teeth may be almost vertical, or they may lean forward or back slightly. I have all three kinds, as some work better on some woods and some on others. Generally I find that the tooth which slopes back toward lower edge follows a line easier, and cuts with less tendency to catch and jump. After cutting the teeth on both sides, heat the cutter end bright cherry red and dip it in water; then dip in linseed oil and flash off the oil once to draw the temper. This leaves it plenty hard for good work, yet soft enough so that the teeth may be touched up a bit with a file when dull.

Before cutting the teeth rub the two edges of cutter on a block of wood and measure the distance between lines carefully with sharp dividers. Then after the teeth are filed, cut a few lines and see how many they run to the inch. If the cutter is too wide, dress off both sides slightly until the cut is narrowed sufficiently and re-sharpen the teeth before tempering. The size cuts best adapted for various grades of wood is discussed in Chapter 12.

44

The size of the teeth of a cutter may vary from 16 to 24 per inch. Hard wood without large open pores is easier to check, and a 20 or 22 point cutting edge is very satisfactory. 16 to 18 points seems to work best on more open grain wood. There is no convenient way to accurately space the teeth—file a few on scrap stock for practice and measure them, then space them by eye, preferably under a jeweler's magnifying glass.

I've heard a lot about three and four row spacers, and while the idea sounds splendid, I have yet to see any such that would work, for me. Of course in such a spacer the teeth must be cut crossways, while the side teeth can be cut only on the two row tool. And the side teeth are the ones I will continue to use until someone shows me the error of my ways.

The V-tool is forged out to the shape shown, and filed to about 1/8 inch thick or less, then the edge beveled back about 1/4 inch, forming a sharp V. This edge should have an angle of about 26 degrees, or a trifle less than the angles on a 3 square file. Cut the teeth on the sides just as you did on the liner, but make them very fine—as fine as you can cut—and space them if possible so they will be even on both sides; otherwise the edge may be ragged. After this tool is hardened and tempered, the teeth should be touched up lightly on the sides with an Arkansas slip stone, to even them. This tool seems to work better and be more easily controlled after it is broken in and dulled a trifle.

The border cutter cuts a sort of reverse bead—a thin V line, a wider U line, and another thin V line. Personally I do not admire these borders on checking and seldom use this tool.

The border tool must be toothed across the bottom, since there is no other way of forming teeth on the middle section; but these teeth should run diagonally, rather than straight across, at about the angle of the teeth on a mill file—and their shape should follow the teeth of a cross-cut saw, rather than those of a ripsaw. Teeth should also be cut on the sides, similar to the line spacer, these teeth corresponding to those cut across the bottom.

Any of the three tools above described may be made in any size desired. Square up the end of shank by filing or grinding to a point and drive on a common file handle of a size that fits your hand well. The length of tool, from ferrule to point, should be from five to six inches.

The bent file is made from an escapement file, or a 6-inch die-sinker's 3-square needle file. The escapement file is best. To bend the file without blunting the teeth you will need a small quantity of the file-hardening compound described in Chapter 21. Coat the points of the files with this mixture and let it dry slowly for a day. Then heat the point dull cherry red and quickly press it against a piece of brass. It cools very quickly and two heats will probably be needed. Let cool, and again coat with the hardening compound

45

and let it dry. Then harden by heating the point bright red and dipping into cold water. The compound may then be brushed out with a file card. This leaves the file very hard and brittle, so use it carefully to prevent breaking. The compound is used merely to prevent the heat from forming "scale" on the edges of the teeth.

Figure 18-E shows an ingenious checking tool designed and made by Mr. John Crowe of St. Joseph, Missouri, while Figure 18-F shows a modification of the same tool which I made after seeing Mr. Crowe's. This tool, by reason of the single edge cutter may be shaped up very accurately. The guide is pivoted at the rear. with a small coil spring which forces the edge of guide below cutting edge normally, but permits the cutter to be pressed down onto the wood against the tension of the spring. The guide thus rides in the last cut, keeping the cutter in line and parallel with it. This one tool is used both for the preliminary spacing and for the finishing of the diamonds, and does a good job. I found Mr. Crowe's device a little awkward at first, as I am accustomed to using longer tools. This of course is only a matter of habit, and what we are used to. The longer cutter with narrower blade gave me better results; and while only time and use can show the possibilities of a checking tool, I would not be surprised if this should make a convert of me in the course of time.

SPECIAL KNIVES, SCRAPERS, ETC. Make these as needed from hacksaw blades, harden and temper in oil. Knives having

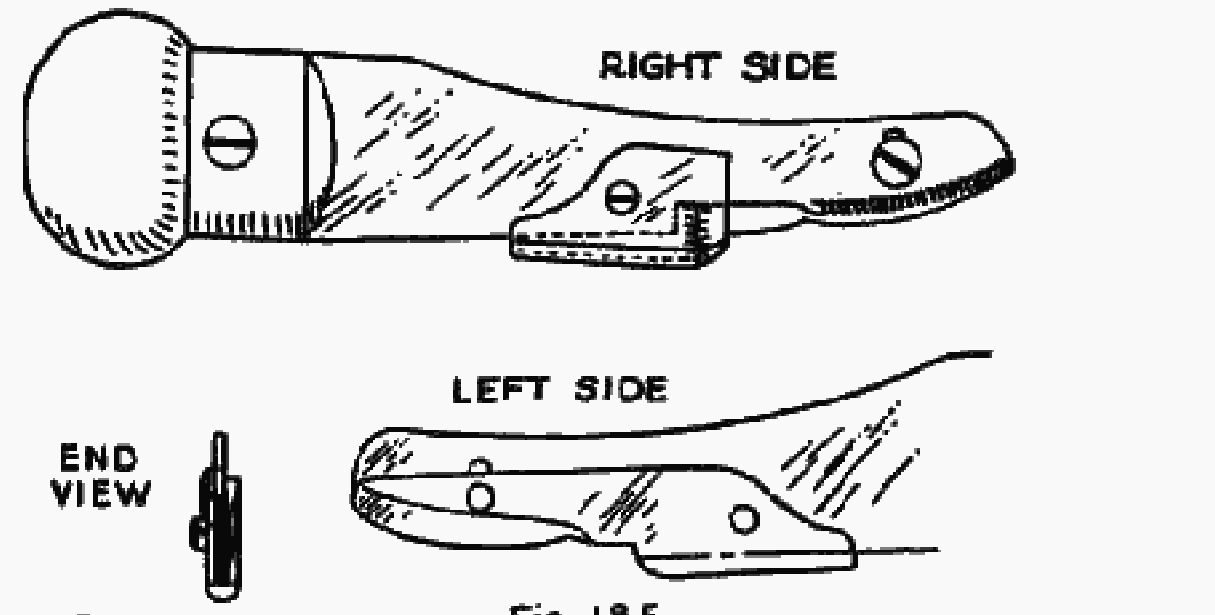


Fig. 18 E

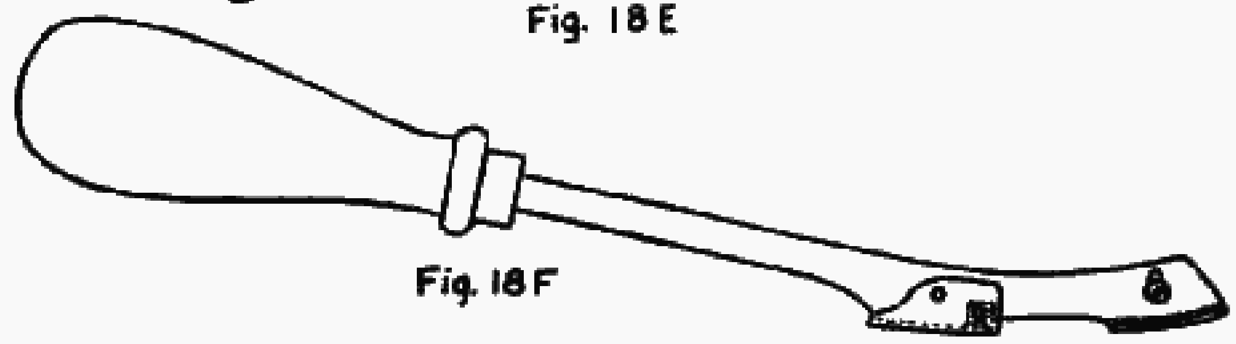


Fig. 18 F

bent blades of various sizes and shapes are very handy in trimming up difficult places in stock mortices.

46

BOTTOMING TOOLS. Ordinary chisels and carving chisels often will not reach into a deep cut to clean out the bottom surface smooth and even. A bottoming tool should be made from drill rod, forged and filed to shape to meet the requirements of the job. Typical bottoming tools are shown in Figure 19. They may be any shape indicated by the cutting you want to do, and may be made of drill rod.

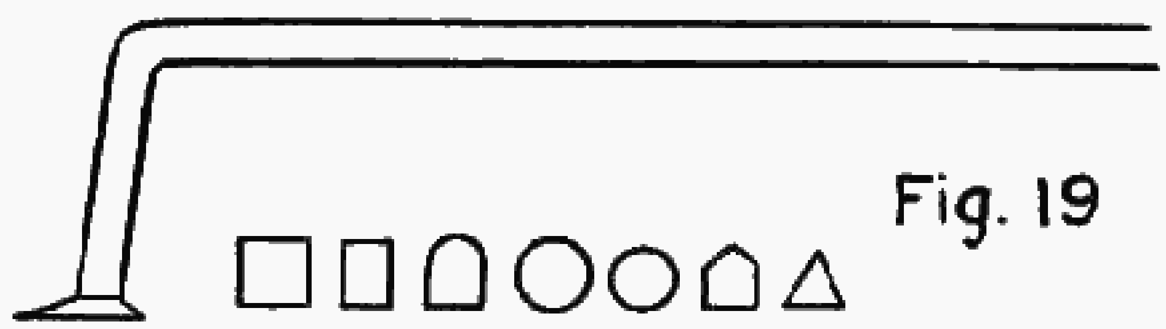


Fig. 19

Heat the end cherry red and quickly clamp it in the vise, then upset the end to desired size by hammering. Two heats may be necessary. Then heat and shape the shank as desired, file to shape, harden, and temper at light straw. The edges should then be sharpened on an oilstone. Square the shanks and fit file handles. Make up a bottoming tool whenever you feel ambitious—there's no such thing as having too many of them.

Special shaped chisels are sometimes made by filing a piece of drill rod to the desired contour. Very good small gouges are made in

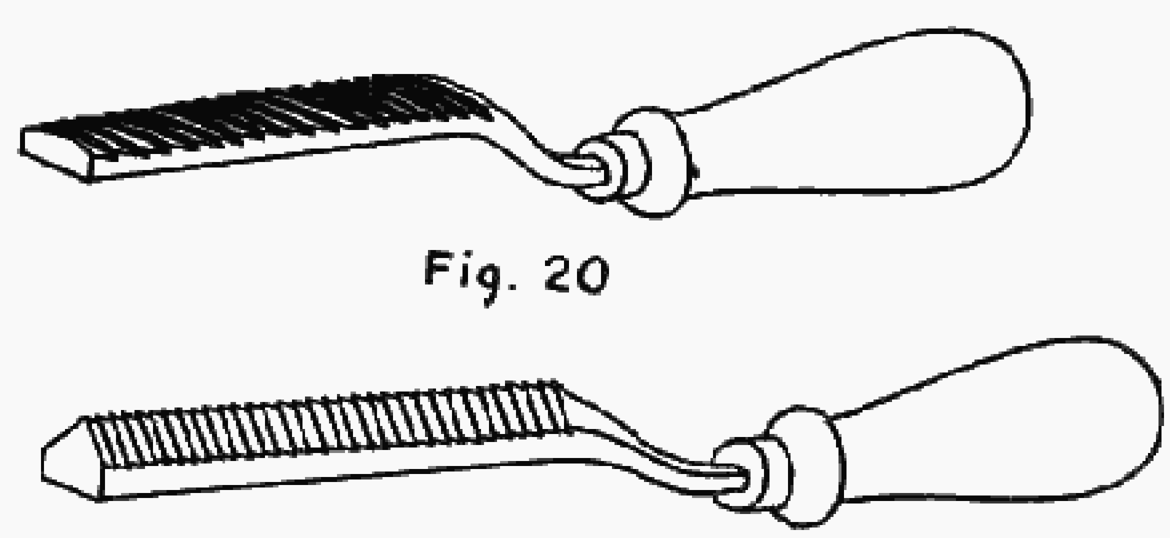


Fig. 20

this manner. Their quality is improved if forged a little before shaping up. Temper in oil at light straw, and hone edges carefully.

SPECIAL RASPS AND RIFFLERS, for wood and metal often save time and labor. These should be made from high grade tool steel, the teeth carefully filed in after a little forging to make the grain more compact, and then hardened in oil at bright red heat. Draw the temper in a clear gas flame, but draw it just as little as possible—just enough to take the stress out of the metal and avoid breaking the teeth off. Chill in water the instant a *very pale* straw color appears. Figure 20 shows a couple of quickly made rifflers

47

that are very handy for roughing off metal, and others may be made any shape to suit the job. Ten or twelve teeth per inch will be about right.

Before trying to hold a barrel or a finished stock in the vise, make a pair of VISE-BLOCKS like Figure 21. Saw these from hardwood about 7/8 inch thick, and glue heavy felt (1/2 inch thick) to their faces. The notch rides over the sliding bar of the moveable jaw, and the felt absolutely protects the finish of parts and prevents it being marred, yet the vise can be set up very tight if necessary.

Also make FALSE VISE-JAWS for holding small metal parts without marring, by bending pieces of heavy sheet brass or copper to hang on the vise-jaws. False jaws of lead or babbit are also very useful at times. These are easily made as follows: Unscrew the

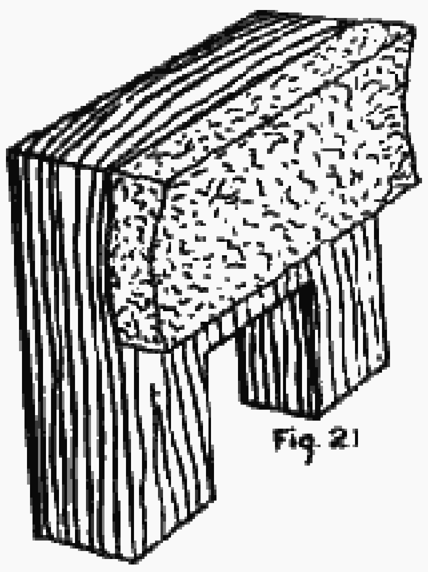


Fig. 21

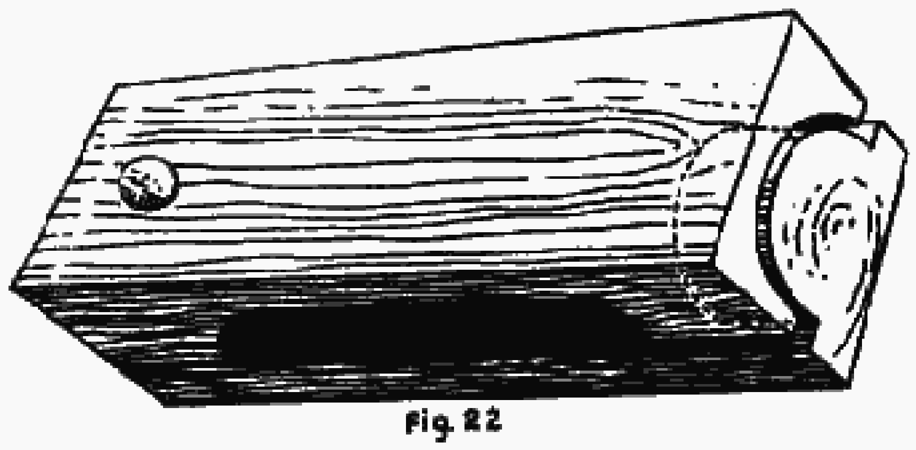


Fig. 22

vise so the jaws are about 3/8 inch apart. Get a lump of stiff clay and pack it against the opening at each end, letting it extend like a box about 1/4 inch above one jaw, and across the jaw about an inch from the edge. Also pack clay under the opening between the jaws. This forms a mould into which the lead is poured. When cool, loosen the vise slightly and lift it out; cast another one in the same way, and you have one for each vise-jaw. With these lead jaws heavy pressure may be applied to hold parts without damaging them; moreover, parts that are so shaped that the regular vise-jaws will not grip them, are easily held rigid in these lead jaws.

The average man would be stumped at the problem of holding a shotgun trigger guard, for example, without bending it in the vise. The gunsmith shapes up two pieces of wood to fit the shape of guard, and fastens the ends together, making the false vise shown in Figure 22. The guard is placed between the wood jaws which are then clamped in the vise, and the guard held firmly for filing. The same idea may be adapted to any thin parts, and is particularly useful for filing flat springs which might be damaged if straightened out in the vise.

SCREW VISES: Cutting down a small screw to very short

48

length is a hard job. It cannot be held in the vise, nor in the fingers. Take a piece of brass 1/2 x 2 inches, and about 1/16 inch thick. Drill and tap a hole near one end for the screw. Turn in the screw the required distance and grind off the projecting end. The thread will be clear to the extreme point when it is turned out. For screws 1/8 inch or larger which must be filed, run a narrow saw cut from the end of the brass into the hole. Turn the screw in the required distance and clamp the brass strip into the

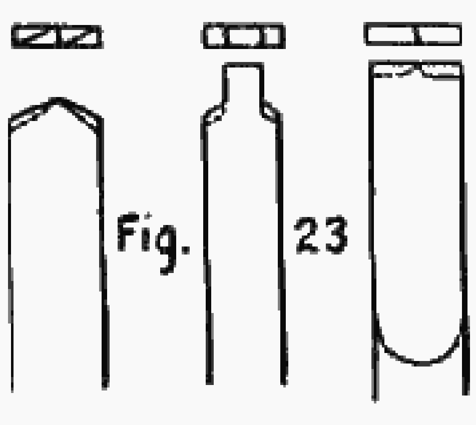


Fig. 23

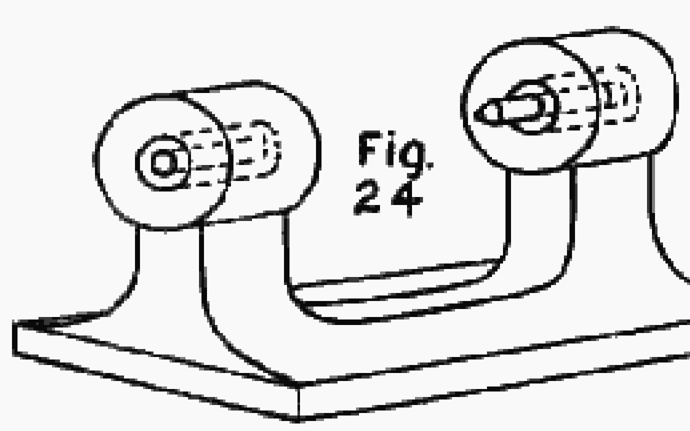


Fig. 24

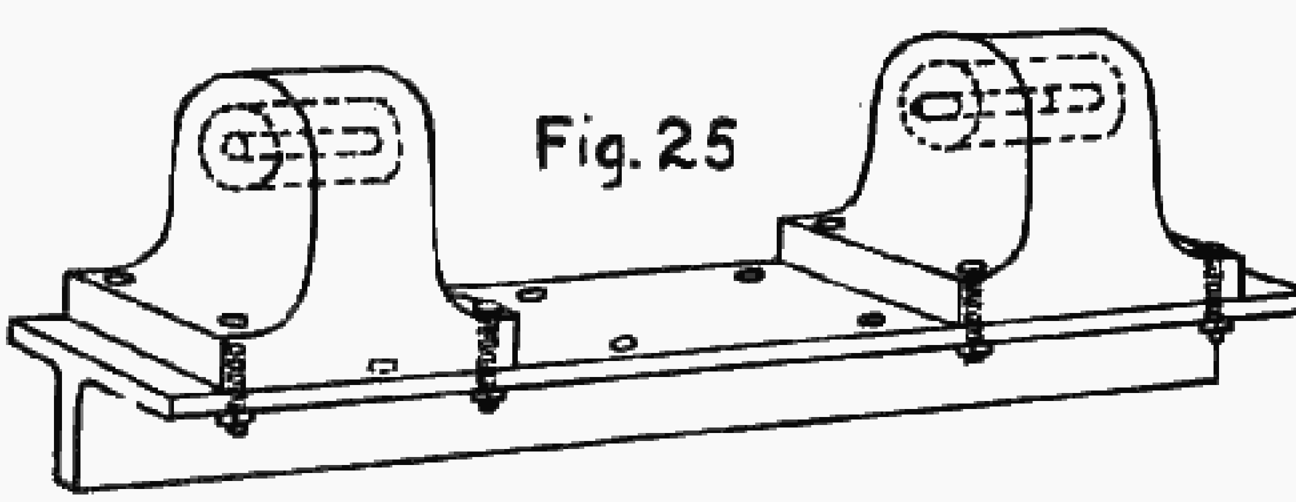


Fig. 25

vise edgeways, the sawcut giving a tight grip to keep the screw from turning. This kind of a "screw vise" is also handy for rounding off the end of a headless screw, for use in unused sight screw holes in barrel, tang, etc.

PITCH GAUGE: Buy a common steel square and rivet, weld or braze a four-foot strip of steel in line with the edge of long blade. By holding the short blade against buttplate of rifle, with the blade touching aperture sight at a point in line with center of aperture, the distance from blade to front sight at point on blade immediately above front sight, gives the pitch of the butt.

FLAT DRILLS for bottoming, counterboring, etc. Figure 23 shows various types of flat drills easily made for special jobs. In certain alterations in which original parts are bent or welded, the screw holes are sometimes squeezed or filed. Standard drills and countersinks probably will not serve to open up or countersink a new hole, as the screws are likely to be bastard size both in shank and head. A flat countersink or counterbore may be made from

49

drill rod. Cut a piece two or three inches long, just a trifle larger than the hole is to be. File or turn the pilot to required size, and file cutting edges on sides or end as required. Harden, draw at dark straw color, and use in the breast or hand drill. For bottoming a small hole in barrel, use stock the same size as the drill. Drill hole a short distance with twist drill, then use a flat drill cutting only on the end to scrape out the bottom. Flat drills may be made in any size for drilling holes in wood. Taper them sharply toward the shank, and shape the point into a wide V, beveling the edges from opposite sides.

The DRILL JIG shown in Figure 24 is worth its weight in gold. The best way is to make a pattern, or have one made in a pattern shop, then have the frame cast at a foundry. Bushings removable from the headstock are made to fit the different size drills you will ordinarily want to use. The hole in head and tail stock should be accurately machined, and the hole in tail stock fitted with a bushing to take a regular tapered lathe center, with cup point. The use of this jig for drilling Springfield guard screw holes and similar work is mentioned later on, and explained fully.

An adjustable drilling jig may be made at small cost as shown in Figure 25. This is a piece of 2 x 3 inch T-bar, with the top planed true and level. Holes are drilled at 2 inch intervals so that the tail stock may be set at any desired distance from the drill.

The CHECKING CRADLE, for holding stocks while being checked, is described and illustrated in Chapter 12.

TEMPLETS and their uses will be mentioned in Chapter 10, and elsewhere. It is advisable to have templets of butt shapes, also for magazine mortices, and similar uses that will be encountered more or less frequently. A number of different templates and their

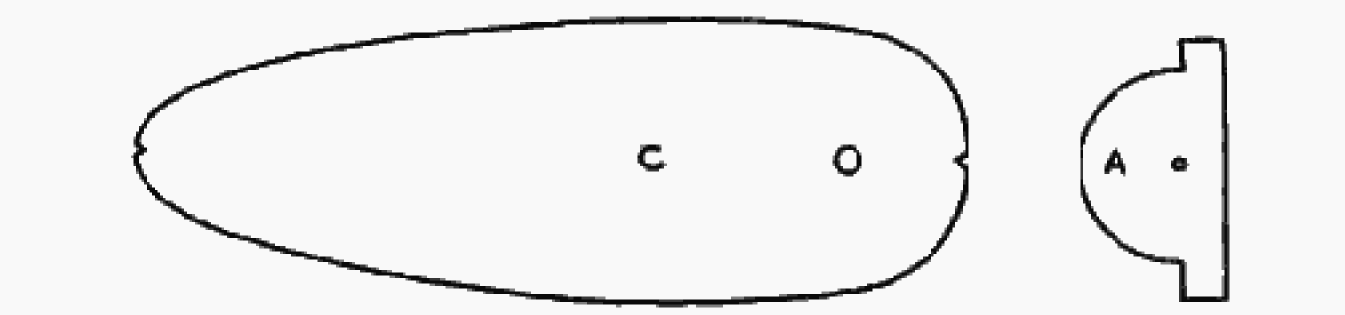
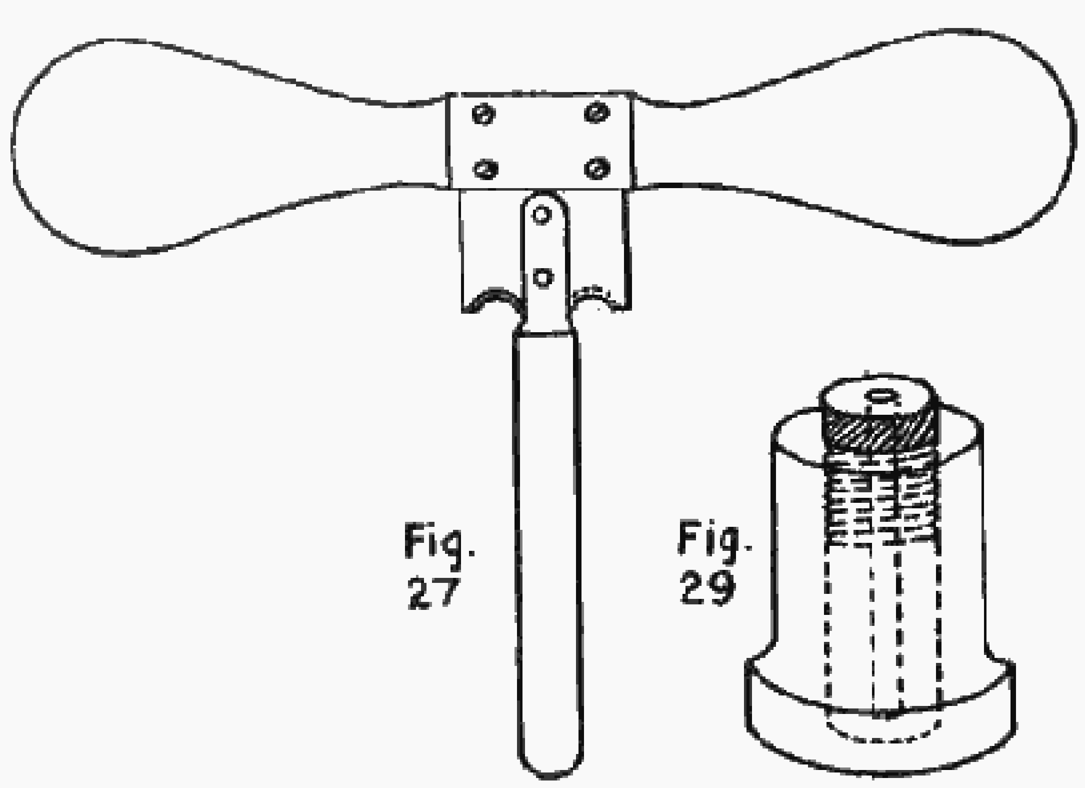


Fig 26

uses are shown in Figure 26. To make an accurate templet for a magazine cut, for example, take the old stock and coat the wood around the mortice with lampblack and oil. Press down on this a piece of clean stiff white paper. Remove the paper carefully and cut out on the outline left by the black. Paste this to a piece of

50

spring brass about 1/32 inch thick, and file the brass carefully to shape. Try it often in the mortice in old stock, until it just fits snugly. Now file it about 1/32 inch smaller all round—this to give you a margin of safety and to allow for thickness of pencil point or scriber when marking around it. Do not make the screw holes full size, but locate their exact centers on the templet and drill them 1/16 inch. Lay the templet on the stock so the center line shows through these holes, and drive a brad into each hole to keep the templet in place while marking. The brad hole then gives you the center for the guard screw holes.



Small templets to serve also as depth gauges may be made to fit the receiver mortice at various points, saving you a lot of time by enabling you to cut down to the depth indicated by templet without frequently trying the action. Such a templet or gauge is shown in Figure 26 "a." This one gives the depth and shape of extreme forward end of receiver mortice. The round side is struck on a 5/8 inch radius. By means of this, one can go right ahead and cut away wood at this point until the side wings of templet rest on top of the stock blank.

MUZZLING CUTTERS: The crowning of a barrel muzzle is often puzzling to the amateur who has sawed off a barrel and doesn't know how to get the muzzle trued up square, with edge nearly rounded. In Chapter 24 I have described a simple method of lapping it true by means of graduated sizes of brass balls. The gunsmith who has frequent calls to cut off and crown Krag barrels, for example, will find the simple cutter shown in Figure 27 a convenience, for speeding up the job and reducing cost. The blade is made of tool steel 1/16 inch thick, with cutting edges beveled on opposite sides. The edge should be shaped and beveled, and the

51

pin holes drilled after which the blade is hardened and drawn at dark straw color, then the sides ground flat and true by rubbing on an oil stone, and the cutting edges whetted. The pilot is also of tool steel, turned to shape and the end slotted on milling machine; then it is hardened, ground and polished to exactly .300 inch. It is attached to the cutting blade by two small screws as shown in cut. The handle is then made from machine steel, slotted and attached to the blade. To use place the barrel in vise with muzzle slightly lowered, so that no chips may work in against the pilot, and turn by hand. Finish by lapping inner edge of cut true with a 5/8" brass ball, as described in Chapter 24.

Brass balls, for lapping and trueing barrel muzzles, should be obtained in the following sizes:—3/8, 1/2, 5/8 and 3/4 inch diameter. Get at least two of each size in case you spoil or lose one. Drill a little more than half way through each ball with a No. 29 twist drill, and tap the hole 8 x 32; turn in a screw 1 inch long, cut off the head, and use the screw as a shank for holding.

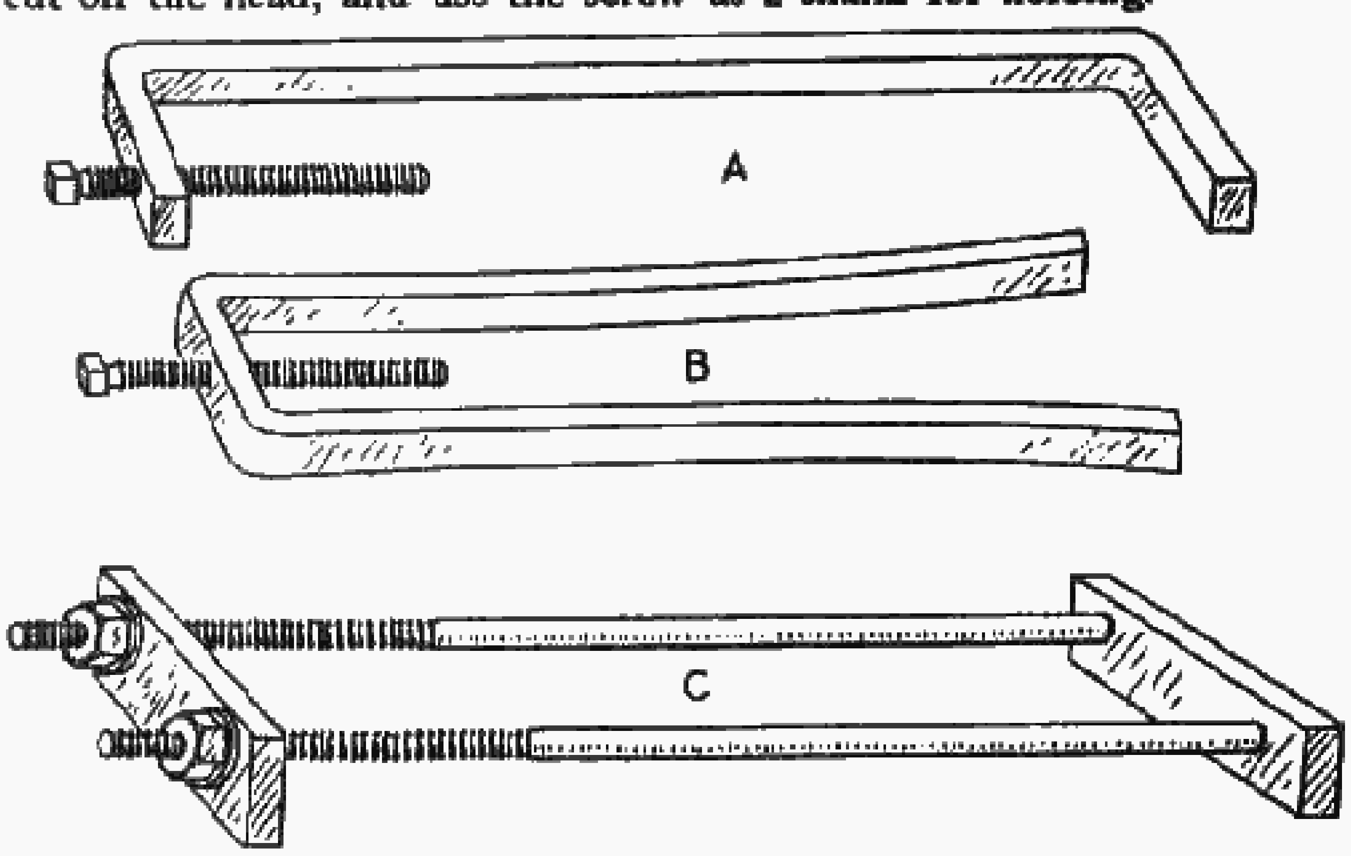


Fig. 28

CLAMPS: For attaching horn, ebony, ivory or other forend tips, there are two special types of clamp, known as the long C-clamp, and the Y-clamp or fork clamp. Figure 28 A shows the long C-clamp, which is made of a piece of 3/4x5/8 inch cold rolled steel heated and bent as shown, and one end drilled and tapped to receive a standard 3/8 inch cup-point set screw 3 inches long. These clamps may be made any length required, so that one end is in-

52

serted in the magazine mortice of a Springfield, Mauser or similar stock, while the set-screw is tightened up against the block of horn or whatever is used for a forend tip. This clamp may also be used on the Krag by hooking the end into the magazine mortice on one side. A piece of heavy leather should be used under end of clamp to prevent damaging the wood.

The Y or fork clamp is also made from 3/4 x 5/8 inch cold rolled steel, bent to the shape shown, the distance between center of prongs being about 2 1/2 inches. This clamp is used for setting forend tips on stocks having no magazine mortice, such as the Model '73 Springfield. A strong vise is required for using this clamp, the clamp being slipped over the forend with one leg on either side; it is then placed in the vise, the jaws of which press the legs tightly against the sides of forend, after which the set-screw is tightened.

Sketch C, Figure 28, shows the butt clamp with which every gunsmith is familiar. This is used largely in stocking shotguns and single shot rifles. The end pieces are 1/2 x 1 1/4 inch cold rolled steel, with 7/16 holes drilled in ends. Into these place two long 3/8 inch bolts, and long enough to reach from the front of action to the butt of stockblank. The distance between the rods should be 4 inches. If long bolts cannot be secured use iron rods and thread both ends for nuts. When placing clamp on the work, tighten up the nuts on opposite sides a little at a time, to equalize the pressure.

Sometimes when using a hand drill it is difficult to judge when the drill is starting at a right angle to the surface of the work—drilling the screw hole in end of pistol grip, for example. This can be overcome by first drilling a hole the required size in a block of hardwood about 1 inch thick; have someone hold this tightly against the stock with the drill through hole in block, which will guide the drill straight into the work. If unable to drill the block straight, make up a number of small blocks, and take the drills likely to be used most to some shop having a drill press, and have the holes drilled. Three or four holes of different sizes may be drilled in each block.

A still more accurate method is to make a pattern and have it cast in iron like Figure 29. The bottom of this casting is then surfaced in the lathe, and a 5/8 inch hole drilled clear through and reamed to size. The upper end of hole is threaded for 1/2 inch. Now make several steel bushings to fit smoothly into the hole in casting, and leave the upper end of bushings large enough to thread into the threaded portion of hole. The bushings are then drilled in the lathe, with various sized drills. Each bushing should be stamped with the size of its hole. A jig of this sort will speed up small drilling jobs and avoid drilling holes at an angle. It must be held with the base tight against the work, and the drills used should be long enough to reach through the hole the required distance.

53

Chapter 5

MATERIALS AND METALS NECESSARY

MODERN gunsmithing has taught the desirability of numerous small parts not formerly used on factory made arms. Many of these will be described in detail in later chapters. Since they are largely made of special material a brief discussion of some of the raw stock which the amateur or professional may require from time to time seems to be in order.

The common or garden variety of corner hardware store has little to offer in this line; the place to buy materials is from firms specializing in machine shop supplies, of which several are listed in the Appendix. It is well to understand exactly what you require before placing an order—because hardware men are not mind readers, and as a rule they know little enough about firearms. So make your instructions definite, and avoid disappointment and delays.

While I am not in the business of handling material for the trade, I receive many requests from amateur gunsmiths to supply them with things they cannot buy locally, and although this necessitates a trip to a supply house I have always endeavored to serve these chaps to the best of my ability,—but it takes mighty close guessing sometimes to decide what they want, or whether they know themselves. Here is a typical request received a few days since: *"Please send me a piece of steel tubing 1/4 inch thick and large enough for a Krag barrel band."*

Now how could I possibly know what to send this man? He may have wanted to make a swivel band to be located at the same point where the military swivel band was originally placed; and for that matter, the rifle and carbine have their lower bands differently located. Or, he may have wanted to make a band to provide a rear sight base over one of the two screw holes in top of barrel. Again he may have had in mind a collar to ease off the abrupt jump-

54

off from receiver shoulder to barrel. What he should have said was "—a band for the Krag barrel to be fitted so many inches from receiver"—then I would have had something to go on. On the other hand, had he been ordering from the supply dealer himself, this plan would have been a poor one, since the dealer probably wouldn't have a Krag barrel to measure, wouldn't have known anybody who had one, wouldn't know a Krag barrel from a vinegar barrel if he met 'em both in church, and wouldn't give a cuss whether he filled this fifteen cent order or not. It isn't hard to set the calipers on a barrel and measure its exact diameter where a band is to be fitted—then the man who fills the order knows what is wanted, or somewhere near it. I mention this merely as an illustration of the importance of being explicit when ordering stock.

Having mentioned BARREL BANDS, we may as well start this discussion with an outline of the materials from which they are made.

That mentioned most often in gunsmithing articles in magazines seems to be old hacksaw blades. Use blades if you want to—they make mighty poor bands, and the steel does not take a good blue to match the barrels. A yard strip of 1/16 x 5/32 inch cold rolled steel will keep you in band material for quite a spell and won't cost over a quarter. Moreover, it will blue to match the barrel. Heavy black sheet iron is about as good if you have some scraps of it, for a band should be dressed to about 1/32 inch thick when finished anyhow, and need be no wider than 1/2 to 9/16 inch.

Cold rolled steel bar stock 1/4 x 3/8 inch square is good for the little block under the barrel to which the ends of band are fastened, and into which the swivel screw is threaded. A foot or so of stock this size may come handy for lots of small gadgets.

The best bands are made in one piece, and the best material for this type is the round seamless cold drawn steel tubing known commercially as Shelby Tubing. This material is also useful for a variety of other items, being perhaps the most generally useful of all material to the gunsmith. Shelby Tubing differs from pipe in that the latter is made from flat stock bent around mandrels and the edges brazed or welded; tubing, on the other hand, is drawn through dies and is without weld or seam, and of very smooth even grain and texture. It cuts nicely, takes a good polish, blues easily by almost any method, and may be bought in a wide range of sizes, both diameter and wall thickness. In the supply catalog before me there are four solid pages of Shelby tubing sizes, of which only a few need be considered here. It might pay the reader to secure a supply catalog listing this material, for future reference. Unfortunately it is listed by outside diameter and wall thickness, and since we are mainly concerned with the inside diameter, it becomes a case of "figger, Nigger, figger." In some sizes the wall thickness is quoted in British Wire Gauge measure; in others, in fractions of

55

an inch. Here are some uses to which the various sizes may be put.

3/4" OD (outside diameter), 14 ga. WT (wall thickness)	Welded to blade as described later makes very good front sight ramp for Springfield. Other sizes could be selected for barrels of various sizes.
1 1/8" OD, 7/32" WT 1 1/8" OD, 3/16" WT 1 1/4" OD, 7/32" WT 1 3/8" OD, 1/4" WT	Will make swivel band for almost any sporting barrel where attached by screw through forend.
1 1/2" OD, 5/16" WT 1 1/2" OD, 3/8" WT 1 1/2" OD, 7/16" WT	For bands with swivel stud to be soldered on barrel ahead of forend, for most sporting size barrels.
1 1/4" OD, 1/16" WT	Makes plain band for breech of Springfield barrel to cover notch after removing original sight base.
1 7/8" OD, 3/8" WT	Makes band with base for No. 6 Lyman folding leaf sight to fit Springfield barrel at breech, covering notch in barrel.

—and so on. Whatever your fancy in inventive genius may conceive, you'll probably find some use for Shelby tubing, and you'll just as surely find the tubing available in a size suited to your purpose. Sight covers, and hoods, muzzle protectors or tompions, wells under grip cap for spare front sight—and numerous others.

Detailed instructions for making such parts will be found in Chapter 24. It must be remembered, however, that since most barrels are tapered the band must have a similar taper when finished. Tubing will stand a good deal of stretching, or it may be reamed to size and taper; so it is advisable to order it a trifle smaller inside than the finished band is to be. For barrel bands select tubing to fit the barrel two or three inches ahead of the location of band, unless the taper is very sudden.

The best material for swivels, connecting links for slings, and the like is BESSEMER STEEL RODS. These come in four foot lengths and cost little. The rods are lightly coppered to prevent rust, and this must be scoured off with emery cloth before using. Bessemer rods are stiff and strong, but designed for cold bending. They come in sizes from 1/16 to 11/64 inch by 64ths; and from 3/16 to 3/8 inch by 32nds.

1/8 to 9/64th inch is the size for swivels and strap links. The 9/64 size is an easy fit in a No. 25 twist drill hole, which hole also fits the pivot bar of the detachable swivel, thus we may standardize on this size for all sling fittings.

In the smaller sizes Bessemer rod also makes good pins for sights, etc., although drill rod is stronger, and available in a wide range of sizes.

The smaller sizes of DRILL ROD are useful in many ways. By keeping it on hand in a dozen or more sizes one is equipped to make any pins needed on short notice. The old damaged or broken pin may be measured by trying it in the Starrett drill gauge mentioned in Chapter 3; when you know the size, it is easy to try your

56

stock of drill rod in the gauge until you find a piece the same size, cut off the length needed for the pin, round up the ends, and there you are. In a pinch I have cut off the end of a twist drill for a pin, trying different drills until the exact size was found. It beats a nail or piece of wire all holler!

Cold rolled STEEL IN FLAT BARS is used for the forms for bending swivels and links, and a few pieces six or eight inches long should be kept on hand for this purpose. Use stock 5/16 x 1 1/4 inches as a form for swivels to take the government sling; grind or file the edges round and smooth. A piece 5/16 x 7/8 inch wide is the right size for links to be used in straps fitting the detachable swivels. The making of these links and swivels is fully covered in Chapter 24.

SWIVEL SCREWS: The best swivel screw is of course made up on the lathe with the kind of head required. It is well, however, to have on hand a few 5/16 inch hexagon head cap screws, S. A. E. standard, for the rush job. Grinding the head round and drilling it from side to side for the swivel makes a fairly good job.

MACHINE SCREWS: Only experience will show what you are likely to require in the way of small screws, but the following sizes I have frequently found useful, and would suggest keeping a dozen or so of each size on hand, both filister head and flat head in all sizes.

10 x 32 8 x 32 6 x 32 6 x 40 5 x 40 4 x 36 3 x 48 2 x 56	These should all be iron screws: you will seldom or never have use for brass machine screws in gun work. Round heads should never be used—either a filister head in counterbored hole, or a countersunk flat head should be used.

You will need a few flat head wood screws from time to time in sizes from No. 5 to No. 8, and in lengths from 3/4 to 1 1/4 inch. A few flat head brass screws may be kept for emergency repairs on stocks. Sizes and lengths should be assorted. Always use iron woodscrews in tangs and other parts of the gun where steel is joined to wood. A No. 9 oval-head iron wood screw makes a first class butt plate screw.

A few brads, nails, etc., always come in good and should be found about every shop.

ADHESIVES: For cementing horn to wood there is nothing equal to the old fashioned white flake glue sold in paint stores and occasionally in drug stores. Being made from hoofs and horns, it is perfect for this work. Brown or amber flake or stick glue has not proven satisfactory. Prepared liquid glue is all right for cementing sandpaper to wood wheels, and such jobs, but don't use it where strength and endurance are required.

Du Pont Household Cement is a pyroxilin compound, and the

best cold adhesive I have ever seen. It comes in 25 cent tubes, and after drying is both waterproof and oil proof. Many glues will deteriorate and allow the joint to break open after prolonged contact with oil or grease. Du Pont Cement and some of its uses will be mentioned frequently in subsequent chapters. It is sold by many hardware and paint stores, and by the larger mail order houses.

Plastic Wood is a paste made of finely divided wood, with a binder added until it is the consistency of putty. It is used in a variety of ways, such as filling small holes, knots, etc., in repairing stocks. It will be mentioned later. It is sold in large and small cans at hardware, paint, and some drug stores. Buy the small can, as it may dry out if long unused after being opened.

PAINTS AND OILS: Shellac, orange or white. Useful for cementing sandpaper to wood wheels, and in various stock finishing mixtures.

Linseed Oil, Raw: For finishing stocks. Used alone, or with other ingredients. Specify Archer-Daniels-Midland Company's linseed oil.

Boiled Oil: There is no kettle boiled linseed oil on the market today. The compound boiled oil of the above company is perfectly satisfactory.

Varnish: Valspar, or Du Pont's Spar varnish, for oiling compounds. Sherwin-Williams hard rubbing varnish for full varnish finishes.

Lacquer: Du Pont's clear Duco lacquer for finishing stocks. Must be used in an air brush.

Alcanet root, for darkening oil mixtures. Gives a deep slightly purplish brown. Obtainable at drug and paint stores.

Oil Soluble Red: A dark red powder, useful for imparting a reddish cast to linseed oil. Obtainable at wholesale drug and chemical houses.

New Method Gun Bluer: Made and sold for bluing guns, and so used by those who don't know any better. Really useful for touching up the shiny end of a pin, point of a screw, etc., without removing part from gun. Also useful for painting the edge of a leaf sight which was filed down while on barrel.

Stain: Sometimes a stock will be very light in color, or have light streaks which look better darkened. Use Johnson's Wood Dye, or Ad-El-Ite Stains in Walnut or Mahogany to get the desired tint.

Turpentine: Occasionally needed in stock finishing compounds. Get genuine spirits turpentine, not turpentine substitutes sold by some paint stores. Hercules Steam Distilled is about the best.

Cup grease, No. 3—any standard make: Used in polishing stocks, also for greasing guns for shipment or storage. Melt it and throw in a handful of iron filings, keeping it melted for two or

three hours, to free it of any acid. Then strain through cloth until clean, and let harden.

ABRASIVES: Sandpaper or Glasspaper, Nos. 1, 1/2, 0, and 00 will be needed in stock making and finishing. Garnet paper is better than sandpaper for use on wood wheels. Carborundum or Aloxite cloth in rolls 2 inches wide is far better than emery cloth for polishing barrels and actions. Use Nos. 1/2, 0, and 00. Emery cloth is better for final polishing as it breaks down more quickly. For an extremely bright finish, follow with Crocus cloth—this is made in but one grade, very fine.

Valve grinding compound, oil or water mix: If oil mix is used, the Carborundum compound is best. Use it for lapping barrels.

Emery, No. 120, for lapping barrels.

Pumice stone and rotten stone—powdered: Used for polishing stocks. Keep it in large sifter top cans for convenience.

HEAVY FELT, 1/2 inch thick: Used for padding vise jaws, and for rubbing stocks. Obtainable at harness shops and large paint stores.

WOOD FOR STOCKS: Should be purchased in ready cut blanks, or else in planks from 2 to 3 inches thick. See list of dealers in Appendix. After cutting out blanks, save your scrap for repairs and patches, pistol stocks, forends, etc.

TOOL STEEL, SPRING STEEL, etc.: The sizes and grades likely to be needed are discussed at length in Chapter 21.

Brass: A few heavy pieces of brass and copper are useful as soft bench blocks, for riveting, driving off military sights, etc. Pieces 1 inch thick sawed from 2 to 3 inch brass bars are very handy. They may be purchased cut as desired from machinery supply houses. Sheet brass and copper 1/16 inch thick should be kept for protecting vise jaws. Get soft brass if possible, as the hard sheets sometimes break when bent. Use 1/32 inch sheet brass for templets.

Solder in various grades may be had at hardware, machinery, and wholesale jewelry supply houses. Tin, lead, bismuth, etc., as well as spelter and silver solder may be bought from the same sources.

Lead: Keep a few pounds of scrap lead—old pipe, etc.—for making very soft bench blocks and vise jaws, also for making barrel laps.

Horn, for forend tips, also ivory, must be purchased from one or two firms who import it in small quantities. Carabao or Asiatic buffalo horn is best. See the Appendix for firms handling this material.

Dowel rods in 3/8 and 1/2 and 5/8 inch sizes are convenient for making plugs for barrels, dowels for forend tips, stock patches, etc., and a few should be kept on hand at all times. Carried in stock by machinery supply dealers and some retail hardware stores. Oil, for sharpening stones, as well as lubricating actions. Marble's

Nitro Solvent oil is the best light oil I know of for general use. Economical in quart cans at $1.50. Also used in oil bluing, as described in Chapter 20, and for "lamping" bright spots on barrels.

Chemicals for bluing processes, case-hardening, tempering and coloring metals. Many of these are not found in the corner drug store. See Appendix for list of dealers.

Bakelite and hard rubber in sheets 1/4 inch thick makes a good inlay material. Obtainable wherever radio supplies are sold. Hard rubber rod 1/4 inch in diameter is used for chasing rifle bolts.

Hard fibre, both red and black, in sheets of varying thickness, also tubes and rods is sold by machinery supply houses and electrical houses. Used in building up butts, and sometimes for making butt plates and grip caps. Hard fibre rod is better than brass or copper for driving out barrel sights, unless very tight. Will not mar the bluing.

Buying materials is like buying tools—no use getting anything you do not need. It doesn't take long to get a good many dollars invested in a lot of stuff you may not use for a year, if ever. A knowledge of the right tool or the right material for the job will prove helpful to you in avoiding mistakes when the time comes to buy.

Chapter 6

FIRST STEPS FOR BEGINNERS

THE man who has never attempted even a simple repair on a gun and who is notoriously inadept with tools can scarcely expect to start in and turn out the class of workmanship found in the best shops. Gunsmithing, while a trade in itself, is really made up of the rudiments of other woodworking and metal working trades, with a number of specialized branches and operations of its own. For this reason the rank, raw beginner is often less handicapped than the man who is expert in one of the branches of mechanics applying to gunsmithing but who knows nothing of the others.

The beginner has nothing to unlearn; he does not, for example, expect to cut an action mortice in a stock with the same degree of fit that a carpenter would make in morticing in a door lock. He is not likely to make the mistake of the machinist who, understanding lathe work, blunders ahead and turns down a barrel without thinking of the "kinks" it is likely to acquire as stresses are released. The beginner meets all problems with a wide open mind, and accepts the instructions of men who are familiar with gun work; and therein lies his adaptability. In the course of time he will turn out very creditable work, often far better work than the cabinet maker or the machinist, albeit he could not make a living in either trade.

If a man is entirely unskilled in the use of tools, so that he is forced to call in a carpenter to hang a screen door, or to drive into a garage to have the carburetor on his car adjusted, it behooves him to first of all familiarize himself with the mechanical trades into which he will delve to a greater or less degree, acquiring some knowledge of their terminology, and some acquaintance with the uses of various tools.

As a first step in the right direction he should occasionally buy a copy of Popular Mechanics, Science and Invention, and similar magazines. In their pages will be found many helpful suggestions for amateur mechanics, from which he will in time absorb a certain amount of "atmosphere" and general understanding. If there is a first class hardware store in his town, he should cultivate the acquaintance of some salesman who knows tools, and will aid him in proper selection of things needed, and explain their uses in detail.

One of the very first things the beginner should do is to write to leading tool makers and secure their catalogs, and study them carefully.

These are more than catalogs—they are valuable textbooks. Besides the information they give, they are indispensable when it is necessary to order some special tool from a small dealer who never heard of it, and who may try to tell you that "there ain't no sich animule." Again, while the rather extensive list of tools named in Chapters 3 and 4 may seem like they should cover every possible requirement, there may be some job the amateur gunsmith wants to do that is not covered herein. Familiarity with the catalogs will enable him to select other tools for special jobs with certainty.

It is a good idea also to secure the complete catalogs of Sears-Roebuck and Montgomery Ward. These mail order houses handle many high grade standard tools, and can often ship them much quicker than the local small dealer can obtain them through jobber or manufacturer—and sometimes they sell them at slightly reduced prices. In using mail order catalogs, however, it pays to avoid the cheap "private brand" articles of unknown origin.

Dealers' catalogs should also be secured and studied carefully. In addition to the many standard tools listed, they also list much raw material, iron, steel, brass, screws, etc. that will sooner or later be needed. Studying the catalogs not only familiarizes one with the supply of such materials, but enables him to order intelligently when the time comes.

But the most important thing of all to the beginner in the field of amateur gunsmithing is a thorough knowledge of guns and loads—not only his own guns and his own loads, but of all makes and models

of guns, and all the cartridges he may want to use some day. To this end he should study carefully every catalog he can get his hands on, both American and foreign. Study the details of various actions: learn how they function; decide which are their good points, and their weak ones. Examine all the guns you can get hold of, and learn exactly how they work, and handle. Get all the cartridge catalogs you can and study them carefully—they are real textbooks, full of valuable information.

The chap who starts in to repair his first gun with only a hazy idea of what the various parts are for, and how the action functions will find himself as bad off as the boy who took his French harp apart to see what made the music—and likely he'll have enough parts left over to make another gun when he reassembles it. But, having acquired a good understanding of principles, and learned how much similarity there really is in guns of different makes and models, you will soon develop an intuitive understanding of mechanisms, so that you need not hesitate to dismantle any action for the first time. You can drop the parts loosely together in a box, and it won't be like working a Sam Lloyd puzzle to put them together again.

Before attempting the more difficult jobs such as complete remodeling of a military rifle, adjusting the trigger of a fine target arm, etc., it is well to get one's hand in with a number of easy jobs and practice work where there will be no great loss if you spoil some material or parts. The practice you will get in making up checking tools, simple chisels, screwdrivers, etc., will stand you in good stead later. Learn trigger pull adjustment first on a cheap single shot rifle; let your first bluing job be an old pot-iron that is ready for the scrap heap anyhow—and if it turns out well, you're that much ahead.

An old wreck of a single barrel shotgun is a mighty good one to start your training on—and most single barrel shotguns are old wrecks. Don't be afraid of damaging it, because that's usually impossible. Fix up the trigger pull, replace damaged screws or pins, make a new spring or two where needed, perhaps a new firing pin; repair the broken stock (they're always broken somewhere), try your hand at checking it; put on a front sight, polish out the barrel (it'll need it) or try your luck at cutting off a few inches of the muzzle and re-choking by the overboring process described in Chapter 31. If the barrel is in very bad shape, cut it off ten or twelve inches, cut off the stock back of pistol grip, and make an "auto and burglar gun" of it. One of those "high power long range Texas Ranger guns" from Roars and Sawbuck will give the student-gunsmith more fun, as well as more real constructive experience, than a brand new stiff would give a medical student! And it will probably have more different things the matter with it, too.

This book is not intended as a mere compilation of shop kinks and detailed descriptions of specific jobs; rather, it is prepared

with a view to its use as a text book, to be studied thoroughly. By familiarizing himself with the entire book before going to work, the reader should have a clearer understanding of the reason behind various instructions; knowing that he will be able to develop initiative to the point of devising ways and means of doing things which are not specifically described.

Woodworking tools, while not difficult to master, call for reasonable skill. The aspiring gunsmith should study the methods of expert woodworkers—not merely carpenters, but cabinet makers, musical instrument makers and repairmen, turners, and pattern makers. Of the trades named, perhaps the last more nearly approximates the skill required of the stocker than any of the others. The gunsmith can learn something from nearly all of the mechanical trades, but in "nosing about" for information, he should avoid those shops where "rough and ready" methods are the rule rather than the exception. Don't expect to see close machine work being done in the garage—the motor mechanic would be helpless on the simplest sort of gun work. Study the work of experts, and learn from them.

Finally be sure that your knowledge of firearms is practical and not theoretical. Be sure you know *what* you want to do, and *why*, before you worry about the *how* of the matter. Study the works of Whelen, of Crossman, Askins, Hatcher, Fitzgerald and other authorities who know whereof they speak. Before making up your mind to risk long hours of time and hard-earned dollars' worth of materials to prove your theories—check up on their practicability through the knowledge of others, whose experience has covered a wider field than your own.

Chapter 7

GENERAL SHOP PRACTICE AND USE OF TOOLS

MUCH of this chapter will be of no interest to those already having a knowledge of common tools and their uses; it is written largely for the benefit of the beginner, who has spent his life working with head rather than hands; and who finds himself awkward in the use of even the simplest tools, and whose knowledge of their uses and possibilities is limited.

Woodworking tools will receive first consideration. Having "tooled up" his shop, the amateur is likely to believe he is ready to go to work. But not just yet. Edge tools of all kinds usually come from the factory ground, but not honed or whetted to a fine working edge. It is necessary to understand, first, how to properly condition new edge tools for use; and second, how to keep them in tiptop shape for finest work.

The bit of cutting blade of your jack plane will do as a first illustration. Remove it by unlocking the cam clamp of the iron holder on the outside. Remove this holder, and you will find the bit can be lifted out, attached by a large set-screw to its guard. Loosen this screw, using the edge of the bit holder as a screw driver. Note that the sharp edge of the guard was set within about 1/16 inch of the edge of the bit.

Now study the bevel ground on the bit. Note that it is about 1/4 inch wide, and slightly hollow ground. Being made primarily for carpenter work on soft wood, the bevel of the edge is usually somewhat shorter than is needed for best results in hardwood. However, if you have no grindstone, leave the bevel alone for the present. Later, if you have access to a good sand grindstone—not an emery wheel—you can grind the bevel back about 1/32 inch, but not more than that.

You will note that little if any WHETTING has been done

65

on the edge. Take your combination coarse-and-fine carborundum stone, and set it on the bench with the smooth face up. Apply a few drops of oil to center of stone. Hold the plane bit in both hands as in Figure 30, with the heel of bevel resting on the stone, as in "A," Figure 31. Now slowly lift the upper end of bit, tilting it forward until you feel the edge touch the stone, and the oil squeezes out in front of this edge. Figure 31-B. The heel of bevel is thus very slightly lifted from the stone, so that only the edge will be sharpened. Maintaining a firm but not too heavy pressure,

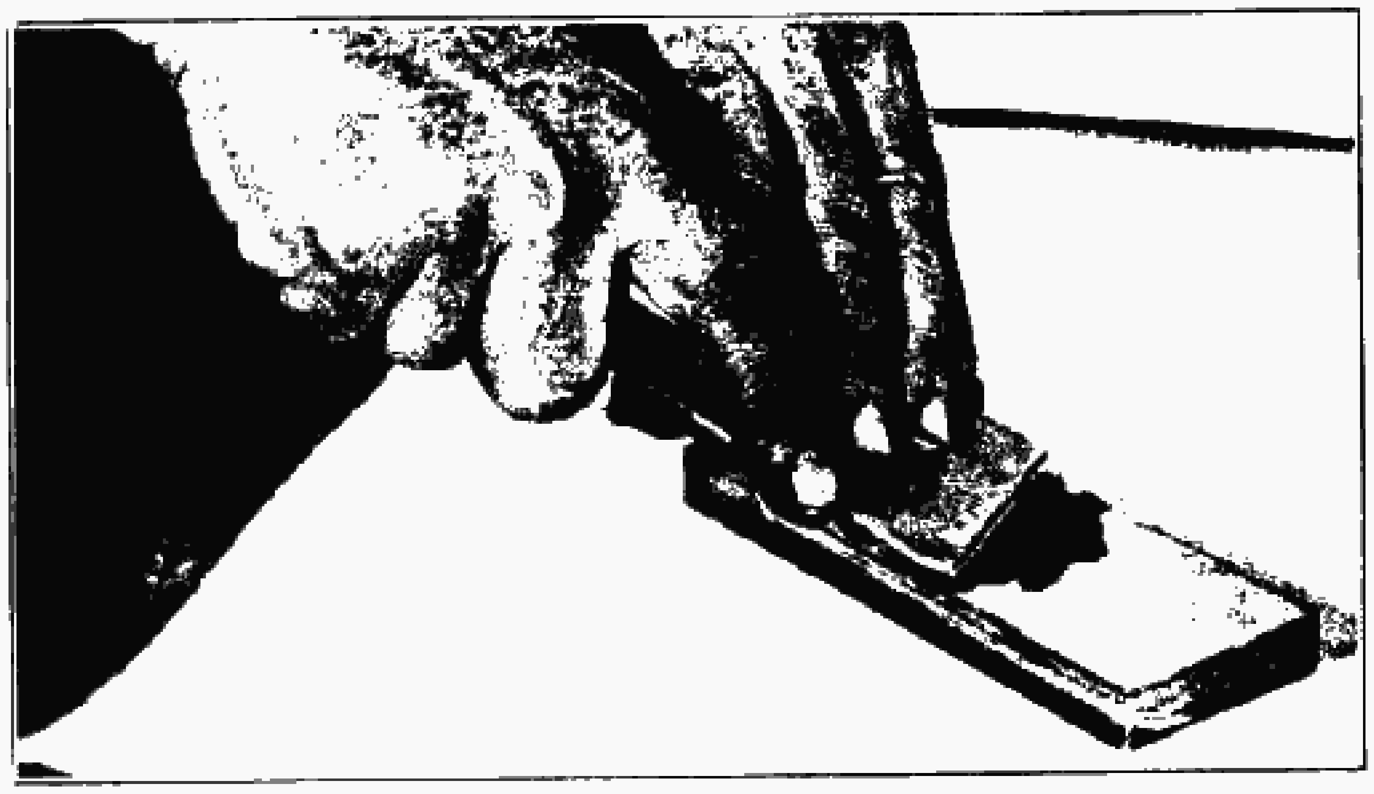
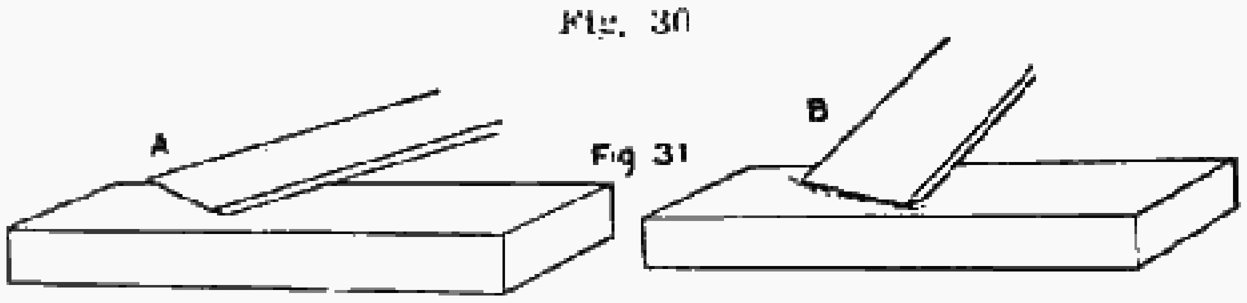


Fig. 30



A Fig 31 B

and holding the wrist joints stiff, so as not to change the angle of the bit with the stone, move the bit in a long oval stroke, with greatest pressure as you go *against* the cutting edge. After a few strokes lift, wipe off the oil, and examine the bright whetted edge. This short bevel should be about 1/32 to 3/64 inch wide, and should be even clear across the width of the bit. If it tapers off toward one corner, it shows the pressure is too great on the opposite corner. Try again, until you have a smooth, even narrow bevel clear across the edge, with a fine "wire" edge turned on the flat (unbeveled) side of bit. Lay this side *perfectly flat* on the stone, and rub back and forth until this wire is whetted off. It will not all be removed but will be partly turned over on the bevel. Reverse and whet the beveled side as before, removing more of the wire and turning the rest on the flat side. Continue whetting

66

the two sides alternately until all the wire is removed and the edge feels sharp to the fingers. Remember, the flat side of the bit must not be beveled the least bit.

Now replace the carborundum stone with the Lily White Washita oilstone, and whet the bit on both sides in the same manner. Be sure to keep the same bevel on edge each time you whet it, and always bring the heel of bevel against the stone first, then tilt it until the heel is barely lifted from the stone, and oil is squeezed out in front of the edge. This stone will produce a finer wire edge, which is carefully whetted off, first one side then the other.

Test the edge by wetting the thumbnail and drawing the bit across it. No danger—it won't cut through the nail at all. If very sharp and smooth, as it should be, you feel it "take hold," and any roughness or dull spots will be noted instantly. Continue whetting on the Washita until the edge is perfectly smooth, sharp and true. At this stage it should shave hair from your arm almost as smoothly as a razor. Now strop the edge on the flesh side of a piece of heavy leather, nailed to a piece of wood, or one end of the bench, or other suitable place. Be careful not to rock the blade in STROPPING, thus rounding the edge. Note that in whetting, most of the cutting is done *against* the edge, while all stropping is done away from the edge.

A splendid tool strop is made by bolting together a number of narrow strips of heavy leather, such as saddle skirting, with slender stove bolts. Sandpaper both sides smooth and even. In whetting tools, the oil and grit from the stone works up into a greasy paste. Always clean this from the stone immediately, and spread it on one side of the strop or leather block. Use this side for the first stropping, and finish on the clean side. When properly sharpened the plane bit or any other wood working tool should cut a hair cleanly as any razor. You can't begin to appreciate the value of this kind of an edge until you have used it and then try to use the kind of edge usually found on tools! It's the same difference as driving a flivver with three cylinders missing and the gas tank empty and two flat tires, when you've been driving a new Cadillac.

The foregoing will apply to all plane bits, though the angle of the bevel differs somewhat for different type planes. For example, a block plane bit lies down much flatter than that of a jack plane, and the bevel of the edge is wider accordingly.

When assembling the plane, reverse operations used in removing the bit, and note carefully how much of the edge of bit projects through the slot. There is a long lever under the bit by which the blade can be shifted from side to side, to even up the projecting edge. The bit moves in the opposite direction to the lever in some planes and in the same direction on others. Shift it until it is perfectly even, and draw it back with the adjusting screw until it *barely* projects below the surface. Some mechanics adjust plane

67

bits entirely by feel; a better way for most people is to hold the plane bottom up in a good light, and sight along the surface. Any variation in depth of bit at either side will be instantly noted.

In USING THE JACK PLANE most beginners (and also many mechanics who should know better) will turn it at an angle on the work, instead of pushing it in a straight line. The reason for the long body of the plane is to carry the cut in a straight line, to true up and straighten an unequal edge. Turning the tool sideways permits it to follow the curves and hollows, thus failing in its purpose. Holding it straight on the work is particularly important in straightening up the top line of a stock, which is one of its principle uses in gun work.

Start in with the lightest possible cut—the bit scarcely scraping the wood. After two or three strokes, if it does not take hold better, set the bit very slightly deeper. Thin, almost transparent shavings give you better control of the work, and produce a better job.

If you find you are cutting against the grain, reverse and work from the other end. When the grain runs "every which way" as it often does in stock blanks, just do the best you can.

When using the smooth plane to merely clean up the side of a rough piece, it is often permissible to turn the plane at various angles to get at the hollow places. Sometimes, in very curly wood, the smooth plane will cut better *across* the grain than it will from either end.

In starting a stock job, one flat side—usually the right side, should be planed perfectly flat and true as a working surface from which

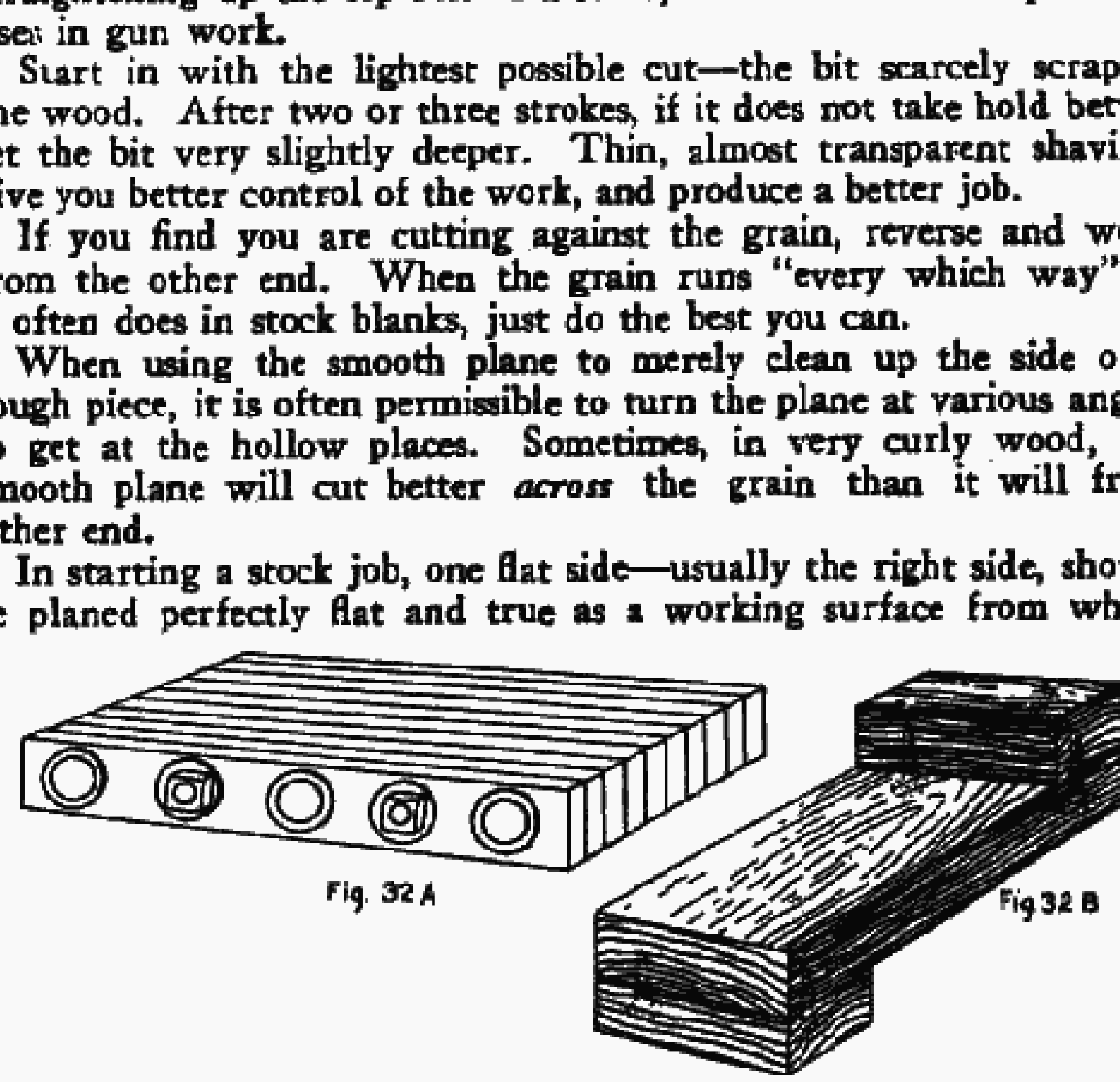


Fig. 32 A Fig 32 B

the center line is run with the marking gauge; and on this job use the jack plane, and sight along the surface to be sure it is kept in a straight line.

The block plane was made for cutting across end grain; yet it cannot well be used for such jobs as truing up the butt of a stock,

because it invariably chips the edges at end of cut. It is a handy little tool however for many small jobs, such as shaping up patches, squaring up ends, etc. Make a bench-hook of hardwood as shown in Figure 32B, and use the plane on its side for small work, which is held in the hook. This device is also called a "shoot board."

68

Never stand a plane upright on the bench when through using it. It should always be laid on the side to prevent the edge becoming damaged. Wherever you keep your planes when not in use, either lay them on their sides, or else have them blocked up with thin strips of wood.

Never drag the plane back on the edge of bit during the return stroke. Either lift it completely off the work, or at least lift the rear end, letting the frame ride on its point. Nothing ruins the cutting edge so quickly as dragging it back on the work after the cutting stroke.

CHISELING: Next in importance to the gunsmith come the chisels used in stock inletting. I have mentioned the J. B. Addis

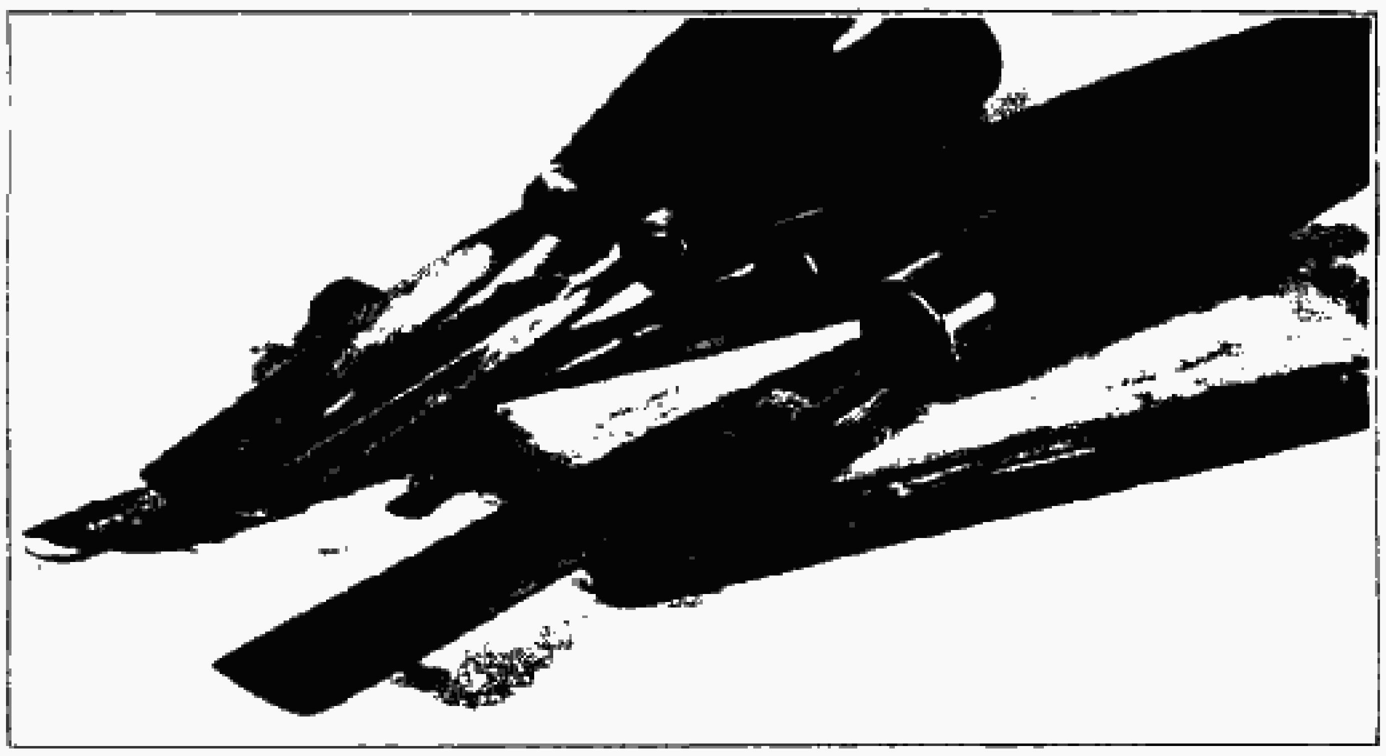


Fig. 33

wood carving chisels as being best for this work. If you do not have these, then your carpenters' chisels and gouges must be ground with a much longer bevel than the carpenter or cabinet maker uses—grind the bevel from half again to twice as long. Also, it should be a rounding bevel instead of straight.

Carving chisels, or any others used for stock making, should have a double bevel. The most pronounced bevel is of course on the bottom or outside; but the top or inside of blade should also be slightly beveled, contrary to the custom of other woodworkers, who bevel chisels on one side only, like plane bits. And both bevels must be very long, gradual, and slightly rounding—the bevel running off into the line of the blade without any definite stopping point. Figure 33 shows a number of carving chisels properly sharpened.

Your chisels will come to you only rough ground, probably with a thick unfinished edge. Use the coarse side of the combination

69

carborundum stone first, and carry the bevel well back. Do not have any short bevel at the extreme edge as you did on the plane bit. Sharpening the outside or bottom causes a wire edge on the inside. This is worked off with the round edges of the carborundum slip hone first, then with the Washita and finer slips, the inside being gradually beveled, but not nearly so much as the outside. Finish both sides on the Washita stones, then strop both inside and outside on leather. For the hollow chisels or gouges, bend or fold a piece of leather to fit into the curve, and rub the leather away from the edge, not against it.

Carving chisels must be as sharp as human effort can make them. They must be so sharp that they will make a smooth, polished cut *against* the grain if necessary. The wood carver's test for sharpness is to try the chisel or gouge *across* the grain of a piece of very soft, spongy pine or "deal." It is not sharp enough for this purpose until it will make a smooth cut in this manner without the least suggestion of tearing.

The slip stones should be kept handy, also the strop, and edges of chisels touched up frequently. Much time is saved, and split or rough cuts are entirely avoided.

Fig. 34

Figure 34 shows the best method of manipulating the carving chisels. The hold will vary slightly with the nature of the work,

70

but both hands should be used whenever possible, to give best control. Figure 81 shows an easy way to cut out a deep channel, such as the guard channel in a rifle stock, when impossible to get in line with the cut. A hollow chisel is used across the grain, which prevents tearing or splitting; the humps are worked out in the same manner as the rough cutting is done, and the bottoming tool is used to level up the bottom of channel. Wood carvers' rasps, or "rifflers" are also handy for this work.

THE DRAW-KNIFE is an accepted tool of the carpenter, but should be used advisedly by the gunsmith. In Chapter 11 I have not mentioned the draw-knife in connection with stockmaking, for the reason that I very seldom use it, nor do I consider it necessary. The only time it can earn its keep is when used for roughing off the corners of a very straight grained blank, on which there is no chance of running in too deeply. The draw-knife is a perverse instrument, following the grain of the wood with the tenacity of an old millionaire after a chorus girl. Before you realize it, there's a bit peeled out, just a sixteenth of an inch perhaps, deeper than you wanted it.

There are stockmakers, however, who use the draw-knife with consummate skill, doing nearly all of the shaping with it. I can see no reason for this, as a good cabinet rasp will do the job just as rapidly, and with absolutely no danger of going too far.

The American workman holds the draw-knife straight across the work, and pulls it toward him by main strength and awkwardness, ripping and tearing off the kindling at a great rate. His draw-knife has a short bevel, and is seldom sharper than the law allows. The Englishman, on the other hand, considers it as a cutting tool; he grinds a long bevel back on the blade, and even bevels the bottom side slightly also. He then stones the edge until it is razor sharp, and in using it, holds it at a decided angle on the work. The left handle is further from his body than the right, and instead of giving it a straight pull, he uses a curving stroke, bringing the right hand in closer to the work at the end of the stroke. Thus instead of ripping and splitting the wood, he pares it cleanly, even cutting across and sometimes against the grain without splitting. He didn't learn this technique in a day or a week, however; such workmen are usually apprenticed to their trade very young, and their skill comes with their years of experience. At that, a man with a good rasp will shape up his stock just as quickly as the English workman will with his draw-knife.

The SPOKE-SHAVE is a cross breed between the draw-knife and the plane. The bit should be sharpened like a plane bit, and set in the same manner. Set it for a very shallow cut. It is useful for trimming down the work after the draw-knife, and is used in the same manner,—providing you like the tool. I can do three jobs with a cabinet file while I'm doing one with the spoke-shave, and do them better.

71

SAWS: The average man uses a saw very clumsily—and this is nearly always partly due to the fact that he has a very poor tool to work with. The Atkins or Disston saws mentioned in Chapter 3 will do good work from the start, and are easy to keep in shape. Saws for hardwood should have rather finer teeth than those for pine. Keep them well sharpened, and with medium set.

A saw vise costs only about 75 cents, and is essential for sharpening saws. Clamp the saw about 3/8 inch from the edge. Run a flat mill file lengthwise over the teeth one or two strokes, to equalize their length. Then take a slim taper saw file, set it in the first tooth and make a light cut. Note whether this is at the same angle as the tooth was cut originally. Shift the position of the file until it is, then hold at this angle throughout the job. File every alternate tooth from one to three strokes as required to bring them to sharp points; then reverse the saw in the vise, and file alternate teeth from the other side.

The saw set is a pair of tongs used for bending the teeth slightly outward to give clearance to the cut, and prevent the saw binding in the wood. Good dry hardwood requires very little set to the saw. The Atkins saws have the back ground about four gauges thinner than the teeth, so that they run easily with minimum set.

The saw is held in the vise for setting just as it was for filing. Set every other tooth, then reverse the saw and set the ones you missed from the other side.

Note the difference in shape of teeth on different saws. The cut-off, or "cross cut" saw has V shaped teeth which chop their way through the wood; the rip saw has chisel teeth, which are filed nearly straight across, while the others are filed at a decided angle. A circular is usually attached to a new saw advising the kind and size of file best adapted to filing that particular saw, and the manufacturer's instructions in this matter should invariably be followed.

Control of the saw in following a line is something that must be acquired by practice. Hold the saw as you would a revolver or pistol, but with the right forefinger extended alongside the handle and pointing forward, giving much better control of the blade than if all fingers are inside the hand hole.

In shaping up a stock, after the blank has been inletted, much time can be saved by sawing the butt to the approximate outline of the finished shape. In like manner, the rip saw may be used to rip off the corners—if it begins to run in too deeply, just saw off the piece and start a new cut slightly outside.

Always mark the wood on all four sides previous to cutting with the saw. Thus you can watch the cut and avoid running in. The thickness of a saw permits some slight change in direction during a cut; thus if the cut is running the wrong direction, the blade may be forced slightly the other way, gradually bringing it back into

line. Too much of this twist, however, will make the saw stick. If the cut runs far to one side, stop and cut off the piece as far as the cut goes, and start over again.

A back saw is the thing for use in a mitre box, as the blade is held straight and rigid by the heavy strip of metal on the back edge. The back saw has very little set, and runs easily in a straight line. For the few jobs on which it will be needed, the gunsmith may dispense with back saw, using the cutoff saw instead.

AUGUR BITS. Always buy the best obtainable, as a cheap bit is the sorriest tool on earth. They must be kept very sharp for clean work in hard wood. Use a regular augur bit file for sharpening or, some of the small die-sinkers' files will be found even better on small bits. A medium long bevel should be filed on upper side of the cutting edge. Do no filing whatever on bottom side, except one small flat cut with a fine file to remove the burr. The side lips should be filed entirely from the inside—any filing on outside of lip will reduce the cutting diameter, causing the bit to stick in the hole and pull out the spur. The spur should have a very coarse thread —the fine thread spur is useless, as it pulls out and will not pull the cutting edges against the wood. Forstner bits are very difficult to sharpen. They are usually quite sharp when purchased, and as their use is limited, the edges should be left alone as long as possible. The best way to sharpen them is with a dental engine and a carborundum point stone. Expansive bits are sharpened in the same manner as regular augur bits.

In the matter of bit braces, about one in a hundred, apparently has the chuck centered in line with the center of form. This causes most of them to run wobbly. Sometimes this wobble is caused by the bit not being straight, and all bits that are sprung should be promptly discarded. The solid center bits are stronger and generally better than the flat twist in this respect. Keep returning your brace to the dealer for exchange until you get one that is reasonably well aligned. One mistake the beginner makes is to buy the largest sweep he can find—which means a brace that is rather springy, when it should be stiff. Select a heavy brace, with a large, strong chuck, and a sweep of not more than ten or twelve inches—ten is plenty. The Miller's Falls No. 872 brace has a 10 inch sweep and is stiff and strong—besides having a chuck that will hold. With such a brace one can exert all the pressure necessary for boring a 6 or 7 inch hole in the butt of a stock, with little danger of the wobbling cut which causes the bit to run out sideways. Before starting a hole in hardwood, always mark the center very accurately and punch deeply with a sharp prick punch.

Twist drills are useful in the brace or hand drill for boring small holes in wood. For this use they should be ground to a point about 1/3 to 1/2 longer than when used for metal.

RASPS. There are two shapes of rasp, one, equivalent to that

of the half round file, known as a wood rasp; the other being thinner, and with a much more flat curve on the one side, known as a cabinet rasp. The latter is best for gun work. In using it, hold the handle in right hand, and the point in left hand. As you push forward also move the rasp sideways, making a diagonal stroke, the rasp being turned at an angle of about 30 degrees with the work. This gives a very even cut over two or three inches of surface, whereas pushing the tool straight in line would merely cut a groove its own width. Always use the rounded side for the first roughing cuts,

Fig. 35. Manner of using rasp.

using the flat side when the stock has been reduced to almost its final shape.

The cabinet file is similar in shape to the rasp, and is used in the same manner. Having finer teeth it makes a smoother cut. This is the tool to use for the final truing up of the surface of a stock, before the first coarse sanding. Some stockers follow the cabinet file with another cut using a common mill file—but this cuts very slowly on wood, and the file teeth also clog badly. Very light finishing strokes with the cabinet file will leave the wood in very good condition for the sandpaper.

FILES AND FILING. Some day I hope to know enough—provided I live long enough—to write a book on this subject alone. It is one of the fundamental mechanical subjects, and one which might easily require the space of this entire volume—and still not tell half the story. The file is the basis of practically all cutting operations in the machine shop; the milling cutters, profile cutters, etc., are really files; a broach is a file; the cutter on a rifling head is a single tooth file—and so is the cutter on the planer or shaper. Even the lathe operations are based on the fundamental principles of filing— the tool being the file, which is held stationary, while the work is revolved against it.

Given the right files, a first class mechanic can make by hand almost any part ordinarily made on machines. Slower—yes; but it can be done. Such a man knows and understands that the file is an

important cutting tool, designed for shaping and forming; while the layman usually thinks of it as something to scratch or smooth the surface. He seldom considers that there is a right file for the job at hand, and knows only that there are flat files, "three cornered" files, and rattails. He usually goes into the store, and says "Gimme a small file;—Oh, about six inches, I reckon; yeah, that'n'll be all right." Then he takes it and skims over the surface of whatever it is he is spoiling, often making no impression to speak of, and at other times misshaping the article badly.

If I included too great a number of different files in my recommendations in Chapter 3, it was because I realize the need for various shapes and sizes, and know how the possession of the right file for the job will speed up work and save cost.

One of the first lessons to be learned in the matter of filing is to take all the short cuts possible—otherwise the job becomes so tedious that one tires of it and gives it up in disgust. I have seen a man scouring away for three hours on a bar of steel with a fine mill file, trying to take off nearly a quarter inch of metal. It never occurred to him, for some strange reason, to saw the strip off close to the line with the hacksaw, and finish with a file.

Before going into these short cuts however, the amateur mechanic should first know how to use a file; to make his strokes in a straight line, without rocking the file, resulting in a perfectly flat surface instead of a rounding one. Once this is learned any man can acquire proficiency with the file; and until and unless it is learned, his work will be of the crudest, most amateurish type.

Whatever it is you are filing, it must be held very firmly in the vise. When a part wobbles about this way and that, you cannot file it correctly. Use leather, brass, sheet lead or whatever is necessary, to hold it, *but set it up solid*. Lay the file evenly on the flat surface of the work; hold the handle in the right hand, the point in the left, and swing the arms forward in a full body movement, keeping the file constantly in the same plane. Despite your best efforts the file will rock, and the surface will be rounded. No matter how flat you think it is, just hold it up to the light with a small square or straightedge touching the surface, and the curve will be plain. Only practice, with constant thought to the direction of the stroke and the movement of the hands, will correct this fault.

I am a firm believer in coarse, fast cutting files. I never could see anything gained by prolonging the job with a slow tool. If there is 1/32 inch or more of metal to be removed, I will use a medium cut bastard file until I almost reach the line, then go ahead with a medium fine single cut or mill file, and finish with a fine cut Swiss. Getting rid of surplus metal quickly relieves much of the monotony —and believe me, even the coarsest file doesn't reduce dimensions nearly so fast as it seems. Measurements with a micrometer after a few cuts will show how fast the work really progresses—and it is

surprising how many cuts with a new sharp mill file are needed to reduce the thickness of a piece of cold rolled steel a thousandth of an inch.

The ingenious mechanic simplifies his filing in a variety of ways. For example on a piece of uneven shape, such as the receiver of an automatic pistol, he will block it with square bars of cold rolled steel between the receiver and vise jaws until the work is held as tight as a square bar would be. No worry now about the thing slipping and the file making an incorrect cut. One kink I have found most useful when making small parts from solid stock is to keep a small cheap cast-iron vise, costing only a dollar or so, and use it partly as a filing jig. Having marked on the material the line to which the filing extends, the piece is placed in the vise with this line just below the edge of the jaws. Now I can use a coarse sharp file and rough off metal without thought of going too far, until the file hits the edges of vise jaws. I can then raise the work slightly in the jaws, and finish-file with a finer-cut tool. I keep the vise jaws filed straight and flat on top, which enables me to keep the surface of the work very true. It makes no difference if the file cuts or mars the jaws—I simply file them true again later. And it takes a long, long time, and hundreds of jobs, to wear even a small vise away.

When the file reaches the vise jaws it is nearly impossible to round a surface of the work held between them, as the jaws keep the file dead level, or if it should rock slightly, it is the outer edges of the jaws that are rounded, and not the work.

This stunt is also useful when cutting irregular shapes—for example the shaping up of a barrel band, like Figure 36. A description of this job from start to finish will include a lot of file technique which can be adapted and applied to other jobs.

In Figure 36, A shows a piece of thick walled Shelby tubing cut to about 5/8 inch long. The first thing to do is level up and smooth one side, which is done in a moment by holding it against the side of the emery wheel. Now saturate a small wad of cloth or waste with copper sulphate solution, a bottle of which should be on the bench at all times. Rub this lightly over the bright clean surface until well coated with copper. Without thus coppering the work, it is difficult to mark lines on it that will show clearly. Now lay the blade of the centering square across this face, with both legs resting against the outer edge (be sure there are no burrs on edges to throw the square out of line) and scribe a center line across the face of the ring. All measurements are to be taken from this line. Let us say you want a swivel screw stud 1/2 inch wide on this band. With dividers lay out dots on either side and 1/4 inch from the center line, and connect these dots by lines as shown at B, Figure 36. C shows the method of projecting the center line and two sides across the edge of stock with a small square. Having

done this, "face up" the other side of the emery wheel, copper it and project the center line across it with the centering square; from this measure off and rule in the side lines of stud, as you did on the other side. Now set the piece in the vise, and with the hacksaw lop off excess metal, as shown by dotted lines in D, Figure 36. Now slide the piece down in the vise so that just enough metal projects below the upper edge of jaws, to give the depth of fillet wanted where the stud joins the band, and with a rattail file of the right size, file down in this fillet until the file touches the vise jaws. Be careful not to make this fillet cut run through the line

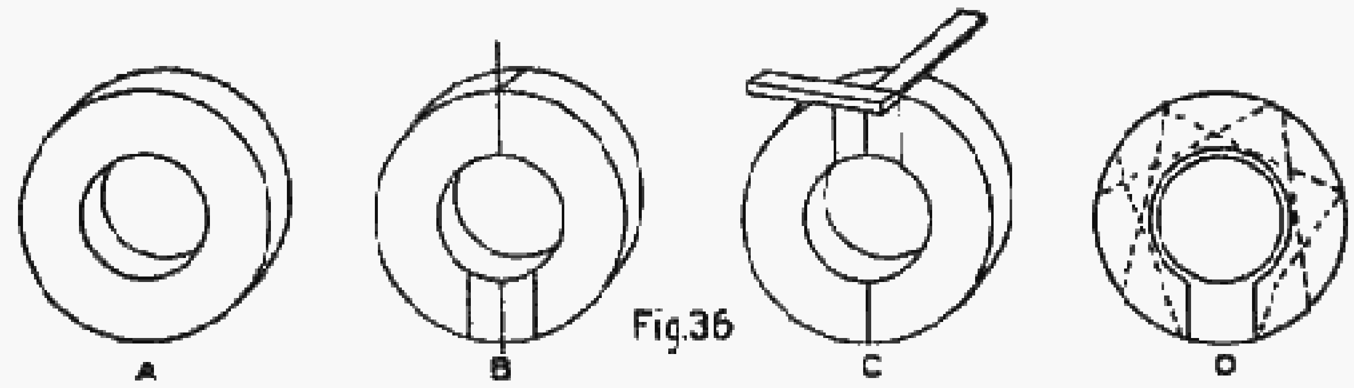


Fig.36

of the side of the stud—bear pressure to right or left as required, or shift the position of the piece in the vise slightly if necessary.

Cut the fillet on the other side of stud in exactly the same manner; then reset the work in the vise so that the side lines just meet the edge of vise jaws, and file down to these lines. Thus the stud is quickly roughed to final shape, needing only smoothing up with a finer file, and slight rounding of the sharp edges.

The band is now clamped edgewise in the vise and the sharp corners of the saw cuts roughed off with a double cut flat bastard file, until the band portion is about 1/16 inch thick. For this work use the file in any direction that is most convenient—around the band, or across it. If you have an emery wheel, some filing may be saved by roughing off the saw cuts on the wheel, the band being held in the fingers on the tool rest of the grinder, and turned about as required. The band is now ready to fit and finish as described in Chapter 24.

When making small parts to replace broken action parts, great care is necessary in the filing to shape the new parts exactly like the old. A hammer, or trigger, for example, must be accurately shaped or it will not work with the other parts in the action. The best way to accomplish this is to first work down the stock for the new part to nearly the correct thickness; tin one side thinly with soft solder; tin the pieces of the broken part, lay them together in correct position on the new piece of stock, and sweat them on. Then grind or file the metal down to the exact outline of the old part. If the part has a hole through it for a pin or screw, this should be drilled through the hole in old part before shaping up.

When there is such a hole, and the shape of the part is not com-

plicated, the sweating is omitted in some cases, by first drilling the hole, then inserting the drill through the hole in the old part and the stock for the new one, and thus holding the two together in the vise while filing. After finishing, a little heat will melt the solder, separating the new part from the old one, when it can be polished up and tempered or case-hardened as desired.

FINISH FILING: Most working parts can be filed so smooth that little if any polishing is necessary—in fact, the polishing is often omitted entirely. After the rough cutting is over and parts brought within ten or twelve thousandths of final shape and dimensions, finish shaping with a single cut mill file. It will often prove desirable or necessary to grind the teeth from the edge of a file to adapt it to the work—and sometimes to grind the edge to an angle to reach in and properly shape the piece. Do not hesitate to do this if necessary—files are cheap, and the special file prepared for the job today will again prove useful on some future job. Plenty of files constitute the gunsmith's greatest asset.

The work with the mill file should bring the part to within one or two thousandths of final dimensions, after which it is finished to exact size with fine Swiss files of the required shape or size. Very small parts that cannot be readily held in a vise for finishing may sometimes be finished by laying them on the file and pushing the part against the teeth with the fingers. Another way is to soft solder the part to a piece of brass or steel large enough to be held in the vise; finish one side, melt off the solder, turn it over and solder the other side, and finish. When finally removed the solder that remains is readily polished off with fine emery cloth.

FILE SCULPTURE: This term has been aptly applied to the work of a few skilled artisans in the manufacture, entirely by the use of files, of various complicated small parts; and certainly there is no greater skill in all the field of mechanics, than was displayed by a few old timers, here and there, in the shaping of ornamental devices, hammers, cocks, frizzens, etc., as well as the even greater feats of cutting out entire breech portions entirely by hand. I have seen John Wright who has served his time with the finest gunmakers in England, take a heavy block of tool steel, and with cold chisels, hacksaws, drills, and files *and no other tools,* shape it into a beautifully formed shotgun breech. The complicated inside cuts, and the wonderfully graceful curves, of the standing breech indicate the ultimate in skilled craftsmanship and natural ingenuity. The cocks on many ancient weapons are still regarded with awe by collectors, who cannot but marvel at the unlimited patience with which the old-time gunsmith filed, day after day, week after week; until the finished gun in its beauty and dignity, embodied not only the soul of its maker, but the very spirit of the indomitable age in which he lived. And then, to have to compare this class of work with the cobbling of some of the so-called mechanics of today!

78

But I am forgetting the die-sinkers; here is a trade which should have been classed with the fine arts. To watch a good die-sinker at work cannot but benefit any gunsmith, amateur or professional—and if you have in mind some little job of filing, like the making of a fancy shotgun hammer, of which you stand in awe, make it a point if possible to visit a shop where die-making is in progress and see some *real* filing done. You'll learn more in five minutes than you could acquire from a week of reading. You will see filing done in corners, angles and inside curves that you never dreamed a file could reach. You will see clean cut work turned out in places where the stroke of the file is so short you will wonder that it cuts at all.

In the shaping of hammers and other parts with curves difficult to reach, you will learn to appreciate the small Swiss files and rifflers; for no other tools will do the work that they do so easily, once you become acquainted with their possibilities. And one of the most useful of these is the American Swiss crossing file, in lengths from three to six inches. Having a nearly flat curve on one side and a deeper curve on the other, and tapering to a slightly rounded point, with hard, sharp teeth to the extreme tip, they will almost do the impossible, cleaning out curves and corners that could not otherwise be reached at all.

COLD CHISELS: The uses of cold chisels are often not appreciated by the gunsmith, despite the fact that lengthy practice is not essential to their use. Often a large amount of filing may be avoided by a little judicious chisel work, and chisels of any required shape and edge may be quickly forged out as needed. A quantity of high grade tool steel in 3/8, 1/4, and 1/2 inch hexagon bars will pay dividends when you learn to use chisels.

In making chisels, both ends should be forged. The butt end is hammered to a slight taper, and at the same time slightly upset and the edge rounded. The point is flattened and drawn to required shape, with considerable "cold forging" as the metal cools, to compact and strengthen the fibres. The shape is then trued up by filing or grinding, then both ends are hardened and tempered separately. First polish the end to be hardened with medium emery cloth. Heat to cherry red for about two inches, and dip the end for about 3/4 inch in oil to harden. Quickly polish the end with emery cloth wrapped over a file, and watch the colors run down from the hot spot back of point. When the butt end is blue, dip entire chisel in oil. Harden and temper the cutting edge or point in the same manner, drawing the temper at light purple or brown.

In using cold chisels always consider the size and character of the work, and avoid heavy chiseling where it is likely to spring or bend the metal. Hold the chisel in left hand, with palm cupped above the edge to deflect chips of metal and prevent their striking you in the face or eyes. When a considerable cut is to be made,

79

start near the edge and work back, taking out a chip with each blow of the hammer. Learn to strike with the same force each time, and take the same depth of cut.

In selecting and sharpening your chisels, don't try to emulate the garage man who uses a chisel principally for cutting off bolts. Your chisels will be smaller, lighter, harder, and with decidedly more bevel than he uses. And you will not be limited as to shape—your chisels may be made any shape required for the job in hand. In grinding (which should be done the minute a chisel's edge is dulled), use a fine, fast emery or carborundum wheel, and very light pressure to avoid burning. Hold the chisel on the wheel only a second or two; dip it in water, and grind again, continuing until the edge is satisfactory.

Cold chisels are never sharpened on a stone; the slightly rough edge left by a fine grinding wheel is best for use on metal. If you have no grinder, it is permissible to touch up the edge on the coarse side of the carborundum stone, but frequent grinding of cold chisels is always necessary. When the grinding has shortened the point to the extent that the temper of the edge has changed, the chisel should be first annealed, then polished, re-tempered, and re-ground.

DRILLING: It would seem an easy matter to put a drill in the chuck, center it on the spot, and turn the crank. But there's more to drilling than this. The first essential is a good, properly ground drill; the second, an accurate center punch; the third a correct drill lubricant.

Metal that has been case hardened or tempered must either be spot annealed, as described elsewhere, or a spot must be ground off the surface so that the drill may take hold. When neither plan is available, coat the surface with melted beeswax or paraffin, work a small hole in the wax with the point of a scriber, and apply a drop of Spencer acid (See Chapter 20) or a solution of 1 part nitric acid and 4 parts water. When the strength of the acid is exhausted, apply more, and continue until it has "eaten" away the surface of the metal to a depth of 1/32 inch. Wash off with water, and center punch, and the drill should go in easily. Sometimes very hard steel can be drilled by a common twist drill hardened by heating to cherry red and cooling in mercury. This makes the point so brittle that great care is necessary to prevent chipping off—use light pressure, and run drill slowly. When drilling very hard steel, use pure turpentine instead of oil as a lubricant for the drill.

Take care of your drills and grind them as soon as they get dull. It is impossible to describe how to hold a drill and give it the peculiar twist required to correctly shape the point—visit a machine shop and watch them do it—then spoil a few old drills for practice. Best to have a good drill grinding attachment for your grinder—it will quickly pay dividends.

80

Never put enough pressure on a drill to spring it; use plenty of good lubricant and if the point does not take hold it means that the drill needs sharpening. If a drill becomes bent, discard it at once, and save it for pins or something else. A sprung drill will enlarge and taper the hole, perhaps making it too large for the screw that it is intended to fit.

Marble's Nitro Solvent Oil makes a splendid lubricant for drilling small holes. Pure lard oil and kerosene is another good one; or the lard oil may be used straight. Turpentine and camphor, half and half, will enable you to drill glass without chipping.

REAMING OPERATIONS: Be sure your reamers are in good shape, correct size, and sharp. Unless you have considerable experience in grinding reamers, take them to a grinding shop when they need sharpening. When reaming it is important that the work be held rigid in the vise—any springiness may cause the reamer to "chatter" and make a rough cut.

A good strong die holder of the proper size makes the best handle for large reamers. Never try to use the reamer in a brace, nor in a monkey wrench, as I have seen done; the tap wrench is fine for small reamers, and the die holder for the larger ones. Grasp the handle in both hands, and turn steadily with equal pressure on both ends. Use the soda water and oil mixture referred to in Chapter 31 as a lubricant, and use plenty of it. Remove reamer and wash out the chips at frequent intervals. Feed the reamer slowly, and if it sticks, do not try to force it, or you will break a blade; back up the cut slightly, and feed lightly.

TAPPING SCREW HOLES: The use of small screw thread taps is often a bugbear to the amateur mechanic, particularly when tapping shallow holes in tough steel. Some information on this subject is given in Chapter 29 in connection with the fitting of sights and scope bases, but a few suggestions of a general nature here may not be amiss.

Be sure your drill is the correct size for the tap—check up on the gauge, and check the drill size by trying it in the hole of the gauge. If the hole is shallow, bottom it out level, either with a wheel or inverted cone burr on a dental engine, or with a flat drill (See Chapter 4), or an end mill of the proper size. Always start the thread with a starting tap, that is with the end ground tapered; and as soon as the end of tap hits the bottom of hole, continue with a similar tap with less taper, finishing with one having no taper at all.

When tapping thick, tough stock, or when using rather small taps, the chips of metal cause the tap to stick at frequent intervals. Use plenty of oil, and when the tap sticks, never try to force it. Back it up a turn or two, then go forward again—slowly and gently. A tap broken off short in a hole is the best thing I know of to cuss about. Sometimes it can be drilled out with a dental burr, but

81

likely as not it will prove necessary to heat the spot red-hot with an acetylene torch to anneal the tap—and this is not going to do the gun any good. After annealing, the broken tap can usually be drilled out.

Remember that taps are very hard, and hence easily broken. When you feel the tap springing ever so little, without turning in the hole—ease up! Something is wrong, and it may snap off in an instant. Back it up a bit, apply more oil, and go ahead.

The fact that a rifle receiver wall is hardened on both sides is often the unexpected cause of breaking both drills and taps. The annealing, or grinding off of the outer surface may leave the inside surface nearly as hard as it was before; and when the drill hits this hard surface in going through, it may snap like a toothpick. Slow up the drill when nearly through, and use plenty of oil. The same applies to the tap, only more so. Take your time when using small taps, and remember it's better to waste ten minutes doing the job than to break off the tap and waste a couple hours getting it out.

A FEW SHOP KINKS: To increase the size of a worn reamer, burnish the face of each of the teeth with a smoothly polished burnisher made from a three-square file. An increase of from two to ten thousandths is possible, after which the reamer may be carefully honed to size with a slip hone.

To make a tap or reamer cut larger than itself, pack twine or waste in one of the flutes, to crowd it over against the opposite side. In very large sizes, put a strip of tin on one side, and let it follow the tap or reamer blade around.

All lathe or other machine work calling for water cuts will be improved by using strong sal soda or soap water instead of plain water.

Babbitting bearings: Put a lump of rosin the size of a walnut in the babbitt, which will make it flow better and improve its quality. Rosin also prevents "blowing" when the bearing boxes are damp.

Kerosene is the best cutting lubricant for turning or drilling aluminum.

Preventing rust on tools or guns in storage: Use vaseline or a heavy acid free grease with a small quantity of powdered gum camphor added; melt the grease and camphor together over a water bath.

Preventing rust on polished steel stock, drill rod, etc. Polish the stock dry with very fine emery cloth, then wash with a solution of 1 pound copper sulphate in 3 pounds rainwater. This forms a rust proof copper coating on the steel.

Scale is easily removed from steel after welding or forging, also from castings, by pickling in water, 9 parts; sulphuric acid, 1 part.

Removing old bluing: Wash with pure hydrochloric acid, then rinse in clear water. It is necessary to polish parts with abrasives before rebluing, but this will greatly reduce the polishing necessary.

82

Bluing steel parts without heat: Coat with pure nitric acid; wipe off acid with clean rag, apply linseed oil, then burnish lightly on a wire buffer.

To distinguish between iron and steel, file the surface bright and apply a drop of pure nitric acid. After a minute or two, wash off with water. On wrought iron the spot will be a pale ash gray; on steel a brownish black, and on cast-iron a deep black.

Case-hardening with kerosene: A quick and easy method for small hurry-up jobs. After polishing, rub the part thickly with ordinary laundry soap, then heat in charcoal fire to cherry red, and immediately plunge into kerosene. The parts are left white and clean by this method and free from scale.

Always maintain uniform speed when using twist drills; to make a drill cut faster, increase the feed but not the speed.

For a quick setting rust joint: 1 part powdered salammoniac, 2 parts sulphur, 80 parts fine iron filings, water to make a thin paste. Useful for setting screws to fill up old screw holes, etc., particularly when screw is loose in hole.

Metal to expand when cooling: Lead, 9 parts; antimony, 2 parts; bismuth, 1 part.

Moisture resisting glue: White flake glue, 1 pound; milk, 1 quart; soak over night, then cook same as water mixed glue, adding milk as needed to thin.

88

Chapter 8

WOOD FOR GUNSTOCKS

EARLY American rifle makers and gunsmiths employed hard maple almost exclusively for their stocks and the use of this wood persisted through the flintlock and well into the percussion period. Although maple possesses many advantages for gun stocks, the exact reason for its selection, in view of the large supply of walnut then available, is unknown, but the numerous beautiful specimens of early American fire arms now remaining with us and the excellent appearance of their stocks after a hundred years or more of service would indicate the good judgment of their makers in the selection of the wood.

From the limited information available on the subject it appears that walnut was used for stocks in Europe almost from the beginning of fire arms, and walnut, both European and American, is today in almost universal use. Stocks have been made from other woods—beech, birch and oak stocks are not uncommon—but walnut is becoming the standard, and while its use may be in a measure due to custom and sentiment, yet its qualities are so well adapted to the purpose that probably no better all-round wood will ever be discovered.

MAPLE (*Acer Saccharinum*, also known as HARD MAPLE, ROCK MAPLE and SUGAR MAPLE.): This wood is a native of Eastern United States and Canada and its many desirable qualities will fully justify its use by those who prefer it to walnut. Its weight is similar—about 37 pounds per cubic foot when seasoned. It is often found with curly twisted grain, also in *birds-eye maple*. When first cut the wood is almost pure white and becomes somewhat rosy after seasoning. When thoroughly seasoned it is extremely hard and dulls tools very rapidly. It has great strength but is somewhat more brittle than walnut. Its white color of course necessitates the

84

use of stains in finishing, but when properly applied to the right kind of maple very beautiful results are obtained. I have seen a stock of curly maple with a few birds-eyes scattered here and there, the beauty of which could not be surpassed by the finest imported walnut.

APPLE (*Pyrus Malus*): Occasionally one of the old school riflemakers would employ this wood for a stock, with splendid results. Although the outer wood is nearly pure white when cut, the heart is a rich reddish-brown very hard and dense—the pores not being visible to the naked eye. So durable is Apple wood that it has been successfully used for cog-wheels in light machinery, and is largely used for tool handles, being nearly as satisfactory as ligum vitae for this purpose. It has also been suggested as a suitable wood for the heads of golf clubs. It should be seasoned for several years, and its use requires sharp tools. Although I never made a stock from Apple wood, I would expect it to take the finest of checking, and would employ oil for finishing, same being thinned with turpentine to assure penetration.

CHERRY *(Prunus Avium)*: A well known wood, and one considerably used in earlier times, particularly by the backwoodsman building his own rifle. It was not the choice of the gunsmith as a rule, who preferred curly maple. Cherry, when first cut, is of a light red or pink, but darkens somewhat on exposure. The annular rings are very distinct, the pores very fine, but numerous, and medullary rays strongly marked. Due to its greater density of grain, greater weight, and greater strength, I consider Cherry superior to mahogany for stocks. It must be thoroughly seasoned, and only the heart wood should be used, as the sap is almost certain to become worm eaten in a few years. By using a little filler, a very fine oil finish can be obtained on Cherry. The weight ranges from 33 to 49 pounds per cubic foot.

ROSEWOOD *(Dalbergia nigra)*, Brazil: This wood is quite well known throughout America and Europe, but is less popular for furniture now than formerly. The grain is very firm, very hard and of close texture. It takes an exceedingly smooth surface and a high polish. Pores are irregular in size and position, varying in size and numbers in the different concentric growths. The color is a light red which, before finishing, fades on prolonged exposure to light. There are irregular belts of dark lines following the concentric growth, and the medullary rays are fine and numerous, often crossed at right angles by fine whitish lines, forming a beautiful and intricate network pattern. Quarter-sawing often brings out a beautiful ripple or "fiddle back" grain.

An excellent stock wood, although quite heavy (54 pounds per cubic foot) and usually difficult to obtain in sufficiently large pieces. Should be oil finished, using light colored oil. Takes fine checking perfectly with sharp tools, and is one of the easiest woods to check, by reason of its density and hardness.

ROSEWOOD *(Dalbergia latifolia)*, East Indian: Although well known in this country as a desirable furniture wood, it is seldom used for gunstocks, although occasionally a rosewood stock is found on a fine handmade shotgun. Its greatest drawback is the difficulty of obtaining it in pieces sufficiently large, as nearly all the supply is made up into veneer. Its color is variable, generally a rich light red streaked with a deep purplish black, and with varying golden yellow shades. It is dense and hard, with fine close grain, heavier than walnut and somewhat more brittle. Average weight 53 pounds per cubic foot. It takes a splendid polish with oil, which deepens the color and improves the appearance. Usually it is easy to check, being so hard and dense that there is little tendency for the tool to follow the grain. Sometimes, however, there will be a contrary hard and soft grain very difficult to handle even with the sharpest of tools.

MAHOGANY: There are so many varieties of this well known wood that one wonders why its use should be so largely confined to furniture. Mahogany is found in Africa, Central America, the West Indies, Cuba, Costa Rica, Guatemala, Honduras and many other parts of the world, and the different species vary so greatly in appearance and character that many of them would not be recognized as mahogany by the average person. "Spanish" mahogany comes from the Spanish possessions in the West Indies, and not, as many suppose, from Spain.

The varieties best known in this country are the Central American, West African, and Honduras. "Cherry" Mahogany is a term applied to any variety that is similar in color to our Cherry wood, and is not a distinct species.

The color varies from a light cherry to a deep reddish brown, although the color of most mahogany furniture is deepened with stains. Most of the wood used in furniture is straight grained, the grain being laid in alternate layers a half inch to an inch wide, each running in slightly different directions. This makes mahogany very difficult to work—roughens one streak while smoothing another.

Most mahogany has a rather open grain, is softer than walnut, and generally less desirable for gunstocks. The man who has a "hankering" for a fine mahogany stock may, if located near a dealer so that he can make his selection from a large stock of several varieties, succeed in finding a piece that will be the everlasting envy of all his shooting friends. For there is nothing in nature more beautiful than the indescribably intricate pattern of a fine African mahogany burl—and nothing much scarcer, either! So unless you are lucky, and just happen to run across such a piece, better stick to walnut—for the straight grained mahogany usually sold to furniture manufacturers would make a mighty cheap looking stock.

Personally I believe that mahogany, if used for a stock, belongs on the sample gun, or one intended for presentation, rather than for serious work. The wood is more brittle, and has not nearly

the strength of walnut. It is much lighter in weight,—from 26 to 31 pounds per cubic foot—so that unless the stock is very large and thick, the gun will be decidedly muzzle heavy. The large pores do not adapt it for checking except by an expert, neither is the wood adapted to oil finishes. Filler is an absolute necessity, and either lacquer or dull rubbed varnish should be employed in preference to oil.

MYRTLE. At least one firm in the United States advertises Myrtle wood stock blanks, but I am of the opinion that the word is a misnomer. Boulger, in "Wood" (London, 1902), says "—a name not applied to any useful wood in the Northern Hemisphere." The Myrtle of this country is a small bush or shrub, although the name Myrtle is sometimes incorrectly applied to some varieties of Beech.

MYRTLE, BLACK *(Cargillia pentamera)*. This wood, a native of northeast Australia, is also known as "Grey Plum," and it, or some of the other varieties of that district should prove desirable for stock wood, and may be the wood offered in this country under the general name of Myrtle. Black Myrtle is reddish in color, close grained and tough, strong and durable, taking a high polish.

MYRTLE, DROOPING *(Eugenia Ventenatii)*. This also comes from Northeast Australia, where it is known as "Brush Cherry." It is heavier than walnut—47 to 57 pounds per cubic foot; it is light reddish or yellowish, not very attractive as to grain, but strong and elastic, stands seasoning without checking or cracking, works well, and takes a good polish. In Australia it is used for boomerangs, staves, oars, boat building, and tool handles.

MYRTLE, SCRUB *(Backhousia myrtilfolia)*. Another northeastern Australia variety, known also as Native Myrtle, Grey Myrtle, and Lancewood. Light yellow, often beautifully marked with dark brown, walnut colored stains, very hard and close grained, tough and durable. Seasons and works well. In common use in this country for bows, also extensively used for tool handles, mallets, etc. Should take checking well, and good finish.

BEECH *(Fagus sylvatica)*. This wood is light reddish brown in color, fine grain, small pores, with annular rings and medullary rays strongly marked. It should be sawn into boards or planks immediately after felling. Beech has been used in gunstocks because of its close grain and rich color, which darkens with oil rubbing, but its liability to attack by worms makes it somewhat undesirable. It takes checking well, and is very strong and elastic. This wood is found in Great Britain, Norway, and throughout central Europe to Spain; also in Asia Minor and Japan. The Asiatic varieties are lighter in color than the European, with more uniform color; are also somewhat softer and more easily worked.

BEECH, TASMANIAN, or EVERGREEN BEECH *(Fagus Cunninghamii)*. Also called Myrtle, and Nigger-head Beech. Native of Tasmania and Victoria. A rich brownish satiny wood, vary-

ing from greyish brown to brown-pink. Cuts to smooth surface, and wears smooth. Very strong and close grained, with greater strength than the European beech. Alexander L. Howard, in "Timbers of the World" recommends it for felloes, staves, saddle trees and gunstocks. Quite possibly this is the "Myrtle" sold for stocks, as the description would indicate its desirability for that purpose, although I have never seen it used.

BEECH, AMERICAN *(Fagus ferruginea)*. A heavy, hard, very tough and strong wood, rather coarsely grained, warps in drying, but takes a very smooth beautiful polish. Color ranges from white to light brown. Used for plane-stocks, shoe lasts, tool handles and furniture. Should take checking well, and make a strong, durable stock, but would likely require staining.

WALNUT *(Juglans regia)*. Boulger states that the European walnut was originally a native of Northern China and Persia, having been introduced into Greece and Italy in the early times from Persia and from thence into other parts of Europe. The trees are similar in size to our American walnut but the wood is considerably more varied in color and grain than that grown on this continent. European walnut includes several varieties, namely English, French, Circassian, Italian, Spanish, Turkish and perhaps some others. The general characteristics of all are quite similar so it is difficult to draw any definite distinction between them. Since all belong to the same order, their variations are only such as would be caused by the difference of soil and climate.

Most of the so-called Circassian walnut imported into this country in the form of gun stocks probably never saw the Circassian district. It makes little difference, however, as Circassian walnut is not necessarily better than any other walnut. This fact, however, is outstanding that a really fine piece of Circassian walnut will probably be of a higher grade than could be obtained in any other variety. Needless to say, the European gun makers have the available supply at their disposal and it is but natural that little of the first grade wood should be permitted to leave the country.

True Circassian walnut is characterized not by curly grain as many suppose but by sweeping dark lines deepening into black when finished and these lines may and often do assume fantastic patterns. Curly Circassian walnut is cut from butts or crotches, the same as any other curly wood. That taken from the body of the tree is usually straight grained. When cut on the quarter, Circassian walnut, in fact almost all varieties of walnut, will show "watered" grain, also called "Fiddle-back" and "Tiger-tail." A straight grained stock of "fiddle-back" walnut of any variety is just about as beautiful a thing as one may expect to see. The fact that a number of very fine guns have been built with Circassian walnut stocks is leading to the rather common belief that Circassian walnut is essential to a fine gun. Nothing could be farther from the truth. Circassian walnut is good if it is good and a poor piece of it is worthless.

Upper blank is on Blazed Maple, furnished by Bell, Lewistown, Penna., and is a splendid wood for stocks but this particular blank is incorrectly cut for best design at grip and comb. Center is a beautifully colored Circassian Walnut blank, ranging from reddish orange to black,—an unusual combination of variegated colors and figure, and a good showing of "fiddleback." Lower blank is an example of high grade American Walnut taken out of upper part of the stump, just above ground. Very beautiful wood, richly colored and figured.

One thing I have noted in the past is that much of the Circassian walnut imported into the United States is very light colored sapwood with little figure and some of it is suffering badly from dry rot. The only way to assure quality in the purchase of foreign walnut is to go to the European dealers and inspect the wood at first hand before buying. There are a few dealers who have advertised gun stock blanks in this country who have supplied very nice wood, but "buying a pig in a poke" is always an uncertain proposition.

ENGLISH WALNUT. High grade English walnut is as a rule finer grained and somewhat harder than most American walnut; also somewhat lighter in color. With proper selection it makes very beautiful stocks and it, together with French walnut, is the preferred material of some of the best English gun makers. Considerable quantities of English walnut are also imported into this country for cabinet and interior panel work.

FRENCH WALNUT is usually straight grained and lighter in color than English walnut. The French walnut I have seen is apparently somewhat softer than the English, although the two woods are very similar.

ITALIAN WALNUT is supposed to be dark in color and well figured. I have never had the opportunity of studying any that I knew positively to be Italian so am not in position to make any assertions but many gun stocks I have examined which were sold by the makers as Italian walnut have been very light in color and of very poor grain, with scarcely more figure than white pine.

SPANISH WALNUT. England imports a moderate quantity of walnut from Spain and the general characteristics of it are so similar to French walnut that one might be mistaken for the other.

TURKISH WALNUT. This is also quite similar to French walnut but is usually darker with a larger proportion of figured wood.

AFRICAN WALNUT *(Lovea Klaineana)*. This wood more nearly resembles African mahogany in grain, finish and weight than it resembles walnut and is not a true walnut at all although well adapted to gun stocks and the other uses to which walnut is put. In color it is similar to much of the European walnut but is somewhat lighter in weight—about 30 pounds to the cubic foot. Occasionally yellowish brown golden tints are found which give quite a unique effect. This wood is not available in the American market to my knowledge.

BLACK WALNUT *(Juglans nigra)*. This wood, which is the only real American walnut, is much better than most people realize. From it is manufactured most of the so-called French, Italian, English and Circassian walnut furniture sold in our stores. One who knows American walnut can give the lie to most claims of the average furniture salesman who glibly calls a panel "Circassian"

if it shows a great deal of burl and French and Italian walnut if it happens to be light in color. The same salesman will also tell you that the piece you are looking at is solid walnut, even though the grain shows identical on top, edges and end proving it to be veneered. Such a great quantity of American walnut is now made into veneer and thus used in furniture that the supply is being rapidly decreased. Year after year we somehow find enough for our use despite a common belief that the supply is nearing an end. The increasing scarcity of the better grades, however, is evidenced by one fact which I have noted. Rifle stocks made by the government some fifteen years ago are much harder and closer grained wood than those turned out more recently. This is particularly noticeable on the Springfield Sporters sold by the Director of Civilian Marksmanship. Every one of these I have inspected and handled has been of very soft wood and so very porous that the linseed oil in which they are dipped has turned them almost black. Apparently, however, they are sufficiently strong, and are straight grained; but their general character seems to indicate a shortage of the fine old hard wood used in the Krags and even the Springfields before the war.

The walnut of North America all belongs to the same family and varies only with the soil and climatic conditions just as European walnut does. The finest grained, hardest and best figured wood is produced in the rough or mountainous country where the soil is somewhat rocky, while the porous wood comes from the low or swampy districts and is really unfit for gun stocks.

I believe it is safe to assert that there is a greater proportion of good figured American walnut available than there is of any of the

European varieties. The color is generally darker and richer and by careful selection the most beautiful stocks can be procured at a fraction of the cost of imported wood of equal grade.

In some of the southern states, particularly Texas, the walnut produced is very close grained with fine pores and is marked with long dark streaks not unlike Circassian walnut. I have known of this wood being sold as Circassian in more than one instance. It has, however, more of a reddish cast and is softer, yet it ranks high as a wood for stocks by reason of its density and the splendid finish which it takes.

One of the largest manufacturers of walnut veneer tells me that the very finest, most beautifully grained curly walnut in North America comes from Missouri, Kansas, and Indiana, in the order named; and the poorest, from the standpoint of density, figure and strength, comes from Iowa. Some very finely figured wood also comes from the semi-mountainous districts in southeastern Oklahoma, as well as from many eastern states.

American walnut will average between 37 and 38 pounds, which weight produces a stock which balances about right with our modern

Upper is a very fine blank of clouded Circassian Walnut. Center is one of Mitchell Bosly's best imported blanks and is about as well figured a piece of Circassian Walnut as will be found today; not a flaw in the grain and very hard and dense. Lower blank is a piece of good old American Walnut with "fiddleback" grain and nothing more beautiful ever comes from Europe either.

92

fire arms, particularly rifles. The Southern wood is somewhat lighter than that grown in the Northern states. Almost all American walnut will show "fiddle-back" when quarter sawed with the exception of the Texas walnut previously referred to. In selecting wood for a high grade stock there is a natural tendency to choose a quarter sawed plank in order to get this effect. Theoretically this is the wrong thing to do if maximum strength is sought. Figure 38A shows a sectional view of a walnut log divided into quarters. Two upper quarters are quarter sawed while the lower half is "board" sawed. Note that the quarter sawed planks have the edge grain presented on the flat surface while the others have edge grain on the

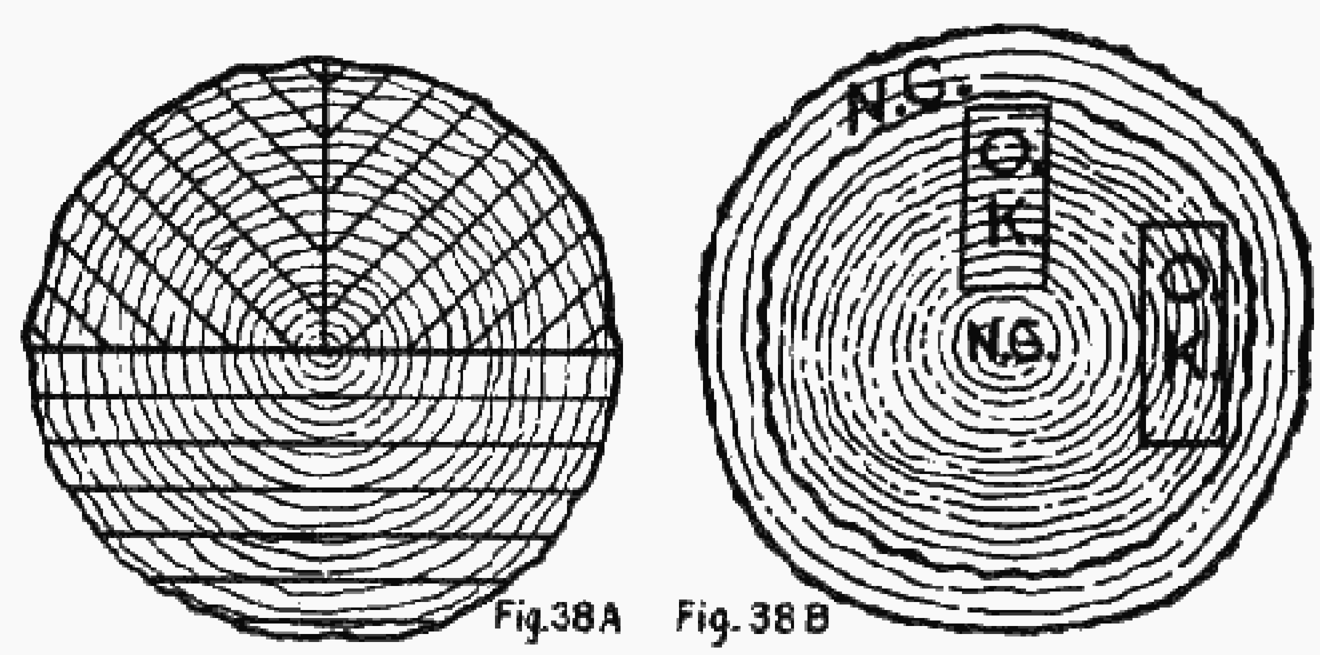


Fig.38A Fig.38B

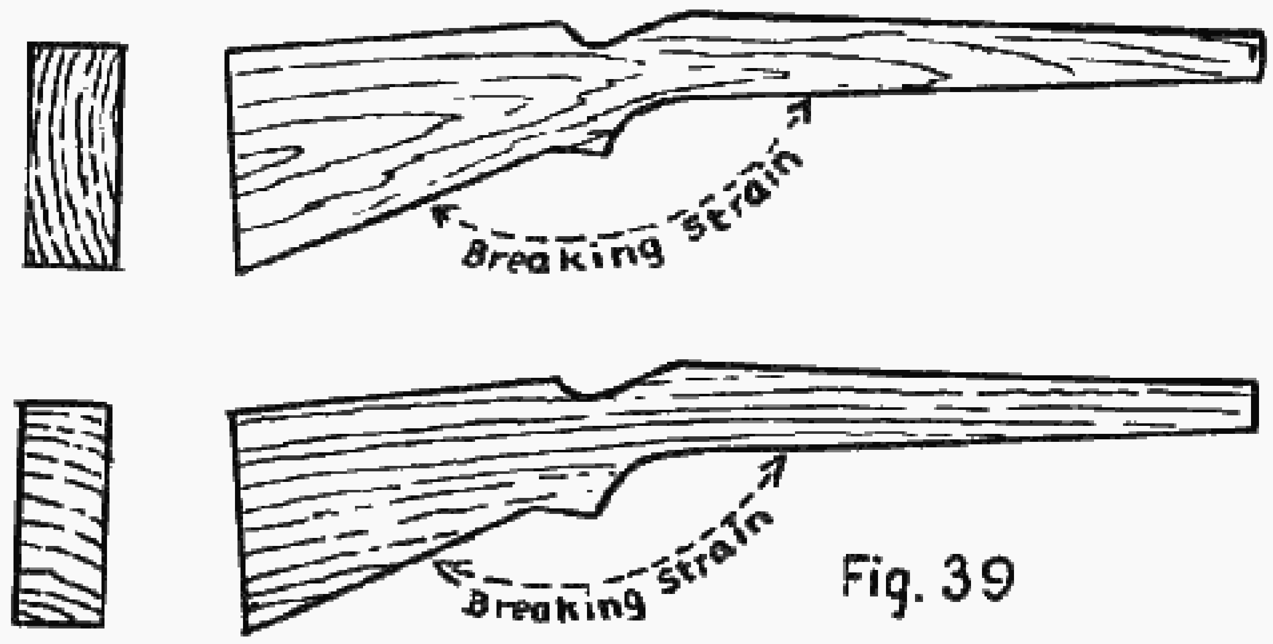


Fig. 39

edge with the layer caused by the annual ring formation showing on the flat sides. Edge grain as presented in the quarter sawed plank is stronger if the strain is brought to bear against the flat sides. However, since the strain on a stock usually comes in the direction of the bend at the grip, it is found that the "board" sawed lumber is better adapted to resist such strain. (See figure 39.) But, if one

93

is careful in his selection he may choose quarter sawed walnut for his stock with most pleasing results and without any danger of breaking, for good walnut possesses an ample margin of strength, particularly if the stock pattern is properly laid out on the wood with due regard for direction of grain.

Figure 40 shows the ideal selection of a piece of walnut for a stock blank and the proper method of laying out the pattern. It is not at all unusual that a piece can be found curly at one end, the grain gradually straightening out but with a slight bend which can be worked into the grip portion so as to get the straight grain in the forend, grain curving with the grip and with plenty of figure in the butt where wanted.

Your choice, however, may be in favor of a piece of quarter sawed wood with the grain running practically straight. In such case it is

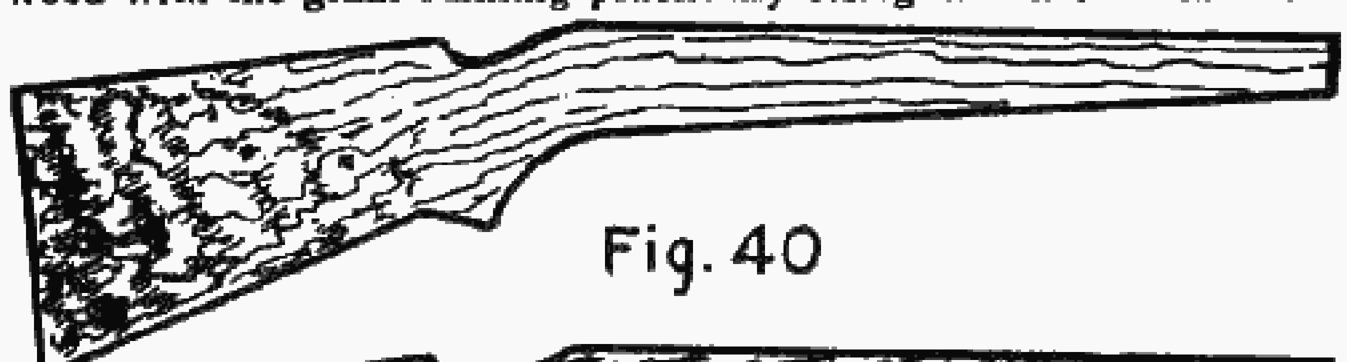


Fig. 40

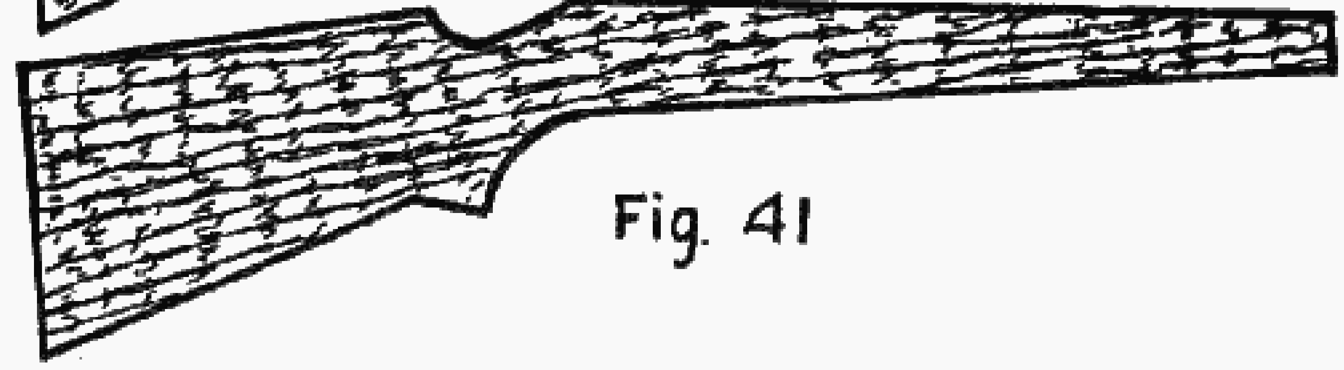


Fig. 41

better to lay out the pattern as indicated in figure 41. This gives the grain running up toward the forend which is not objectionable as it renders quite easy the inletting of the barrel, permitting chisel work mainly in one direction.

Figure 42 shows the right and wrong way of laying out a butt stock for shotgun or two-piece rifle stock. When the grain parallels the grip and bottom line of stock rather than the top line, the grip is greatly strengthened, and the danger of splitting off the toe (a very common accident) is eliminated.

The usual oil treatment provided for high grade stocks darkens the wood considerably and in unskillful hands may result in hiding much of the beauty of the grain. For this reason it is well to select wood that is not extremely dark in color with due care to avoid sapwood. Another thing to be avoided is that variety of walnut sometimes termed gray walnut by the trade, which usually runs to

94

the grayish purple tints and which is very soft with large open pores. In the rough plank this wood often seems more attractive than the lighter colors but it soaks such a quantity of oil that it becomes almost black and the finishing process is needlessly prolonged. Moreover this wood does not work well under checking tools, fuzzing up badly under the cutters so that it is almost impossible to sharpen and smooth up the diamonds in the proper manner and this is in-

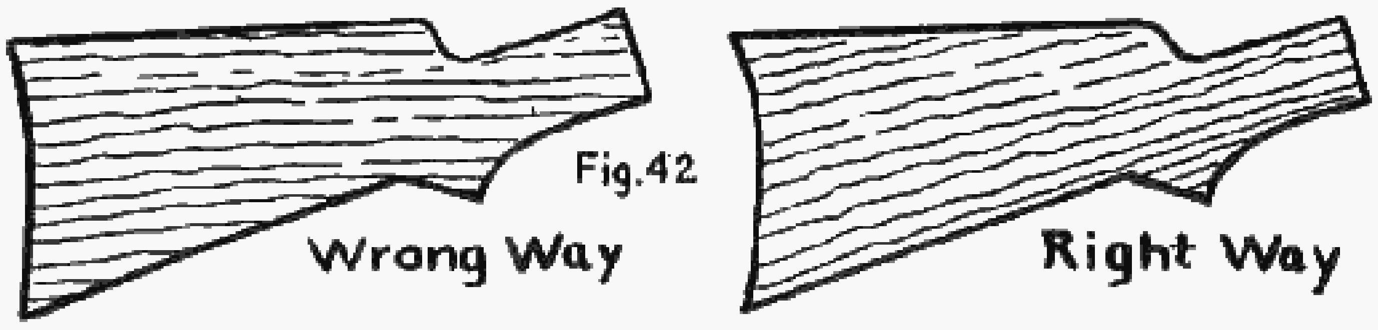


Fig. 42

creased by the repeated application of oil necessary to finally secure a finish. Often the lightest of American walnut (providing it is not sapwood) will finish up sufficiently dark to make a truly beautiful stock.

From the foregoing remarks the reader will probably gather that I am somewhat partial to American walnut as compared to the foreign woods. The fact is, I am partial to the wood which is strongest, soundest and most beautifully grained regardless of whether it grew in the Catskills or the Himalayas. This thing of specifying foreign walnut because it is foreign and not because it is good is all bunk. Some of the most beautiful stocks ever produced have been made of American walnut and some of the poorest, both as to design and appearance, have been of European walnut. This is not a general condemnation of the latter, however, but refers particularly to the lack of knowledge of what one is getting when he orders a foreign product. I have a Circassian walnut stock blank that is unusually dark in color and the most beautifully figured piece of wood I have ever seen anywhere. I have been offered $50 for this piece in the rough blank and was not in the least tempted. I have another piece of American walnut of equally fine finish and which from my own view point is equally valuable although it would not bring as much if offered for sale. The main object in deciding in favor of American walnut is that if it cannot be inspected personally when bought it can at least be purchased from a firm in this country to whom it can be returned if unsatisfactory.

The success or failure of any stock depends quite as much on the seasoning of the wood as upon its other qualities. The demand for walnut today is such that dealers cannot afford to keep their stock in the log for five or six years as required for best results. Green walnut contains a sap which if not thoroughly removed will cause excessive warping and cracking. Prolonged air seasoning

95

under shelter destroys the effect of this sap. Some authorities claim that the logs should be soaked in water for the first few weeks after cutting, to soak out as much of the sap as possible. At all events the wood should be seasoned for at least one year and preferably two years in the log and from two to four years after the planks are sawed, and this treatment should then be followed by steaming in the steam kiln and drying in the dry kiln. The usual kiln drying time is 30 days but if I want to be certain of the quality of the stock blank I send the wood through the kiln a second time, or a total of 60 days. A peculiarity of walnut which renders it particularly valuable for gun stocks is that once properly seasoned it is virtually immune from any warping, either from immersion in water or by exposure to dampness or rain.

All over this country there are small patches of walnut timber as well as others not so small; and fortunate indeed is the fellow who has a few fine old walnut trees on his place if he happens to be a dyed in the wool gun-crank. He need not worry about material for the stock he hopes to make some day—for Europe never produced finer wood then the best of our American walnut.

The man who plans ahead to get out some native walnut for stocks should cut his trees, if possible, five years before he expects to use them. Cut with a short stump, or better yet, grub them out well down into the roots. Cut off the branches and let the log lay in the weather for two years, or possibly three. Then cut off the roots at about the ground level, and store the log in the open air but under shelter for another year. It should then be quarter-sawed and cut into planks three inches thick, to allow for further shrinkage. Stack these planks in the weather for three months, then under cover for the balance of the year, when they may be planed and sawed up into stock blanks, which should then be kiln-dried, or else store them inside in a warm dry place—close up under the roof of a barn during a hot summer will bake out any remaining moisture.

When you have an entire log to select from, there's always a temptation to cut your stock from the extreme butt, where the roots branch out; for here you get the most wonderful figure and coloring. But DON'T. Too much of a good thing is objectionable—and this wood will never get through warping this way and that; it will never seem to become thoroughly dry; and there is every likelihood that the stock may split any time it takes a notion.

Just above the ground line, or near a crotch where large branches occur, is the best place to get fancy stocks from a log. Figure 38B shows the portions of the log from which the soundest and strongest wood may be obtained.

With the supply diminishing and the demand increasing, it would seem that a vigorous program for the planting of walnut trees in localities where they will produce the finest wood, should be included in a National plan of reforestation.

96

CHAPTER 9

STOCK DESIGN

THE earliest gun stock was merely a handle by which the piece could be held, after a fashion. Later, as it was learned that the best way to fire a gun was from the shoulder, the butt stock was developed somewhat along the lines seen today. On early matchlocks and wheel locks the stock was very thick—sometimes two or two and one half inches, and was usually fluted and heavily carved on the sides. Guns of this type were exceedingly heavy and ungainly, and little adapted to the use of early American hunters; consequently, when the Pennsylvania gunsmiths, to meet the requirements of the new country, developed that most famous of all arms, the Kentucky Rifle, they went to the other extreme, making their stocks very small and very thin, often—in fact, usually—with what is now considered excessive drop.

In appearance alone, the lines of the Kentucky Rifle left little to be desired; they were very graceful, with smooth, flowing lines, and possessed a "snap" wholly in keeping with the spirit of the pioneers who used them. Their small size, however, was just as much a mistake then as it would be today. True, the very heavy barrel absorbed most of what little recoil there was from the relatively light powder charge; yet the stocks, particularly the grip, had not sufficient strength to withstand the rigors of hard service—in support of which we have the fact that in the specimens available today as relics, *nearly every one* shows a crack in the grip, usually on the right side just back of the lock recess. Some of these have been repaired with screws or by winding with wire, while others were not repaired at all. It is scarcely conceivable that these fractures were caused by the recoil—more likely they were the result of dropping the butt on the ground. The fact remains that a rifle should be capable of withstanding any normal strain to which it may be put in its regular line of service.

97

Most of the Kentucky Rifles also had excessive drop, and very thin combs. The former was perhaps permissible owing to the light recoil, but the thin comb has always been a mystery to me. Apparently the early rifleman liked to shoot with his "head up and tail over the dashboard" and a diet of corn pone and venison must have made them a heap fuller in the face than most of us today. Some of these old rifles had cheek pieces, usually very small in size, and located too low on the stock to be of much use. The butt plate was four or four and a half inches long, and a deep crescent in shape—another feature possible by reason of the light recoil. It is a notable fact, however, that the heavier European smoothbores of that period, using large balls and tremendous powder charges had wide, heavy butts, the plates nearly or quite straight—more along the lines of our present shotgun butt.

Following the Kentuckys came the army muskets and carbines with larger, more comfortable, more sensible stocks—developed as a result of the heavier charges they used. The under edge of the stock, which was usually square in the Kentuckys, was now rounded; butt plates became larger and straighter, with the sharp corners rounded off.

The Henrys, Winchesters, and other factory made arms then came out with stocks somewhat of a compromise between the two. The grip was larger; the stock was considerably thicker, but, instead of the more sensible military butt plate, they used a crescent shape similar to the early muzzle loaders. At this point firearms designers made their first great mistake, in the development of the two-piece stock; yet it was not so great a mistake as it is today, by reason of the rather light loads to which the early repeaters were adapted. Marksmanship training, as the term is known today, was then unknown. Shooters doubtless had little idea of what their rifles were really capable in the way of accuracy—they gauged it by the phenomenal lucky shot instead of on a basis of steady performance, just as some shooters still do.

Somehow, I am unable to enthuse very much at the recital by some old timer of what wonderful shooting he used to do with his old rifle. I am reminded of an incident related by one of our local liars, concerning a shot he made when a mere lad (What a pity he was permitted to outgrow such proficiency!). It seems that his dad "kept store" in a small settlement in one of the northern states, doing a considerable trading business with the hunters and trappers of the district. As he tells the story:

"One old feller kind o' took a likin' to me—I was just a kid hangin' round the store—an' I was alluz beggin him to lemme try his rifle. One day he was in an' he pointed t'ward sump'n shiny settin' on a stump off a piece, and sez t' me, 'Son, kin you see that?'—an' I sez 'Yep, jest kin see her—she's a gallon syrup bucket.' 'Well,' sez, he, 'Ef you kin hit 'er in three shots the rifle's yourn—pervidin'

98

yore pappy let you hev it.' Well sir, I picked up thet ol' rifle—bigger'n I was—could jest barely heft it—an' drawed down on that bucket, an' let drive—DANGed ef I didn't knock 'er off the first pop! Well sir, Y'outa saw that ol' boy's eyes stick out! He paced it of jest a quarter of a mile exactly from where I stood to the stump—an' he gimme the rifle, too, an' I had her fer years! Aw, I was allus a good shot—come natcherl to me—my daddy, he was one o' the best shots in the country in his day—an' his daddy b'fore him. Why I've seen him stand off sixty paces an—"

At this point I impolitely interrupted to inquire as to the make, model and calibre of the rifle with which the syrup bucket was shot. He didn't remember, but his studied answers to leading questions seemed to indicate a '73 model Winchester; and he was sure it was a "thirty eight"—so I assumed it was a .38-40, black powder cartridge. Now, at 600 yards, the 1/20 inch blade of a Springfield just about covers a 20 inch bull; and I couldn't help wondering how much of an eight inch syrup bucket the big coarse hunting sight of that '73 Winchester would hide at 440 yards, assuming the shooter could see the bucket at all at that distance. I wondered also how an untutored lad of his years could have learned enough of the trajectory of that rainbow load to hold over sufficiently for a hit at that range, and how he would know where in time the bucket was while holding over. But at the very first question he cut me off with "Aw, hell, sonny—you young bucks today dono what shootin' is—we knowed how to shoot in them days—had to." So what's the use!

But we were on the subject of stock design, or at least approaching it. Apparently the factories, until a very few years ago, thought that the only purpose of the comb was that it provided a means of reducing the stock to grip diameter at that point. Combs were whittled down until they served no useful purpose whatever, and might better have been omitted—in fact, the comb is omitted on the British Lee Enfield, and on our own Model of 1917—and might just as well be on our Springfield service stock.

A few years back the pistol grip was practically unknown on a rifle, but was invariably found on all American shotguns—even the cheapest of them—and is yet. Gradually, however, we have learned that a pistol grip is a highly desirable thing on a rifle, and not so essential on the scatter-gun—particularly the type that is merely a wart located midway between the trigger and the toe of buttplate. Many of our best hand made double guns, and practically all our trapguns are today made with straight grips; while it is the almost invariable rule that the properly made rifle stock shall have a full, sharply curved grip located close behind the trigger guard.

The modern, properly designed rifle stock is a thing of beauty and grace and symmetry of lines; and its beauty is only equalled by the ease and comfort with which it is handled, particularly if built to

99

order, to fit the shooter. Yet—and here's where I get scalped—the stock has not yet been built which really conforms to the physical characteristics of the human hand; and probably it never will be built—at least not unless and until our firearms are completely redesigned, which seems doubtful. The reason for this may be understood from Figure 43. By closing the hand, as in grasping the grip of a rifle stock, it will be observed that the lower joint of the fore-

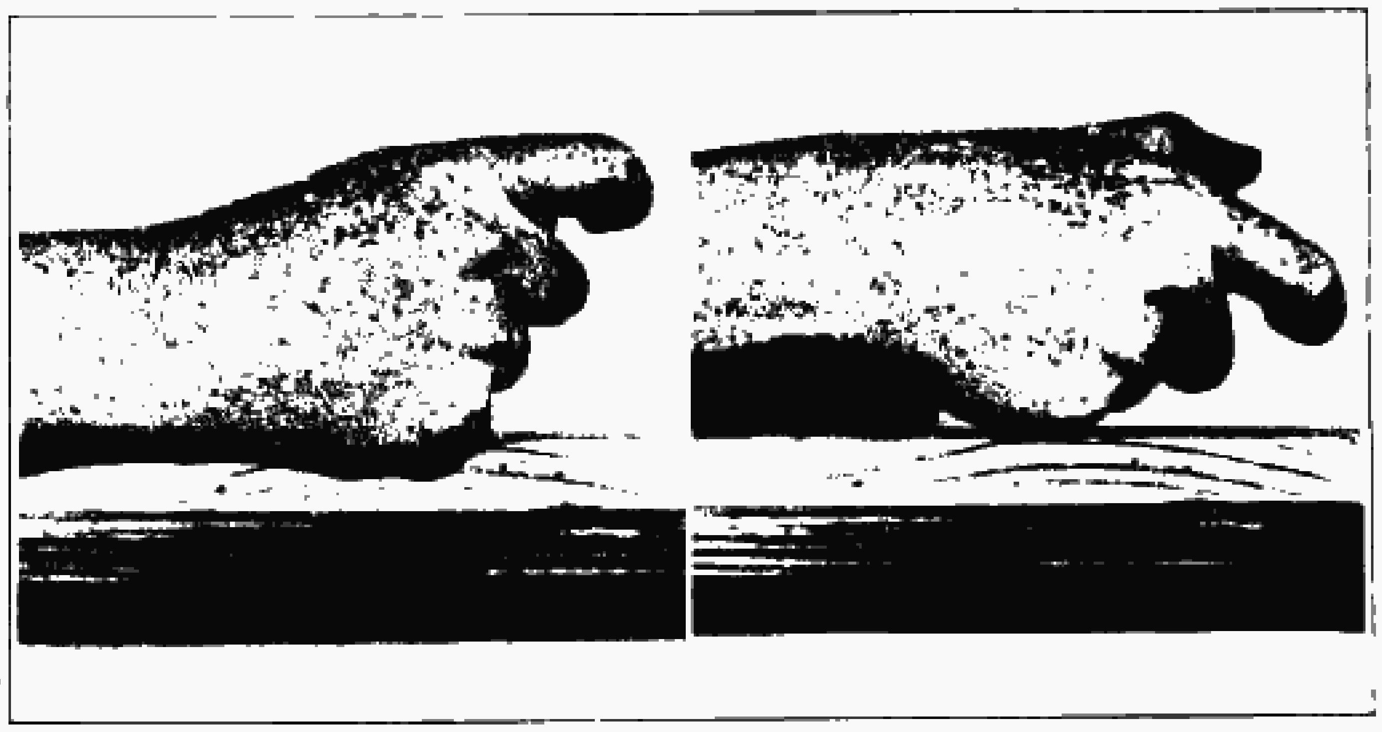


Fig. 43 A Fig. 43 B

finger is in prolongation of the forearm (a, Fig. 43), and not at a forty-five degree angle with same, which position it is forced to assume in grasping any stock (b, Fig. 43). The exception to this is the grip of almost any automatic pistol. Here the hand is in a natural, comfortable position, the forefinger in the same horizontal

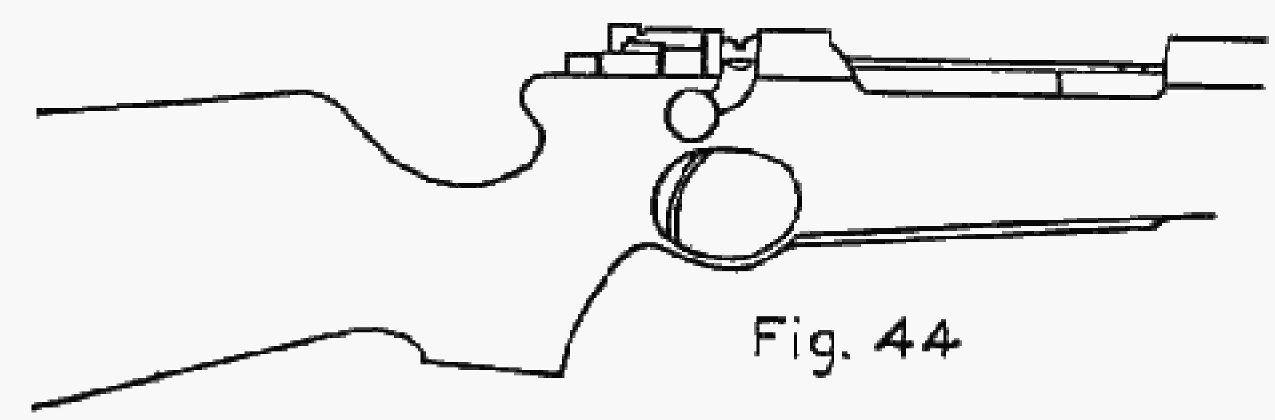


Fig. 44

plane as the trigger—not reaching down to it from above as when shooting a rifle, shotgun or revolver.

From a strictly utilitarian standpoint, then, our ideal stock should assume something like the shape shown at Figure 44, giving a grip similar to that of the automatic pistol. With present actions this is not possible; and if it were, we should soon tire of it, by reason of the ungraceful lines of such a stock. A gun—any gun—should

100

appeal to the eye quite as much as to the hands that hold it—else why do we spend our money for fine finish and decoration?

Evidently, then, we must effect a happy compromise so that our stock, while following to a degree the conventional lines we have come to accept as standard, yet is so dimensioned as to provide maximum quickness of aim, and comfort in holding.

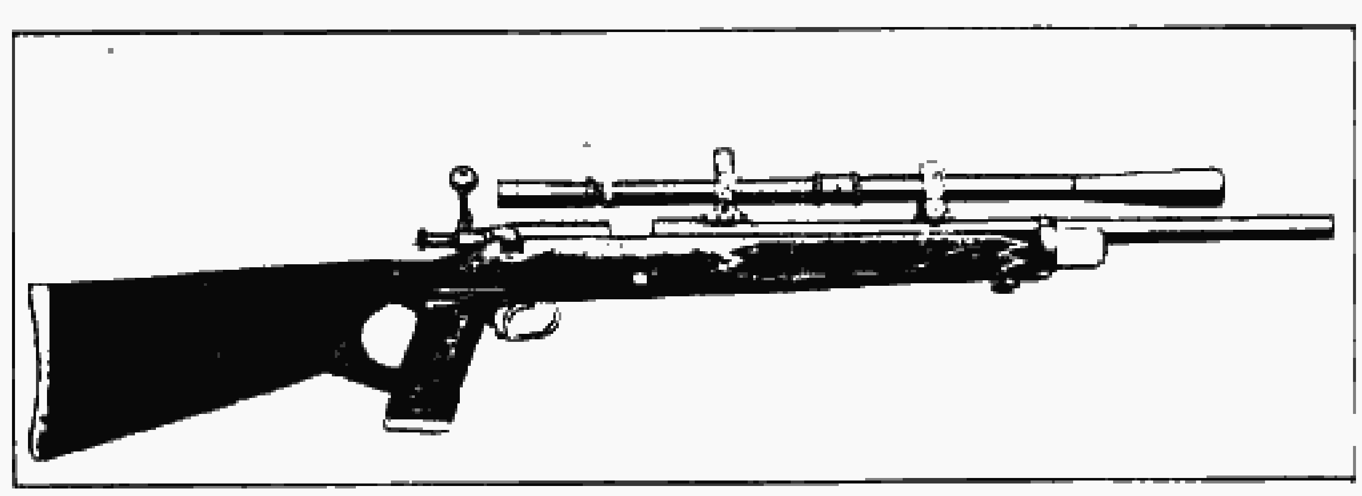


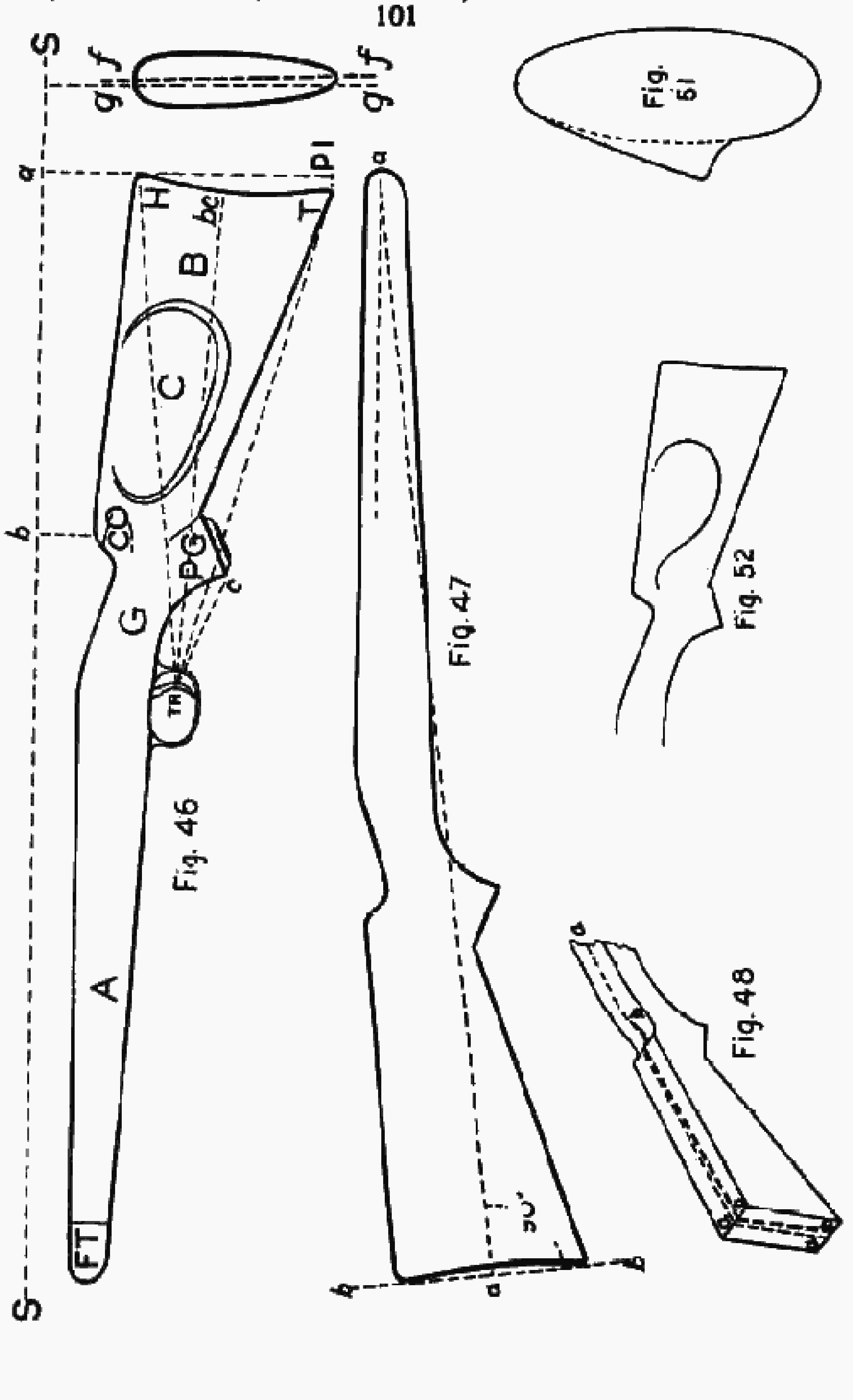
Fig. 45

Figure 45 shows a stock illustrated a year or so ago in the American Rifleman—the work of a man trying to attain his ideal of practicability. I have no doubt this stock was far more comfortable and more easily held than any of our old stand-bys; yet, without knowing the owner, I'd be willing to bet my shirt he has before now discarded the idea in favor of a more conservative design. For deeply rooted in the heart of every shooter there is a secret admiration, a real affection, for a gun that *looks* like a gun; the familiar lines of old favorites that have been our companions in field and forest will not easily be supplanted by new and unfamiliar shapes, albeit they might prove thoroughly practical.

And, happy to relate, it is wholly possible to design our stock along conventional lines, yet modify dimensions in a manner to improve the handling and the beauty of the arm many fold. It is surprising what a difference little things make. An eighth of an inch in thickness or height of comb—a bit of castoff at the butt—a slight change in pitch—a different curve in the grip—these are some of the points that make or mar a stock. One may have two stocks that to all appearances are identical in size and shape; yet slight differences not readily discernible will cause one to handle perfectly while the other feels slow and clumsy.

STOCK NOMENCLATURE: Before going further into a discussion of these points, study Figure 46 if not already familiar with the nomenclature of a modern sporting stock. "A" is the forend, or forestock; "FT" is the forend tip; "G" is the grip, or as the English stockers call it, the "hand;" "PG" is the pistol grip; "CO" is the comb—and the low upper surface of grip just ahead of comb is sometimes spoken of as the "hand hole;" "C" is the cheek piece; "B" is the butt; "H" is the heel, and "T" the toe of butt.

101



102

The line "S-S" represents the line of sights when set for the range used most—usually 100 yards; from this line all drop measurements are made while all length measurements of butt stock and forend are made from center of trigger, "c." Thus, the length of stock usually refers to distance from center of forward surface of trigger to center of outer surface of buttplate, "c-c," although this may differ from the measurements to heel and toe, "c-H" and "c-T." Length of pistol grip is usually measured from center of front surface of trigger to forward edge of grip cap "c-c," and is of far less importance than is generally supposed; the curve of the grip, its thickness, its cross-section, and last and most important, its height with relation to the bottom line of stock, have far more to do with the feel and handling of the gun than this distance from trigger. This will be further explained later on in this chapter.

PITCH: The line H-PI is at right angles to the line of sight, and the distance from PI to the toe of butt, T, determines the "pitch" of the stock, if any. Pitch means the distance of the front sight from the perpendicular, when both heel and toe of butt are in a horizontal plane, i.e., resting on the floor. If a stock has too much pitch, or as some say, if the toe is too short, the heel may strike under the shoulder as the gun is brought to the firing position, delaying a quick shot. If it has too little pitch, or none at all (as when the buttplate forms a right angle with line of sight) there is a tendency of the butt to slip down on the shoulder, especially when shooting prone. Moreover, shotgun shooters and some rifle shooters also, claim that lack of pitch, or lengthening the toe, makes a gun shoot higher; and by this they mean that the bullet or shot charge actually leaves the gun at a higher angle with relation to the line of aim!

I cannot concur in this belief. I see no reason why the angle of departure would be altered the least bit regardless of how the butt might be shaped. This leaves us facing the alternative theory that with a long toe on our stock the recoil throws the muzzle high, causing us to shoot higher—I can't believe this either, for the simple reason that electric spark photographs of bullets and shot charges in flight invariably prove that said bullet or shot charge is well out of the muzzle and on its way *before the muzzle has started to rise from the recoil.*

In seeking the cause, therefore, of this almost universally acknowledged fact that the long toe actually does cause one to shoot higher, I have come to this conclusion—that hard pressure of such a stock against the shoulder causes it to slip down, just as the beveled latch of a door slides in when the door is pushed shut; and that, since 99 per cent. of shooters "buck" their shots, i. e., increase the pressure of the shoulder while pulling the trigger, this bucking causes a slight, and entirely unnoticed elevation of the muzzle a fraction of an instant *before* the discharge takes place—and naturally the shot flies

103

high. I may be right or I may be wrong—am plumb willing to be shown the error of my ways; but it will take a lot of argument, and a lot of proof, to convince me that changing the pitch of any stock causes the least change in the relation of the bore to the line of sight—and that is what determines where the gun is shooting.

I have said that 99 per cent. of shooters buck their shots. Of the other one per cent. who don't, those who are riflemen know enough about stocks as a rule to have a pitch that keeps the stock in place on the shoulder; and those who are shotgun users are usually able to do pretty good shooting with anything that burns powder! But this argument is beside the question. Shooters have varying opinions as to the right pitch for rifle stocks, and many shotgun users prefer no pitch, or at least very little. The thing for a man to use is what he can use best—what he believes in—for confidence plays a mighty big part in the shooting game. Townsend Whelen prefers about a 3 inch pitch on his rifle, and this is the choice of many other expert target shooters and hunters. E. C. Crossman allows he wants from 4 to 5 inches, and for offhand shooting with a hunting arm this amount of pitch handles better for me. But on several rifles of my own that I have stocked for offhand shooting, I have no idea what the pitch is, having never measured it. My own rule is to cut the butt so that it forms a right angle with a line drawn from center of butt to a point in the forend tip level with the bottom of the barrel channel; in other words, making the butt, (b-b, Figure 47) at right angles with the center of form of the entire stock. This gives me a definite rule to apply on my own stocks, as on bolt action rifles I want the forend tip about 18 inches from the trigger; others prefer a shorter forend, however, so the rule cannot be made universal.

When a man specifies the amount of pitch he wants on a stock, I make it as he wants it. When he leaves it up to me to fit him, I usually follow my own rule, carrying a line from center of butt to a point on bottom of barrel 18 inches ahead of the trigger and cutting the butt at right angles to it, and he usually remarks that the pitch seems to be just right. A stock so made will deliver the recoil very nearly through its center of form, and will cling to the shoulder in any of the shooting positions like a poor relative during a hard winter.

CAST OFF: Going back to Figure 46, the small "head-on" view of the butt illustrates what is meant by "cast off" in a stock. The line g-g is in prolongation with the center of the bore—in other words, the original center line of the stock. The buttplate has been shifted to the right a trifle so that its center comes on the line f-f. The stock is therefore cast off, or bent to the right a distance equal to that between these two lines. This slight bend is of course unnoticeable when the stock is viewed from the side; and one must look closely to see it from a top view. But it is there just the same.

104

and while some deny the value of castoff and will have none of it, I find, in common with many others, that it speeds up my aim considerably. Castoff is not necessitated by either a thick or a thin comb—in fact, comb thickness has nothing to do with it, and neither has a cheek piece, contrary to common belief. But take a stock without castoff which fits you fairly well; bring it up so that you glance quickly through the aperture of the rear sight; and you are quite likely to observe that the front sight is off to the left of where it ought to be, as much as a half inch or so, and a perceptible fraction of time is required to give the slight twist to the neck that brings it into line. Therefore, moving the butt a trifle (say 1/4 inch) to the right, amounts to moving the front sight about twice that distance to the right, so that as you look through the aperture it is practically centered instantly. All this explanation presupposes the shooter is right handed—a left handed shooter would naturally reverse proceedings, making his stock bend to the left—"cast on", as it is usually called.

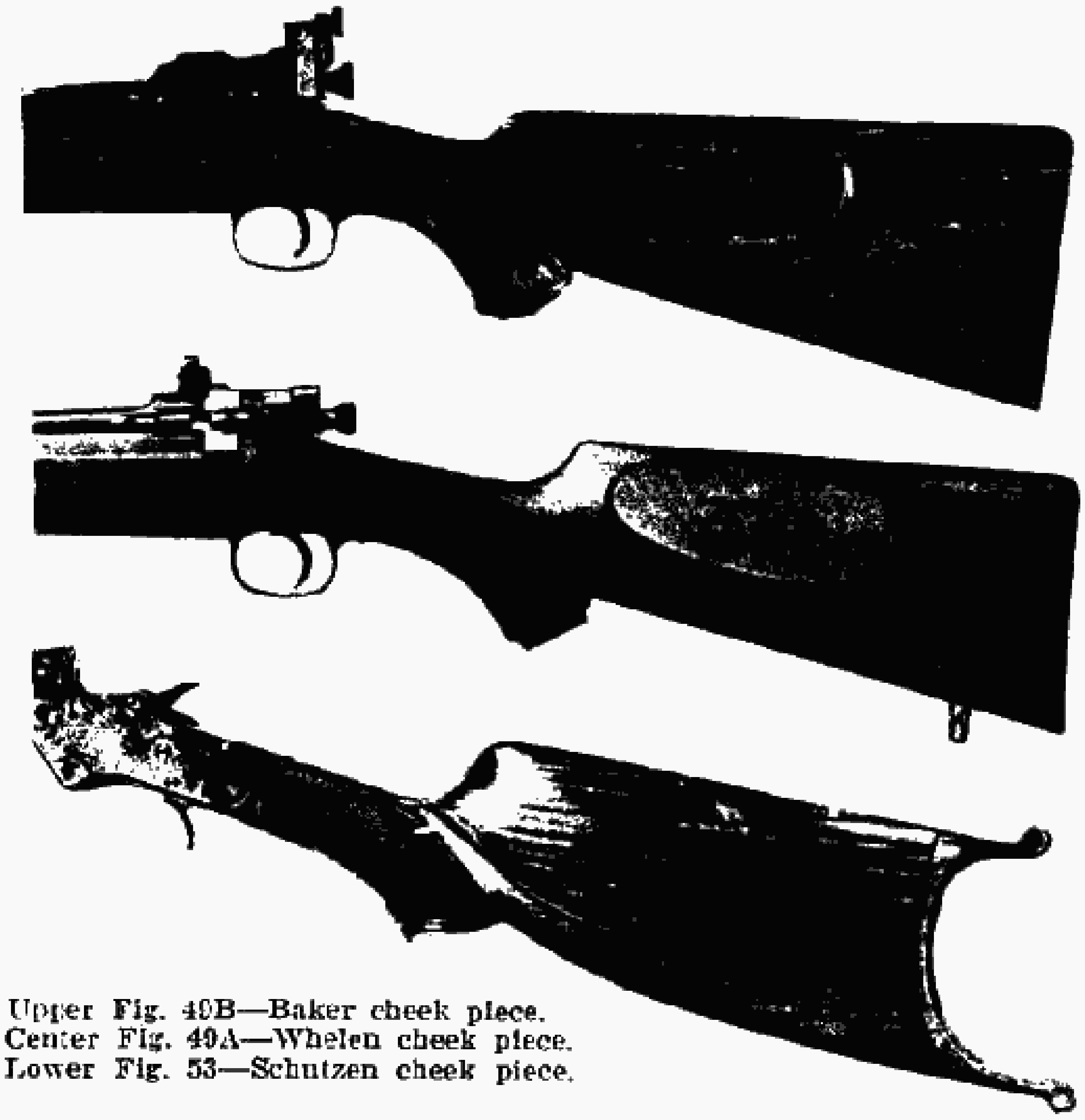
Castoff may be from 1/8 to 1/2 inch according to the shooter's build and method of aiming. Usually it is well to have a little more castoff at toe than at heel, since the hollow in the shoulder where the butt should rest slopes outward a trifle on most people. My own castoff dimensions are 1/4 inch at heel and 3/8 inch at toe. The bend should start just back of the trigger and run in a straight line to the butt. Figure 48 shows the stock blank laid out for a cast off stock, the line a-a-a being the original center line, and b-b-b the new center to which the stocker will work in shaping up the butt.

CHEEK PIECES: Next we come to the cheek piece, if one is to be used. I prefer, and have used for years a cheek piece of the pattern designed and recommended by Whelen, except that I like it set a trifle higher on the stock, its upper outline blending into very nearly the upper edge of the stock. Figure 49 shows the two types, A being the cheek piece preferred by Whelen and B, the one on my own favorite sporter. The distinction is largely theoretical, and the whole question is pretty much a matter of personal preference.

The cheek piece must be thinner at its forward end that at the rear, (See Figure 50) otherwise you will take severe punishment from recoil. When properly sloped forward, however, the recoil throws the pressure slightly away from the face, making the stock both safe and comfortable to shoot, and permitting a slightly thicker and more snugly fitting comb. Figure 51 is a cross section of a stock with well designed cheek piece—note that it forms a straight line from top to bottom edge, and is not hollowed or rounded. It may also be perfectly straight from its front to its rear end, although I prefer it very slightly hollowed in this direction. Thus shaped, the face finds exactly the same position every time, while with a convex cheek piece you will find yourself shifting about somewhat from shot to shot.

105

Referring again to Figure 51 note that the cheek piece *does not* add any thickness to the comb or upper edge of stock; the thickness starts increasing, of course, immediately below this edge, and continues to the bottom edge of cheek piece. The cheek piece is not



Upper Fig. 49B—Baker cheek piece.
Center Fig. 49A—Whelen cheek piece.
Lower Fig. 53—Schutzen cheek piece.

necessary to add comb thickness—that is not what it is for. You can make your comb as thick as you like—even the very thick combs on some Parker shotgun stocks are not unpleasing. But take up a gun without cheek piece, and with a comb that fits you perfectly, just throwing you into the line of sight when face snuggles the stock. Now you will find that you can slip your forefinger between the stock and lower part of the jaw—in short the face is supported by the stock at one point only slightly below the cheekbone. Now lower the gun and bring it up again, so as to bear the whole side of face against the stock. Now the eye is not looking through the sight line, but a half inch or so to the left of it. Shooters accustomed

106

to shooting a stock without a cheek piece have developed an instinctive habit of cocking the head slightly to the right—and they do this *irrespective of the thickness of the comb.* The cheek piece merely provides a positive and controlled method of canting the head, thereby lessening the time required to line up the eye with the sights, and providing a firmer hold.

The forward end of a cheek piece as described should fall at a

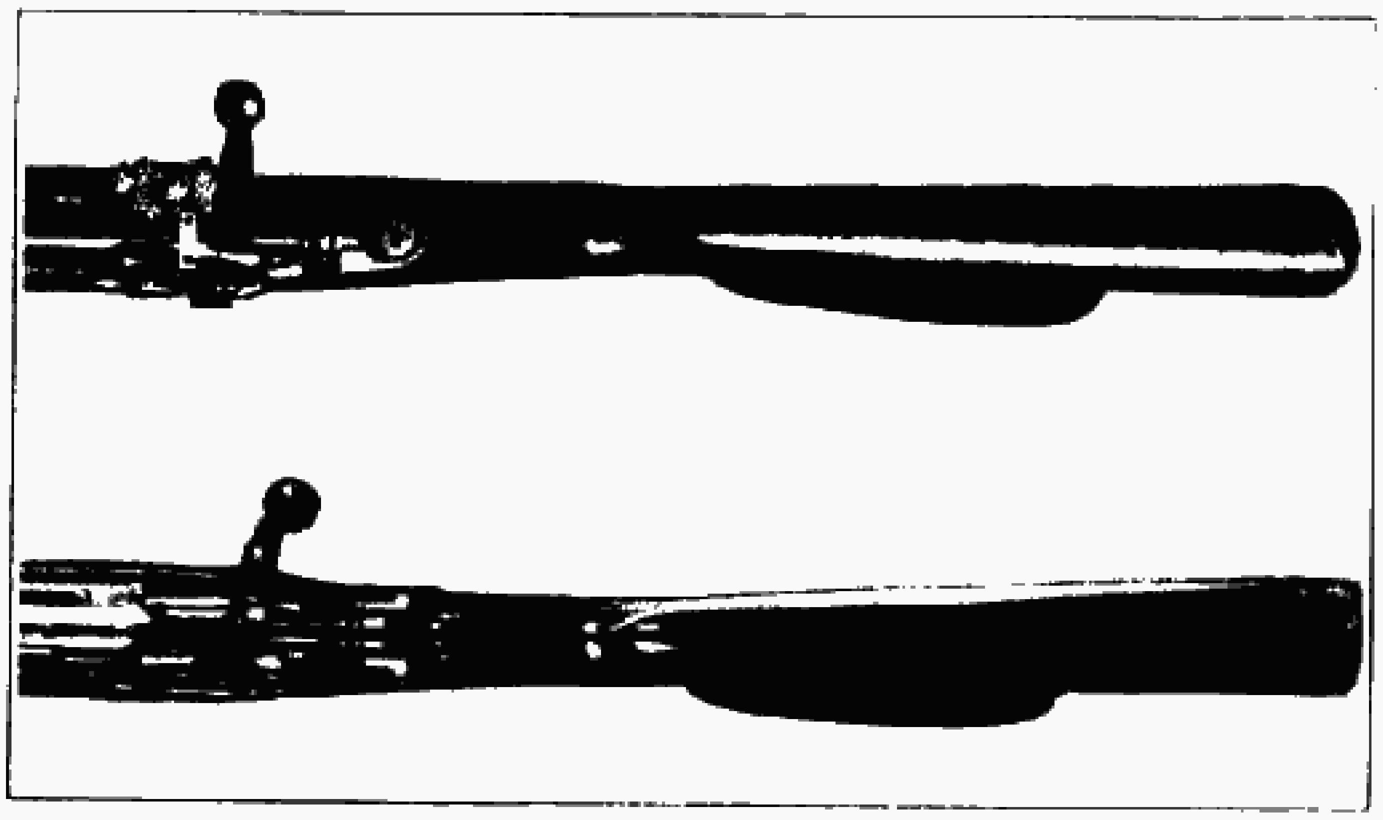


Fig. 50. Upper Whelen—Lower Baker cheek piece

point from 1 1/4 to 2 inches back of the comb—assuming that the comb is set well forward as it should be. There is a type of shooter, however, who "crawls" his stock, shoving his head forward almost touching the cocking piece or hammer—and for him a cheek piece like Figure 52 is of more value. A similar cheek piece is shown in

Figure 53, this being an old Stevens Schutzen stock, on which the cheek piece is extra full and rounded out to what should have been the thickness of the stock itself—if they hadn't made their butt plates so blamed narrow in those days! The type shown in Figure 52 should have the same cross-section formation as the ones previously described, it being merely carried forward.

A friend of mine recently made the stock shown in Figure 54 for a M. 22 Springfield, and uses it with the keenest delight. He is a "stock crawler" in every sense of the word—virtually wrapping his right eyebrow around the sight disk and resting his cheekbone where the grip ought to be! He made this stock out of one of the most beautiful pieces of burl walnut I ever hope to see, and I'd have given a leg, almost, for the privilege of working it into one of a more Christian shape; nevertheless, if this stock fits him and handles right for him, I can't blame him a bit for using it.

107

COMBS: Passing the cheek piece in our forward journey on the stock, we come to the comb,—and here is where the cranks yell their views the loudest, and where, in my opinion, stock makers most often fall down. A comb may serve its purpose very well, and still look like a last year's bird nest. Or it may be as gracefully modeled as a flapper's ankle—yet serve no more useful purpose. Probably the first comb ever shaped on a stock was a happen-so—the result of cutting away the wood to form a place to wrap the thumb round—so it was cut back plenty far enough so that there would be no danger of interference with the hand grasp. I said *plenty* far.

Eventually, no doubt, some enterprising shooter discovered that when he slipped his hand back an inch or so, permitting the base of the thumb to be supported by the comb, his hold was much firmer and more steady. The properly designed stock has the comb so placed that when the grip is grasped for shooting, with the finger in position on trigger, the base of thumb is so supported. Just where to place it to get such support is the problem. Some tell us the point of the comb should be over the center of the pistol grip; some say over the rear half of grip. But since the position of the grip may be variable, the rule isn't a good one. Moreover, some shooters grasp the stock with thumb along the right side, while others place it across the grip, grasping it as they would a pitchfork handle. The former can use a comb fully a half inch further forward than can the latter. The type of rear sight has something to do with the location of the comb also. Cocking-piece and bolt sleeve sights often extend so far back as to interfere with the cross-grip unless the comb is cut back a bit.

It is difficult to lay down a hard and fast rule for the position and thickness of the comb—the "cut and try" method being of course

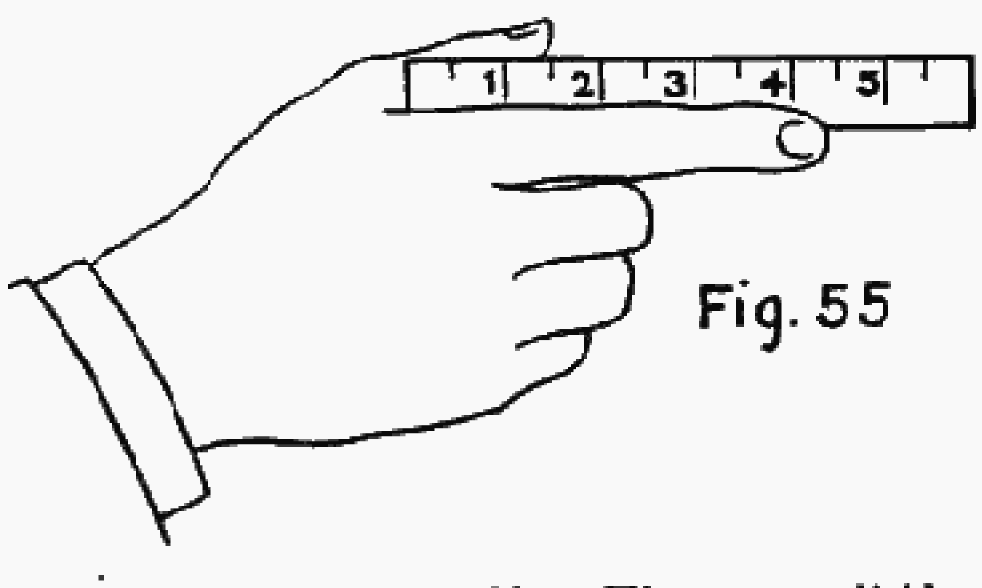


Fig. 55

the most reliable when it is possible. The most reliable method I have found when a try-on of the stock is not possible, is to measure from tip of forefinger to crotch of thumb, then project this measurement from center of trigger to upper edge, (Figure 55). On my

108

hand this measurement is just 4 1/2 inches, which is the exact distance from center of trigger to point of comb on the D. C. M. Sporter—and this comb is correct for my hand. Numerous fittings by this method by mail have worked out very satisfactorily.

Formerly, combs were made much too thin, but in recent years both shooters and stock makers have awakened to the advantage of a good thick comb. Here again there is no set rule, and the cut-and-try method is best if it can be followed. If it cannot be, then the best judgment of the stocker should be aided by a photograph of the owner of the gun. The thinner the face the thicker the comb should be, and vice versa. A man with a very thin face can use a comb up to an inch in thickness, while the very full face will require one not more than 3/8 inch. Perhaps the best average is 1/2 inch, which will fit almost anybody fairly well provided the height is right.

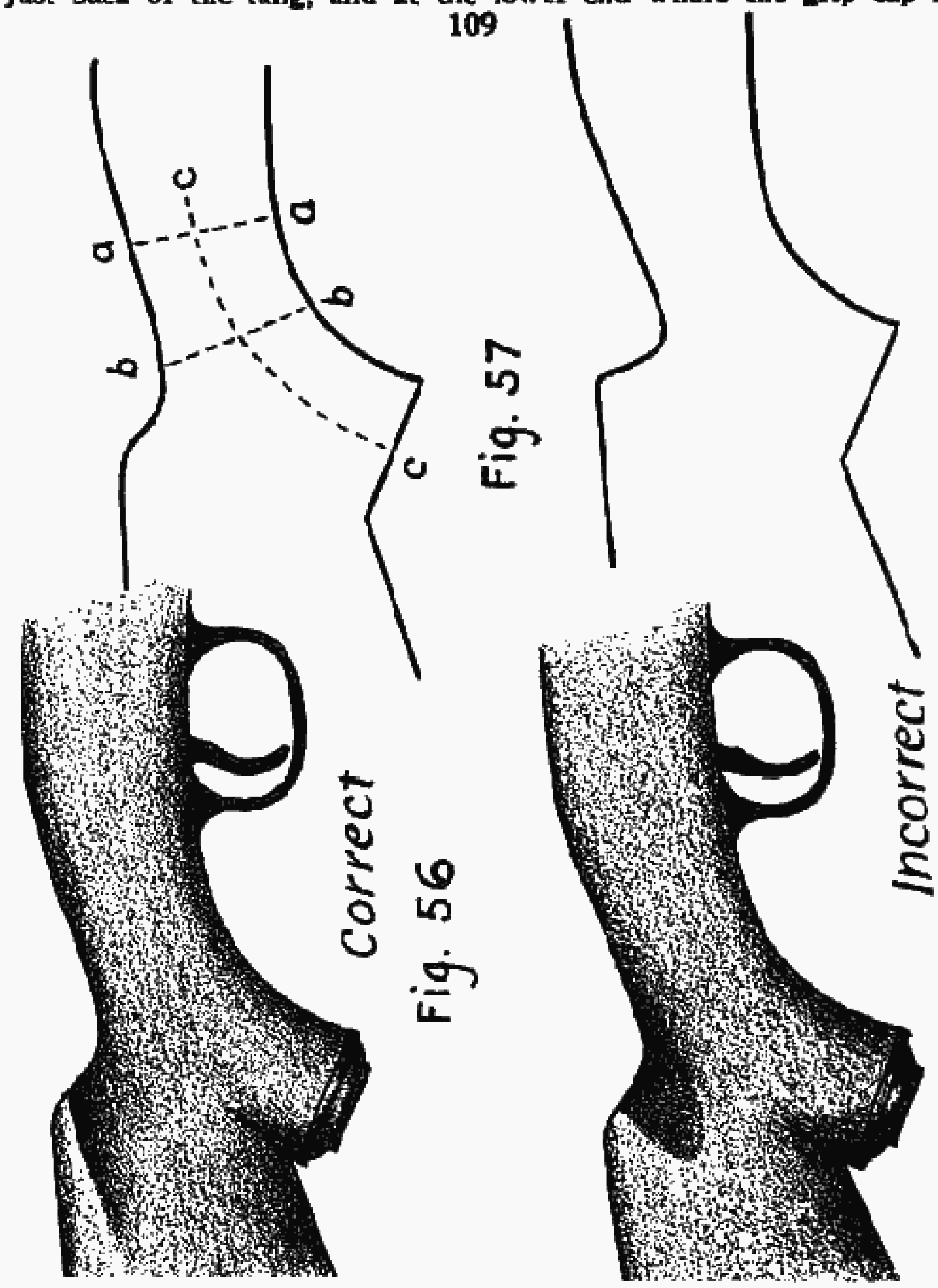
It is a mistake to make a comb too thick, or too high; but on most bolt actions it is almost impossible to make it too high. With the comb barely clearing the cocking piece of a Springfield, it will stand from 1 5/8 to 1 7/8 inch below the line of sight, depending on type of sights used. The higher comb is preferable when it can be worked out.

Parenthetically, I know a gunsmith of forty years experience, who, because he considers 1 5/8 inch too much comb drop, solves the problem to his own satisfaction by making the comb higher—and cutting it back a couple of inches so the bolt can be withdrawn! He invariably does this, regardless of the customer's specifications, and all remonstrance is in vain. Forty years has taught him how to make a stock, so he says—and he makes them all to the same dimensions throughout!

The comb may be UNDERCUT or not, as you prefer. But unless you or your stockmaker are adept in shaping an artistic undercut, best make it without. A neat, plain comb, well rounded, and about the same thickness for a distance of half an inch below the upper edge, then gradually swelling to the full thickness of the grip, is very attractive and 100 per cent. practical. If undercut, the overhang should run nearly, but not quite parallel with upper edge of comb—not drop downward at a sharp angle, as it does even on many high priced stocks. And the rear portion of the undercut should blend into the surface of the stock with no perceptible angle, instead of being a harsh, flat cut that looks like it was done with a pocket knife. Figure 56 shows the right and wrong way of shaping up an undercut comb. Figure 57 shows the right and wrong way, in my opinion, of shaping the drop to the grip. Here, as elsewhere on the ideal stock, stream lines should prevail. There is no excuse for the sharp downward drop so often seen, nor should this drop, however gradual, carry to the smallest grip diameter.

PISTOL GRIP: The smallest diameter of the grip should be just back of the tang, and at the lower end where the grip cap is

109



110

fitted, if one is used. We speak of the circumference of grip inadvisedly, since in the well shaped stock it cannot be the same circumference at all points. The specified diameter should be given it about 1/2 inch back of tang, (on the line a-a, Figure 57), while the circumference just forward of the comb will be slightly greater, (line b-b). The circumference at bottom end where cap is fitted

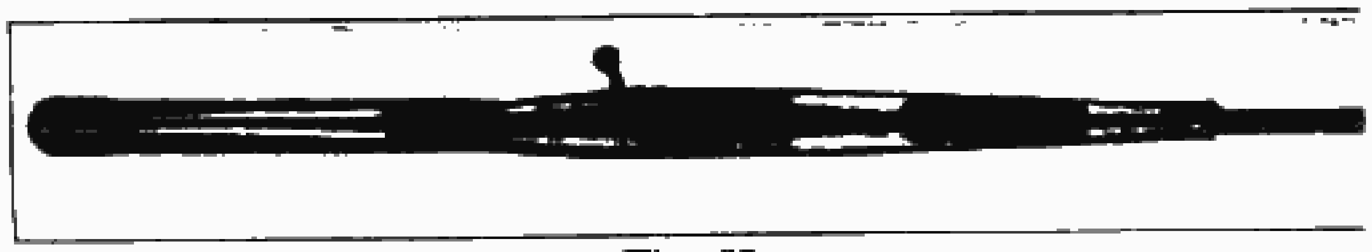


Fig. 58

should be about the same as at a-a. The sides of grip should be about parallel along the line c-c, except that a slight swell on the right side to fill the hollow of the palm is quite permissible, and often desirable. This was a feature of Ludwig Wundhammer's stocks which pleased many shooters so much. This swell is quite noticeable on the Springfield sporter stock of which a bottom view is shown in Figure 58.

Now we come to the length of the pistol grip, i. e., the distance from center of trigger to nearest point of grip cap. Recent decisions from headquarters are to the effect that this distance should be from 3 1/4 to 3 5/8 inches—4 inches being the extreme for the largest hands. Now I'll probably raise a storm of protest with a statement that this dimension doesn't mean a blamed thing—and I'm going to try to prove my assertion with Figure 59. Here are shown a number of different grips drawn to exact scale, and each one measuring exactly 3 1/2 inches from center of trigger. Test it on the cut with a pair of dividers. The curve of the grip, whether an arc or a parabola, and the *vertical* distance of the point "x" below the center of trigger, in its relation with the distance from trigger, is what determines the grip's efficiency or lack of it. In Figure 59, "G" is the grip of the D. C. M. Sporter stock as issued; while "H" is the same grip slightly altered, but with the distance from trigger *not* increased. The curve was originally an arc of a circle; it is cut back in "H" to a parabola, i. e., the curve in creasing toward the end. In theory the "as issued" grip looks better, and seems like a closer grip; but handling the two shows that the one at "H" gives the firmer hold—the sharper curve at lower end giving a "hook" effect, while there is a slight but decidedly noticeable tendency for the hand to slip down and back on the other.

The best grip I know of is one having a slight parabolical curve toward the rear, with plenty of finger room just back of guard; the length from center of trigger to edge of grip-cap to be anything de-

111

sired from 3 1/4 to 4 inches; and the *vertical* distance from edge of grip cap to center of trigger, about 1 1/2 inches.

I am not in sympathy with extreme grips like some of those in Figure 59 projecting straight downward, which form a projection from the stock at their rear edge. The most graceful grip is the one whose bottom edge just meets and forms an angle with the bottom line of stock. If a grip cap is used it will project something like 1/4 inch, which is sufficient for appearance's sake.

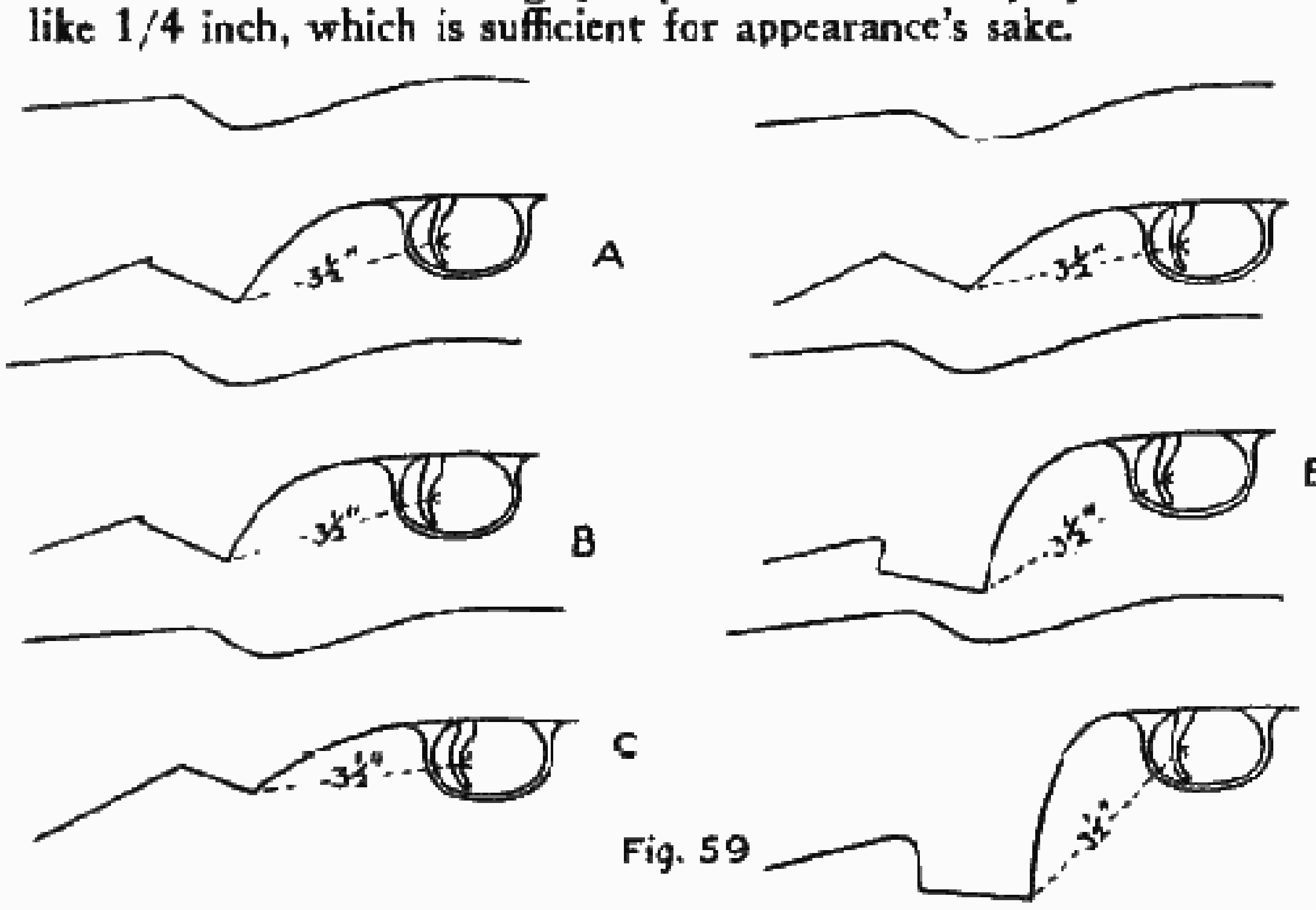
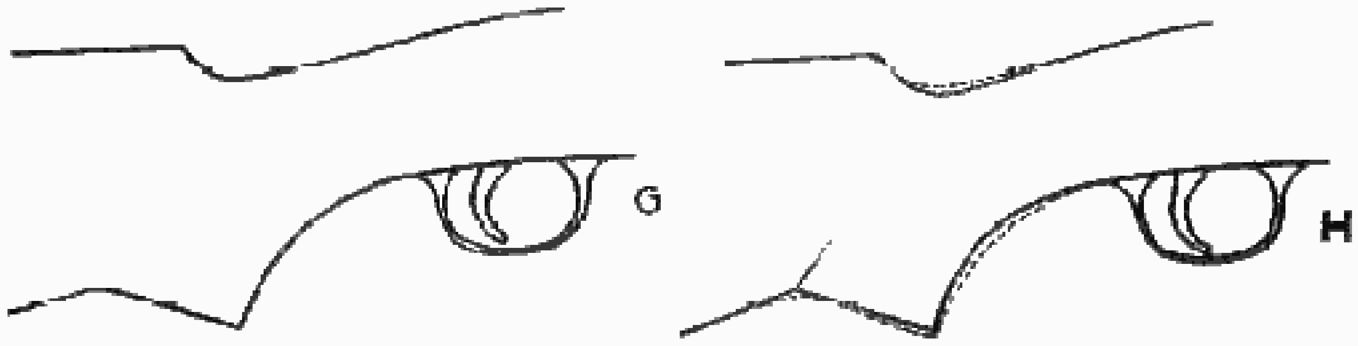


Fig. 59



An important point is the angle of bottom of grip and its forward edge. When these surfaces form an acute angle like "a", Figure 60, the grip looks like something had been forgotten; and a widely obtuse angle like "b" is equally undesirable, indicating either a grip carried too far back, or a stock that is too shallow from top of comb to a point behind the grip. A right angle, as at "c" gives a properly shaped grip of splendid appearance, and permits a full sized grip-cap, and about the right depth at comb.

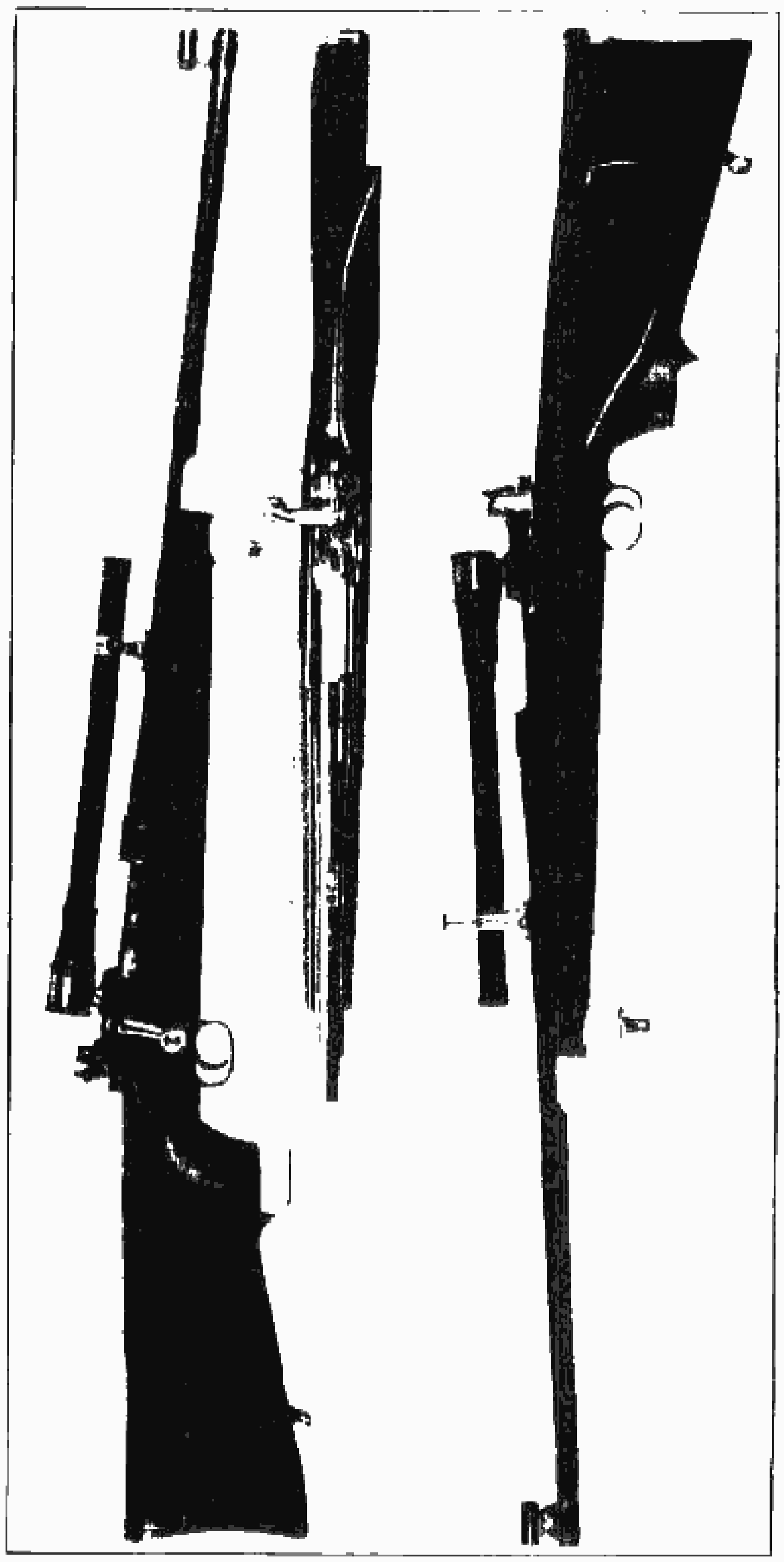


Figure 54. The "Stock Crawler" .22 Springfield; designed and shaped by C. C. Jackson to fit and suit C. C. Jackson. Sighting equipment:—Front, Watson No. 2 with original dovetail base cut off—light tube brazed to Springfield movable stud. Howe-Whelen Rear. B. & M. Hunting Scope with Fecker rear mount used in front. For rear mount a special wide dovetail was made and shaped to fit on top of receiver bridge; sweated and screwed into place. This fits into a female dovetail carrying a spring clip which grips scope around eyepiece. All adjustment is done on front mount. Notice low scope line of sight. Scope can be used without removing rear or front sight.

113

This depth, or vertical distance from comb to point just back of grip, is another point where many stockmakers fall down. Too shallow a stock at this point always results in a grip set far back and virtually useless; and such a stock, if not actually lacking in strength, at least gives the impression of flimsiness. Again, too great a depth at this point ruins the lines and makes any stock look like a boat oar. The attempts of some of the factories to design a stock with pistol grip well forward has resulted in just this effect—it is particularly noticeable in the old Model 20 Savage stock, which I honestly believe to be one of the homeliest ever produced. The new Model 20 is much better in this respect.

There is no set rule for thickness of the grip, but experience has

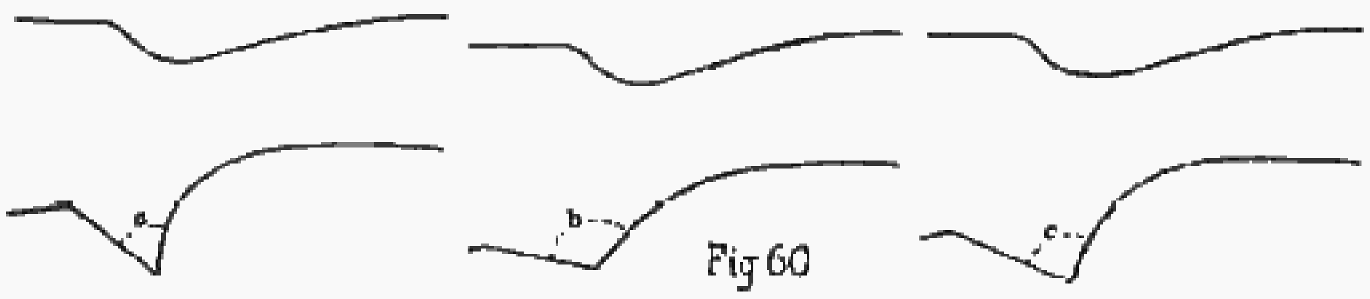


Fig 60

shown that it should be from 4 3/4 to 5 1/4 inches in circumference. My preference is 5 inches in American walnut, and 4 7/8 inches in high grade European which usually is a little stronger and harder. In cross section I favor a grip of very full oval—not round, but much more nearly round than many stockers make them. The oval outline, Figure 61, is 5 1/2 inches in circumference, and an oval in these proportions seems to be about right. The grip can be roughed out to this outline, then reduced in finishing to the desired diameter without changing the proportions.

BUTTSTOCK: The stock immediately back of the grip should be the same thickness as the grip. A grip bulging out from sides of stock looks like the devil—or worse. The bottom edge just back of grip should be full and rounded to about a half circle, and narrowing in a straight taper toward the toe to conform to shape of buttplate. This is just the reverse of the upper edge of stock, which is thick and full rounded at butt end, narrowing in a straight taper toward the comb. The thickness and shape of butt is controlled by the shape of the buttplate, the shape and dimensions shown in Figure 62 being about ideal. If your buttplate does not conform to your ideas of what you want, it should be filed to shape before fitting, then the stock worked down to it. The top and bottom lines of stock should be *absolutely straight*. There is no excuse in rhyme nor reason for the shadbelly curve often seen on old stocks, but now, thank the Lord, disappearing. A very slight fullness may be permissible on the sides when it is desired to gain weight, but the side surfaces should run as nearly straight as possible from buttplate to grip. I may add also that thick, bulging sides on a stock do not add enough weight to materially reduce recoil. If a buttplate of

114

the desired size and shape is not available, thickening the stock ahead

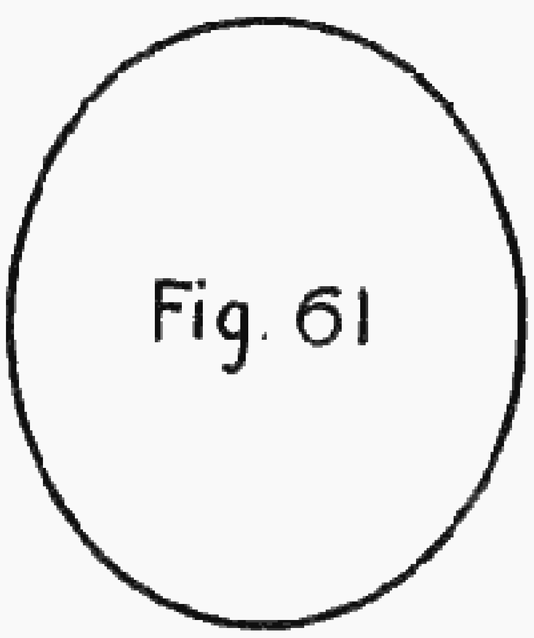


Fig. 61

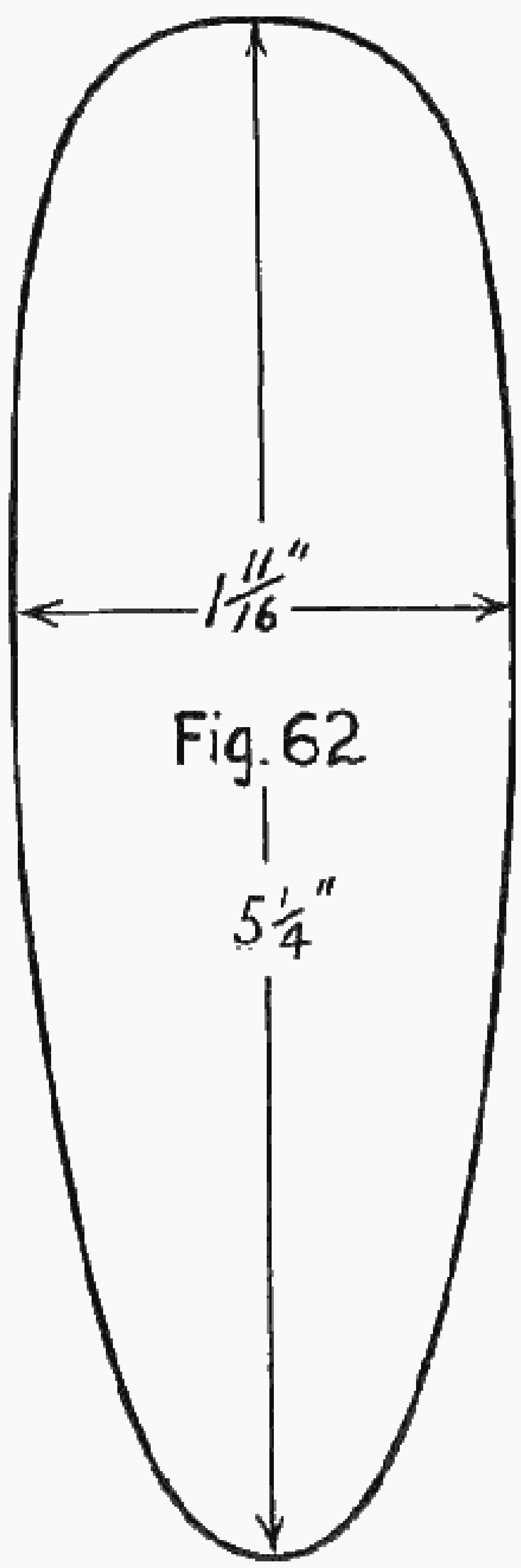


Fig. 62

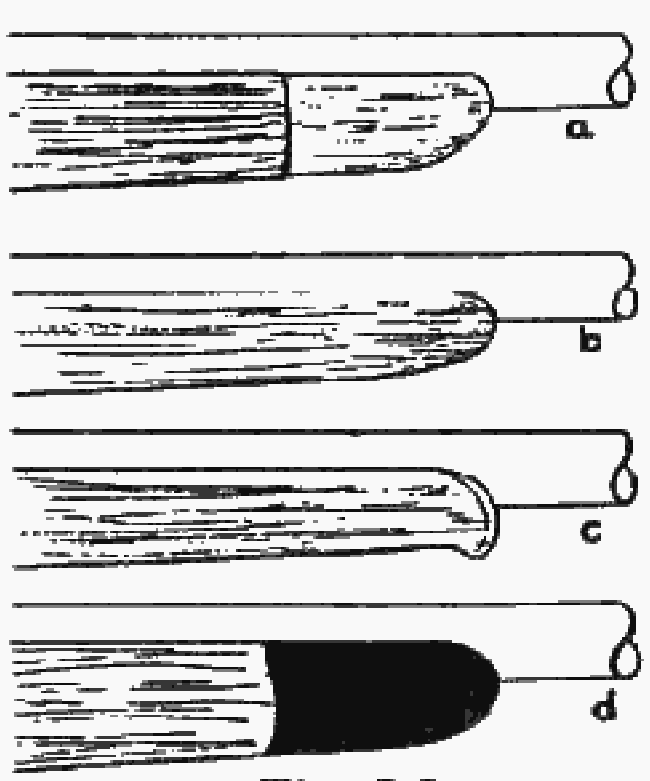


Fig. 66

of butt will add only an ounce or so. It is area of buttplate, not stock thickness at sides, that distributes the recoil over an area which makes it less noticeable. Recoil in a rifle of .30-06 or lesser caliber should not, in my opinion, bother any man physically capable of carrying a gun in the woods—particularly if the stock is properly designed and shaped. But if the shooter is sensitive to recoil and must be protected from it, he should use a rubber recoil pad, especially if he cannot get a buttplate of the proper size and dimensions.

115

ACTION SIDES: Beginning at a point slightly back of the tang, the stock of a bolt action rifle commences to swell to accommodate the action mortices. Many leading stockers apparently try how thin and flimsy they can make the stock at this point. True, a rifle is more easily carried if not too thick where the hand naturally grasps it, at the point of balance. But strength is even more important, and right here where the magazine and receiver are let in is the thinnest point on the stock. If the grain happens to take a slight side turn about this point, you can expect the stock to split or break almost certainly, sooner or later. I am convinced that the stock should be at least 1 7/8 inches through at the thickest point, which as I shape them, comes 1/2 inch ahead of rear end of magazine—my own are 2 inches at this point, and oval in cross section, not slab sided. This applies to all bolt actions in big game calibers. A stock by a famous maker which is now on hand for duplication measures but 1 5/8 inch at this point, and the sides are flat as the proverbial pancake. An additional 1/8 inch of wood at center would have made a more pleasing stock, with far greater strength, and the increase in weight would have been trifling.

There is another big advantage in having a stock extra full over the action; its lines can be carried forward in a straight taper, or very nearly straight, to tip of forend, and the forend thus formed will be a comfortable handful instead of the ridiculous sliver found on so many rifles.

FORENDS: I am a staunch believer in the comparatively full forend; yet I do not want it at the expense of handsome lines in the balance of the stock, nor is it necessary to gain it in this way. The stock above mentioned which is 2 inches thick over the magazine, tapers to 1 1/4 inch at forend tip, and thickness at point where hand grasps forend is 11/16 inch. This is just 1/16 under the 1 3/4

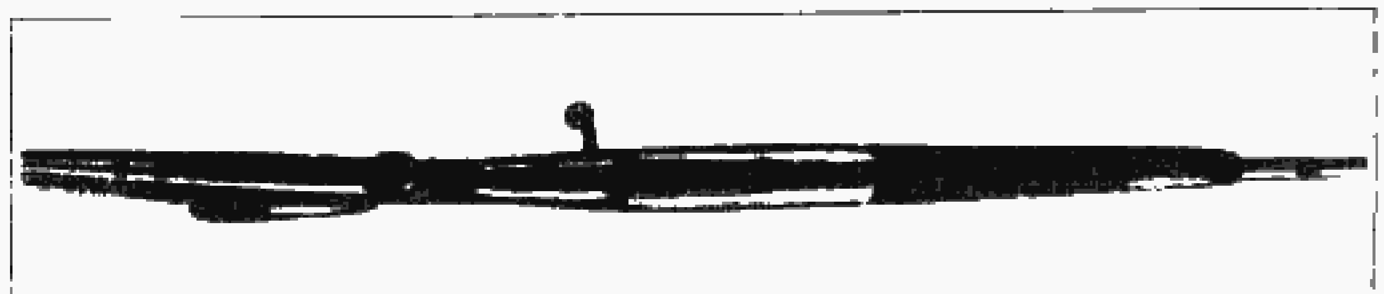


Fig. 63

inch endorsed by Captain Crossman and this extra sixteenth of an inch could be added without appreciably changing the contour of the stock, which, as will be noted from Figure 63, is not extreme at any point, unless it is in the length of the forend.

I like long forends. I like them longer by an inch or so than most stockers recommend, the usual length being nine to ten inches

116

from receiver, while this one is 11 1/2 inches. Such a forend adds a bit of weight out toward the muzzle where it is needed to balance the rifle having a light barrel with comparatively thick buttstock. It permits the shooter to grasp the forend well forward, for better control of the piece. And it permits of better lines in the entire stock. And finally, it eliminates to a large degree, the skinny appearance of a rifle with thin barrel; and when the forend is made comfortably hand filling, the extra or so length relieves the otherwise chunky effect.

But then, I can carry and use a rifle weighing 8 1/4 pounds. I weigh 160 pounds and am 5 feet 7 1/2 inches tall—which means I'm carrying a few pounds of fat that I shouldn't have, and wouldn't have, if able to spend more time afield using my guns, instead of in the shop working on them. Nevertheless I prefer this rifle to a lighter one—its weight is a real help after a puffing climb up a hill when a quick shot presents itself. It balances like a shotgun, is very quick handling, and actually feels lighter and swings faster for me than some others weighing nearly a pound less.

If asked to lay down a general rule for forearm length, I think

I would make it read this way: Let the distance from receiver to extreme tip of forend equal approximately half the barrel's length, but not in excess of a 12 1/2 inch forend—provided this dimension permits placing the front sling swivel from 15 to 18 inches ahead of trigger. If the swivel is attached to barrel ahead of forend, this point can of course be ignored. If it goes through the forend it will be necessary to have it of such a length as to permit the desired distance. The swivel will look better if placed 2 or 2 1/2 inches back from tip of forend.

I often wonder if some of the gunsmiths who insist on giving us very short forends are not thinking of the extra time required to inlet a barrel into the longer one, and of the extra care which must be exercised to bed the barrel with even pressure at all points. This does greatly increase the labor, and the difficulty of it, and the beginner may well be excused for making his forend the minimum length which he can handle to advantage.

In cross section the forend may be any shape that rests comfortably in the hand with a minimum tendency toward rocking or canting. Whelen prefers a forend nearly cylindrical in shape. Some of our best stockmakers shape them nearly flat on the sides, sharply rounded on the bottom. My own choice is a modified pear shape like Figure 64A—nearly flat on bottom, slight bulge on sides, and drawing in toward barrel at upper edges. This shape should blend gradually into lines of stock over action, and should also taper off forward to the tip.

Figure 65 shows a Springfield stock which is one of the best examples I ever saw of how a stock should *not* be designed. The comb is too low, and sets too far back. The grip has the "hook"

117

effect previously advocated, but too much of it, and it is too thick—six inches in circumference. Buttplate is too narrow, barely 1 1/2 inch wide, and the stock swells out into a regular Molly Fullbosom in the middle. The side panels have no place on a modern rifle;

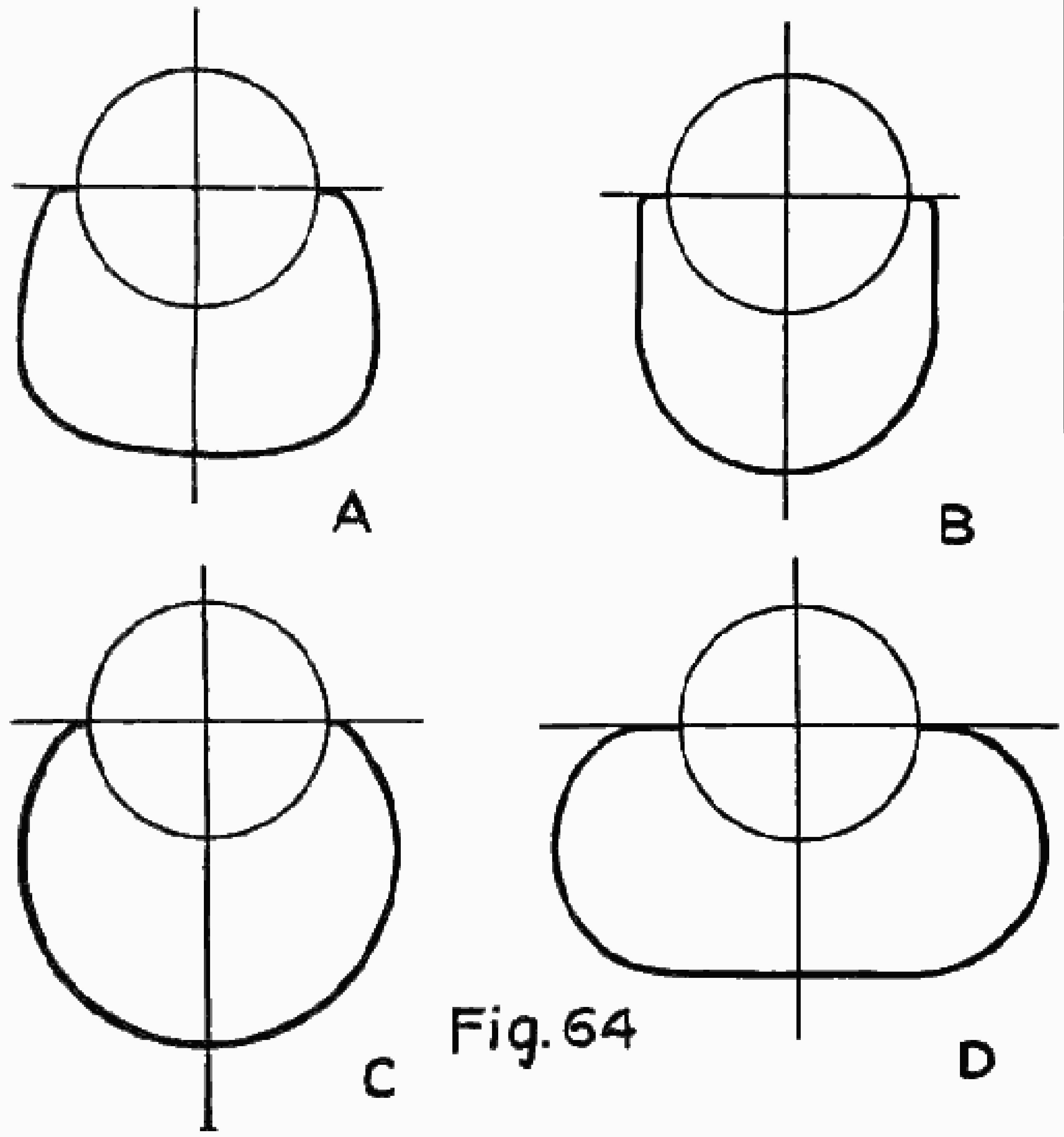
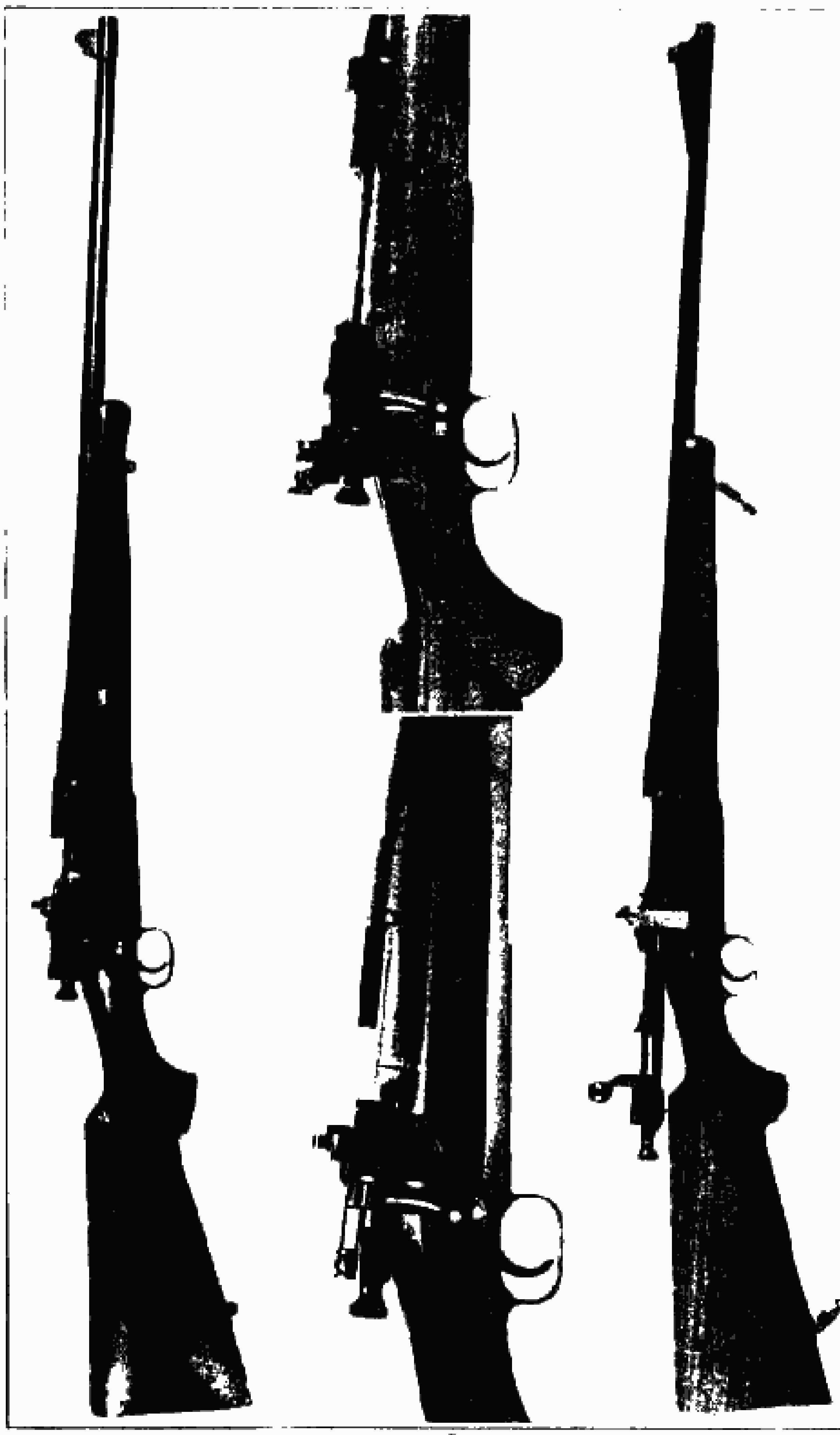


Fig. 64

they serve no useful purpose, spoil the lines, and make the gun very clumsy. This particular stock is 2 1/2 inches through the panels!—while the forend where left hand grips it is but 1 3/16 inch thick and is V-shaped on bottom edge. Note, also, that this enterprising gunsmith has saved himself a few hours work by making the upper edge of forend coincide with the receiver where the shells are ejected, instead of bedding the barrel to half its depth, as it should be, and the line dropping to edge of receiver at rear of barrel ring. A comparison of the two close-ups in Figure 65B and Figure 65C will make this clear.



Upper—Figure 65: a good example of how NOT to design and stock a rifle. Left Center—Figure 65B: a "close-up" of Figure 65. Right Center—Figure 65C: a properly designed and inletted forend and action. Lower—A well designed sporter with close grip, high comb and full forend.

119

The last point for consideration on our stock is the FOREND TIP. This may be shaped in a variety of ways, as shown in Figure 66, in which "a" illustrates the shape commonly used on Krag carbines and D. M. C. Springfield Sporters—practical enough, but scarcely ornamental; "b" is the English idea of a plain forend; "c" shows one of the several types of snobble that Crossman haughtily refers to as a "chair leg", and which is seen at its worst on the Savage bolt actions and Model 30 Remingtons as stocked by the factories; "d" is a tip of carabao (Asiatic buffalo) horn, ebony, bakelite, ivory, or other material, and is usually shaped like the plain tip shown at "b", although some makers shape it into a snobble if desired.

The properly designed snobble is not so unattractive—in fact, some of the older ones seem to me particularly graceful, but it must be admitted that those seen in recent years merit all the criticism they have received. The average shooter may wonder just why such designs were made, and wonder if the designers are proud of them. I think it likely they are not. Doubtless the reason for such abortions lies in the modern idea of cheap, rapid machine production. It is reasonable to suppose that much more hand shaping and finishing was done on stocks formerly than is done today. Such a graceful, well proportioned forend as that found on the old Winchester Single Shot rifles, for example, could not have been shaped by machinery. The snobble on this forend, by the way, is ideal, and can be copied on almost any stock without detracting from its appearance.

Factory stocks are shaped in what is known as a copying lathe, which operates on the same principle as the little machine locksmiths use to cut duplicate keys. The stock blank is mounted between centers, in line with a cast iron pattern stock, and both are revolved slowly. A cutter wheel running at high speed is brought against the stock blank, and this is guided by a guide wheel bearing against the iron pattern stock. About one minute or less is required to rough out a stock to shape. The cutter wheel, being about six inches in diameter and an inch in thickness, the knives set around its periphery taking a cut at least 1/4 inch wide, it is evident that minute details of stock formation cannot be followed with such a device; hence the stock must receive its final formation by hand. Having seen stocks being rough turned, an inspection of many factory models will convince anyone that quick finishing, with minimum hand labor, has played an important part in the shape selected by the makers, rather than any thought of beauty or utility. Which is one more reason for making, or having your stock made by hand.

TWO PIECE STOCKS: Thus far our attention has been principally centered on the more or less conventional sporter type of rifle stock. We must now consider others designed for a special purpose, or whose design is limited by the type of action used.

120

The one piece bolt action stock was chosen for discussion first, because it embodies practically all of the points found in other stocks, and some of its own besides. Two piece stocks, as required on various single shot rifles, should follow pretty much the same lines as the ideal one piece stock. There are certain features of the actions, however, that may necessitate modifications. For example, the long upper tang may force the stocker to cut the comb back further than it should be. A straight lower tang may preclude the possibility of using a pistol grip. On most single shot actions this lower tang may be bent to form a fairly good grip, but on some repeaters this is impossible, due to action parts extending back into the stock.

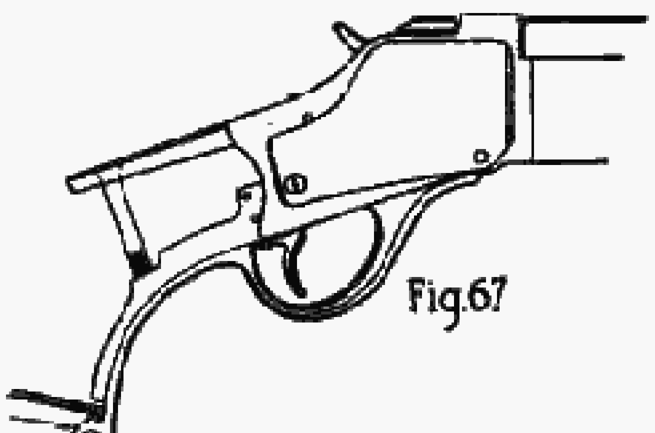


Fig.67

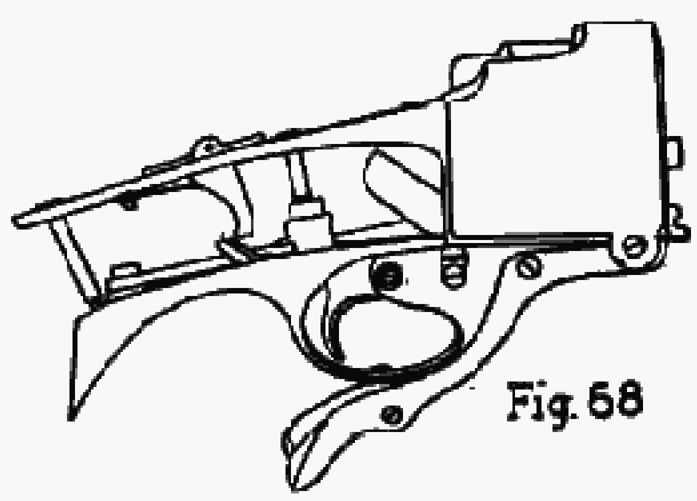


Fig.68

Figure 67 shows a Single Shot Winchester remodeled for a customer to his own ideas. Details of this job are described fully in Chapter 30. A comparison of this with the original factory design shows very clearly the increased beauty and improved handling qualities possible as a result of re-designing and hand workmanship.

The Farquahrson falling block S. S. action, made in England has its lower tang well shaped for a full pistol grip. (Figure 68) American gunsmiths have awakened to the possibilities of this splendid action, and a good many of them are being imported and fitted with American made barrels and stocks.

Figure 69 illustrates a .22 caliber target rifle on Martini action first designed by Mr. Russel Wiles. This is an unusual stock, and an unusual forend, but well adapted to the particular use for which the gun was designed. The sights, both front and rear, are removable, and the stock is made so straight and with comb so high as to give the same drop dimensions when using telescope, as when the scope is removed and iron sights attached. The beaver-tail forend is unusally heavy and stiff, with its forward section to which the sling is attached, forming an abutment against which the crotch of the hand rests in firing. This permits a very rigid hold with tight sling, and eliminates the discomfort of the front swivel digging into the back of the hand.

The beaver-tail forend is preferred by many target shooters, and while somewhat clumsy in appearance it permits of a very steady hold. In its usual form the cross section is about like

121

Figure 70, flat on the bottom and flaring very full on the sides. Quite often such a forend is made wider at the forward end than at the receiver; sometimes the widest section is in the center, at the normal hand grip. Both of these patterns I believe to be wrong —I think the forend, regardless of its type, should taper slightly toward its tip. This for the reason that the left hand will invariably exert some backward pull on the forend; and the firmer hold is possible when the hand has an increased thickness of wood behind it to pull against. See also Figure 64D.

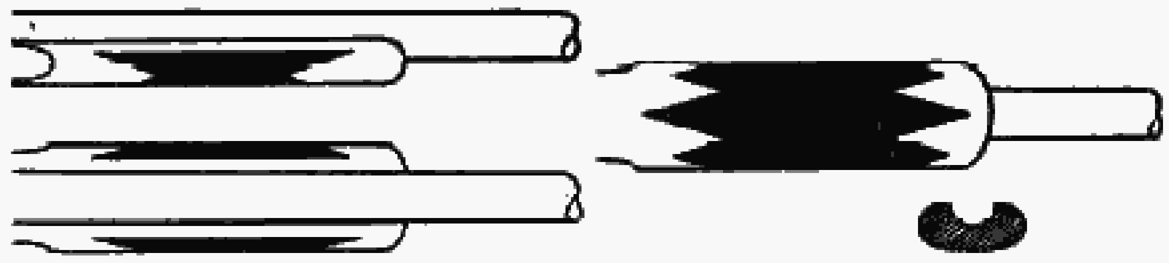


Fig. 70

Most of the light .22 caliber repeaters are very poorly stocked; and while their actions place a good many limitations in the way of the stock designer, it is nevertheless possible to greatly improve their handling qualities. A longer stock with larger buttplate; less drop at heel; a higher and thicker comb; a pistol grip if the action permits; and a thicker, better shaped, and possibly longer forend, will often make such an arm handle like a real gun instead of like a toy.

The 99 model Savage is another that may be re-stocked to good advantage. Figure 71 shows a special job on one of these rifles, which resulted in at least 100% improvement in its handling. A higher comb is the thing most needed on this rifle as turned out by the factory, with a thicker grip, larger buttplate, and larger forend next in order of importance.

SHOTGUN STOCKS: Thus far I have said little about shotgun stocks. Fitting in the lock action of a double gun, either box or side locks, is a job beyond the reach of any amateur workman until he has had considerable experience and spoiled a few stocks. Yet some consideration of the essential points of shotgun fit will be of value to the man having a gun stocked to order, or who through courage and perseverance will eventually stock his own gun.

The author lays no claims to being an expert with the shotgun. The rifle is "my dish". I don't even like to stock shotguns, as the work, in my hands progresses far more slowly than the work on a rifle stock, and becomes irksome. I have my own ideas on the subject of shotgun stock design and fit, which I will give for whatever they may be worth; and the reader is referred to the more extensive and comprehensive views of Charles Askins, Paul B. Jenkins, E. C. Crossman, and others, as expressed in their various books and frequent magazine articles.

123

The shotgun stock should invariably be longer and straighter than the rifle stock; and the gun intended for use at the traps both longer and straighter than for field use.

Shotgun shooters are as a rule, somewhat superstitious in their beliefs as to the way their guns perform. A straight stock with a high comb will not make the gun itself shoot one bit higher; but it will make the owner *shoot it higher,* by forcing his eye higher above the rib, which amounts to the same thing as raising a rear sight. Another thing the straighter stock will do, is to absorb recoil better, and eliminate much of the "jump" of the barrel when fired, which jump, while it does not occur until the charge is out of the barrel, usually causes the shooter to believe it is responsible for wild shots.

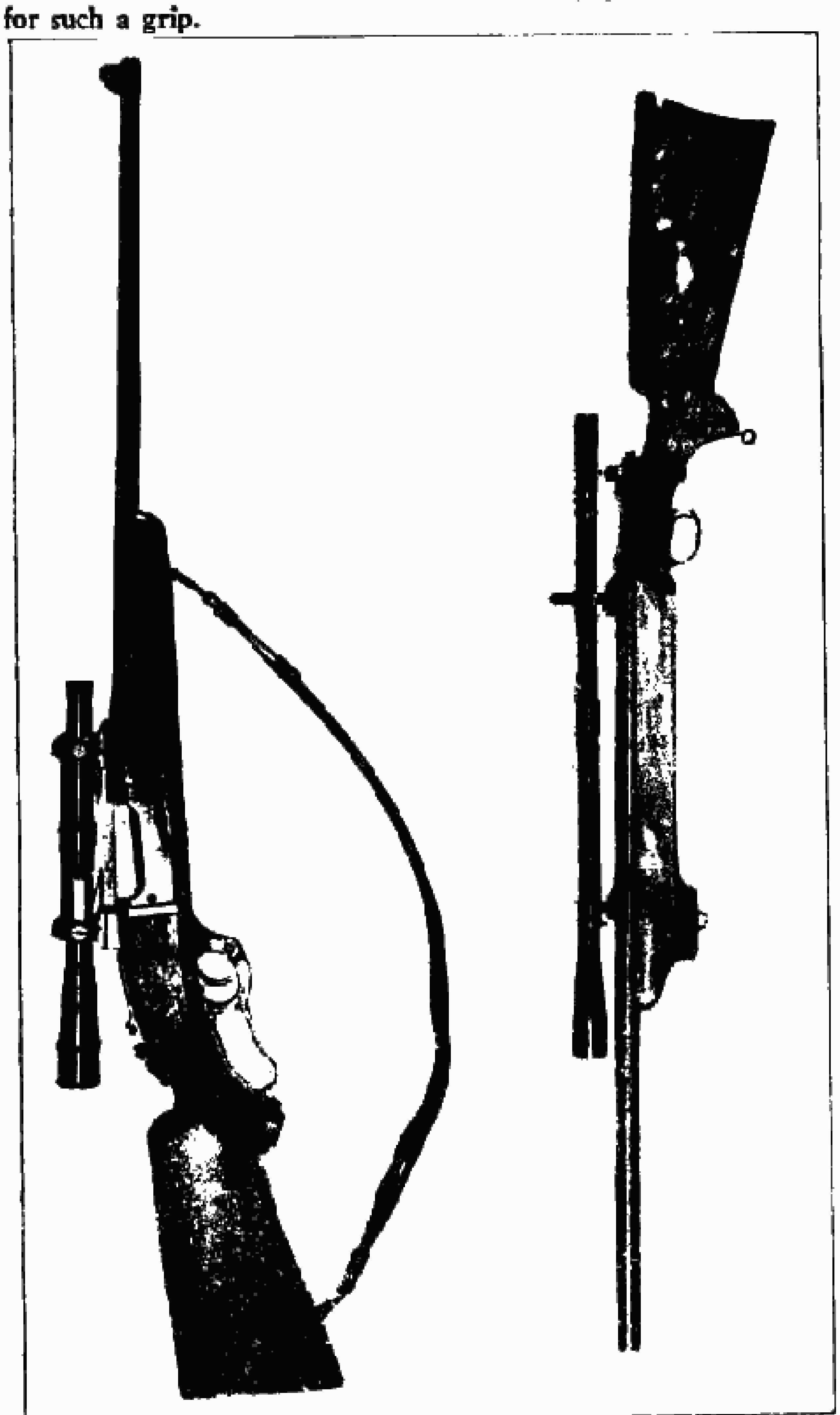
Due to its triggers placed an inch or more apart, the double gun must always be stocked on a compromise. I thoroughly concur in Charles Askins' belief that the left barrel should be the more open bored of the two, so that the rear trigger will be fired first. Since 90 per cent. of one's shooting will be singles, the stock which is dimensioned from the rear trigger as a starting point can be given a more comfortable shape for 90 per cent. of one's shooting. When the front trigger is used for the first shot—which is to say, for most of the shots taken, the sloping rear portion of the guard often punishes the second finger severely, and a habit of flinching develops.

Despite the usual practice of stockers, there is no good reason for making the grip of a shotgun so thin and fragile that it is easily broken. The shotgun grip should be comfortably handfilling, the same as a rifle grip, and it should be a full oval in cross section, not diamond shaped, as many foreign stockers make it.

The comb is set much further back on most shotguns than is necessary—no reason that I know of why it should not be of some use in supporting the thumb, the same as on a rifle stock. True, the shotgun is handled more quickly, as a rule, than is the rifle;—all the more reason why it should be fitted so perfectly that the same hold would become automatic.

Shooters argue a lot over the value of a pistol grip on a shotgun. What most makers call a pistol grip is nothing more than a pimple about the center of the stock's bottom edge. As to provide a steadier hold, it certainly does not. But if we design a full pistol grip similar to our ideal rifle grip, and place it in the proper relation to one of the triggers, it will be largely useless when we are using the other trigger. For this reason it is generally conceded that the straight grip is preferable on a double gun: while giving more racy lines to the stock, it also permits a quick shift from one trigger to the other, without altering the feel of the grip.

When using a gun fitted with single trigger, or a single barrel trap gun, pump gun, or automatic, the pistol grip can, if desired, be worked out so as to be of real use—and my personal preference is for such a grip.



Lower: Fig. 69. A .22 target rifle designed solely for shooting in the prone position. Upper: Fig. 71. A model '99 Savage restocked and fitted with hunting scope.

124

The shotgun stock may well be provided with a cheek piece—it is quite as useful as it is on a rifle; and the same applies to castoff. With a shotgun the pointing is almost entirely instinctive, many shooters claiming they never see the front sight when shooting at game; and a reasonable amount of castoff is almost invariably a big help. In fact, more castoff is usually permissible than on a rifle. A light 16 bore of mine with a 14 inch stock has 1/2 inch castoff, and is the best pointer I ever had in my hands.

Many shotgun stocks are made with "knife-edge" combs—always a serious mistake. The comb need not be so thick as to make the stock appear clumsy, but a comfortable thickness not only reduces the punishment from recoil, but encourages speedier, more accurate aim. Often the shotgun stock will be made with the same drop or nearly the same drop, at heel and comb—this is a feature pre-

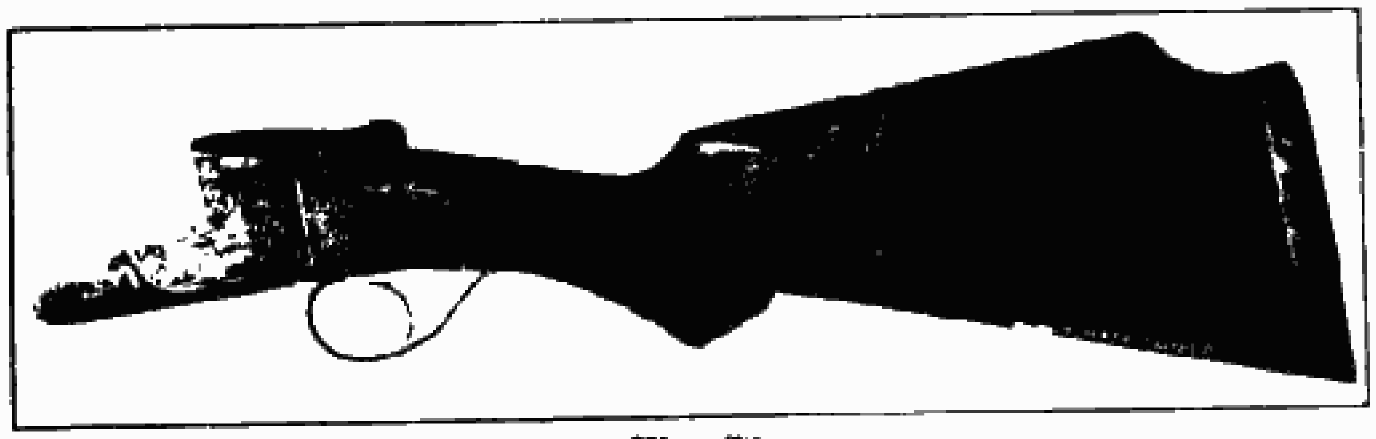


Fig. 72

ferred by a number of shooters after years of experimenting with stocks. They claim that such lines speed up the aim and prevent over or undershooting, since the aiming eye is held at the same relative height above the rib, no matter where the stock may be cheeked.

The man with a long neck or very sloping shoulders, however, finds that such a stock brings the butt too high on his shoulder so the solution for him is a Monte Carlo comb, as shown in Figure 72. This gives all the advantage of a high, level comb, yet permits the necessary heel drop to bring the butt snugly into the hollow of the shoulder.

We hear so much about the high comb and its desirability on both rifle and shotgun, that the man designing his first stock may well heed a word of warning on this point. Theoretically the perfect comb is one which when the cheek is pressed quite hard against it, with the cheekbone resting snugly on the top edge, the right eye will

125

C—Rigby "One Arm" gun.

D—A "Try Gun" designed to permit adjustments giving any dimensions of length, drop, pitch, etc.

B—Holland and Holland "Cross Eyed" gun, shot from right shoulder using the left eye.

A—Ithaca "Left Eyed" gun to be fired from right shoulder.

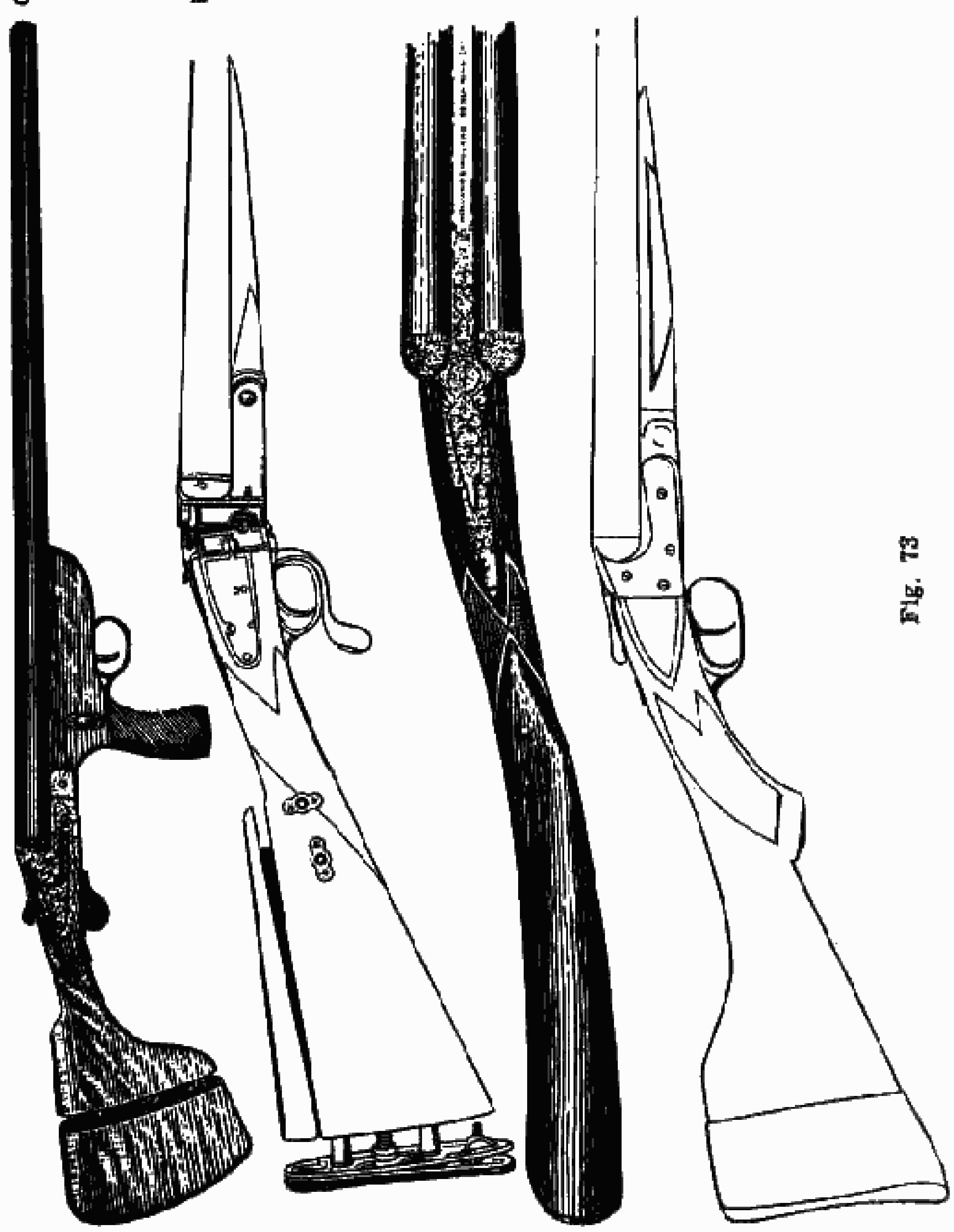


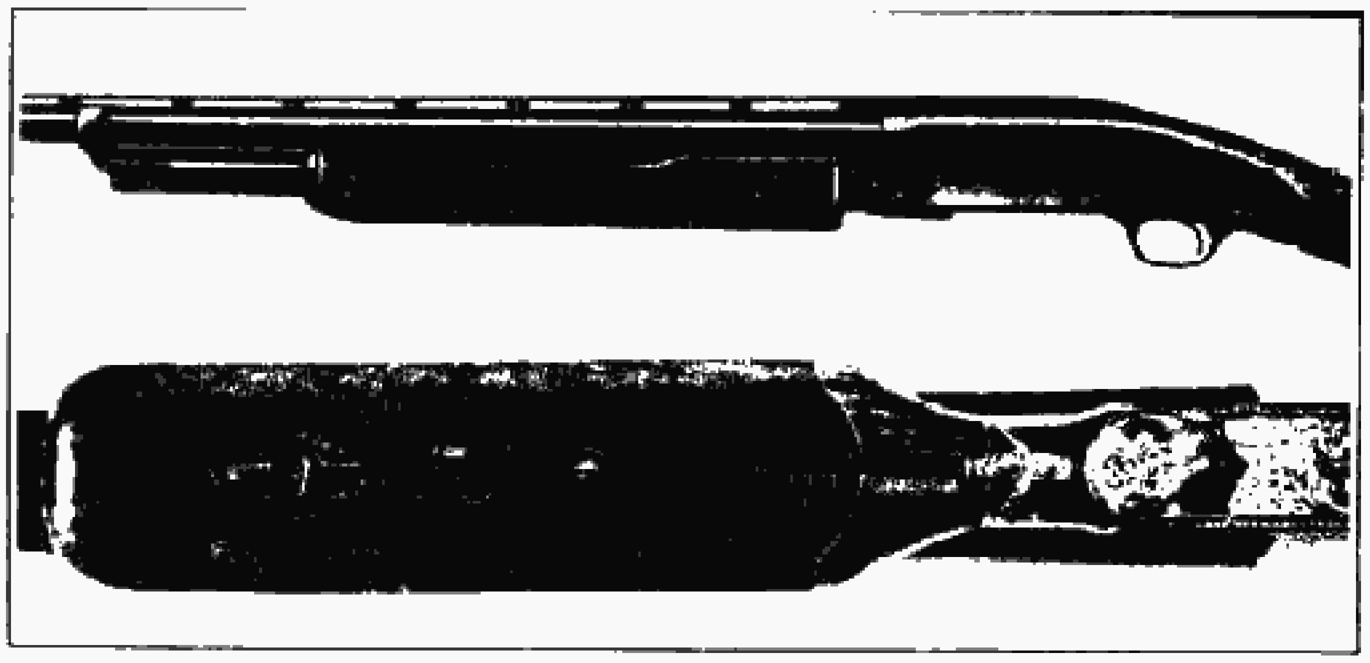
Fig. 73

be looking though the line of sights. I once stocked a rifle in this manner and took it to the range for testing. After half a dozen shots I was quite ready to sacrifice some of this ultra perfect stock fit for a bit of comfort—the punishment my cheek bone took from that comb was equivalent to a first class slugging, and the spot remained sore and bruised for a week afterward. Such a fit may well

126

be sought on the very light caliber rifles—but not on a big game rifle or a shotgun.

FREAK STOCKS. Numerous "freak" stocks have been built for shooters having some physical deformity or impairment, and serve their intended purpose admirably. Figure 73 shows a few such guns. "A" is an Ithaca stock designed for a right handed shooter who, through impairment of vision, must shoot with the left eye; the comb is cut away to permit of laying the face well across the stock. "B" is the Holland and Holland "Cross-Eyed" gun to fill the same need. A job of this sort is necessarily more expensive than the cut-away stock of the Ithaca, since the stock wood must be selected with a natural bend to give it sufficient strength, and the



Upper: Fig. 75—Remington trap forend.
Lower: Fig. 74—Ithaca beavertail forend.

rear portion of the action is built with a bend to the right. "C" shows the Rigby One-Arm Gun, developed principally as a result of the World War. As one hand has to do all the work, it was necessary to give a grip at the best point of balance. This necessitated carrying the trigger mechanism well forward of the breech, with consequent shortening of the stock because of the longer arm reach. A single trigger is also essential, and is connected to the action by means of steel rods, while a thumb operated safety is placed on the right or left side of grip, according to whether the right or left hand remains. Since but one hand is available to hold the gun against recoil, shock springs have been inserted in the butt stock, and being held in line with light metal pistons the recoil is efficiently absorbed with minimum disturbance of aim.

Shotgun shooters are gradually turning from the small forend to the larger, handfilling type on all classes of guns. The beavertail is preferred on single trap guns, and is often seen on doubles as well. Many field shooters also prefer such a forend on doubles,

127

the favorite type being shown in Figure 74. This forend not only protects the hand from the heat of the barrels, but also gives better control of the arm, and at the same time protects the finish of the barrels from wear where the hand grasps them in shooting. The large round forend which is standard on pump guns is very good, but is too short for many shooters, necessitating an uncomfortably long reach with the left arm. To overcome this objection a type known as the "trap-gun" forend has been designed, and can be had on Remington, and perhaps other pump guns at a nominal additional charge. This forend is illustrated in Figure 75.

As a closing injunction to the beginner in the field of gunsmithing, —and perhaps to others who are not beginners, I wish to quote excerpts from an article discovered in a printers' book of type specimens; while referring originally to typography, the advice it gives may so aptly apply to the field of gun design also, that I have thought it worth reproducing, deleting only the references to the original subject:

"The best kind of originality is that which comes after a sound apprenticeship; that which shall prove to be the blending of a firm conception of all useful precedent and the progressive tendencies of an able mind. For, let a man be as able and original as he may, he cannot afford to discard knowledge of what has gone before or what is now going on in his own trade or profession. * * * *

"All those concerned in what are accepted as the fine arts, the learned sciences, and professions, surround themselves with the history, the literature, and concrete examples of the work with which they may be particularly engaged. * * * *

"Art does not flourish in hidden places, nor under restraint, nor in ignorance of what talent and genius have accomplished and are now accomplishing throughout the world. For to follow precedent wisely does not mean to imitate slavishly one great exemplar, but to study all the masters faithfully, letting their great achievements sink slowly into the mind in order that we may patiently derive from the richness of our acquired knowledge and organized system an attitude of our own.

"The sprightly minded young man, who with his first business breath projects the new and startling, inevitably becomes tiresome, and is driven to an early disappearance; while the slower, more solidly endowed student will at least spend as much of his time in avoiding mistakes as in evolving brilliant schemes wherewith to dazzle his contemporaries."

In this chapter I have avoided, as far as possible, laying down exact butt stock dimensions for either rifle or shot gun stocks. These will vary according to the build and characteristics of the shooter, and must be determined by trying out guns until the right fit is found. The following tables give dimensions which will handle well, and be comfortable to a large percentage of shooters:

128

AVERAGE BUTT STOCK DIMENSIONS—RIFLE

Length, center of trigger to center of butt plate	13	1/2	in.
Drop at comb	1	11/16	"
Drop at heel	2	7/8	"
Length from heel to point of comb	9	3/4	"
Length from tang to point of comb (on bolt actions)	2	1/2	"
Length from center of trigger to point of comb	4	5/8	"
Length from center of trigger to nearest point of pistol grip cap	3	1/2	"
Drop of front edge of pistol grip cap below center of trigger	1	5/8	"
Length of butt plate	5	1/8	"
Width of butt plate at thickest part	1	11/16	"
Pitch of butt	3	1/2	"
Circumference of grip	4	7/8	"
Castoff at butt — Heel		3/16	"
Castoff at butt — Toe		5/16	"

NOTE: These are *average* dimensions—not any one shooter's ideal. A rifle so stocked will fit almost any man fairly well, and most of them perfectly, for either offhand or prone shooting. In the ideal stock both the grip thickness and width of buttplate would be increased slightly—the former to 5 inches, and the latter to 1 3/4 inches. For offhand shooting entirely the heel drop might be increased to 3 or 3 1/2 inches, and for prone shooting entirely might be decreased to 2 1/4 or 2 1/2 inches.

AVERAGE BUTT STOCK DIMENSIONS—SHOTGUN

Length, center of front trigger to center of butt plate	14		in.
Drop at comb	1	1/2	"
Drop at heel	2	1/2	"
Length from heel to point of comb	9	1/2	"
Length from center of forward trigger to point of comb	5		"
Length from rear trigger to nearest point of grip cap (double guns)	3	3/8	"
Length from trigger (single trigger, pump, or automatic) to nearest point of grip cap	3	1/2	"
Drop to front edge of grip cap below center of trigger	1	1/2	"
Length of butt plate or recoil pad	5	1/4	"
Width of butt at thickest part	1	11/16	"
Pitch of butt	0 to 2	1/2	"
Circumference of grip	4 3/4 to 5		"
Castoff at butt		7/16	"

These also are average dimensions, but will come very close to fitting the greatest majority for all round shooting. Stock thickness and grip circumference should be reduced somewhat on light, small bore guns, and increased a trifle on heavy trap and wildfowl guns.

129

CHAPTER 10

STOCKMAKING: LAYING OUT AND INLETTING

HAVING selected and procured a piece of wood suitable for a stock, and decided on its form, dimensions and finish, we are ready to go into the subject of actually stocking a rifle or shotgun.

By reason of the many types of stock necessitated by various actions, it is plainly impossible to give in one, or even several chapters, detailed instructions for stocking every gun in existence. Our efforts therefore, must be confined to general instructions applying to the principal types commonly used, namely, the one-piece bolt action stock, the two-piece stock in which butt-stock and forend are separated by the action, and the shotgun stock, which is also in two pieces. Examples of the first named are found in the Springfield, the Mausers, the 54 Winchester, 52, 56 and 57 Winchester, Model 30 Remington, the Newton, the Ross, Model '17 Enfield, Models 19 and 23 Savage, the Russian, the Krag, and in fact most military arms. The ancient and honorable .45-70 Springfield comes in this class although not a bolt action, as do many old arms, including all the muzzle loaders, both rifle and shotgun.

In the second class we find all of the lever action rifles—the Winchesters, Marlins, Savages, Remingtons—the trombone or pump actions in all standard makes, and the Winchester, Remington and Browning auto-loaders.

Shotguns, whether single or double barreled, or of the pump, lever, or automatic persuasion, invariably have the stock and forend separate, with the single exception of the muzzle loaders, which have one-piece stocks.

ONE PIECE STOCKS: Since the greatest majority of amateurs are interested in making a sporting stock for a military bolt action rifle, we will start with this type; and we will illustrate on the Springfield, since that is, and with good reason, the most popular of all bolt actions.

130

Figure 76 shows the complete barrel, receiver and action assembly of a Springfield without the stock. Study it. Set it up on the bench in front of you and familiarize yourself with every curve in the receiver formation. Note carefully the concave and convex surfaces—remembering that wherever a portion of the metal has been hollowed, the wood of the stock at that point will be rounded out to fill it. In inletting the stock you are simply carving out a *reverse*

Fig. 76

impression of the metal parts of the gun. The barrel and receiver may be regarded as the positive, while the stock is the negative of the complete arm.

Now study, *very carefully*, Figures 77 and 78. In Figure 77, A shows the action mortices on a Springfield service stock, cut out on a routing machine in a few minutes. B shows a stock blank inletted for the same action by hand, requiring several hours careful labor. Note particularly the difference in the two from end of tang to rear of magazine mortice. In the machine-made stock contours are limited to the scope of a revolving cutter, while in the hand made job, there are no limitations. Only the wood actually displaced by the steel is removed, thereby greatly increasing the strength, and also helping to absorb vibrations when the gun is fired. Note particularly the extra wood left at "a" in B, Figure 77. This fills up the hollows cut underneath the tang on either side. Note also the cuts "b" and "c" in B, Figure 77. These fit into the portion under rear of receiver which holds the trigger mechanism. Note the difference in method of bedding the rear of tang in the two stocks, the hard-fitted job supporting the metal at all points, while only two or three essential points are supported by wood in the service stock.

131

At the point "d" in B, Figure 77, note how the wood extends further forward to bear hard against the recoil lug on under side of the receiver. Thus, in the hand inletted stock, the receiver has firm bearing in the wood at points "a," "b," "c," "d," and at rear of tang "e;" while in the machine inletted stock the principal bear-

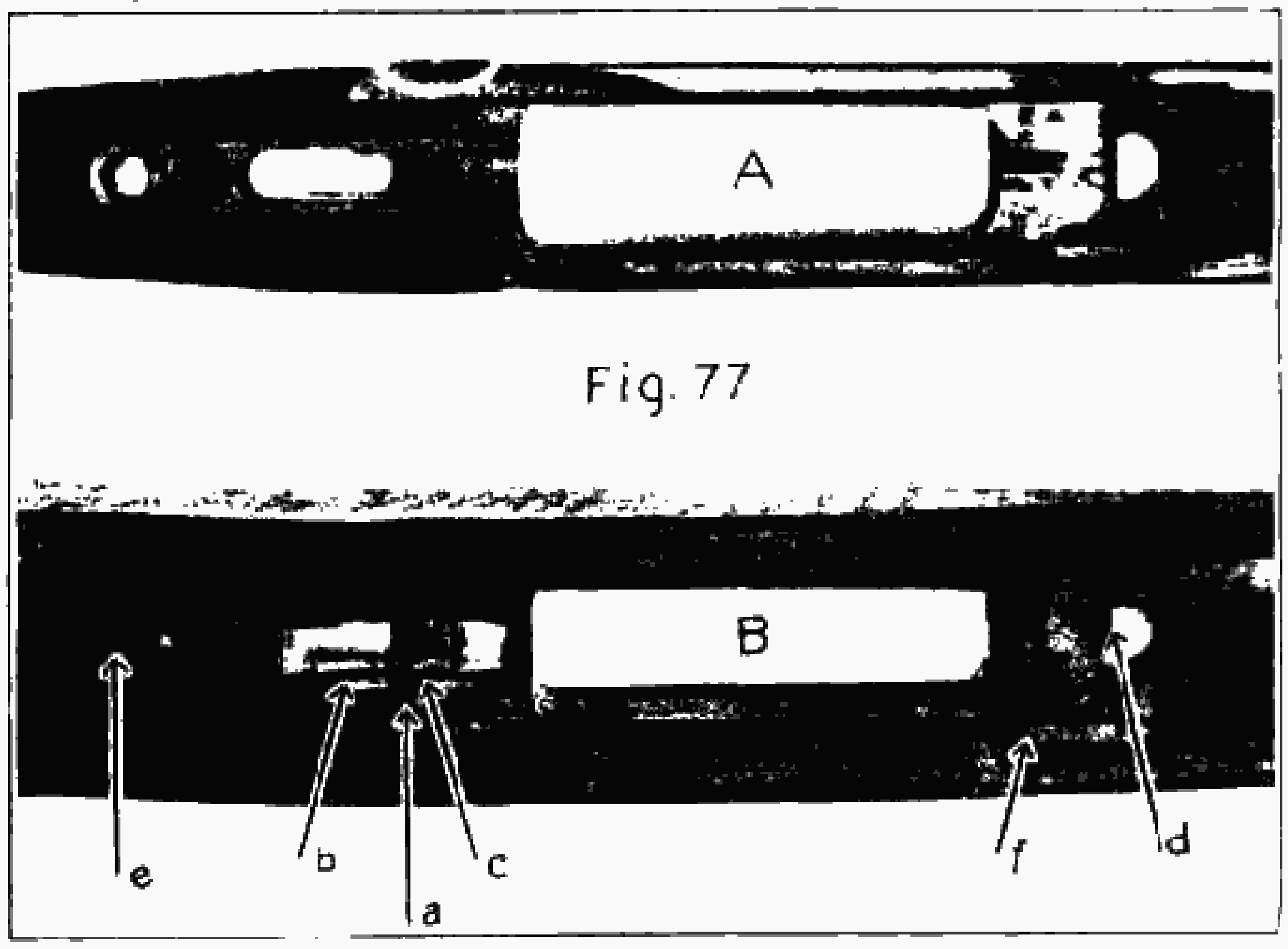


Fig. 77

ing is at the recoil lug and rear of tang—two points of support against recoil compared with seven.

Now study Figure 78. This shows a sectional view of the two stocks, one inletted by hand, the other on a routing machine. The difference in the amount of wood left in the stock at its weakest points shows very clearly, indicating the extra margin of strength to be expected of a hand made stock. Now set your barrel and receiver in the machine made stock. Probably you will find that you can move it backward and forward from 1/32 to 1/16 inch. This tolerance is necessary by reason of the inaccuracy of machine fitting, and the slight variations which occur both in stocks and actions; for in quantity production, any action must fit into any stock.

Set the magazine into position and tighten up the guard screws. Now note that there is clearance back of the rear end of tang of about 1/16 inch—this to make sure that there is nothing to prevent the recoil shoulder on receiver from setting back tight against the wood. In our hand fitted stock—assuming that the fitting is properly done, this gap behind the tang is not necessary. For it will be readily

132

understood that the thrust of the blunt, round end of the tang against the wood has little if any tendency to split the grip. The reason a grip splits under recoil is usually due to incorrect fitting of the tapered portion of the tang; unless there is reasonable clearance underneath, the tang acts as a wedge, and being unsupported at its rear, it comes right on back. At its upper edge the tang may be fitted quite close to the wood—the clearance should be down inside where it doesn't show. With the wedging effect thus eliminated, the tang supported against rear thrust at the end, and also at the points "a," "b," and "c," in Figure 77, there can be no movement of the action in the stock to start a split. It's the same principle as driving a nail in a board. Try to press the nail in with the hammer, using all your weight and strength, and you will make no headway; but when you swing the hammer on it, it is quickly driven in with moderately light blows.

The amount of wood routed out on the inside of a machine made stock necessitates the use of stock screws to give added strength. In a hand made stock of normal dimensions these are never needed, except for magnum cartridges having very heavy recoil—assuming of course that the stock is of sound, hard wood.

Look again at the point "d" in A, Figure 77, against which the recoil lug bears. The recess for this lug is a trifle wider than the front end of the magazine mortice, consequently, at its extreme outer edges this lug is well supported by solid wood extending clear back along the sides. Certainly the wood is not going to give way at these points. But in the center of this shoulder, there is solid wood for only about an inch, reaching to the magazine mortice.

Evidently, then, heavy pressure against the recoil lug recess in the center will break out this wood. So, if we fit the lug into perfect contact clear across its surface, then relieve the center by taking off a light cut, the back thrust is taken up by the solid wood at the sides, and there is no pressure in the center to cause a break. Thus we can well eliminate the unsightly stock screw at this point, and it is not even necessary to insert a piece of metal on the inside. More often than not the cutting required to fit such a recoil plate actually weakens the stock, while giving the owner false security in the belief that it has strengthened it. Recoil plates and stock screws cannot take the place of perfect hand fitting, with the removal of as little wood as possible.

Note the point "f," at the rear end of the recess which accommodates the projection on right side of receiver. Here is a point often overlooked which may easily develop into a "splitter." It may be fitted quite close on the side, but where it curves in at the rear, there must be a little clearance. Not much is needed—the thickness of a sheet of paper is sufficient, but pressure here must be relieved.

Now take your service stock and turn it over, studying the magazine and guard mortices from the under side. The magazine, being

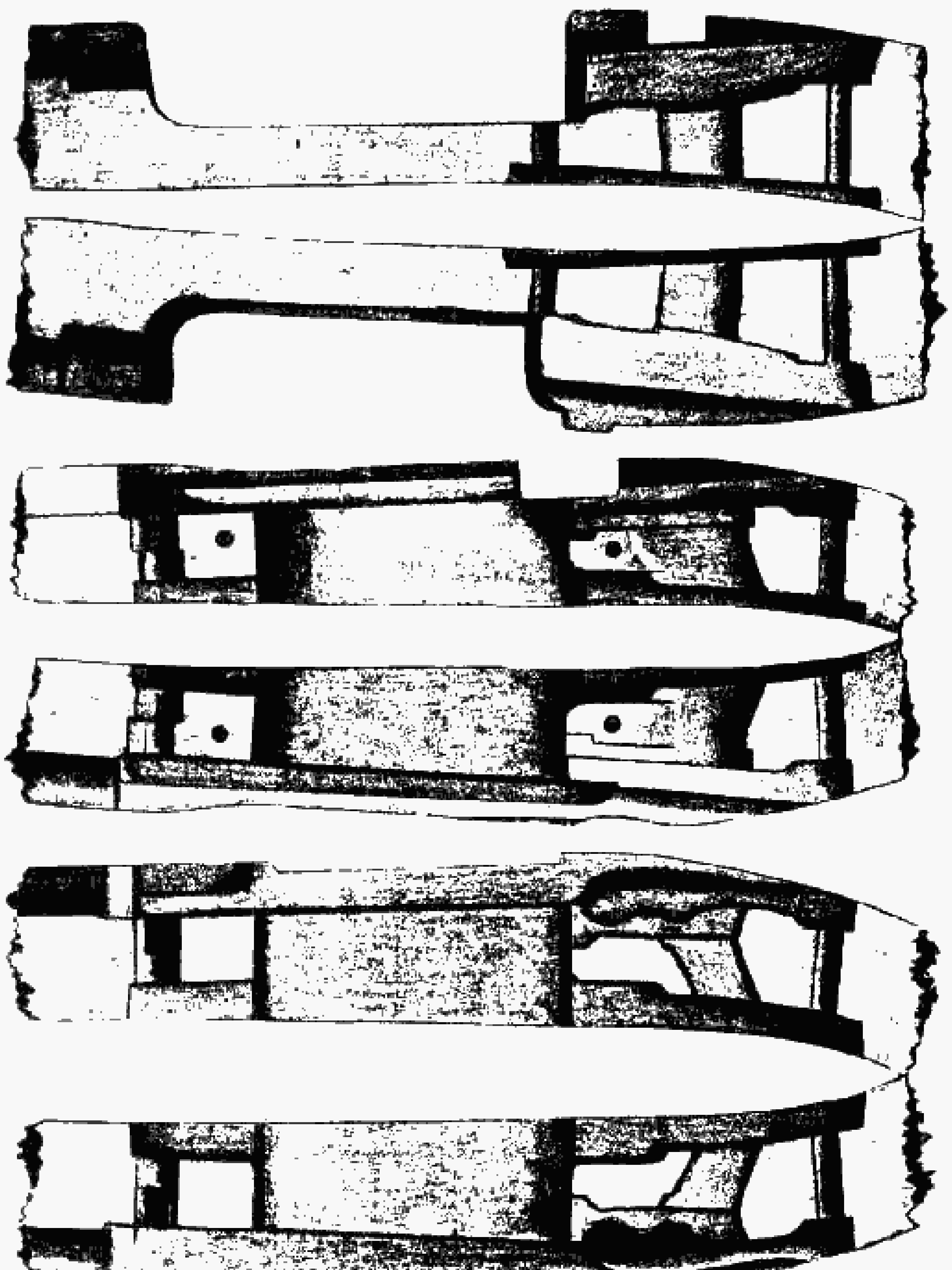


Fig. 78

"Inside facts" on action mortices in stocks. Upper is a Krag stock split lengthwise to show shape of cuts. Center shows inside of machine inletted Springfield service stock. Lower shows inside of a hand inletted stock for Springfield action. Note the several points where extra wood is left in hand made stock, resulting in a much stronger stock, with action supported at practically every point absorbing much of the vibration of firing and tending to improve accuracy of the gun. Lower is hand inletted stock.

134

wider at its rear end has no tendency to split the stock under recoil, so the fitting may be quite close at the sides. But, the rounded corners of the rear of magazine, and the inner corners where the guard joins it, ("a" and "b," Figure 79) can develop decided splitting tendencies unless the wood is relieved at these points.

We have dwelt at some length on this analysis of the Springfield stock mortices, to show the reader how to study the requirements of an action, the danger points, and where stock relief must occur. A similar analysis of other stocks will not be necessary; study your action carefully and locate every point to be supported and every point to be relieved. They will be self evident once the principles are understood.

LAYING OUT: Now we are ready to start actual work. To provide an accurate outline of the magazine and guard you will require a templet, which is made as follows: Take the original stock and rub a mixture of lampblack and oil around the edges of the mortice; then press a sheet of stiff white paper firmly over it and rub the paper down smoothly with the fingers. Remove it and you will have a fairly clear outline of the cuts. Carefully trim this out and paste the paper templet on a strip of brass or tin, then file it to shape. Locate the center of the guard screw holes at each and drill a very small hole at these points—just large enough so that a small brad can be inserted. Now try this templet in the original stock, note the inaccuracies, and carefully file where necessary until it will enter the mortice easily. Then go round the edges and carefully file templet about 1/64 inch smaller all round.

Clamp the stock blank upside down in the vise, and with the marking gauge mark a center line along its entire lower edge, then carry this line round both ends and continue along the entire top edge. The top edge should of course have been previously planed to a straight line, and if the blank happens to be warped, it should be straightened in planer or jointer, otherwise the center line will not be straight. If you expect to provide the stock with a cheek piece, the line may be run off center to the right, to allow the maximum thickness of wood for cheek piece. It should not, however, be less than 1 inch from right side.

Now, with the stock held as in Figure 80, place your magazine templet in position, so that the center line of stock shows through the small hole in each end of templet. Fasten in place with a brad driven through each hole, and mark carefully round templet with a sharp awl or scriber. Before removing templet, retrace the scribed line with a sharp pointed pencil to show it more clearly. The rear end of templet should be located in relation to the pistol grip so that grip is about 1/4 inch forward of where you want it in the finished stock—this to give you a little working leeway.

Remove the templet, and hang it up until the next job. With a try square mark a line across the stock at each of the brad holes.

135

Continue the forward line up both sides of the stock, squaring from top edge. Lay the blank along side the original stock, and with try square and sharp pencil mark cross lines where each shoulder appears in the original. Now set the blank straight up in the vise, and with a 7/8 inch augur bit bore a string of holes through the portion where the magazine is to be let in. If this is your first job, better use a 3/4 inch bit to play safe—it just means a bit more chisel work, but it is safer, in case the bit should run a trifle sideways. Bore until only the point of bit comes through the wood,

Fig. 80

and then finish from the other side. If the point is missing the center line you can center it from the other side, and possibly avoid trouble.

INLETTING: At the forward end, where the brad holding the templet was driven in, drill clear through with a 1/2 inch augur bit, centering the spur in the brad hole. Now take a steel straight edge or ruler, and a very sharp, thin bladed knife, and cut down deeply along all the straight lines, turning the point of knife a trifle toward the center, and using care not to enlarge your outline. Use a 1/8 inch Number 9 or 10 Addis chisel for cutting the round corners of the magazine mortice, and a 3/8 inch Number 8, 9, or 10 for cutting around the extreme ends. (See Chapter 3). Make these cuts of the outline about 1/8 inch deep then remove the wood by cross-cutting with a very shallow gouge, such as a 7/16 inch

136

Number 5 or 6 Addis Chisel. Figure 81 shows the method of cross-cutting from center toward each side, to avoid any splitting or tearing, no matter how curly or cross-grained the wood. All inside cuts are much more easily made across the grain, but the tools must be kept very sharp, so as to really cut, and not merely "dig," "gouge," or "tear." This cross cutting leaves a ridge in the center which is removed with a 1/2 inch flat chisel at first, and later, as the cuts are deepened, the bottoming tools described in Chapter 4 will come into use. They are especially necessary in the end next the grip, where the chisels cannot be held at the proper angle.

Having removed the wood to a depth of 1/8 inch or so inside the outline, the next step is to let in the magazine. Use a wide, very slightly curved chisel for this. A 7/8 inch or 1 inch Number 3 or

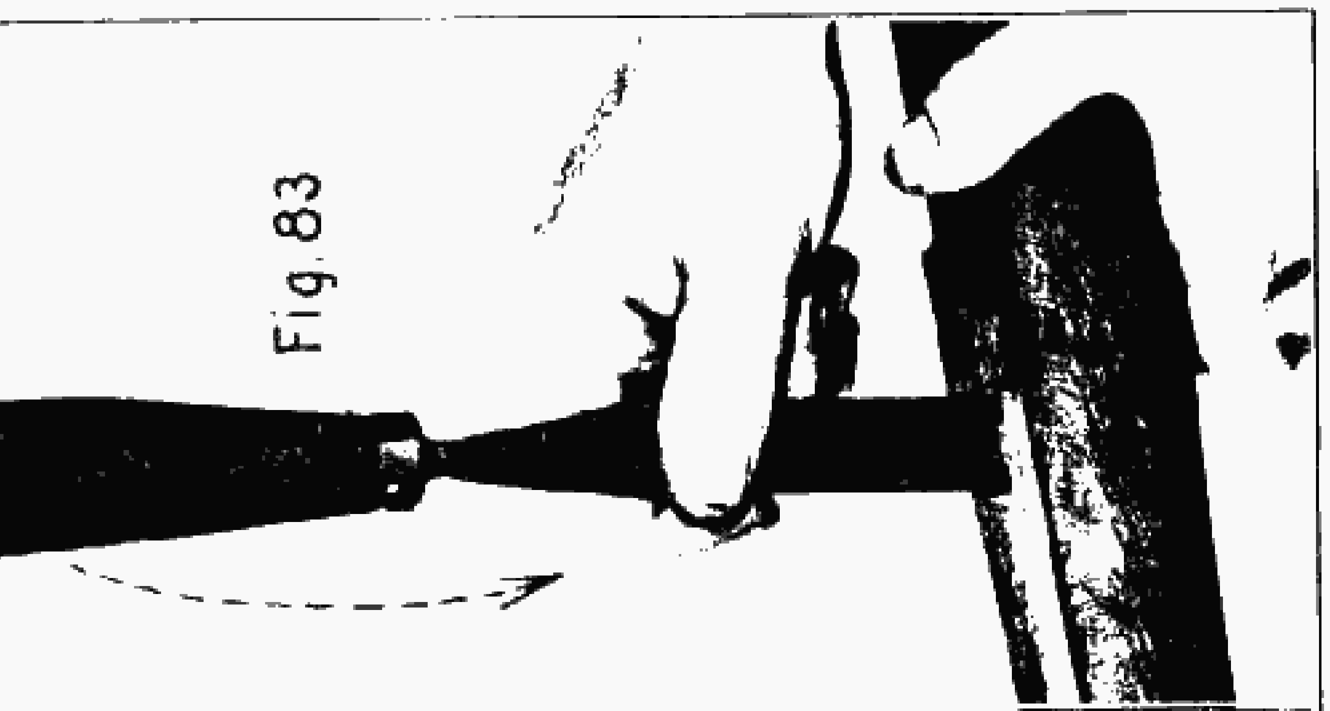


Fig. 83

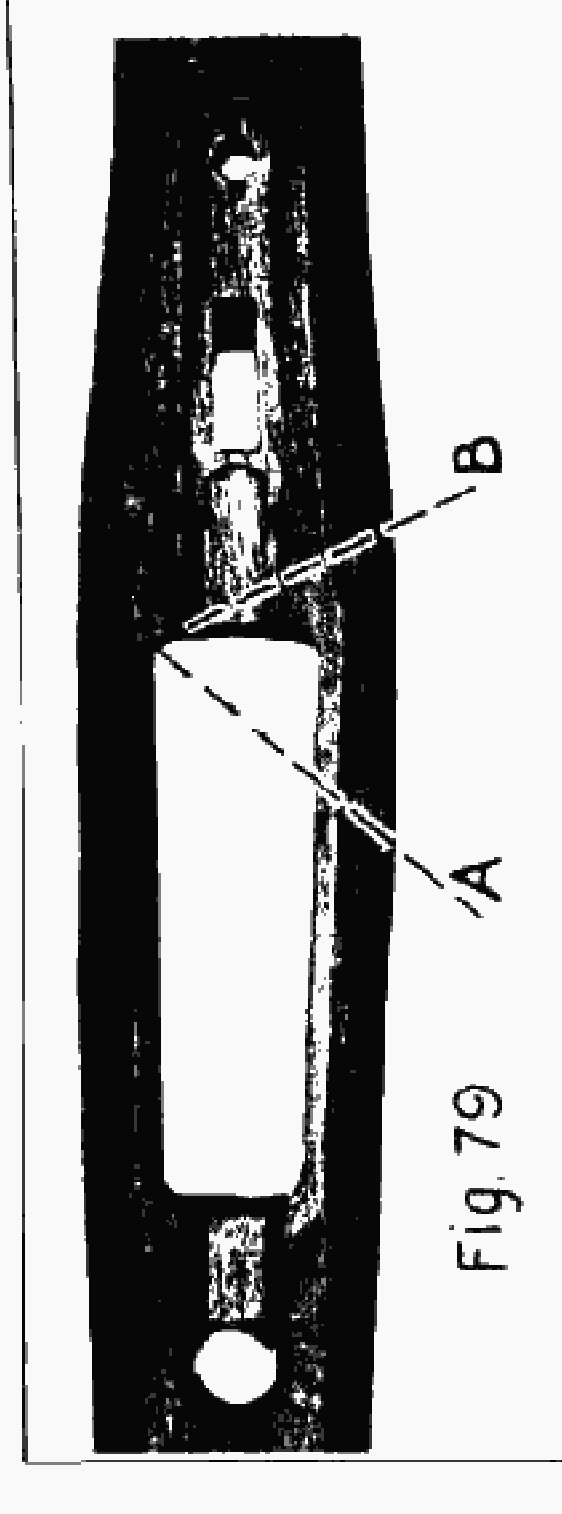


Fig. 79

Fig. 81

4 Addis Chisel is almost indispensable for this work. If you have nothing but a plain carpenter's chisel, the cutting edge should be ground and whetted to a slight curve. Push the chisel straight through until the sides are straightened up and the magazine will start to enter. Now coat the entire surface of magazine and under side of guard with lampblack and oil, using a stiff bristle brush and applying the thinnest possible coat. Try the guard, forcing it in as far as possible without driving it. The black smudges will show you the high spots which must be taken off. Trim them slowly and carefully, always across the grain, and always with a very slightly curved chisel rather than a perfectly flat one. Re-blacken the magazine and try it after every few cuts, and as it approaches its final seat, take the lightest possible cuts to avoid leaving gaps. When fully seated the outer surface of guard will be perhaps 1/8 inch below the surface of the wood— the blank should be sufficiently oversize for that.

IMPORTANT: When fitting the guard, the edges of tang portions must be tight against the wood. This of course will blacken the wood each time it is tried. So long as it can be seated with moderate pressure, do not keep cutting away the wood at the sides, or wide, unsightly gaps will result. Remove only the wood where it actually prevents the parts entering.

Compare your work as it proceeds with the machine cuts in the original stock. Many points will be noted where you can leave in extra wood, providing additional support to the steel. Work slowly and fit as closely as possible at all points, particularly where the wood and steel join at the outer edges, where gaps will be most unsightly. Be sure the magazine goes in straight—not canted to either side. If the thickness of the blank necessitates sinking the guard much below the surface, the surplus wood should be trimmed from the outside. Use a wide, slightly hollow chisel for this. Rest it on the surface of guard tangs and cut toward the sides, but do not bring the wood closer than 1/16 inch from the surface of steel until ready to shape up the stock.

138

All of this work with the chisels has been done by merely pushing the tool with the hands. The only place where a hammer or mallet may be needed is for cutting straight down through the wood at either end. The commonly accepted method of "chiseling"—striking the chisel with blows of a hammer or mallet—has no place in stock making. Hold handle of chisel in right hand and push it with a firm, steady motion, making short, light cuts. Rest the left wrist or forearm on the work, and use the first and second fingers of left hand to guide the chisel point, resting the fingers firmly on blade, but without heavy pressure.

The guard and magazine should be fitted sufficiently tight that a smart blow with heel of hand is needed to seat it to its depth. To remove it, hook the forefinger in the guard and tap the wood around it with a hammer. Eventually you will free it up a bit to a slightly looser fit—but leave it tight for the present.

Having inletted the guard and magazine, the barrel and receiver come next. The easiest way, and the most practical way in large shops, is to have the barrel out of the receiver, and fit the receiver alone first. However, since the majority of readers will desire to fit the two together, we shall consider that method first.

It will be remembered that when fitting in the guard we bored a 1/2 inch hole clear through the blank at front end of guard—this to accommodate the projection through which the front guard screw passes. Probably this hole had to be trimmed out a bit with the chisel as the guard was bedded.

Secure a piece of iron or mild steel rod just large enough to slip through front guard screw hole, and thread one end for a half inch so that it may be screwed into guard screw hole in forward end of receiver.

Clamp the blank in the vise right side up, and with magazine and guard fitted in snugly. Insert this rod, previously screwed into receiver, from the top down through guard screw hole in guard. Thus the parts are held in their proper relation to each other, while the guard and barrel rest upon the top edge of stock blank, with only the recoil lug and the rearward projections on underside of receiver touching the wood. Mark around these with a pencil, and rough out the wood beneath them with a hollow chisel or gouge, until the receiver and barrel are resting on the wood. Now mark around both barrel and receiver, turning the pencil point inward, always keeping the outlines smaller than the parts being fitted. Again rough out some wood, until the barrel and receiver are settled, a little way into the blank, making sure that both barrel and receiver tang are centered on center line of stock. Now remove barrel and receiver, and coat underside at all points with the lampblack and oil. Settle back into place in the stock,—always leaving the rod screwed into receiver to guide it to exact location; press down firmly, and note the points where black spots are left. Cut away the wood

139

at these points, selecting the chisel that fits best, and cutting across the grain wherever possible. Use a 9/16 inch Number 9 Addis chisel to rough out the barrel channel—this will of course have to be cut with the grain. Cut right up to the outlines until the barrel is resting down tightly against the edges of the wood. Keep working out the receiver mortice at the same time, so that the whole assembly is kept level as it settles. When the barrel is bedded about 1/8 inch less than half of its diameter, you may outline it carefully—and the receiver also—with a very sharp scriber or point of a knife. Be sure to turn the point slightly inward, keeping the outlines a bit narrower than the parts. Now remove barrel and receiver, and work out the barrel channel the full width of the outline, carefully cutting to the exact center of the knife or scriber line. Study the grain of the wood constantly, so as not to cut against it, possibly splintering or tearing beyond the lines. Use a small steel try-square, or any piece of steel having a right angle corner, to gauge the depth of the channel. Figure 82 illustrates the method of depth-gauging half round grooves known to all pattern makers. With the blade and head resting on the edges, the corner will just touch the bottom of groove when the right depth is reached; moreover, when the groove is true and round, the corner of square will touch at any point on the inner surface ("b," Figure 82).

A templet like Figure 26A (Chapter 4) may be conveniently used for gauging the depth of receiver cut at its extreme front end. This is made of sheet brass, being one half of a 1 1/4 inch circle. By cutting clear down at once at this point, you have a convenient guide for many of the other cuts.

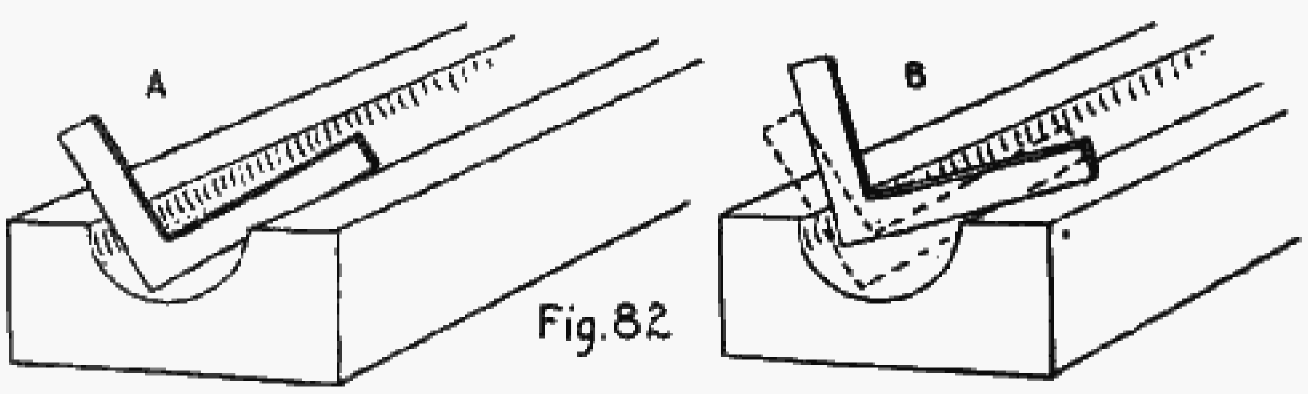


Fig.82

Now, having cut the barrel channel out to a true half circle, you are ready for the final fitting. The channel will be slightly narrower than the barrel, due to the scriber point having been turned slightly inward when the outline was marked. Thus the barrel is resting not quite half its depth in the channel. Work away the edges with extreme care, taking off the thinnest shaving imaginable, at the same time working out wood as needed in the receiver mortice. Finally, the barrel will be resting on the bottom of channel, but is not seated to quite half its depth, because our original outlines were a bit narrower than the barrel. The wide, nearly flat chisel now comes into play—and for this use it is worth its weight in

140

gold. This may be a 7/8 or 1 inch Number 3 or 4 Addis, or it may be a common 1 inch socket firmer chisel such as carpenters use, with the end ground to a very slight curve. Hold it as shown in Figure 83, and starting at the extreme edge, cut toward and slightly past the center of bottom of channel, meanwhile rocking the handle outward as indicated by dotted arrow. The cuts thus made should be very shallow, overlapping each other slightly, and scarcely more than scraping off the surface. The chisel must be honed and stropped until it will shave the hair from the back of your hand. (See instructions for sharpening and care of chisels in Chapter 7).

Coat the barrel with lampblack and try it frequently. When the channel is opened up so that you get black smudges on bottom and both edges, remove no more wood from the edges—keep them tight against the barrel from now on—and deepen channel only in the center until the *entire surface* of channel from edge shows the impression of the lampblack.

Toward the last the final deepening may be done, and the tool marks removed with No. 1/2 sand or garnet paper wrapped about a round stick. Extreme care must be observed not to rub the sandpaper against the edges,—just a stroke or two will leave ugly gaps.

All the while you have been thus bedding the barrel, you have also been cutting away wood in the receiver mortice as indicated by the black smudges, bedding it at the same time. When the barrel is down nearly half its diameter, you can remove the rod which is screwed into the receiver, and substitute therefor the short forward guard screw. Set this screw up snugly each time you try the barrel for fit, using the screw to draw the receiver and magazine together. A little later, when almost, but not quite the full depth has been reached, drill the hole for the rear guard screw.

This can be a very easy job, or a very difficult one, according to the way you go about it. The receiver tang, being "blind" on the upper side, the first thing is to locate the center of the hole. Coat under side of tang rather thickly with lampblack and press it hard against the wood, leaving the screw hole outlined thereon in black. Center this carefully with dividers and prick-punch the center. If you have a lathe, put a 60° center in the tail-stock; chuck a drill the same size as the guard-screw bushing in the head-stock; on under side of stock blank mark the position of rear guard screw hole with awl or scriber, and center it with dividers. Now hold the blank between the lathe center and drill point, so that the center in tail-stock of lathe is pressing into the punch mark in top of stock, and the drill point into mark in under side. Run the lathe slowly, using the handfeed on tail-stock to force the wood against the drill until you feel drill meet the point of the dead center. Remove, and finish the hole with handdrill. Thus, the hole is absolutely lined up to register with screw holes in guard and tang. This is particularly difficult when using a brace or breast

141

drill on the "b'guess and b'gosh" system, as the screw takes a very slight angle forward, which is hard to control. If necessary to drill it by hand without guides, drill from both sides using a drill smaller than the required hole, and finishing it out to size with a small rat tail file.

If the shop makes a good many stocks, the drilling jig described in Chapter 4 will be found indispensable, for drilling for guard-screws, stock-screws, and many other purposes.

With both guard screws in place and set up tightly, you can see just how much more cutting must be done in the stock. When both magazine and barrel and receiver are fully seated, the upper edges of magazine should just touch the bottom of receiver, with lip at rear of magazine seated smoothly in place against rear end of magazine cut in receiver. Usually it will be found necessary to inlet the magazine a trifle deeper to bring it to final position, but this should not be done until barrel and receiver are seated to full depth,—half the diameter of the barrel. The projecting portion on left of receiver where cutoff is located must be carefully fitted—its recess being considerably deeper than it is in the service stock. Keep the upper edge of stock on left side in a straight line from forend tip to extreme rear of cutoff—this looks much better than to slope it off at front end of receiver, as many factory stocks are made. Even up the bearing surfaces in receiver mortice, so there is no rock or wobble at any point.

Now, when you think everything is fully seated, set the guard screws up tightly, and look at the tip of forend. Quite likely there will be a gap of a sixteenth inch under the barrel at this point. Sandpaper lightly the entire inside of barrel channel and receiver mortice to clean it up, then coat barrel and receiver again with lampblack and seat carefully, drawing up the screws again. Note the points near breech of barrel and front end of receiver which must be cut down a trifle more. Work them down until pressure there is very light, and quite firm at tip of forend as indicated by the black smudges. The inside work on the stock is then finished except for a very slight dressing out along the walls and at rear of magazine to relieve pressure.

Figure 84 shows a stripped receiver being inletted without the barrel. It is much easier and faster to inlet the receiver alone, and shops doing a considerable amount of stocking on any one model of gun should have a spare receiver kept for this purpose. When the receiver is fully inletted, then the barrel and receiver together are put in place, the forward end of receiver being raised and the barrel resting on the wood. The barrel is gradually bedded by cutting out the wood from receiver forward, all work in barrel channel being done in the same manner as already described.

This method of first inletting the receiver without the barrel can be adopted by the man who is having a special barrel fitted to his

142

receiver. After the receiver is inletted it is sent to the barrel maker, then, when returned with the new barrel fitted, the latter is bedded in the stock as described.

The foregoing instructions apply to what may be termed fully bedded barrels. This method is usually followed on high grade custom built hunting rifles. The point of greatest pressure between barrel and forend should be at the bottom of forend tip, but light pressure should be maintained at all points. The upper edges should be tight against the barrel, with equal pressure on both sides. This method is quite satisfactory unless the condition of the wood makes

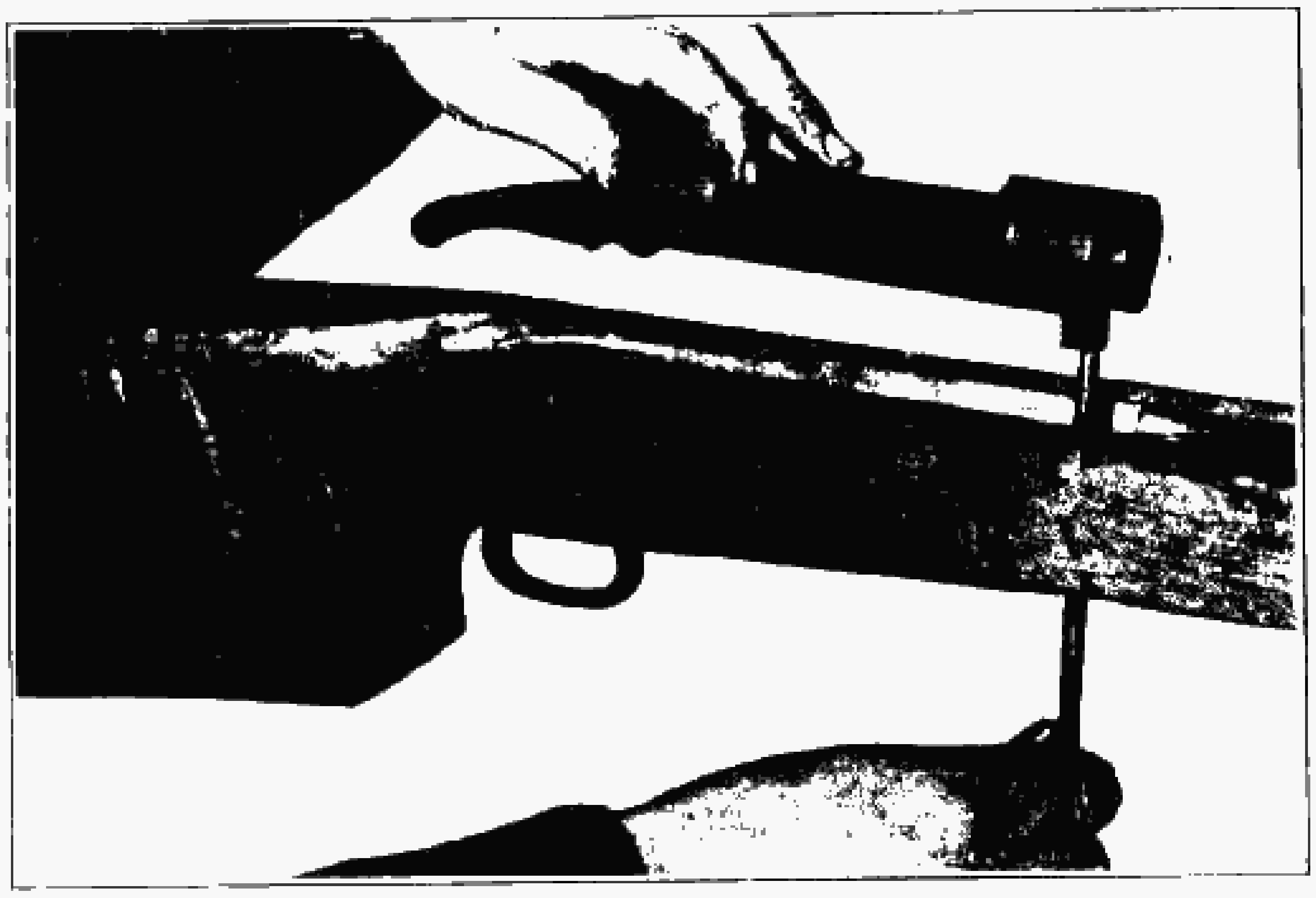


Fig. 84

it likely that the forend may sometime warp and develop undue pressure against one side of barrel—and if the barrel is of the pipe-stem variety, the point of impact will be changed thereby.

This may usually be guarded against in very light barrels by the semi-floating system of inletting. The barrel is bedded tight as above described, then the wood is shaved out all round except at the upper edges and at the tip of forend, so that there is about 1/16 inch clearance at all points but these. These points are then relieved by lightly sandpapering until they are just clear of the barrel so that a sheet of thin paper may be slipped between barrel and forend. This much clearance is scarcely noticeable, and allows for slight warping of the wood due to atmospheric conditions, dampness, etc.

Examples of the full floating barrel are found in many military rifles—the Springfield service rifle, the Lee Enfield, Ross, and per-

143

haps others. Here the barrel is left entirely free from the wood, touching nowhere. The handguard and forend are bound together by two or more bands, and the barrel has clearance of at least 1/32 inch all round at the muzzle. I believe Captain Crossman's old favorite target Springfield by Wundhammer is stocked in this manner—the band encircling both forend and handguard, and the barrel entirely free from contact with the wood.

Having successfully inletted one or more Springfield stocks, the beginner will have acquired experience enabling him to do a good job on any bolt action arm. The essentials are the same in any case, with a few minor differences which will be briefly discussed.

On the Mauser, the rear guard screw usually sets in from the top of the receiver tang, and is at right angles to the bore, making it somewhat easier to bore the hole for this screw than the Springfield. The Mauser, moreover, has fewer projections and irregularities on the receiver than almost any other, and is somewhat more easily inletted for that reason. The receiver tang is narrower and more tapering, moreover its rear end does not enter the wood quite so deeply, which increases the danger of its splitting the stock. When stocking any Mauser having more recoil than the .30-06, or weighing less than 7 3/4 pounds, it is advisable to use at least one stock screw, placing it in such a position that the recoil lug of receiver bears directly against the screw. The ends of stock screws may be concealed, if desired, by the methods described elsewhere. (Page 145).

The 54 Winchester is quite similar to the Springfield, but the receiver is simpler in outline. The square portion on under side runs in a straight line from tang to barrel ring, making a very simple mortice. The magazine is separate from the guard, fitting tightly into the receiver. It should be driven out and the barrel and receiver may if desired be inletted before the magazine cut is made. The guard and floor plate being separate from magazine, may be used as a templet for itself. After receiver is inletted, bore and cut out the magazine mortice from the top side, then the magazine may be driven back into receiver.

The Model 30 Remington, along with its daddy, the Model 17 Enfield, is considerably more complicated than either the Springfield, Mauser or Winchester, when it comes to inletting. There are no special instructions, however,—simply study the original stock mortices carefully, and follow the rule to remove as little wood as possible, giving maximum support wherever you can.

The various .22 caliber bolt actions, such as the 52, 56 and 57 Winchester, and the Savage Models 1919 and '23 sporter series, are all quite simple, since the receiver is practically cylindrical—the Savage receiver being merely a continuation of the barrel, the whole assembly being bedded in a half round groove in top of stock. On these rifles the barrel and receiver may also be inletted first, then the guard screw holes and magazine well are located and cut

144

from the top, after which the guard is fitted. On the Winchester there is a hole in the side of stock over the magazine, through which the magazine catch operates. This hole should be located by carefully measuring the distance from bottom edge of stock to its center, and the distance back from front end of receiver. Bore this hole undersize, then work it out carefully with sharp rattail file and hollow chisel until the magazine catch bushing nut will just fit snugly.

The Model 5 Ross also has a receiver nearly cylindrical, and is very easy to inlet, the barrel and receiver being inletted first, then the guard, after the magazine has been removed from it, will form a self-templet like that of the 54 Winchester. The guard screws are used to draw the parts together as the inletting proceeds.

The peculiar construction of the Krag necessitates certain changes in the usual procedure. The first cut to make before doing anything else is the rectangular recess for the magazine. Lay your blank with the left side up on the bench; lay the original stock on top of it, and outline this recess with a sharp pencil. Saw and chip out the wood, keeping about 1/4 inch inside this outline, then with chisels carefully enlarge the recess until the magazine will start in. Spotting frequently with lampblack as previously described, gradually work out excess wood and let the magazine in deeper, until tang and barrel are resting on upper surface of stock. Now mark your outlines all round, turning the pencil point well in; rough out surplus wood, then continue spotting and fitting slowly and carefully until all parts are fully seated, studying the shape in the original stock constantly.

The Krag has no recoil lug, the square rear end of magazine acting in that capacity. It is important therefore, to keep the wood very full here and fit it up tightly against the back of magazine.

The guard-screw holes are located from the inside by coating under side of receiver thickly with lampblack, and drilling in the center of the impressions thus left. Lay the guard in position over the holes, outline it with a knife point, cut the outlines and remove excess wood, and draw in the guard as fitting proceeds by tightening up the guard screws.

The 7.62 mm. Russian is one of the meanest of all to inlet. The long, narrow guard and magazine is very easily thrown out of alignment, and the shape of the sides is difficult to cut into the wood. Make a templet for it by taking a paper impression of the old stock, as described for the Springfield. These templets should be made for all jobs where the magazine and guard are in one piece, like the Springfield, Mauser, etc., but are not necessary on guns having the guard and magazine separate. As a general rule, all actions of the Mauser type should have the magazine inletted first, and on others, with guard and magazine separate, the barrel and receiver should come first.

145

CONCEALING STOCK SCREWS: When it is necessary to use stock screws as a safeguard against splitting from recoil, or when putting in a screw in repairing a broken stock, or for any other reason, the screw may be concealed by inlaying a piece of wood, ivory, bakelite, horn, ebony, or other material. The inlay is first cut and filed to the shape desired—a diamond, circle, etc., and its edges slightly beveled on the under side. If the inlay is used to cover stock screws, the screws should be cut short enough so both ends are about 1/8 inch below the surface of the wood. The inlay is then held over the hole, and its outline marked out with a sharp knife. Cut the outlines deeper with a thin bladed, very sharp chisel, and carefully trim out the wood. Press the inlay into place, noting where the edges must be trimmed to fit. When finally fitted, cement in place with Du Pont Cement, and hold in place for 48 hours by clamping in a vise. Use a piece of felt or soft leather to prevent breaking, and be sure the inlays are held flat against bottom of recesses. These inlays should be made thicker than required, then filed and sanded off flush when the cement is dry.

Another way of hiding screwheads which is known to expert cabinet makers, is as follows: Before drilling the screw hole, take a thin and very sharp flat chisel 1/2 inch wide, and after wetting the surface of wood to soften it, cut a shaving about 1/16 inch thick and 3/4 inch long, leaving one end attached. Wet or steam this shaving so it may be turned back out of the way without breaking off, then bore the hole and set in the screw at the desired point. Hot glue or cement is now applied and the shaving glued back in place, with a piece of blotting paper over it, and firmly clamped. When the glue is hard, sand the spot smooth and clean, and if the cut was made with a sharp tool which did not bruise the edges, it will be invisible.

Having inletted the magazine and the barrel and receiver, and brought them together to the proper fit, take a sharp pencil and mark out the trigger cuts from the opening in bottom of receiver. Drill through with a small drill or augur bit, making several holes as required, then cut out the space between them with a 1/4 inch chisel, following the lines of the cuts in the original stock, but leaving in wood wherever you think you can. Now fit the trigger, sear, and other small parts into the receiver, and try it in the stock. Coat the trigger mechanism with lampblack and oil, and the spots where more wood must be cut out will be clearly indicated. Replace the cutoff, or bolt release, if it was previously stripped from receiver, and likely a few cuts will be needed to make it work freely. When you are satisfied that the job of inletting is complete—that each part is fitted as perfectly as may be, and when the bolt and all other parts work freely, the rifle is ready for its first "shootin' in."

"SHOOTIN' IN" THE STOCK: Tighten up the guard screws. If your fitting is right they should set up very tightly due

146

to pressure of the wood, before stopped by the bottom of holes in the receiver. With a little practice one can learn to tell when the screws are in their full depth. If being stopped by the points touching the bottom of the holes, it is well to grind off about one thread, to provide a little more take-up for tightening. Having set them as tightly as possible, take the gun out behind the barn, or any place where the neighbors won't object, and fire twenty or thirty of the heaviest loads you will ever use through it, holding the butt against something solid such as a tree or stump. If the stock is ever going to split from setback or recoil, you want it to do so now, before any more precious hours have been expended on it—so give it the works. Split it if you can.

The stock having passed successfully through this ordeal, and your anxious gaze having discovered no evidences of faulty fitting, you are now ready to shape it up. This is one of the bright spots in the stocker's somewhat sordid existence. Now you can see your work begin to take shape under the tools—you really feel that something is being accomplished,—and your dreams of a stock "just for you only"—a stock that fits you to a frog hair is about to be realized.

147

CHAPTER 11

STOCKMAKING: SHAPING AND FINISHING

IN shaping up a stock I like to start at the forend and work right on back. This is as good a place as any to describe the method of ATTACHING A FOREND TIP, so we'll begin with that.

Figure 85 shows the blank with tip of buffalo horn, ivory, ebony or what have you, clamped into place with the home-made C-clamp described in Chapter 4, while Figure 86 shows how the tip was prepared before fitting. Make the dowel of a piece of 3/8 inch hardwood dowel rod cut about 2 1/4 inches long. This plug

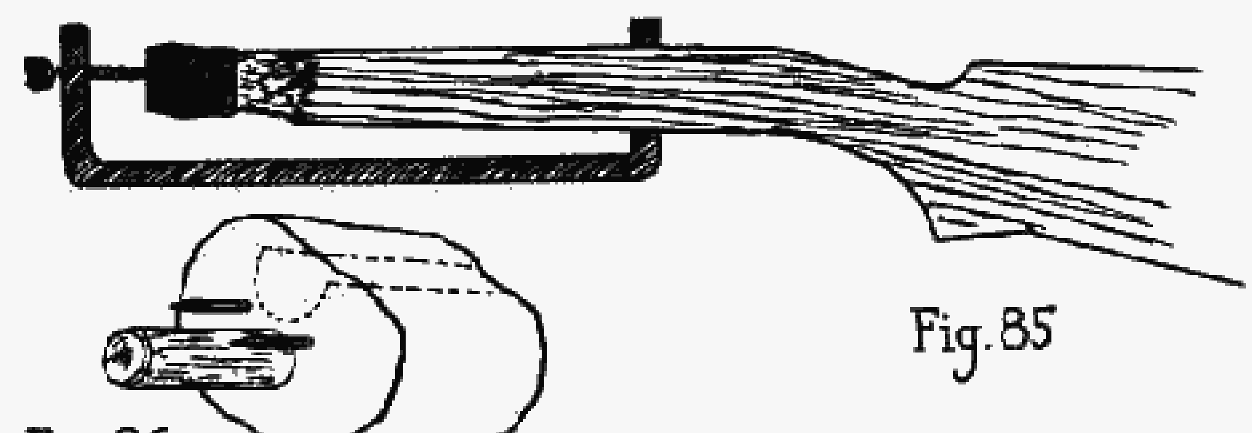


Fig. 85

Fig. 86

should be sanded to a smooth, snug, but not tight fit in the hole in horn, which hole should be drilled with a twist drill to a depth of about an inch, or more, depending on the length of the horn. The steel pins are not to be put in yet.

Saw the forend off square at the length desired, preferably in a mitre box—this to be done before any shaping. Drill the dowel hole in it directly under center of barrel channel, so that it comes about 1/8 to 3/16 below bottom of channel. Now remove the dowel from the tip, coat the tip with lampblack and oil, replace

148

the dowel, and push it into the hole in forend until the surface of tip touches the wood. Work the horn about slightly to rub the black against the wood, then remove and note the spots of contact. Work them off carefully with a medium cut file, again coat the horn with black, and fit again. Continue until there is perfectly even contact of the two surfaces—horn and wood—*at all points.* In some forms of glued joints, it is permissible to have perfect contact only at the outer edges. Not so in this case—for the reason that we don't know yet just where the outer surface of our forend will be. Absolutely perfect contact over the entire surface is what we require here, and nothing else will do.

When the wood and horn are fitted together so there is no gap anywhere, wipe off the lampblack and scrape the horn to remove every bit of oil or grease. Also scrape the end of the wood clean. Drill holes as indicated which will be a tight fit for two six penny nails. Keep the holes in fairly close to the dowel, so there will be no possibility of cutting into the nails in dressing down the tip. Drive the nails into the horn, cut off the heads and sharpen the projecting ends with a file. These should be about 1/2 to 5/8 inch long. Fit the tip into place on forend and mark where the points of nails strike the wood, and drill two holes so they will enter readily. Now melt up some white flake glue and let is simmer at just below boiling point. Remove the dowel from the horn and apply glue into the hole over the surface of the horn, and in the dowel hole and on surface of wood. Also coat the projecting end of dowel with the glue. Work fast while the glue is hot. Seat the tip firmly with a blow of a mallet, then clamp tightly as shown for 48 hours. The joint will then be firm and solid, and the groove for the barrel may be cut with chisels, just as it was cut in the forend. Be careful!—this horn sure is death on chisels.

Now for THE SHAPING. The only tool you will use for a while will be the half-round cabinet rasp, which should be 12 inches long for convenience in handling. Clear the bench of all other tools and parts, so that nothing will be lost in the filings. Keep a picture of a gun having the kind of tip you want before you, and study it at frequent intervals. First round off the end of horn tip, from top to bottom, then from side to side, and make it the shape you want, while bringing it almost to finish size. Leave the upper edges square along the barrel channel.

Continue the rasp work back into the wood an inch or so, then stop work on this end and move back to the portion over the magazine. Here the Prentiss No. 19 vise proves invaluable, for the swivel jaw enables you to hold the stock on its side, the jaws gripping upper and lower edges of buttstock, while the swivel base enables it to be swung about as desired and locked in any convenient position. Shape the sides of stock as desired over the magazine mortice—

either oval or flat—using the round side of the rasp to rough off

149

the surplus wood, then the flat side for the final shaping. Allow about 1/16 inch extra thickness all over for finishing. Now turn the stock top edge up, and with a sharp black pencil draw a line from the upper edge you have established over the magazine, forward to the edge established at the forend tip, using a straightedge. (See Figure 87) Clamp the stock sideways in the vise again, and rasp the forend down to this line, working across the grain always, and *against* the square upper edge, to avoid slivering. For the present, regardless of its final shape, leave the bottom of forend very much wider than the top. Work down both sides of forend in this manner, then turn stock bottom edge up in vise, clamping it about the grip portion.

The original center line you marked on the stock blank still shows. Blacken it with a lead pencil to bring it out clearly. Draw lines

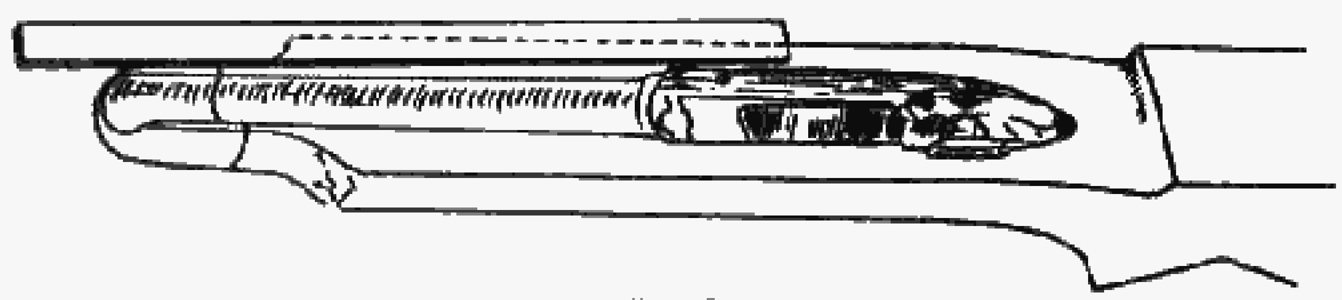


Fig. 87

running in the same direction but closer together at the tip of forend, to establish the taper, then rough off the wood to these lines. The forend may now be rounded up and shaped as desired, using the flat side of rasp for most of the work.

The stock is now shaped in the rough from forend tip almost back to the grip. The next question to be decided is, shall the stock have A CHEEK PIECE, and shall it have CASTOFF? Assuming that it is to be cast off, first measure and mark the desired length from center of trigger to center of butt; draw a line for approximately the desired pitch, and saw off the butt, allowing about 1/4 inch extra length. Remark the original center line on butt, then establish a new center for the castoff as explained in Chapter 9. (See Figures 46 and 48, Chapter 9). Now make a brass templet the shape of buttplate to be used, and 1/8 inch larger all round, notching the center of templet at both ends. Center it on the castoff line on butt and mark round it. Now set the stock in vise as shown in Figure 34 (Chapter 7) decide on the shape and position of cheek piece, and sketch its outline in pencil. Cut round it with a hollow chisel as shown in Figure 34, making the cut deeper toward bottom of stock. When about 1/4 inch deep, start shaping this side of stock with rasp, using the round side to speed the work, and

150

working from rear of cheek piece back toward the butt outline. For the present leave the butt its full length from heel to toe, making no attempt to establish the drop.

The surplus wood directly below bottom of cheek piece can be roughed out with hollow chisel.

Now turn the stock over and rough off the surplus wood on right side of buttstock, leaving it very full all over. The best way to hold the stock while working on butt is to lay a round tapered stick of hardwood, such as a piece of broomstick or a chair rung in the barrel channel, and hold the stock sideways by the forend, the jaw of vise pressing against this stick, which must be slightly smaller than the barrel channel, so as not to split it. For the present do not rasp the stock nearer than 1/4 inch of its final thickness.

Next comes THE GRIP. With dividers measure carefully the required distance from the trigger to where the front edge of grip is to be located; mark the bottom line of grip, and saw to this line. Dress the end off square and smooth with a flat wood file, then replace the center line which was sawed off. If you use a metal or horn grip cap, place this in the required position and mark its outline. If not using a cap, then a paper pattern should be made the desired oval shape, and pasted on. Now, using the round side of the rasp, round off the forward edge of pistol grip, then work down the sides, but leaving the grip at least 1/8 inch thicker all over than it is to be when finished. Next file down the comb slowly and carefully, so that when the bolt is drawn fully to the rear the sear notch on cocking piece drags heavily over it. Round off upper edge of stock, and thin the sides of comb and upper part of cheek piece just enough to enable you to see through the sights, and the rifle is READY TO BE SIGHTED IN. Instructions for fitting and aligning sights are fully covered in Chapter 29.

When the barrel and receiver were inletted, probably everything was stripped from the receiver. If you use a Lyman 48 or any other receiver sight, it should not be fitted until the stock has been fully inletted. Then, after sight is attached to receiver, as explained in Chapter 29, set the action as far as it will go into the stock, and mark the position of the sight base on side of stock with a sharp knife. Take a coping saw or scroll saw blade (using the blade only, without the saw frame,) and reverse ends with the blade so it cuts as you pull it toward you. Using it thus, cut down about a quarter inch into the wood at front and rear of sight base, and carefully remove the wood between the cuts with a 1/2 inch flat chisel. Coat bottom of sight base with lampblack and oil, and press down into stock. Take off the wood slowly, so as not to make the notch too deep. The cut should be deep enough, however so that the wood does not quite touch the sight base, as the strain would tend to loosen the screws. There should also be 1/32 inch clearance between the back of sight base and the wood, for there is very little wood at this point, and

151

any back thrust that might develop would easily split off a piece.

Having sighted in the rifle for the desired range, and set the sights firmly, the line is established for measuring the drop of stock. Usually the range for sighting in is 100 yards.

Set the rifle right side up in the vise, and attach a heavy thread to the tip of front sight, by winding a heavy rubber band around it. Run this thread through the smallest aperture of the peep sight, and draw it taut, keeping the thread not touching the rim of aperture at any point. With the rasp work down the heel until its vertical distance from the thread is about 1/16 inch less than the required drop. In like manner, work down the comb—or, if you want the comb as high as bolt will permit, keep it as it is, with the cocking piece just dragging. Now rasp the upper edge of stock between heel and comb to a straight line, and immediately replace the center line on the new surface.

If the stock is castoff, you need not replace the original center line, but draw a line from the heel castoff at butt, forward along the top of stock until it intersects the original center at rear of tang (Line b—b—b, Figure 48, Chapter 9). Draw a similar line on bottom of stock from the castoff point on toe of butt, intersecting original center line back of trigger guard.

FITTING BUTTPLATE. The buttplate or recoil pad is to be fitted next. Assuming that you will use a steel shotgun type butt plate, or one of the Mannlicher-Schoennauer type, proceed as follows: First, remove the trap and spring, if the buttplate has a trap. Hold plate in position on butt so that the center line, or the castoff center shows exactly in center of screw holes in buttplate. The lip at heel of plate should come just below the surface of upper edge of wood at heel. Mark the outline of plate carefully on butt, and with the rasp bevel off the stock all round almost to this line. Now rasp the butt to a slight curve toward the middle, working down the edges first, and replacing the center line as fast as it is worked off. Start the notch for the lip of buttplate, but deepen it very slowly as you proceed. For this notch select hollow chisels which fit the curve, and cut straight in along the outline, removing the wood between outlines with a 1/4 inch flat chisel. Coat entire undersurface of plate with lampblack and oil, and press into place. Most of the fitting can be done with rasp and half-round wood file. Sometimes it will be found convenient to use a wide flat chisel with very slight curve for taking off the high spots. Work down the butt until the entire outline is in perfect contact all round, when the plate is pressed to place with the hands. Do not use the butt screws in fitting plate, for their pressure will spring the plate so as to change its curve slightly—then the trap will not fit. The screw holes should be bored only after outer edges of plate are in perfect contact all round.

Set the upper or heel screw first. Drill the hole at a slight downward angle, so the screw will draw the lip of plate down tightly.

152

Turn in this screw, then center and drill the hole for the toe-screw, and set it. Ordinarily countersunk head wood screws are usually better than the regular coarse buttplate screws. The thread holds well, but being somewhat smaller, the screws can be set so that their slots stand vertically, and in line with each other. Little things, such as keeping screw slots in line, make a big difference in the appearance of a gun, and often indicate the experience of the maker.

The screw heads, being larger and deeper than the countersink in the plate, will stick out from the surface. First loosen them three or four turns, then deepen the slot with a slotting file or hacksaw blade. Tighten them again, to be sure the slot comes well below the countersink. Then file the heads down smooth and flush with surface of plate. This makes the screws nearly invisible, only the slots showing. Later, when finishing the gun the plate and screw heads will be polished down with emery cloth, the screws carefully removed, and all parts blued.

The D. C. M. Sporter buttplate is the easiest of any to attach. Merely saw the stock on a straight line, smooth up the end with a file until edges of plate touch all around, and turn in the screws.

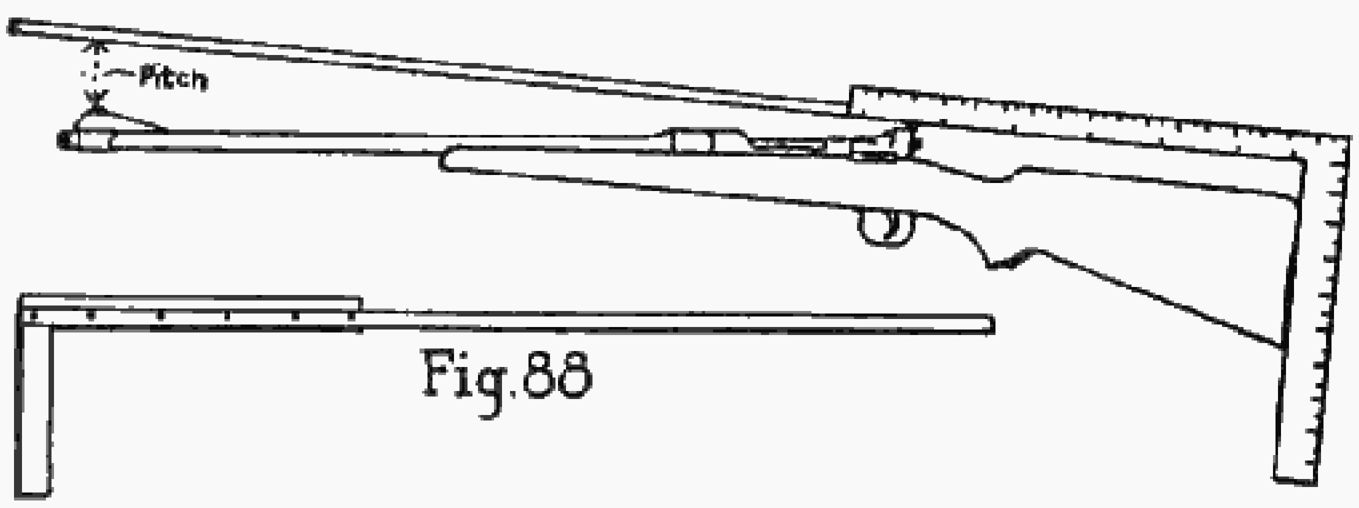


Fig.88

After fitting the plate, and before dressing down the screw heads, test the butt for PITCH. The most accurate way of doing this is to rivet or braze an extension to the long blade of a steel square, like Figure 88, which also shows this device in use. The short blade of square is held against heel and toe of butt plate, with inner edge of long blade in line with middle of rear sight aperture. The distance from end of long blade to tip of front sight indicates the pitch of butt. (See discussion of pitch in Chapter 9).

If the pitch is too great, remove the buttplate and dress off a bit of the heel of butt, setting that end of plate a trifle deeper until the required pitch is obtained. If more pitch is desired, shorten the toe. The distance from center of trigger to center of buttplate should be carefully measured while the plate is being fitted.

153

RECESSING THE BUTT STOCK. Sometimes it is desired to hollow out the butt, either to lighten it and balance the rifle, or to provide a compartment for cleaning materials, if a trap buttplate is used. The recessing should be done after the stock is all shaped up, ready to sand. Hold the stock in vise, with jaws well padded, butt vertical. Mark the outline of recess in buttplate, and mark centers for two or three holes, as preferred. The Mannlicher-Schoennauer plate will permit two 7/8 inch holes, and one 5/8 inch. Use a sharp augur bit with single cutter lip. Center the spur carefully, and have someone stand to one side and tell you whether to raise or lower end of brace to keep the hole at the correct angle. Watch the bit as you never watched anything before, and call on your favorite household gods to keep it in the center of stock. I never yet had one run out the side, but never have I bored out a butt without serious misgivings that this very thing would happen.

After boring the holes the edges should be beveled off with a knife. The wood between the holes may be removed with the "scraper gouge" described in Chapter 4, or may be left solid between the holes—the usual practice. This makes a stronger stock than if it is reduced to a mere shell, and holds more than you will want to put into it, most likely. Nothing throws a rifle out of balance so badly as a jointed steel rod and a lot of tips in the butt; I usually carry my rod in pocket or pack, with only a pull-through, a few patches, and small oil can in stock.

FITTING RECOIL PAD. The fitting of a rubber recoil pad to a new stock just being made is quite easy. First of all the butt should be sawed off on a straight line and trued up with a wood file, and the center line replaced. Now carefully work the butt down to very nearly its final shape and size, allowing not more than 1/32 inch for finishing. Set the recoil pad in place and with an awl or scriber mark the position of the two screw holes on the center line. Drill the upper hole. Next drop the pad into boiling water for a moment, to soften the base—unless this is done, turning in the screw may crack the hard rubber base. Set the upper screw in fairly snug, then insert the drill through lower screw hole and drill the hole. Set in this screw, then mark the outline of the butt on the hard rubber base, and remove the pad.

A fast running motor grinder is essential for shaping butt pads. Replace the grinding wheel with a disk of wood seven or eight inches in diameter, and on the side of wheel glue a sheet of garnet or sand paper—about number 1. Use this to dress the pad almost to the lines marked on the base. Now coat the hard rubber base with lampblack and oil, and spot it to perfect contact with the butt, just as you did the buttplate. Be careful not to press it too hard and break the base. The center surface of butt may be hollowed very slightly by scraping with a small steel scraper, to insure tight fit at edges. When the fitting is completed, put the pad in boiling water again to soften it;

154

wipe it dry, and quickly coat it with du Pont Cement, also coating the butt. Put pad in place and tighten up the screws. Thick shellac may be used instead of cement if preferred, but the cement is better. It completely closes the joint and prevents dampness affecting the stock through the end grain.

The next step is to buff down the edges of pad even with the wood. This is done on the sandpaper wheel as shown in Figure 89. Work very carefully, holding the stock so that its surface is parallel with the surface of the wheel, and move stock up and down so as not to

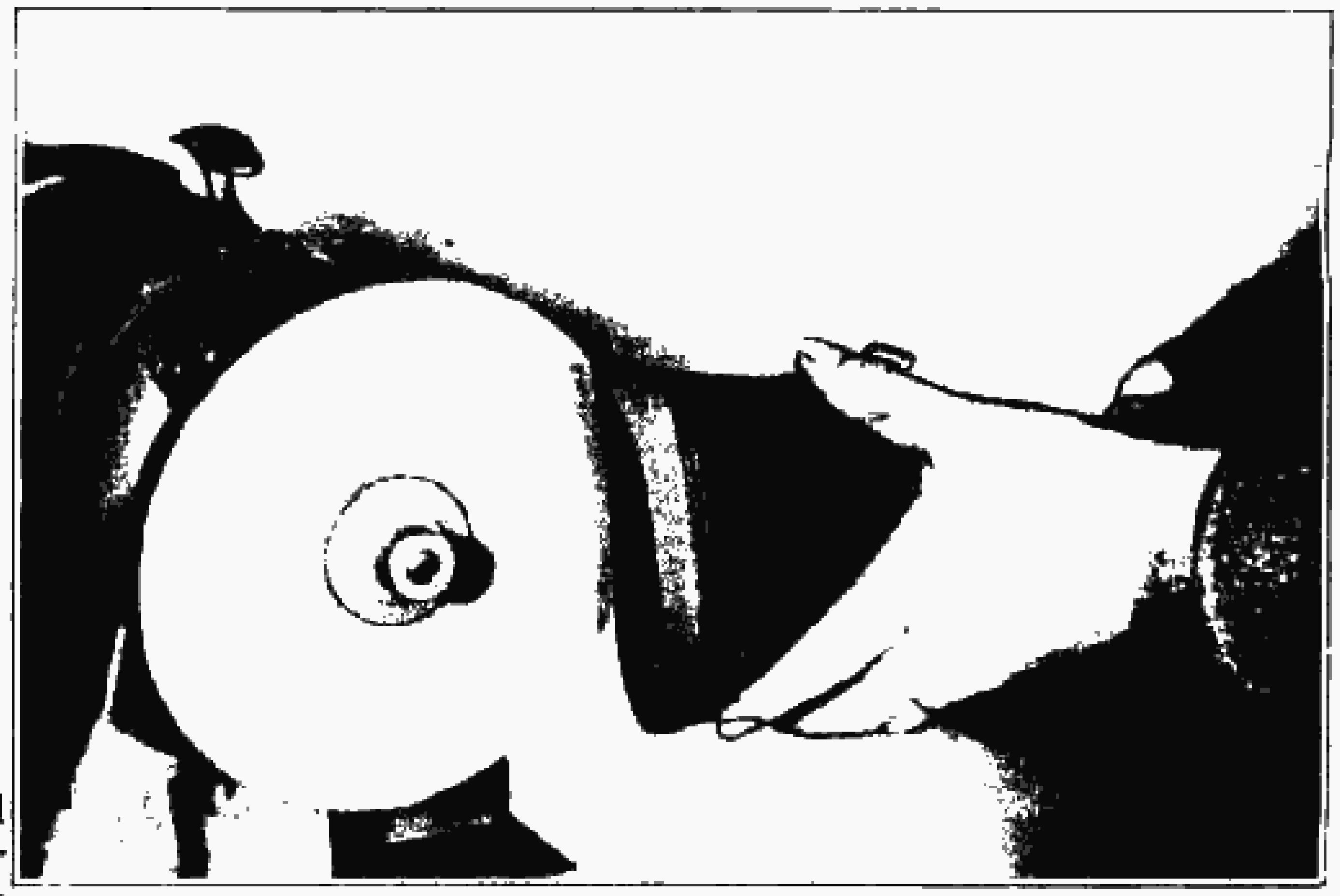


Fig. 89

cut too fast in any one place. Be especially careful when working round the toe and heel, particularly the toe. It takes steady holding and fast thinking to avoid cutting notches in the wood at these points, and also to prevent beveling the edges of the pad, which should be in continuation of the stock lines at all points. Use very light contact between the rubber and the wheel, especially when finishing the cut.

The red rubber pads with hard black rubber base are all attached in the above manner. This includes the Hawkins, the Jotsom Anti-Flinch, Hi-Gun, and the various Silvers type pads. The first three named all have variously shaped holes cut through the red rubber from side to side, to increase resiliency, while those of the Silvers type are solid, but with a hollow on the inside, which provides an air cushion. My own preference is for the Silvers type pad, particularly on rifles. Having no holes cut in the rubber, the pad is always clean and free from dirt and trash, which is bound to ac-

155

cumulate in the holes. This type is slightly less resilient than the others, as it is thinner.

The thickness of the pad should be carefully measured before fitting, and the stock cut off so that it will be the right length when pad is fitted.

Of the pads having holes cut in the sides, there is little choice so far as comfort and durability is concerned. I find, however, that the Jotsom Anti-Flinch can be buffed to a smoother surface than the others. The Hawkins pad is somewhat prone to scaling on the sandpaper wheel, while the slightly tougher rubber in the Jotsom cuts much more smoothly. The Hi-Gun has the same quality of rubber, but the shape and size of the holes leaves the edges very thin, which makes it hard to finish smoothly.

There are other pads made of layers of black sponge rubber cemented between layers of soft red rubber, which are popular with shooters prone to flinch, and who stand in fear of recoil. These pads have no hard rubber base, the base being a layer of soft red sheet rubber, one end of which is cemented to the pad. To fit the pad, peel off this sheet, and tack it to the butt with the small tacks which come with it. There is also a small tube of rubber cement with which the pad is then cemented to this soft rubber base. The pad is then dressed down on the sandpaper wheel—and it isn't the easiest job to be found, either. Due to its softness, this sponge rubber is easily cut out of shape, and it is necessary to have the wheel covered with new, sharp sandpaper, and use the lighest possible pressure.

For myself I have little use for a recoil pad on a rifle, although it is a necessity on most shotguns. The man who is physically capable of going into the woods after big game, and doing a man's work about camp, certainly should be able to stand up against the recoil of the average big-game load. For with a rifle averaging eight pounds weight and stocked to fit the hunter, the recoil is almost unnoticeable. A good steel buttplate, for me, is in all ways preferable.

On rifles using any of the magnum loads, however, there is a legitimate reason for the recoil pad, as well as on very light weight rifles using a load like the .270, 7 mm., or .30-06. When the weight is reduced below 7 1/2 pounds the recoil is often unpleasant, and a good pad will often cure a bad habit of flinching.

The gunowner will often wish to fit a recoil pad to a gun he already has. The method of fitting is essentially the same as when fitting it to a stock in process of making; except that greater care must be exercised in buffing the pad down to the outlines of the stock, so as to remove as little of the original finish as possible with the sandpaper wheel.

After the pad is shaped, sandpaper the stock carefully where the wheel has touched it, letting the bare spots blend gradually into the finished portion. If the stock has an oil finish the bare spot may be obliterated by proceeding just as you would to finish a new stock,

keeping plenty of oil on the bare spots, and wiping it off the finished portion. In time the spot will take on the same color and finish as the balance of stock. The work may be hastened by judicious use of the red oil and shellac mixture given in Chapter 13.

When the stock has been varnished, it is more difficult to repair the finish where it has been buffed off. Varnishing this spot is a mistake, for the new varnish will not have the same color as the old, and the lap is sure to show. Most gunsmiths use a mixture of about 85 parts orange shellac and 15 parts linseed oil. This is rubbed into the spot with a rag, then when dry polished lightly with pumice and oil, then another coat rubbed in and polished. Afterward, the whole butt stock is usually given a good rubbing with furniture polish.

All such methods, however, are cheap makeshifts, and should be avoided unless the owner must use the gun immediately. The only thoroughly satisfactory method is to remove the old finish completely, and refinish the entire butt stock,—preferably with an oil finish.

FINAL SHAPING. But we have digressed somewhat from our subject,—that of shaping up the rifle stock in process of making. Having fitted the butt plate or recoil pad as the case may be, we are now ready to bring the stock to its final dimensions. About the only tool needed for this work is the cabinet file, which is similar to the rasp, but has finer teeth. The stock is held in the most convenient position in the vise, using the felt lined vise pads to prevent the jaws marring the wood. When gripping the stock by the forend, always use the round tapered stick in barrel channel, so that the vise-jaws do not come in contact with edges, with the ever present possibility of splitting them off.

Start in again at the forend, and work back on the stock, using the flat side of the file on all flat and convex surfaces, and the curved side only where the surface is concave. If there is considerable wood to be removed, you may use considerable pressure on the file; otherwise, use it very lightly, so as to just take off the marks left by the rasp and even up the surface. Always make the file stroke across the grain, or at least diagonally; if the file moves in line with the grain, it will shred the wood, leaving deep tooth marks which must be worked out.

Use only good sharp files. It is poor economy to keep on using a file after the teeth are blunted and worn. This applies particularly to wood files, as all wood has hard and soft spots, and a dull file will slide over the hard places without cutting, causing an uneven or ridgy surface.

If the tip of forend is to be shaped into a snobble (See Chapter 9), the snobble outline may be formed roughly with a hollow chisel, after which it is shaped up with the round side of the wood file. Do not cut too deep a hollow back of the snobble—try to retain a streamline effect at all points.

The undercutting of the comb is also done first with a hollow

chisel, then the lines smoothed and blended into the sides of stock with small end of file, using the round side. (See Figure 56, Chapter 9). It is impossible to describe exactly the shaping of such a comb. Study as many stocks as you can get hold of—but do not assume that all are correct. Learn to recognize their faults as well as their good points, copying only the latter in your stock.

Exercise the greatest care in shaping the sides of stock over the magazine, to get them exactly alike. Take time to study them carefully as you work. And when shaping up the portion around the tangs, it is well to have the action and barrel fitted into place. Where the tangs set into the wood, always work *against* the edges to avoid splintering. Go slow, and work the wood down almost, but not quite flush with the steel.

When you come to the grip, take your time and don't get in a hurry to see how it is going to look. If you have a grip cap, it should be fitted, and properly centered before the grip is shaped up. Outline the cap with pencil, bring it to a position where its forward edge will be the required distance from center of trigger. Mark the screw hole and drill it carefully at right angles to the surface. Be sure this hole is large enough so the screw will not split the grip. On under side of grip cap, scratch some kind of mark to show which is the front edge. After squaring up end of grip with the file, cup it very slightly with a wide, nearly flat chisel, so the edges will fit tight. Screw the cap into place, then proceed to file the grip down flush with its edges, and shape it up all over to desired shape and dimensions. Study it frequently from both top and bottom, noting any unevenness in its side contours. It is permissible, and often helpful, to leave the right side a bit fuller than the left, so as to fill the hollow in palm of hand more completely. Bring the gun to shooting position at short intervals, and try its feel in the hands.

Next comes the shaping of sides of stock, comb, cheek piece, etc. First of all, file down the flat surface of cheek piece until it feels just right as you look through the sights. Trim the edges to shape with a slightly hollow chisel (My favorite for this is a Number 7 Addis Chisel 5/8 inch wide, which gives the edge a neat inward curve), and finish it carefully with the round side of cabinet file. This curved edge narrows gradually toward upper edge of stock at both ends, until finally blending into the stock proper and disappearing. The outer edge of cheek piece should be rounded off smoothly. A small bead or square edge where cheek piece joins the body of stock is permissible, and is of assistance in retaining correct lines on the stock. (See Figure 51, Chapter 9).

The entire left side of stock should have the same lines as the right side, except for the cheek piece. It is easy to cut in too deeply around cheek piece, and it is equally easy to not go deep enough. Cut a templet from thin wood to fit the right side of stock after it is shaped up, from a point an inch below heel, reaching forward

to base of comb. Then cut away just enough of this templet to clear the cheek piece, and use it to assure correct lines on left side of stock.

In shaping up lower edge of stock back of grip, don't leave a deep fillet. Use the square edge of a file, and carry the bottom lines right up against the grip, making the angle between butt stock and grip and clean at lower side, the grip blending into stock at its thickest part. Figure 90.

Now our stock is all shaped up except for a little trimming around the action. The receiver being slightly cut away for the ejection of empty cases on the right side, the wood is sticking up a little along this edge. Take a rattail file and cut down at each end, against the barrel ring and receiver bridge, then cut out the excess wood between the file cuts with a sharp chisel, then file the wood thinner in toward edge of receiver, making it somewhat like Figure 65C, in Chapter 9.

If desired to use the magazine cutoff, the notch for it should now

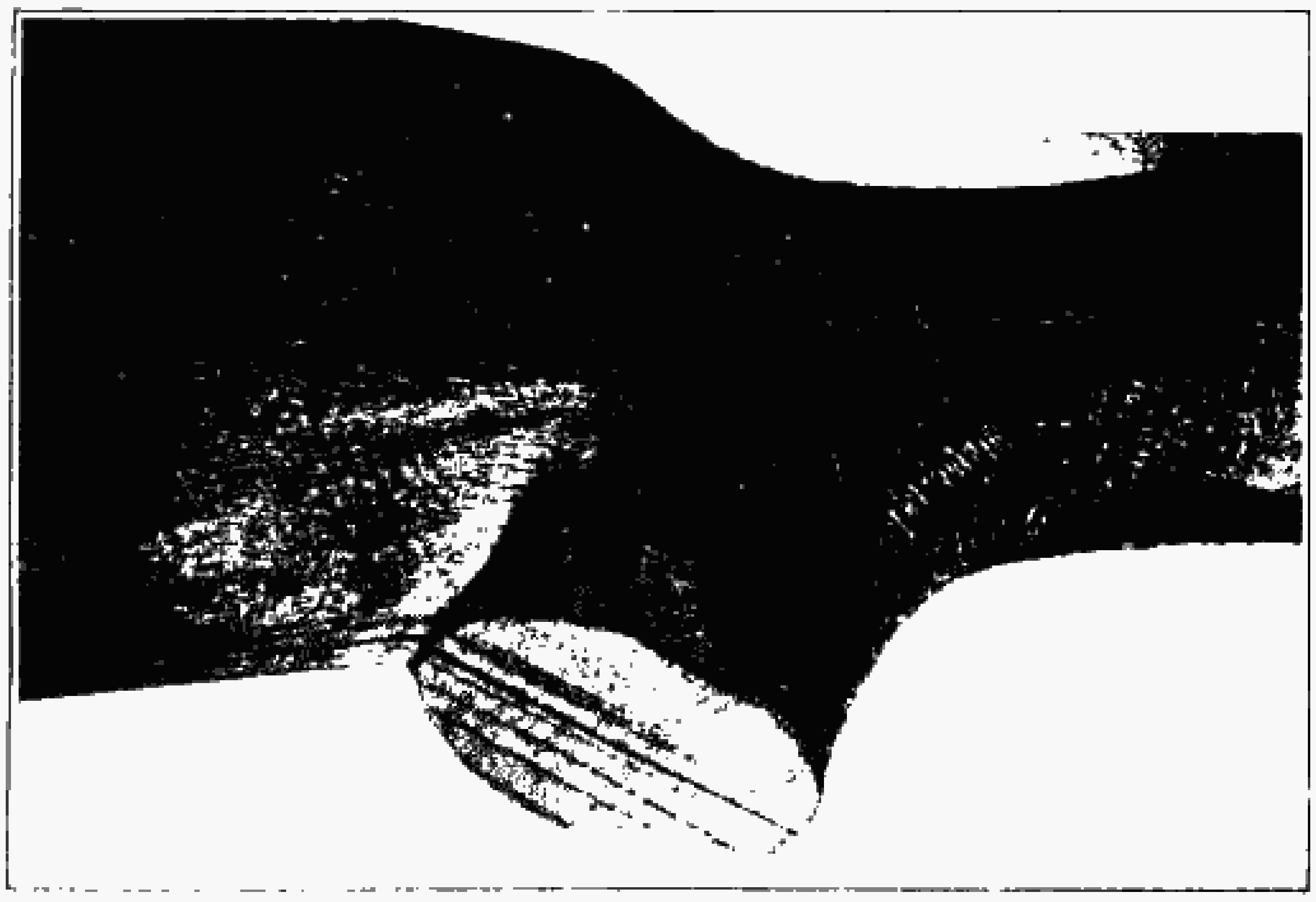


Fig. 90

be cut in left side of stock. Since a cutoff is not needed on a sporting rifle, I prefer to omit this notch on a Springfield stock, rounding off the stock at left of action just enough so the cutoff may be turned straight out for removal of the bolt. If the notch is desired, however, it need not be cut as wide or as deep as in the service stock. Make it just large enough to hold the cutoff, and let the latter turn down to an angle of only about 45 degrees, instead of nearly straight down.

159

When the stock seems to be exactly right as to form and size, it is a good plan to assemble the gun and take it out for a little target practice. Try it out in all the positions you expect to use—you may find a few changes necessary. The high, snug fitting comb that seemed so perfect in the shop, may punish the cheekbone severely under recoil, necessitating cutting it down a sixteenth inch or so. Again, the comb may be too thick, or the cheek piece require tapering a bit more forward, or thinning at the bottom edge a trifle. No harm will be done by taking the wood file to the range and working down a little here and there as required. After all, there's nothing like the "cut-and-dry" method to really fit a stock.

Having assured yourself that the stock is right, the next step is sanding. Hold it in the vise, protected by the felt pads, and go all over it from one end to the other with a strip of No. 1/2 carborundum cloth, used like shining a shoe. Do not bear much pressure or you will make deep cross scratches. This preliminary cross sanding removes all the file marks, and takes out any slight inequalities in the surface.

STOCK IMPERFECTIONS. Now look carefully over the entire surface for imperfections such as "shakes," dry-rot, or small splits or knots. Often these do not extend to the outer surface of the wood, and show up only when the stock is about finished.

A "shake" is a small (or sometimes large) separation of the fibres of the wood, caused by the fatigue resulting from the swaying of the tree in the wind. It appears as a small crack or split, almost anywhere along the side of the stock. It may not be deeper than 1/16 inch, or it may run nearly through the wood. Unless located where it materially weakens the stock, such as at the tang, a shake will do no harm, and may be permanently repaired as follows:

Wet the stock where the shake appears, then dry over a good hot blaze. This will open the crack slightly. Now, while the wood is quite warm, rub some thick orange shellac over and into the crack. Heat a bar of iron about as hot as for soldering, and rub it over the shellac, burning it into the crack. The iron should be hot enough to make the shellac smoke and smell. Sand off the surface, and if the crack is not fully sealed, repeat the treatment several times, or until it is sealed. Then sand down smooth, and when finished, this crack will never open. Very small splits and seasoning cracks may be treated in the same manner, unless located where they will weaken the stock.

Dry-rot often occurs in imported wood that has been in storage for years, with weather conditions not right—and sometimes it does not show up until the stock is all shaped and sanded. It is evidenced by a streak where the wood looks "powdery," the outer layer being partially separated for a short distance, and the powdered rotten wood beneath sifting out. Sometimes such a place can be worked out by reducing the dimensions slightly, but as a rule the deeper you cut

160

the worse the condition. The best thing to do is treat the place with shellac as described for windshakes, after first soaking the spot with shellac thinned down with alcohol until scarcely thicker than water. Let this dry, then burn in the thick shellac several times, and sand off. If this doesn't cure the trouble, throw the stock away—and swear. The latter injunction is doubtless superfluous.

Very small "pin" knotholes can be plugged. Whittle out walnut splinters to fit, dip them in du Pont Cement, and drive them in, cut them off flush, and sand smooth.

Larger knotholes are sometimes plugged, and sometimes filled with Plastic Wood. The best way is a combination of the two methods. Find a scrap of walnut with a knot about the right size. Whittle and file this knot until it fits the hole easily. Coat inside of hole with du Pont Cement, then a layer of Plastic Wood. Coat the plug with the cement and drive it snugly into the hole, letting the plastic wood and surplus cement squeeze out around the edges. Let this dry at least 48 hours, file off smooth, and sandpaper.

After all defects have been repaired and the stock cross-sanded, it should be sanded lengthwise of the grain with Number 1/2 sandpaper or garnet paper, when it is ready for the final sanding and finishing as described in Chapter 13.

FITTING TWO PIECE STOCKS. When the principles and practice of inletting and shaping have been learned on any one stock, the worker will be able to go ahead on almost any other kind of stock with little difficulty.

These principles vary, however, with the two piece stock, on which some further instruction may prove helpful. On the bolt action stock the action is bedded straight down into the wood. With a two piece stock, the tangs must be let *down and back* into the grip portion, and a clamp like Figure 28C is the first essential. This may

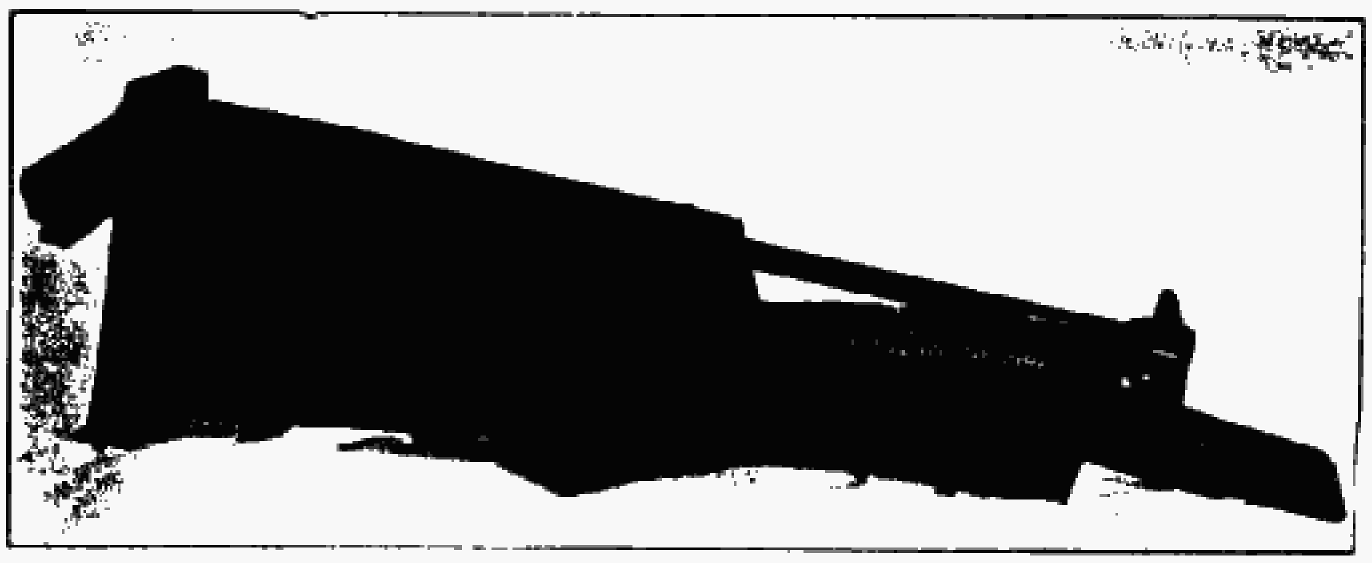


Fig. 91

be made of two 3/8 inch bolts about 15 to 18 inches long, and two pieces of cold rolled steel 1 inch by 3/8 inch, and 4 1/2 inches long.

161

These pieces are drilled at each end to slip easily over the bolts. As the nuts are tightened up, the action is drawn back tightly into the stock recesses.

On many rifles the lower tang may be removed from the receiver, while on others both tangs are made in one piece with receiver. When possible, remove the lower tang; set the upper tang in position on upper part of grip portion of blank, and mark round it with a pencil. The tang of course will not go back to place, but will be somewhat forward of its proper position. Cut out the recess for the tang, working in the manner described for inletting the Springfield guard—cutting across the grain wherever possible. Coat underside of tang with lampblack and oil and try it in the channel you have cut. Remove the surplus wood as indicated by the black smudges, and carry the tang mortice back a little. When within 1/4 inch of its final position, put on the clamp as shown in Figure 91, and tighten it up—but not so much as to split the grip. Remove and continue the cutting, until finally the clamp draws the receiver firmly against the end of wood. If the angle here is not correct, it should be worked off as required with chisel or file, and the tang mortice carried back the required distance to make all joints tight. This fitting should be done with all working parts—springs, screws, hammers, etc., removed from the action and inside of tangs.

Now rasp down underside of the grip to nearly its final size, and with the receiver and stock blank clamped together, fit the lower tang in place in receiver, and mark its outline on underside of grip. Cut the channel for it slightly undersize, then fit it tightly into receiver in its permanent position, and gradually let it back into the stock, just as you did the upper tang. When both tangs are fitted, locate and drill tang screw holes before the clamp is removed. Then remove the stock, replace hammer and trigger springs, and other inside parts. On old stock note the cuts for these parts, and rough cut them in the new stock. Coat all parts with lampblack, and let the assembled action into stock, cutting away any wood where needed, and drawing the receiver up tight with the clamp until the tang screw may be turned in to place.

The blank being fitted to the action, try the trigger, hammer, lever and other parts to be sure the wood is not binding at any point. If it binds, coat all parts with lampblack to show where wood must be removed, and trim out as required.

Now draw a center line back from the center of both tangs, and you are ready to fit the buttplate and proceed as already described.

The work is considerably more difficult when the lower tang cannot be removed from the receiver. Take careful measurements from the old stock; cut the grip portion of blank nearly to right thickness from tang to tang; cut both tang recesses slightly under size, and let them back gradually, as the clamp is tightened.

On most rifles the tangs are tapered toward the rear, which enables

162

the stocker to secure tight fit along the edges by carrying the inletting back toward the comb.

The Savage '99 Model rifle is easily stocked, although it looks like a tough job at first glance. Have your blank an inch or so longer than required, and mark on each end the center point for the hole to be bored through lengthwise, into which the long stock screw is inserted. This must be a two-diameter hole, as the head of this screw goes well up toward the grip. Measure the screw, and mark the position of the head on outside of stock, leaving about 1/2 inch extra length at receiver end. Now measure back from this mark to butt, and set a bit or drill of the right size to accommodate screw head in the chuck of a machine lathe.

This bit should project from the chuck the exact distance required to make the hole the right depth. Set spur of bit in center point on butt, and set the dead center in the tail-stock on the point marked on receiver end of blank. Turn the lathe slowly, holding the stock blank in the hand to prevent turning, and feed with the hand feed on tail-stock. When the bit is in the wood as far as the chuck permits, withdraw it, and insert another and longer bit in the chuck, this bit to be the size required for the stock screw. Replace the blank as before and continue the hole (the smaller bit will readily find the center left by the spur of the larger one) until point of drill touches the dead center in the head stock.

Now measure the width of tangs and lay out their outline on center line of stock. In case the drill happened to run a trifle sideways, locate your center lines with the center of the hole. With ripsaw and chisels, remove the excess wood and inlet the tangs to final position, using the stock screw to draw the blank up tight against receiver. The stock is now ready for final shaping up.

The above method of drilling a stock lengthwise may be employed on the Lee Enfield, the Ballard, or any other stock held by a screw set in through the butt. On the Lee Enfield, there is a deep socket at rear of receiver into which the grip is fitted, and the depth of this socket must be allowed for when cutting the blank to length.

In shaping up a stock thus attached, the exact position of the screw must be carefully penciled on both sides of the stock, so that you will not, perchance, cut into this screw in cutting the grip to shape. As a rule this hole comes close to the surface of the wood just ahead of the comb.

FITTING SHOTGUN STOCKS. Several of the pump shotguns have the stocks attached with a long screw through the butt, and the same method of boring the hole may be applied to them also. This scheme has a number of other practical uses—for example, the deep hole for recoil spring which runs back into the stock of most automatic shotguns. Boring this hole with brace and bit is an uncertain method. The position of the hole may be laid out on the sides of the blank, and its center line projected to a point in the

163

butt, which is held against the dead center in lathe, while the drill enters at the proper angle at front end of grip. It is evident that the mechanism of the arm would not function if this hole were not properly located and set at the correct angle—hence this lathe method eliminates all uncertainty.

It may be desired to restock some rifle having the magazine located in the butt, like the Remington or Winchester .22 Automatics—here again we have the only accurate and easy method of drilling the holes in the right place and at the correct angle.

The fitting of a stock to a pump or automatic shotgun is quite similar to fitting a two-piece rifle stock, and the same general instructions will apply. Once the tang is fitted to the blank, the stock may be shaped in any manner desired, following the working details already laid down for rifle stocks.

But stocking a double gun is a different matter—as previously stated, this is a job I dislike, and avoid whenever possible, because it is so everlastingly slow and tedious. Most gunsmiths, however, get a great deal more shotgun work than they do rifle work, and become quite adept at stocking double guns. The work is really very much the same as stocking a rifle with a two piece stock, and is only slower and more difficult by reason of the great amount of wood removed from the stock, due to the design of the action. Because of this, the thin walls of wood left are not strong, and the greatest care must be exercised to prevent breaking the edges.

The first move in inletting a stock for a double gun with side locks, is to completely strip the receiver of locks, trigger bar, top lever, locking lug, safety and everything that will come off. Get the angle of the recoil shoulder and saw your blank as nearly correct for it as possible. The blank should be extra full in all dimensions. Now inlet the upper tang and draw it in to a close fit with the clamp, just as you did in the two-piece rifle stock. Keep your tools very sharp and cut the edges clean—work slowly and take no more wood out than absolutely necessary. If using a full, square blank, let the tang in an eighth inch or so below the surface, to give you some leeway on final measurements. If using a rough turned stock almost worked down to size, you will have to take drop measurements as you go. This is done easiest with a long straightedge (I use a bar of hardened tool steel 4 1/2 feet long, 1/8 by 1/2 inch in size), resting the edge at one end on top of front sight, and on the matted rib at breech, the other end projecting back over the stock. From this edge the heel and comb measurements are easily made with inside calipers.

Next remove the triggers and springs from the trigger bar, fit the bar in place in receiver, and let it into under side grip. This is a job requiring care and patience. Keep the receiver tight against the stock all the while with the clamp. It is well at times to set a short wood screw into the upper tang also. The lug for tang screw

164

on trigger bar has a sloping shoulder. This shoulder, as well as the top of the lug, must fit tight against the wood—otherwise the tang screw will spring the trigger bar, throwing the whole works out of "kilter."

Next strip the lock plates completely, file the wood down nearly to proper width where they go in, and let in the plates. Their forward ends will start into the recess in receiver, and they may be gradually let into the wood at rear by coating the underside and edges with lampblack. Now, using the old stock to go by, sketch in with a pencil the outline of the inside recesses under lock plates, then locate and bore the hole for the sears. This should be bored through from both sides.

After rough cutting the recesses under the lock plates, assemble the locks, coat all parts with lampblack, and start them into place. Guided by the black smudges, cut out the wood as required, so the locks will go into place. Use care when inserting and removing the lock plates to prevent chipping the edges of wood. Best have a trifle of clearance all around—about enough so that a thin piece of paper can be inserted—and the oiling later will swell the wood enough to eliminate any gap. Bore the hole for the lock plate screw from each side, and set in the screw. Try the hammers to see if they cock easily—the tumblers may bind against the wood as the hammers are brought back. Now turn the stock bottom side up, fit the triggers into the trigger bar, and replace same in stock. Copy the recesses in old stock when fitting the triggers, and be sure they work freely. If they bind or catch, coat them with lampblack to locate the trouble. When all is working smoothly, let in the guard. If the shape of the grip on the old stock is to be changed, the rear end of guard should be first bent as desired, then let it in carefully to prevent changing its shape, and the grip will be right when the wood is worked down flush with guard. Now remove all parts from the stock, and again using the old stock as a guide, outline with pencil the additional recesses required under the tang, for top snap spring, safety, etc., and cut out the wood where necessary. Do the final fitting with lampblack, as before. In the face of stock cut out the hole for the locking lug, and other recesses as indicated by the old stock. Now reassemble, making sure that all parts work smoothly, and proceed to shape the stock as desired. (See comments on shotgun stock design in Chapter 9).

Box lock guns are fitted in pretty much the same manner, but the job is easier because there are no lock plates to be let in. Proceed as before, letting in the top tang first, then the trigger bar and other parts that go in from the bottom. So much wood is removed from the face of the stock that great care is necessary, also very sharp tools, to prevent splitting. At all times be sure to take out no more wood than is absolutely necessary—there's little enough left at best.

FORENDS. Since we started with rifle stocks, we will go back

165

to the point where our two piece butt stock was inletted and ready for shaping. Now comes the forend. On rifles, as a rule, the forend is easy to make and fit, being, in most cases, merely a grooved piece of wood held to the barrel by one or two screws, with its rear end sometimes set into a shallow socket in front of receiver.

First take off the old forend and study it carefully. Note any peculiarities it has, and decide how they may be most easily copied. Have your forend blank sawed out square, and an inch longer than desired. With the marking gauge scribe a center line all round. Mark with chalk the exact point on barrel where tip of forend is to be. Measure barrel at this point with outside calipers, and with dividers prick half this distance on each side of center line near one end. In the same manner lay out the diameter of barrel at other end, and connect the points thus formed with a fine line.

If the barrel has a straight taper, as most single shot rifles do, the work is going to be easy. If you have or can borrow a rabbetting plane, the groove may be cut out almost to size, and finished to taper with chisels, as already described. Gauge its depth and roundness with a try-square by the method given earlier in Chapter 10. Make the groove to fit the barrel easily at a point 1/2 inch *ahead* of its final position. Now coat underside of barrel with lampblack and oil, and fit the barrel closely, gradually working the forend back to final position. This method keeps the edges tight, without any possibility of gaps between barrel and wood.

If the end of receiver has a socket for the forend, as in the S. S. Winchester, coat this with lampblack and tap the forend against it —this gives you the outline for shaping the end. Cut the shoulder sharp and square as you work the forend back.

To locate the screw holes, first clean out the hole or holes in bottom of barrel, and sandpaper the barrel channel clean. Coat the barrel thickly with lampblack at this point and press into forend. Drill hole from the inside through the spot thus shown. To fit the escutcheon or bushing for the forend screw, use a sharp counterbore of the proper size to start it, or outline the hole with a small gouge of the right size, and chip out the wood inside the line. Then use a Forstner bit of the same diameter as the bushing, and press bushing to place.

Most of the shaping up of the forend can be done right on the barrel. It is nearly impossible to hold it in the vise safely and firmly. A good plan is to turn up a hardwood rod the same size and taper as the barrel, and a few inches longer than the forend, which is held to it with a wood screw through the bushing, then the end of this wood bar can be held in the vise and turned about as required.

Making a forend for tubular magazine rifle is not so difficult as would appear. Square up the blank, scribe the center line all round, and bore the hole for magazine tube in a lathe, as described for boring butt stocks. Lay out the shape of barrel channel on each end,

166

and cut out with chisels. Spot rear end and fit to receiver with lampblack; fit forend cap in the same manner. Then shape up as desired by rasping and filing.

When shaping the outside, be careful not to crack or split the forend, which is merely a shell of wood. A hardwood rod should be dressed down to a smooth sliding fit in the hole through forend, and this rod may be held in the vise while the shaping is done.

Forends for pump guns and trombone action rifles are bored out as already described, then fitted over a hardwood arbor and turned to shape and size. The upper edge is then planed or rasped flat to desired width, and barrel channel cut as before, after which the end caps are fitted by spotting with lampblack.

A forend for a Winchester, Remington, or Browning automatic shotgun calls for patience and careful workmanship. Due to the large hole for the magazine tube, its side walls are very thin and easily broken. Bore it out between lathe centers, using a very sharp auger bit, and turning the lathe slowly by hand, while holding the blank to prevent it from being turned by the bit. It may be necessary to use an expansive bit for this job, the shank of which will be too short to permit boring clear through the blank. In this case, bore half through, then turn up a hardwood cylinder to a snug fit in the hole. Reverse ends, centering the dead center of lathe in center of this wood cylinder, and bore until bit cuts into the cylinder. Now turn up another cylinder several inches longer than forend, on which to hold it in the vise—as this type of forend must be shaped with the rasp.

In my humble opinion, one of the meanest jobs in the whole field of gunsmithing, is the FITTING OF FOREND IRONS of double shotguns. The amateur who is short on patience will do well to buy his forend blank with iron fitted, from Schoverling, Daly and Gales, unless he is using the original forend iron on the gun. In that event he must fit it himself, as no two irons were made to quite the same shape or dimensions. The fitting, while seemingly simple, requires utmost care. Plane up your blank until it is just slightly thicker than the finished forend is to be. For the first time, attempt nothing more elaborate than the plain, shallow "regular" type of forend. Strip the old forend and keep it before you while you work. The job is similar to inletting the upper tang of the stock. As the tang is seated into the wood, the end of wood must at the same time be brought up tightly against the face of the iron at end. A wide opening vise in which the forend may be tightened up endwise, is a big help in this work. The tang must be bedded deep enough to take care of the shallow barrel grooves on upper surface. When the upper iron is fully fitted, drill holes for the screws, and fit the outside plate, cutting out wood where necessary to permit the catch to operate freely. It is difficult to hold this type of forend while shaping up, and it will pay to have the blank about three inches

167

longer than wanted, so that this end may be held in the vise while the piece is rasped and filed to shape. The barrel channels on upper side of forend should be smoothly sanded, and this surface polished and finished as carefully as the outside. A forend with inside unfinished indicates a sloppy workman.

Sometimes the owner of a double gun will want a big, "handful" forend on it. This is made in the same manner as just described, except that the deeper barrel channels must be cut before the forend iron is fitted. Spot the fitting with lampblack, and cut the channels almost to final depth. Then fit the forend iron, and deepen the channels until the catch operates freely.

168

CHAPTER 12

CHECKING AND CARVING

IT should not take long to say all there is to be said on the subject of checking, because the tools used are simple and few, and the actual operations are equally simple. About the only rule to be laid down is, first, learn the proper method of handling the tools to cut straight, parallel lines—then PRACTICE.

Some years ago Charles Askins, in answering an inquiry through Outdoor Life, remarked in an offhand manner, "Anybody can checker a stock." I am not disposed to contradict this statement since Captain Askins placed no time limit on the period that might be required to enable an operator to turn out a strictly first class job; nor did he limit the number of stocks one might be permitted to ruin in the learning.

Checkering, or to use the correct term, checking, is an art requiring the utmost concentration, patience, and perseverance to learn.

Moreover, it requires a lot of optimism; for just as sure as the inexperienced man picks up a checking tool and starts in on his first job—just so sure is he to ruin that job. Make up your mind to spoil a few—and in order that the spoilage may not mount into too much cost, start in on plain pieces of walnut.

CHECKING TOOLS. To start at the beginning, there are but two tools essential to the stock checker; these are the line spacer, and the V-tool, or deepening tool, as it may be called. These are illustrated in Figure 18 and the making of these and others is described in Chapter 4. The gunsmith will have a number of spacers cutting lines of varying distances apart; and he may also have a number of V-tools having different sized teeth, for hard and soft woods. The two tools, however, are all that are needed for the job, with a fine file for smoothing up the diamonds.

But more important than the cutting tools, is a suitable cradle

169

for holding the stock being checked, so that it may be turned about as you work. Descriptions of the checking process usually omit all mention of this cradle, without which it is absolutely impossible to do any kind of a job. If I had to choose between doing without checking tools and doing without the cradle, I would choose the cradle, and try to do my checking with a saw file! Details of the checking cradle are illustrated and two different types are shown in the following photographs. One is made of a piece of hickory, 2 by 4 inches in size with iron brackets sliding in a groove on top, and

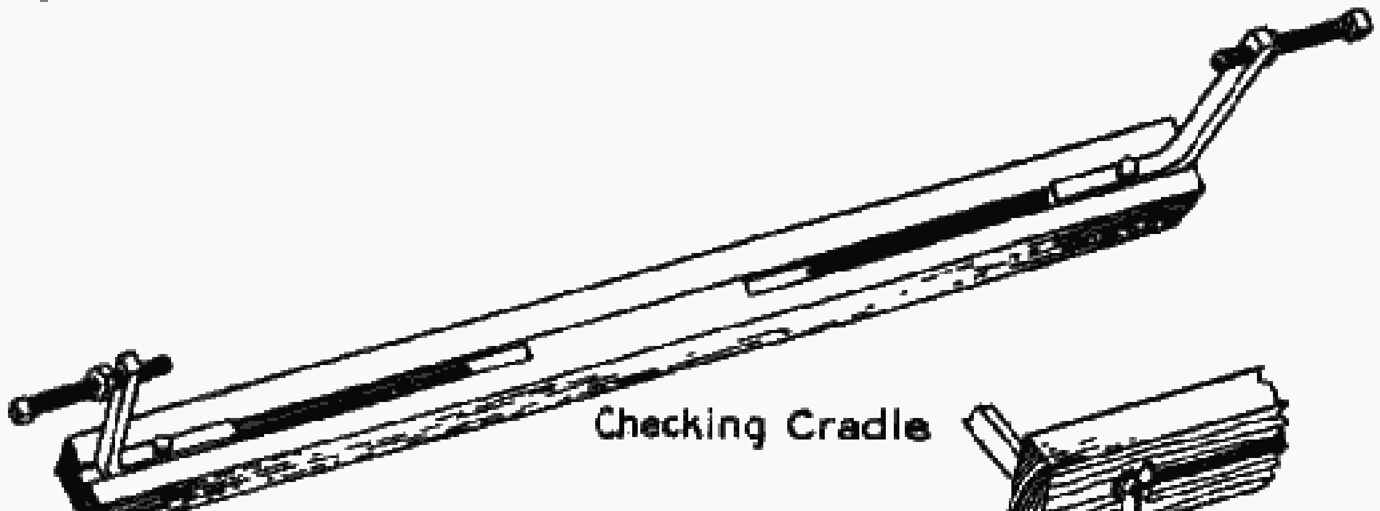


Fig. 92

held in position by a cap screw and wing nut. The other is made of 2 by 3 inch T-bar, and is unnecessarily heavy and clumsy.

The cradle is first set in a convenient position in the vise, and the stock set in the cradle as shown, using a round piece of wood laid in the barrel channel and held by a single wood screw, as a bearing point. The two set screws should be tightened up enough so the stock will not turn under pressure of the tool, but may be readily turned by hand.

PRACTICE CHECKING. Before starting on a brand new job of checking, it is best to have some practice re-tracing an old job. This requires the use of the V-tool only, and while this is usually the second tool used on a job, it is by far the most difficult to handle, so it should be mastered first.

The best practice I know of for the beginner is a double barrel shotgun forend, and since most forends have the checking pretty well worn down, it isn't difficult to find one. Moreover, the practice work I am going to describe will not damage the forend, even if this is your first attempt. So don't hesitate to try it on the forend from your own gun if unable to borrow one from a friend.

Cut a piece of 1 by 2 inch pipe long enough to fit between centers in the cradle. Set the screws up on each end of it, and fasten the forend, bottom up, to the middle of this piece, by a wrapping of tire tape about each end. Now take the V-tool and start in at one of the rear points in the checking design, holding the tool as shown in Figure 93. Note that right forefinger is extended alongside the

170

shank of tool, not on top of it. The right hand exerts no pressure other than weight of the tool. Pressure is supplied with the left thumb, and should be *very light.*

Now push the tool forward in the line of checking, working it back and forth with a filing motion, but advancing it about one-half inch with each stroke. Let the tool follow the groove easily, and do not stand with the eyes directly above the work. Keep the hands slightly in front of you all the time—this makes it easier to see the groove and follow it in a straight line. Make no effort to deepen this groove to its full depth the first time over—barely clean out

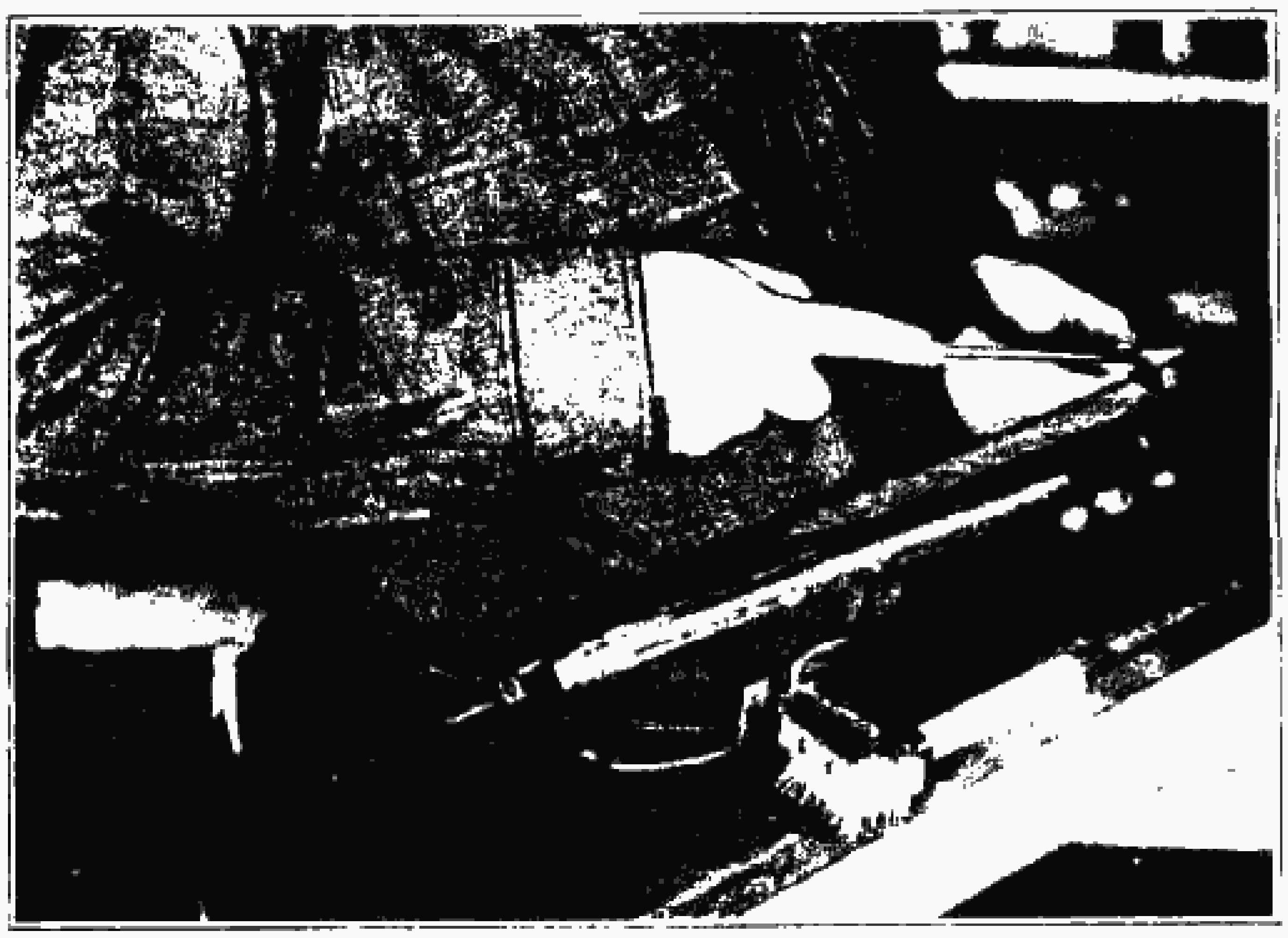


Fig. 93

the bottom with the edge of tool. Work carefully to the extreme end of line—then STOP. No need for running the checking out over the border.

Now go back to the starting point and trace the second line in the same manner. Keep a stiff bristle brush handy and brush off the dust after tracing each line. Continue line after line until you have re-traced the entire design in one direction, then change your position, or swing the cradle around and retrace the cross lines in exactly the same manner.

The appearance of the checking will now be greatly improved despite the very light cut. Brush off the surface, and start at the beginning again, deepening the lines *slightly.* Make every cut the full length of the line—dont think you can stop in the middle and then finish later from the other side. *It can't be done.*

171

The shank of the tool should be in prolongation with the bones of the forearm and wrist. Never let the tool start the least bit to one side, and never tilt it, or it is sure to ride up the sides of the diamonds and jump over into the next line—spoiling a line of diamonds in the jumping. Keep the tool well out in front of you at all times, and "sight" along the lines frequently to make sure they are not wavering.

After going over the design four or five times you will find the diamonds almost sharp pointed, and if you have done your work carefully, they will be quite as even as the original checking when the gun was new. Now take your "checking file," which is an American Swiss three-square escapement file with the point bent slightly, as described in Chapter 4, and using it in the same manner as the V-tool, carefully go over the lines once or twice, bringing the diamonds up to sharp points.

If the wood is dry it is a good idea to keep a few drops of linseed oil on the brush which you use for brushing off the dust after each cut. This not only polishes the diamonds slightly, but also makes each new cut show up very distinctly, helping to prevent running off the line. When the job is completed to your satisfaction, retrace the outlines carefully with the V-tool, then with the file, then scour the diamonds vigorously with linseed oil on the brush; wipe off excess oil with a soft cloth, then brush dry with a clean brush, and the job is finished.

Having successfully re-traced the checking on a shotgun forend, don't get the mistaken idea that you are able to do checking. Repeat on three or four more forends, by which time you will begin to have some understanding of the possibilities and limitations of the V-tool. Then try a shotgun butt stock in the same manner. To hold the stock in the cradle, carve out a small block of sound wood to fit squarely against the recoil shoulders at front end of stock, with projections on the wood to reach into the action cuts. Tacking small blocks of leather to this piece will enable you to shape it easily so it will not slip off the stock. Set one of the set-screws on cradle-bracket into this block, and the other one into the butt, after having removed the butt plate. If the stock has a recoil pad, hollow out a block of wood to fit over center of pad, and set the screw point into this.

Begin on one of the upper outlines of the grip checking, and follow it with the V-tool in the same manner as you followed the lines on the forend. Turn the stock as you advance the lines, so that the tool is always held in approximately the same position. Retrace all the lines one way, then go over the cross lines. Then take the other side of grip in the same manner. The lower curved portion of pistol grip is the most difficult point to check, as in following the unequal contour it is quite easy to let the lines run off a trifle to one side—which is ruinous to a good checking job. The shotgun

172

stock is selected for beginners' practice because the grip has less curve, and is easier to handle than a rifle stock. The checking of a good close pistol grip on a rifle is a job for "few men and no boys" as the saying goes—and the closer the design approaches the forward lower curve of grip, the harder it is to handle. Moreover, a very full rounded grip offers far more difficulty at this point than one that is more nearly flat on the sides.

Having completed this retracing of the grip design with more or less success, try it on a half dozen other stocks. Then—and not sooner—you will have acquired a fair mastery of the V-tool, which will be a big help later. Some excellent further practice may be had if you can persuade your local hardware or sporting goods dealer to allow you to finish the checking on his cheaper guns. These usually are not checked at all, but are merely scored with shallow lines, and the appearance can be wonderfully improved by an hour or so of work with the V-tool. As a rule it is impossible to hurt the appearance of these stocks—and you might improve them some.

While doing this re-tracing of old checking for practice, you should prepare some scraps of walnut for practice with the line-spacer. Select pieces about the size of a shotgun forend, and round them off to about the same shape, sand them smooth, and give them a regular oil finish. They should be as well finished as any stock, and the oil should be pretty well cured in. In selecting scraps for this purpose, try to find some that are soft, some that are hard, some curly, some straight, some open grained, and some dense. It is impossible to explain on paper just how some walnut handles under the tools—this must be learned by experience. Some walnut will permit the use of finer line spacing than others—this also must be learned by experience.

LAYING OUT CHECKING PATTERN: Now you are ready to start learning the first steps of checking. Select one of the pieces you have prepared, having a very hard, dense grain. Tape it onto the piece of pine as you did the first shotgun forend. Mark a pencil line down its center. About two inches from one end of this line, prick a dot with the divider point, or with an awl. Measure toward the nearest end 1 1/4 inches and make another dot. On each side of this dot, and at right angles to your center line, make another dot 1/2 inch from the second dot. Now lay a flexible straight edge, or strip of thin celluloid so that the edge connects one of the side dots with the first dot you made on center line, and mark a line with pencil connecting the two, and continuing until it runs off the side of the walnut. Next connect the other side dot with this same center dot, and continue the line until it runs off the other side. These two lines now form an angle which will make the diamonds two and one-fourth times as long as their width. Checkers' ideas vary as to what constitutes the correct proportions for diamonds, some even making the length four times the width. Usually the

173

most pleasing ones will run from two and one-fourth to three times the width. If made more nearly square they will fall far short of being attractive.

Having the two guide lines laid on with pencil, take your line spacer which cuts parallel lines about 18 to the inch; don't try to use a finer spacer at first, even though practicing on a piece of hard close grained wood. Hold the tool as shown in Figure 94 and use it with a filing motion, the same as the V-tool, advancing the cut about an inch at each stroke. Keep the tool well out in front of

Fig. 94

you, and run it *straight*. Any bend or inaccuracy in the first cut will be copied and increased in subsequent cuts. The right forefinger should bear on the tool with very light pressure, the left hand adding slightly to the pressure on the point, but not guiding it. The right wrist and forearm does the guiding. Advance the cut carefully until you have two very light lines, one of them on the pencil guide line, the other close beside it. DON'T TRY TO CUT THESE LINES DEEP. The line-spacer is just what its name implies, and is not intended for deep cuts.

After cutting the first guide line, swing the stock cradle round and cut the second one in the same manner, otherwise the pencil line will be obliterated. Now go back to the first one, and continue cutting parallel lines. You may work to the right or left of the

174

first line, as required—both edges of this tool are the same. Set the cutting edge close to the last line, with light pressure in the wood, move it sideways—"click"—the edge snaps into the line, ready to guide the next cut. Use a steady filing motion, always advancing a little with each stroke, and using constant care that the guiding edge *never* rides up the side of the cut.

At first you will find your lines spreading out fan-shaped, or running together. You will swear that the tool is no good, and the system worse. Only by practice can you acquire the steady, even stroke that pushes each line forward parallel with the preceding one. Another fault will be in permitting the lines to curve slightly toward right or left. They must be absolutely straight, regardless of the shape of the surface over which they are cut. Because there are almost no flat places on a stock, it is best to learn to work over rounded surfaces right from the start—then a flat surface will be mere child's play for you. Learn to cut the lines as straight as a die from one side to the other, no matter how rounded the surface, and you have mastered the essentials of checking.

Having successfully covered the surface with parallel lines running straight in one direction, next cut the cross lines, starting with the other guide line already cut. Cut every line its full length without lifting the tool. If they run out on you and you spoil the piece, file and sand the surface smooth, rub in some linseed oil and lay it aside while you try another piece.

First practice should always be with a fairly coarse spacer—cutting 16 to 18 lines per inch—and should always be on hard, dense wood. Soft open grained wood is very hard to check, and some of it will not check at all without "fuzzing" up the diamonds. The walnut used in the D. C. M. Sporter stocks is among the worst in this particular, for which reason I always duck a checking job on one of these whenever I can. Later, after you have mastered the technique of the spacer, you can use narrower cutters, spacing the lines 20, 22, or 24 to the inch—this on hard close grained wood only. Stick to the 16 to 18 line cutters for softer wood.

Having successfully spaced off the surface both ways—without any attempt at outlining a design—take the V-tool for a change and go over the lines to deepen them. This will be easy after your preliminary practice on old stocks. Don't try to finish the diamonds up to points—just go over them once or twice with the V-tool to keep your hand in. Then start in with the spacer again on another practice-piece. Use up the harder pieces first, then try your hand with the softer ones. Be sure to keep the brush handy and brush out each line vigorously—and always use a little oil on the brush. After you have successfully spaced off six or seven practice pieces, you may go back to the V-tool and bring up the diamonds to sharp points. Now—and not sooner—you are ready to try checking your first stock.

175

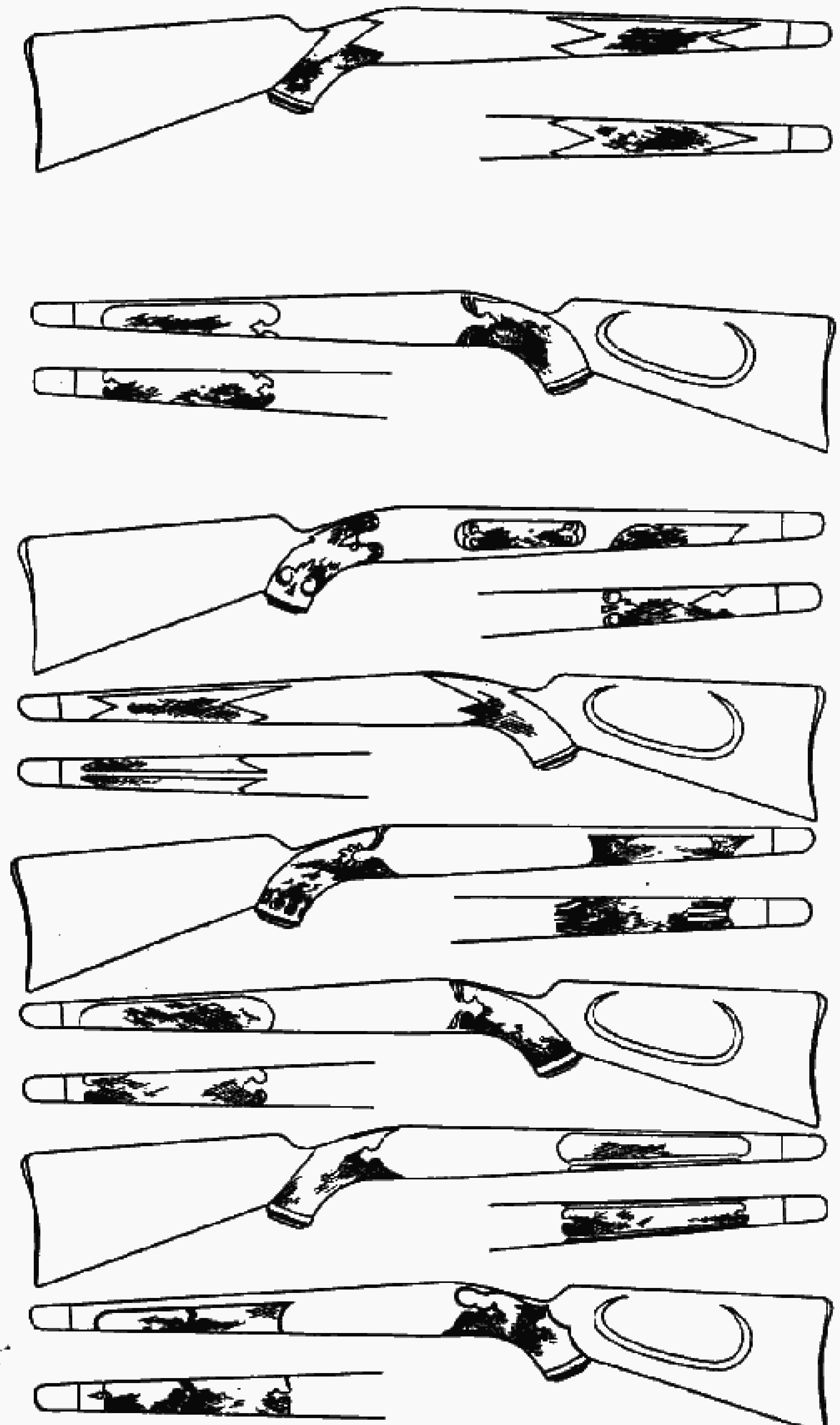
CHECKING DESIGNS: The first thing to do is to decide on the design. You may copy one from the plates shown herein, or you may copy the design from another gun, or you may make up a design of your own. The beginner, while admiring some of the curved or scroll outlines on high grade guns, is more likely to decide on a plain "point" design for his first attempt. And therein, more than likely, he makes his first mistake. The point designs, while appearing far more simple, are really much more difficult of execution than those having rounded or curved border lines. The reason for this is not hard to understand when you consider that the shape and size of the points depends entirely on the angles formed by the lines of checking. One may lay them out properly to begin with, then the least variation in spacing—and there is always some variation except with a few experts of long experience—will cause the checking to take a slightly different angle than was originally planned for it, so that the lines do not come up parallel to the border at the points, but meet this border line at a slight angle. Thus we have a "bastard" design instead of a true diamond-point—and you can find them on the best efforts of some of our leading makers.

When properly done the checking itself should form the border line of the points, and when it does not do so, you may know that someone has erred in his calculations. There are exceptions, of course, as when a design must be worked out to conform to some peculiar stock formation, when it is permissible to cut a border at an angle different from that of the checking lines. The very best English shotguns all have the points of the design formed by the checking lines themselves, and a perfect point design thus formed is the most expensive of all to produce.

Nevertheless we have come to consider the various curved border designs as the most ornate and representing the highest quality; so there is no objection to the beginner selecting such a design, as he will do much better with it, and be prouder of his results, than if he attempted a diamond-point and failed to do it correctly. And if successful it is not necessary that he explain all this.

The photos and line drawings shown herewith should prove helpful in choosing a design, or at least in giving the aspiring checker a starting point from which to work out an original design for himself. Full size outline patterns should be useless, as the varying shapes and sizes of grips and forends do not lend themselves to any standard size or shape. Some of the end curves, fleur-de-lis, and other shapes, may be transferred, however, and the result of the design worked out from them. To transfer a design, first trace it from the page on fairly heavy tracing paper; then with a sign painter's "pounce wheel" (similar to a dressmaker's "tracing wheel" but much smaller) the outline on the paper is perforated. This is then called the "pounce pattern." To use, lay it on the wood in correct position, and rub it over with a small wad of cotton dipped

176



A FEW CHECKING PATTERNS

177

in lampblack, to which a very little turpentine has been added, transferring the dotted outline onto the wood.

Before laying out any pattern on the forend, first draw a center line in pencil, and take all measurements from this line. Then lay on the end pattern if one is used, and transfer the outline. Sketch in the balance of outline carefully, measuring at all points from the center line with dividers to get it alike on both sides. The checking should extend up the sides of forend to within 1/4 or 3/8 inch of the edges. It is entirely permissible to work up a design wherein the checking is in two sections, separated up the middle by a straight or wavy "ribbon" of unchecked wood. The grip may also have such a ribbon separation through the middle of the design on each side, and if artistically worked out they are very attractive. Many a man has raved over the design of checking used on his gun, little thinking that the ribbon was worked in to separate the otherwise long lines, thus making the job much easier, and helping to prevent mistakes. It's a wise gunsmith who recognizes the limit of his ability!

I would strongly recommend that the beginner's first forend job should have the checking thus separated up the center. Cutting a perfect line from one side clear across to the other tasks one's abilities to the utmost; and while you may have had plenty of this sort of practice on the scrap pieces, remember this is a stock you're about to work on, and you can't afford to spoil it. Keeping perfectly straight even spacing from one side of a deep rounded forend to the other is not a job to be undertaken facetiously, nor without much prayer and meditation.

Having the design marked out carefully on the forend, which we will tackle first, take the checking file with point slightly bent, and go over this outline very carefully, cutting it very lightly into the wood. Now decide on the shape diamonds you want. If you decide on "3 to 1," let us say, proceed as follows: Measure off 1 1/2 inches from the end of design and make a mark on center line. Now make a mark on each side of center line at end, and one-half inch away from it. Connect these points with two lines which will cross each other at the correct angle to give diamonds 3 times as long as their width.

Now decide on the width of your spacing, making use of the experience gained on the scrap pieces. Better not undertake to make too small diamonds on this first job. The practice work may have led you to have confidence in yourself, but it is best to take no chances. Good 18 point checking is preferable to poor 24 point diamonds.

CHECKING THE FOREND: Select the line spacer you propose using, and start off exactly as you did on the scraps, first cutting the two guide lines you have ruled off, then going back to the first one and filling the entire outline with parallel lines run-

178

ning in one direction. Again—*do not try to cut these lines deeply.* Just a faint scratch the first time over; then, the other side of spacer running in this scratch as a guide will deepen it, while scratching another line; again, the second line will be deepened while the third one is scratched, so that when the space is filled each line has received two light cuts—and this is enough. Brush off the dust after each line is cut, and always use a little linseed oil on the brush. When all the lines are cut one way, start in at the second guide line, and cut them all the other way. Should you find the spacer riding out and "wide spacing" or "narrow spacing" at any time, stop immediately. With a fine file carefully work off the lines at this point; rub smooth with fine sandpaper, and go over and correct the spacing. Nothing so mars a job of checking as extra or "dutchman" rows running part way across the design, and tapering off into nothingness. They are absolutely inexcusable, and no self-respecting stocker would turn out a job with them, even if he had to make a new stock. Here is another reason for making the spacing lines very light—mistakes may be corrected without materially affecting the shape of stock.

Start the lines as close to the border line as possible without actually touching it with heel of tool. The finish ends can be brought up close to the opposite border line—actually touching it, if one is careful, without running over it. Then go back from the other side and finish the first end up against its border line.

The lines having been evenly spaced in both directions, they are then deepened with the V-tool, working carefully up against the border line, or rather the outline, at each end of cut. Use the V-tool with light pressure, just as you did in re-tracing the old checking design. Do not try to finish the lines to full depth in one direction first—you will simply obliterate the cross lines, and it is impossible to space them correctly after the first lines are cut deeply.

Keep going over the lines, first one set, then the other, gradually deepening both sets until the diamonds are nearly sharp. Then finish with the bent file as already described.

Getting into very small corners, short curves and angles is difficult with the spacer as well as with the V-tool. Do not try to work too far into such spaces, or you will run over the outlines and spoil the job. Work in as close as you can conveniently by tipping the tool slightly toward its point, then make the rest of lines with the file, as there will be only four or five such lines, and they will be very short. It is often best to omit this corner work until the diamonds have been entirely completed. Then take care of them with the file when touching up.

Having checked the entire design, go round the entire outline with the spacer, the inside of tool riding in the light outline first made, and the outer teeth cutting a second line. Use the cutter thus on all straight sections, and if you handle it well you can use it on the

179

wider curves. Do not try to run it around very short curves, however, but use the point of the bent file, and space it carefully by eye. Now deepen both these outlines with the V-tool along straight sections and wide curves. On narrow curves, use the small veining chisel mentioned in Chapter 3. This double border line should be about the same depth as the diamonds, and spaced the same. Fancy triple border lines are out of place on curved designs, as the three-cut border tool will not follow the curves. A single outline is in still better taste, but should not be attempted until you have had considerable experience. The double line is recommended as being neat, and is a help in hiding any small marks where the tool has run over the first outline.

Inspect the checking carefully, touching up the lines at ends with the file, and deepening slightly where necessary. Finally, give the checking a good scouring with stiff brush and plenty of linseed oil. Then wipe off all the oil, brush with a clean brush, polish up around the edges with the hands—and there you are.

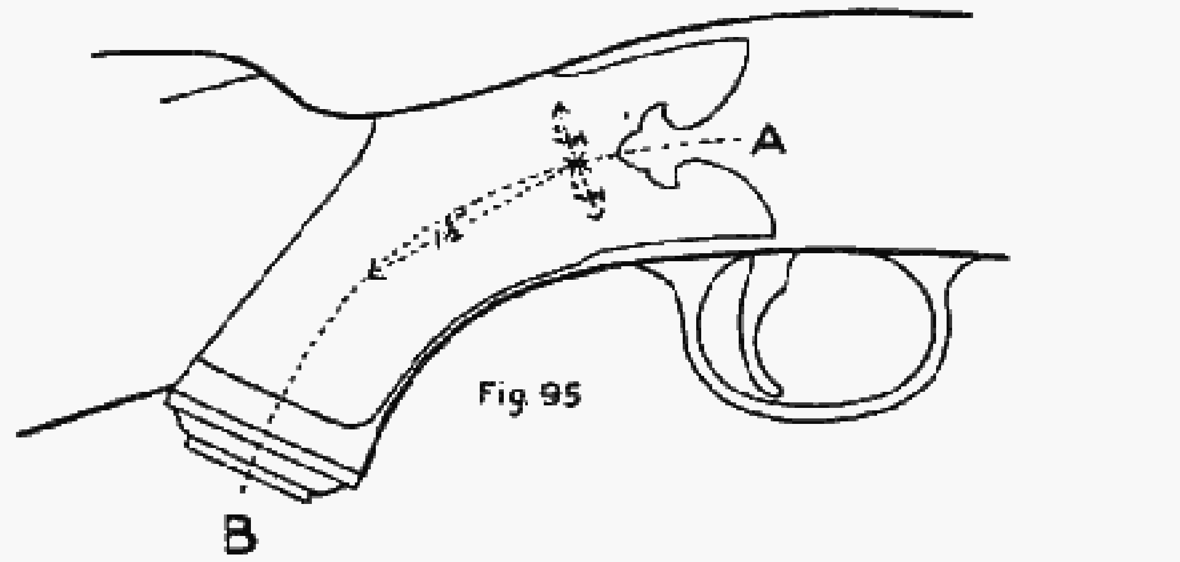


Fig. 95

CHECKING THE GRIP. Now for the grip. Select a design to harmonize with the forend design, and if possible make pounce pattern for the end shape. The same pattern can be used on both sides of grip by turning the pattern over. First, draw a center line A—B, Figure 95, following the curve of the grip. Lay out the proper distance to form the desired shaped diamonds on this line, just as you did on center line of forend. Cut the two guide lines in the same manner after marking the outline of design and cutting it lightly. Then fill in the spacing lines as before, working on both sides of guide lines until the space is filled, then deepen these lines with the V-tool and finish as before.

In laying out a grip design, the checking should not run too far under bottom of grip, for here you get into difficulties. You are cutting on an inside curve here—a mighty difficult thing to do,—and the less you have of it, the better you will get along. Draw a center line on bottom of grip, from rear of guard to grip cap, and for your first job, better let the checking stop 3/8 inch from this

180

center line, leaving a 3/4 inch strip unchecked. When the second outline is cut this will be reduced in width to nearly 1/2 inch, which is as close as the checking runs on most high grade arms. One may have a terrible yearning for checking all over bottom of grip—but try and do it! There is no objection to cross scoring the grip at this point, but it really is not necessary. Good sharp and attractive checking on sides is enough for most of us after one attempt on the bottom.

Some of the best and most expensive stocks now have the checking extend across the top of grip back of the tang. This is an excellent idea for the shooter who places his thumb across the grip, but is not necessary for those who shoot with thumb along the side. If the grip is to be checked clear across, plan your design with this in mind. There are very few cases where one can so plan to cut angles on each side so that the lines can be continued clear across. If you start from one side and run on over to the other, the diamonds on that side are almost sure to point in a different direction. Quite likely they will run at right angles to the grip instead of the long way. The safe plan is to score a very light line from center of tang, back toward center of comb, and work the checking from each side stopping at this line. Or, the design of each side may stop short of the upper surface, on which a small separate design is used. This method eliminates the break in the line of diamonds at center of grip.

POINT DESIGNS. If you do not favor the curved outline patterns, and decide to tackle a diamond-point design, first lay out your center line as described, then locate the desired position for the first two points on one end; space them at such a distance from each side of the center line that when connected with it they will give you the desired shaped diamonds. Now starting at these points, cut the first two guide lines as before. With a narrow strip of transparent celluloid, lay off the other points and mark them lightly with lead pencil. *DO NOT CUT THE OUTLINE OF DESIGN YET.* The first two guide lines form the outlines of the first two points. Proceed with the spacing as before, but do not work quite up to the pencil outlines until you see where you are going to come out. Any variations in spacing will throw the points formed later into different positions and angles than those you started with. A well designed pattern on a high grade stock is a big help at this point, for you can study it and see how the checker has worked out his design. As you continue the spacing you will see where other points can be developed at ends of design, and these should always be in prolongation of the like spacings themselves. Sometimes, but not always, the first two guide lines which form the first two points can be made to form the second pair of points at the opposite end. This will depend largely on the shape and proportion of the diamonds formed. If you cannot get the shape you want on the points by extending the checking lines, then do not hesitate to make a bastard design by cutting the points

181

as you want them, and letting the checking meet them at a slight angle—remember better checkers than you and I have done this often.

After spacing lines are cut, deepen them with the V-tool and finish as before, then cut a double outline all round, or if desired use the three-line border tool. You will have no difficulty with this tool on straight outlines.

CARVING. I seldom attempt much or any carving on a gun stock; first, because I am not a wood carver, and claim to know very little about the work; second, because in my opinion, elaborate carving is out of place on any gun. Study the work of the best English makers, and you will find simple, but beautifully executed checking even on guns having hundreds of dollars worth of engraving on metal parts. Good fine checking is an art in itself, and so is wood carving. There is no objection whatever to finishing the end of a checked area with a simple oak leaf pattern, or perhaps a conventionalized floral suggestion; provided you can develop the skill to do it well. Otherwise, better let it alone, for poor carving is the cheapest, and shoddiest looking thing on the face of the earth.

If you must have a carved stock, I would recommend that you study first one or more of the several elementary textbooks on carving, and practice on plenty of scraps, until able to turn out something you are not ashamed of. The hollow carving chisels made by J. B. Addis & Sons are best for this work, and you will use sizes of 1/4 inch and smaller almost entirely. The chisels must be honed and stropped until they will cut the softest white pine or basswood *across* the grain without the least bit of tearing. Then practice making curved cuts with the gouges, straight cuts starting narrow and shallow and ending wide and deep; practice with the 1/16 and 1/32 inch round and V-veiners, until you can cut in any direction without tearing or splitting. Then practice sketching designs—always of the simplest sort—until you can turn out something artistic, yet not complicated or hard to cut.

When planning a carved border on lower part of grip, for example, the grip where the carving is to be should be left about 1/16 inch thicker on both sides. Then draw your design on transfer paper, make a pounce pattern of it, and transfer the pattern to the stock. First cut the outline with a 1/16 inch V-veiner, then deepen it as required by straight cuts with straight or hollow chisels, according to shape. Then with a nearly flat hollow chisel, cut away the background portion, bringing the rest of grip to desired thickness and contour, leaving the portion to be carved stand out in low relief. Carve up the leaves, scrolls, or whatever the design contains, using the veiners for forming the outlines, veins and other shading lines. Don't cut too many lines—simplicity is the keynote of good carving.

182

Round the edges and shape as the design calls for. The cuts should be so smooth that no sandpapering is required, as this ruins good carving. The places where the background was cut away, however, must be filed and sanded smooth, and well oiled before checking. Work the checking up close to the carving, and where impossible to use the tools in small corners, finish off with stippling, using a No. 6 wood carver's marker. These can be purchased from Hammacher & Schlemmer & Co., New York City. Or, a small prick punch, with point slightly blunted, may be used, but the work will be slower by reason of the single point. When finished the carving should be well oiled and carefully rubbed to a polish with the fingers, taking care not to get too much oil in the checking, which will fill up and gum between the diamonds.

When working up a leaf design at the end of a checked area, the points of the leaves should always run in toward the checking, originating in the solid wood outside the design. When the leaves point out away from the checking they give one the impression that they are ready to blow off and leave the stock bare. The stem ends should be worked out to blend and disappear in the wood outside the design.

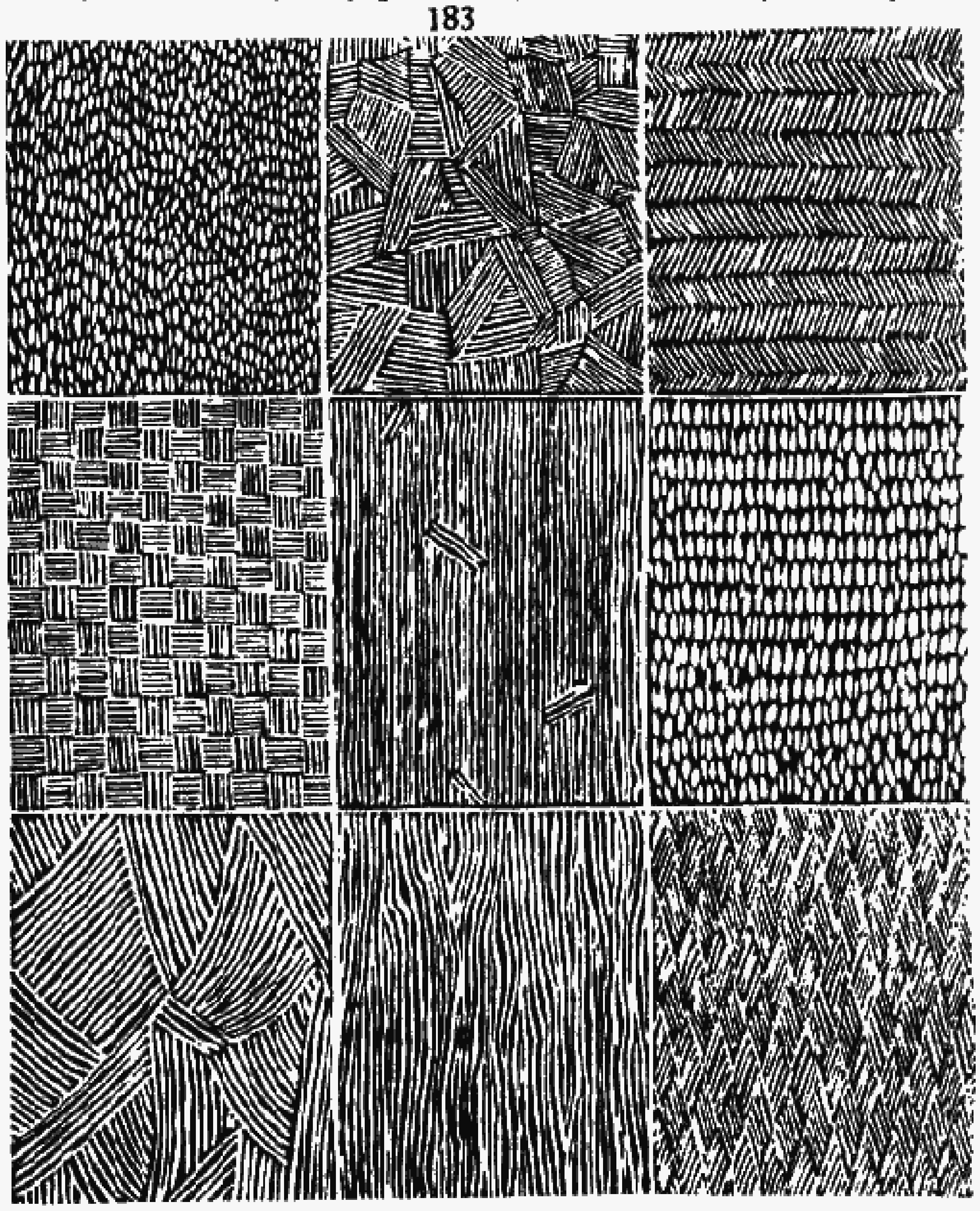
There is another method of stock ornamentation that I have never seen described, which was quite popular for other uses some fifteen or twenty years ago. This is called Pyrography, or wood burning, and many readers will recall it as a popular fad among young ladies for making glove boxes, wall plaques, and other useless articles, which were usually constructed of thin white wood, on which the aspiring artist burned pictures of flowers, fruits, Gibson girls, Dutch mills, and the like. It seems a pity that some really practical use for Pyrography was not discovered before the manufacturers stopped making the equipment.

Pyrography outfits are hard to find today. I bought one three or four years ago from a company located in St. Louis, Missouri, the cost as I recall it being about eight dollars. Without a doubt a little attic exploring will bring many an old outfit to light.

The outfit consists of a platinum point or needle which is hollow, and is attached to a cork insulated handle so that it may be used as a pen in tracing the designs. The handle is connected by rubber tubing to a bottle of benzine, which is supplied with air pressure by a small hand bellows or rubber bulb. To use, the point is first heated in an alcohol torch until white hot, then pressure on the bellows feeds the benzine vapor to the point, maintaining an incandescent heat. The point is then used to trace and burn in the desired lines, dots, or other shapes.

Figure 96 shows a Pyrographic outfit complete, also a walnut panel with a number of background designs that should prove both attractive and practical on a stock. The work is quite easy, and a very little practice will quickly give the operator the knack, enabling him

183



Above are a few background designs which may be adapted for use on gunstocks.

184

to turn out a creditable job. Thus a magazine picture of a game head, floral or other design can easily be cut out and made into a pounce pattern, transferred onto the stock, and the design burned in. Very fine shading of detail is possible, as almost hair-lines can be made with the platinum point. The same point will make large deep round or oval dots which give a splendid grip.

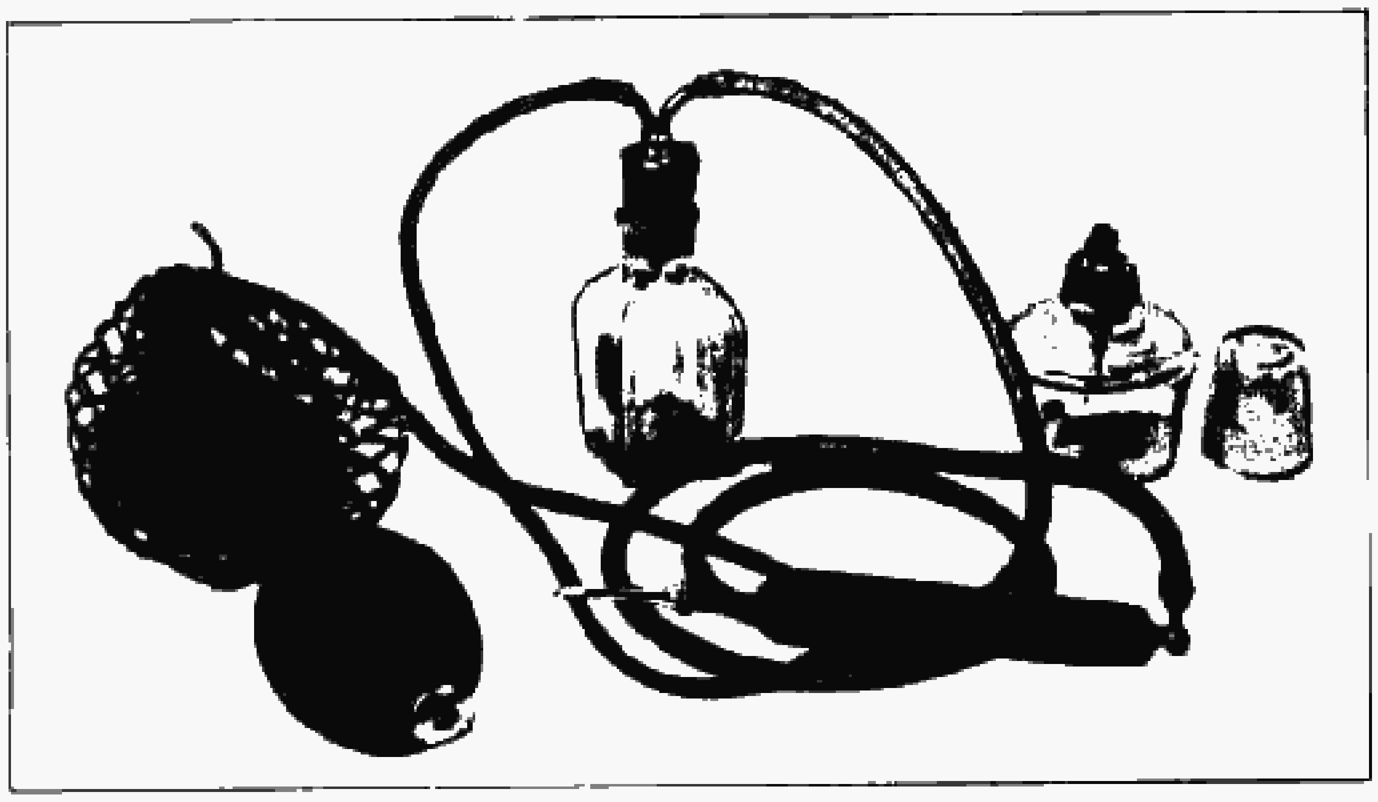


Fig. 96

For pyrographic decoration the work must be perfectly dry, clean and free of oil, paint, varnish or filler. Any of these will ruin the thin delicate point, and usually break it. Do the work before any finishing or polishing has been done. When the background work is finished, take a stiff bristle brush, or better, a brass wire brush, and brush out all the charred wood, making it as clean and free of dust as possible. Then oil over design and all, but scrub excess oil out of the burned areas before it dries.

185

Chapter 13

FINISHING AND POLISHING STOCKS

If ALL the magazine articles on this subject were assembled into a single volume it would probably contain more pages than this book—and variety would *not* be its outstanding characteristic. Every time the gun writers run out of material they sit down to the typewriter and hammer out a set of stock finishing instructions, which seldom vary in any essential detail from dozens of previous blurbs. The substance of all of them seems to be that the "London" oil finish can be produced only by bone-breaking, muscle rending labor extending through many months, with pure, unadulterated "kettle-boiled" linseed oil as the sole medium. And whenever the finish produced does not come up to expectations, the finisher invariably blames the oil.

There's plenty of absolutely pure raw linseed oil on the market—and by linseed, I refer to the natural oil pressed from flax seeds, and not adulterated with cotton-seed oil, or fish oil. As for "kettle-boiled" oil, that's a horse of another color.

The Archer-Daniels-Midland Company of Minneapolis, makes the following statement: "As for boiled oil, we do not believe there is anyone selling the kind of boiled oil you describe made in a kettle over a fire, as such a product would be of so dark a color that paint manufacturers and painters would not use it. Our boiled oil, however, is heat treated and the proper amount of suitable drying compounds incorporated into the oil to give the desired drying time. Boiled oil cooked in a kettle over a fire will dry a little faster than raw oil, but will not satisfy the paint trade which requires an oil drying in from 12 to 18 hours; whereas raw oil dries in from 72 to 80 hours."

I was so impressed with the frankness of the above concern in stating they did not have what I wanted, instead of trying to sell me what they had and evade the question, that I tested their raw oil

186

thoroughly, and decided that it was the best available for gunstock work. They guarantee it to be absolutely pure, and its performance indicates that this is true. A-D-M oil is used and sold by many paint manufacturers, jobbers, and dealers, and can be obtained without difficulty if you insist on it.

I also decided, in view of their explanation, to quit worrying about "kettle-boiled" oil and use their regular prepared boiled oil for better or worse. And it has proven "all to the good." Litharge is the principal dryer used in this oil, which cannot be considered objectionable in view of the following, quoted from U. S. Army specifications No. 3—142, dated March 24, 1927: "V. DETAIL REQUIREMENTS. Boiled linseed oil shall be pure linseed oil that has been treated (preferably by heating—kettle-boiled) with compounds of lead, and at the option of the manufacturer with suitable compounds of other drying metals, so as to produce a product that will dry rapidly. It shall be clear, free from sediment, and shall meet the following requirements:—" (This is followed by technical specifications of no interest or value to the stock finisher.)

A comparison of the above with the manufacturer's statement previously quoted, indicates that this company is producing an oil which is in keeping with government requirements, and further, that the government finds this processed boiled oil suitable in all respects.

Be that as it may, the subject of boiled oil doesn't worry me very much for I use mighty little of it. Pure raw linseed oil will do (for me, at least) anything that boiled oil will do—and it will do it better. It is more penetrating, going deeper into the wood, hence a better preservative. Let it be known, however, that despite popular belief, linseed oil is not a waterproof finish; and the higher the polish given an oil finish, the more susceptible it is to spots from raindrops or water splashed on it. Its chief value lies in the fact that it will not chip or crack off like varnish, leaving the wood totally unprotected; and when the stock is thoroughly impregnated, the absorption of moisture in damp climates will be reduced to a minimum.

Now let it be known that I do not confine myself to the use of linseed oil exclusively in the finishing of stocks. Call it heresy or what you will, I use, as occasion demands, raw oil, boiled oil, varnish, shellac, and cup grease—and in a pinch I can produce a good "oil finish" with floor varnish and axle grease! Now that the bullets of the horror stricken cranks have all flattened and ricochetted from my tough hide let's go on.

Varnish is nothing on earth but boiled linseed oil, plus a little turpentine, and perhaps other dryers, and a liberal quantity of copal, spar, or other hardening gums. It is applied to the surface of wood, and does not penetrate to amount to anything. It preserves only while the coating is intact—not broken or scratched. Oil alone, on the other hand, sinks below the surface of the wood, and the protective coating it forms is a part of the wood itself. Oil finishing

187

changes the character of the surface of a piece of wood, without actually forming an additional coating. Therefore, if a means is found for using varnish so that it functions *within* the fibres of the wood instead of forming an outer coating, such a method will prove valuable in many cases as will be explained later.

For there is no set rule whereby all stocks may be finished, any more than there is a set rule for treating all diseases. Some will respond better to one treatment, and some another. It is up to the stock finisher to study his wood, and employ the finish that will produce best results in the least time.

Very hard, dense, close-grained wood needs a finish that penetrates well; soft, open-grained wood requires a method of stopping penetration when the oil has gone deep enough. Maple, Apple, Hickory, and Cherry belong in the first class, along with the better grades of Walnut; while the softer Walnut, Koa, Mahogany, Oak, and perhaps others, belong in the second class. The white or very light colored woods such as Maple and Apple must be stained to give them the much desired dark color. Walnut, Mahogany, and the darker woods will darken sufficiently (entirely too much, in some cases) from the oil alone. Sometimes Walnut becomes too brownish, and sometimes too reddish. All these things must be taken into consideration by the finisher, and corrective measures applied.

Sometimes, moreover, the finish that will produce the desired color tone will have the effect of hiding much of the beauty of the grain. Any finish that does not increase and develop the natural beauty of fine wood is inefficient. Quite often a piece of Walnut that appears mediocre in the blank, may, by proper finishing, develop un-dreamed of beauty of grain.

The essential steps in producing an oil finish on a stock, are (1) preparation of the wood; (2) staining (if necessary); (3) penetrative oiling for color tone and to preserve the wood; (4) stopping penetration when it has proceeded far enough; and (5) oiling for polish and development of natural beauty.

PREPARING THE STOCK FOR OILING. Let us assume we are working on a new stock, which has been shaped up and sanded (with No. 1 sandpaper) sufficiently to remove all file marks. The purpose of the present operation is to make it as smooth as it can be made, and at the same time open the pores to receive the oil.

The No. 1 sandpaper with which it has been smoothed up has left its own marks, and the pressure of the rubbing has mashed into the pores the fine slivers or "whiskers" which will block the oil and delay penetration if not removed. The beginner will be inclined to start in and dry-sandpaper the stock as smooth as possible now. But a moment's thought will show that the stock may be "whiskered" at the same time it is smoothed up, thereby saving much time.

With a sponge or wet rag go over the surface and wet it thoroughly, then dry off lightly with another rag. Immediately, hold the

stock close to a gas burner or other source of quick heat, moving and turning it about, drying it within a minute or so. Keep the stock close to the heat so that the water is turned into steam rapidly, and in escaping it pushes out the whiskers further than if dried more slowly. Keep it moving slowly to avoid scorching—and be particularly careful of the thin edges at barrel channel and action mortices.

As soon as dry, go over it carefully and *lightly* with No. 0 sandpaper, or preferably garnet paper. Heavy rubbing will mash the whiskers back into the pores instead of cutting them off.

Now examine the surface under a good light; if the coarser sandpaper has left scratches that show, go over them with the No. 0 until they are eliminated, and the surface very smooth at all points. Don't use a sandpaper block, but fold a quarter sheet for convenience in handling, and hold in thumb and fingertips. *DO ALL SANDING IN LINE WITH THE GRAIN FROM THIS POINT ON*, except around the curve of the grip, which curve may be followed, as the sides of grip will be covered with checking and slight scratches here will not matter.

Having removed all coarse sandpaper marks, repeat the wetting and drying and sanding with No. 0, until the whiskers will no longer raise when stock is wetted and dried. Use plenty of sandpaper—discarding it when it shows wear, so as to keep cutting the whiskers off instead of mashing them in. When no more will raise, take some well-worn sandpaper and polish the wood as slick and smooth as possible. Good hard wood will take a sort of polish under this treatment, and this "dry shine" greatly improves the final finish. Now, having the stock as smooth as you can make it, and all whiskers removed, wet and dry it once more to expel the dust from the pores and open them up. This completes the preparation of a new stock for oiling.

OLD STOCKS to be refinished must be cleaned off down to the bare wood. Don't attempt to remove varnish with sandpaper as you'll never get it all off, and the final finish will be streaked. Make a boiling hot lye solution—about a heaping tablespoon of lye to a half gallon of water, and holding the stock above it, splash and scour with a scrubbing brush until the varnish is dissolved and washed off. Rinse in clean warm water and dry, then proceed same as with a new stock. This treatment removes all the old filler and leaves the wood bare. It will appear quite dark while wet with the lye solution, but after rinsing and drying will have its natural color.

This same treatment should be applied to old service stocks, which have been partially remodeled, or to D. C. M. Sporter stocks after trimming down, to remove as much of the old oil as possible—otherwise, subsequent oiling operations will result in a spotted finish.

STAINING: To darken maple or other light colored and very close grained wood, the commercial stains known as "acid" stains are best. Both Johnson's Wood Dye and Ad-El-Ite stains are excellent

for this purpose. Use "Walnut" or "Mahogany" or "Weathered Mission Oak" or any other color desired. Generally I find that a mixture of two parts of "Walnut" and one part "Light Mahogany" gives the best color for stocks. Apply the stain with a brush or sponge to the bare wood; let dry half an hour, then rub with clean dry cloth. If the color is not dark enough a second coat may be applied.

Beware of stains on walnut! Unless the color is very light indeed, the oiling may be regulated to give the desired color tone. If stain must be used, first apply a coat of linseed oil, let soak in for an hour, wipe off and dry three or four days. Then apply the stain and the grain will not be hidden as it is with stain applied directly to dry walnut.

Old time gunsmiths sometimes darkened maple stocks by applications of aquafortis or ammonia; sometimes they wrapped the stock with a piece of tarred string wound spirally, then burned off the string, which scorched in a sort of "fiddleback" effect. Some of their stocks were varnished, and some were hand rubbed with soot and oil, which further darkened the color.

Sometimes a backwoods gunsmith would "figure" a stock by laying on a train of gunpowder and burning it off. I once tried this on a light colored walnut stock, with fair results, but the color, as produced with black powder, was very shallow, and much of it disappeared under the oiling. I tried another piece using a slow burning smokeless powder with better results. But while such methods of artificial graining may fool some, they never fool the owner of the gun—so why bother? Select the right kind of wood for your stock and you won't need to singe curleycues on it!

The use of any pigments or solid coloring matter should be avoided so far as possible, particularly on walnut. This is the reason stains are not very successful—they color the light spots and the medullary rays all the same shade, and hide the grain. The real beauty of walnut is in its contrasting colors, and these are brought out to best advantage with transparent oils containing no solid pigments.

PENETRATIVE OR FIRST OILING. The purpose of this operation is to drive into the wood, as deeply as possible, an oil which will afterward oxidize slowly and bind the outer fibers of the wood firmly together, while partially sealing the pores. For this purpose there is nothing better—nor half as good—as pure, raw linseed oil. Warm the stock slowly before a fire for a half hour, until it is quite hot, and also warm the oil until it is just a bit uncomfortable to handle. If the wood is very close-grained, thin the oil with 1 part pure turpentine to 3 parts oil—otherwise omit the turpentine. Apply the oil liberally with a rag swab on a stick, both inside and outside, and on the butt end. Rub with the swab while applying, and keep the stock warm while applying. Stand it on end in a pan and let it drain, turning it end for end and applying more

oil every few minutes for an hour or so. Now let the stock alone! Don't apply any more oil, and don't do another thing to it but turn it occasionally for at least a week; and if you're not in too great a hurry, two or three weeks will be better still.

Time is the best stock finisher in the world; and if you keep on applying oil before this first coat is completely oxidized by the air, you'll have to do about double the amount of work actually necessary. Too much oil, or too rapid application, is worse than none at all. The thorough and complete drying of this first coating is the secret of a perfect finish.

A somewhat better method, but practical only in shops doing considerable stock work, is to use a sheet iron tank like Figure 97, slightly larger over all than the stock, and five or six inches deep.

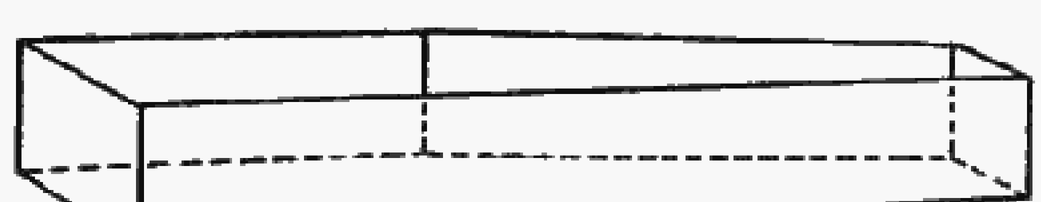


Fig. 97

A gallon or so of oil will be sufficient, as the stock will displace a lot of it, and you only need enough oil to cover the stock. The tank may be tapered toward one end as shown to reduce its capacity, and seams should be welded, not soldered.

Warm the stock thoroughly, and heat the tank of oil over stove or gas burners, but do not let it boil. When the stock is well heated through, put it in the hot oil, turn off the burners, and leave the stock until the oil has cooled to the temperature of the shop. Remove stock and stand up to drain, leaving it as long as possible—four days at least. Complete drying will take place quicker when the oil is applied in this manner.

STOPPING PENETRATION OF OIL. The first application should have penetrated from 1/16 inch to 3/16 inch below the surface of the stock. If wood is very soft and spongy this penetration may go on indefinitely, resulting in an oil soaked stock which will never take a good finish, and which will ooze oil under the checking tools, making clean sharp diamonds impossible. The next step, therefore, is to stop further penetration, so that subsequent oilings will build up in the outer pores, producing a finish.

There are several ways of doing this. If the wood is very soft, with large open pores, apply a coat of the following mixture with a small wad of cloth:

Boiled Linseed Oil	4 oz.
White Shellac cut in Alcohol	2½ oz.
Spar Varnish	1 oz.
Venice Turpentine	10 drops
Oil Cedar Leaves	20 drops
Oil Soluble Red	To color

191

Oil soluble red is a dark reddish black powder sold by large drug stores and chemical houses—it is the same material used to color motor gasoline by companies wishing to get three cents per gallon more for their product. A quantity of this powder the size of a match head will color a half pint of oil or any oil mixture a brilliant red. This red in a stock finish merely imparts a rich glow to the wood without actually staining it red. It may be omitted if desired, or if the wood has a pronounced reddish cast, use alcanet root instead. This usually comes as a vile smelling powder, and should be mixed with the linseed oil before other ingredients are added. Warm the oil, and let the powder remain for two or three hours, then strain.

Venice turpentine is a thick substance harder to pour than molasses in winter. Violin makers add it to varnish to prevent cracking. It is advisable to use a few drops of it in any stock mixture containing varnish and it also helps to seal the pores of the wood.

This mixture quickly sinks in and penetrates, and should be allowed to set 24 hours before any further finish is applied. Some stockers merely coat the stock with thin shellac after the first oiling, and this is a desirable practice on extremely open grained wood. When it dries, it should all be lightly sanded from the surface before you proceed with the oiling.

Hard, close-grained wood with small pores may be sealed with this mixture:

Raw Linseed Oil	½ pint
Spar Varnish	3 oz.
Turpentine	1 oz.
Venice Turpentine	10 drops
Oil Soluble Red	1 grain
(Omit if desired, or substitute alcanet root)	

Warm the stock slightly and apply above mixture with a swab, once over. Note time required for it to sink in. If the wood absorbs it immediately, it may be necessary to use the first formula given. If a lot of it remains on the surface, it is probably going to be O.K. This should be permitted to dry for two or three days.

OILING FOR FINAL FINISH. With the pores below the surface pretty well sealed, we can now expect results from our work from this point. I prefer to use either straight raw oil, or red oil (pure raw linseed colored with oil soluble red) according to color desired. Apply a light coat with a small rag or swab, and let it stand for an hour. Then rub briskly with palm of hand for ten or fifteen minutes. Set the stock up with a thin coat of oil on surface, but not running or dripping.

Repeat this treatment at 12 to 24 hour intervals—every 12 hours if the surface looks dull, or every 24 hours if the oil remains on surface that long. After four or five such treatments, allow the stock to stand for a couple of days, then apply another coat of raw oil

192

(or boiled oil if you want to hurry the job), set the stock away and forget it. In three or four days this last coat should be hardened and gummed over the surface—about like a coat of varnish, roughly applied, would appear.

With a small wad of rags or waste, coat the stock with hard automobile cup grease; sprinkle sparingly with powdered pumice and *scour off all the hardened coat of oil.* Grind it right down to the bare wood—you can't hurt the finish. Then rub with the bare hand. You now have a finer finish than any factory ever turned out, and the gun is ready to use if you want to, although the finish is still a little "green" and had best be allowed to dry a few days yet. Take it up whenever you feel like it and hand rub for a few moments—using a little cup grease on the hands will also help, but rub the stock until dry each time. And at the end of each trip to range or woods, rub in half teaspoonful of oil—preferably raw—with the hands.

The coating of oil that was allowed to dry on the surface completely filled the pores of the wood level with the surface. Some

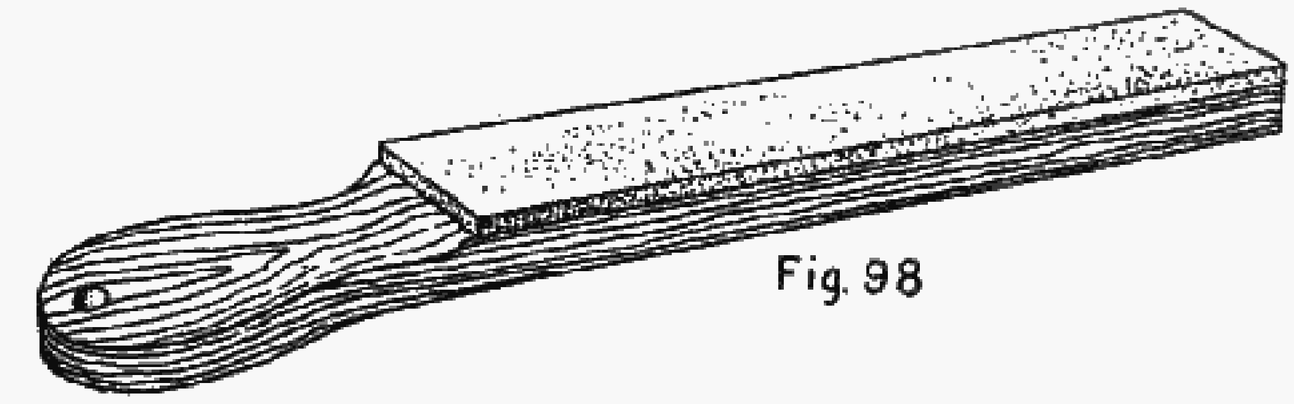


Fig. 98

finishers follow the pumice rubbing with powdered rotten-stone, using a rubbing stick (Figure 98) about a foot long with a piece of heavy leather glued on one side. The rotten stone is sprinkled on the leather, and the stick used like a file, mostly across the grain. By this method the rotten stone helps to fill the pores, but may work out in time.

Checking should not be done until all the oiling has been finished, provided time permits. It may, however, be done when only the last two or three oilings remain, if the gun is needed as soon as possible. After checking treat the stock to one more oiling, well rubbed in by hand, and when the oil has stood in the checked sections for an hour, rub it out well with a stiff bristle brush to prevent gumming in the diamonds.

The foregoing is my pet method for producing a high grade finish, when there is time for it. It involves all told four to six weeks, yet the actual labor time will not total more than two or three hours. It is the easiest, and best method I know of. Yet the time consumed prevents its use many times, when a man wants his gun within a week or so.

193

For a speedy job, and a very good one at that, proceed as follows: First oiling same as with previous process; then apply one coat of natural wood filler, thinned with turpentine to consistency of thin cream; let this dry an hour, then rub off with burlap; let stand till next day, then apply one coat of raw oil, rubbed in vigorously with bare hands. Wipe off next day, and apply spar varnish, and boiled oil, half and half. This should gum in 12 hours, and be well gummed in 24 hours. Then grind off with pumice and cup grease as before described. Subsequent oilings with raw or boiled oil may be applied as time permits.

A job may also be speeded up by alternate applications of Formula No. 1 and boiled linseed oil applied a day apart.

When a stock has had two or three oilings, and it becomes necessary to complete the finish at once, rub on a coat of pure spar varnish with a rag; the oil already in the wood will prevent its hardening, but it will gum quickly and in eight to twelve hours be about as hard as a well dried coat of oil. Grind it off with pumice, polish with rotten stone on the rubbing stick, then polish with Formula No. 1 on a rag, using it just as you would furniture polish. Conclude with a brisk hand rub with a few drops of boiled oil.

Sometimes, when stocks are very soft, I find the following procedure desirable: Coat with boiled oil and let stand until oil begins to set; then delay setting by rubbing in hard cup grease. Wipe off dry in 12 hours; and apply boiled oil, and repeat process two or three times.

When an oil finish has been completed, it is always improved by a light coat of cup grease rubbed all over it. This grease should be wiped off and stock rubbed with the bare hand before using the gun.

In refinishing old stocks already checked, exercise due care to prevent the oil running into the checked portions and gumming there. After each oiling, scrub out the checking with a stiff brush to remove surplus oil, and after the job is completed, retrace all the checking with the V tool, then oil lightly and brush out clean.

The time honored method of finishing a stock by 10 to 50 coats of oil laboriously rubbed in by hand often produces a fine finish; too often, however, it results in building up an outer skin or coating much like a coat of varnish, which shows finger prints, and which will sometimes be seriously damaged by a heavy rain or by immersion. And in many cases it results in the wood absorbing so much oil that much of the grain is hidden and the wood is turned almost black.

There is no reason, traditional or otherwise, for a black or very dark stock. A rich deep brown, with perhaps a slight reddish cast, with the dark and light portions showing in pleasing contrast is, to my mind, the most beautiful stock of all. If you want it black, you can paint it.

VARNISHING STOCKS. Some people think that the only way to finish a stock in a hurry is to varnish it. Personally, I see no

194

excuse for a varnish finish in any case, since I can, by one or other of the methods above described, turn out an oil job about as quickly as a good varnish job, if speed is needed.

Nevertheless, varnish is the thing on some woods other than walnut, and since it is occasionally preferred for walnut by some, a few remarks on varnishing are in order.

After the stock has been sanded and "whiskered," as for oiling, mix up some natural (uncolored) wood filler with spirits turpentine until the consistency of thin cream. Apply with a stiff paint brush and let dry for an hour. Then take a piece of coarse cloth such as burlap, and rub off across the grain.

An easy way to hold a stock while working on it is to have a tapered stick eight or ten inches long which will rest easily in the barrel channel. Turn the stock sideways and clamp the forend in vise, using a vise block or felt or leather pad to protect the bottom surface. Now you can use your rag across the grain like shining a shoe. Another good way is to hold the stock in the checking cradle, as described and illustrated in the chapter on Checking.

After rubbing off the filler, let stand till next day, then go over lightly with very fine sandpaper. Wipe off carefully with a clean rag, and be sure there are no particles of grit or dust on the surface. Get 1/4 pint of hard rubbing varnish and 1/4 pint of good spar varnish (Valspar is good; also du Pont's spar varnish), mix the two and pour out about a fourth of the mixture, to which add an ounce of turpentine. Apply this to the stock quickly with light, long strokes, using brush fairly full but not dripping, and "flowing" the varnish with a minimum of brushing. An excess of varnish will run, causing thick places in the finish—this must be avoided. Let dry until absolutely hard. Test by pressing hard with the thumb—if it shows a "thumb print" that won't rub off, it isn't hard enough.

When well hardened, take a thick piece of felt (obtainable at paint stores), dip it into water, sprinkle with powdered pumice, and scour the varnish down to a smooth even surface. Be careful not to grind clear through, but grind off all the "pimples," of which there will be plenty, unless you have a dustproof room in which to do your varnishing. When surface is smooth as possible, sponge off with clean water, wipe dry, and let stand for an hour or so. Then take the remainder of the varnish to which no turpentine was added. Mix in just a few drops of Venice turpentine, and apply a smooth even coat. This should dry for two or three days at least, after which it should be ground as before with pumice stone and water; let stand a day, polish with rotten stone and light oil on felt. Subsequent coats may be added if desired, but will only thicken the varnish, making it more liable to crack.

Some painters prefer to use shellac instead of filler, but it tends to make a more brittle outer coat, and moreover, requires more varnish for a smooth finish than when regular filler is used.

195

If commercial filler is not available a good one can be made as follows:

Powdered pumice or quartz ....1 part
Fine wheat flour ....1 part

Mix to a stiff paste with boiled linseed oil, color with alcanet root, raw umber, or any pigments available to make it dark; thin for use with turpentine as needed. Common putty can also be reduced with turpentine and used for filler in a pinch, but it will be improved by the addition of a small amount of boiled oil and Le Page's glue.

Always use a dark colored filler on a stock that is to be varnished, and a white filler when stock is to be oiled. The oiling will darken the filler, but the varnish will not.

Cherry, Maple, Apple, and other dense woods, or woods that have been stained should receive one or more coats of varnish without any filler. The varnish should all be ground off the surface, leaving it only in the pores. Then a third coat may be applied and ground down very thin, after which such woods will take a nice finish with boiled or raw oil.

Mahogany and similar open grained woods soak up so much oil that it is almost impossible to complete the job. The better plan is to use filler and varnish, applying several coats and grinding each coat down thin; after which apply Formula No. 1, using it like furniture polish. Mahogany and oak are about the two meanest woods to check that I know of.

Once in a while one can get hold of a piece of African Rosewood, and it makes one of the most beautiful stocks imaginable, although too showy for some people. This wood is naturally very oily, and its first treatment should be pure turpentine, which is allowed to dry 12 hours. Then use only boiled oil, and use it sparingly. Rub it in by hand, and grind it off with pumice if it commences to coat the surface. You will secure a beautiful finish very quickly. Rosewood is a little brash for stocks, and would scarcely be selected for guns with heavy recoil, but it takes the checking better than any wood I know of.

LACQUER. Here is the quickest finish of all, and would undoubtedly be more popular if it were better known. In addition to du Pont's clear brushing lacquer there are several other brands almost equally good. No filler and no preparation of the wood are needed, except sanding and whiskering. Support the stock by the ends so that you can work all around it (set it up in the checking cradle if you have one); thin the lacquer 20 to 30 per cent. with the thinner recommended by the maker, and spray it on with a painter's air-brush or with one of the commercial hand sprayers sold for two to three dollars. There's a knack about using one of these sprayers that must be acquired by practice, but once you get it you'll never want to

196

use a brush again. A lacquer stock will be dried hard and ready to use in 30 minutes to an hour and the finish will be water proof and nearly all other kinds of proof. It will look for all the world like varnish, but lacks all the disadvantages of varnish. A second application may be used, but is seldom necessary. If you object to the shine, the finish may be dulled by rubbing down with pumice stone and water, using plenty of both.

Lacquer may be used over a stained stock, but not one that has oil in it. It works best on clean, dry bare wood. It is a thoroughly practical finish, but will not bring out the beauty of the grain as an oil finish does. Nothing will.

197

Chapter 14

REPAIRING AND REMODELING STOCKS

PERHAPS the gunowner may hesitate at re-stocking his gun until experience with tools has given him a measure of confidence. Remodeling an old military stock, or a factory stock, to give a better fit and to conform more nearly to our present ideas of stock design will not only provide excellent practice with tools but will often result in a mighty practical, good looking stock. The job of course calls for far less work than the making of a new stock, and the tedious, particular job of inletting barrel and action is entirely avoided.

The stocks on most military rifles are extra thick and heavy in all their dimensions with the exception of length, and these may often be considerably improved by merely working them down to more comfortable and pleasing size. Sometimes one can take advantage of this extra thickness of wood to do a little re-shaping to improve the handling of stock. An example of this is the Krag stock, which has very little comb. Yet the grip just ahead of the comb is very thick, and will stand some reducing. By cutting down the grip just forward of comb,—in other words, deepening the "hand hole"—the comb is made to appear higher. Thus we take advantage of the grip's thickness by doing all our reducing on the top and sides, and none on the bottom.

Since we have mentioned the Krag, we will take this as an example of what may be done in complete stock remodeling. The Krag stock is longer than the Springfield—in fact, it is a fairly good fit for most shooters "as issued." The comb is too low, and sets too far back; the trip is too thick; it lacks a pistol grip; the butt can stand considerable thinning, also re-shaping, and the fitting of a better butt plate, or a rubber recoil pad.

INLAYING COMBS AND GRIPS. Figure 99 shows what

198

may be done in the way of re-shaping the Krag butt stock to give any desired shape and dimensions. The dotted lines show the original shape of stock, while the heavy lines show its final shape after remodeling. The thin solid lines indicate saw-cuts made in the original stock, to which larger pieces of walnut are fitted. The first cut is made in upper side of grip about 1/2 inch ahead of where you want the point of comb to be located. This cut is from 1/4 to 3/8 inch deep, and slopes forward slightly toward the bottom. With the rip saw a cut is made starting at a point on the butt from 1 to 1 1/8 inch below heel; the cut goes forward to meet the first cut. It is advisable to make the saw cut 1/16 inch outside the line, and work carefully down to the line with a cabinet file. Then with file and scraper, work this edge into a perfectly straight line, and scrape out the center of the flat surface to a *very slight* hollow from side to side of stock. Now cut a piece of walnut to fit, leaving it considerably higher than you want the stock. Fit this very carefully with file and scraper, spotting the two surfaces together with blue chalk. Rub the chalk thickly on one surface, then place the other piece against it, and rub back and forward slightly. Then scrape off the spots left by the chalk until the two surfaces are in perfect contact at all points. Be sure to get a good fit at the forward point. Now slightly hollow the surface of the piece being fitted—just a light scrape or two is sufficient. Bore two 3/8 inch holes in stock at the positions shown, for dowel pins. Coat the wood around the holes with dry lampblack. Press the piece into place, so as to get an exact imprint of the holes. Find and mark the centers of these imprints, then bore the holes *about 1/64 inch off center, toward the butt, in this piece.* This causes the dowels to "draw" the piece forward to a very tight fit at the point. Now cut the dowels from a regular hardwood dowel rod, and fit them into the stock, using hot white flake glue. Cut them off so that they project from 3/8 to 1/2 inch, and bevel the ends slightly. *Now work fast*—coat edge of stock and edge of new piece with the hot glue, set the piece in place, force it down on the dowels, and clamp tightly at a point about two inches from each end. Use cabinet-makers' "C" clamps, or if you have a very wide vise, the clamps need not be used. The main thing is to get plenty of pressure, so as to squeeze the glue out of the edge, leaving wood touching wood, with no line of glue between. Let dry for 48 hours.

For a pistol grip, saw the stock at right angles to grip, at a point about 3/8 inch back of end of guard. This cut should be from 1/4 to 1/2 inch deep, depending on the fullness of original grip. The cut must be carried far enough up the curved side so as to provide the full thickness desired in new grip. The common mistake is to make this cut too shallow, making it necessary to flatten the grip like a board when shaping it up. These old stocks are usually of strong, straight grained walnut, with an ample margin

199

of strength; and they are not materially weakened by inlaying pieces in this manner, especially if the pieces fit tightly at both ends, thus taking up the back thrust of recoil.

The rear cut should be made exactly where the rear end of pistol grip is to come, and should extend from 1/2 to 11/16 inch into the stock. To locate the position of this cut, lay out an outline of the old stock on paper, then mark out on it the curve and shape of the desired grip, giving the bottom of grip a length equal to the long dimension of the grip cap you purpose using. From 1 3/4 to 1 7/8 inch is about right.

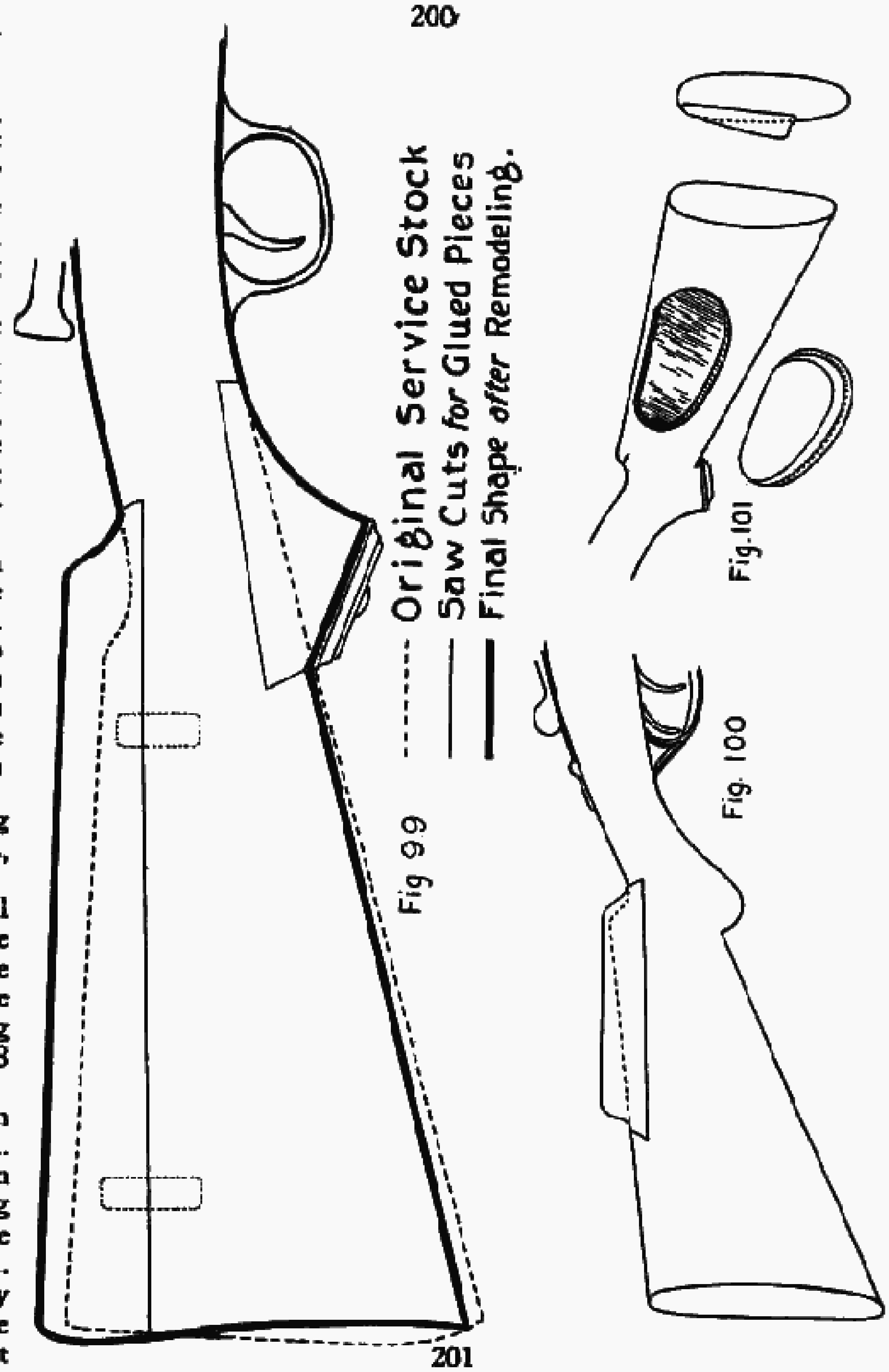
Saw out a block of good sound walnut so that the grain, when shaped into a grip will run well in line with the grain in the stock. By careful selection it is often possible to match the grain. Trim out the wood between saw cuts in stock with a flat chisel, cutting and scraping the bottom of cut to a good straight line—cut a piece of hack saw blade the right length and use it for a straightedge. Scrape the center of this surface to a very slight hollow. Now lay the stock over the block you have prepared, and carefully mark the shape of this dovetail on block with the point of a knife. Do not cut the block quite to the line at first, but fit it carefully and slowly into stock. Chalk the surface of dovetail and start the block in as far as it will go, then work off the chalk smudges as required. It should be a light driving fit, and should always be pushed in and withdrawn from the same side. As you approach the final fit, file the saw cuts at end of dovetail in stock to a *very slight taper,* so that the further in the block is pushed, the tighter it will fit. Now coat both surfaces with hot glue, drive in the block—being careful not to drive hard enough to split the stock. Just a good snug fit is what you want. Then clamp stock in vise for 48 hours, setting up the vise until the glue squeezes out of the edges.

In using hot glue, it is important to get the work clamped within a few seconds from the time glue is applied. It starts to cool and set very quickly, and the difference between a perfect joint and a shoddy one that will sooner or later break depends on getting the two parts together and under pressure without loss of an instant. The right kind of a glued joint is invariably stronger than the solid wood around it—the wood usually breaking under strain before the joint will let go.

If desired a dowel can be put in through center of pistol grip, but it is not really necessary. The best plan is to use a grip-cap screw long enough to reach 1/2 inch past the joint. The hole for this screw should be larger than the threads before the joint is reached, so that only the threads that are in the stock itself do the holding. Thus the strain constantly draws the two pieces together.

RESHAPING BUTT. Next comes the shaping up of the butt, which shape of course will be governed by the shape of your butt plate. If you have a good shotgun type butt plate it will be nearly

200



201

as wide, perhaps, as the service plate. However, the butt will very likely have enough thickness to spare to enable you to give the stock a little castoff if desired. (See Chapter 9.)

First rasp off the end of piece glued on top of stock, and work down the butt from heel to toe to approximately the pitch desired—remembering that most buttplates are thicker, or have a slight hump at heel, which increases the pitch. Then find exact center of stock and mark a line from heel to toe. Now if you want castoff, mark the castoff center as described in Chapter 9, and run a line from this point to center of upper and lower edges of grip, just back of tang on top, and just back of guard on bottom. If no castoff is wanted, merely run the lines in exact center of stock.

The fitting of the buttplate or rubber recoil pad, and the shaping up of stock, are done in the same manner as for a new stock—the difference being that in this case there is less work. All of the remaining surface of the old stock should be filed off a trifle, as the wood is likely to be well soaked with oil and grease, and a fresh clean surface is desirable for the new finish. Moreover, oiled wood does not sandpaper very smoothly, but remains "fuzzy" regardless of the time spent on it.

If a grip cap is used, fit it as soon as the grip is roughed nearly to size, then work to the edges to get the final shape.

There have been some fearful and wonderful suggestions for stock remodeling contained in various magazine articles, from time to time. One man, I recall, said he fitted a small wedge-shaped piece of walnut to the toe of the Krag stock, where it is rounded off. It may be that he was able to do a good job and make the stock look like something, but personally I don't care for such tricks. If the grain of such a piece runs with the grain of the stock, it is almost sure to split sooner or later— and probably sooner. Moreover it will look just like what it is—a patch. And finally there isn't one man in a thousand who could fit such a piece without having the paper-thin edge chip or break, leaving a small gap under the buttplate. The thing to do if you want to get rid of this rounded toe—which incidently is not a bad thing, as it prevents the toe of stock cracking off when struck on the ground, is to shape the butt as shown in Figure 99, which gives four or five inches pitch, and is mighty comfortable either offhand or prone. If this makes the stock too short, a recoil pad can be used to lengthen it up to 7/8 inch, or one of various other methods may be used.

LENGTHENING STOCKS. One way to lengthen a stock is to cut a walnut block, with the grain running in the direction of the stock, fit and glue it to the butt, which has first been sawed off square and the surface accurately finished. I am unable to consider this at all good practice. First, it looks like a patch, which it is. The grain cannot be well matched, nor can a good joint be made. Due to the grain running the short way of the block it is difficult to get a per-

202

fect glueing surface, and when sufficient pressure is applied for a glued joint, the block will likely crack. Nevertheless, this practice is often followed, so let your conscience be your guide. Use the "C" clamp or the fork clamp illustrated in Chapter 4 for clamping the block in position, and have a hardwood block under the setscrew.

Sometimes layers of heavy leather are used to lengthen the stock. This makes a fairly good looking job, and also makes it easy to fit the butt plate, because there is a certain amount of "give" in the leather. The pieces should be cut a little larger than the butt; coat both sides of all but the outside piece with du Pont Cement, and clamp in position as already described. Let dry 48 hours or longer. Then fit butt plate, using file and sandpaper to shape the leather butt, attach plate, set the screws up tight, then buff off leather on sandpaper wheel, as described in Chapter 11 for fitting rubber recoil pad.

Another material that may be used in the same manner is fibre. Strips of red and black fibre cemented alternately give a good appearance and look less like a patch than leather. Moreover, they take a better finish. The linseed oil used for finishing the stock does not do so well on leather, so that it is necessary to do a lot of extra rubbing with shoemaker's "heel ball," beeswax, etc., to complete the finish on the leather—then it will be rough most of the time. No special treatment is needed for finishing the fibre—just sand and oil it when finishing the stock.

A butt extension block may also be made by glueing up thin layers of various colored woods—maple, cherry and ebony, for instance, and this may be fitted and glued to the butt, giving a very good appearance.

When fitting the piece to upper edge of stock from which the comb is shaped up, be careful about holes in the butt. In some rifles these will be so close to upper edge that you will saw into them when making the cut for this piece. In that case it is advisable to measure the holes and turn up walnut plugs to a tight push-fit and long enough to fill holes completely. Don't get them too tight. Coat them with hot glue, apply glue in the holes, and drive in the plugs. Afterward the stock may be recessed as desired for a trap butt plate.

PATCHING. I have often seen instructions for building on pistol grips which recommended hollowing out a block of walnut to fit the round side of the original grip. I don't like this for two reasons. First, because the correct fitting of the round surfaces runs into more time than anyone is willing to pay for; and moreover, due to the oil in the wood, the glue joint is going to have mighty little strength, requiring a long screw or a dowel to make it secure, and even then it will probably come loose in time. Finally, the feathered edges of the false grip where they join sides of stock, are bound to show, even if the grip is checked. It's just contrary to the laws of woodworking to get a good joint in this manner. If

203

one feels that the dovetail method is likely to weaken the stock, he may use the other way if desired; but I never knew a stock to break because of a dovetail grip.

When shaping up a stock on which a false comb has been glued, it may prove necessary to undercut the comb slightly (See Chaper 9), as the original stock is not very thick at that point, and the piece may have a square edge showing after shaping to required thickness. Undercutting here brings the surface smooth and also helps the appearance of stock.

The foregoing will apply to a number of stocks having straight grips, when it is desired to have a pistol grip. Some rifles have a long tang extending back of trigger guard, and on such the practicability of fitting a pistol grip depends on the type of action. If the tang is merely to strengthen the trip it may be bent to the desired curve, then the grip dovetailed in, and tang inletted into it, thus adding strength. Quite often some of the action springs or other working parts are attached to this lower tang, in which event some careful study is advisable before attempting to change its shape. An example of such a job will be found in the description of the remodeled Single Shot Winchester described in Chapter 30. Chapter 24 also gives detailed instructions for bending tangs, and making necessary inside alterations.

The shotgun owner whose stock has a pistol grip back under the middle of stock where it does no good, may decide the stock would look better with a straight grip—and usually his decision is the right one. It is quite easy to make the change. Set the stock in the vise and saw off the grip, then use the cabinet file to round off edges to conform to the lines of stock. Be careful not to file further into the checking than necessary. Carefully sandpaper the bare portion, then straighten out the tang of trigger guard. Most shotgun guards are made of soft iron and may be re-shaped cold. Use a smooth faced hammer, and rest the guard on a steel, iron or brass bench block with a heavy leather on it. When the tang is the right shape, screw in the guard, then inlet the tang into the stock, as described in Chapter 10. Finally refinish the bare spot and check the grip, following the lines of the original checking as far as they go, and using a checking liner *exactly* the same width as the original diamonds. Don't try to get by with a liner that is *almost* correct,—your checking will come out all galley-wampus. If you haven't the right size liner, make another.

REFINISHING. Any stock having an oil finish may have any part worked off or reduced in size; after which the bare spot may be finished to match the balance of stock perfectly. Just follow instructions for finishing new stocks, doing most of the oiling on the bare spot, and then working on entire stock as the finish nears completion. Altering or cutting down a varnished stock necessitates, or should necessitate, complete refinishing. Some gunsmiths would rub

204

over the spot with oil and shellac, or try to "splice" the varnish. To do the job right, remove all the old varnish, prepare the stock for a new finish, and oil or varnish as desired.

The trapshooter may take a notion he wants a Monte-Carlo comb on his gun. No reason why he can't have it. Cut down as shown in Figure 100, make and fit the block in same manner as the grip was fitted in Figure 99—that is, slightly wedging the dovetail. Drive in the block snugly with plenty of hot glue, let dry a couple of days, and shape up as required—then refinish stock. In this instance it will probably be impossible to carry the comb forward very much as most shotguns have upper tang extending back nearly to the comb. This job should not be attempted on any gun like the Winchester hammerless pump, or the Remington or Browning Automatic, or any gun having an attachment screw running through the grip from the butt, or any part of the "works" such as recoil springs, etc., located in the grip.

INLETTING CHEEKPIECE. Making and fitting a cheek piece to a stock originally made without one is a job no one need be afraid of. Select a piece of walnut matching the stock in grain and color. Cut it to size and shape desired, leaving a base portion about 1/8 inch thick at lower edge, and 1/4 inch thick at upper edge. This piece may be practically finished around the edges before any work is done on the stock. Lay it in position on stock and mark around it carefully with knife point. Cut out the seat in stock, removing more of the wood at the upper edge than at lower edge of recess. Fit the cheek piece into this depression with chalk, spotting both surfaces into perfect contact. Use hot glue, and leave the stock clamped for 48 hours or longer. Then round off upper edge to conform to lines of stock and shape up cheek piece on surface as desired, then refinish entire stock. Fitted in this manner there will be no visible joint except along top edge of comb, and if the wood matches and the fitting is carefully done, this will be well-nigh invisible. Figure 101 shows the method of fitting the cheek piece, also a sectional view of the stock recess. No dowels, screws, pins or nails are needed if your glue is good and the fitting properly done—there is no strain on a cheek piece.

REMODELING BUTTPLATES. The question of a suitable buttplate usually comes up when remodeling a military or factory-made stock. Military buttplates were designed—apparently—for making dents in the armory floor. However, the military plate may often be remodelled as outlined in Chapter 24, which also describes the making of special buttplates.

The Mannlicher-Schoennauer buttplate is almost ideal in shape and size, and has the very desirable long trap for cleaning materials. For strictly offhand shooting it is ideal. Many, however, find it unsuited to prone shooting, as it is more deeply hollowed than the shotgun plate, and has considerably more "hump" at the heel. This

205

plate may be purchased from Von Lengerke & Detmold, of New York City. The Mauser sporting type buttplate is even better designed and better made. It is a heavy drop forging, and the trap is set in on a square milled cut around the edges of the hole, instead of being merely bevelled. It is a trifle smaller than the other, being barely 5 inches long, which will take it out of the running for those demanding the largest plate obtainable. The Mauser plate may be had from A. F. Stoeger, Inc., New York City. The Mannlicher-Schoennauer plate has deep cross corrugations, while the Mauser plate is smooth. It may be corrugated or checked, or may be given a sharp matted surface by stippling, as described in Chapter 19. This, to my mind, is the best way to roughen up a buttplate. It takes mighty little roughening to prevent a steel plate from slipping on the shoulder. Some insist on having deep coarse diamond or square checking on it, or very deep cross corrugations, in the belief that anything else will slip. I like to shoot with as few clothes on as possible—particularly as little as possible on my right arm and shoulder. And I have come in with the print of a very rough buttplate clearly stamped on the skin of my shoulder and the blood showing through—this through an O. D. Shirt and underwear. Such a rough buttplate will stay put not one bit better than one with almost a smooth surface, and is far easier on the shoulder. Fine diamond checking or cross scoring or fine stippling only are needed.

RE-SHAPING FOREND. Re-shaping a military forend into one more suitable for sporting use is generally easy because there is plenty of extra wood to work on. The different kinds and shapes of forend tips are described in Chapter 9, and one may work out almost any shape desired, so long as it is not larger than the original forend.

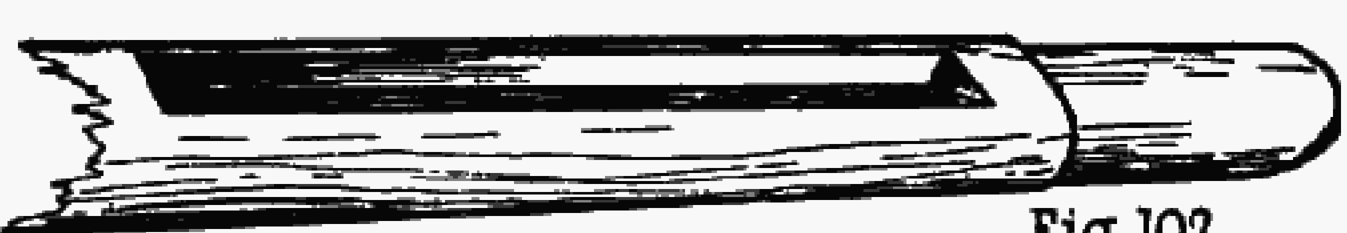


Fig.102

Even then it is entirely practicable to square up the sides, dressing off enough of the original wood to get rid of the oil, and glue on slabs which are later worked down into a beaver-tail forend.

One may object to the hand-grooves along the sides. These can be removed by cutting them out to a wide V-shape as shown in Figure 102, then planing down strips of walnut to match and glueing them into the grooves. This is much easier and makes a better joint than trying to fit pieces into the round grooves, and it also gets rid of the oil, so the glue will hold. Use hot glue, and lay a strong

206

strip of wood over each of the strips, then clamp in the vise for 48 hours before shaping. The strips should be spotted in with chalk, same as other patchwork, and don't depend on the glue filling up any gaping edges, because it won't. The instant the checking tool hits it, it's out. Fit the strips tight at all points.

Most military stocks have deep channels cut in the forend under the barrel to lighten the stock. Usually cutting the forend to sporting length exposes one of these at the end. This one must be filled to make a good job. I usually use a piece of solid wood from the same stock, taken from the muzzle end where there is no channel—this gives a piece of walnut that will match. Square this piece

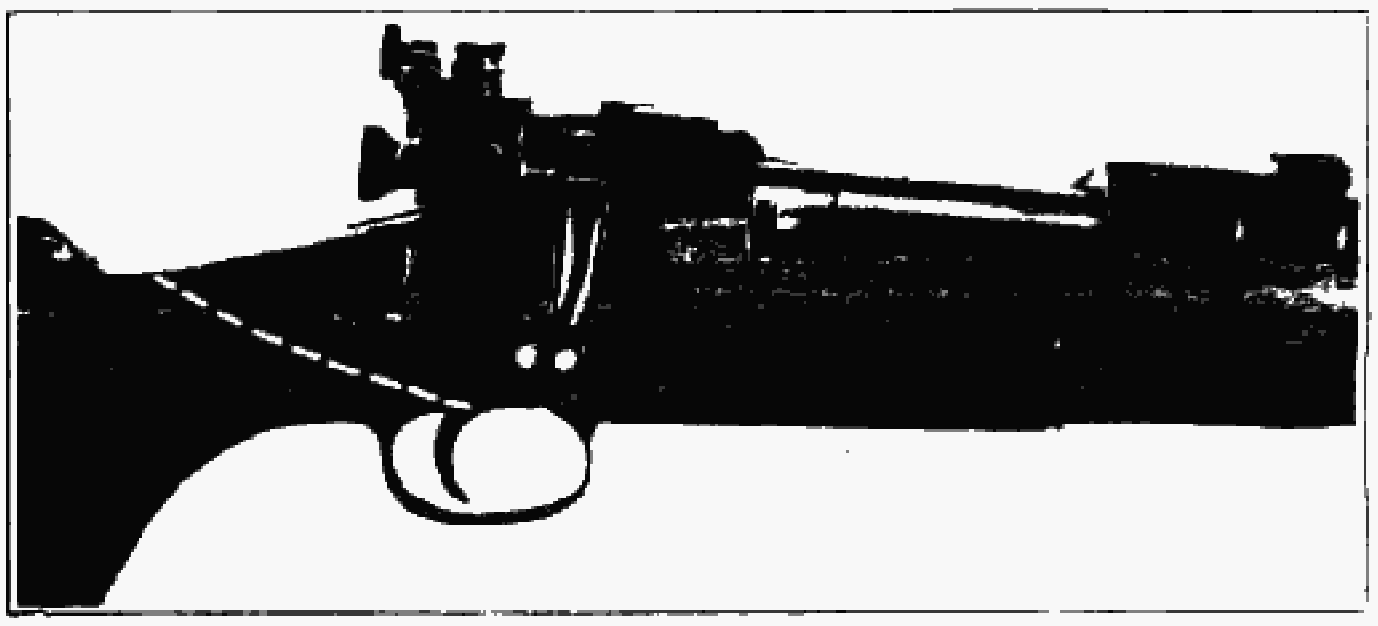


Fig. 103

up to a snug sliding fit in the hollow under barrel at muzzle. Coat it with hot glue, or du Pont cement, also coat the inside of hollow. Slip it in place, and clamp in the vise from side to side, also use a small clamp from top to bottom. Or, place a round stick on top in the barrel channel and clamp from top to bottom of forend in the vise, using a hand clamp against the sides. When dry, cut the heads off four small cigar box nails, and drive them in, two on each side, sinking them well below the surface. When the stock is sanded and oiled the holes will close up and will not be noticeable.

The barrel is held to the forend by the original outside band, or by one of the inside bands described in Chapter 24, according to the design of your forend.

REPAIRING BROKEN STOCKS. Sometimes—but not often—a broken stock can be repaired to make it as good as new, and as strong. Usually a new stock is indicated. Since no two breaks are exactly alike, the exercise of a little ingenuity is usually required to decide how to make the repair and whether or not any repair is practicable.

Stocks of bolt action rifles, if they break at all, usually break across the grip as indicated by Figure 103, or else split vertically

207

back of the tang screw. The former is caused by improper selection of wood, so that the grain at grip runs downward toward the guard, or by too small a grip, or both. The split back of tang is caused by incorrect inletting of the action, leaving it too tight against the wood on sides of receiver, especially toward the rear where the tang tapers;—this, and lack of support against the shock of recoil thrust.

A grip broken like Figure 103 always calls for a new stock. It may be repaired to give service for a time, however, by coating both surfaces with hot glue or du Pont cement and clamping together under heavy pressure. Then put two brass wood-screws in each end, drilling the holes carefully to avoid further splitting. Then wind the entire grip tightly with copper wire, using about No. 24 gauge size. Fasten the wire at beginning of winding by laying the end under five or six turns. Wind on evenly and smoothly over the entire break, then fasten the end by holding tightly and running on solder for about an inch to hold it to the last winding. Cut off, leaving about an inch project, and force this under the windings. Coat the wire all over with solder, working it well in between the windings with the soldering copper, uniting the wires into a solid covering. Then dress off the surface smoothly with emery cloth. A repair of this kind will occasionally prove as strong as the stock was originally, and equal to it in all respects except appearance.

Once in a while some maker will let his enthusiasm for beautiful grain run away with him to the extent of making a stock with curly cross grain at the grip. I was recently called on to repair a broken grip like Figure 104, which shows the direction of the crack on both sides. The grain ran almost at right angles to the grip, and the break had followed the grain, extending almost to the bottom on right side, and about half way down on the left. This was a hign grade English 8-bore, and it was desired to make a permanent and invisible repair if possible.

After removing the action from the stock, the latter was held tightly in the vise, with felt covered blocks gripping the grip just back of the crack. A red fiber block was then laid in the upper tang channel, and vigorously hammered until the forward portion broke off, the crack continuing in an angle forward through bottom of lock recesses. Various trials showed that there was no way to hold the parts together with clamps, and that only the action itself would hold them. Both of the broken surfaces were then slightly coated with du Pont cement, which was allowed to dry a few minutes; they were then placed together and the action parts fitted, with a layer of blotting paper under the tangs to provide extra tension, then the screws set up as tightly as possible. The edges of tangs were lightly greased to prevent the cement sticking where it oozed out. The stock was left without touching for nearly a week, then the action

208

removed and the repair tested by putting a block of fibre in upper tang channel and hammering, as when breaking off the piece. When the stock showed no signs of letting loose under some pretty vigorous blows, it was decided the job might hold. Then to further reinforce it, a round-head brass wood screw 2 3/4 inches long was turned in as shown in Figure 105. The hole for this screw was drilled starting just below the lock plate shoulder in extreme rear of lock

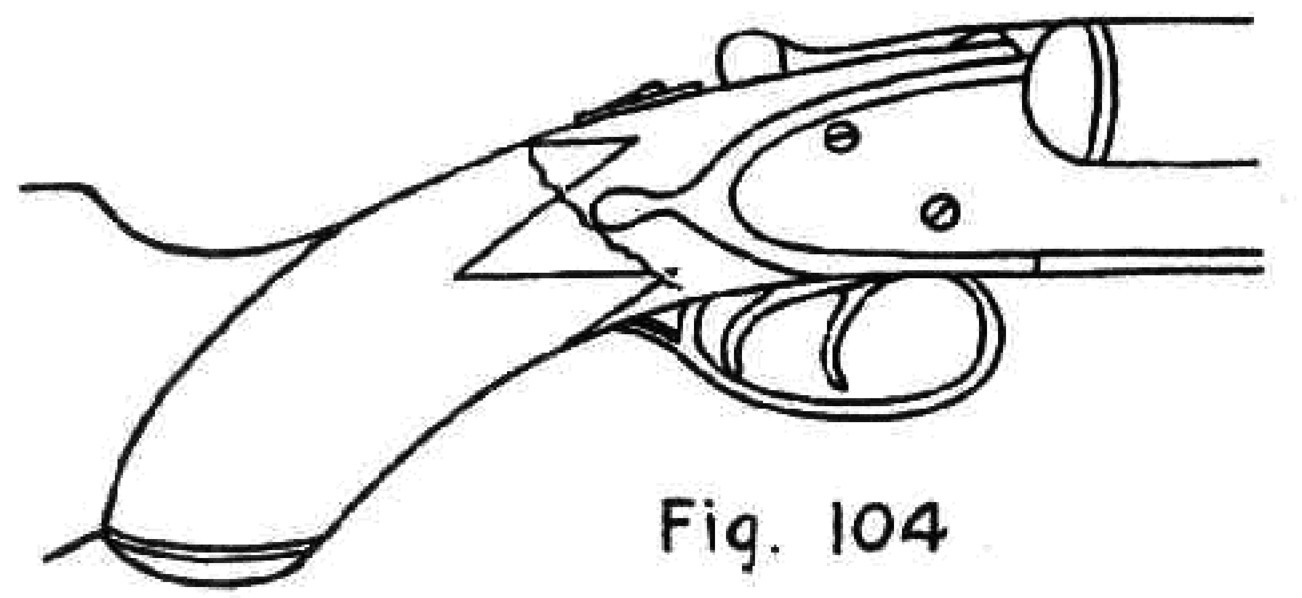


Fig. 104

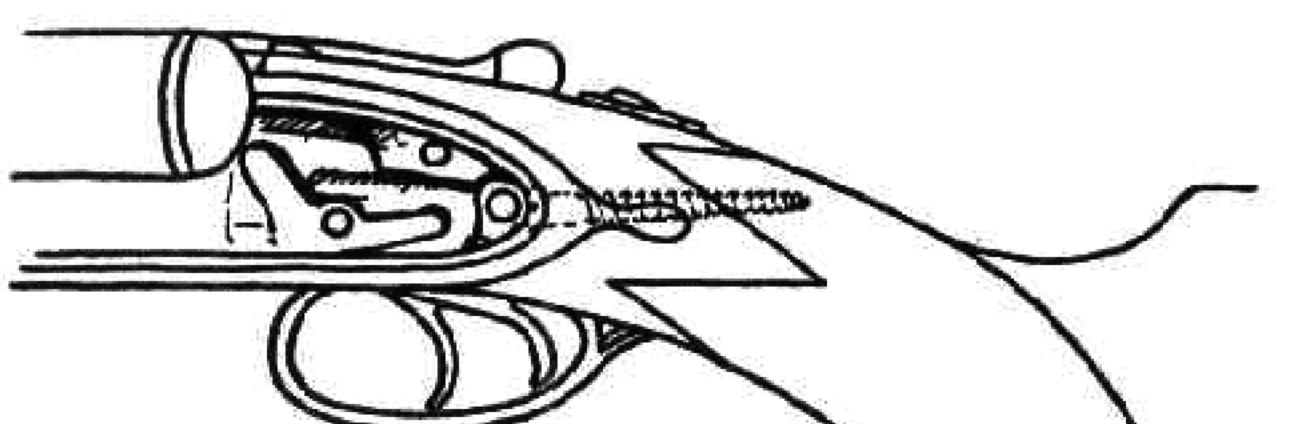


Fig. 105

recess, running back at a sharp angle almost in line with the stock and nearly at right angles to the break. Outer end of screw hole was drilled body size, the threads being allowed to take hold only in the inner end of hole, to give a good draw. This screw was then turned up very tight. Then the surplus cement was carefully scraped from the edges of the break, and the wood dressed down on edges where they showed on bottom under the action recesses by scraping and fine sandpaper. Most of this break had occurred in the checking of the grip, so all the checking was completely retraced with the V tool after the stock had been re-finished. I don't know whether this repair held, but have heard nothing to the contrary from the owner to date. I would expect it to hold indefinitely.

Because of the perverted ideas of some factories with regard to

209

pitch and shape of buttplates, splitting off the toe of a stock is a common occurrence. It doesn't take much of a blow when dropping the gun on the butt to split off a piece two or three inches long. The ideas of some mechanics relative to repairing such breaks is occasionally startling. A Model '99 Savage was brought to me recently on which a broken stock toe had been repaired by drilling a hole through the butt edgewise, from heel to toe, through which a long stove bolt had been inserted. The nut had been set up tightly with a washer under it, and the end of bolt peened or riveted to keep the nut from coming off. When I called the owner's attention to the fact that the stock was loose and wobbled on the receiver, he asked me to tighten it, and was quite surprised when I told him there was no way to get a screwdriver in to the butt screw past that stove bolt! After several futile efforts to slip the screwdriver past the said bolt, he instructed me to make a more satisfactory repair, which was done by grinding off end of bolt and taking it out, gluing on the broken toe, and reaming out and plugging with walnut the holes in toe and heel, then refinishing stock.

INLAYING AND PLUGGING. Plugging holes in this manner is a job requiring some care. The holes should first be cut out true with a Forstner bit. Then turn the plug to exact size, making a snug fit but without enough pressure to cause splitting. The easiest plug to make is of course the one with end grain exposed, but it is more conspicuous on the stock. To make a plug with side grain exposed, screw a piece of pine onto the face plate of the lathe, and on this glue a 1 inch thick piece of walnut. Set the tool rest across the bed, that is parallel to the face plate's surface, and turn the plug from the end, same as when turning a disk; then cut off to the required length. Half an inch is plenty in most cases, and the grain may be lined up with the grain of stock, then, when oiled, will take the same finish and be almost unnoticeable.

Small inlays are easily made from walnut, bakelite or fiber to fill up recesses left by removing swivels and the like. To get the shape required, coat the stock around the recess with dry lampblack, press a piece of white paper over it, then trace the impression on the piece from which the inlay is to be made. Shape up the inlay carefully, with a file, trying often for fit, and tapering the edges slightly. Coat inside of stock recess with du Pont cement, also coat bottom and edges of inlay; press into place, cover with paper, and clamp in vise. when using the vise for clamping, if the jaw is not swiveled to turn at an angle, make a wedge shaped piece of wood to give the required fit to parts being clamped.

Sometimes in remodeling rifles—the Krag is an example—it will be desired to use the handguard in order to cover sight screw holes, or rough places on the barrel. Figure 106 shows a method of remodeling a handguard. The rear sight hole is cut to a dovetail, into which is fitted a thick block of walnut. Coat edges of dovetail and bottom

210

of block with du Pont Cement, slide the block in tightly, and clamp in the vise with light pressure. When dry, the projecting top of block may be held in the vise while inside is dressed out with a hollow chisel to conform to the curve of barrel channel. Then, holding the block in vise so that handguard stands vertical, saw off

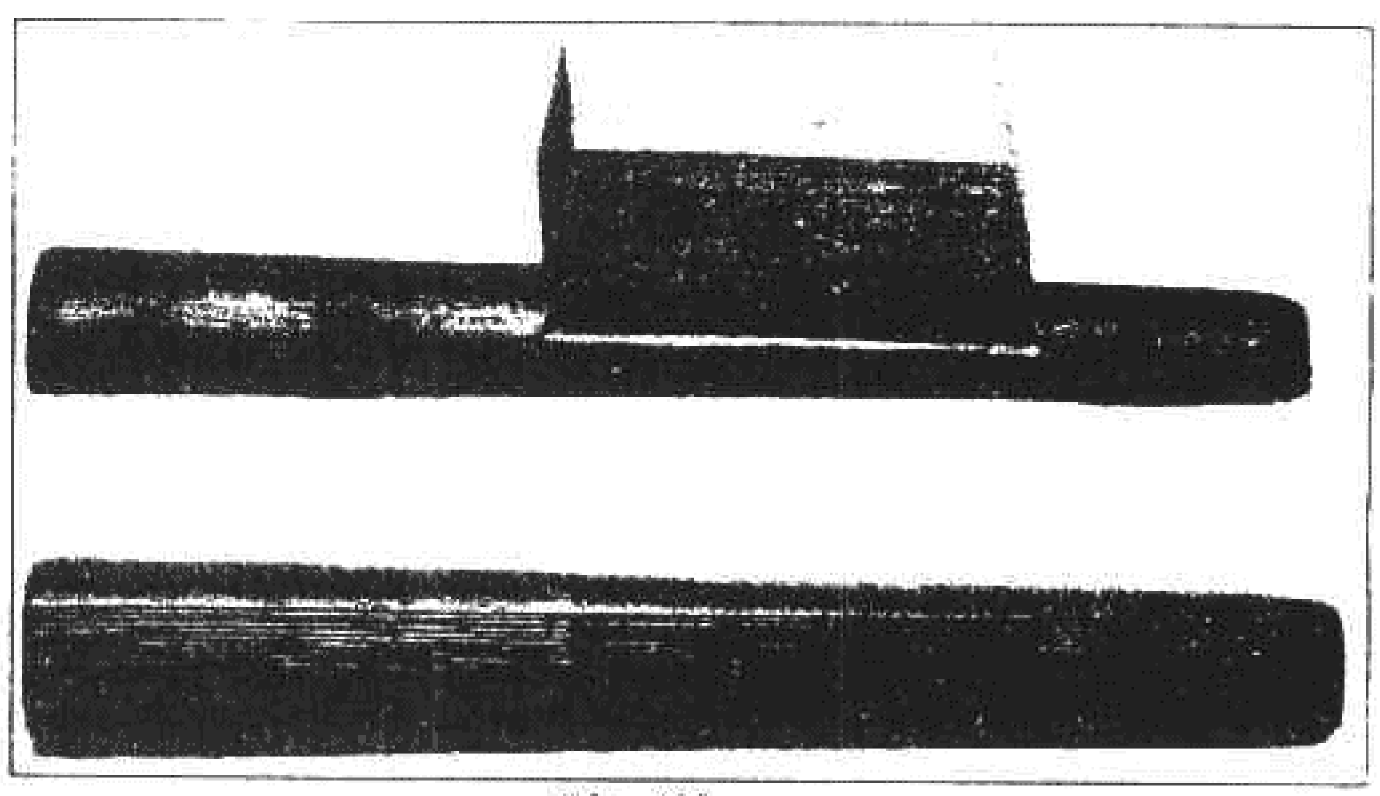


Fig. 106

excess wood, snap handguard into position on rifle, and round off top of patch with cabinet file. Smooth up with sandpaper and oil to match rest of guard. This job will be further improved by checking the upper side of guard in a strip half an inch wide, or by scoring it lengthwise with the line spacer.

SPLIT GRIP. When a rifle stock is cracked at rear of tang, the best thing to do is to get a new stock. A temporary repair may be made by forcing the crack open as far as possible with a thin bladed chisel, and squeezing in some du Pont cement. Clamp stock firmly in vise until cement dries, then drill through stock from side to side and insert a 1/8 inch brass screw. Countersink the head, and also countersink on other side and set up a small nut as tightly as possible. Cut off end of screw and rivet slightly to prevent nut turning. If a high power rifle having considerable recoil it is advisible also to wrap the grip with wire, and solder the wire, as already described, or at least to wrap it tightly with surgeon's adhesive tape. A roll of this tape an inch wide should always be carried in the field kit for temporary repairs.

After repairing the break the next thing is to remove the cause. Don't expect a stock to fit if the action is able to exert a splitting effect every time the gun is fired. First scrape the inside of all action cuts clean, then coat the action with lampblack and oil and fit into place. Relieve all pressure at sides, particularly the rear, by cutting

out wood, just as in fitting the action into a new stock. If the smudges indicate the recoil lug has not a good bearing against the shoulder in stock, insert a metal plate as described in Chapter 10. Then assemble, and set up the screws very tightly. In doing this be sure the screws are not too long so that their points bear against bottom of hole, stop them before they are exerting pressure on stock. If such is the case, grind or file off the points sufficiently to give them good tension.

Stocks having small splits lengthwise can sometimes be permanently repaired by breaking them entirely apart at the splits, and gluing, either with hot flake glue, or with du Pont cement. For small surfaces I find the latter best, while I like the glue for large joints. The pieces must be broken apart carefully, with due care not to bruise the edges; also, take care not to lose any small splinters that may develop. They should be kept in position, leaving one end of splinter attached if possible. They must be coated all over with the glue or cement, and worked carefully in their place before the parts are clamped. Perfect contact and tight clamping are the secrets of good glued joints. Merely "pressing parts firmly into place" as the directions say, or binding with twine, will not answer—get a hundred pounds or so pressure on them, and leave it a while! *The more of the glue or cement you can squeeze out of a joint, the better and stronger the joint.*

REMOVING DENTS AND NICKS. Stocks that have been badly marred by an accident can often be brought back to new condition by careful treatment. Examine the places and decide whether they are merely dents, or whether they are nicks. If no wood has been gouged out, dents can easily be raised up even with the surface. Fold several thicknesses of cotton cloth, wring it out in water and lay over the spot. Take a hot flatiron and rub it over the cloth, wetting the cloth and repeating again until the dent is raised level. This will do for shallow dents. For very deep dents, take a can holding a gallon or so and having a tight fitting lid. Punch a hole in lid and solder into it a small piece of brass tubing, over which slip a rubber tube long enough to handle conveniently. Make a nozzle from a six inch length of brass tubing fitting tightly into the rubber. Pinch the outer end together and solder, then drill a 1/16 inch hole in one side near end.

Fill can two-thirds full of clean water and set it on the fire. When it starts boiling, pinch or clamp the rubber tube until you have a pretty good head of steam. Then turn the small jet from the nozzle into center of dent. Work it round over the sunken spot, lightly tapping the wood around dent with a small, smooth hammer. It may take several cans of water to do the trick, but dents which look utterly hopeless can be raised in this manner, which is employed in furniture stores to recondition pieces damaged in shipping. The more steam pressure you have the better. A good "corn" still of heavy

copper, with a strong screw cap, would of course be better than the can I have described.

Steaming out a dent by either of these methods will not hurt an oil finish except at the place where the steaming occurs. The spot when dry should be smoothed off with very fine sandpaper, and reoiled until it matches the rest of stock. A varnish finish will of course be ruined by the steaming, and that is a good time to decide to remove all the varnish and oil finish the stock.

Sometimes a stock will be gouged or scratched on barbed wire, sharp rocks, etc., and of course when wood has been removed, no amount of steaming will level the surface. Very slight scratches and nicks are best removed by rubbing out with fine sandpaper, then refinishing the spot. A real bad gouge must be filled up. Plastic Wood is very good for this purpose if properly handled. All varnish or oil must be scratched out from the gouged spot, exposing the bare wood. Take a small lump of plastic wood, which is soft and works like putty, and force it into the hole. Smooth off the surface, letting it extend slightly above the hole, and when dry and hard it may be dressed down even with a fine file and sandpaper.

Plastic wood after drying does not take stains readily, and as it is nearly white in color it should be stained before drying. As soon as it is worked into the hole (it begins to set on the surface very quickly) work in a little raw umber or other coloring—even a drop of common brown paint will do in a pinch. Work this well into the surface, but don't work it into the entire mass, or it may cause it to loosen. After it has dried a day or so it may be smoothed down and oiled, using plenty of alcanet or other coloring in the oil.

Instead of Plastic Wood, a mixture of powdered walnut with glue or cement may be used, and this will have a much better color. Set a block of good hard walnut end grain up in the vise and use a moderately fine bastard cut file to make the powder. Sawdust or coarse filings do not work well. Coat the inside of hole with du Pont cement, then very quickly mix some of the cement with the powdered wood to the consistency of the stiff putty, and force it into the hole. Build it up a little higher than the surrounding surface, as it shrinks in drying. Then file and sandpaper smooth, and oil. This mixture should dry two or three days before being filed off. Le Page's glue may be used instead of du Pont cement, but the latter makes the hardest and best repair. Hot glue does not work well for this purpose.

Sometimes when remodeling the service stock of a military rifle, (our own Springfield for example), the barrel channel in forend will be found much larger than the barrel, not touching it at any point. This is called a "full floating barrel." Rather than making a slipshod job by gluing strips against the sides of barrel channel, measure this channel carefully with dividers, and turn up a piece of wood in the lathe to just fill it snugly. Glue this piece into the

channel, and when dry cut off the projecting upper half with ripsaw, and plane down level with edges of stock. Then cut a new channel, same as when inletting a new stock, to fit the barrel snugly at bottom and sides. The cutting of a barrel channel is not the difficult job which many suppose, particularly when the action is already inletted.

Another way which I have never seen but have had described to me as entirely successful is to fill in the square grooves under barrel with strips of wood, then quickly pack Plastic Wood into the barrel channel and press the barrel firmly into place, letting it form its own channel, and leaving it there several days until the Plastic Wood is thoroughly dry. The barrel must be covered with a light coating of grease to prevent sticking. My suggestion would be to use Plastic Wood except at the upper edges, and use the powdered walnut and cement mixture here where the filling will show.

While the Springfield service can be remodeled by piecing out where needed, there is little reason for doing so with the D. C. M. Sporter stock available at five dollars to members of the National Rifle Association.

Chapter 15

RIFLE BARREL DESIGN AND FITTING

WE debated a long time as to whether we would include instructions for boring, reaming, and rifling barrels in this book, and we decided not to for several reasons. These operations are a separate art in themselves, and a very specialized art in these days. To describe them would require several hundred pages, and such description would be intelligible only to a trained machinist or toolmaker, who alone is competent to undertake such work. While it is possible for a very skilled and ingenious machinist to set up an engine lathe to bore, ream, and rifle a barrel, yet generally speaking, heavy and expensive special machine tools are necessary for this work, and these are far beyond the resources of the small professional or amateur gunsmith, necessitating a large and expensive layout which must be in addition to a general purpose machine shop, the latter being needed for related work and for tooling up for the rifling operations. Even a very modest equipment may easily run to $25,000 or higher. The various boring bits, reamers, and rifling cutters cannot be bought, but must be made, hardened, and ground by the workman himself, who must have the necessary skill. Such skill cannot be taught in any book, but requires years of training in general machine work.

There are a number of large companies as well as small firms in this country who supply professional and amateur gunsmiths with barrels bored and rifled to order to any specification at a reasonable price. It is also often entirely practical to remove barrels from certain rifles, such for example as the surplus military rifles which have been sold in large quantities and at low prices since the World War, and fit these barrels to other receivers and chamber them as desired. In addition barrels for the Springfield rifle can be bought by members of the National Rifle Association through the Director

of Civilian Marksmanship, and these barrels can be cut off at the breech, be rethreaded, fitted to other rifle actions, and rechambered, or of course they can be fitted to the Springfield breech action by anyone having the necessary headspace gages. We are therefore going to confine ourselves to giving the gunsmith that information which will enable him to draw up proper specifications for his rifle barrels, to fit them to proper breech actions, and if necessary to chamber them for the cartridge desired.

BARREL STEEL: In general the steel used in the manufacture of rifle barrels may be divided into four classes:

1. Black powder barrel steel.
2. High power carbon steel, sometimes called "Ordnance Steel."
3. Nickel steel.
4. Stainless or rust proof steel.

Under these general classes each barrel manufacturer has his own specifications as to chemical composition and physical properties under which he buys his steel from the steel mills in the form of long bars. It would do us little or no good to know all these specifications in detail, so instead we will look at the general properties of these four classes of barrel steel.

BLACK POWDER STEEL, the steel generally used before the advent of high power cartridges and jacketed bullets, is generally a rather soft, simple carbon steel. It is easily machined, and works up into a smooth, even, and uniform bore and rifling. Its limitations are that it has not the tensil strength and elasticity for cartridges giving breech pressures over about 25,000 pounds per square inch, that is for high power cartridges, and it often wears out very quickly from friction when bullets jacketed with hard metals are used. For .22 and .25 caliber rim fire rifles to be used with lead bullets exclusively it is probably as satisfactory as any of the other classes of steel, and it is believed that its use should now be restricted to these calibers of rifles.

HIGH POWER CARBON STEEL, or Ordnance steel, is the steel now being used by a majority of the manufacturers of high power rifles, including Springfield Armory, The Remington Arms Company, and the Savage Arms Corporation. It is an exceedingly satisfactory steel for all kinds of rifle barrels, being easily machined, having high tensil strength, excellent wearing qualities, and making very fine barrels. A typical composition of such steel is:

Carbon	0.45 to 0.55
Manganese	1.00 to 1.30
Phosphorus (max.)	.05
Sulphur (max.)	.05

Often it is heat treated to increase its yield point and its ultimate strength, which in Government barrels are about 75,000 and 110,000 pounds per square inch respectively.

NICKEL STEEL is used for barrels by the Winchester Repeating Arms Company, the Niedner Rifle Corporation, and several small barrel makers. It was also used at Rock Island Arsenal at the time that a portion of the Model 1903 rifles were being made there. Theoretically it is the best steel for high power rifle barrels, and it is used almost exclusively in England for this purpose. It is slightly more difficult to machine than carbon steel, sometimes requiring a slight change in tools used. It has high tensil strength, excellent wearing qualities, slightly more resistance to corrosion than the ordinary carbon steels, and makes most excellent barrels. From an entirely practical point of view it has not been demonstrated that nickel steel is markedly superior to carbon steel for rifle barrels, but most riflemen think it is. Certainly among the older and more used rifle barrels in the writer's gun-room, the nickel steel barrels seem to have worn less, and to be brighter and in better condition than carbon steel barrels of similar service. Much of the popularity of nickel steel for barrels is due to its use by the Winchester Repeating Arms Company, who for thirty-five years have been manufacturing barrels of this steel which have been superb in their workmanship, accuracy, and wearing qualities. The chemical composition of Winchester nickel steel is 3 1/2 per cent. nickel and 0.30 to 0.40 carbon, and it is made by the acid open hearth process.

As this chapter is being written STAINLESS OR RUST-PROOF STEEL, is coming more and more into use for a great many purposes. Whether it will be the barrel steel of the future or not cannot be foretold at present. Some of the earlier forms, such as Poldi "Anticoro" steel and Boehler "Antinit" steel, have been imported from Austria and Germany for some years and used in rifle barrels. The chemical composition of these two steels is not known. The American so called "Stainless" steel, as now being used to a limited extent for rifle barrels, is really not a steel at all, but a high chrome iron. A typical composition of this iron as now being used in rifle barrels is chromium 13 per cent., carbon 0.10 per cent., and copper 1.50 per cent. Certain intricate heat treatment is necessary in order to make it both machineable and rust-proof. None of these steels are absolutely rust-proof—all will rust if given enough exposure, but they are very much more resistant to rust than the other barrel steels. Poldi "Anticoro" steel for example, is so resistant that it takes five to ten times as much application of the bluing solution to blue it (which is a rusting process) as ordinary barrel steels. Stainless steel is still further resistant, cannot be successfully blued, and is generally copper plated outside and then subjected to a treatment which turns the copper black. All of these steels are very difficult to bore, ream, and rifle, requiring tools of a very special steel. This, in addition to the original cost of these steels in the bar, make barrels constructed of them much

more expensive than ordinary barrels. Owing to the difficulties connected with machining, heat treatment, bluing and fitting of these steels, it is thought that they cannot be utilized profitably in work by the average gunsmith who had better place orders for complete barrels fitted to actions and bolts, and ready chambered by the manufacturers specializing in them.

OUTSIDE DIMENSIONS AND WEIGHTS. Besides being of proper steel, a rifle barrel must have a certain minimum thickness or wall diameter in order to be safe against bulging or bursting, this thickness depending upon the cartridge to be used, that is the breech pressure. Other things being equal, the heavier the barrel the more accurate it will always be. Barrel length also must be considered, and there are many other factors which must be carefully weighed in the final determination of the diameter and length of the barrel of any rifle.

The barrels of our old lever and pump action repeating rifles were made very light in weight and small in diameter in order to reduce the weight of the complete rifle. They were also usually cut with two or three transverse dovetail slots for the attachment of sights and forearm. Such barrels performed fairly well with black powder cartridges, the breech pressures of which did not often exceed 20,000 pounds per square inch, and they will still be satisfactory for such light cartridges as the various .22 calibers in rim fire, and the .25-20 and .32-20 center fires. But such barrels are not satisfactory for modern high power cartridges giving pressures from 36,000 pounds to 50,000 pounds, not because they are not safe enough, but because they are not stiff enough. These thin, slotted barrels when fired with high power cartridges vibrate with very great amplitude and as each cartridge differs slightly from every other cartridge, one may set up a slightly different vibration from the next, and thus cause a delivery of the bullet from the muzzle at a widely varying point in the vibration. The result is mediocre accuracy.

In the design of modern barrels, in addition to safety and stiffness, we must consider the ultimate weight of the rifle and its balance. In a hunting rifle we desire as light weight as is consistent with accuracy and moderate recoil, and the balance should be only a short distance in front of the trigger so it will handle and move quickly for snap shots and shooting at running game. In a target weapon, on the other hand there should be weight to hold it steady, and this will also minimize movement from little tendencies to flinch or jerk the trigger, or small muscular tremors, which will not disturb it so much. And with the target rifle we prefer that it be a little muzzle heavy so that in the process of holding and aiming it will swing slower towards and away from the bull's-eye.

To reduce weight and give the desired balance, and at the same time minimize vibration, the modern hunting rifle barrel is made

218

heavy at the breech end. This large diameter or cylindrical portion (see "A" Figure 107) is carried forward to a point corresponding to the forward shoulder of the chamber. There is then usually a short, sharp taper to a point approximately 2 inches ahead of the chamber, thus insuring heavier metal over that portion of the barrel where the chamber makes the walls thinner and where the peak of the pressure comes. From the forward end of this short taper there is usually one (occasionally two) long, straight taper to the muzzle. Figure 107 shows a hunting rifle barrel of this design intended for a high power cartridge, and the accompanying table gives the approximate dimensions at the various points for the

DIMENSIONS OF HIGH POWER RIFLE BARRELS

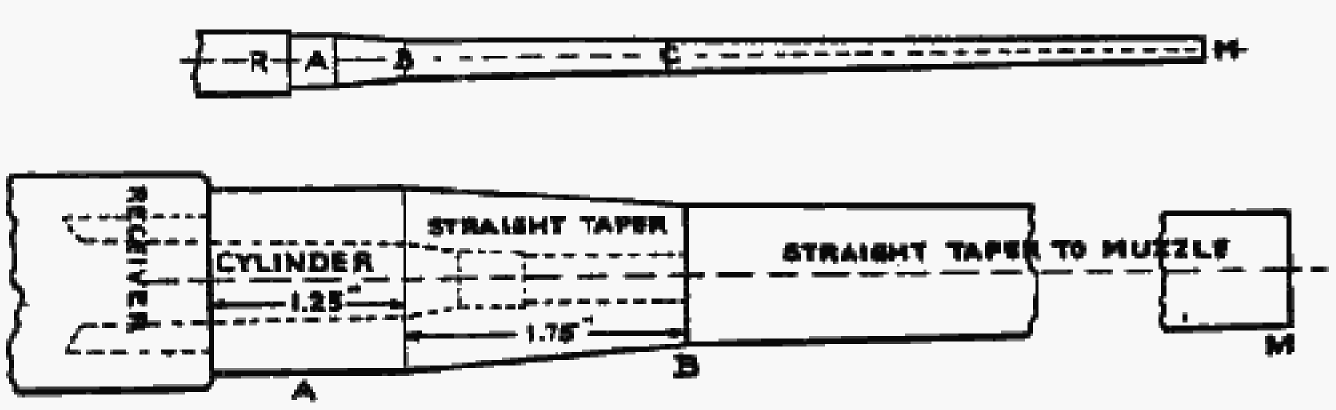


FIGURE 107

No.	Diam. at A	Diam. at B	Diam. at M	Remarks
1	1.00	.75	.50	Minimum weight .25 cal. barrel.
2	1.05	.850	.550	Minimum weight .30 cal. barrel. Accurate .25 cal. barrel.
3	1.14	.956	.647	Springfield .30 cal. service barrel. Diam. at C .71", C being 9.00" from receiver, B-C and C-M being straight tapers. Minimum .35 Magnum barrel.
4	1.14	.956	.647	Springfield .30 and .22 cal. sporting barrels.
5	1.18	1.00	.70	.35 Magnum barrel, minimum .375 and .400 Magnum barrels.
6	1.20	1.05	.75	.375 and .400 Magnum barrels.
7	1.25	.....	.875	International Springfield Free Rifle barrel. Taper breech to muzzle.
8	1.05	.....	.90	Winchester Single Shot No. 3 barrel, round, .30-40. Straight taper breech to muzzle.

most common calibers, weights, and kinds of rifles. Generally speaking a barrel of the dimensions of the service Springfield barrel (No. 3 in the table) is the lightest barrel from which really first class accuracy can be obtained with cartridges of power and caliber similar to the .30-06 U. S. Government. Fine results can be had from such cartridges as the .25-35 W.C.F., and .30-30 with slightly lighter barrels. The barrels for .35 and larger cartridges of the Magnum class should be slightly thicker than the service Springfield barrel for the best accuracy and moderate recoil. Particularly

219

these hunting rifle barrels should not be suddenly reduced to small diameter an inch or less forward from the receiver. Many foreign hunting rifles have a short radius of concave form cut about a quarter or half inch forward of the receiver, reducing very quickly to a quite small diameter at this point. Such barrels do not, as a rule, give very fine accuracy, for they vibrate excessively, and the slight difference in the load causes very different sight adjustment to be required. There is no objection to making barrels slightly lighter than the above provided their owner understands that he must sacrifice somewhat in accuracy. For example, a .30-06 rifle made with a barrel like the No. 2 in the list will make a fine light rifle for deer and moose in country where these animals are scarcely ever shot at long range, but one must not expect it to perform with satisfactory regularity on mountain sheep at 300 to 400 yards.

Barrels intended for target shooting have much less pronounced tapers, and are heavier. Thus the very heavy "Free Rifle" barrel used in the International Matches (No. 7 in the list) has but one straight taper its entire length from 1.25 inch at the breech to .875 inch at the muzzle. This is about the heaviest barrel that is advisable, as if a heavier barrel be used the muscular effort to hold the rifle of such resulting weight will make for trembling. It is well to have the breech of the barrel where possible, only slightly smaller in diameter than the receiver where the latter joins the barrel, as this gives better appearance than where there is a sudden drop from a large receiver ring to a small barrel. Thus on a Krag rifle, or on the .22 caliber Model 1922 Springfield, or Winchester Model 52, a very excellent diameter for a target barrel is 1.10 inch at the breech, tapering gradually to .75 inch at the muzzle. Such single taper barrels are also better to mount target telescope sights on, where the two bases are screwed to the top of the barrel, than sudden taper barrels of the hunting type.

It will be noted that a majority of the hunting rifle barrels have a diameter of .647-inch at the muzzle. This is for convenience sake to permit of fitting the front sight stud with its encircling barrel band as made for the Springfield rifle, or the many inclined ramp front sight bases which can now be had in more or less finished condition for this size muzzle. If other diameter at muzzle is selected it will usually be necessary for the gunsmith to make by hand the front sight band and stud to fit.

Considering that a Springfield or Mauser breech action is used, and a rather light walnut stock of medium density, with barrel length of 24 inches, a No. 1—.25 caliber barrel or a No. 2—.30 caliber barrel will cause the rifle to weigh approximately 7 to 7 1/4 pounds, No. 3—.30 caliber 7 1/2 to 8 pounds. No. 4—.30 caliber 7 3/4 to 8 1/4 pounds, No. 5—.35 caliber 8 3/4 to 9 1/4 pounds, and No. 6—.375 caliber 9 to 9 1/2 pounds. Barrel No. 3 differs from barrel No. 4 in that the former has three tapers instead of

220

two, and is slightly smaller than the latter at a point 9 inches forward from the breech, and hence slightly lighter. A No. 7 "Free Rifle" barrel 28 inches long, on Springfield action with rather heavy stock and heavy International butt-plate will cause the rifle to weigh from 12 1/2 to 14 pounds, depending upon stock, fittings, etc. A Winchester single shot rifle with the Winchester No. 3, 30 inch barrel (No. 8 on list) .32-40 caliber, pistol grip stock, shotgun butt, weighed about 10 pounds. In giving the weight of rifles the weight with iron sights, unloaded, and without gunsling, is usually that given unless otherwise specified.

So far we have not considered BARREL LENGTH at all. Twenty-four inches from receiver to muzzle is perhaps the best average length for high power hunting rifles, except that those of .375 caliber and over had better be regarded as standard at 26 inches. The longer the barrel the higher the muzzle velocity that a given cartridge will develop. With the Springfield cartridge 1 inch in barrel length is equivalent to approximately 25 f.s. in velocity. With the Krag using the older W.A. powder which burns more completely in short barrel length, the difference between a 30 inch barrel and one of 22 inches is only 60 f.s. in muzzle velocity. As the barrel is shortened muzzle blast, flash, and report become greater, and these become very objectional with high power rifles when the barrel is made shorter than 20 inches, which should be regarded as the minimum length for rifles of high power, particularly .30 caliber. Eighteen inches should be the minimum length for .25 caliber barrels, and 22 inches for .375 caliber barrels.

It is not true that the longer the barrel the better the accuracy. The most accurate length for .30 caliber barrels is between 24 and 28 inches, but we cannot say that a 28 inch barrel is any more accurate than one of 24 inches. In fact the longer a barrel the greater the chance that there may be a tight or loose place in the bore which may affect accuracy, and it is usually best to choose a length of barrel that the factory is accustomed to making on the theory that the workmen will do better work on something that they are thoroughly accustomed to doing day after day than on an unaccustomed special order. Of course if iron sights are used the longer sight radius of the longer barrel minimizes errors of aim. Also some men can hold and swing steadier when firing offhand with a long barrel than they can with a short one. This is why most International Match rifles are made with barrels 28 and 30 inches long. Rifle barrels are usually shortened below 24 inches to make them lighter, or handier on horseback, or because of fancied easier handling particularly in thick brush. One inch of barrel length at the muzzle of a .30 caliber Springfield barrel of service type weighs about 550 grains, or a little over an ounce. To find the weight of a round bar of steel; square the diameter in inches and decimals of

221

an inch, and multiply by .2225, and the result will be the weight in pounds of a section 1 inch long. To find the weight of a rifle barrel, or a section of such barrel, first find the weight of a bar of the outside diameter of the barrel, and subtract from it the weight of a bar of the diameter of the bore.

A barrel for a cartridge like the .25-20 can of course be made very much lighter than one for a high power cartridge, and still give excellent results. The barrel on the .25-20 Winchester Model 53 rifle measures .85 inch at breech and .57 inch at muzzle, and is perhaps the minimum barrel that will give fine accuracy in this caliber.

Barrels for the .22 caliber rim fire cartridges can probably be made as light as .60 inch at breech and .40 inch at muzzle if of good steel. Such a barrel 10 inches long fixed from machine rest might group as closely as an inch at 25 yards with suitable .22 Long Rifle ammunition. The .22 Long Rifle cartridge seems to give its maximum muzzle velocity in a barrel somewhere between 18 and 22 inches long. It is doubtful if any increase in accuracy (human element eliminated) results from increasing the length over 24 inches or the diameter over that given for the Springfield sporting type barrel (No. 4 on the list). Both weight and length are given to .22 caliber barrels to give proper appearance and balance to rifles, and to maintain a weight and swing that will enable the shooter to hold the rifle steady. Thus the Winchester Model 52 rifle has a quite heavy 28 inch barrel, and the expert shot finds it very convenient from the standpoint of hard and steady holding in all positions. But the same rifle could probably be fitted with a light 18 inch barrel and from a machine rest this light, short barrel might give quite as good average groups as the longer and heavier standard barrel.

TURNING DOWN BARRELS: Rifle barrels should be turned to the desired weight and shape in the process of manufacture, and not after they have been bored, reamed, and rifled. Turning a completed barrel down to reduce its diameters and thus lighten it almost invariably results in releasing strains in the steel to such an extent that the barrel bends considerably. We have seen .30 caliber heavy barrels that were turned down to lighten them bend so much that one could not see through the bore when viewing it from breech or muzzle. Military rifles are frequently remodeled into sporting weapons, and when the military rear sight fixed bases are removed from these barrels there will be a rough, ugly, uneven portion of the barrel exposed. Such a barrel may be placed in a lathe and this rough place turned smooth, and the barrel polished for bluing and no bending will result if the work is done carefully.

First you make a plug for the muzzle to hold it in the lathe. This plug is shown in Figure 108. It must be made of hardened steel and ground on centers. If made of soft steel it is liable to cause wear and to freeze in the bore. The long shank which goes into the bore must be a push fit on the top of the lands. The center hole

222

must be located and drilled with a small drill, and then countersunk with a 60 degree countersink as in all lathe work. Place the muzzle plug in the muzzle of barrel and fit to dead center of lathe. Put the breech end of barrel in chuck or live center, attach a lathe dog to barrel, and tighten up on face plate with dog and raw hide belt lacing. Then when you have the barrel running truly in the lathe turn a short length on the barrel to true diameter about an inch in front of the rough portion of the barrel. If possible turn only through the bluing or Parkerizing finish. Set the steady rest up here. Then using a second-cut flat file or a mill-file, smooth up the rough portion of the barrel, giving it an even taper and contour with the adjoining portions of the barrel. The file should be moved at right angles to the axis of the barrel, and with light uniform pressure. It is advantageous, although not essential, to give the file a slight rocking movement. Each successive stroke should advance a small fraction of an inch lengthwise of the work until the total length is covered. The file strokes may be slower than in vise work, but holding the file still on the lathe always causes rough and botched work. It is desirable to finish up with a very fine file. When the rough portion has thus been trued up, the entire barrel should be polished to remove the old bluing and to give a mirror-like surface prior to rebluing.

If the original barrel had a very rough Parkerized finish it may be desirable to go over the entire barrel lightly with a file to smooth up, leaving the steady rest in place. Then remove the steady rest and lightly file smooth the spot where it bore. Next take medium emery-cloth and move it back and forth by hand lengthwise of the revolving barrel until it is polished and perfectly clean all over. Then repeat with fine and extra fine emery-cloth and crocus cloth each in turn until a perfectly smooth, mirror-like surface is obtained. The barrel is now ready for final polishing as explained in Chapter 18.

It might be remarked here that in purchasing a Springfield rifle for the purpose of remodeling, it is always better to purchase one of the sporting models which has no rear sight fixed base attached, and with a barrel which is already polished and blued from receiver to muzzle, thus making it unnecessary to do all this lathe work, or even to reblue.

STRAIGHTENING BARRELS. When a shooter contemplates turning down a barrel to smaller than its original diameter he should consider carefully the facts and dangers that almost invariably attend such an operation.

In turning down the barrel originally, it was in all probability removed from the lathe and carefully straightened *after each cut.* After rifling, it was again checked for straightness, and straightened if necessary. The pressure of the lathe tool always springs the barrel slightly out of a straight line, so that straightening after each cut is

223

necessary to keep the outer surface concentric with the bore. The final straightening leaves the bore approximately straight (very few bores are absolutely straight) and the tension of the metal such that it stays straight under normal conditions.

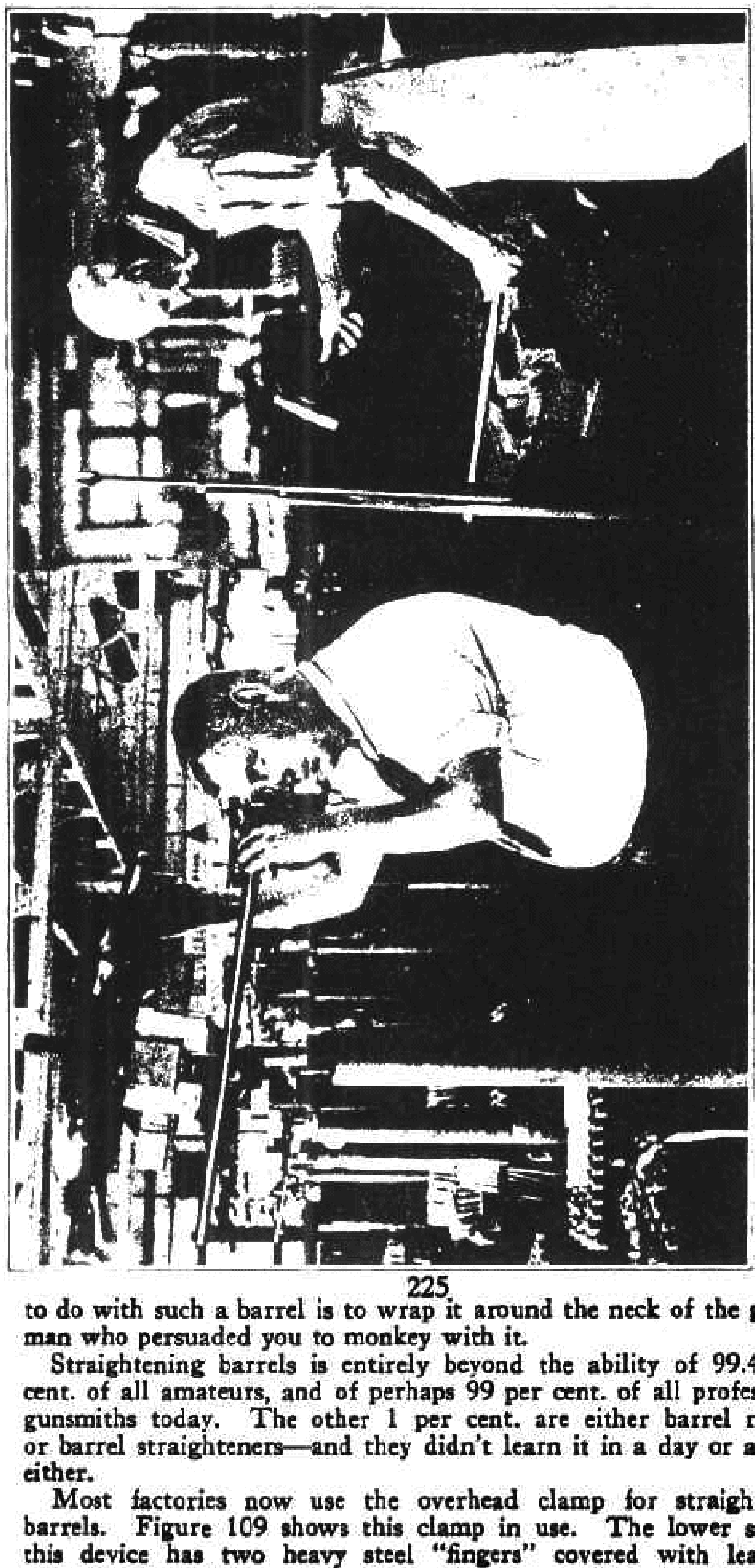
Now, a cut only a few thousandths of an inch deep, taken from the outer surface of such barrel, may, and usually does release internal stresses in the metal, causing the barrel to spring back to its original crooked or curved state as it was before being straightened.

A very common mistake of the amateur is to center his barrel in the lathe, and turn it down to the size wanted, without thought of straightening. The fact is, he probably cannot tell by looking at it whether it is straight or not. He finishes the job and stocks the barrel and action, only to find that it is shooting far—very far—from its previous sight adjustment. Probably it is necessary to shift the sights well off center to bring the group into the black. And—here's the worst of it—that cussed group moves up or down, right or left, stringing its shots all over the paper, as the barrel becomes warm from firing.

How come? The barrel looks straight on the outside—and probably is. But were you to saw it in two at the right point, you would find that the wall was considerably thicker on one side than the other—the difference often being quite plain to the eye, without any measurements. What has happened is that the very first cut taken from the outside sprung the barrel slightly, or else released stresses which permitted it to spring itself. Subsequent cuts, either lighter or heavier, sprung it some more—perhaps causing a compound bend; the light finishing cuts gradually turned the outside true and comparatively straight, while the bore remained crooked. Thus there are places where the wall is thicker on one side of the bore than the other, and this brings about a complicated state of affairs.

The crooked bore causes the barrel to shoot away from its normal sight adjustment; as the barrel becomes heated from firing, the expansion of the thicker wall being greater than that of the thin side, the barrel naturally bends itself in the direction of the thin walled side; and the hotter it gets the more it bends. There is no remedy for this except straightening of the bore, and turning the barrel down smaller to make it concentric—straightening after each cut—and this is likely to reduce the size entirely too much.

The third result likely to be encountered, will be the increased "whip" of the thinner barrel, making it more susceptible to even the slightest variations of load; such a barrel is permanently erratic in its shooting, and there is nothing to be done for it. The best results that can be obtained from such a tube involve the use of only reduced loads, giving minimum vibration and whip—and the bullets should be selected by weighing and measuring, holding them within limits of 1/4 grain, and of .0005 inch diameter; and powder charges should be weighed, and held to 1/10 grain. Really the best thing to do with such a barrel is to wrap it around the neck of the gentleman who persuaded you to monkey with it.



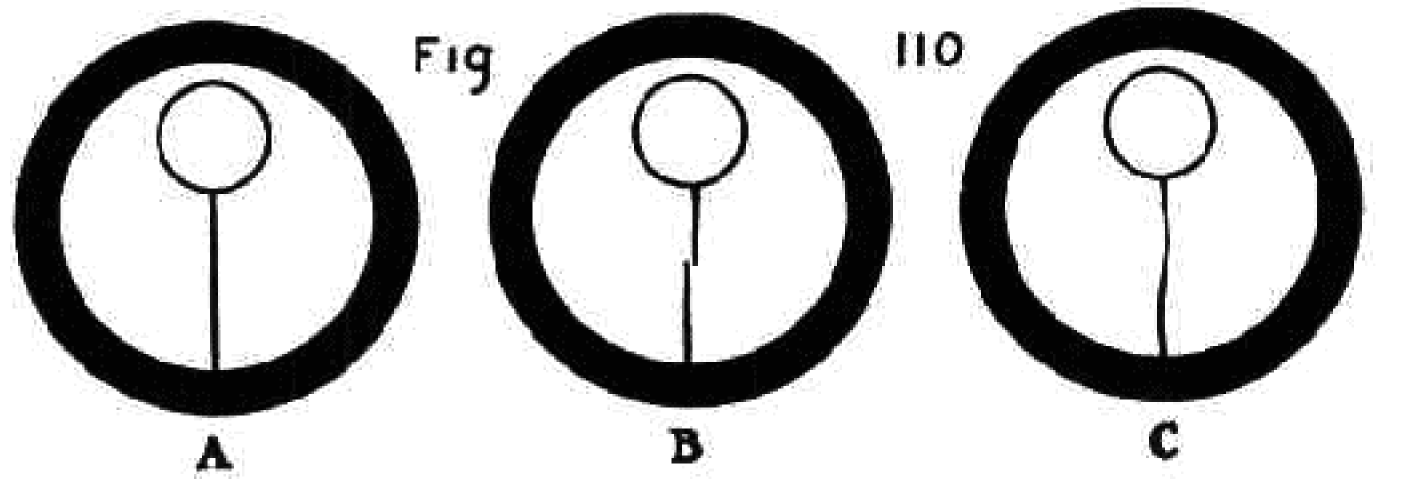
Up at Ilion in the Remington factory they can straighten a barrel by either the old or the new method. At the left is shown an operator using the overhead clamp while the party at the right is using a lead hammer and blocks in the old fashioned way.

225

Straightening barrels is entirely beyond the ability of 99.44 per cent. of all amateurs, and of perhaps 99 per cent. of all professional gunsmiths today. The other 1 per cent. are either barrel makers or barrel straighteners—and they didn't learn it in a day or a week either.

Most factories now use the overhead clamp for straightening barrels. Figure 109 shows this clamp in use. The lower side of this device has two heavy steel "fingers" covered with lead, on which the barrel rests, these fingers being about 3 or 4 inches apart. Above and between them a third finger presses against the barrel from the top, its pressure being regulated by a heavy screw turned by a large hand wheel. The barrel is pointed directly toward a window which has a wire, rod or other clearly visible line in front of it. This throws a distinct shadow along the bottom of the bore. If the shadow's edge appears perfectly straight, as in Figure 110-A, the barrel is straight along that surface if the shadow "breaks," as in Figure 110-B, or shows a curve or bend, as in 110-C, the operator knows there is a crook or curve in the barrel at that point.

Fig 110



The skill of the operator lies in his ability to judge by eye the exact location of the kink or curve, and its direction; and to slide the barrel backward or forward on the lower fingers to exactly the right point, turning the wheel exactly the right amount to exert the required pressure to straighten the bore. By watching the shadow carefully he can tell when it is straight—but here the trouble begins. He must give it enough pressure to bend the barrel slightly in the opposite direction, just sufficiently so that when it springs back, it will spring to a *straight* line. Too little pressure will not remove the bend permanently; and too much will bend a kink in it the opposite way. Taking it by and large, the barrel straightener's job isn't the easiest on earth; yet a few of them become so expert that they can straighten out a bore with great exactness in a minute or so, locating the right place to set the clamp with almost uncanny precision.

The older method of straightening barrels is to rest the barrel

226

on two blocks of lead placed close together, striking it with a lead hammer at the point of the bend. I have heard it argued that this method was superior to the more modern clamp, since the sharp hammer blow breaks the fibres of the metal somewhat, preventing the barrel springing back to its original crook as it heats up in firing; while, (so it is claimed) the straightening clamps merely stretch the fibres, making a barrel so straightened more liable to change its point of impact. Just how much merit, if any, there is in these two arguments, I cannot say. I'm not a barrel straightener.

The lead block and hammer method would appear far more difficult for the operator, since he is unable to watch the shadows in the bore while striking the blow; moreover he must learn to regulate the force of the blow with great nicety, which would seem a more difficult accomplishment than learning how much pressure to put on the screw. And since the force required will vary greatly with barrels of varying size and stiffness, the difficulties are further increased. I'll bet my shirt that barrel straightening will not be included in the curriculum of the folks at Scranton for some time to come.

But no matter how some folks are warned away from attempting the impossible, there are those whom such warning merely incites to the attempt; and sure as shootin' some reader is going to insist on trying to straighten a crooked barrel—and just as surely, a few of them are going to be lucky and actually get out the kinks. The well known fact that heaven protects drunks and damphools still holds.

So if you attempt the job, get a bar of lead or soft babbitt about 3/4 inch diameter and cut three pieces each about 5 inches long. Bend these near the center at a right angle, so they will hang on the jaws of the largest vise you can command—one piece at each end of the rear jaw, and one in the center of the front jaw. Turn the vise so it is pointing into a window or door where the light is good, and fasten up a rod or straightedge *horizontally* to cast the shadow. Since the vise exerts horizontal pressure, you will have to watch the side shadow instead of the one on the bottom of bore. Squint through and do your stuff.

RIFLING: Since the introduction of the breech-loader we have seen many systems of rifling—that is many shapes of lands and grooves. Each system has had its advocates, and each has been given very exhaustive tests in comparison with every other system. Thus the Henry system, or its modification, the Pope system, seemed to prove a very distinct advantage for muzzle loading rifles using conical grooved bullets. The Metford system of rounded lands and grooves was very successful with breech loading, lead bullet, black powder rifles. The Lancaster oval bore system has had many admirers because of ease of cleaning and theoretical long life, but in actual practice has not always given the accuracy desired. The

227

Rigby system of flat sharp cornered lands, with corners of grooves slightly rounded, appears right in theory for modern high power ammunition with jacketed bullets, but in practice has not shown any marked improvement over the system now in almost universal use in the United States. This system, the Enfield, with an even number of lands and grooves, is used in practically all American rifles, and in most modern foreign rifles. It is used because it gives results which equal those of any other system, and because it is cheaper and easier to rifle a barrel on this system than on others. The lands and grooves are square and have sharp corners. The English gunmakers usually give their barrels an uneven number of lands and grooves, so that a groove is diameterically opposed to a land. In the United States, and on the continent of Europe, however, an even number of grooves and lands are usually used. The number of grooves varies greatly, as well as the width of lands and grooves.

Generally speaking, it may be said that the grooves should be at least as wide as the lands, and that they had better be twice as wide. Four grooves are plenty for rifles of from .22 to .30 caliber. Above .30 caliber it is perhaps best to employ six grooves. There is no real advantage in employing a greater number of grooves than this, but neither is there any great disadvantage in using slightly more. The fewer the number of grooves employed, the cheaper it is to rifle a barrel, and probably the only reason why a larger number of grooves are employed than above is because manufacturers started to use the greater number because of some fancied advantage, and have continued to use that number because they have gotten good results, and because they do not care to change their present standards on account of expense. Generally speaking it may be said that the system of rifling employed by all American rifle makers in their barrels is good, and no real or marked advantage will accrue from any change. This refers to the number, width, and shape of the lands and grooves only.

The depth of grooves varies according to the caliber. Long experience has shown that in .22 caliber rim fire, grooves should be .0025-inch deep; in .25 caliber, .0035, for both lead and jacketed bullets. In .30 caliber and larger for jacketed bullets they should be .004-inch deep. Rifles of .32 caliber and larger intended only for lead bullets do well with slightly shallower rifling—about .0035-inch. Large bore magnum rifles using jacketed bullets may often use grooves .005-inch deep, but for .30 caliber .005-inch is usually considered a little too deep.

The diameter of the finish reamed bore before it is rifled is called the "bore" or "land" diameter. The diameter to the bottom of the grooves is called the "groove diameter," and of course it exceeds the land diameter by twice the depth of the rifling.

BULLET FIT: The groove diameter of a barrel has consider-

228

able influence on accuracy and barrel life, and this must be understood by the gunsmith who would concern himself with design and specifications for rifle barrels. Groove diameter must always be considered in connection with the diameters of the bullets that are to be used in the rifles. The diameters of the bullets are usually fixed by the ammunition manufacturer, but different manufacturers may use bullets of slightly different diameters for a given caliber of cartridge, so it is best to find out what the average diameter of all bullets likely to be used is, and use that figure in the selection of the groove diameter for the barrel. Rifle barrels can often be had with slight variations in groove diameter, thus allowing the gunsmith a certain latitude in fit between bullet and barrel.

Of course where barrels and bullets are made in quantities by machinery certain tolerances of allowances from the standard diameters are absolutely necessary, for no company can afford to discard its tools as soon as they show any wear. Thus a manufacturer, starting with new tools, will cut his barrels to a certain diameter. As the tools wear or have to be sharpened, the diameter changes slightly, and finally the tools are discarded when they are producing barrels to the limit of the tolerance. The same holds true of bullets, the dies for making which are ground to the minimum diameter, and are discarded when they are producing bullets of the maximum allowable diameter. Most manufacturers have found it best, from the standpoint of economy and excellence of product, to maintain a maximum of variation between maximum and minimum groove diameters of barrels and diameters of bullets about as follows:

	Commercial production	*For Match rifles*
Groove diameter of barrels:		
.22 caliber	.001"	.0005"
.30 caliber and larger	.002"	.001"
Bullet diameters:		
Lead bullets	.002"	.001"
Jacketed bullets	.001"	.0005"

Thus the ordinary run of inexpensive .22 caliber repeating rifles may have groove diameters running from .222-inch to .223-inch, but the allowable tolerance for the more expensive small bore match rifles made by the same firm may run only from .2225-inch minimum to .223-inch maximum. Likewise another firm may have a tolerance for the groove diameters of its ordinary .30 caliber sporting rifles of from .308-inch to .310-inch, while on the fine barrels it turns out for long range match shooting they may start making barrels .308-inch groove diameter, and discard any barrels measuring over .3085-inch. Lead bullets for ordinary use may vary in different lots by .002-inch in diameter, but the .22 caliber lead bullets which a cartridge company sends to an important small bore rifle competition will probably not vary more than .0005-inch from what may be regarded as standard. One lot of bullets should not vary this much,

229

in fact they will hardly vary at all, as they will probably all come from one die on one day's manufacture, but a lot made one day may vary from a lot made the following week, or from a lot made on another press by the amounts given above. It is the constant endeavor of the manufacturer to maintain as good a fit as possible between barrels and bullets. In this he is handicapped by the necessity for making a profit on his goods. He must consider speed of production, wear of tools, and skill of workmen, etc.

SPECIAL BARRELS: Where the gunsmith demands a barrel of exact groove diameter he can sometimes get it if he has a large number of barrels to select from. Suppose for example a large maker's .30 caliber barrels have been found to run in groove diameter from .308-inch to .3095-inch, and the gunsmith wishes a barrel which shall measure between .308-inch and .3085-inch (for nothing is gained in specifying closer than this). By measuring three or four of that maker's barrels he will most probably find one which comes well within his specifications, or the maker himself may even be willing to make the selection for him. But if the gunsmith wishes the same firm to make a barrel for him to a standard dimension, inside or outside, and differing from the standard factory barrel, he must be prepared to pay high for it, for that barrel must be put through the factory as a special job from start to finish, special workmen must set up special machines with special tools for it, and special machine operators must work on it. All this costs like the mischief as compared with the cost of running 1,000 barrels through on machines already set up for standard production, and operated by workmen who have to be skilled only on standardized operations.

Many factories are organized only for standardized quantity production on stock articles, and they may not wish to disturb that steady flow of quantity production, and hence they may very properly establish a policy of refusing special work. In fact most of the large arms companies have established such policies. There may be some special jobs that they will do because they have enough demand for these particular jobs to warrant keeping the special tools needed to do the jobs. For example, at the present writing one of the large companies are making a specialty of furnishing and fitting heavy and selected match barrels to two makes of .22 caliber small bore rifles and .30 caliber bolt action rifles because there is more or less of a steady demand among target shooters for such barrels, and because such barrels used in important rifle matches have a certain amount of advertising value. But if the gunsmith were to approach this same firm with a request to fit a special .38-55 barrel to a Ballard action he would probably meet with a refusal, for there is so little demand for such work that it does not pay to maintain tools for it. He could, however, get his .38-55 barrel from another firm who makes a specialty of making rifle barrels

230

strictly to order and to customer's exact specifications, but he will pay twice as much for such a barrel as he would pay the first firm for a regular quantity production barrel.

It is this inability of the large factories to do special work which has caused the recent large growth in the number of small gunsmiths in this country, and finally in the organization of several fair sized gunmaking firms catering entirely to made to order weapons. This also is largely responsible for the interest being shown in amateur gunsmithing, and hence for the writing of this book. A small gunmaker can make a barrel to exact specifications, for every barrel is a special job. But he must employ very skilled workmen, every man probably has to be a $1.10 an hour machinist or toolmaker instead of a $0.75 an hour machine operator, he must discard his tools and make new ones when they show wear at all, and he must employ a highly paid force of clerks and stenographers to handle the voluminous rifle crank correspondence which such a trade entails in this country.

And by the way, let us remark here that the average rifle crank has no right to burden a small gunsmith with a large volume of correspondence. Time, even time at the typewriter, is extremely valuable to such men, and it probably actually costs the small gunsmith from $2.00 to $3.00 a page to answer letters. The crank should not approach such men until he is satisfied just what he wants, and writes only for prices and deliveries. General questions should be sent to the arms and ammunition editor of one of the sporting magazines, or to the Dope Bag Department of The American Rifleman, and let the little gunsmith put in his skill at his bench where he belongs.

But we digress, and there is still one little matter to speak of before we leave this particular subject. It usually costs more for a shop to rebore a rifle barrel to larger caliber than it does to make an entirely new barrel of that particular caliber. This because it takes the most skilled man in the shop to set up for a reboring job. So remember this, when some firm asks you $25.00 to rebore a barrel.

Now we have still to consider the best relationship between groove diameter and bullet diameter. In .22 calibers the best results are obtained when the bullet diameter is slightly larger than groove diameter. Bullets and barrels vary in diameter, and different makers' products vary slightly in standard, but generally speaking the bullet should be from .0005-inch to .002-inch larger than the groove diameter of the barrel to do good work in .22 caliber rim fire rifles. Actually most barrels run from .222-inch to .2235-inch in groove diameter, and most bullets run from .222-inch to .225-inch in maximum diameter of bearing. Practically the desired fit can always be obtained by trying various makes and lots of ammunition in the particular rifle, and selecting the

231

lot which gives the best accuracy. Captain Edward C. Crossman's book "Small Bore Rifle Shooting," contains a vast amount of useful information on .22 caliber barrels, rifling, chambering, bullet fit, and ammunition, and no gunsmith doing any work on .22 caliber rifles can afford to be without it.

In .25 caliber high power rifles groove diameter runs from about .2555-inch to about .2585-inch, usually, however, the vast majority of barrels run from .257-inch to .258-inch. Bullets run from .255-inch to .257-inch. From an ideal standpoint both groove diameter and bullet should be .257-inch. Practically, excellent results can be obtained if the bullets are not more than .001-inch smaller than groove diameter. So the expert gunsmith endeavors to get a barrel measuring from .257-inch to .2575-inch, and to select bullets which measure not less than .2565-inch.

We know more in regard to bullet fit in .30 caliber than in any other size, and in .30 caliber the bullets which are made specially for the .30-06 cartridge run closer to standard diameter, and are better made than any other class of bullets. This is one of the reasons why we get better average accuracy from .30-06 rifles than from any other size. .30-06 bullets run very regularly in diameter from .308-inch to .3085-inch. Such bullets will give splendid accuracy in rifle barrels having groove diameters anywhere from .308-inch to .309-inch, and will give very good accuracy in barrels as large as .310-inch. A very wide belief has developed that for best results a .30 caliber barrel should have a groove diameter of .308-inch, and certainly not larger than .3082-inch. This is not borne out in actual results. There is no difference in accuracy between a .308-inch and a .3087-inch barrel that can possibly be determined as due to diameter alone, and it might take a series of 1,000 rounds from a Mann "V" rest to determine that a .309-inch barrel was less accurate than a .308-inch barrel. The other side of the balance is not true, however. A .3095-inch jacketed bullet will not shoot well in a .308-inch barrel until the barrel gets well heated up from repeated firing, and a .311-inch bullet shoots poorly from a .308 or .309-inch barrel and runs the breech pressure unduly high. These principles of .30 caliber bullet fit apply equally to larger bores using jacketed bullets, certainly to as large calibers as .40.

When lead bullets are used with smokeless powder in calibers larger than .22, another principle of bullet fit applies. Bullets must be cast of a rather hard alloy, and should be larger than groove diameter for the best results. In .25 caliber such lead bullets should be from .0005-inch to .002-inch larger, in .30 caliber from .001-inch to .0035-inch. It does not appear to matter what the size of the bullets are provided that they come within these figures, but of course a given batch of bullets must be uniform in diameter, and also they must be of a size such that when seated in the case, the chamber of the rifle will receive the cartridge without undue crowd-

232

ing. Bullets smaller than groove diameter do not give good results with smokeless powder, although they do give fair results with black powder which hits the bullet a blow and expands it to bore size even before it starts out of the case. But in many cases even with black powder, better results will be obtained if the bullets be slightly larger than groove diameter. This matter of bullet fit in all calibers, together with the fullest information on ammunition of all calibers is discussed exhaustively in the book "Handloading Ammunition" by J. R. Mattern, which every gunsmith should have for reference. Professional gunsmiths in particular will find that "Handloading Ammunition" will point out to them a way in which they can make additional money and give better service to their customers by handloading and reloading rifle and pistol ammunition. Every gunsmith should also have a copy of the Ideal Handbook published by the Lyman Gun Sight Corporation, Middlefield, Conn., price 50 cents, which gives much absolutely necessary information regarding reloading, bullets, bullet fit, and reloading tools. The following table from the Ideal Handbook gives the average groove diameter and pitch of rifling of the most common calibers of American rifles:

Caliber and Cartridge	*Make*	*Groove Diameter Inches*		*Twist of Rifling 1 turn in —inches*
		Min.	*Max.*	
.22 Short, R. F.	All	.222	.2238	20
.22 Long Rifle, R. F.	All	.222	.2238	16 to 17
.22 W. R. F.	Winchester	.2255	.226	14
.22 W. C. F.	Winchester	.224	.2245	16
.22 Baby H. P.	Niedner	.223	.2235	16
.22 Savage H. P.	Savage	.226	.2265	12
6 mm. Lee Navy	Winchester	.242	.244	7½
.25 Stevens R. F.	All	.257	.2575	17
.25-20 S. S. & W. C. F.	Winchester	.257	.2575	14
.25-35 W. C. F.	Winchester	.257	.2575	8
.25-36 Marlin	Marlin	.257	.2575	9
.25 Rem. Auto	Remington	.257	.2575	10
.25 Niedner, Spg. & Krag.	Niedner	.2565	.2575	12
.250-3000 Savage	Savage	.257	.258	14
6.5 mm. Mannlicher	Austrian	.263	.264	7½
.256 Newton	Newton	.264	.265	10
.270 W. C. F.	Winchester	.278	.2785	10
.28-30 Stevens	Stevens	.285	.286	14
7 mm. Mauser	German	.2854	.2874	8.66
7 mm. Mauser	American	.2845	.2855	10
.280 Ross	Ross	.289	.290	8.66
.30-30 W. C. F.	Winchester	.308	.3085	12
.30-30 Rem. Auto	Remington	.308	.3085	12
.30 Krag	U. S. Govt	.308	.310	10
.30-06 Springfield	U. S. Govt	.308	.309	10
.300 Savage	Savage	.308	.309	10
.30 Magnum	Griffin	.3083	.3085	14
.32 Short and Long R. F.	All	.313	.315	20 to 24
.32-20 W. C. F.	Winchester	.311	.3115	20
.32 Ideal	Stevens	.323	.324	18
.32-40 W.. B. & M.	Winchester	.320	.3205	16
.32 Win. Special	Winchester	.320	.3205	16
.32 Rem. Auto	Remington	.319	.3195	14
8 mm. Mauser	German	.318	.326	9 to 10
.303 British	English	.312	.314	10
.303 Savage	Savage	.308	.309	10
.32 Win. Self-Loading	Winchester	.351	.352	16
.33 W. C. F.	Winchester	.338	.3385	12
.35 Win. Self-Loading	Winchester	.351	.352	16
.351 Win. Self-Loading	Winchester	.321	.322	16
.35 Rem. Auto	Remington	.356	.3565	16
.35 W. C. F.	Winchester	.358	.3585	12
.35 Whelen	Griffin	.357	.3575	18
.35 Newton	Newton	.359	.359	12
.35 Magnum	Griffin	.357	.3575	18
.375 Magnum	Hoffman	.375	.376	14

.38 Short, Long and Extra Long, O.L.	All	.358	.359	36
.38-40 W. C. F.	Winchester	.400	.4005	36
.38-40 W. C. F.	Remington	.400	.4005	20
.38-55 W., B. & M.	Winchester	.379	.3795	18
.38-56 W. C. F.	Winchester	.379	.3795	20
.38-70-255 W. C. F.	Winchester	.379	.3795	24
.38-72-275 W. C. F.	Winchester	.379	.3795	22
.38-90 W. C. F.	Winchester	.379	.3795	26
.40-50 Sharps Straight	Winchester	.403	.405	18
.40-70 S. S. and Ballard	Winchester	.403	.405	20
.40-70-330 Win.	Winchester	.403	.405	20
.40-72-330 Win.	Winchester	.406	.407	22
.40-82-260 Win.	Winchester	.403	.405	28
.40-90 Sharps Straight	Winchester	.403	.405	18
.40-110 Win.	Winchester	.403	.405	28
.40-60 Win.	Winchester	.403	.405	40
.400 Whelen	Griffin	.4105	.4115	14
.401 Win., S. L.	Winchester	.407	.408	14
.404 Magnum	Hoffman	.423	.424	14
.405 Winchester	Winchester	.413	.4135	14
.43 Spanish	Winchester	.439	.440	20
.44-40 W. C. F.	Winchester	.4285	.429	36
.44 Henry R. F.	Winchester	.4285	.4295	36
.45-60 W. C. F.	Winchester	.456	.458	20
.45-70 Winchester	Winchester	.456	.458	20
.45-70 U. S. Govt.	U. S. Govt.	.457	.458	22
.45-75 W. C. F.	Winchester	.456	.458	20
.45-90 W. C. F.	Winchester	.456	.458	32
.45-125 W. C. F.	Winchester	.456	.458	36
.45 Sharps, 3¼	Sharps	.458	.459	18
.50 Sharps	Sharps	.509		
.50-95 Winchester	Winchester	.512		60
.50-1110-450 Win.	Winchester	.512		54
.50-70 Govt.	U. S. Govt.	.515		24 & 42
.505 Magnum	Hoffman	.5045	.5055	16
.58 Govt. M. L.	U. S. Govt.	.509		68

It may be said that this table shows dimensions which are the results of many years of experience. The dimensions are those which best fit existing bullets, and they should be departed from only after considerable experience and careful thought and study.

234

CHAPTER 16

CHAMBERING AND BARREL WORK

THE MEASURING OF BORES: The Ordnance Department takes the measurements of the bores of Springfield and Krag rifles with an instrument called a "Star Gauge." This is a long steel rod, bored out to contain another rod inside it. One end of the smaller rod contains studded projections which fit tightly into the grooves, expanding to fit the bottom of the grooves when the smaller rod is pushed into the larger rod, and a scale on the breech end of the rod gives the groove and land diameters. The combined rod is inserted the desired distance into the bore, the inner rod pushed up until the projections come up tight against grooves or lands, and the diameter read off the scale. Thus the groove and bore diameter can be recorded for every inch of the bore from chamber to muzzle, and any tight or loose places can be determined.

A star gauged barrel is simply one which has thus been measured and found to come within certain prescribed limits. Usually a barrel is not sent out from an Ordnance Department arsenal unless the groove diameter comes within the figures .308 to .3085-inch, and unless it is practically free from tight or loose places. Star gauges are very expensive, and are not available except at Government arsenals.

But there is another way to measure the bore of a rifle barrel which is about as good. This is by driving a bullet through the bore, and then measuring the bullet with a micrometer caliper. Select a bullet of pure lead which is several thousandths of an inch larger than the expected groove diameter of the barrel you wish to measure. It should have a rather short bearing surface. For example, if you wish to measure a .30 caliber barrel about the best bullet to use is the regular factory lead bullet for the .32 W. C. F. cartridge, which is short, of pure lead, and measures .311-inch. If you have no bullets correct in size, turn some up on a lathe of

235

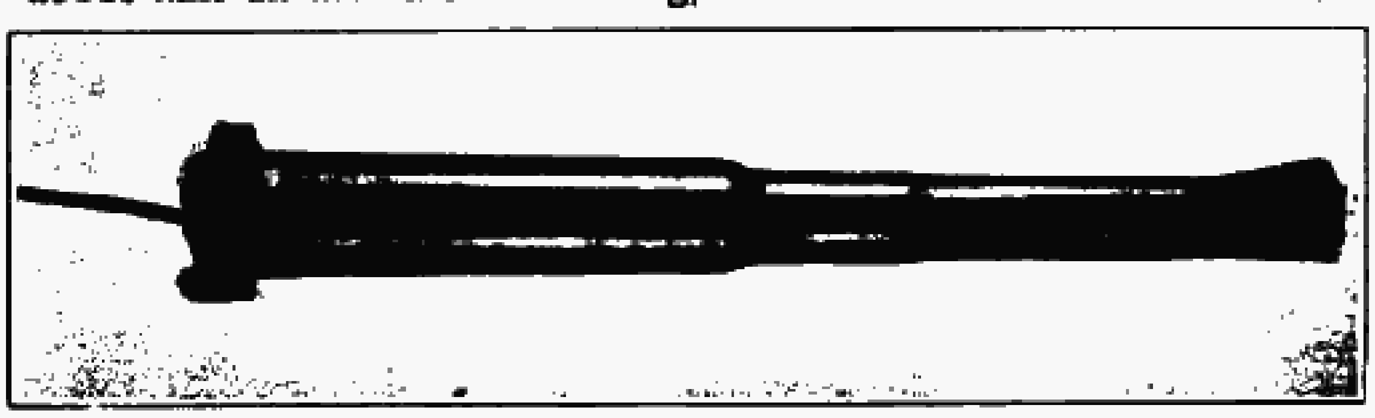
pure lead. Clean the barrel thoroughly and lubricate it very lightly with a thin oil like "3 in 1." Have a stiff, steel rod about ten inches longer than the bore, and almost the diameter of the bore, with a square, blunt tip. Slightly lubricate the bullet, drop it point first into the chamber, and with the rod shove it about an inch into the rifling. It may be necessary to hit the rear end of the rod a few light blows with a hammer to get the bullet started into the rifling. Insert the rod into the muzzle, and very carefully press the bullet out again at the breech. Slight tapping with the rod on the point of the bullet may be necessary. Catch it as it comes out so that it does not fall and deform itself, and measure it with a micrometer caliper. Measure across portions which fitted into bottom of grooves. This will give you the groove diameter of the barrel at the breech. In a similar manner push a bullet into the bore and with the rod shove or drive it straight through the bore to within about an inch of the muzzle. Sometimes the bullet can be shoved straight through, but often it will require light taps on the rear end of the rod with a hammer to gradually drive it through, and if these taps be made light and uniform, the resistance of the rod to the hammer will give a fair indication as to whether there are any tight or loose places in the bore. Now with the bullet near the muzzle, hold the fingers at the muzzle so as to catch the bullet as it comes out, and holding the rod in the other hand, tap light blows on the base of the bullet, gradually driving the bullet out at the muzzle. Catch it with the fingers and measure it, thus obtaining the groove diameter at the muzzle. In measuring these bullets, always measure the greatest diameter, from the raised portion which has upset into the groove on one side, to similar portion on the other side. To obtain bore diameter, with a very sharp knife carefully cut away the raised groove portions on either side so that the micrometer will fit into and measure those portions which bore on the tops of the lands.

To determine the smoothness of bore, and to detect and locate any possible tight or loose places in the bore, place the barrel in a heavy vise, using brass jaw covers so as not to mar it. Force a lead bullet into the breech as before. Have a good big cross-piece handle on the rod or wrap it heavily with a piece of cloth. Get the body weight behind the rod, and force the bullet through the bore with a steady motion, as slowly as you can move without letting the bullet stop for an instant. It should take two or three seconds for the bullet to pass through a 30 inch barrel. If it goes through with an even and gradual speed and pressure it is fairly uniform, but if there are tight or loose places the difference in pressure and speed will show these up. A little knack is necessary and one should practice it three or four times, and should also repeat the test a few times to be sure of his findings. The best barrels are those

236

which have no tight or loose places, but have even diameters from breech to muzzle, although most riflemen have the opinion that a rifle to shoot lead bullets exclusively will do better work if it gets just a little bit tighter towards the muzzle, being gradually tapered.

MEASURING CHAMBERS: To measure the chamber of a rifle it is necessary to make a sulphur cast. The chamber, and about one inch of the rifling forward from it, should be thoroughly cleaned and then covered with a very thin film of light, clean oil. Take a cork the size of the bore of the rifle and drill a small hole through its exact center. In this hole place a piece of straight wire, about .0625-inch in diameter. Press the cork into the chamber and up about half an inch into the rifling, so that the wire extends through



A FINISHED SULPHUR CHAMBER CAST

the cork and back to a point several inches in rear of the breech. The wire functions as a handle for the cast as the cast is very brittle. The mixture for the cast is made of the following materials:

Sulphur	2 ounces
Powdered lamp black	3 grains
Gum camphor dissolved in alcohol	3 drops

Heat very slowly and stir continually. When the mixture arrives at a thin pouring consistency, pour it into the chamber quickly, and allow to cool thoroughly before removing. To remove, place a rod in the muzzle and shove lightly on the cork, letting the cast come out slowly, and handling it very gingerly as it is quite brittle. This cast can now be measured with a micrometer and scale, and will give the dimensions of the chamber as well as its shape. The mixture is almost shrink proof, but it is well to allow .0005-inch for shrinkage if measured at once, or .001-inch if measured a day after cast. It is important that the mixture be heated slowly, otherwise it becomes too thick to pour.

TWIST OF RIFLING: The table on the previous page in Chapter 15 shows the twists of rifling which have proved best for various calibers and cartridges as a result of years of experience. The lower the muzzle velocity, the longer the bullet, the poorer the quality of the bullet, and the longer the range at which accurate results are desired, the quicker the twist of rifling must be to correctly spin the bullet so that it will keep point on and fly accurately.

237

For example: the standard twist of the .25-20 rifle is one turn in 14 inches. In black powder days that twist often failed to keep an 86 grain bullet from keyholing slightly because the velocity that could be given with a full charge of black powder was too low for the combination of twist and length of bullet. Seventy-seven grain bullets gave much better accuracy with black powder. Today smokeless powder gives higher velocity, and a 14 inch twist is ample for an 86 grain bullet in .25-20 caliber. A 14 inch twist will fail to spin a 117 grain .25 caliber bullet at M. V. 2,000 f. s., but will spin it very nicely and keep it point on up to 200 yards at least if the velocity be increased to 2,500 f. s., but if accuracy is desired at very long range the twist had better be one turn in ten inches for a .25 caliber barrel to use 117 grain bullets.

A standard twist of one turn in 10 inches has been established for .30 caliber rifles. A 14 inch twist is sufficient to spin a perfect 220 grain .30 cal. bullet to 1,000 yards, but such a twist may permit a poor 220 grain bullet to keyhole at 600 yards, or a perfect 220 grain bullet to keyhole at 1,500 yards. The 10 inch twist is dictated by military necessity for accuracy at extremely long range with war time ammunition. A 14 inch twist might be ample for a hunting rifle and excellent ammunition, because accuracy over 400 yards is not demanded. Slow twist, if permissible, is an advantage as it makes for less friction, hence longer barrel life, and greater ease in cleaning.

THREADING BARRELS: The gunsmith may find it desirable or necessary to thread new rifle barrels to fit them to certain receivers. Or he may desire to cut the thread off of an old barrel, and rethread it for another receiver, which of course involves rechambering. Or again it may occasionally be necessary to turn the thread off of a barrel, shrink or solder on a sleeve, and cut a new receiver thread on the sleeve. All of these jobs he can readily do provided that he is a trained machinist and familiar with the cutting of screw threads on the engine lathe. If he is not accustomed to this work he must either serve an apprenticeship at it, or he must farm this work out to some competent machinist, or preferably to a barrel making firm.

The threading of a barrel is inseparably connected with chambering and headspacing, and all who attempt to thread barrels must have a complete understanding of these subjects which are explained later. Rifle makers use many different styles of thread and pitch for their receivers and barrels. There is no standard, and we find on various makes of rifles, the "V," Whitworth, U. S. Standard, National, and Square forms of threads. The thread of the barrel must be cut so that there will be a small tolerance between threads of receiver and barrel in order that the index lines will meet when the barrel is screwed entirely home with a wrench.

FITTING BARRELS TO RECEIVER: The barrel should

238

screw fairly easily to within about 1/4-turn of meeting of index lines, and should then require a heavy wrench to screw entirely home. The "index lines" are the two short, almost invisible lines, one cut in receiver, and one in barrel, which meet exactly when the barrel is screwed entirely home into the receiver. The assurance of correct headspace and security of barrel in receiver are the most important reasons for seeing that barrel is screwed exactly to index lines, but also if front and rear sight bases have previously been mounted on the barrel, then these should stand truly vertical when the index lines meet.

If it is impossible to get the index lines to meet when the barrel is screwed up forcibly with a long wrench, then instead of easing up on the threads to give them more tolerance than is allowed in good machine practice, the face of the shoulder on the barrel should be lightly squared off until they do meet. Some barrel makers lay great stress on the fitting of this shoulder to the end of the receiver ring, and employ the "spotting" method to secure perfect contact. One celebrated barrel maker maintains that best accuracy, particularly in .22 caliber match rifles, is obtained when the entire surface of the barrel shoulder is in perfect contact with the end of the receiver, with equal pressure at all points. To "spot in" a barrel, the end of the receiver which bears against it is very lightly coated with Prussian blue, and the barrel screwed in fairly tight; then remove it and note the spots of contact. Dress them off carefully with very fine files—a 3-inch die-sinker's needle file will usually serve; or some of the various die-sinker's rifflers as made by the American Swiss File Company. Continue the spotting and test-fitting until the contact is perfect when barrel lacks about 1/16 inch of being screwed up; then give the wrench the final twist which sets it all the way.

Figure 111A shows a good type of wrench to use in screwing barrels into and out of receivers. It is made by welding or brazing a piece of tool steel to the upper jaw of a large monkey wrench, with handle from 18 to 24 inches long. The notch in this false jaw is cut at an angle of 90 degrees, giving it two-point contact on the round, upper portion of front end of receiver. The flat lower jaw bears against the flat portion found on the under side of most bolt action receivers, and the wrench should be screwed up rather tightly. It is advisable to drill four to six 1/8-inch holes in the set-screw of the wrench so that it may be tightened with a short length of drill rod. The surface of both jaws of the wrench should be polished off smooth to avoid marring the receiver, and the jaws may be modified as desired to obtain purchase on receivers of various types. Most lever action and single shot receivers have two flat surfaces on either side on which a standard long monkey wrench without modification of jaws other than to polish them, will take hold.

239

Never hold the receiver in a vise and screw out the barrel when it can be avoided. Rather hold the barrel in the vise and turn the receiver with the wrench. A good inexpensive method of holding the barrel in the vise so that it will not be marred is as follows: Take a piece of Shelby tubing, 4 inches long, with inside diameter slightly smaller than barrel near the breech, and walls about 1/4

Fig. 108

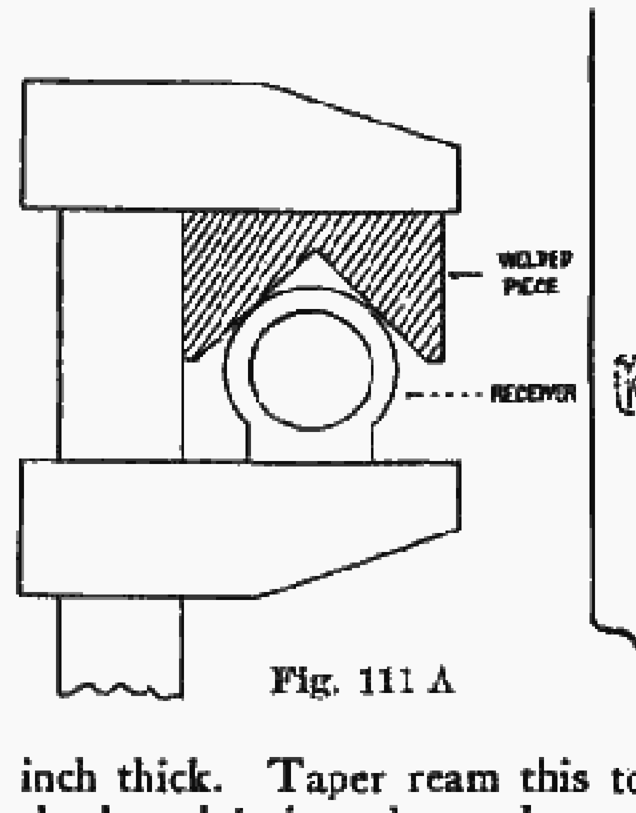


Fig. 111 A

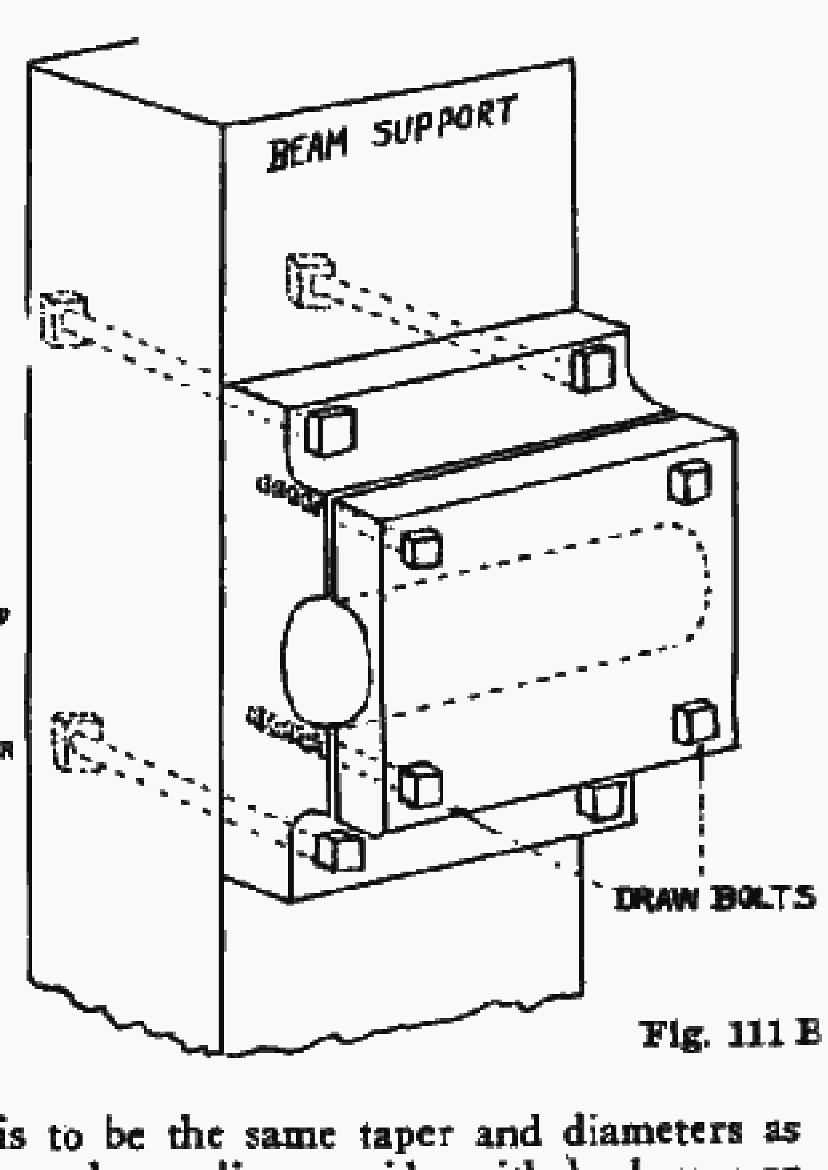


Fig. 111 B

inch thick. Taper ream this to be the same taper and diameters as the barrel it is to be used on, then split one side with hack-saw or milling cutter. Slip it over the barrel snugly, then grip it in a pair of pipe jaws in a large vise, setting the vise up as tightly as possible, and use the wrench on the receiver as above. If this split tubing is used on a straight taper barrel it may be made to fit clear back to the breech. However, on a barrel with two or more tapers it would be both difficult and expensive to ream the sleeve to fit; so in such a case fit it far enough forward to get a single straight taper.

When seating new barrels which screw in very tightly, particularly if one has to set up many barrels of exactly the same type or outside dimensions, a pair of blocks as shown in Figure 111B will pay for themselves, although rather expensive to make. Cast-iron is probably as good material as any for this purpose, and it is easily machined. A heavy block is first drilled and then reamed to fit the barrels, and then split on both sides with milling cutter.

240

Or the two blocks may be made separately and the barrel groove profiled. Holes for 1/2 inch draw-bolts are drilled, and the device bolted firmly to some solid upright support, such as a root supporting beam in the shop. With a clamp of this kind, and the barrel grooves lapped out and polished, barrels already blued may be screwed into receivers without the slightest danger of marring the finish. I have not had much success with wooden blocks hollowed out to fit the barrel, as perfect contact required for a non-slip grip can hardly be obtained in wood. Some gunsmiths use these blocks hollowed out larger than the barrel and lined with heavy leather glued in, and dust the surface of the leather with powdered rosin. This method is all right if it works—sometimes it does.

Most .22 caliber barrels are easily removed, as they are usually not screwed in as tightly as the high power barrels of larger caliber. Octagon barrels are easy—hold them in an ordinary flat jawed vise with sheet brass or copper to protect the barrel.

Be careful in all cases to avoid marring, bending, denting, or springing the receiver. If it is of a shape which cannot be readily gripped in a smooth jawed wrench without damage, better inlet a couple of hardwood blocks to fit its contour, and grip these blocks with the wrench. Sometimes a piece of sheet lead wrapped around it will solve the difficulty. In the May 1, 1923, issue of The American Rifleman, Colonel Stodter offered a method of removing Krag barrels from actions, which is substantially as follows:

> "The first problem is to remove the old barrel. Take two pieces of wood about 4 x 6 inches and two inches thick and shape them roughly with saw, chisel and rasp to fit on each side of the receiver."
>
> "Place the receiver with blocks in place in the vise and screw it up tight so as to hold the receiver securely. Take a piece of strong rope about one-half inch in diameter and twelve to fifteen feet long, double it in the middle, stick the end of a pick handle or similar piece of strong wood through the loop and wind the doubled rope smoothly and tightly from near the breech toward the muzzle. Wind the rope in the proper direction so that when the lever is rotated around the barrel so as to tighten the rope the twisting force will be exerted in a counter clockwise direction and tend to unscrew the barrel."
>
> "Hold the rope tightly near the muzzle with one hand and twist the lever with the other hand. By getting a shoulder under the lever and lifting up great force can be exerted. If this does not get results, heat the receiver slightly with a blow torch or a candle. This will usually expand it sufficiently to allow the barrel to be unscrewed."

A word of caution. Remove the bolt or breech mechanism before attempting to remove the barrel. Such a warning seems superfluous and unnecessary, and should be, but I have seen a gunsmith of thirty-odd years' experience grunt and twist a barrel out by main strength and awkwardness without even opening the action, breaking off the extractor finally, and cutting a slice out of the breech with it, and then cuss for ten minutes without repeating himself!

CHAMBERING: Chambering of rifle barrels is an operation

241

that many gunsmiths may be called upon to do. If they undertake it they should know all about it as it is extremely important that it be done exactly right. On the correct chambering of a rifle barrel depends its safety, its accuracy, and to a great extent its length of life, to say nothing of its ability to handle its cartridges efficiently. Let the gunsmith make a little slip in design, workmanship, or dimensions and the barrel may have no semblance of accuracy, and what is more important, it may maim or kill the man who fires it. Chambering is inseparably connected with the threading of the barrel, and with headspacing, and these three operations must be considered together.

At the time that this is being written there has occurred a case where a very prominent maker of hand made rifles turned out a rifle for an equally prominent rifleman, which had a little excessive headspace. Moreover the gunmaker acquiesced in the rifleman making his own cases for this rifle by necking down existing .30-06 cases in a hand tool. This of course resulted in the cases being not uniform, which is exactly the same as though the rifle had very excessive headspace for some of the cartridges, for if there is anything that takes the greatest skill it is the forming of dies for assuring the exact dimensions of cartridge cases. The result was a most serious accident which crippled the rifleman for life, and he was very lucky not to have been killed.

Every gunsmith who undertakes chambering, or the fitting and threading of barrels should know exactly what he is doing, and why; he should have good mechanical ability, and he should be equipped with the best of tools. These are not operations which an amateur can do right the first time. Nor are they operations which riflemen should trust to any gunsmith. Purchasers of rifles should ascertain that their gunsmith has the necessary skill, or else they should insist that their rifle be chambered, and the receiver and bolt fitted at a factory where there is no doubt whatever that the proper and necessary skill will be used and every precaution taken.

Briefly, chambering consists of reaming out the breech of the barrel with a series of fluted reamers known as chambering reamers, so as to form the enlargement or chamber into which the cartridge fits. The operation is done gradually, each reamer in turn being slightly larger than the preceding one. Before the last, or finishing reamer is used, the barrel is threaded and fitted to the receiver, and finally the finishing reamer is run in to exactly the right depth in conjunction with a set of headspace gages and the breech block that is going to be used in that individual rifle, to be certain that the chamber is cut to exactly the right depth, and thus assure correct headspacing.

If the diameters or length of the chamber be too small the cartridge will not fit, or it will give too high—possibly dangerous—pressures, or the fired cases will be difficult to extract, and in

242

addition, unless bullets of a very even and selected diameter be used, it will probably result in an inaccurate barrel. If the diameter of the chamber be too large the barrel may be inaccurate, although we have seen some large chambered rifles shoot with a very fair degree of accuracy; also the life of the barrel will be short due to gas cutting, and the fired cases will expand so much that they cannot be reloaded—they may even split. If the chamber be too long, that is too much headspace, the cartridges may misfire, the primers may blow out, the cartridge case may separate a half inch in front of the head leaving the forward portion of the case lodged in the chamber, and even the whole head of the case may blow out, allowing gas to escape to the rear, completely wrecking the breech mechanism, and perhaps seriously injuring the shooter. In many of the measurements of the chamber even a few thousandths of an inch may make all the difference between success and complete failure or disaster.

The first detail we will take up is that of the design of the chamber, that is its dimensions and shape with reference to the cartridge that is to be used. The dimensions and shape of the chamber must be based on the dimensions and shape of the cartridge, and the kind of load that cartridge contains, and must also conform to good ordnance engineering practice. No cartridges are made absolutely uniformly, but are made with maximum and minimum dimensions, the system of inspection at the cartridge factory insuring that no cartridge will be produced larger than the maximum measurements, nor smaller than the minimum measurements. The chamber must be cut to fit and operate safely with either a maximum or a minimum cartridge. To do this it is necessary that it be just large enough to work successfully and safely with the maximum cartridge, but no larger, for if it is larger it will probably be unsafe with the minimum cartridge. This establishes the size and shape of the chamber within very close limits.

Unfortunately most gunsmiths are unable to obtain the dimensions of maximum and minimum cartridges from the cartridge makers, who usually regard their drawings and designs as confidential. Fortunately we can, in most cases, arrive at a very close approximation of the dimensions of the maximum and minimum cartridge from the measurements of a number of standard factory cartridges of the various makes, the mean of the measurements of which may be taken as the average or mean cartridge. These measurements should not be taken from cartridges of only one make, for these may differ from those of some other make slightly, and you want the rifle to be satisfactory with cartridges of all standard makes. Therefore, when starting to design a set of chambering reamers, one should first obtain at least twenty cartridges of all makes of that caliber, and also sometimes all the varieties loaded with different weight bullets.

243

Figure 112 gives the maximum and minimum dimensions of the .30 caliber M1 (.30-06) and the .30 caliber Model 1898 (Krag) cartridges, the measurements being copied from official Ordnance drawings. The mean or average cartridge may be taken as being the mean of these extreme dimensions. Thus if the gunsmith will measure a lot of any other make and size of cartridges, and average these measurements, he arrives at a series of mean measurements for that particular make and caliber of cartridge. Then take half the difference between the maximum and minimum dimensions as shown in Figure 112A or Figure 112B, and add it to these mean dimensions, and you have what may be regarded as the maximum dimension of the particular cartridge you are considering. These, then, are the dimensions which you use for the maximum cartridge in considering the design of your chamber. Several hours can profitably be spent with 100 cartridges (20 of each five makes), a micrometer, vernier ruler, pencil, and paper, in determining measurements, and this work should be checked and rechecked to be sure that there is no error anywhere. Do not shirk it. The result will be a drawing of the maximum cartridge for which the chamber should be cut.

Figures 112A and 112B also show the maximum and minimum chamber dimensions for the .30 caliber M1 (Springfield), and the .30 caliber Model 1898 (Krag) chambers. If the chamber is to be cut for some cartridge other than these, there should be the same tolerance between the maximum cartridge selected and determined, and the finishing chambering reamer as there is between the maximum cartridge and the maximum chamber in these drawings. The finishing reamer should always be made to cut the maximum chamber, for as it is used on barrel after barrel it will become dull, will have to be stoned to sharpen it, which will of course reduce its size, and then it must be discarded when it is cutting the minimum chamber, or else ground down for use as one of the preliminary reamers.

A lot of foolishness has been written about minimum or tight chambers. Many shooters seem to think that tight chambers are very desirable, and that they are more accurate. The truth is that tight chambers are very undesirable. They are fairly accurate only when a bullet of the exactly correct diameter is used, and it is often extremely hard to get such bullets. Chambers cut with the relative dimensions and tolerances shown in the drawings are the most accurate and satisfactory chambers known. Practically every American manufacturer is now designing his chambers for new cartridges with tolerances between maximum cartridge and minimum chamber very closely approximating those shown here, and we cannot too firmly impress upon the gunsmith that he should follow these as a guide.

Very often a customer will write to a gunsmith or a manufac-

244

turer, and state that he desires a barrel cut with an extremely tight chamber, or a chamber of some peculiar shape. The gunsmith might very properly refuse to cut such a chamber from the standpoint of safety alone. But he can also plead the cost of making the necessary reamers. Certainly the cost of making the two finishing reamers which will probably be necessary to cut a chamber to some special dimension would be not less than $40.00 in man labor, plus at least the same amount for machine labor, both doubled for overhead. To these we might add the day's labor of the highly trained man spent in figuring out dimensions as previously described. Indeed a complete set of chambering reamers today costs from $200 to $300 to make, and the customer who glibly talks about having a specially chambered rifle, hardly realizes what he is getting into in the way of expense if he really wants to go any further than bothering the gunsmith with many letters about it.

When one starts to chamber a barrel it is probably bored, reamed, and rifled all the way to the breech end. A series of about four to six reamers are used, graduated in size and diameter so that each succeeding one makes a shallow cut, and slowly and gradually enlarges the chamber to the desired size and shape. See Figure 113. The reamers are made by hand, being ground from fluted reamers purchased from gage and tool-making firms. They are usually used by hand, although in large arms factories they are operated for

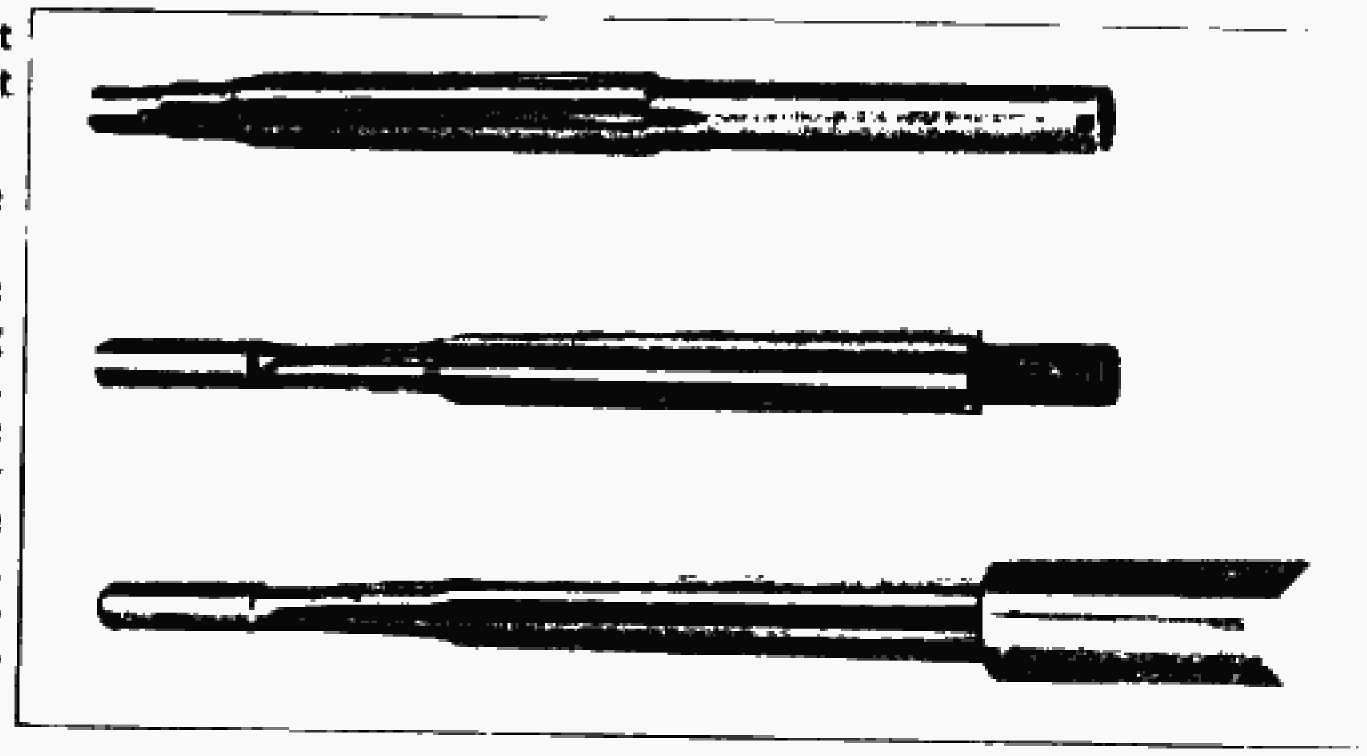


Fig. 113

convenience and speed in a special turret lathe. It is a principle of reaming that a reamer, if operated by hand, and if not forced unduly, will ream out exactly in line with the axis of the original bore. To assist in this, each reamer is provided with a pilot or cylindrical portion in front of the cutting edges, which, riding on the top of the lands, acts as a guide and a centering agent for the

245

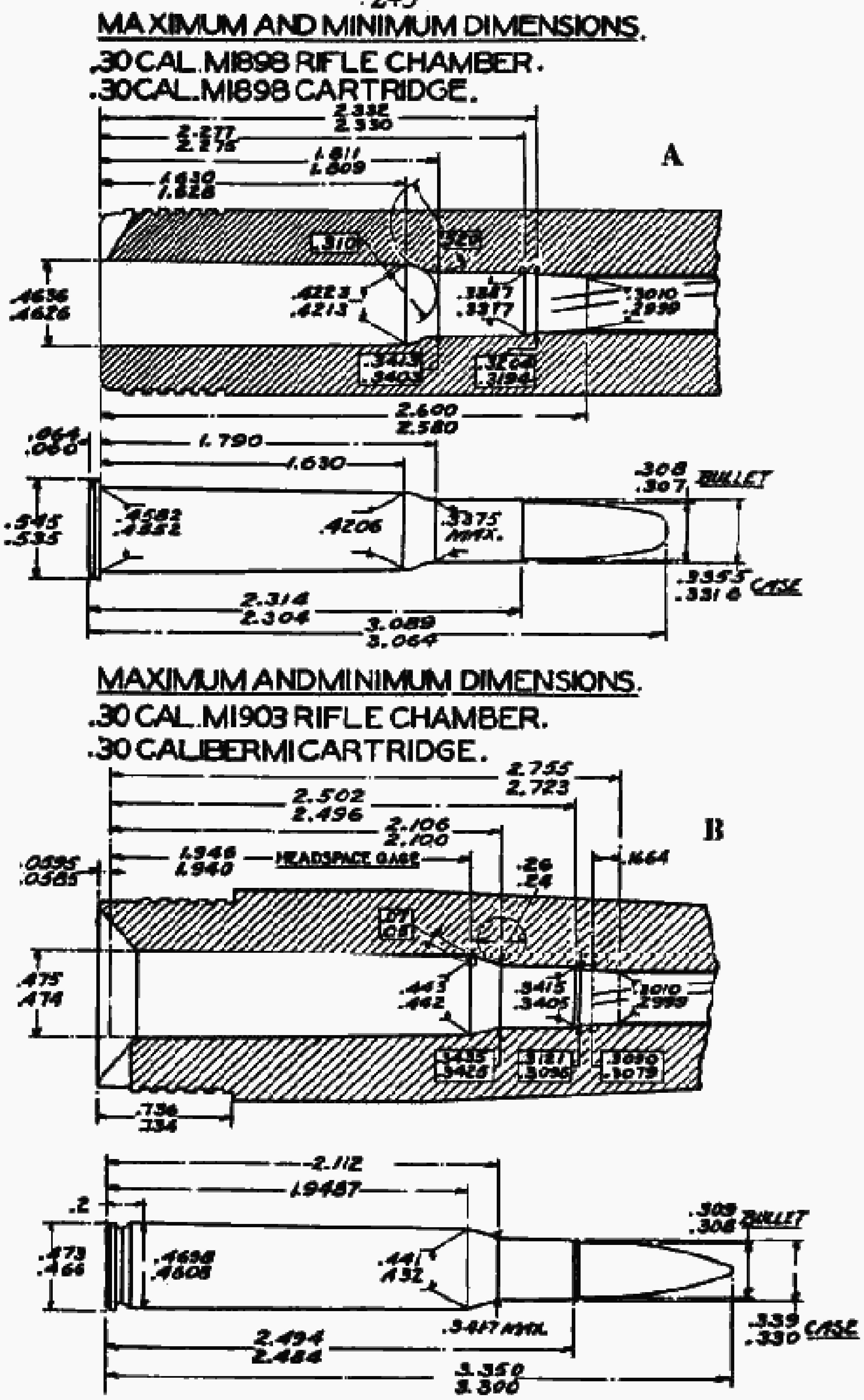


Fig. 112

246

front of the reamer. This pilot is ground and polished to be a push fit on the top of the lands. There are also stop guides at the rear of the reamers to show when each has been run into the chamber deeply enough.

The finishing reamer, that is the final one used, must be ground to very close dimensions, and it is this reamer also which cuts the bullet seat or leed. The bullet seat is that portion of the chamber ahead of the mouth of the case, into which that portion of the bullet projecting out of the brass cartridge case fits. It should be cut so that the ogive of the bullet, that is the curve of the point, will just barely touch the origin of the lands, and the beginning of the lands should be cut on the same curve or slope as the ogive of the bullet. Usually there is a short portion of the chamber ahead of that portion corresponding to the mouth of the case, which is cut cylindrical and smooth by simply reaming out the lands, leaving this portion a true cylinder of groove diameter. This cylindrical portion receives the portion of the bearing or maximum diameter of the bullet which projects outside of the case. Then ahead of this the lands start on a gradual slope.

Generally speaking, the best accuracy is obtained, other details being correct, when the cartridge and bullet are so shaped and assembled that there is a portion of the cylindrical, maximum diameter of the bullet projecting beyond the mouth of the case, and fitting with almost a push fit into the cylindrical portion of the bullet seat. Then the bullet seat straightens the bullet up so that its axis is in line with the axis of the bore, and thus on discharge the bullet slides straight forward into the bore and rifling without any wobble or jump which might tend to deform the bullet.

That portion of the chamber corresponding to the neck of the case should be a little longer than is necessary from the measurement of the cartridge. That is about 1/32 to 1/16 inch should be allowed for the lengthening of the neck of the case, and the shoulder of the chamber ahead of the mouth of the case should be pushed forward correspondingly. Cases lengthen considerably when fired, particularly cases which have been reloaded a number of times, and the chamber must allow for this, or it will actually crimp the cartridge just as a reloading tool does, and this may lead to ragged shooting or even to excessive pressure.

Only experienced tool-makers have the art and skill necessary to make chambering reamers. Such a man will readily understand the instructions and explanations herein. If the gunsmith is not also a tool-maker he will be obliged to have his chambering reamers made for him, preferably by a firm of rifle barrel makers. The making of a set of chambering reamers is expensive work. Besides the time of the designer, and of the workman, much machine time is necessary, and thus the cost of making one complete set of reamers and the accompanying headspace gages will run somewhere between

247

$150.00 and $300.00, for a modern bottle-neck rimless cartridge. Reamers for simple, straight pistol cartridges are very much cheaper. Figure 113 shows several chambering reamers complete with pilot and shank.

Starting with the first or smallest reamer, each in turn is run in and turned, cutting out until it has entered into the bore up to its stop. Then the next is run in, and so on, using light oil, and clearing all chips from the chamber between each operation, thus gradually enlarging and shaping up the chamber until finally it is in semi-finished shape, lacking perhaps .003-inch of its finished diameter, and about .02-inch of being deep enough. At this point the barrel should be screwed into the receiver, if that has not been already done, the barrel having been threaded and the breech end faced and cut for the extractor, lugs, etc., before the chambering was started.

HEAD-SPACING: Here we must explain the very important matter of headspace. It will be obvious to all that the chamber must hold the cartridge back against the face of the bolt, and must support the cartridge and its primer firmly against the blow of the firing pin. Few gunsmiths, however, realize how accurately headspace must be adjusted in order that the rifle shall operate efficiently and safely. When a rimmed cartridge is used, the headspace is the distance from the shoulder of the chamber on which the forward surface of the rim of the cartridge rests to the face of the breech bolt or breech block. See "A," Figures 114-D. This distance must be equal to the length, that is the thickness from front to rear, of the rim of the maximum case. No tolerance should be allowed, and this distance or headspace is cut carefully and gradually with the finishing reamer, after the barrel and breech bolt have been assembled to the receiver, with constant trying of the headspace gage or of a cartridge known to be of fairly maximum dimensions. In the case of a rimmed cartridge the headspace gages are merely dummy cartridges very accurately turned of steel, the smaller or "GO" gage being exactly the size and shape of the maximum cartridge, and the "NO GO" gage being just a trifle larger or longer in length, with a rim which is approximately .003-inch thicker than the rim of the maximum case. The finishing reamer is run in until the breech block will just barely close, without undue effort on the bolt handle or finger lever, on the "GO" gage, but the action positively must not close on the "NO GO" gage or the rifle will be both unsatisfactory and unsafe. The exact dimensions of the finishing reamer assure that the shoulder, and bullet seat of the chamber will all be at the right distance ahead of the rim seat, and that all portions of the chamber will have the correct diameters.

The headspacing of a chamber for a rimless cartridge is slightly different, and it is also more important because as a rule rimless rifle cartridges are used with much higher breech pressures than rimmed cartridges. Here it is the shoulder of the chamber just in rear of

248

the neck which holds the head of the case back against the breech block and supports the case and primer against the blow of the firing pin. The headspace is thus that distance from some selected point on the cone of the shoulder to the face of the breech block or breech bolt. See "A," Figure 114-C. Finish chambering is done in the same way as with rimmed cartridge, the receiver and bolt assembled to the barrel, and the finishing reamer being run in until the bolt will just barely close on the smaller or "GO" headspace

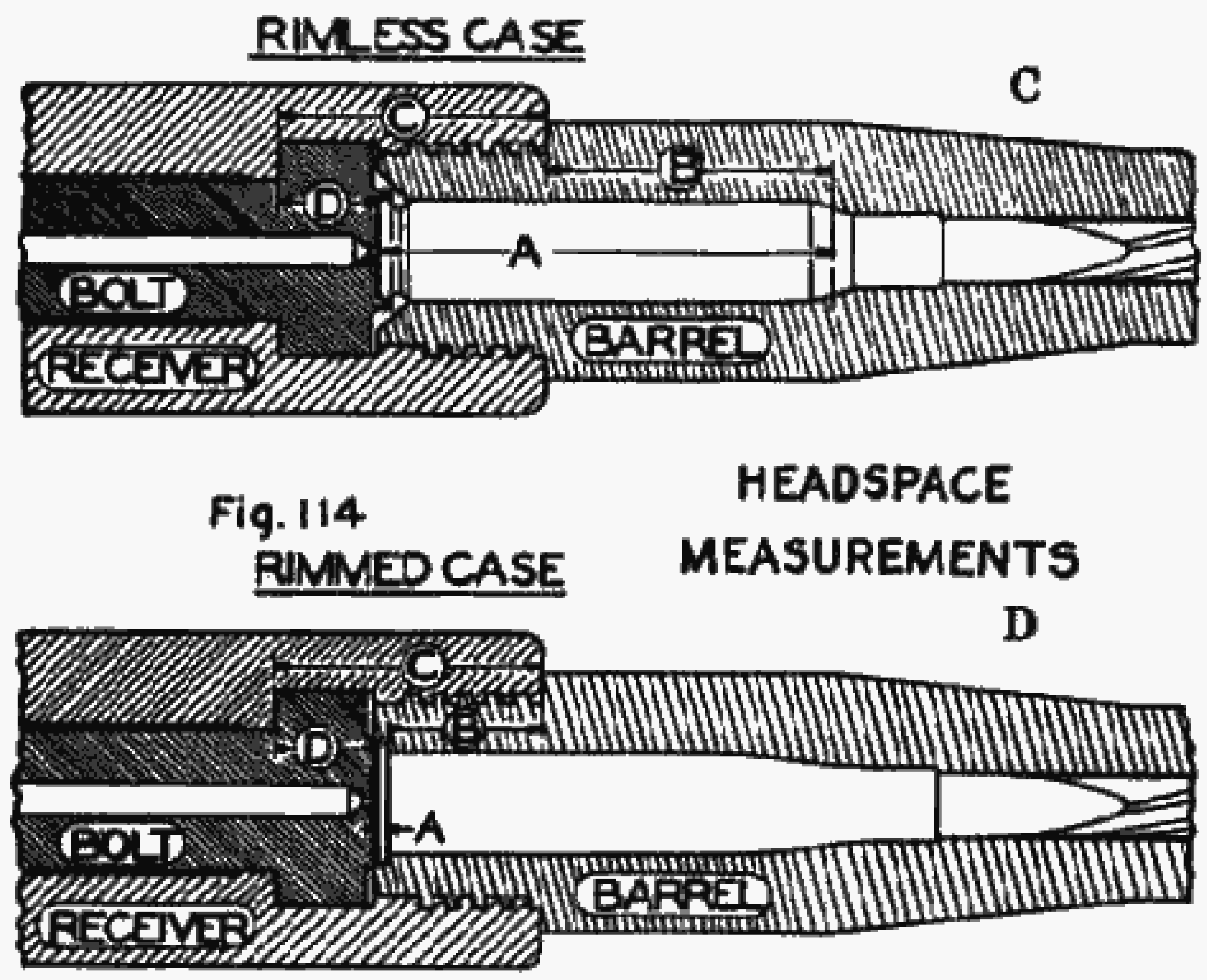


Fig. 114 HEADSPACE MEASUREMENTS

gage. The bolt handle should turn down on this gage with just a slight suspicion of feel, but not so hard as to cause any difficulty in operating the rifle and having the cartridges insert easily in rapid fire. At the same time the bolt should not close down completely on the "NO GO" gage. Figure 115 shows the two headspace gages, "GO" and "NO GO" for the Springfield rifle.

The minimum headspace gage for the .30-06 rifle and cartridge is known at the 1.940 gage, that being its length from a determined point on the cone to its head. The bolts of all rifles for .30-06 cartridges, military or sporting, must close readily on this gage. The "NO GO" gage for arsenal use is known as the 1.946 gage, being .006-inch longer than the minimum of "GO" gage. Bolts of rifles issued from arsenals must not close completely on this gage. The "NO GO" gage for rifles in the hands of troops is known as the 1.950 gage. If bolts of rifles in the hands of troops or in storehouses at posts close on this gage when they are inspected such rifles are

249

withdrawn from use and issue, and are sent to an arsenal for repairs.

Headspace gages, as a rule, cannot be bought, but must be made by the gunsmith, or by the man who makes the chambering reamers, from ground and hardened steel. When a gunsmith has a number of barrels of a given caliber to chamber or fit he should certainly have a set of gages for that caliber. He is then prepared to fit ready made and chambered barrels of that caliber to any breech action. For example, if he has a set of such gages for the .30-06 cartridge he may buy his barrels ready chambered and threaded from the several sources of supply for such barrels, and he can then screw these barrels directly to his receiver, and then he can proceed to try different bolts in that rifle until he finds one bolt which will close down on the "GO" gage, but will not close down on the "NO GO" gage. That barrel, receiver, and bolt are then perfectly satisfactory and have the correct headspace.

But if the gunsmith has but one barrel to fit he may be able to get by with it all right by using a loaded cartridge as a gage. Procure a number of cartridges of different makes of the caliber desired. Select from this lot by trial in another new rifle of standard make the two cartridges which appear to be the largest and longest. It will be difficult or impossible to measure their length from shoulder to head if they are rimless cartridges, but one will probably be able to tell by the way they feel when they go in the standard rifle, and the way the bolt closes on them. Use one of these for the "GO" gage. Paste a disc of paper .005-inch thick, on the head of the other and use it for the "NO GO" gage.

The gunsmith, and all riflemen in fact, must beware of the ready chambered and threaded barrel. It cannot be stated too strongly that rifle barrels cannot be made strictly interchangeable, and that the only way a ready made and completely chambered and threaded barrel can be safely fitted to a rifle is by changing breech bolts until one is found which fits tightly enough (and not too tightly) to successfully pass the gaging test, or by carefully fitting the breech block or bolt in an unfinished state, machining or grinding it to a perfect fit with the gage.

The reason why barrels cannot be made to be interchangeable is shown in Figures 114-C and 114-D. To assemble interchangeably it would be necessary that the sum of the measurements B, C, and D be not greater than the difference between the minimum and maximum headspace permissible. But in production no one of these measurements can be assured closer than, say, .003-inch. Thus, if in a given barrel and receiver and bolt, these three measurements were all maximum, or all minimum, we would have an aggregate of .009-inch, whereas in most rifles the maximum permissible difference between max. and min. headspace is about .006-inch. The barrel is therefore always finish chambered after being assembled to the receiver and bolt in connection with the headspace gage.

250

It therefore follows that it is extremely important that only that particular bolt and no other be used in that rifle. Considerable trouble, and some serious accidents have happened due to changing bolts. For example, the bolts of most high power bolt action rifles, and also of many .22 caliber bolt action rifles, will apparently interchange very nicely to the uninitiated. The bolt of any rifle will fit nicely into any other rifle of that make and caliber, and the tyro thinks that everything is all right. But the use of that bolt in that wrong rifle may give poor accuracy (particularly in the case of .22 rifles), or it may cause the cartridge cases to separate in two about half an inch in front of the head, leaving the forward portion of the case wedged in the chamber, or if the cartridge be a little overloaded or if the case have a soft head from too much annealing in the cartridge plant the head of the case may give way, permitting gas to come to the rear, completely demolishing the breech action and perhaps seriously injuring the shooter. On the other hand, modern military bolt actions made of properly heat treated alloy steel like the Springfield, Winchester Model 54, Remington Model 30, Mauser, and Mannlicher, which are designed to stand a regular working pressure of 48,000 pounds per square inch, will successfully withstand an accidental pressure up to 100,000 pounds per square inch without anything giving away provided that the headspace is correct, and that the cartridge case is in good condition. It is the rarest thing in the world to find a soft headed cartridge case in the product of our standard cartridge manufacturers—that is, their peace time product. Practically all the soft headed cartridge cases we have found have been in war time ammunition, such ammunition being made in enormous quantities with brass which was not quite up to that which the cartridge companies can always assure in times of peace.

While we have emphasized the danger of excessive headspace, we do not wish the reader to suppose that great numbers of rifles are unsafe. Headspacing is very important from the standpoint of safety, but it is also a very simple little test, taking not more than a minute to make if one has the proper gages. The product of our large arms companies, of many of the smaller made to order firms, and of many of our most prominent gunsmiths is all properly headspaced, and these weapons are absolutely safe if used with any standard cartridge of the correct caliber made by any of our large cartridge companies or by the Government arsenals, or with hand loaded cartridges assembled with the loads recommended in the Ideal Handbook or in the book "Handloading Ammunition" by J. R. Mattern.

We must also speak of too small or too short headspace, because that also is likely to occur, although it is not accompanied by such grave consequences as excessive headspace. If we have too small headspace then the breech block or bolt will fail to

251

close down on the cartridge, or it may close down on cartridges of one make, but not on those of another. The chamber is just too short, and the remedy is to run the finishing reamer in a little deeper or to select a shorter bolt. Once in a while, in using reloaded ammunition, the rifleman may run into similar trouble due to the stretching of fired cartridge cases. The fired cartridge cases one reloads may have stretched too long for that chamber. This often occurs in lever action rifles using cartridges giving high breech pressure, particularly in .250-3000 and .300 Savage cartridges in Savage Model 1899 lever action rifles, and in .30-06 cartridges in Winchester Model 1895 rifles. These breech actions, not having bolts locked at the front, and not being made of hard, heat treated, alloy steel, have a certain amount of spring or give to them, and the cartridge cases fired in them lengthen so much that they cannot be resized to again fit easily into the chamber in which they have been fired.

252

CHAPTER 17

RIFLE CARTRIDGE DESIGN

IF you essay to build a rifle of your own, or, if you are a professional, one for a patron, it is probably because no existing model quite meets your ideas. Naturally you want this new rifle to represent the very highest type, and that may even involve carrying out your own ideas as to a cartridge. Now in times past we have seen both amateurs and professionals air their views as to cartridges. Some of these views are excellent, some fair, while many violate almost every rule of good ordnance design and would be complete failures were they carried into execution. This chapter is therefore going to be devoted to illustrating certain principles of cartridge design to the end that your ideas as to cartridges may be sound. Knowledge in this respect will also help you in your understanding of the proper design of rifle barrels, bores, and chambers.

First we want to explain briefly HOW RIFLE CARTRIDGES ARE MADE. Particularly we wish to show what an intricate matter the making of a cartridge is, and what an expensive outlay in tools is necessary before any change can be made.

Take first the making of the brass cartridge case. Cartridge brass comes from the mill in long sheets or strips about 6 inches wide, many feet long, and of the thickness desired, depending upon the particular cartridge. This brass strip is first fed into what is called a double action press where a round disc is first cut out of the strip, and the disc then formed into a shallow cup by means of a punch and die. The cup then passes in succession to a number of other presses, also provided with punches and dies in which it is gradually drawn out into a long cylinder or tube, closed at one end—the head. The presses are big, heavy, strong machines. No hand tools could possibly do such work. The punches and dies have to be made with extreme accuracy, and are cut, hardened, and ground by tool-

253

makers specially skilled in such work. No mere machinist has the skill to make such dies.

One of the properties of brass is that when it is worked or drawn through a die it becomes hard, and several draws in succession would make it very brittle. Therefore, between every draw the cups or tubes are sent to a gas or electric furnace where they are heated red hot to a certain exact temperature to soften or anneal them, and after each anneal they are washed and dried before they are sent back to the next press. Figure 116 and Figure 117 shows the various stages that the cartridge case goes through from the original cup, through the various draws, and the trimming, heading, and necking operations, to the finished case. When the cup is drawn out into a long enough tube the ragged mouth is trimmed off, and then it goes to a series of machines called headers which form and stamp the head of the case and form the primer pocket and the rim. If it is a rimless case another machine like a little lathe cuts the extracting groove. Up to this point the case body is straight with no neck. The case next goes to a press which necks it down gradually in four or five sets of punches and dies with several neck anneals in between, these annealings being localized so as to leave the head of the case hard and the neck rather soft. Finally, after the last necking operation, the neck of the case is usually given a last neck anneal to assure that the neck shall have the exact grain structure which will assure against season cracking as the cartridge gets old.

In all these thirty-odd operations it is necessary that the anneals be very carefully controlled in order that the brass shall have just the right grain structure as will insure the required strength, toughness, life and temper. To this end each cartridge plant employs a metallurgist skilled in non-ferrous metals whose duty it is to inspect to insure that each operation and anneal is to the required kind, length, or temperature to give the desired property to each case or complete cartridge.

The sets of dies, punches, tools, etc., to form one case or one bullet cost several thousands of dollars, while the sets of presses, headers, trimmers, cutters, bullet machines, loading machines, etc., to make cartridges, cost into the hundreds of thousands of dollars.

Figure 118 shows the various stages in THE MANUFACTURE OF A MODERN JACKETED BULLET. The bullet jacket is drawn from a sheet of gilding metal (copper 90 per cent., zinc 10 per cent.) in much the same manner as the brass case is drawn until it is finally completed, being formed at one end and open at the other. In the meantime the lead core is being formed. A large ingot of lead of the required mixture, usually lead, tin and antimony, is placed in a huge extruding press, from which a long wire of lead is extruded. This wire is then fed into a press in which it is cut off into short lengths, and formed into the required

254

shape for the bullet core. The completed jackets and cores then go to a bullet assembly machine where the core is first inserted into the jacket, and the assembled jacket and core then pass in succession through a number of dies in which the bullet is shaped and swedged into the required shape and size.

In all of these operations exact shape and size are of extreme importance. Punches, dies, and other tools must be most uniformly and accurately made, and as they are worn they must be replaced to assure that the completed cartridge will come within the tolerances shown in Figure 112.

CARTRIDGE ASSEMBLY: Finally the completed cases and bullets go to the loading room where, with powder and primer, they are assembled into complete, loaded cartridges by operations very similar to those which are performed by the Ideal, Bond, or Belding and Mull hand reloading tools, except of course that there is one big automatic machine which does all the operations in turn and loads about 2,000 cartridges per hour.

It should be understood that through all the operations there is very complete inspection, mechanical, physical, chemical, and visual, to assure that each case, bullet and complete cartridge shall be safe, correct size and material, etc. For example, usually each morning and afternoon a batch of bullets are taken direct from the bullet assembling machine, and sent to the proof house where they are immediately hand loaded into cartridges and fired to see that they are accurate and give the required velocity and pressure, and thus insure that the bullet machines continually turn out first class bullets. Also each cartridge after loading is mechanically weighed to see that none contains too much or too little powder.

From all this it will readily be seen that it is a very expensive matter to tool up TO MAKE A SPECIAL CARTRIDGE. No cartridge company can possibly afford to do it unless they can foresee a ready sale of at least several hundred thousand of such cartridges yearly. Therefore the amateur or professional gunsmith is obliged to confine his alterations in design to such slight changes or adaptations that he can make in existing cartridge cases or jacketed bullets.

Let us say, for example, you want a 7 mm or .25 caliber cartridge, but no existing one has just the required shape or powder capacity, so you decide to take a larger case, say a .30 caliber case, and neck it down to the desired caliber. Or you may even wish to cut it off shorter, reshape its neck, or otherwise alter it. Right here we must interpose a few words of caution. We have already seen in the chapter dealing with rifle chambers, how necessary exact headspace is, and how with a rimless case the shoulders of the case and chamber assure this headspacing. The entire rimless case must therefore be extremely exact in size and shape or we will have a lot of trouble—perhaps extremely dangerous accidents. No ordinary

255

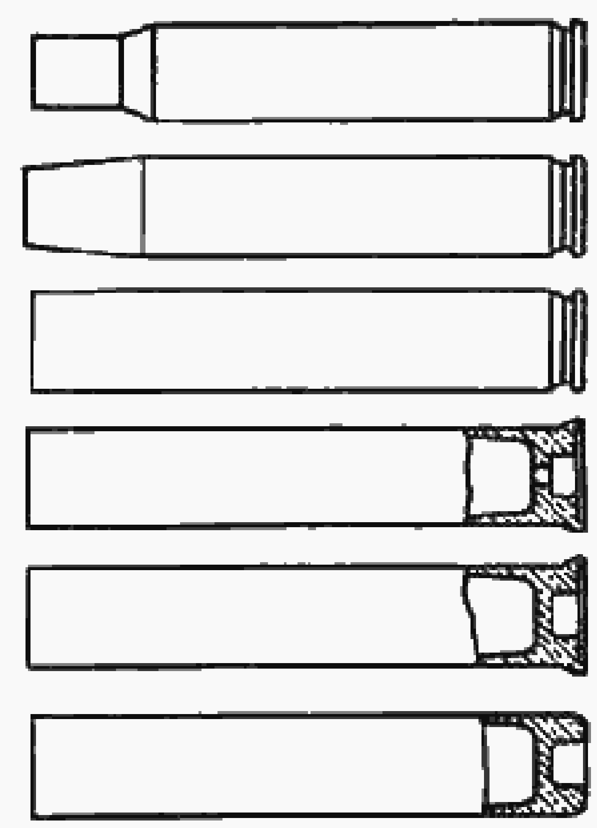


Fig. 117

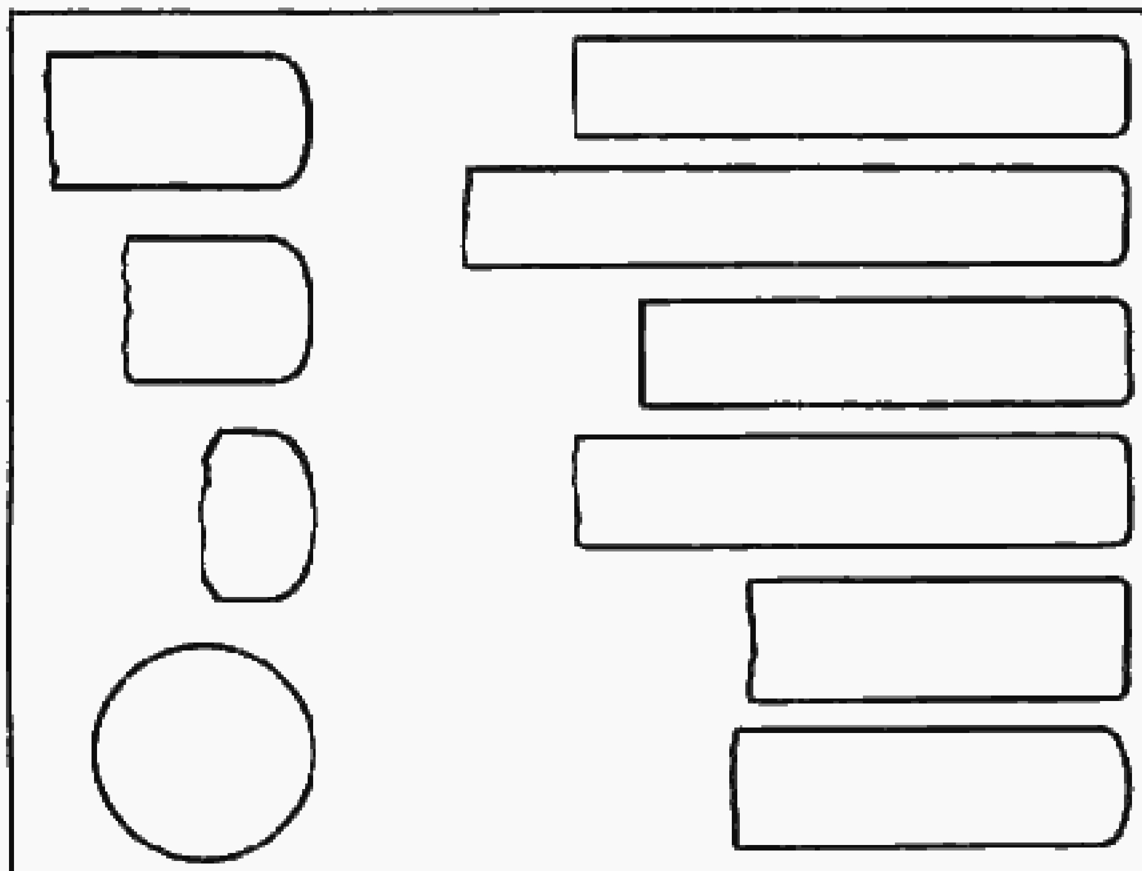


Fig. 116

machinist is capable of making dies accurate enough to neck down or reform rimless cartridge cases, and let no one suppose that such work can possibly be done on hand presses or with hand reloading tools. It must not be attempted.

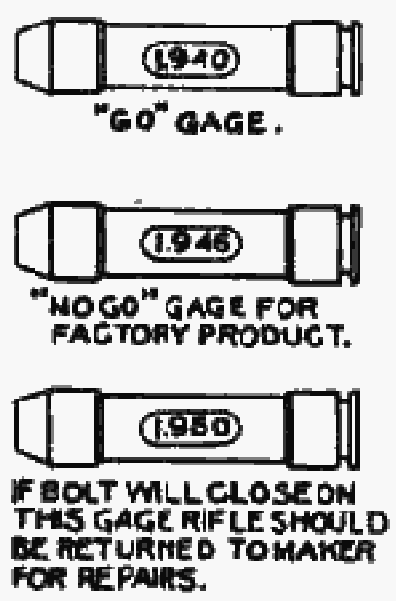
The necking down of a rimmed cartridge case, however, is an entirely different proposition. Here the rim of the cartridge insures the correct headspacing, and if the hand made dies do not form the shoulder and neck of the case to absolutely exact dimensions, a

256

light charge fired in that case in the rifle will usually swell the reformed cartridge to exactly fit the chamber and thereafter all will be well. In this way one can neck down existing cartridges to other calibers and shapes, of which the following will serve as examples:

.38-55 necked to .35 or .33 caliber
.30-40 or .30-30 necked to .28 or .25 caliber
.25-35 or .25-20 caliber necked to .22 caliber
.25-35 expanded to 6.5 mm—etc.

Suppose we wish to neck the .30-40 Krag case to .25 caliber. First we make a drawing of the finished case we wish. Then we make a series of dies to neck the case down gradually, and we must anneal the neck between each necking operation or the neck would



HEAD-SPACE GAGES. .30-06 CARTRIDGES.

Fig. 115

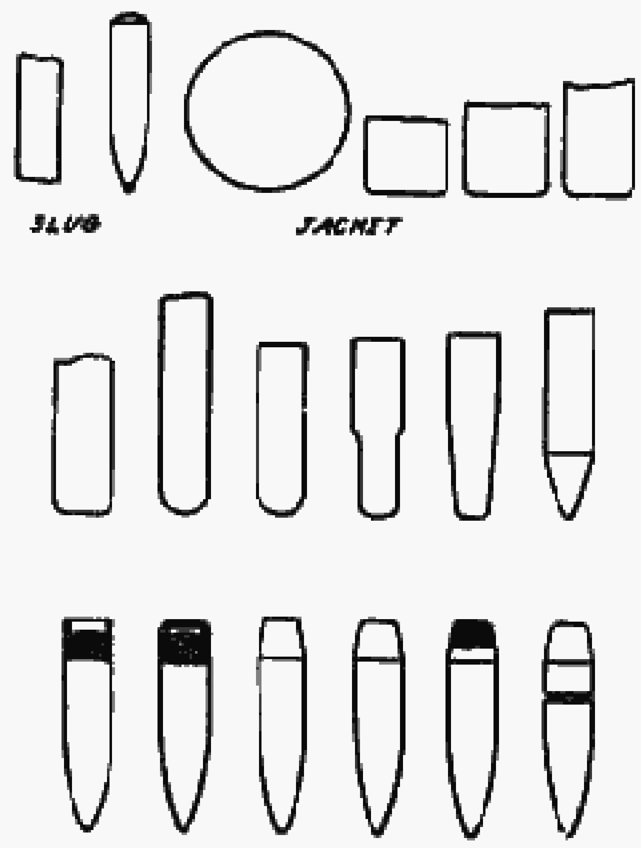


Fig. 118

get too brittle or hard. The first die necks the case down to perhaps .290 caliber, the second to .275 caliber, the third to .265 caliber, and the last die completes the reforming and necking so that the neck now measures .255-inch inside and both neck and shoulder are the required shape and length outside. (.25 caliber bullets usually measure .257-inch, and neck for a jacketed bullet should be .002-inch smaller than the bullet to hold it friction tight in the case.) As you neck a case down the brass in the neck is compressed and must go somewhere. Consequently the neck of a case necked down from .30 to .25 caliber will have a thicker wall than the original .30 caliber case had. For this reason the final die must be cut gradually with much experimenting until a size is arrived at which makes the neck of the case measure just .255-inch inside.

257

The cases are forced into and pulled out of the dies either in an arbor press or in an Ideal bench loading armory press. The ordinary hand reloading tool is not nearly strong enough nor accurate enough for these necking operations. Between each operation you must anneal the neck. Hold the *neck only* of the cartridge in a properly shaped gas flame so that it will just come to a dull red heat in about 10 to 20 seconds. This is best done by arranging two gas burners, each of which plays a pencil shaped flame about 1/8-inch in diameter on opposite sides of the neck. The neck is held between the two flames until it just begins to glow red hot which it should do in about ten to twenty seconds. Then it is allowed to cool, then washed in hot soapsuds and water, then boiled in clear water, taken quickly from boiling water, put hot in a wire strainer, and shaken above a stove or gas burner so as to cause the cases to dry completely within three or four minutes after being taken from the boiling water. The cases can of course be washed and dried in large batches. The neck of each case is then finally wiped with a slightly oily rag before being forced into the next die. After the last necking operation it is best to clean the entire case with acid, wash, and dry as explained in the Ideal Handbook. In many cases after necking in this way it is necessary to trim the mouth of the case so that it will have a uniform and desired length. This is best done in a lathe with a special fixture and cutter made to trim to exact neck length.

The overall length of a cartridge case from head to mouth should be from 1/32 to 1/16-inch shorter than the chamber. Rather it is better to say that when a new cartridge is in the chamber of the rifle there should be about 1/32 to 1/16-inch between the mouth of the case and the shoulder of the chamber just ahead of the mouth. This is particularly necessary where one is going to reload his fired cases because cases, as they are fired and resized at the neck, get longer in the neck, and if there is not some length tolerance between case mouth and forward shoulder of the chamber the case will soon become too long so that the breech bolt will not close on it, or if it does close, it will crimp the case on the bullet in a way that may tend towards very high breech pressures.

Turn now to Figure 119 while we explain certain of the details of MODERN CARTRIDGE DESIGN. "A" is the old fashioned straight taper rimmed cartridge of black powder days. The outside of this case must have a slight taper from rim to mouth otherwise it would stick badly in the chamber and would be very difficult to extract. This cut shows the bullet seated deeply in the neck of the case.

The depth to which a bullet must be seated in its case depends upon the throat of the rifling, the shape of the ogive and bearing of the bullet, and on the length of the magazine of the rifle. In a cartridge like the .38-55 for example, it is necessary to seat the

258

bullet as deeply as shown in "A", if the cartridge is to work through the magazine of repeating rifles and in factory cartridges the bullets are seated as deeply as shown. But this deep seating does not result in the best accuracy because the bullet cannot extend up into the throat of the rifling in such a manner that the throat will hold the bullet into almost exact centering with the axis of the bore. For use in single shot rifles it is better not to seat the bullet so deeply and it can usually be left to protude 1/8 to 1/4-inch further out of the case or enough so that the ogive of the bullet will just touch the beginning of the lands when seated in the chamber.

Cut "B" shows how Cut "A" could be modernized somewhat. Here the bullet is not seated nearly so deeply in the case, and quite a long portion of the cylindrical bearing of the bullet extends out beyond the mouth of the case. The throat of the chamber should be cut for this shape and projection of the bullet so that the cylindrical portion of the bullet is almost a push fit in the throat. The magazine of course must be long enough. Also in order that the cartridge may be secure, the bullet firm in the neck and waterproof, the base of the bullet should be seated at least a diameter deep in the neck. That is, a .38 caliber bullet should be seated at least .38-inch deep in the neck; a .25 caliber bullet at least .25-inch deep.

Next turn to Cuts "C" and "D." These show bottle-necked, rimmed cartridge cases. "C" has a much more abrupt shoulder between body and neck than is desirable. An abrupt neck gives a poor shape of powder chamber that churns up the powder gases too much, increases chamber pressure, and the powder does not burn as uniformly as it would in a more gradual slope of shoulder. "C" also has a much longer neck than is necessary. Many of the older bottle neck cartridges have these two faults. Cut "D" shows a much better design of shoulder and neck. The shoulder is of much more gradual taper and is carried further forward thus shortening the neck and at the same time giving a larger powder capacity than in "C."

In considering THE NECK OF THE CASE we must think of the bullets we are going to use. The neck should be just so long that the base of the longest bullet will not extend to the rear beyond the neck into the powder space. Suppose we are designing a .25 caliber cartridge in which we intend to use 87, 100 and 117 grain bullets. We cut the throat of the chamber just correct for the 87 grain bullet when that bullet is seated .25-inch deep in the neck. To fit this throat the points of all the other bullets must extend the same distance outside the mouth of the case that the 87 grain bullet does. When seated thus there will be quite a length of the 117 grain bullet inside the neck of the case, and the neck must be just long enough so that the base of the 117 grain bullet will come just flush with the rear of the neck.

Cut "E" shows a rimless case. Here too the same remarks apply

259

with regard to the slope of the shoulder and length of the neck as with "C" and "D," only we cannot have as gentle a taper of the shoulder as is possible with a rimmed case like "D" because our shoulder with the rimless case must be abrupt enough to surely hold the head of the case against the blow of the firing pin and insure correct headspace. Cut "E" has been carefully drawn to show the gentlest slope that is permissible with a rimless cartridge case.

A RIMMED CARTRIDGE CASE is a very great advantage. It solves lots of problems for us, and greatly simplifies both cartridge and rifle design and manufacture. It is much safer than the rimless case. The rimless case is a necessary evil forced on us by magazines similar to the Mauser magazine and it is the logical case for assembly in clips. We cannot use cartridges of the rimmed type in the Mauser magazine and load with a clip because to have the cartridges feed properly from the magazine the rim of an uppermost cartridge must be in front of the rim of the cartridge immediately below it. Therefore the rimless case is necessary in all rifles having magazines similar to the Mauser, Springfield, etc. Were it not for this there would be no rimless cases. The chambering

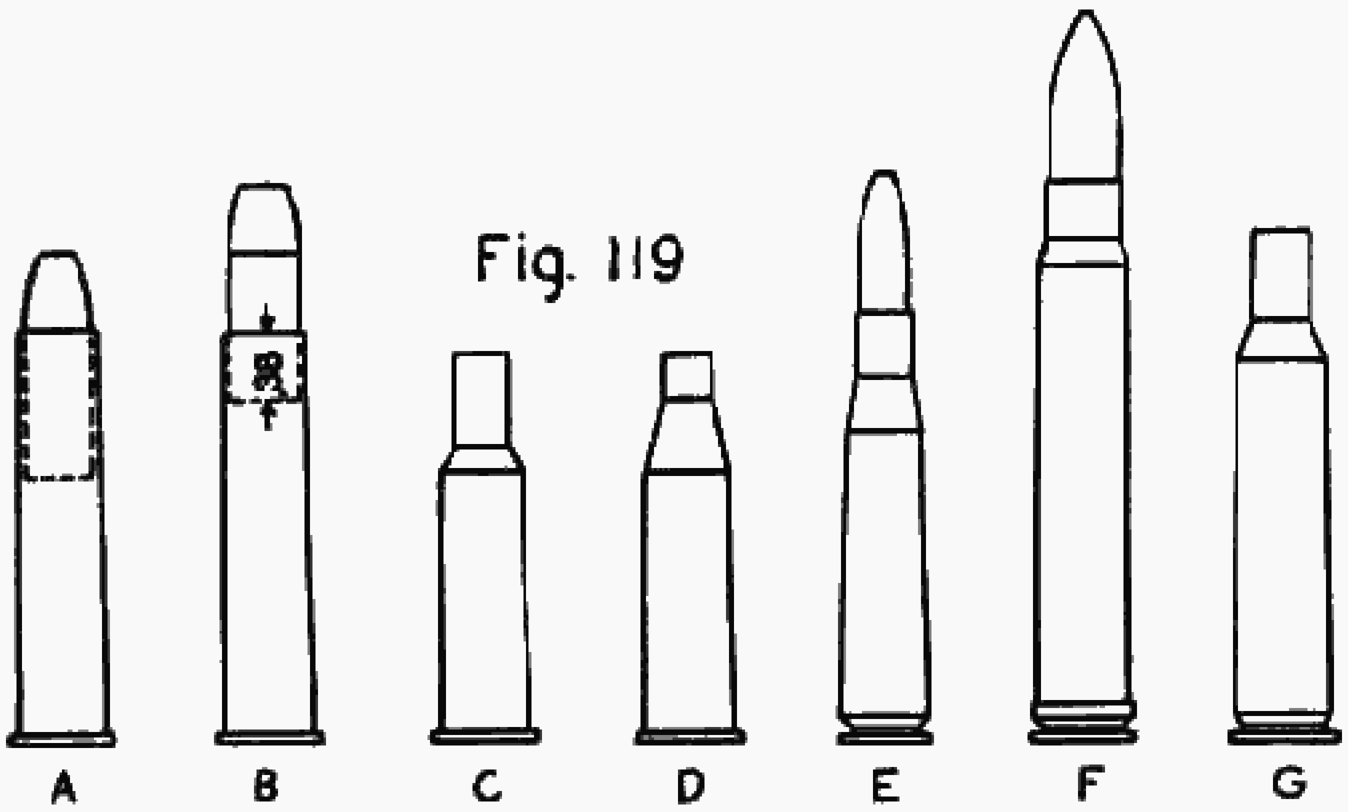


Fig. 119

of a single shot rifle for a rimless case is always a grave mistake. The design and making of an efficient rimless case extractor for such an action is difficult, and at the best such extractors are not nearly as sure in action as rimmed case extractors.

In order to get away from the disadvantages of the rimless case, THE BELTED CASE has been designed, and was first made popular by Messrs. Holland and Holland of London. It is shown in Cut "F." The shoulder ahead of the extracting groove which

260

holds the head of the case back against the face of the bolt, supporting it against the primer blow, and assuring correct headspace, measures .02-inch and is not so large as to interfere with one cartridge sliding smoothly over the cartridge just below it in magazines of the Mauser type.

Cut "G" is THE SEMI-RIMLESS TYPE, of which the .280 Ross and the .401 Winchester self-loading cartridges are types. In this case the rim stands just enough above the body of the case to permit of its seating against a shoulder like the rimmed case, but not enough to prevent upper cartridges from sliding smoothly over the lower cartridges in Mauser type magazines, the extractor being of a type similar to those for rimless cartridges.

The POWDER CAPACITY of a cartridge case must be correct in size for the proper charge of an existing and suitable powder which will give the muzzle velocity desired within the limit of the permissible working pressure of the rifle, and also the limit of proper burning pressure of the powder.

In general it may be said that the LIMIT OF PERMISSIBLE PRESSURE in lever action rifles is about as follows:

Winchester Model 94 and 86—38,000 lbs. per sq. in.
Winchester Model 95 and single shot—44,000 lbs. per sq. in.
Savage Model 1899—44,000 lbs. per sq. in.

The limit for the Krag rifle, and for the .303 Lee Enfield is about 41,000 pounds, while the limit for modern bolt actions made of heat treated alloy steel with locking lugs at the head of the bolt, like the Springfield, Mauser, U. S. Model 1917, Winchester Model 54, Remington Model 30, and Ross, is 48,000 to 50,000 pounds per square inch.

Cartridge cases also have their limits in pressure. The older cases like the .30-30, .32-40, .38-55 and .33 W.C.F., were neither by their design nor their anneal made to stand extremely high pressures and they should not be loaded to pressures higher than about 40,000 pounds per square inch, and neither should they be necked down to make other cases to stand higher pressure.

The various kinds and granulations of SMOKELESS POWDER have high and low limits which should not be exceeded. With any of our rifle powders, when the pressure is over about 50,000 pounds a point is soon reached where even one grain additional charge will cause the breech pressure to sail to a very dangerous figure. Hi-Vel powder will burn cleanly and well at pressures as low as about 25,000 pounds, while if du Pont No. 17 1/2 powder were used at a pressure much below 34,000 pounds, it would not burn cleanly, there would be many unburned grains, and the fouling might be highly corrosive. Any powder, even Hi-Vel, may act in this manner if fired at pressures well below its minimum efficient working pressure.

261

Take, for example, the various .30 caliber cartridges. The .30-30 cartridge with 165 grain bullet has just enough capacity so that a charge of a finely granulated and relatively quick burning powder can be used to give a muzzle velocity of about 2150 to 2200 f. s. That is about the limit for that case and bullet. With a lighter bullet a still higher velocity can be obtained until we come to the point where the bullet is so light that it will not give enough resistance to develop a pressure which will cause existing and suitable powders to burn cleanly. The .30-40 Krag cartridge with more powder capacity has a limit of pressure plus velocity which, with existing powders, will permit of giving a 220 grain bullet M. V. 2150 f. s., or a 110 grain bullet M. V. 2800 f. s. The .30-06 case permits us similarly to speed up a 220 grain bullet to 2375 f. s. or a 110 grain bullet to 3400 f. s. And the largest case of all, the .30 Magnum, makes it possible to fire the 220 grain bullet at M. V. 2525 f. s. or the 180 grain bullet at 2850 f. s.; but the 110 grain bullet would be unsuited because it will not give sufficient resistance to burn existing powders cleanly in such large charges.

Where one wishes very high velocity combined with the burning of existing powders under conditions as will insure the highest degree of accuracy, the present thought is that for various calibers the cases should have about the following powder capacity:

.30 Caliber—.30 Magnum case
7 mm. —.30-06 case
.25 Caliber—7 mm. case (.25 Roberts)
.22 Caliber—.25 Rem. Rimless case

BULLETS: The modern metal jacketed bullet should be jacketed with gilding metal (copper 90%, zinc 10%) or with Lubaloy which is gilding metal with about 1 per cent. tin added. Pure copper jackets may also be used. Cupro-nickel jackets may be regarded as obsolete. The objection to them is that at muzzle velocities over 2100 f. s. they give a lot of trouble by depositing metal fouling in the bore. Below 2100 f. s. there is no objection to them.

Where the highest degree of accuracy is desired, modern bullets should be of such length and shape that at least one caliber of their length can be inserted within the neck of the case, and one caliber length of their bearing remains outside the case to permit of centering by the throat of the chamber. Of course other things also must be attended to, such as pitch of rifling, proper muzzle velocity, pressure, etc.

The best bullet for any rifle is one with a flat base. Boat-tail bullets present no advantages for use in rifles. Theoretically they give slightly less pressure, can be loaded to slightly higher velocity within the limit of permissible pressure, and have a shape which makes for slightly greater remaining velocity. But these very slight

262

advantages are more than offset by the facts that such bullets cause more erosion and wear the barrel out quicker; that unless they are extremely well made they do not shoot as accurately as flat base bullets, and that it is difficult to seat them so that there will be enough of their bearing inside the case neck for security and outside case neck for accuracy. The only reason why a boat-tail bullet is used in the .30 caliber M.1 new service cartridge is that this same cartridge is used in both rifles and machine guns. In a rifle we care nothing about what happens to the bullet after it passes 1,000 yards, but in a machine gun we desire a cartridge, the sheaf of fire of which can be controlled to the longest possible range, and the boat-tail bullet presents a great advantage in this respect.

The reader who desires to go into more detail with respect to rifle ammunition is referred to the "Ideal Handbook" published by the Lyman Gun Sight Corporation, and the book "Handloading Ammunition" by J. R. Mattern. In fact these books are essential for every gunsmith or shooter doing any work whatever with rifles.

PROOF FIRING AND PROOF CARTRIDGES: There is one matter regarding cartridges which is of extreme importance to gunsmiths, both amateur and professional. Whenever a new rifle is built, or a new barrel fitted to an old rifle, or any work connected with chambering or fitting breech bolts is done, the complete and finished rifle should be proof fired with a cartridge giving a higher pressure than any factory cartridge or reloaded cartridge that will thereafter be used in the arm. This should be done before the rifle leaves the shop. It is a matter of proper prudence, for one cannot surely tell whether or not there is some little flaw or mistake somewhere which might render the weapon decidedly unsafe, even with quite normal ammunition. Particularly the professional gunsmith should always proof fire every weapon on which he does any work connected with barrel or breech, and he should keep an exact record of headspacing and proof firing of that weapon for future reference. The purchaser also has a right to expect, and should know that his rifle has been properly proof fired.

The rifle is placed in an extemporized rest, arranged to take up recoil, and is loaded and fired with a proof cartridge. It should be fired from a distance by means of a string, with operator under cover. Then inspect the rifle carefully to see that nothing is broken, cracked, upset, or deformed. Test with headspace gage again and see that the chamber has not been enlarged.

For these purposes the arms and ammunition manufacturers have SPECIAL PROOF CARTRIDGES made with which to test their product. These cartridges are made with cases much thicker than ordinary, and are usually nickel plated or blackened so that they will not be mistaken for regular cartridges. They are usually loaded with a charge of powder and a bullet which will give a breech pressure about twenty-five to fifty per cent. in excess of the

263

pressure of the heaviest regular cartridge made in that caliber. Such proof cartridges can scarcely ever be obtained by gunsmiths, and they will usually have to load their own. Use new primed cases that have never been fired before, and load them with the heaviest bullet to be regularly used in the particular rifle, and a charge of powder about two grains heavier than the powder company recommends as the maximum charge for that particular rifle, cartridge, and bullet. This will give a pressure of from 2000 to 5000 pounds per square inch higher than the permissible regular working pressure for that rifle, and should prove a practical and easily prepared proof cartridge. E. I. du Pont de Nemours & Company, Wilmington, Delaware, and the Hercules Powder Company, Wilmington, Delaware, will mail on request little leaflets showing all the recommended charges of the powders they manufacture for various calibers of rifles, sizes of cartridges, and weights of bullets from which one can select the maximum charge and increase it by two grains weight of powder. But be particularly careful never to get these proof cartridges, or "blue pills" as they are often called, mixed with regular cartridges for obvious reasons.

264

CHAPTER 18

STRIKING AND POLISHING BARRELS AND ACTIONS

IN the remodeling of old guns, as well as in the manufacture of new ones, the polishing of the metal parts prior to bluing or case-hardening is one of the most important phases of the work. On this "white" finish depends the final appearance of the weapon. Amateur workmen seem to have the opinion that the bluing or hardening will "cover up" scratches or spots in the steel, while just the opposite is true. Any marks which show before bluing or hardening will show still plainer in the finished job.

The degree of polishing necessary depends entirely on the kind of finish wanted, whether bright, or dull matte. Whichever is chosen, however, the polishing must be done evenly all over, and the "grain" of the work must all run in the same direction. You may have a barrel polished perfectly, then one little swipe with the abrasive cloth away from the direction of previous work, will make a glaringly ugly streak in the bluing.

In most cases, before a barrel can be polished it must be "struck." STRIKING is merely another term for draw-filing, which as most mechanics know, means holding the file at right angles to the work, and pulling it back and forth, much as a carpenter uses a draw-knife. (See Figure 120).

This striking is necessary for the removal of dents and scratches in old barrels which are too deep to be removed by polishing. It is vitally essential in the remodeling of "as issued" Springfields and other military arms on which the barrels are merely rough turned without any finishing cut. For these extremely rough barrels, unless they are turned down in a lathe, as explained in Chapter 15, a special method of striking is necessary, which will be explained later.

In factories, when a new barrel comes from the machine which turns it to the required taper and form, it is usually ground in a

265

barrel grinding machine. This machine is in effect a lathe in which the barrel is revolved slowly between centers, but instead of a cutting tool a grinding wheel running at high speed is brought against the barrel's surface; and this wheel, as it travels the length of the barrel, is guided so as to follow its taper formation exactly. Thus the barrel is brought to its finish dimensions, and comes from the grinding machine with a very smooth, bright surface. Nevertheless, the "grain" of the grinding is around the barrel, whereas it should run lengthwise, and must be polished off. On a barrel that has been ground very little striking is needed—sometimes none at all.

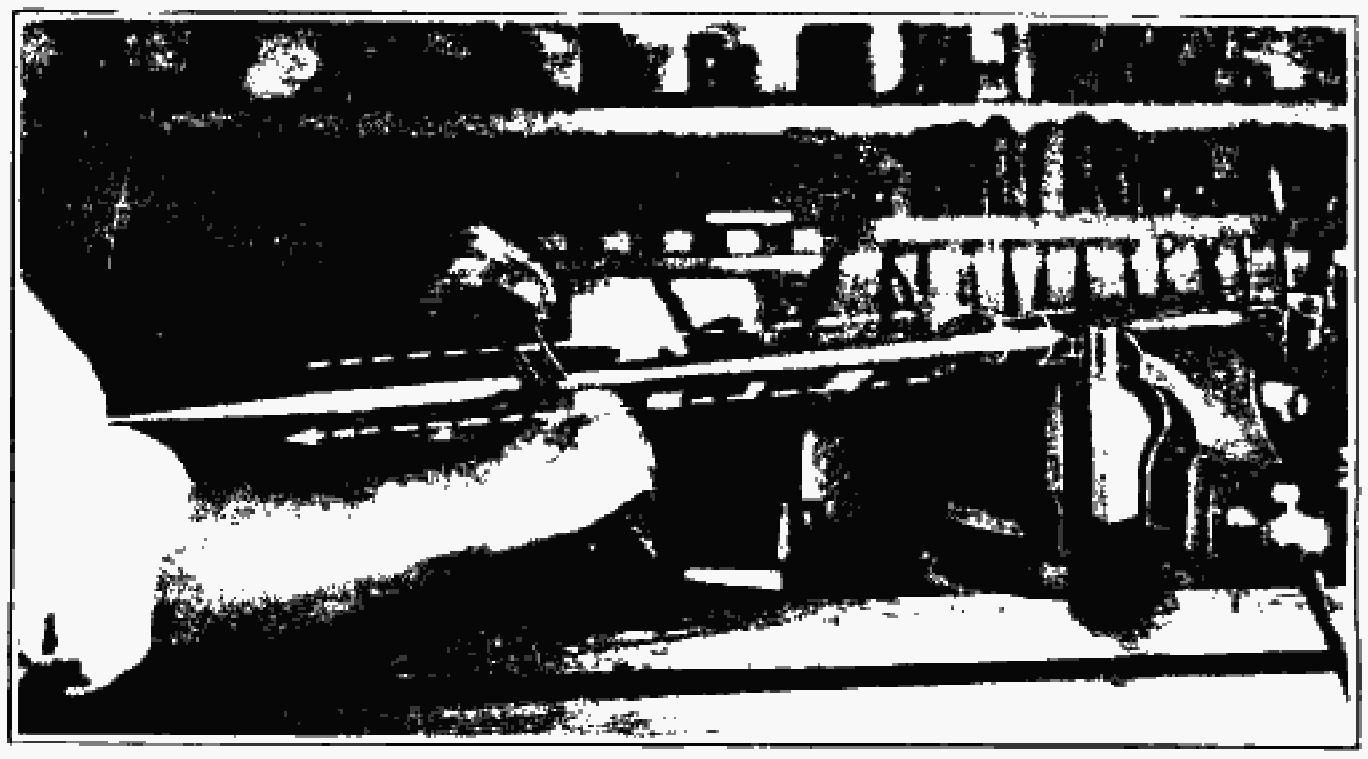


Fig. 120

The principal tool needed is a large, wide, and very fine cut file. The best for the purpose is an American Swiss, a Nicholson, or a Disston "pillar file" as described in Chapter 3. This should be at least ten inches long, and at least an inch in width—the wider the better. A wide file follows the straight surface of the barrel, while a narrow one tends to cut unevenly, giving it an "ocean-wave" effect as you look down the sights.

These pillar files are available in much finer cut than ordinary machinists' files. Ordinarily the 00 cut is about right for striking, but if a particularly good job is wanted, the barrel may be struck again with a file having a 0000 cut.

Using heavily padded vise-blocks to prevent damage, hold the action in the vise with the barrel's entire length available for the work. Keep a piece of chalk handy, and chalk the cutting side of the file all over at frequent intervals. This prevents the particles of steel from the barrel from clogging the file teeth, or "pinning" as it is termed. If this occurs, deep scratches will be gouged in the barrel which will be difficult to strike out. The file card, or brush

266

with short, stiff, steel wire teeth, must be used to clean the file thoroughly after every few strokes, and the file rechalked after each cleaning.

Use the file in both hands as illustrated in Figure 120, and run every stroke the full length of the barrel, maintaining a constant firm pressure. It is not necessary to bear down hard enough to spring the barrel—just a firm steady pressure both ways, so that the file takes a cut "coming and going." A little practice will enable you to feel the right pressure, so that the file will just take hold. Excessive pressure will result in too deep a cut and make "flats" a sixteenth of an inch or wider along the barrel, and these are hard to work out.

Too little pressure, however, is as bad as not enough. A file's purpose is to *cut*—not to scratch. Each stroke should remove an appreciable amount of metal. Some men never acquire the knack of fine surface filing—the fear of cutting too deep causes them to merely scour and scratch the surface. It is surprising how many full pressure strokes are required to reduce a piece of stock a thousandth of an inch.

When you learn to strike a barrel with the proper pressure, neither too light nor too heavy, the cuts taken will have scarcely any appreciable width—or in other words, there will be no flats visible on the surface.

Nevertheless, the flats are there, and the next step is to polish them out. Emery cloth is the usual polishing medium, but I prefer carborundum or alundum cloth when it is obtainable, due to its longer cutting life, and faster work. This material is sold by ma-

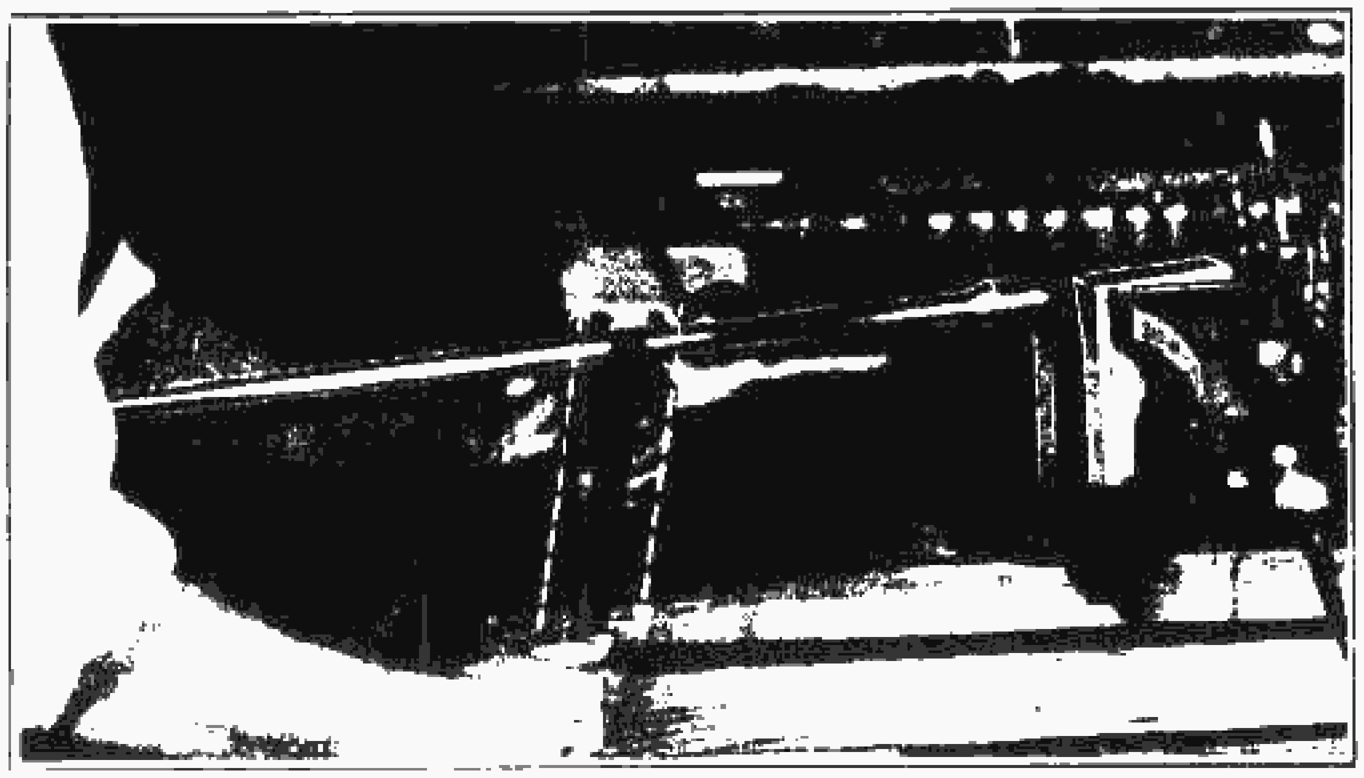


Fig. 121

267

chinery supply houses in large rolls, of one, two, or three inches in width. Most firms will sell it by the yard, from the roll, and three or four yards will last a long time in the small shop. The large shop will find it economical to buy it by the roll. The size of grit needed will be 00, 0, and 1/2.

To show up the small flats left by the striking, cut a strip of 00 emery or carborundum cloth 3/4 inch wide and about a foot in length. Grasp the ends firmly in each hand and use it as shown in Figure 121—just like shining a shoe with a rag. Very gradually, move from one end of the barrel to the other, using very light pres-

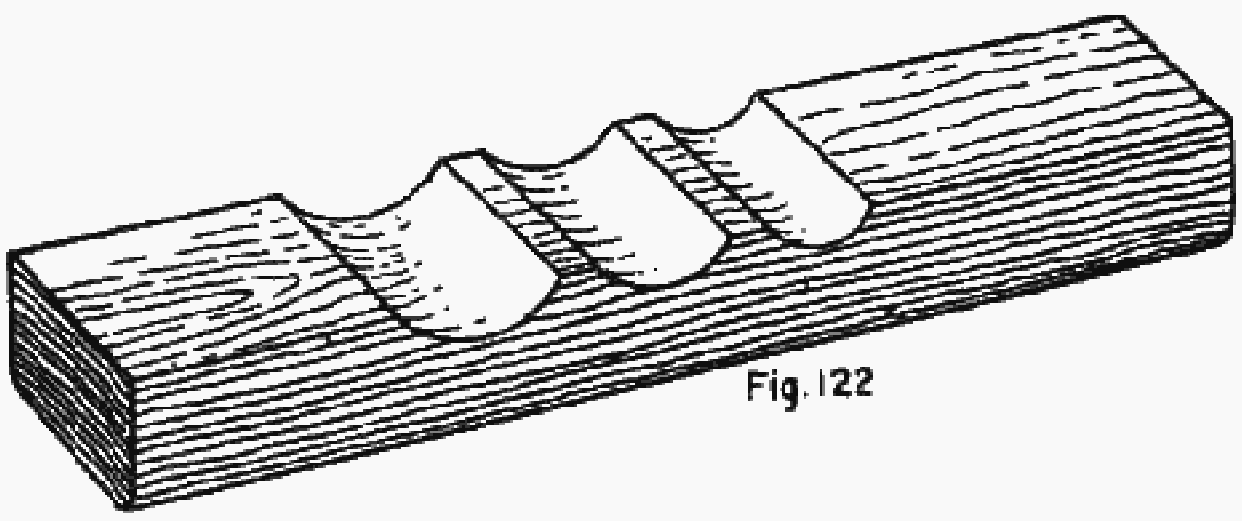


Fig. 122

sure. This will cross-polish the barrel for about half its surface, then it should be turned over in the vise, and the under side polished in the same manner.

Now you can see the small flats left by the file. If they are very pronounced, they may be partly eliminated by again cross-polishing with No. 0 abrasive cloth.

And then you are ready for the "DRAW-POLISHING" which is the same as draw-filing, except that the abrasive cloth is used instead of the file.

Cut a hardwood stick ten to twelve inches long as shown in Figure 122 with semi-circular notches in two or three sizes. These may be cut by first making the stick wider than wanted and boring holes in it with the proper sized bits, after which half the stick is ripped off and discarded, or may be saved for a "spare." The working surface should be lined with a piece of thin leather—about the weight used in the upper of a shoe or a piece of thin strap. This should be firmly glued to the wood, to form a slightly resilient base for the abrasive cloth. The cloth may be shellaced to the leather, but a better way is to coat both the leather and back of cloth with thick rubber cement and let it dry for ten minutes. Then press the cloth in place and it will remain until worn to the point of uselessness, when it may be readily peeled off, and a new strip cemented in place.

The round notches in this polishing stick should be of such a size as to fit easily over the barrel after the leather and cloth are applied. They should not fit the barrel tightly, or they will make

268

cross scratches as the stick is lifted at the end of the stroke. On tapered barrels you will have to use a notch big enough for the largest part, although a smaller one may be used near the muzzle, and the stick lifted gradually as the stroke approaches the thicker part of barrel.

Grasp the stick in both hands and use it just as you did the file. If it has to be stopped short of a full length stroke, lift it as you stop. Never stop with the abrasive still on the barrel, or there will be small scratches at the end of each stroke.

The first polishing with the stick may be done with No. 1/2 abrasive, using moderately light pressure at first, and increasing pressure as the abrasive wears down. When you have polished the entire surface, and the barrel has an even, silvery appearance with no flats showing, do a little cross polishing with No. 00 abrasive cloth, and you will probably find the flats still visible, although partly worked. Now cross-polish again all over, and again draw-polish with the stick; continue to alternate these operations until the flats are no longer visible, then draw-polish with No. 00 cloth on the stick, and if you want a moderately dull finish on your barrel, you have it without further work. Use the 00 cloth until it is pretty well worn away, and no finer abrasive will be needed.

When a very BRIGHT FINISH is desired—and particularly on pistols and revolvers, as well as parts that are to be niter-blued, the polishing should be continued as follows:

Fold a quarter sheet of 00 emery cloth twice, making a pad about two inches square, and partly wear out the surface on a piece of scrap steel or an old barrel. Then squirt a few drops of thin oil (any gun oil) on this partly worn surface, and holding the cloth in the palm of hand, scour the barrel with full length strokes until the emery no longer cuts. Carefully wipe barrel dry of all oil, and polish again in the same manner, using crocus cloth. The crocus will produce a very high polish, but works slowly; and the polish it produces will likely show a few streaks and imperfections, due to incomplete polishing with emery. If so, they must be completely worked out with the oiled emery cloth, and the crocus polishing then resumed. Finally the barrel may be buffed on a thick, six inch cloth buffing wheel, to which a very little polishing rouge may be applied.

When a barrel has been polished with oil, or buffed, the pores are so filled that it cannot be successfully blued by any method until thoroughly cleaned. Make up a hot solution of strong soap and sal soda, dip into this a clean rag, sprinkle on it a small amount of powdered pumice, and scour the barrel thoroughly; rinse in clean boiling water, and if the water puddles off showing a greasy surface, scrub and rinse again. Then flush it off thoroughly with Pickling Solution No. 4, (See Chapter 20) again rinse in boiling water several times, and dry with a clean cloth. This treatment is merely to remove foreign matter from the pores of the metal, and the regular

269

boiling in lye prior to the bluing must still be done as explained later.

WORKING DOWN BARRELS: The barrel of our Springfield service and national match rifle is rough turned almost its entire length, having only four or five inches at the muzzle smoothed down, since the remainder is hidden by the forend, hand-guard and rear sight base. When this or any other rifle having a very rough barrel is converted into a sporter, it should, if possible have the barrel removed from the action, turned down smooth in a lathe, and ground. This being beyond the reach of the amateur remodeler, however, the following method is nearly if not quite as effective.

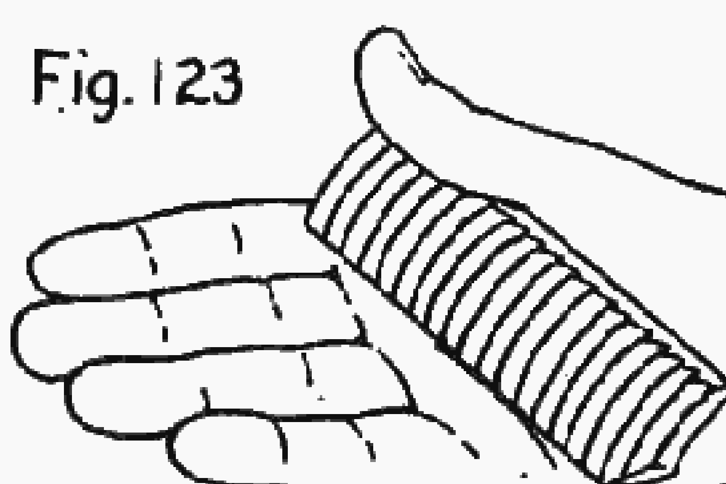


Fig. 123

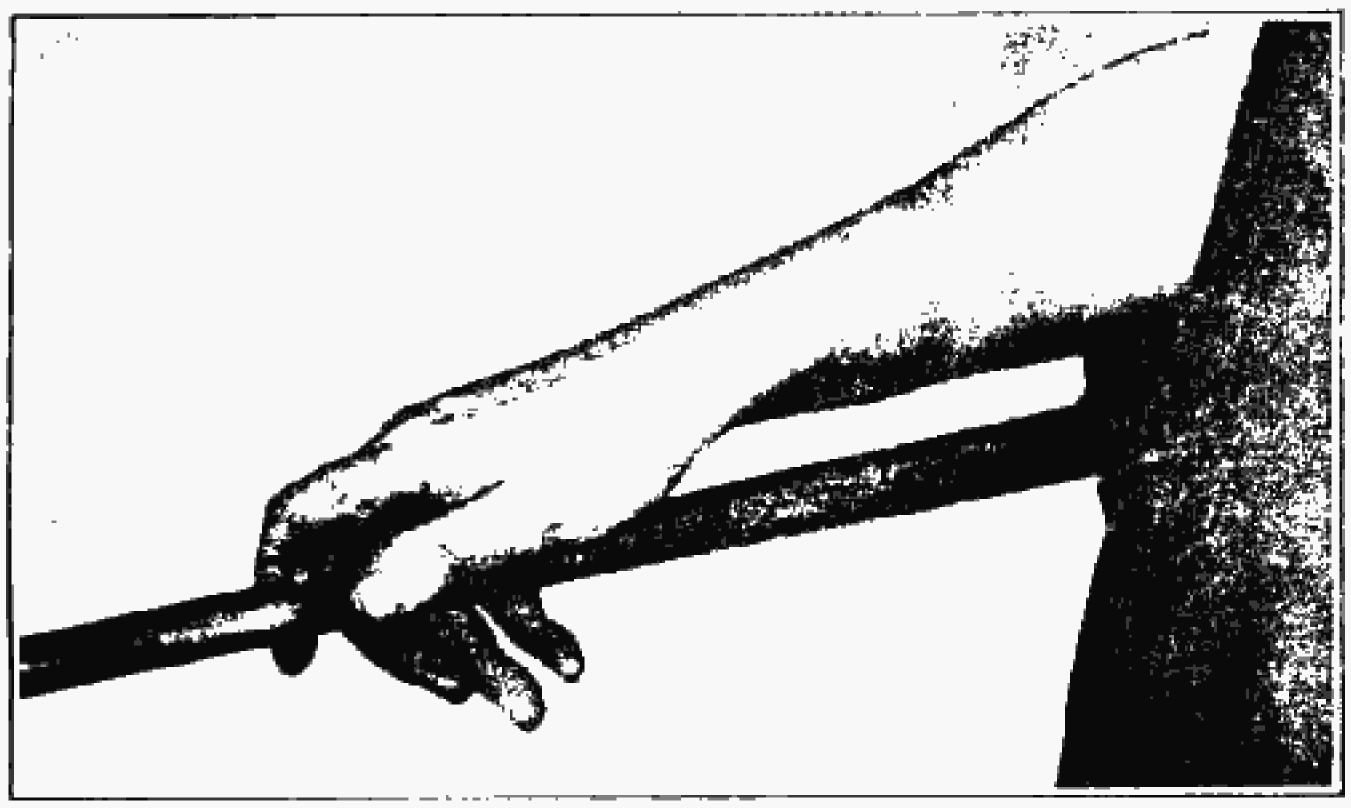
In one sense it is better, since it involves no danger of some machinist turning the barrel down too small, or perhaps springing it in the turning process.

Secure a "Vixen" file, which has very large, deep single teeth cut on a curve. This file will be an inch, or an inch and a quarter wide—the wider the better. Set it in a vise and break it up into pieces two to three inches in length and grind the broken ends smooth on an emery wheel. Clamp the rifle action in the vise leaving the entire barrel available for working. Hold a short piece of the file in right hand as shown in Figure 123, planing off the barrel evenly and removing all high spots. Do not take too deep a cut, and work completely round the barrel, until all the rings made by the turning tool are planed off. The short length of file, laid lengthwise of the barrel avoids the danger of making a wavy surface, as you would be almost certain to do otherwise. The Vixen file cuts very rapidly and of course forms larger flats than would a finer file. To remove them, strike or drawfile the barrel first with a wide mill file (one inch or wider); then cross polish vigorously with No. 1/2 carborundum cloth to show up the flats; next draw-polish with folded emery or carborundum cloth on palm of hand; again cross-polish lightly with No. 0 cloth, then strike and polish as already explained, starting with the large pillar file.

POLISHING PROBLEMS: The foregoing includes all essential principles of barrel polishing, and should enable one to handle

270

any job without difficulty. A little ingenuity is of value here, as elsewhere in the field of gun work. Each job presents its own problems, the most common difficulty being that of getting at inaccessible places, such as around sight bases, etc. A good rule to follow is always to remove everything that is removable, and polish first the barrel, then the sights, bases, etc., and put them back on. Then any pins used in attaching can be polished off with a minimum of labor and difficulty. One exception to this rule is the fixed stud



Planing Down a Barrel with a Piece of Vixen File

on the Springfield barrel which need not be removed. The stud should first be polished without regard to the barrel. Then the polishing cloth and files may be worked right up against edges of barrel band without damage to its finish. When bands for swivels or forend screws, or bands forming leaf sight bases are used, they should be fully polished *in the direction of the barrel's length*, before being fitted into place. Polish the barrel, fit on the polished bands, or sight bases, then a light final polishing of the entire assembly will not be difficult.

Barrels and parts should also be fully polished before soldering on any bands, sight ramps, etc. The heat of soldering will of course blacken and discolor the metal at this point, but the surface being quite smooth, only a little final polishing is needed.

Both care and patience are necessary when polishing around parts that have been soldered on. If the least bit of solder remains in the edges of a barrel-band or ramp, it will not blue, but will "grin" through the final finish and mar the appearance of the whole arm. The solder, being practically the same color as the bright steel is

271

often unnoticed until the bluing is well under way. When this occurs, the best course is to step outside where there's plenty of room, cuss until you feel properly relieved, then scrape off the solder, repolish the barrel, and resume operations. Kicking the cat, providing you have a cat, will also help materially.

I keep an old hacksaw blade—or rather a short piece of blade—with the end ground to a long point and sharpened on both edges. This forms an excellent scraper for getting into the edges of a barrel band or ramp and removing the solder. It must be remembered that in the "sweating" process the solder actually penetrates the surface of the steel, though perhaps not more than half a thousandth in depth. Nevertheless, wherever excess solder shows on the outside after a sweated job, a good bite must be taken to assure its complete removal. A light etch with a 1-to-7 Nitric acid solution at this point will usually assure complete removal, and the surface so etched may then be polished to match the rest of the job.

Double shotgun barrels and ribbed rifle barrels are of course slower and more difficult to polish than plain round single barrels. Shape small pieces of hardwood to fit into the various corners and crevices, and glue your abrasive cloth on these. Nothing looks worse on a finished barrel than a streak showing where the polishing failed to get into the corners.

The rear end of a rifle barrel where it abuts the receiver, is another hard place to get at. A strip of abrasive cloth folded around a hacksaw blade will get you up about as close as anything I know of.

Where an extreme matte finish is desired on a barrel, this may be easily produced after the barrel has been smoothly polished with abrasive, by buffing on a rather stiff iron or steel wire buffing wheel. The buffer should run at least 2000 R.P.M., and preferably 3000. Hold the barrel with light pressure against the buffer. At first the wire will merely burnish the barrel to a rather bright finish. Now increase the pressure gradually, until you feel it "take hold" and you will notice this pressure has given the barrel a dull, silvery, and somewhat "grainy" appearance. By maintaining just this required pressure while moving barrel about on the wheel this matte finish may be imparted to its entire surface evenly, although considerable practice is needed before one can do a good job.

Most actions present greater difficulties than barrels, by reason of the various curves, angles and inside cuts, which are difficult to reach. Practically all polishing must be done by hand, with abrasive cloth folded into convenient shapes. Flat surfaces on lever and pump action receivers can often be struck or draw-filed to advantage, with the same files used for striking barrels. Inside curves and hollows, such as the inside of trigger guard, can best be reached with a very fine oval section file, and when polishing these places, the abrasive can be wrapped around this same file, or around small pieces of wood shaped to fit.

272

Regardless of the difficulties a job of polishing presents, remember it was polished at the factory when made, so your work is no harder than that of the man who made the gun. By studying the surface carefully you can usually see in what direction the original polishing was done, which gives you your cue.

The same applies to automatic pistols and revolvers, both of which offer some mighty mean polishing problems. The polishing is usually done in the direction of the milling cuts which formed the shape. The main thing is to avoid all scratches or cross marks, which will appear as glaring defects after the gun is blued.

BUFFING may well be resorted to on any pistol or revolver job. The best wheels for this purpose are the hard, solid felt ones which may be purchased in a variety of sizes. Use Tripoli or other standard brand of rouge. If you have a high speed grinder with

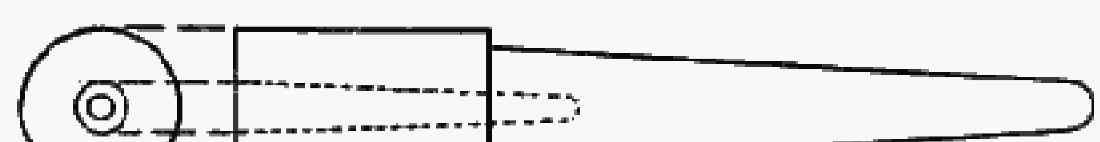


Fig. 124

tapered spindles on each end, it will pay also to turn up some small pieces of hardwood like Figure 124; these are bored at one end to screw on end of grinder spindle, and the other end covered with felt, to which rouge is applied. These spindle buffers are worth their weight in gold for working inside the trigger guard, and in narrow and shallow outside curves.

On military arms with hardened receivers, you will find emery of little value for polishing. It cuts slowly, and breaks down very quickly. Carborundum or alundum cloth is much better, and due to the hardness of the metal, a coarser grade may be used without danger of cutting too deeply. Thus, where you would use No. 0 on a barrel or other soft parts, you can use No. 1/2 or even No. 1 abrasive on hardened receivers. A finer grade should of course be used for finishing, followed by buffing on a muslin buffer with plenty of rouge to remove any cross marks that show. There is no need to polish the bottom side of receivers where they are hidden within the stock. This is a waste of time and necessary only as a matter of principle on high priced jobs.

POLISHING BOLTS is not difficult, although one's ingenuity is often taxed to devise ways of holding them in the vise. The Springfield bolt from a service rifle is Parkerized, hence quite rough and hard working. The extractor and extractor collar should be removed, and with one end of bolt held firmly in vise, the bolt should be cross-polished with No. 0 Carborundum cloth until all old finish is off. Along the sides of the safety lug and locking lugs cross-polishing will not get to the surface—here you must have recourse to a small piece of cloth folded to reach into the corners. After cross polishing, the bolt should be draw-polished lengthwise

273

with a piece of oiled emery cloth, folded as required, making the surface as smooth as possible. It should then be worked in the action with fine abrasive until it works very smoothly, as described under "hard fitting" in Chapter 25.

The mottled effect or "chasing" seen on bolts of many high grade arms is easily produced as follows: Cut off a small piece of hard rubber or fibre rod about 2 inches long, and 1/4 inch diameter. Round one end *very* slightly and chuck it in a drill press or lathe. Mix a little very fine emery flour with heavy oil or grease (or use a little valve grinding compound) and apply this to the rounded end of the rod. The drill press or lathe should be run at fairly good speed, and the bolt brought against the end of the fibre rod. Move the bolt slowly from end to end, pausing momentarily at intervals of a quarter inch or so, until the whole surface has been chased. Very little abrasive is needed for this, as you want to merely mark the surface—not cut it deeply.

One objection to such a finish, attractive though it may be, is that it will reflect a ray of sunlight for a long distance—a bad thing for any hunting arm to do. However, this chased surface may be blued, which in no way detracts from its appearance.

If you have no drill press or lathe, you can get the same results by setting the fibre rod in a breast drill which is held in any convenient position in the vise; have an assistant turn the drill rapidly, while you guide the bolt.

SMALL PARTS, such as triggers, etc., are often best polished by cross-polishing with a very narrow strip of abrasive cloth. Be sure they are held firmly in a vise, and in such a manner as not to mar, bend or otherwise damage them. This matter of holding parts during the polishing is one that must not be overlooked. Even a 45 Colt automatic slide can be so badly sprung that the arm will not function, with just a trifle too much pressure in the vise. Yet parts must be held firmly—rigidly—or they will slip and be badly marred. Shotgun receivers are often milled quite thin, and are easily bent. Where any considerable outside pressure is needed to hold parts, pieces of hardwood, scrap steel stock, old barrels, short pieces of heavy tubing, or other suitable material should be fitted inside to take the strain.

Protecting the parts from damage by the jaws of the vise is equally important. The maddest man in the world is the fellow who has spent an hour polishing a receiver, then ruined it by squeezing in the rough checked jaws of a vise. Sheet brass, copper and lead should be on hand always, and the vise jaws covered with the material that proves most suitable. Scraps of heavy leather, such as saddle skirting, are also valuable. When the work is inclined to slip against a leather protective piece, the surface of the leather may be dusted with finely powdered rosin, which will make it take hold firmly.

274

Small flat surfaced parts, such as hammers, must be polished in such a manner as will not alter their flat surfaces. The best way to do this is to hold the part in the hand and rub it back and forth on a piece of fine abrasive cloth stretched over a flat surface—a flat bar of steel, a file, strip of plate glass, or a new oilstone. For the final bright finish the abrasive cloth should be oiled, then the part may be buffed lightly with a little rouge. Most inside mechanism parts must be brought to a fit as the polishing proceeds, and this is covered in Chapter 25, under "hard fitting." After polishing, inside parts may be chased in the manner described for bolts.

Referring once more to the frequent difficulty of holding parts while polishing, I often find it advisable, for parts having a small hole for a pin or screw, to drill and tap a hole in a piece of scrap steel or brass and attach the part firmly to it with a suitable machine screw. The scrap piece can then be set up tight in the vise, or may be used as a handle while buffing the part. Very small screw heads present a difficulty that is easily overcome. In guns that have been used for any length of time, the screwheads are usually damaged by someone's misguided efforts to remove them. The heads may be smoothed up and their shape restored with a fine file, and the slot trued up either with a slitting file or a piece of hacksaw blade with the "set" ground off the sides. Holding the screw during these operations presents the difficulty. Take a piece of brass or copper about 1/8 inch thick, and drill and tap it for the screw. Turn the screw in firmly but not too tightly, and hold the scrap in the vise. This is a good way to hold any screw while working on it, but larger screws often fit the threads so loosely that they turn as you work on them. This can be prevented by cutting a slot with a hacksaw from the end of the scrap piece into the screw hole. This permits the vise to force the edges together and grip the screw firmly, without the least possibility of damaging the threads. This kink is good also where a screw shank has to be cut off very short. Turn it into a piece of brass the required distance, and grind off the end on the emery wheel—the threads will be perfect to the extreme end.

After the parts are polished, unless they are to be blued immediately, they should be protected from rust by wrapping in waxed paper and kept in a dry place. Coating them with grease is not advisable unless they must be kept for some time, as it merely increases the work of cleaning when the time comes to blue them.

275

CHAPTER 19

ENGRAVING AND ORNAMENTATION OF METAL PARTS

WHEN this book was first drafted the question of giving instructions for elementary engraving was discussed and its possibilities thoroughly investigated. After talking to a good many engravers it was decided that any attempt at engraving by the amateur or anyone not fully apprenticed in this art, would surely result disastrously. Jewelry engraving on soft metals requires several years of close application before it can be mastered, yet few jewelry engravers will attempt even the simplest job on a gun. There are few really good gun engravers in America, and these have reached a high state of perfection in their art. The man who desires engraving on barrel, receiver, guard or floor plate must make up his mind to pay the price for good work, or else do without it. In no instance should a high grade gun be entrusted to one not thoroughly familiar with the cutting of deep designs on hard, tough steel, nor one who has not a well developed sense of the artistic, as well as the mechanical ability.

Among leading engravers of fine guns may be mentioned Mr. Rudolph J. Kornbrath, of Hartford, Connecticut. Mr. Kornbrath's work is of the highest character, and quality considered, it is reasonably priced.

There is no reason why the home gunsmith may not have his gun as beautifully engraved as the finest de luxe jobs of the best makers. The barrel and action should be well polished, and sent to the engraver "in the white." Do not try to tell the engraver how to do his work—and don't tie him up with a lot of specifications that will hamper him in the exercise of his talent. If possible, send him a picture of a gun that is engraved about the way you want yours, and he will give you an estimate of the cost. Or, decide about how much money you want to spend on this decoration,

276

and tell him to give you what he can for the price.. Initials, monograms, birds, game heads, etc., can be worked out in gold, silver or platinum inlays which combined with the engraving on the steel give very beautiful effects. All these details must be taken up with the engraver himself, and you will find him ready with many helpful suggestions.

The cost of engraving may run from ten or fifteen and up to several hundred dollars. Often a simple border line or two cut around the breech and receiver, on floor plate and guard, will relieve the plainness and add many times their cost to the appearance of the arm. Do not rush the engraver—he usually has work for weeks ahead, and his kind of work cannot be hurried. Give him all the time he wants, and trust him to give you value received.

THE DANGER FROM ENGRAVING: Before you decide to have your high power rifle engraved, remember that the receiver must be annealed before the engraver can cut it. Be sure your engraver is reliable, understands his business, and has the facilities for properly hardening and heat-treating the parts after engraving. I have seen Springfield and Mauser receivers come into a shop and be blued and finished and delivered to the unsuspecting purchaser, with no pretense at heat-treatment or even case-hardening. Every gun-crank knows what that means, with modern high pressures.

When having barrel fitted to an action the receiver must be annealed, engraved and rehardened before the barrel can be fitted. Then the engraving on barrel must be done later—this means two trips to the engraver's. I believe Niedner is prepared to do a very good job of receiver hardening, and were I having a special barrel from him, would have the engraved receiver sent to him for hardening before the barrel was fitted. Mr. Kornbrath advises that he is also in a position to have receivers properly hardened after engraving, and in view of the fine work he turns out for leading manufacturers, I would not hesitate to entrust this work to him. Under no circumstances, however, should this work be entrusted to some unknown person of doubtful ability, who may do a poor job that will endanger the weapon itself and the life of its owner. A good, safe rifle should be the first consideration; beauty of finish comes afterward.

There are some gunsmiths, barrel makers and others whose bump of self esteem is highly over-developed. They will "yes" you to the limit on any question of design, construction, or finish. They know it all. Every now and then one of their jobs let loose, maiming or injuring the shooter for life. The least harmful things they do is to ruin a gun which you may prize highly, and on which you have spent considerable money. I am reminded of the time I watched the efforts of a man who stood high in his field, remodeling the bolt handle of a Mannlicher-Schoennauer. The owner didn't like the flat handle, nor did he approve its location. He wanted it length-

277

ened and bent back closer to the trigger, and provided with a knob shaped like that on the 54 Winchester. Yes, the gunmaker could give him what he wanted—in fact anything he wanted. And he should have been able to do so in this instance. The bolt handle was bent to position and fitted with a knob slightly smaller than a bantam's egg. Naturally the customer refused it, and returned the gun. On the second attempt, instead of wrapping the bolt in wet rags thus protecting it from the heat, the entire bolt was allowed to become red hot. This bothered the famous gunmaker not one bit—he would re-harden it. He did so—by heating it nearly to white heat in cyanide and dropping it into cold salt water. It came from the water in two parts—and there was not a spare Mannlicher bolt in the United States at that time. Another time I saw an attempt to harden a Springfield receiver in cyanide—the owner was a great admirer of color hardening, and the gun maker was in an obliging mood. The result was a cracked receiver—which was a mighty good thing because it taught the owner a lesson.

GRINDING DOWN RECEIVERS: I have observed that at least two shops do not hesitate to grind off the serial number and name of the armory on top of the barrel ring of the Springfield receiver. Personally I have never considered that the stamp of United States government manufacture is any disgrace on a rifle, or detracts in any way from its quality or its beauty. I cannot make myself believe that grinding off a sixteenth of an inch of steel at this point adds anything to the receiver's strength. I have noticed that some of the best imported rifles have the matting right over and around the lettering on the barrel ring, and the effect is not at all unpleasing. One knows who is responsible for the gun he is shooting, and he knows the receiver still has the same dimensions specified by its designer. While the gunmaker who has spent his life hunting the wild wahoo in the fastness of Abyssinian forests and pulling the teeth from old tough drunken republican he-elephants all over the dark continent *may think* he can grind away half of a rifle and still have it safe to shoot, I'm going to take the word of the folks who designed and built the gun in the first place. I may be a fatalist—at times—but I'm careful all the time.

AMATEUR DECORATION: The only decoration that should be attempted by the amateur—and by most professional gunsmiths also—is that of matting the top surface of sight ramp, rib, or top of receiver if it is not too hard. There are several easy ways to do this. One method I have found very successful on ramps and other soft steel parts is as follows:

Get a big rattail file—the bigger and coarser the better. I have one 14 inches long and 3/4 inch diameter which turns out a good job. After the sloping part of ramp is worked down to size on the barrel, the barrel is set horizontally in the vise. Now lay the big file across edge of ramp and with a hand on each end of file push

278

it up and down the ramp—just like rolling out biscuits with a rolling pin. The file teeth pressing into the surface of the steel make a good impression if you bear down well. Change the angle of the rolling from time to time so as not to leave an exact imprint of the tooth pattern. About five minutes of this will give you a good matted surface—not very deep, but plenty deep enough. Now bevel the edges slightly with a sharp file, to leave a clean smooth line about 1/32 inch wide.

Another way is to make a multiple stippling punch, or use a wood carver's marker, which is the same thing, and hold it above the surface to be matted, lightly tapping it with a small hammer, while moving it about over the surface. The impression of the points will quickly cover the surface, making a very attractive job. A small sharp prick punch makes an even more attractive surface, but the single point slows up the job to a half hour or more. Hold the point of punch just above the surface, and keep up a light tapping with the hammer or piece of hard wood, constantly moving the punch about. The edge may be slightly beveled if desired, to give a good finish.

The workman who is provided with the dental engine described and illustrated in Chapter 4 is as well equipped for matting as he can ever hope to be—this device is the peer of them all. In addition to having rotary motion in the head for small grinding wheels, it may be adjusted to give a hammer motion at the point—similar to the big pneumatic riveters—and striking hundreds of blows per minute. With a small sharp punch in the head the device may be used like a pen or pencil, and the finest sort of matting job done in a very few minutes. Keep moving the point rapidly over the surface until no bare spots remain—the machine does its own hammering as it goes. The matting thus produced is even better than the prick punch method—deeper and more even, so that it fairly glistens. It is so sharp that it may be advisable to smooth the surface slightly with fine emery cloth before bluing.

Using a very sharp well hardened punch in this tool, one may mat the top of a Springfield receiver if not extremely hard. It may be necessary to grind and harden the point several times, but this device will do the work. Most other receivers may be matted without difficulty or damage to the point.

Now for the last and easiest way of all. If you are located in the city and have electric lights you will need a 6 volt transformer costing $3.50; if out in the sticks, get half a dozen dry cell batteries, or use the battery in the family flivver. What you're after is six volts at 75 amperes—makes no difference how you get it, so you do it honestly. The Akr-O-Graph pen is a little gadget about the size of a fountain pen, with a piece of copper wire for a point. A wire from this connects with one side of the transformer. A wire from the other side is grounded anywhere on the metal of the gun.

279

The instant the point is touched to the surface of the steel a tiny arc is formed—sparks fly—and there's a dot on the surface, burned in with the heat of the arc. The Ark-O-Graph doesn't know the difference between hard and soft steels. You can write your name on files or other hard tools with it, and by moving the point rapidly over any metal surface it is matted quickly and without fuss. The dots are not so deep as they might be, but they're there to stay—burned right into the steel. The D. C. M. Sporters now come from the armory with the serial number written on the bolt—with an Ark-O-Graph. The device is sold direct from the factory, Ark-O-Graph Pen Company, 1171 E. Stark St., Portland, Ore., and costs $3.50.

I wish somebody would bring out an Ark-O-Graph with a hot enough spark to do very small electric welding—what a handy thing it would be on sight work, for welding ramps to barrels, etc., etc., etc. And I wish somebody would rig up an electric pryographic needle, with a coil inside that would heat the point white-hot. When not dolling up stocks for the fellow who hasn't much money to spend, I'd use it for brazing, maybe. At least I'd try it.

280

CHAPTER 20

BLUING, BROWNING, AND COLORING METALS

THE bluing or browning process is one of the most intriguing subjects in the realm of gunsmithing, either amateur or professional. It is a subject on which the large arms companies have spent many thousands of dollars. Moreover, it is a subject that many otherwise excellent gunsmiths have never fully mastered, while others have become highly proficient. Both the factories and the gunsmiths, having found one method giving fairly satisfactory results, usually settle down to that method, and refuse to attempt any other.

This is not the ideal attitude to take, however, by any means; for experience has taught that certain parts of an arm are best finished by one method, others by a different process. Moreover, different steels react differently to treatment, so that a process perfectly adapted to one barrel or receiver, may not be so successful on another.

Some shooters have the belief, largely erroneous, that bluing or browning is intended and serves as a protection against rust. The fact is, that most finishes are themselves the result of rust or oxidation in one form or another, and offer very little protection against further rust. The only finish that affords rust protection is a plating with a non-rusting metal—of which more will be said later.

The real purpose of bluing or browning is to impart to the gun a dark color which will not glitter in the sun, and at the same time give it the appearance which we have come to associate with guns through long usage.

The old time gunsmith back in the woods "browned" his barrels by rusting them with a solution of aqua fortis, cider vinegar, or what have you. His barrels were of soft iron, and of course the original finish quickly wore off; but hard usage in all kinds of weather, with

281

perhaps not too much care as to condition of the finish, kept the outside always somewhat rusted, while the wear of handling kept the rust off, but left a dark brown color that answered the purpose.

When a factory settles on some one method of finishing, they get busy and develop that finish to a high degree. Often the finishing is in charge of one workman, who, likely as not, keeps the process largely to himself in order to have things his own way. Then if he dies, or is proselyted by a competitive organization, it is necessary to do a lot of experimental work involving considerable cost to develop a new and satisfactory finish or even to keep the old one up to standard.

It is remarkable how "sot in their ways" some gunsmiths get to be—especially in the matter of bluing and browning. There is an old timer in my town who cannot be persuaded to tackle a bluing job in summer; but take him the gun in winter and he'll "do it up brown"—literally. He uses an oldtime cold rusting process (which he guards most jealously,) and he doesn't have good luck with it in warm weather—or thinks he doesn't. Probably he is able to maintain a more uniform humidity when using artificial heat. Anyhow, he is superstitiously afraid to change his process, which he maintains is the only one in existence worth a hoot.

Bluing and browning methods may be classified under four general heads, as (1) Chemical solutions, either hot or cold, which cause surface oxidation and consequent coloration; (2) Chemical solutions which change the surface of the iron or steel into a different substance; (3) Heat, or combination heat and chemical processes causing surface oxidation and coloration; and (4) Plating.

Numbers 1 and 3, being of greatest interest to the trade, will receive most attention in this chapter. It will be necessary, however, to mention another process that belongs in the second class mentioned, namely, Parkerizing. Springfield service rifles are now finished by this method, which is highly rust resisting, and which is also used on typewriters, adding machines, telephones, outdoor hardware, ornamental ironwork, and many other items.

Parkerizing, briefly described, consists of boiling the parts to be finished in a solution of "Parko Powder," composed of specially prepared powdered iron and phosphoric acid. In the process, minute particles of the gun or other object being treated, are dissolved from the surface and replaced by insoluble phosphates which are rustproof. This results in a slight etching of the surface, giving a dull, non-reflection finish, which, while less attractive than bluing is far more practical from a military standpoint. It is possible, moreover, by afterward buffing the surface with various oils, to produce a soft gloss that is quite attractive. With a little further development it seems that some arms factory might bring Parkerizing up to the standard of appearance demanded by shooters, and the rustproof qualities of such a finish would be highly desirable.

282

Parkerizing is a patented process; the materials are sold by the Parker Rust Proof Company, Detroit, Michigan, to licensees who are required to pay a very nominal sum for the right to use it. A somewhat similar process involving the use of a commercial product known as Hydrogen Acid R & H No. 1, and powdered iron is offered by the Roessler & Hasslacher Chemical Company, New York City. The treatment of parts being finished is about the same as in Parkerizing. Both of these processes will require from one-half to three hours, according to size of the work, and both are one-operation processes.

Plating, in my opinion, offers possibilities that the firearms industry might develop with advantage to itself. While the nickel plated "bull-dog" revolver does not enjoy its old time popularity even among the town boys who bought their guns from the mail order house, yet modern electro-plating would be well worth while on many guns. "Black Nickel" is something that only a few master platers know anything about; nevertheless, I recently inspected a fancy Browning automatic shotgun that I would swear was black nickel plated from stem to stern; the color is distinctive—a rich, deep brown-black—and can scarcely be mistaken by one who has ever seen it. And it is absolutely and permanently *rust proof*. The danger to its permanence lies in the fact that some platers have never learned to make nickel "stay put" on steel; unless done right, it will eventually peel off like tinfoil. The best practice is to first plate the job with copper, then the nickel, deposited over the copper, will seldom if ever come off. Nickel has but slight affinity for steel; but its affinity for copper is high.

I have had small pocket guns, derringers, etc., plated with copper which was then treated with an ammonia solution to oxidize the copper and turn it black. The color is not particularly good, however, although the gun will not rust in a sweaty pocket, which was the end sought. I even knew a chap who, noting the tarnishing effect of his morning egg on the family silverware, went so far as to have his gun silver plated, then oxidized it with the contents of an egg previously prepared by letting it stand in the sun for a few days! And it was a pretty fair job of bluing at that—and rust proof.

In Amateur Gunsmithing, Colonel Whelen suggests a practical method of using the oxidized copper method, briefly described as follows: "With the bore of barrel tightly plugged, and outer surfaces cleaned, support the barrel in a horizontal position, and splash on a solution of 1 dram blue vitriol (copper sulphate) in 12 ounces distilled water. Apply the solution with clean soft bristle brush, or mop of clean cotton cloth. A coating of copper will be deposited on the barrel. Then, in the same manner, apply a solution of ammonium disulphide, which turns the copper coating black. Flush off with clean warm water, and dry lightly with clean rags."

283

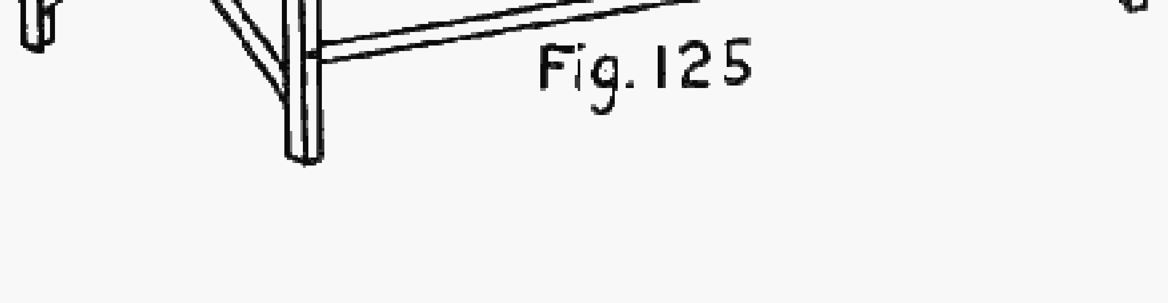


Fig. 125

The method described is good for a quick temporary treatment; but the coating produced is very thin, and does not wear well; moreover, oil is somewhat destructive to it, which makes it a poor finish for a gun.

Further consideration of plating methods need not be considered here. The plater has and requires equipment not needed by the gunsmith, and costing more than most shops would be justified in investing. If any plating method is selected, it will be found desirable to arrange with a first class plater to do the work on contract, and to allow him to use his own processes with which he is familiar.

BLUING EQUIPMENT: Before going into the solution and heat methods of bluing and browning, we must give a thought to the equipment needed. Fortunately it is simple and inexpensive, yet some equipment is necessary regardless of the process employed.

The first requisite is a sheet iron tank at least 40 inches long, 5 inches wide, by 6 inches deep. 42 or even 44 inches will be a better length—you can't tell when you're going to want to reblue a long barrel and action, and a tank a little too long is better than one a little too short! This tank is essential whether you use a cold rusting or a hot solution process, for you must be able to boil the barrel and make it chemically clean—absolutely free from any suggestion of grease.

Provide a three burner, or better still, a four burner gas plate or heater; shops located where fuel gas is not available can use a good oil or gasoline cook stove or plate to advantage; better yet, the Coleman Lamp Company, the Sunshine Lamp Company, the American Gas Machine Company, and others, supply gasoline-gas burners separately on order. These may be bought at small cost and three or four of them fitted in line into a light frame of angle iron riveted or spot welded together. The fuel supply is kept outside the building, in a 3 or 5-gallon tank with hand pump for pressure, and is carried into the shop through a hollow copper tubing.

284

Shops doing much bluing will find it desirable to arrange two sets of burners, and at least two tanks—one for use with a strong alkali cleaning solution, and one containing clean water for rinsing. If a hot solution is to be used for bluing, a third tank may well be added, standing it between the two sets of burners. In use, the barrel and action is first boiled in the alkali cleaning solution; then immediately dropped into clean warm water to remove the alkali; then into the third tank, in which the water is boiling and the solution ready for use, as described later. See Figure 125.

Fig. 126

But, for the man with a home workshop, or the small gunsmith doing only a few bluing jobs per year, a single tank will answer nicely. Figure 126 shows a simple and inexpensive outfit within reach of any crank. The tank should be of heavy black iron—not tin or galvanized—and any tin or sheet metal works will make a good one at small cost. Or, make it yourself by folding back the corners of a piece of metal, and putting a rivet near the top edge. The other essentials are: a can or two of household lye; a quantity of fine steel wool; several pairs of white *cotton* gloves; a few clean rags of *cotton or linen;* a small scrubbing brush with long handle; some powdered pumice stone; small iron wire bristled scratch brush; and every one of these items may be purchased at the five-and-ten-cent store except the rags, which you will probably steal, if you're onto your job.

285

Before starting the job be sure your rags and cotton gloves have been through the wash, and never touch the work unless you have the gloves on. They are more important to you than rubber gloves to the surgeon! Also, wear a clean cotton shirt and apron, and keep your shirt sleeves rolled down. One touch of the work on woolen cloth or the bare skin, and you can stop the job and begin over again!

CLEANING THE WORK: Assuming you are preparing to blue a Springfield, Krag, Russian, or other rifle barrel and action; the action will be *completely* dismounted, all parts polished as described in chapter under Polishing, and grease removed by scrubbing with gasoline, then dried. Coat the inside of bore *lightly* with a heavy gun grease—just a thin coat. Make plugs for both ends of the barrel from soft white pine boiled in lye water; or cut the plugs from birch dowel rods, which should also be boiled and thoroughly dried. Leave them long enough to use in handling the barrel, and drive them in snugly, but not too tightly. Sometimes the muzzle plug swells and sticks and breaks off short, requiring considerable blasphemy to get it out.

Fill the tank two-thirds full of water (hard or soft—makes no difference), and bring to a boil; then add about 1 heaping tablespoon of lye to each gallon of water. When dissolved (and not before) put the barrel and all the loose parts into the solution. A couple of pieces of heavy iron wire may be bent into U-shape, with hooks on ends and suspended inside the tank; the barrel will rest on these instead of on the bottom, making it easy to lift it out with wire hooks.

Boil all parts from five to fifteen minutes, or until there is not a trace of grease on them. Lift up one end of the barrel occasionally and note if the surface remains wet, or if the water puddles off. This is the true test of whether or not it is grease-free. So long as the water puddles up and runs off the surface, it is greasy and will not blue by any treatment. If it seems impossible to get it clean, lift it out and quickly scour it from one end to another with a wet rag dipped into powdered pumice. A solution of strong soapsuds along with it may help also. Throw a little more lye into the tank, put the barrel back, and boil again. In lifting it out to test, don't keep it out of the water more than a second or two, or it will start to rust in spots and streaks. Just lift it quickly and see if it's wet or dry. If there is grease present, the water runs off instantly.

A long handled scrubbing brush may be used to scrub the parts lightly while in the tank, hastening the removal of the grease. If you failed to remove all surplus grease with gasoline, and much forms on the water, a second cleaning may be necessary.

The whole success or failure of the job depends on this first cleaning, so do it right. Nothing short of absolute chemical cleanliness will answer.

286

When you are sure the barrel and all small parts are clean, boil them for a moment in clean water only, then rinse thoroughly in a second warm water, and you are ready to proceed with the bluing.

Use great care when removing the parts from the lye solution. As they dry they will rust almost instantly—a yellowish rust which causes spots that the bluing will not hide. This is why a second tank is desirable—you can get them right out of the lye into the hot rinse water before this rust can occur.

If using a hot bluing solution, proceed with the work at once, without drying the parts. If using a cold rusting process, dry them carefully and quickly with absolutely clean cotton cloths that have been washed and boiled. Otherwise, rust may start while cooling and spoil the job.

HOT BLUING SOLUTIONS: A solution which, when applied to a warmed or heated barrel, will produce the desired color within an hour is not difficult to prepare, nor are such solutions new to the gunmaker's trade. Some English gunsmiths have used such solutions for years, and several formulas are known in this country. The Hoffman Arms Company used one of these solutions, and sold many bottles of it to gunsmiths and amateurs, who used it, in most cases, with very good results. Griffin & Howe state that they use a similar solution, which they call Old English Gun Bluer on hurry up jobs in their shop, but use a slower process where time permits. This solution is also for sale on the market. Mr. Fecker, known to target shooters for the excellence of his rifle telescopes, also markets a similar solution made on a formula supplied by Mr. James V. Howe.

I have used both the Hoffman and the Fecker solutions; I have seen the Old English Bluer used in another shop; and from this experience, as well as having seen Hoffman solution used in the Hoffman shop, will say that all are good, and, in my opinion as good as an all round, easy-to-use solution can be made. They have the disadvantage, however, of falling down on the job at most unexpected times, and for no apparent reason. When this occurs the barrel under process takes on a brownish tint instead of a blue-black; it shows streaks where the bluing was applied, and these streaks are not eradicated by subsequent applications. They usually occur early in the process, and if a first class job is expected, it is best to repolish the barrel and start the job over again. They possess another disadvantage in that they require the use of soft water, often impossible to obtain, particularly in the city.

In addition to the three solutions referred to there are a number of Toms, Dicks and Harrys running ads offering to send you a bluing solution formula for four-bits, a buck, or what have you. Save your money! Public libraries are full of old recipe books that tell you how to make everything from mustard plasters and ringbone remedies to near-Scotch. Get hold of such a book and you can

287

start peddling antiquated and obsolete formulas too—and can keep it up just as long as you can find a sucker.

The whole trouble, as I see it, with ready prepared solutions is that they have been worked out to apply to conditions in one particular shop, and usually on one variety of steel. I can scarcely take credit for originating the formula for the solution I have come to use and depend on; it has been developed, largely by cut and try methods, from older formulas, changing ingredients as seemed necessary, for the work in hand. And be it understood that this is not offered as an all-purpose solution; it is a basic mixture which, in my hands, gives perfect results on all government Springfield barrels and actions; and, with certain modifications which I shall describe gives equally good results on almost any steel or iron. For convenience in reference, formulas given will be numbered consecutively.

No. 1. HOT BLUING—BASIC SOLUTION:

1/4 oz. Sodium Nitrate
1/4 oz. Potassium Nitrate
1/4 oz. Bichloride Mercury
1/4 oz. Potassium Chlorate
10 oz. Distilled Water
1/2 oz. Spirits Nitre

The first four ingredients are powders. Mix them dry in a clean, wide-mouthed glass jar. Heat the water good and warm, but not boiling, and pour in slowly, stirring with a glass rod or tube, stirring continually until almost, but not quite cool; then add the Spirits Nitre, which will precipitate a light brownish powder. Pour immediately into a dark brown glass bottle with glass stopper and keep in a dark place. Shake the bottle before using, to mix up the precipitate.

VARIATIONS OF ABOVE SOLUTION:

On most case-hardened parts—receivers, lock plates, hammers, etc., add 20 to 40 grains more potassium nitrate, and an equal amount of potassium chlorate.

For .45-70 Springfield barrels, most .22 caliber barrels, and all old soft steel barrels, use only 1/4 oz. spirits nitre in above solution, and use 14 oz. distilled water instead of 10.

For Stainless Steel, Boehler Antinit and Poldi Anticoro, use solution with the addition of 1/2 oz. Tincture Ferric Chloride, 1/4 oz. Nitric Acid, and 1/4 oz. Hydrochloric Acid. Bluing these steels is a tough job, because bluing is a rusting process, and these steels are highly rust resisting. From thirty to forty applications are often necessary.

Other slight variations of this formula may be worked out for special jobs, but the foregoing have met my requirement to date.

No. 2. ETCHING SOLUTION:

Nitric Acid .... 1/2 oz.
Distilled Water .... 6 1/2 oz.

288

When bluing Stainless, Antinit or Anticoro steel, use "Spencer Acid" obtainable from jewelry supply houses or chemists instead of this etching solution. In case this cannot be obtained readily mix up:

SPENCER ACID

Mix
Silver Nitrate .... 1/2 oz.
Distilled Water .... 13 1/2 oz.
Then add
Mercurous Nitrate .... 1/2 oz.
Then
Nitric Acid .... 6 1/2 oz.

Put in brown bottle. Keeps well but light spoils it.

BLUING BY THE HOT SOLUTION PROCESS: Clean the work as previously described, and as quickly as possible thereafter, put into a tank of clean hot water. Shake up the bluing solution (No. 1, or one of the variations thereof) and pour an ounce or two of the mixture into a four ounce glass jar, such as a mayonnaise jar. *Be sure this jar is absolutely clean and free from grease.* Twist a piece of baling wire around jar and hang it in corner of bluing tank, so that it is down in the water. Cut a 6 inch length of clean dowel rod and slot the end for an inch with a hacksaw, and into this force five or six thicknesses of sterile gauze bandage. This makes the best kind of swab for applying the solution. Avoid the use of a thick wad of rags, or a pine swab-stick containing rosin.

Now bring the water in the tank to boiling point and let boil for several minutes. *WEAR CLEAN COTTON GLOVES ALL THE TIME,* and avoid touching them to anything that might be greasy. Remove the gloves if necessary to adjust burners or to handle anything but the parts you are bluing.

When barrel (or other parts) are thoroughly heated in the boiling water, lift out with iron wire hooks, and coat quickly with No. 2 Etching Solution, using a tuft of clean rag. Work very quickly, splashing on plenty of this solution, and try to cover the entire surface at a stroke or two. Keep going over it, both barrel and receiver, and keep the whole surface wet. In a very few seconds the steel will take on a slightly frosted silvery appearance. If inspection shows this to be uneven, coat the spots again and hold a few seconds. Otherwise, plunge instantly back into the tank and reheat for five minutes.

FROM THIS POINT ON THE WATER IN THE TANK MUST BE KEPT AT A HARD, ROLLING, BUBBLING BOIL—NOTHING ELSE WILL DO.

When the barrel is as hot as boiling water can make it, lift out and coat quickly with No. 1 solution. Press the solution out of the swab against mouth of jar, and *work as fast as you are capable of moving*—or a little faster. The barrel should be so hot that the solution dries off as fast as applied, leaving a slight bluish gray coating. And it must "take" all over the barrel and action. If

289

spots are not affected by at least the third coat, it means the steel was not properly cleaned and etched, and the job is hopeless.

If the first coating is red rust, the solution is not right for the steel. Try diluting it with a spoonful or two of distilled water, or try one of the variations previously mentioned.

The barrel should be quite dry from its own heat within two or three seconds from the time the solution is applied. If it dries slowly, blow on it. The instant it is dry, put it back into the water and boil for a minute or two.

Now you can be more deliberate. Lift it out of the water, stand one end on a stool, bench or other convenient support, holding the upper end by the plug with the left hand. Take a handful of steel wool and scour entire surface with long, light, even strokes. Use just enough pressure to remove *all* the rust that has formed, clear to the naked steel—but don't rub off the slight color that has started. Use the wire scratch-brush to get into crevices in receiver, etc., and around front sight base. Use the brush briskly, but with light pressure. Any of the rust that is left on is likely to result in brown or uneven streaks and spots in the finished job, so get it all off.

Now put the barrel back in the water and let boil for several minutes; then apply the solution again just as before. Work "fast and furious" when applying solution, but take your time if you like when rubbing off the rust. No harm is done by leaving the parts to boil for several minutes after solution has been applied, hence, you may blue all the parts at one time by coating them all one after another, and rubbing them off in the same order. Each small part should have a short length of wire attached so that it may be lifted out of the water when wanted.

In most cases from three to five applications and subsequent rubbings are sufficient for a first class job. Ten or twelve may be necessary, particularly on hard or very thin parts.

The secret of bluing small parts is to work almost on the surface of the water, coating them with the solution the instant they are lifted, and before they have started to cool. Also, keep the swab in the hot solution until the very instant of applying.

When the color rubs off, it usually means the parts were not hot enough. With small parts I sometimes apply solution three or four times, putting them back in the water a moment to re-heat, and not rubbing off the rust each time. This is often necessary on floor plates,—and a floor plate is the hardest thing I know of to blue. Next in order of plain cussedness comes a trigger-guard.

Bear this in mind—unless the solution dries from the heat of the part almost the instant it is applied, the job will not be right. Get that solution on *quickly*.

When several applications have brought out a rich blue-black color as dark as it will apparently become, give it a couple more

290

shots for luck, rubbing them down with a clean cotton rag instead of the steel wool, using the brush only where necessary—inside cuts, matted or engraved surfaces, etc., and using it *lightly*. Then put the parts back and boil them for five minutes or so to kill all further rusting.

If you have a motor or grinder it is well now to buff *very lightly* with a soft iron (not brass) wire buffer. This burnishes the surface and seems to deepen the color. If you have no buffer, burnish with steel wool that is well worn, rubbing lightly with long strokes. Then while parts are still very hot, apply plenty of boiled linseed oil with brush or rag. Let stand until nearly cool, when the oil will show a tendency to start gumming. Wipe it off carefully, and oil with any thin light gun oil. Remove the barrel plugs, wipe out bore, and the gun is ready to assemble.

All this is a lot simpler than it sounds. The job should take from an hour to an hour and a half. Some claim to do it in twenty to thirty minutes, but I can't.

I have never seen the etching solution recommended in connection with a bluing solution, but I am a firm believer in it. Often it will give a fine blue-black which would otherwise come out chocolate brown. I am convinced that failure with ready made solutions is often due to extremely high polishing of the surface, resulting in filling up the pores so that the solution cannot take hold. The No. 2 etching solution does not pit the surface, but merely cleans out and opens the pores, resulting in a fine velvety finish, far more practical than the high polish sought by some. The after burnishing with steel wool or buffer gives all the polish needed, and if a matte surface is desired, this may be omitted. If it is omitted, the resulting finish will be almost identical with that formerly seen on Savage '99 model receivers and Savage auto pistols.

No. 3. ETCHING SOLUTION:

Nitric Acid	½ oz.
Distilled Water	3½ oz.

Use this solution for pitting the surface of leaf sights, etc., where a very dull finish is desired. Such parts may afterward be blued by any of the methods described in this chapter.

No. 4. PICKLING SOLUTION:

Sulphuric Acid	½ oz.
Distilled Water	4½ oz.

Flush this on the surface of an old gun with finish partly worn off and it will remove every bit of the finish, leaving the steel bright. Then flush off with plenty of clean boiling water. This avoids much needless scouring to remove old finish—only polishing is necessary unless there are deep nicks and scratches which must be filed and polished out.

291

No. 5. ZISCHANG BROWNING SOLUTION:

This is published through courtesy of Mr. James V. Howe. I have tried it on old guns with soft steel or iron barrels and with excellent results. The color is a deep brownish black with an attractive translucent appearance, and very durable.

Muriatic Acid	16 oz.
Nitric Acid	20 oz.

Mix the acids in a glazed stone jar, *out of doors*. Let the mixture cool—it gets "hotter'n holl" for a few minutes—then put in 4 ounces of common wire nails. Keep away from the thick brown vapor that arises, or wear a gas-mask if you must watch it. In half an hour the nails will be completely dissolved. Then add 240 ounces distilled water, and bottle in brown or blue glass. A fourth of the above quantities will give you all the solution you will need for some time to come.

Instructions for Use

Clean barrel as previously described, and after final boiling in clean water, dry and cool. Apply solution lightly with clean swab, and let barrel stand in cool damp place for 12 hours, when a heavy coat of rust will be formed. Scour off with steel wool and scratch brush; boil in clean water for five minutes, dry, cool, and re-coat with solution. Repeat every twelve hours for 10 days. After final scouring, boil, dry, and oil with linseed oil, followed by light oil after cooling.

No. 6. COLD BROWNING SOLUTION: This is the solution recommended by Col. Townsend Whelen in Amateur Gunsmithing, and has been used by hundreds of gun-cranks and professionals with excellent results:

Tincture Ferric Chloride (U. S. P.)	1 oz.
Alcohol (95% by volume)	1 oz.
Bichloride of Mercury	¼ oz.
Nitric Acid (sp. gr. 1.40)	¼ oz.
Copper Sulphate	¼ oz.
Distilled Water	1 qt.

This should be made up a few days prior to use, and kept in brown glass bottle with glass stopper. (Any large drug or chemical supply house accumulates many 8 ounce brown glass acid bottles with ground glass stoppers lapped to a perfect fit. They may be bought for a few cents each, and nothing better will be found for the purpose.)

This solution is used in the same manner as the Zischang solution, except that Col. Whelen says nothing about boiling the barrel after rubbing off each coat of rust. I find it desirable, though not absolutely necessary, to do this, as each boiling kills all chemical action of the previous coating, and gives the next application of solution a fresh start. This tends to eliminate any tendency toward spots or streaks.

292

No. 7. COLD BROWNING SOLUTION: According to Captain E. C. Crossman, who certainly should be in a position to know what's what in the gun factories, the following solution has long been standard in the Savage plant:

Spirits of Wine	4½ oz.
Tincture of Iron	1½ oz.
Corrosive Sublimate	1½ oz.
Spirits of Nitre	1½ oz.
Copper Sulphate	1 oz.
Nitric Acid	¾ oz.

Dissolve the solids in one quart of pure water, then add the spirits of wine, tincture of iron, nitric acid, and spirits of nitre.

This solution is applied to barrels as already described, but most large factories hasten and improve the job by the use of a steam room or cabinet. This is merely a small room or large cabinet made air tight and provided with racks where the barrels may be arranged without touching, and treated with live steam for three to six hours. The rust coat is scoured off, and treatment repeated—three rustings being the usual rule in most factories. Crossman also describes the following formula used by the United States government:

No. 8. COLD BROWNING SOLUTION:

Tincture of Iron	8 oz.
Sweet Spirits Nitre	6 oz.
Nitric Acid	1 oz.
Corrosive Sublimate	1 oz.
Copper Sulphate	½ oz.
Distilled Water	2 qts.

Mix in the order given, and apply like the other solutions. Barrels are kept in steam room for 24 hours after first application; then scoured, after first being boiled in water; then coated again and placed in steam room for 3 hours; boiled again, scoured off, re-coated, steamed for 3 hours more, boiled, scoured, and oiled.

No. 9. COLD BROWNING SOLUTION: This is another U. S. government formula given in "United States Rifles and Machine Guns" by Colvin and Viall. This is a most interesting and valuable book to all rifle cranks, by the way. It costs but three dollars, and is worth three hundred. I am under the impression that it was prepared as a manufacturing guide to the production of our service arms, during the emergency when contracts with private manufacturers were contemplated. The formula follows:

First, prepare a "tincture of steel" by putting 3 pounds of carbonate of iron in a stone jar and adding 3 quarts muriatic acid; stir until the acid has dissolved all the iron it will take up, then pour off carefully, into glass demijohn, being careful to keep out the sediment, and add 9 quarts grain alcohol. Then—

Tincture of Steel	4	oz.
Spirits of Nitre	4	oz.
Nitric Acid	1	oz.
Copper Sulphate	½	oz.
Corrosive Sublimate	1	oz.
Soft Water	2	qts

293

The process is similar to that used with Solution No. 8, except that each coating is steamed for only 1 hour, there being three coatings in all. Each coating of rust is boiled for five minutes before carding off.

From the foregoing it is evident that there are quite a number of solutions, both home-made and of the "store" variety, any of which will, with proper persuasion, blue a gun. I have in addition about a dozen other formulas that I have never tried, simply because I don't need them, and as they are somewhat obsolete would expect no better results from their use. I personally do not care much for the slow rusting processes which are applied cold. They require the same equipment (tank for boiling) as the quicker hot solutions, and their use entails considerably more work and time. And of all the methods I have used for barrels and receivers, the No. 1 Solution gives, in my hands, the best results.

The various heat processes are somewhat more difficult to handle, especially in unskilled hands, but are, nevertheless more desirable for revolvers and pistols, as well as for many small parts which are not tempered, case-hardened or heat treated. Obviously such parts would be ruined by bluing methods calling for high heats, and must therefore be finished by one of the solution methods.

No. 10. NITRE BLUING: This is one of the best known bluing methods, having been described in gunsmithing articles in several magazines during the past few years. Different operators vary the proportions somewhat, but the usual formula is:

Sodium Nitrate	10 pounds
Potassium Nitrate	10 pounds
Manganese Dioxide	1 to 2 pounds

Some shops eliminate the sodium nitrate and double the quantity of potassium nitrate. Others reduce the quantity of manganese dioxide.

The nitrates should be melted in a castiron pot or kettle, and the black oxide added after they are melted. For small parts a pot such as is used for melting bullet metal is satisfactory. For large parts, revolvers, etc., have a castiron box made at the nearest foundry, about 5 by 8 inches by 4 inches deep—or larger if necessary. A wooden box of the right size, with sides slightly tapered for "draw" will serve as the pattern.

Set the pot or iron box on a large gas burner or a plumber's gasoline blast furnace, and put in the nitrates. Add more as they melt down until the box is nearly full. When melted, add the black oxide, and heat the mixture to a point where it will just ignite sawdust or a thin pine splinter.

Parts to be blued should have a much higher polish than is required for solution bluing. Buffing does not hurt them in the least—the higher the polish, the better the color to be obtained by this method. Attach them to iron wires or hang them on hooks in

294

the mixture for about three minutes, after cleaning by boiling in lye and rinsing in boiling water. Lift out at the end of three minutes and inspect color. The first blue will be a bright tempering color—pay no attention to this, but put the parts back. In four to eight minutes a deep rich blue should appear, and this should be even over the entire surface. If not, put them back for a minute or so longer. When color is right, quench quickly in good hot (but not boiling) water. Then oil with heavy bodied gun oil, or use linseed at first and lighter oil when parts are nearly cool.

Sometimes the job is improved by a second heating in the nitre bath after the first water quenching. At other times the second treatment seems to have no effect. Be sure there is no oil or water on the parts when putting them in. Oil will burn and cause ugly spots, while water will cause the nitre to pop and sputter over your face and hands, causing nasty burns.

One of the most beautiful and lasting finishes I have been able to obtain, is done as follows:

Blue parts in nitre as just described; after quenching, and without oiling or touching, bring the water to a hard boil, and re-blue with No. 1 Solution. The rust coating that forms will be very light and soft, and is easily rubbed off with a rag. Three or four quick applications only are needed, after which the parts are boiled and then oiled. The finish produced is deep and brilliant, and for beauty is not surpassed by Winchester's best barrel finish. Parts that are already nitre blued may be greatly improved by this treatment—using the solution right over the original bluing, after boiling off the oil and grease.

No. 11A. CHARCOAL BLUING: An old English gunmaker gave me the following, which I have seen him use to produce very fine work, although I have never used it myself:

Make a box of heavy sheet iron large enough to hold the largest part to be blued. It is not necessary to rivet or weld the box—merely fold the corners. Fill it with pulverized wood charcoal in lumps about the size of a small pea, and heat in furnace or large forge until the charcoal is partly burning throughout, but not quite redhot. Attach an iron rod at least two feet long to the gun, and bury it in the glowing mass, allowing the rod to stick out for handling. In 5 to 10 minutes, lift out and examine it. If the color has started, take a large wad of clean cotton waste or tow, dip it into dry powdered lime and rub vigorously over every part of the gun. Get it back into the glowing charcoal as quickly as possible. Repeat this treatment every 7 to 10 minutes, using plenty of lime and rubbing it into every part and *work fast*. You may be fooled at the first bright blue that appears. This is merely a "tempering color" and must be disregarded. It will not wear, and it is not the blue you are after. Continue the treatment until a deep blue-black similar to that seen on Colt revolvers has developed. Let

295

cool in the air (do not quench) then apply any good light gun oil.

The process may be repeated a second time if desired, usually deepening the color. The parts must of course be cleaned of all grease, just as for any other bluing process. Many gunsmiths do this by applying a mixture of chalk and water, letting it dry on the gun, then brushing it off.

A variation of this method was at one time used by Smith & Wesson, except that the gun was rubbed with oily waste instead of lime. Either method requires considerable skill and experience, but the results fully justify the effort.

No. 11B. HEAT AND OIL BLUING: This method is my stand-by for small parts such as screws, sights, pins, swivels, barrel bands, sling loops, buttplates, etc., where the article is of such size and importance as not to warrant heating up the nitre box. Mix up:

Linseed Oil (boiled or raw)	6 oz.
Marble's Nitro-Solvent Oil	2 oz.

Keep this oil in a wide mouthed jar or can with screw or friction top, and it is always ready for instant use. Parts may be held on a stiff wire, or in a pair of tongs or pliers. Heat the parts in a gas flame to a dull red (below cherry red); hold at this heat for a minute or so, then quench in the oil mixture; lift out for a second or so before quite cool, and re-dip immediately. Keep the parts moving in the oil. This is the best method I know of for small or thin parts that are hard to blue with a solution, and the results on small parts are fully equal to original factory finish in appearance and wearing qualities. There will be no scale formation at the heat used in this process.

LAMPING. Slight alterations may result in bright spots where a little filing or polishing was necessary, and these spots can be reblued in most instances without refinishing the entire gun. Holster-worn spots on a pistol barrel; a shiny muzzle resulting from fitting a front sight band; these are subjects for the simple heat-bluing process known as "lamping."

First rub off all oil with a clean cloth. Then etch the spot for a moment with a 1 to 13 solution of Nitric acid in water; or omit this etching if desired, although it will improve the finish. The solution should be washed off with clean water almost immediately—just as soon as it "takes hold" of the metal. Then dry with a clean cloth, and hold the spot in a gas flame or blow torch and watch the colors. Pay no attention to the tempering colors—wait until all the colors have appeared, including blue. This tempering blue will change to a lighter blue, then to the natural bright color of the steel; a moment later the metal will turn dark, almost black; remove from the flame, watch the spot for a moment; at the least sign of the natural color returning, put it back into the flame. "Tease" the metal in this way for several minutes, trying to hold

it at that heat at which it is very dark, just before red begins to appear. Then remove from the flame and rub vigorously with a handful of rags or waste lightly saturated with a mixture of 2 parts boiled linseed oil and 1 part Marble's Nitro-Solvent. At first the oil will smoke, and burn slightly. Work fast, and keep taking clean spots on the rag or waste, and continuing the rubbing until the oil stops smoking, and for a minute or two longer. The barrel will still be quite warm. Now scour the spots with a soft wire brush, or buff lightly on wire buffer until the oil spots caused by the burning oil are rubbed off and the metal burnished; then continue rubbing with the oily waste until barrel is nearly cool. Wipe off all oil, and coat with gun grease.

Spots treated in this way, while they may not match the rest of the color exactly, will greatly improve the appearance of a gun having worn or scratched places, and often the colors will match almost perfectly.

When lamping out spots in this way, you may be alarmed to see the good bluing being somewhat discolored by the heat. Rest easy—those colors on the bluing are only temporary, and the minute you start rubbing with the oily waste, they disappear.

On a gun whose finish is perfect but for one or two small spots, it will pay to use a blowtorch with a very small, pointed, hot flame, and make a mask of sheet asbestos with a hole just slightly larger than the spot.

Lamping should not of course be attempted on hardened or heat treated parts, nor on parts attached with soft solder. Brazing will not be damaged by this process.

NEW METHOD GUN BLUER. This is simply a metal lacquer colored to a purplish, bluish black, and sold at one dollar per small can for the alleged purpose of bluing guns. It will "blue" them, the same as a coat of paint blues a house—if you use blue paint. The crank will not enthuse very much over the appearance of an arm finished with New Method, but it will cover a certain amount of the scabbiness of some rusty old wreck which the owner may desire to unload upon an unwary victim who thinks he is buying a gun. One of the best things about this preparation is that it is easily washed off with a little denatured alcohol.

Having thus thoroughly damned it, I must now confess that I keep a can of New Method on hand in my shop, and find it very useful for touching up the end of a drift pin now and then, or some other tiny spot such as the edge of a sight that has become slightly marred, or something of similar nature. It is worth having around for such uses, but as a satisfactory means of finishing guns or parts, this or any other paint or lacquer is entirely out of the running. Good workmen won't use makeshift methods.

No. 12. HEAT AND WATER BLUING: Once in a while you will find a part which from sheer cussedness apparently will

not take a satisfactory finish. Usually it is some part that has been case-hardened, or one made of some unusually hard steel. Krag buttplates are particularly obstinate in this respect, and while on a butt plate is the last place in the world to worry about finish, still, it is a good idea to have the job leave your shop looking like something had been done to it. If the part is not one having a temper or heat treatment that must be preserved, just heat it a dull red as in No. 11, and dip into boiling water. Keep a burner going under the water. It's surprising how long a part will stay redhot under water! The color thus produced is a grayish blue, lighter than the oil blue, but very even, and one that no one will object to on a buttplate.

The subject of case-hardening for colors has already been discussed in another chapter, and need not be considered further here.

There are, however, times when the gunsmith will want to make some small part such as a grip cap, or perhaps even a buttplate, from some softer metal more easily worked than iron or steel. Brass, copper, bronze, aluminum, etc., may readily be finished in almost any color desired—one is not by any means confined to black or gun-blue, but may give free reign to his fancy and often produce some beautiful effects.

I have used several of the following formulas with highly satisfactory results. I give others which I have not used simply because I have not required them, but have no doubt of their efficacy as they are taken from technical works prepared for the plating and metal finishing trades, and many of them are well known to platers.

No. 13. CLEANING AND PICKLING: Almost all soft metals may be cleaned by first scrubbing with a stiff brush and pumice with water, then boiling in solution of caustic soda or potash for a few minutes. Then rinse in clean warm water and dry with clean cotton cloth, and avoid handling during coloring processes. The following is an excellent pickling solution for brass and all copper alloys:

Nitric Acid	100 parts
Salt	1 part
Common Soot	1 part

Dip the articles only a few seconds and wash immediately in clean warm water. This leaves a fine luster in the true natural color of the metal.

No. 14. DEAD PICKLE:

Potassium Bichromate (Saturated Solution)	1 part
Hydrochloric Acid	3 parts

Leave articles in this mixture for two or three hours, or longer if necessary. When the surface presents a "dead" appearance—natural color of the metal, with absolutely no gloss or lustre—wash through several waters.

No. 15. BLACKENING SOLUTION—ALUMINUM:

White Arsenic	1 oz.
Iron Sulphate	1 oz.
Hydrochloric Acid	12 oz.
Distilled Water	12 oz.

Scour the aluminum with pumice and water, then in a very weak lye solution and rinse immediately. Immerse in above solution, slightly warmed, until black. Dry in fine clean sawdust, then lacquer.

No. 16. BLACKENING BRASS:

Hydrochloric Acid	2 parts
Nitric Acid	1 part

Warm in glass bowl on a sandbath, then dissolve as much platinum foil in the mixture as it will take up. Do not let it boil. After pickling brass in Solution 13 or 14, warm it slightly and dip into the blackening solution, or paint it on with a brush. When black, remove and wash in warm water, dry in sawdust. This is the dead black finish used by manufacturers of optical instruments, and is expensive to make, due to the use of platinum. It is a most durable finish, however, and should appeal to the experimenter in sights or scopes, as the best finish for this purpose.

No. 17. BLUE-BLACK FOR BRASS:

Copper Carbonate	7 oz.
Stronger Ammonia (26 to 28% gas)	3 pints

When above ingredients are mixed a precipitate will be formed. Then add 1 quart warm water, and immerse the brass until the color comes, then wash and dry as before.

No. 18. BLACKENING BRASS:

Corrosive Sublimate	1 oz.
Vinegar	1 pint

Clean and pickle brass as before, wash, and dry. Brush the solution on and let it remain until brass is black. Wash thoroughly in clean warm water, dry, and rub in finely powdered graphite with soft brush. Lacquer if desired.

No. 19. BLACKENING BRASS:

(a)	Copper Nitrate ..	50 parts	(b)	Potassium Sulphide .	10 parts
	Water	100 parts		Hydrochloric Acid ..	5 parts
				Water	100 parts

Clean and pickle the brass as before, then immerse or paint on solution "a" with soft rag swab, rubbing it in gently, then heat over a gas flame until dry and greenish salts are formed. Then immerse in solution "b" for a few minutes, and heat again until dry and the color black. Wash in warm water, dry and lacquer.

299

No. 20. OLIVE GREEN ON BRASS:

Copper Sulphate	8 parts
Sal Ammoniac	2 parts
Water	100 parts

Suspend the brass parts in this solution and boil, leaving parts in until color is obtained. Wash thoroughly and dry in sawdust.

No. 21. BRIGHT RED FOR BRASS:

Potassium Chlorate	75 grains
Nickel Carbonate	30 grains
Salt of Nickel	75 grains
Distilled Water	10 ounces

Immerse the brass for a considerable time and watch the color. In a few hours it becomes a yellow-brown, which later changes to a brilliant fire-red. Those who advocate the use of a bright red bead on front sight may make it of brass and this solution will produce a color that will make a bull paw up the turf!

No. 22. IRIDESCENCE ON BRASS (ALSO COPPER AND NICKEL):

Lead Acetate	1 part
Sodium Hyposulphite	3 parts
Water	48 parts

Immerse articles in solution and let stand until desired effect is obtained; rinse in clean water and let dry without rubbing or touching. The colors will be beautiful, and very lasting.

No. 23. BRONZE ANTIQUE FOR BRASS:

Vinegar	1 litre
Copper Sulphate	16 grams
Sea Salt	32 grams
Sal Ammoniac	32 grams
Sanders green (mountain green)	70 grams
Ammonia	32 grams

Immerse the brass, or spread it rapidly with soft brush. The object will turn a greenish color. Remove excess liquid lightly with long bristled brush, and let dry 24 hours. Additional coatings may be applied if desired.

No. 24. BLACKENING COPPER:

Dip parts in pure nitric acid, remove, and heat to a dull red. Let cool, wash, dry, and oil or lacquer.

No. 25. BLUING COPPER:

Liver of Sulphur	1 oz.
Chlorate of Soda	1 oz.
Water	500 oz.

Immerse or paint on solution until blue color is obtained; wash, dry and lacquer.

No. 26. BROWNING AND BLACKENING COPPER:

Nitrate of Iron	5 drams
Water	1 pint

Immerse parts in solution until desired color is obtained—colors will range through all shades of brown to deep black. Remove and wash, dry in sawdust, and lacquer.

300

No. 27. BRIGHT RED FOR COPPER:

Sulphide of Antimony	2 drams
Pearlash	1 oz.
Water	1 pint

Use same as Solution No. 26.

No. 28. RED-BLACK FOR COPPER:

Sulphur	1 oz.
Pearlash	1 oz.
Water	1 pint

Use same as Solutions 26 and 27. Gives all shades of red, deepening into black.

No. 29. ROYAL COPPER:

Sulphide of Antimony	2 drams
Pearlash	1 oz.
Water	1 pint

Immerse until desired color is obtained—a very intense red.

No. 30. SILVERING COPPER:

Silver Nitrate	30 grains
Common Salt	40 grains
Cream of Tartar	7 drams

Moisten with a little water and apply with a soft cloth until the copper is plated with a light coating of silver. Wash, dry and lacquer.

No. 31. BLACKENING NICKEL:

Nickel-Ammonium Sulphate ..	24.02 grams
Potassium Sulphocyanide	35.05 grams
Copper Carbonate	56.70 grams
Water	3 litres, 785 grams

Immerse until nickel is black. Then wash, and dry. I have never used this solution, but it is highly recommended by an old experienced finisher, as giving a very rich, deep velvety black color. It is not the "black nickel" plating process in which the nickel deposited is black clear through. The plating process is still regarded as a trade secret, and I have been unable to secure any formula that I could guarantee to work. It would appear that this No. 31 solution might prove valuable for nickel plated revolvers, etc.; also, that any barrel, particularly those of stainless steel which are very hard to blue, might be nickel plated and treated with this solution. Similarly, a gun could be copper plated at small cost, and blackened with solutions 24, 25 or 26.

No. 32. BLACKENING SILVER:

Rub the object with a solution of silver nitrate until black; wash and dry. Or, dip in any alkaline sulphide solution, then brush with cream of tartar.

No. 33. BROWNING SILVER:

Dip in solution of equal parts of sal ammoniac and copper sulphate dissolved in vinegar. This gives a deep brown color. Afterward, wash and dry.

301

No. 34. OXIDIZING SILVER:

Bromine	5 grains
Potassium Bromide	120 grains
Water	10 oz.

Boil silver in this solution 2 to 5 minutes, then polish with rouge.

No. 35. BLACKENING ZINC:

Nickel Ammonium Sulphide	4 parts
Sulphuric Acid	1 part
Water	40 parts

Clean zinc by scrubbing with fine sand, pumice or emery, and immerse for a few moments in suphuric acid. Then immerse in above solution for only an instant or so, wash through several waters, and dry. This gives a very fine black color which becomes a bronze tint if burnished.

The amateur designer who has a leaning toward the artistic will find keen enjoyment in working out some new "gadget" for his gun or rifle. Perhaps it will be only a simple monogram plate inlaid in the stock; or it may take the form of a grip cap or forend tip modeled in clay or plaster, and cast in one of these soft metals. With this thought in mind I have given formulas for finishing metals not usually considered in gunsmithing—yet these are but a few of the colors that may be obtained with other formulas available.

302

Chapter 21

ANNEALING, HARDENING AND TEMPERING

TO BE able to devote but a single chapter to this all-important subject is somewhat disconcerting, and, in the light of the many volumes published in recent years, perhaps foolhardy. To really understand hardening and tempering of steel and iron an extensive study of the character of the metals, their structure, and the manufacturing processes by which they are produced is essential.

But since this book applies to the field of gunsmithing as a whole, and is not confined to any special branch of that subject, all I can hope to do is to give the reader an outline of practical methods evolved by leading authorities, and touching but lightly on the theories and formulae on which such practices are based. To encourage the most complete understanding of the technique herein explained, some discussion of fundamentals is essential.

STEEL is an alloy, composed principally of iron, with additions of Carbon, Chromium, Vanadium, Nickel, Manganese, Tungsten or other substance—any one of these, and sometimes a combination of two or more. Many steels also contain minute quantities of copper, and a small percentage of impurities, although modern steel manufacturing processes have reduced such impurities to a minimum.

Pure iron—that is, iron containing no element to change it into steel—is almost unknown commercially today. For some reason the production of pure iron is expensive, and low grade steels are used almost universally instead. The early backwoods riflemaker welded his barrels from pure iron which he or perhaps some of his neighbors mined and smelted by the most primitive methods—yet methods which resulted in iron of the finest and purest grade. Their steel was made by combining carbon with this iron in an open forge, working it in at welding heat. By this simple means they produced carbon steel of fine quality, yet varying in its carbon content by reason of the method employed.

303

Steel making is today one of the exact sciences, the proportion of carbon or other hardening element being carefully controlled to produce special material best adapted to its particular purposes. Yet no existing process has been perfected to the point of absolute, unfailing uniformity. Large plants employing quantities of steel must make laboratory tests of every batch obtained from the mill to determine its suitability and methods of treatment. When this fact is realized, it will be readily understood that no set rules can be laid down for use in every instance. Everything said in this chapter must be taken as applying in a general way, and individual experiment must govern final operations.

The piece of steel from which the gunsmith makes a spring, for example, may be somewhat different in composition and characteristics from that used in the tables herein presented; the tempering color you find it necessary to employ may vary a shade or two from that specified—and your next one may require slightly different handling from the last. And while each job thus presents its own peculiar problems, a general understanding of underling principles will facilitate their ready solution.

Our principal consideration will be carbon steels, since they are best adapted to the use of the gunowner with a basement workshop, as well as the average professional gunsmith; moreover, they are the least expensive, as well as the most readily obtained, particularly in small quantities. A list of the various tempers used in commonly known tools will prove of value; but first, we must understand the two distinct meanings of the word "temper."

To the steel maker, *temper* means the percentage of carbon the steel contains, regardless of the hardness or softness of the finished metal. But to the steel user (tool maker, machinist, etc.) temper signifies the degree of hardness he imparts to the finished article by his heat treatment.

The term *point* is used to denote carbon content, a point being one *one-hundredth* of one per cent. Thus a 100 point steel contains one per cent of carbon, 60 point steel contains 6/10 of one per cent carbon, and so on.

Razor temper, (to use the steel maker's term) or razor-steel, is about 150 point, or 1 1/2 per cent carbon. It is so easily burnt that only the most skilled worker can handle it; yet with proper treatment it will do many times the work of the best tool steel.

Saw-file temper is 137.5 point, or one and three-eighths per cent carbon. It, too, requires careful treatment, and should never be heated above a low red.

Tool temper is 125 point—one and one-fourth per cent carbon—and is adapted to machine tools and cutters of various sorts for lathes, drills and planers. In recent years, Tungsten self-hardening steels are gradually replacing carbon steels for machine tool operations.

Spindle temper is 112.5 point, or one and one-eighth per cent

304

carbon. It is used for large turning tools, circular cutters, screw thread dies, etc.

Chisel temper is 100 point—one per cent carbon. For tools requiring a hard cutting edge, with great body strength and ability to withstand shocks, it is ideal. Properly tempered it is excellent for hammers and triggers, and other gun parts subject to considerable wear and strain, although harder than really necessary for such work.

Set temper is 87.5 point, or 7/8 of one per cent carbon. It is really better for most gun parts than the harder grades. Its strength is indicated by its extensive use in stamping and pressing dies, where ability to withstand enormous pressure is important. When a steel maker speaks of "very hard" steel, he means 150 point or harder; "hard" refers to 100-120 point, and "medium" to 70-80 point. It makes no difference whether the steel is annealed or hard when sold—the above terms apply only to the carbon it contains.

Carbon steels are made by two processes—the crucible process and the open hearth process, both of which have merits peculiar to themselves. While a description of such processes would undoubtedly be of interest, it would occupy too much space and do little or no good. What we are interested in is the best steel for making gun parts, and perhaps some of the tools we need, and how to make and temper them to do their work properly. Since most supply houses carry a somewhat limited stock of steel, and since in many instances we may want to make parts from old tools or other articles easily available, a general list of steels commonly used in various tools, etc., will likely prove valuable. The following is an extract from table in Woodworth's *Hardening, Tempering, & Annealing.*

	Carbon		*Carbon*
Augur, wood	0.60 to 0.70	Jaw, vise	0.85 to 0.90
Axe	1.20	Knife, belt	0.80 to 0.85
Ball bearing	1.20	Knife, paper	1.05 to 1.10
Barrel, gun	0.60 to 0.70	Knife, wood working	1.15 to 1.20
Bits, mining	0.80	Knife, putty	0.90 to 1.00
Blade, pocket knife	0.90	Magnet	1.23 to 1.25
Blade, reamer	1.20 to 1.22	Machinery, crucible	0.55 to 0.65
Bushing, spring	0.80	Mower, lawn	1.00
Centers, lathe	0.80 to 0.90	Plow, crucible	0.85 to 0.90
Chisels, cold	0.85	Punch, blacksmith	0.80 to 0.85
Chisels, chipping	0.80 to 0.90	Rake	1.16 to 1.25
Chisels, wood working	0.60 to 0.70	Saws, circular	0.80 to 0.90
Dies, envelope	1.15	Saws, for steel	1.40
Dies, drop forging	0.85 to 0.90	Saws, cross cut	0.85 to 1.00
Drills, twist	1.20 to 1.22	Saws, band	0.68 to 0.75
Driver, screw	0.60 to 0.70	Skate	1.16
Edge, straight	1.05 to 1.12	Spring, common locking	1.20 to 1.25
Facing, anvil	0.85 to 0.90	Spring, railroad, or locomotive	0.90 to 1.10
Files	1.25 to 1.30	Tape	1.20 to 1.22
Hammer, blacksmith's	0.67 to 0.78	Tools, blacksmiths'	0.60 to 0.70
Hammer, machinist's	0.90 to 1.00	Tools, moulders'	1.25 to 1.30
Hatchet	1.15 to 1.22	Tools, bricklayers'	0.90 to 0.95
Hoe	0.85 to 0.90	Wrenches	0.80 to 0.90
Hooks, grass	0.60 to 0.70		
Jaw, chuck	0.85 to 0.90		

305

From the foregoing it will be evident that many odds and ends of old tools may supply steel that is well adapted to making springs or other parts of guns; it will be equally evident that others will *not* supply suitable material, for which reason they are shown herein. Many old time gunsmiths are in the habit of making a small part from any bit of metal that is handy, without the smallest inkling of its suitability.

The practice of making parts from old tools, etc., is not to be condemned—on the contrary, the knowledge of the temper of such tools will often prove a more reliable guide than some material salesman's word.

For gunsmiths who have access to a large machinists' supply house carrying a fairly complete stock of steel, it is advisable to lay in a small supply of short lengths (a foot or so will be sufficient) of the several grades likely to be needed. This stock should be plainly labeled with the kind of steel and carbon content, and placed conveniently in pigeon-holes or small bins. The following list is suggested as likely to cover most requirements:

Drill rod (tool steel, 1.25% C) in sizes to make various pins, etc., and in sizes from 1/8" to 1/4" for checking tools, screw drivers, etc.
Drill rod (flat) in sizes adapted to various flat springs; also in sizes 1/2" x 1/16" to 1/4" x 1/2" for forging special chisels, gouges, etc.
Annealed tool steel in 1/2" x 5/8" bar, and in 5/8" x 3/4" bar, for various small parts, sights, etc., and mechanism parts.
Cold rolled, or mild machinery steel in flat bars, 1/8" x 1/2", 3/16" x 1/2", 1/4" x 1/2", 1/4" x 5/8", 1/4" x 3/4", 3/16" x 3/4", 1/8" x 3/8".
Thin "lock spring" (for cold bending) in widths of 1/4", 3/8" and 1/2".
Piano wire, in various sizes likely to be needed for coil springs. (This is advisable whether you have a lathe for winding springs or not, for you can supply the proper size to the machine shop where you place your order, and avoid disappointment.)

While most small parts will be sawed and filed, or milled from the bar, it is advisable whenever possible to forge all pieces of irregular shape to something like their finished form. By so doing you can have the grain of the steel running in the direction of greatest strain, and this forging also seems to knit the fibers closer together, and strengthens the part materially.

But since this chapter deals with hardening and tempering, and not forging, we will proceed to that subject.

ANNEALING TOOL STEEL. The raw stock you buy in the form of steel bars is usually annealed, to permit easy cutting and forming; but if you make a part from some old tool or other piece of tempered steel, it will be necessary to anneal it before you can work it. Factories employ great annealing ovens in which steel can be heated to predetermined temperatures, and cooled slowly at a specified rate; but such equipment is costly, and not necessary even

306

to the good sized shop. The best way I know of to anneal an ordinary piece of hardened steel is to get up a good red bed of coals in the furnace, bury your steel in it and let the fire go out. This is particularly pleasing to friend wife if the thermometer is standing around zero and she is expecting guests to dinner.

Good annealing can be done in a forge if you will build up a good big bed of coals—the ordinary small working fire in a forge may let the piece cool too quickly for best results. But whether you use furnace, forge, or kitchen range, avoid heating the steel too hot, and too rapidly.

No air blast should be used—just a good bright fire that will bring the steel to a cherry red in two or three minutes without permitting it to pass that heat. In annealing—and this also applies to hardening—the lower the heat at which you can do the work, the better the job will be. Try first a *dull* red; if that fails, heat to full cherry red—but no hotter. Sometimes you will find steel that will not anneal at all, but is apparently as hard after the treatment as it was before. In such case you may know that you have a piece of tungsten or other air-hardening steel, and the best thing to do is to try something else. Air hardening, or self hardening steel is only adapted to high speed cutters, drills, etc., and is usually worked by grinding. It can be annealed, but the process is long and complicated, requiring expensive equipment.

A method practiced in many shops is to heat the part to be annealed cherry red and burying it in lime until cool; or it may be buried in hot ashes, powdered charcoal, hot sand, or almost any material that will prevent rapid cooling. Very small parts that have been hardened and must be annealed may be heated cherry red and clamped in the vise between two blocks of soft wood, so that the steel burns itself an airtight pocket and cools slowly.

Or it may be heated and placed between two larger pieces of redhot iron. The larger pieces, cooling more slowly, will retard the cooling of the smaller part.

When only a gas burner is available, the steel may be suspended in the flame, and brought to a red heat; adjust the burner to hold this heat and leave it for several minutes; turn the burner down a little at a time, so that the cooling extends over a half hour or so. Another way is to heat the part then place it in a very hot kitchen oven, lowering the temperature very gradually.

WATER ANNEALING. The author is familiar with two methods which are quite satisfactory for carbon steel in most cases, particularly where the carbon content is not too high. The first method consists of heating the steel to cherry red, then let it lie until the red has almost disappeared—in other words until it is black hot; then quench it in thick soapsuds.

The second method is to heat the steel red hot, then remove it quickly to a dark closet, letting it cool in the air until the red is no

307

longer visible in the dark, then drop it into hot (but not boiling) water.

These methods will not remove all the temper, perhaps, but will soften the steel so that it can be readily cut and drilled, and this is often desirable practice where it is not planned to re-harden and temper the finished parts.

It must be borne in mind that any steel parts should be carefully annealed after forging, as the forging and subsequent cooling in the air will almost surely have caused some hardening; consequently the necessity for annealing before the final hardening and tempering processes. Moreover, the forging and cooling may have resulted in slight internal stresses in the parts, which the hardening might cause to warp badly. But careful annealing will relieve all such stresses, and the parts, if warped, may be trued up with little danger of warping in the hardening and tempering that follow.

One more warning against heating too hot when annealing! As a general rule, steel should be annealed at a slightly lower heat than is required to harden it; and the danger of burning the "life" out of the steel is much greater when annealing. Play safe—try annealing at a little lower heat than you think necessary; chances are it will work. And if it doesn't, just heat it a little hotter next time.

The tendency of most workmen is to demand softer and softer annealing, for easy working; whereas they should be educated to working it harder, for better final results. More steel is ruined by over-annealing than in any other manner. Over-annealed steel will shrink badly in the hardening, and is more liable to warping also. A little more "elbow grease" on the file, a little more time in the lathe or milling machine, will often pay big dividends in quality.

HARDENING. This section refers only to the hardening of carbon steel prior to tempering. Case-hardening of soft steel and iron will be treated later.

All steel has what is known as the "critical temperature"—the heat at which its structural formation undergoes a complete change necessary to the desired hardness. The critical temperature varies by several degrees in different steels, and is usually known only to the firm who made it; and since it could only be determined accurately by costly metallurgical tests, it is customary to assume, for practical work, that bright cherry red is the critical temperature. Here again, the worker must exercise care, for the same danger of overheating applies, as was mentioned in connection with annealing. Generally a slightly higher temperature than that used for annealing is advisable—but always use the lowest heat that will give the results required. If the part will not harden at a very bright red, you have probably made a mistake in the steel itself and are using machinery steel or cold rolled instead of carbon steel—either that, or else the steel has been "burnt" by heating too hot.

The general plan to be followed is to heat the parts, or tools, after

308

they have been finished to shape and polish, to the critical temperature (or as near to it as practicable) and quenching in oil, oil and water, oil water and soap, soap, wax, grease, or plain water. Quenching in water makes the steel very brittle—too brittle for most uses. Oil, or some solution of oil, gives toughness and strength.

Uniform heating of irregularly shaped parts, or parts with holes in them, is often difficult; and as uniformity is very necessary, the practice of heating in hot lead, both for hardening and tempering is common. A cast iron box, or plumber's iron melting pot such as handloaders use for casting bullet metal, will answer nicely, provided it has been used considerably so that the sulphur contained in the castiron is burned out. A graphite crucible is best, but is expensive. Use chemically pure lead if possible for the hardening bath. Never use scrap lead of unknown origin as it always contains much sulphur, and this will ruin the steel. Bring the lead to a bright red heat, and hang the steel parts in it until they too are red. The heating will be absolutely uniform, and by controlling the heat of the lead it will be impossible to overheat the steel. If the parts are large it is advisable to pre-heat them nearly red in a forge before dropping into the pot, to prevent cooling the lead.

Keep the surface of the lead covered with powdered charcoal to prevent oxidation.

If the lead has a tendency to adhere to the steel parts, this may be avoided by dipping them first into a solution of potassium cyanide, in proportion of one pound to one gallon of water. Be sure they have dried thoroughly before putting them into the lead.

Sometimes it is necessary to heat and bend files to permit of their doing special work, afterward re-hardening them. To do this without risk of burning the points of the teeth, the U. S. Ordnance Department recommends the following mixture:

Pulverized charred leather	1 lb.
Fine family flour	1¼ lbs.
Fine table salt	2 lbs.

The leather charcoal should be ground very fine, and put through a No. 45 sieve. Mix the ingredients dry, add water slowly to form a stiff paste and prevent lumps, then add more water until the mixture is of the consistency of varnish. Spread it on the parts with a brush—a very thin even coat, and dry slowly, but thoroughly, over a *slow* fire.

The above mixture having been applied and dried, the files or other parts are hardened in a lead bath as described.

Another well known formula for hardening files consists of:

Potassium ferro-cyanide, pulverized ...	12 parts
Powdered charcoal	20 parts
Powdered rosin	25 parts
Powdered white glass	10 parts
Rye flour	85 parts
Neatsfoot, burned and pulverized	75 parts
Common salt	200 parts

309

The ingredients are mixed with alcohol to form a thin paste, then spread on the work and dried before heating, similar to the Ordnance formula.

I have used the Ordnance formula, and have seen the other one used, and know that both are dependable. They absolutely prevent the formation of scale even when the steel is heated a bright red. Hammers with small sharp sear and safety notches, finished sears, and outside parts with a knurled or checked surface are perfectly protected with either of these mixtures.

They are extremely valuable also, for protecting the inside of a rifle barrel when necessary to braze on some part like a sling swivel, sight base, or binding-screw stud, or when filling up screw holes by electric welding. (See Chapter 23.)

When,using a forge for hardening, a charcoal or coke fire is best; anthracite is very satisfactory, but soft coal is no good—it contains sulphur which may ruin the steel. Heat the parts a little more quickly than when annealing, and see that the heat is as even all over the part as possible.

A gasoline blowtorch or plumber's blast furnace may be used in a pinch, but is not nearly so good. Have the torch as hot as possible, and move about in the flame to promote even heating. If an acetylene torch must be used, exercise great care to prevent overheating in spots, and play the flame rapidly over all surfaces, resting longer at the thick parts which heat more slowly.

The parts should not be held at the critical temperature longer than necessary—quench them as soon as they have an even color all over, and get them into the cooling bath the instant they are out of the fire.

The most common quenching bath, and the poorest for most uses, is cold water. Usually water, or some water solution is of more value in tempering than in hardening.

For hardening thin and delicate parts an oil bath is preferred. For hardening tools used for cutting, raw linseed oil is excellent; so is linseed oil and beef tallow, in proportion of 3 to 1. Lard oil, or sperm oil, are sometimes preferred to these, a sperm oil bath being considered best for steel springs.

The following formula was adopted by a firm making numbers of heavy duty springs: Spermaceti oil 48 parts; neatsfoot oil 45 parts; rendered beef suet 4 parts; rosin 3 parts.

There is no set rule for determining the best hardening bath. The coolant that works perfectly with one steel is worthless with another. Therefore it has been thought advisable to give several proven formulas, and only by experiment and some disappointment can the worker determine which is best for his use.

Some steel cannot be hardened sufficiently in oil baths, but hardens nicely in boiling water. Sometimes water at about 180 degrees solves the problem, while sometimes lukewarm water is best.

310

Most hardeners using water prefer water that has been boiled, or rain water; while some assert that old water, that has been used for some time, is best. Some shops use a strong salt water, or "brine," for all hardening. This is good where extreme hardness is wanted. A pound of citric acid crystals in a gallon of water is also used for producing maximum hardness. Steel can usually be hardened at a slightly lower temperature in water than in oil solutions, but increased brittleness, and tendency to crack or break under stress of work, is more likely to result. A safe rule to adopt is to oil harden parts that have to endure great stresses and vibration, such as hammers, firing pins, and the like, while parts that are only subject to surface friction may be water hardened. Many firearm parts, particularly shotgun parts, must be both "soft" fitted and "hard" fitted,—that is, before hardening, they are first worked to within a thousandth or so of final dimensions; then after hardening, they are brought to an exact fit with other parts in the mechanism by stoning, grinding or lapping and polishing.

TEMPERING. With very few exceptions, steel parts or tools must have the temper "drawn" somewhat to be fit for use. The hardening leaves the steel under great internal stress, and this stress is greatly relieved even by very slight drawing. Therefore, some drawing is essential even in parts requiring maximum hardness, otherwise they would be so brittle they would lack the strength to do the work required of them.

Some confusion has existed in the minds of amateur mechanics as to the principles of tempering. It must be understood that any piece of iron or unhardened steel that is polished, will run the whole scale of tempering colors as it is heated. *But, unless the steel has previously been heated to the critical temperature and hardened, these colors mean nothing, and have absolutely no effect on the hardness or strength of the steel.* When first hardened, as already described, then polished and slowly re-heated, the colors that appear indicate clearly the changes that are taking place, and the drawing of the temper to the exact hardness, stiffness and toughness that is wanted. This scale of colors given in order of their appearance, and the approximate temperature represented by each, is as follows:

Tempering colors of steel:

Very faint yellow	430 deg. F.
Straw color	460 deg. F.
Dark straw	470 deg. F.
Yellowish brown	500 deg. F.
Purple	530 deg. F.
Blue	550 deg. F.
Full blue	560 deg. F.
Polish blue	580 deg. F.
Dark blue	600 deg. F.
Pale blue	610 deg. F.
Blue and green spots	630 deg. F.
Bright red in dark	725 deg. F.
Redhot in twilight	884 deg. F.
Redhot in daylight	1077 deg. F.

311

Don't attempt to "blue" a gun by these tempering colors—they mean nothing and the colors are not durable. See chapter on "Bluing and Browning."

A list of commonly used tools, and the colors to which they are usually drawn, will prove helpful in determining the colors to use on many gun parts:

Augurs	Light purple	530 deg. F.
Hand reamers	Straw yellow	460 deg. F.
Burnishers	Very light yellow	420 deg. F.
Cold chisels for steel	Light purple	530 deg. F.
Cold chisels for cast iron	Dark purple	550 deg. F.
Collets	Dark yellow	490 deg. F.
Woodworking chisels	Spotted red-brown	510 deg. F.
Surgical instruments	Light purple	530 deg. F.
Drills for brass	Straw yellow	460 deg. F.
Gauges	Yellowish brown	500 deg. F.
Milling cutters	Straw yellow	460 deg. F.
Needles	Dark purple	550 deg. F.
Penknives	Straw yellow	460 deg. F.
Screw drivers	Dark purple	550 deg. F.
Springs	Dark purple	550 deg. F.
Springs	Very dark blue	601 deg. F.
Twist drills	Yellow brown	500 deg. F.
All percussion tools	Blue	549 deg. F.
Wood engraving tools	Very light yellow	430 deg. F.

Thus it will be understood that hardening and tempering are two opposite operations; hardening is intended to produce all the hardness the steel is capable of acquiring; while tempering removes some of this hardness, leaving the part at the right temper to do its work best. And the *higher* the *tempering* heat, the *softer* the steel becomes.

There are various methods of drawing the temper of hardened parts or tools. The simplest is to heat the article in the forge or in a gas flame until the right color appears, then quench. Such a method is unreliable, however, due to the difficulty of heating evenly, so various methods are employed to overcome this difficulty.

Knowing, or having ascertained by tests, the exact temperature at which certain articles are to be drawn, many large shops now employ oil baths in which the heat can be controlled within very close limits. This is strictly a production process, and somewhat dangerous unless proper equipment is available. Precautions must be taken against the oil catching fire, and special receptacles with close covers are required to hold the oil. In practice, the oil is heated to the proper tempering heat, and the hardened parts dropped into it a length of time sufficient to impart to them the temperature of the oil. They may be left in the oil to cool, or taken out to cool in the air. Quenching is unnecessary, as it is evident the parts can become no hotter than the bath into which they are dropped.

A simple and safe method that may be profitably employed in small shops is to heat the parts in a bath of melted lead, or lead, tin and other soft metals, or melted saltpeter. By referring to the Appendix

312

the Table of melting points of various solids, some substance, or mixture may be adopted that will give the right drawing temperature. For example, a mixture of 8 parts lead and 4 parts tin has a melting point which will produce in the steel immersed therein a pale or straw yellow; 19 parts lead and 4 parts tin will produce a purple; 48 parts lead, 4 parts tin, gives a bright blue; 50 parts lead and 2 of tin, a deep blue. Melted saltpeter is excellent for tempering flat springs, and it gives them a nice finish at the same time.

The parts to be tempered must invariably be polished, so that the colors may be seen—unless they are tempered in an oil bath, when colors are disregarded, and temperatures gauged by thermometer.

A simple, and very reliable method of tempering both flat and coiled springs has been evolved from the oil tempering process. It is known as "flashing" and consists of first hardening the spring in oil (usually sperm oil), then wiping off the surplus oil and heating the spring again until the small amount of oil remaining flashes and burns off. On thin springs one "flashing" is usually sufficient to draw the temper just right. When made of heavier stock, two or even three flashings may be needed.

Great difficulty is sometimes encountered in both the hardening and tempering of very small parts, such as pins, screws and very small drills; the method employed by watchmakers, for hardening watch drills, solves the problem. The drill (or other part) is heated in the flame of a candle to a good red heat, and instantly plunged into the candle grease. This, because the drill is so small that it cools in the air before it could be moved to a quenching bath. It may be flashed off to temper if desired.

Springs that have been "flashed" do not necessarily require quenching afterward, but no harm is done by quenching in the same oil in which they were hardened. Boiling linseed oil may also be used for tempering, but great care must be exercised in its use, as the temperature is so high the oil is likely to catch fire.

The sand bath is another effective method of tempering, but better adapted to the shop having a large furnace. However, small parts may be thus tempered by laying them on an inch layer of fine sand in a pan, and heating the pan in the forge, stirring the sand and parts together so as to heat evenly. Watch for the desired color, and quench the instant it appears.

A simple and often effective method of tempering small parts where even temper is desired, is to heat a good sized piece of iron red-hot, and lay the parts on it. This piece of iron should be supported over the quenching bath, so that the parts may be knocked off into it the instant the right color shows.

The following tempering liquids have been used in shops under varying conditions for different steels. Specific uses for the different formulas cannot well be laid down, as they were largely the result of experiment; but with the formulas available it is believed that the

workman will find one or more of them to be adapted to his purpose:

1. Saltpeter, 1 oz.; borax, 1 oz.; sal ammoniac, ½ oz.; salt, 12 oz.; mix ingredients dry and dissolve in 1 gallon rainwater.
2. ½ oz. corrosive sublimate dissolved in 3 qt. soft water; add 1 handful of common salt. This solution gives both toughness and hardness. BE CAREFUL! *It is a deadly poison.*
3. 1 oz. saltpeter; 2 teaspoons pulverized alum; 1 teacup salt; dissolve in 2 gal. soft water. Do not heat above cherry red. *Draw no temper.*
4. Alum 6 oz.; sal ammoniac 5 oz.; saltpeter 5 oz.; dissolve in 5½ gal. water. *Draw no temper.*
5. Salt 1½ pint; white vitriol 1 oz.; borax ½ oz.; saltpeter ¼ oz. Dissolve in 2 gal. water.
6. Alum 1 oz.; saltpeter 1 oz.; sal ammoniac, 1 oz.; salt ¾ lb.; dissolve in 1½ gal. soft water. *Draw no temper.*

Those solutions which specify "draw no temper" are adapted to small blocky parts subject to much surface friction but little strain. When thus hardened and the temper drawn the parts show little or no wear after long usage. This treatment is also adapted to tools and parts made of steel with a rather low carbon content, which do not harden enough to stand drawing.

SPECIFIC INSTRUCTIONS FOR VARIOUS TOOLS AND SMALL PARTS. To the man who doesn't care to experiment and work out his own methods from the general instructions already given, the following methods, which I have used successfully, will perhaps prove acceptable. Note, however, that none of these methods are recommended as infallible—what will work for one man often fails for another.

Cast steel: Small quantity sal ammoniac in rainwater. Heat steel red, drop into water a second or two (according to size of part) remove, leaving enough heat to draw temper somewhat, then quench finally. If left in water the first time until cold, will be much too hard for any use.

Axes: Heat poll in charcoal fire to bright cherry red; change ends and heat bit cherry red, and dip bit only into cold salt water *immediately.* Polish sides of bit, then heat poll until edge of bit turns blue. Quench. Use no air blast.

Burglar and Drill Proof Temper: (Sometimes called "diamond chill") Heat steel bright cherry red and quench in 1 gal. urine, 1 oz. borax, 1 oz. salt. Do not draw.

Drills: 1. Heat drill and rub in potassium cyanide. Drill should be just hot enough to melt the cyanide. Heat drill to dark cherry red and cool in very strong brine, made with warm soft water. Will be hard and tough. Do not draw temper.

2. For drilling glass: Heat to low red, cool in strong solution of zinc chloride.

3. Heat drill cherry red, cool in strong brine; polish, and draw to light straw color.

Knife blades: Heat to cherry red between two straight pieces of bright red-hot iron; dip perpendicularly into raw linseed oil. Polish,

and draw to light or medium straw color on hot iron; cool in linseed oil or weak brine.

Gun Hammers: Heat to cherry red in charcoal or lead bath, cool in linseed oil; polish and draw temper in lead or sand bath to yellowish brown, purple or blue.

Firing Pins: Same as for hammers, but draw to dark straw.

Extractors: Same as for shotgun main-springs.

Screw gauges: Heat to dull red in melted lead; harden in cold water or brine; polish bright, and draw to straw color in sand bath. This is a good method for any parts where it is important to reduce shrinkage to a minimum.

Cold Chisels: Heat in charcoal or coke fire (no blast) to dark cherry red, to a distance of two inches from point. Dip edge or point a distance of one inch, in clear salt water (1 qt. salt to 10 qts. water). Have ready coarse emery cloth wrapped around file, and quickly polish point and watch the colors run down from red spot. Dip entire chisel when point has color wanted (light purple for steel, dark purple for castiron).

Screw Drivers: Most ready-made screw drivers are made of poor steel—if you want good ones, make them yourself. Harden and temper in same manner as cold chisels, drawing temper at dark purple.

Springs: Shotgun main-springs. Heat to dull cherry red in lead bath, or charcoal fire, and quench in clear water with the chill taken off. Keep spring in water until it has temperature of water. Put spring in ladle or iron pan with equal parts lard oil and tallow, and heat pan until oil catches fire; turn springs about in flames until the oil on springs blazes freely when they are removed from flames. Lay them aside to cool without chilling.

Coil Springs: Heat to dull red and dip in linseed oil; flash off oil one, two or three times according to size of spring. Lay aside to cool. Revolver Springs (flat): Heat to cherry red, cool in linseed oil; flash off oil 3 times. Or, after hardening, polish springs and hold in melted saltpeter, (or Nitre Bluing Compound—see Chapter on Bluing and Browning) until dark blue. Remove to warm—not boiling—water.

Triggers, sears, etc. Harden and draw *point only* to dark straw.

Checking tools. Make them of drill rod. Coat working end with mixture used when hardening files; heat to cherry red, dip in linseed oil. Flash off once.

Chisels for woods: Same treatment as for checking tools; or, follow instructions for cold chisels, quenching in water when cutting edge is light straw color.

Parts subject to friction only: Parts requiring great hardness to resist wear, and which are subject to but little danger of breakage from strain or percussion, may be hardened at dull cherry red without drawing. To relieve internal strains however, a slight tempering is usually advisable, particularly in the better grades of steel.

Heating in sand bath or melted lead to a *very* pale straw—scarcely any color at all—will add strength without noticeably decreasing wearing qualities. Quench in oil, or water with the chill taken off.

TREATING ACTION PARTS OF HIGH POWER RIFLES: The man not specially trained and experienced in the heat treatment of rifle actions has a mistaken sense of his abilities, and is courting disaster—perhaps death, when he attempts to tamper with the hardening of Springfield, Krag, Mauser, or other modern bolt actions designed to handle ammunition developing over 40,000 pounds pressure. The best advice that can be given is "LET THEM ALONE." Failure, due to ignorance of the composition of action parts, and lack of knowledge and the expensive equipment needed, is sure to follow such attempts. The splendid work of Springfield Armory and of the large arms plants cannot be improved upon by the amateur or the professional gunsmith—nor even by the larger machine shops more or less familiar with hardening and tempering. There have been too many blown up rifles to warrant any man taking unnecessary chances, and when one considers the all too frequent propensity of handloaders to seek velocities higher than standard, there comes a feeling that the maximum strength developed by the foremost experts is not too much for the arms we are to shoot.

For this reason, the writer always tries to discourage the desire of a rifleman to have the position of his bolt handle altered, or any other alteration that might affect the original hardening. If a bolt handle must be bent, protect the bolt, and particularly the end carrying the lugs, with wet rags, as described in another chapter.

I once saw a man who claimed to be an expert, and whose reputation was national, attempt to harden a Mannlicher bolt by heating to nearly white heat in cyanide and quenching in ice-cold salt water. The owner of the gun could have thanked his stars that it broke in half instead of merely cracking, and letting loose in his face at some later date.

A good many Mauser actions are imported into this country in the white, and sold to private makers who fit them with special barrels and stocks. Purchasers of such arms are sometimes disconcerted to find the receiver so soft it can be scratched and nicked with a penknife. Why?—simply because the maker—perhaps assembler would be better—had neither the means nor the knowledge required for properly heat treating it. These actions are sold soft, in most cases. If not soft when purchased, they are usually annealed, so that they can be engraved. I have seen not one, but dozens of rifles come in from the engraver and immediately turned over to the bluing man, without any pretense of heat treatment.

In the case of Mauser actions these guns are probably safe to shoot, for the steel is of high quality, and designed for strength.

316

With modern loads they will undoubtedly stretch and develop excessive headspace in time; yet I should much prefer an action not hardened, to one hardened by some bungler who didn't know his stuff.

Many a good Springfield,—and many another good action as well—has been ruined in the "dolling up" process. Good engraving is certainly to be admired on a high grade arm; but bear in mind that engravers cannot perform miracles. Before making a single cut on a receiver it must be thoroughly annealed, and if the rifle is to give satisfactory service, must be subsequently rehardened. The man who contemplates purchase of a beautifully decorated arm will do well, therefore, to make sure who is to do the engraving, and whether he is capable of annealing the action without damage to the steel; and further, whether it will be re-hardened, afterward, by whom, and how. The ordinary case-hardening methods used so successfully on machinery steel are not adapted to the steel used in rifle actions—and may result in ruining them. Yet such methods have often been employed to give the gun owner a false impression that his arm had received the necessary hardening treatment.

If a gunsmith objected or hesitated about giving full and complete information on these points I should feel warranted in assuming that he had something to conceal. And unless his claims of ability along these lines could be fully verified by recognized authorities, I wouldn't trust his guns outside the showcase. I have but one face to give to my country!

317

Chapter 22

CASE-HARDENING

ALTHOUGH many believe that the use of machinery steel for cutting tools is of comparatively recent origin, yet such is not the case. There seems to be good evidence of the use of Case-Hardening, or Cementation in China during the eighth century; and Brearly in his book "The Case Hardening of Steel" refers to a book written by Theophilus Presbyter, a Benedictine monk, in the latter part of the thirteenth century, giving instructions for case-hardening files. His method was so similar to many in use today, that one is surprised at the apparent lack of progress in the fundamentals.

Even today, files made of mild Bessemer steel are still in common use in certain parts of Europe, particularly Russia; and these are capable of doing excellent work.

For many uses in gunsmithing the use of soft machinery steel is to be commended. When properly case-hardened the surface resists wear even better than tempered tool steel; while the soft, tough metal inside gives strength.

Before going into the processes employed it will be necessary to understand just what case-hardening is, the principles, and the effect on the steel. Cementation, the technical term for case-hardening, implies the addition of substances into the surface of the metal which changes its structural formation, cementing or binding the fibres into a finer grained mass with the hardening properties of steel. And in fact, the surface of the metal is actually changed into steel, the thickness of this skin varying from a few thousandths up to a sixteenth or even an eighth of an inch.

Mechanics will argue that once a piece of case-hardened iron is heated the hardening is destroyed. But such is not necessarily the case. Due to the thinness of the skin, it is easy to burn out the carbon; yet by careful handling a case-hardened surface may be an-

318

nealed, rehardened, and even the temper drawn somewhat. Further, it is possible, and often practicable, to produce cementation (develop an outer skin of steel) without hardening it in the process; after which it may be hardened and tempered the same as tool steel.

Briefly described, therefore, case-hardening or cementation consists of combining carbon with iron or machinery steel by heating the two substances together; and for some reason which the author does not pretend to know, the use of some form of animal charcoal as the carbonizing agent is deemed preferable, if not absolutely essential in most processes; although wood charcoal is used in some. In addition to the form of charcoal used—charred wood, horn, hoofs, bone, hair, leather—there are numerous other substances named in carburizing mixtures, as sodium carbonate, common salt, saltpeter, rosin, raw bone, flour, soot, sawdust, hair, vegetable fibre, potassium bichromate, ferrocyanide, limestone, seed husks, etc. Probably—and quite possibly—not all of these ingredients have any particular value; while others are too costly to make their use at all practical, particularly in the small shop.

There are on the market numerous carburizing mixtures, or case-hardening compounds under trade names and secret formulas. Generally speaking, we do not favor their use. They are not noticeably superior to standard mixtures, formulas for which appear in several authoritive handbooks; they cost more, and, should they fail to do their work properly, the operator is totally in the dark as to the cause.

There is no mystery about case-hardening. Having learned its principles one can by a little experiment evolve mixtures and processes best adapted to his purpose—and having done so, stick to those mixtures with reasonable certainty of uniform results.

The essentials of a good carburizer are: porosity, so that the gases released may move freely through and around the parts being treated; ability to evolve carburizing gases at the heat required for cementation; compactness, and freedom from shrinkage, so that parts may not be left unsupported, to bend or warp in the hardening box; and good heat conductivity, so that the work in the box may be of uniform temperature.

CASE-HARDENING EQUIPMENT. Hardening boxes will vary in sizes from a few inches up to two or three feet; they are usually oblong in shape, and made of cast iron, though sometimes a mild steel box is required, as will be mentioned later. As most gunsmiths need equipment only for hardening small parts, boxes eight or ten inches long by five or six inches in width and depth will probably answer all purposes. The walls need be only about 1/4 inch in thickness. Wooden pattern boxes may be made up, as any pattern is made, and sent to the nearest foundry for casting. Each box should have a cast iron lid, which fits loosely, and which in operation is cemented in place with fire clay. And, if the process requires that

319

the box be dumped into water or a solution, there should be rings cast on ends or sides so that it may be handled readily with iron hooks on removing from the furnace. Iron and steel hardening and annealing boxes are also offered by several manufacturers, and any large hardware jobber or machinist's supply house can arrange to obtain them in the sizes required.

Despite the increasing use of electric furnaces, many hardeners still prefer gas blast furnaces, of which several excellent ones are made in this country, specially designed for hardening, tempering, annealing and case-hardening, as well as special oil tempering furnaces for production work. They too can be obtained through any dealer in machine shop supplies. Furnaces of this type, are small and compact, and simple, once their operation is mastered. Yet, while ideal for the larger shops, their cost, and cost of operation is prohibitive in the smaller ones.

We will, nevertheless, describe several processes involving the use of gas furnaces, as well as simpler processes adapted to the occasional job, and calling for no more costly equipment than a small forge, or even a gas burner.

A good outfit for fine grain case-hardening consists of a good hardening furnace or oven, the required number of iron boxes, a good supply of granulated raw bone, a similar supply of granulated charcoal, a quantity of hydro-carbonated bone and a quantity of charred leather. Hardening materials are usually sold by the manufacturers of hardening furnaces, or of patent hardening boxes, through the supply dealer or jobber. Bulk single ingredients are preferable to secret compounds. Charred bone may be produced by putting the granulated raw bone into one of the boxes, covering tightly, and placing in the furnace at the end of the day's work when the fire is allowed to die. The object is simply to char the bone thoroughly without burning it. Charred leather, also called for in some work, may be prepared in a similar manner. Use thick leather, like saddle skirting or shoe sole scrap, obtainable at any leather house. The leather should be thoroughly charred and crisp, so that it may be pounded to a fine powder before using.

In addition to the foregoing a tank or barrel must be supplied for quenching the work, and a smaller tank with steam coil so that water in it may be heated to any desired temperature, and a bath of raw linseed oil.

For very fine grain case-hardening, use only charcoal, granulated raw bone, hydro-carbonated bone and charred leather, for the first heat. Bring to cherry red heat and hold at that temperature for two to four hours, depending on size of work. Leave box in oven to cool slowly. This "cements" or forms a steel outer skin on the work, leaving the grain open. When the work has become cool, unpack and heat the parts to red heat in molten lead, and quench in oil, same as in hardening tool steel. Then repack in box, using

320

only granulated charcoal, and bring to a dull red heat. Remove from oven, open box, and dump contents instantly into water with the chill taken off. This treatment brings out a dense, tough, close-grained and very hard surface, and the parts will be much stronger than if made of tool steel.

Note: When dumping parts into water, carry the box very close to the surface of water, so that parts are quenched in water without the air striking them. This applies to all methods of case-hardening.

CASE-HARDENING WITHOUT COLOR: The foregoing process may or may not result in some color, but cannot be depended upon to produce the brilliant colors often desired. A method that produces no color, but gives a hard, even grained surface, follows:

In the bottom of box place a layer of granulated raw bone 1/2 inch deep; on this arrange the parts to be hardened, then another layer of bone, and so on to within an inch or so of the top. Then fill up with old bone that has been used before. Put on cover and seal with fire clay. Heat to good cherry red three to four hours, then dump in clean cool soft water. Very small or thin pieces should be dumped in oil. This results in good even hardening, and the parts come out a clean steel gray, free from scale.

CASE-HARDENING MALLEABLE IRON: Buttplates, pistol grip caps, and many other parts not essential to the mechanism of a gun may be made of malleable iron castings. If they are *completely* annealed in the making, they may be successfully case-hardened—otherwise results are doubtful.

For this work use one part granulated raw bone, well mixed with three parts granulated charcoal. For Bessemer steel or very small parts, slightly reduce the proportion of bone. Pack in boxes or parts as previously described, sprinkle charcoal dust over the top, and heat to cherry red two to four hours. Dump in clean soft water.

CASE-HARDENING WITH COLORS: This involves the use of charred bone, prepared as previously described. It is essential that the parts be well polished—the better the polish, the more brilliant the colors. Burnishing and buffing is not advised, as it closes and fills the pores and retards the process. Polish the parts with fine abrasives as described in chapter on polishing, and clean by boiling in lye solution as for bluing, or by pickling; after cleaning, handle the parts only with clean, white cotton gloves that have been washed and boiled. A single touch with the bare finger will leave a spot that will mar the final finish.

Pack the work in layers as before, having the layers of charred bone about 3/4 inch deep, leaving about 2 inches at top which is filled with charred bone. Put on lid and seal with fire clay. Be sure that none of the parts are nearer than 1/2 inch from sides of box, and that the parts do not touch each other. Bring the box to a nice cherry red and hold uniform at this heat two to four hours. *Too high a heat will result in no color.*

321

The quenching bath should be clean, cool *soft* water. Arrange a wire mesh screen six or eight inches below the surface, and from bottom of tank bring up a pipe connected with an air pump, so that a strong jet of air may be injected while dumping. If possible, also have a supply pipe carrying fresh water in near the bottom, with an overflow pipe near the top, to keep the water at uniform temperature. Hold the box almost at the surface of water and dump quickly. The wire mesh catches the parts while the bone drops through into the tank.

If the parts are small and few in number, a simpler method may be improvised by having an assistant stir the water vigorously with a paddle while dumping. It is the air bubbles in the agitated water that gives the fine mottled effect so much admired.

When cool the work should be taken out and boiled in clean soft water, dried in sawdust, and oiled or lacquered.

HOWE'S METHOD: Mr. James V. Howe is responsible for the following method which we have tried only once, but with very good success. The hardening, however does not extend very deeply, although the colors were very good.

Into a cast iron pot or box large enough for the parts to be colored, place a quantity of potassium cyanide and melt in a forge with air blast. *Due to the poisonous fumes of the cyanide, great care must be exercised*—use a portable forge outdoors, or see that there is a hood to carry off the vapors. Otherwise, one sniff may mean *taps*. Place the work to be colored into the melted cyanide, and bring to cherry red. Hold at this heat for ten to fifteen minutes. Remove work and quench instantly in a solution of 2 quarts water, 3 ounces saltpeter, and 1 ounce gunoil. Stir this solution vigorously while quenching.

AUTHOR'S EXPERIMENT: To ascertain just what the home gun tinkerer might hope to accomplish with limited equipment, the following experiment was made: A quantity of powdered leather (shoe sole grindings from a shoe repair shop) was obtained and charred over a gas burner, spreading out a thin layer on a tin pan. Some bone meal from a poultry supply house was charred in a like manner. These materials were conveniently arranged with some willow charcoal from the drugstore, and some powdered potassium cyanide, sodium nitrate, potassium nitrate, and common salt, each on a separate pan. The work, (an old Stevens Favorite receiver that had been polished and cleaned) was held on a rod bent like tongs, with the two ends inserted into the barrel ring, so that the receiver could be turned either side up, and then heated over an ordinary gas plate. I could just get a cherry red by turning the burner up as high as possible, and had no difficulty in keeping the heat uniform. At this heat the receiver was removed from the fire for a moment, while I quickly dropped on it some cyanide, sprinkling it unevenly in spots with a small spoon. This was fol-

322

lowed by similar applications of the saltpeter, the salt charred leather and charred bone in no particular order. I just worked as rapidly as possible, and as soon as one material was melted I dropped on another. I continued this for perhaps twenty or twenty-five minutes, keeping the receiver red hot and in the fire all the time except when actually applying the materials. I then quenched it in a solution of a gallon of water and a half pint of linseed oil which was kept vigorously agitated by means of a tire pump with long tube reaching to bottom of bucket.

Just which of the above materials was responsible, or whether it was the combination of all, I do not know; but I did get a very attractive job of coloring, although the hardening was not as deep as I wanted—just a few thousandths. The coloring was generally darker than I wanted, with more blue than was necessary. The red was brilliant—this I believe to be due to the salt used. Perhaps reducing the amount of saltpeter, and eliminating the willow charcoal would have resulted in more yellow and less blue, but up to this writing have had no time for further trial.

I am not recommending this as a fixed process, but it does seem to hold possibilities for the occasional job, particularly on some small caliber arms where strength and extreme hardness are not primarily essential.

CYANIDE HARDENING: It must be remembered that, generally speaking, the use of potassium cyanide is not considered as good practice as the use of animal charcoals. Yet it offers an easy means of achieving very fair results with little or no equipment.

Quite often small tools such as drift, prick and center punches, will prove to be made of such low carbon steel that they will not harden by ordinary means. It is a simple matter to heat them red hot in gas burner or blowtorch, dip them in powdered cyanide and reheat—repeating two or three times—and finally quenching in clear water or brine. Tools, and parts of gun mechanisms so hardened will do their work. Often in working down a trigger pull the sear and hammer both prove so soft that the pull will not remain. This method of hardening saves the day. It is also applicable to screwdrivers—and one can quickly make up a number of these for various sized screws from ordinary coldrolled steel, and harden them so that they will give good service for months. Such screwdrivers will better stand the strain of loosening tight screws than if made of tool steel, with its constant danger of snapping off the point, and possibly marring the gun.

Cyanide hardening should never, under any circumstances, be used on the bolt or receiver of any high power rifle.

COLORING WITHOUT HARDENING: Heating small parts to red heat in cyanide melted in a cast iron pot or crucible and quenching in water under proper conditions produces both hardness and colors. When hardening is not desired, the colors only can be

323

obtained by the same process, but by substituting a mild steel pot for the cast iron one. Have the pot made by riveting and welding, as shown in Figure 127. Heat the parts in cyanide melted therein, and quench in water that is being agitated, as before described. The first time such a pot is used the parts will come out as hard as though treated in a cast iron pot—but parts heated in it thereafter will come out soft, but colored. Therefore, if coloring only is wanted, the pot should be heated for a half hour before putting in the cyanide.

Cyanide hardening is, in the final analysis, merely a substitute for the more satisfactory, but more expensive and difficult processes using charred bone and leather. Yet it is often the only process readily

Fig. 127

available in the small shop, and if extremely deep hardening is not essential, is quite satisfactory. *But be careful.* Avoid putting articles into melted cyanide with any moisture on them—it will sputter and fly like melted lead. I have seen a dog die almost instantly when half a grain of cyanide was dropped into his eye. A photo-engraver accidently took a drink of water from a glass that had a few drops of cyanide solution in it. He started to walk out of the developing room—and fell dead with his foot in mid air and the glass in his hand.

SOME HARDENING KINKS: For drilling glass, chilled iron, hardened steel, etc.,—a Springfield receiver, for example—take a new drill that is well sharpened and has never been heated to cherry red. Dissolve zinc in muriatic acid to saturation, then add an equal quantity of water. Heat drill to dull cherry red and quench instantly in this solution, until cool. Use drill without further sharpening. Wet the drill point with turpentine when drilling very hard steel or glass.

Small drills may be made of any piece of steel wire, by filing to shape. Mix 4 parts powdered rosin, 2 parts fish oil and 1 part tallow, heated together to melting point. Heat drill to dull red and dip into mixture, leaving it until cool. Reheat to red, and quench in cold water. Repeat two or three times, and the drill will easily cut glass.

A short piece of cast iron pipe, with ends threaded for caps, sometimes makes a handy substitute for cast iron box for case-hardening

324

small parts. Weld an iron rod to the center for holding while removing from fire, and use very short threads on ends; notch caps, and make a special spanner so that both caps may be removed instantly. Hold one end almost touching water, and push out contents with an iron bar.

Yellow prussiate of potash is sometimes substituted for potassium cyanide with excellent results in hardening small articles; also, a mixture of prussiate of potash, sal ammoniac and salt. Some mechanics use a mixture of prussiate of potash and black loam, mixed to a paste with water and spread on the work. When dry, heat to red heat and quench in salt water.

When hardening steel (low grade) by case-hardening, avoid the use of raw bone; the phosphorus it contains will make the steel brittle.

325

Chapter 23

SOLDERING, BRAZING AND WELDING

THE art of joining metals together by soldering, brazing or welding is well known in a general way, yet comparatively few become proficient in either of the three named processes. And since all three are of importance in the field of gunsmithing this chapter is devoted to the clearing up of some of the difficulties surrounding the subject.

While reasonable experience is the greatest aid to soldering, nevertheless the rankest amateur can do a splendid job once he is given an understanding of the principles involved, which are simple and few.

Brazing is more difficult, usually requiring some special equipment, but it also can be mastered with a little time and patience. Welding, on the other hand, is a specialty trade and like other trades must be mastered thoroughly. It requires special and expensive equipment, and most gun shops—even the larger ones—usually find it desirable to send their welding out to a shop doing this work exclusively. Our discussion of welding, therefore, is intended principally to aid the gunsmith or home worker to lay down intelligent specifications on the work for best results.

SOFT SOLDERING, OR SOLDERING, as it is usually called, is the simple process of uniting two pieces of metal by means of an alloy having a relatively low melting point. The beginner's most common difficulty lies in making the solder "stick." Instead of flowing and taking hold on the metal, it forms little balls which roll off the work as fast as it is melted. In a good job the solder is spread or "flowed" evenly over the work, and when so applied its holding strength is surprising. Brass, copper, zinc, tin, sheetiron, iron, and steel, are readily soldered with suitable alloys and fluxes, and while the solder joint, due to greater softness, will not be as

326

strong as the metals joined, it will nevertheless resist any normal strain it is likely to receive, and will "stay put" until the solder is removed by melting.

In soft soldering two principle methods are in common use. The first involves the flowing in of the solder between the metals to be joined by means of a heated soldering copper; the second, and more useful method for the gunsmith, is known as "sweating," or "sweat soldering." In sweating, a thin coating of solder is applied to the two surfaces to be joined, which should be fitted very closely. These

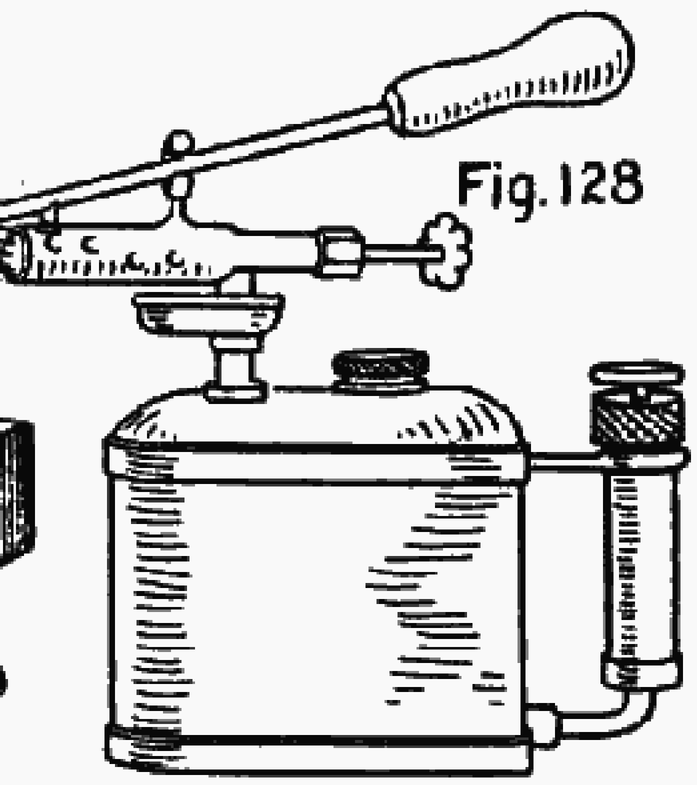


Fig. 128

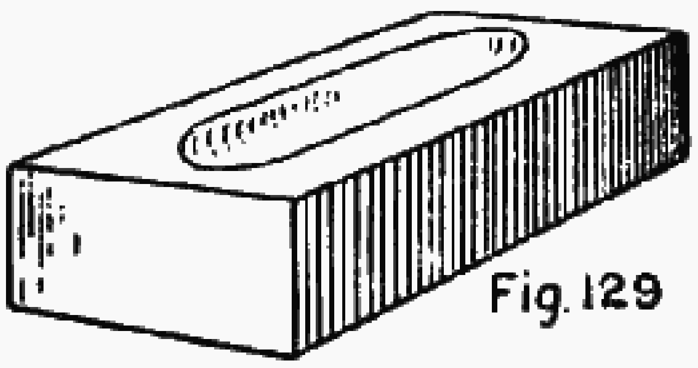


Fig. 129

surfaces are then brought together, usually under pressure, and the whole assembly heated until the solder is thoroughly melted.

All things being equal, the sweated joint is much the stronger of the two; for in heating up the parts being joined the pores are opened and the solder, which is heated well beyond its normal melting point, penetrates the surfaces for a short distance. Such a joint is nearly as strong as a brazed joint.

The equipment required for soft soldering are: a gasoline blow-torch, gas heater, plumber's gasoline furnace, or other suitable means of heat; a soldering "copper" of good size (from one to two pounds weight); a knife, file, or scraper for cleaning off the surfaces to be joined; a quantity of suitable solder; and a "flux" to prevent oxidation of the surfaces while they are being joined. Figure 128 shows a gasoline blowtorch and soldering copper of practical design. For ordinary soft soldering, however, a common gas burner will heat the copper very satisfactorily.

Of all equipment for this work, the shape and condition of the copper is most important. The point should be filed very sharp, with clean, square edges, and the point well tinned. By "tinning" is meant the coating of the point with solder so that it will pick

327

up the metal and carry it to the work. There are several good methods of tinning the point. One is to chip out a hollow in a soft yellow brick, as shown in Figure 129; melt some rosin and pour it into this cavity, along with a small quantity of melted solder. Heat the copper until solder touched to its point will melt quickly, and then press it into the rosin and solder in the brick. Stroke it back and forth a dozen or so times, turning it so that all surfaces are rubbed against the brick. This abrasion cleans the point, the rosin fluxes it, and the solder adheres, forming an even coating all over the point for half an inch or so back. Keep this tinning brick handy at all times—it is a reminder to you to tin the copper well before every job.

Overheating the copper must be avoided. Too much heat will burn the metal and destroy its efficiency. Just a few degrees above the melting point of the solder used is hot enough. You can tell when the copper is overheated by the appearance of the tinned point, which will take on a dull, partially corroded appearance, showing that the tinning has burned in. When this occurs, file the point clean and retin—and be more careful next time. Continued overheating will ultimately ruin the copper.

Another method of tinning which I like better, but which must be used with discretion, is to merely rub the point of the heated soldering copper on a large piece of sal ammoniac, then rub it on a bar of solder, alternating until the point is well coated with solder. This method is quick and sure, the sal ammoniac cleaning the point instantly. The fumes and vapor from the sal ammoniac, however, are very conducive to rust, and this operation must be performed away from tools and guns, and in good ventilation. Otherwise, every bit of steel will be found covered with thick rust within twelve hours.

After the copper, the flux comes next in importance. A metal surface that has been oxidized cannot be soldered, and flux is used to retard oxidation until the solder has taken hold. Despite the

Fig. 130

many soldering fluxes on the market, common rosin, one of the oldest fluxes in use, remains one of the best. It is used by merely grinding or pounding up the chunks as they come from the dealer, and may be applied with a wool brush made like Figure 130, by forcing a bunch of wool yarn into a small piece of brass tubing and pinching the end together. Despite the almost universal usefulness of rosin, there are other fluxes better adapted to certain metals, as

328

shown by the following table taken from "Soldering and Brazing" by Raymond F. Yates:

Metal	*Flux*
Bismuth	Zinc Chloride
Silver	Zinc Chloride
Gold	Zinc Chloride
Zinc	Hydrochloric Acid (Muriatic)
Pewter	Gallipoli Oil
Steel and Iron	Ammonium Chloride
Galvanized Steel	Hydrochloric Acid
Tinned Steel	Rosin or Zinc Chloride
Lead	Tallow or Rosin
Tin	Zinc Chloride or Rosin
Gun Metal	Ammonium Chloride or Zinc Chloride
Copper	Ammonium Chloride or Zinc Chloride
Brass	Ammonium Chloride or Zinc Chloride

To make zinc chloride, drop a few pieces of scrap zinc into a wide mouthed bottle of hydrochloric (muriatic) acid. The acid will fume and boil as the zinc is eaten up by it. When it will dissolve no more zinc, and all action has subsided, it is ready for use. Apply with a small brush—the stiff bristled brush in a tin handle that comes with a bottle of mucilage is just the ticket.

Ammonium chloride is the same as sal ammoniac, and may be purchased in powdered form at any drug store. It is applied with a brush like powdered rosin.

Some fluxes, if used on copper, will cause an objectionable after-corrosion. Plain rosin is very good for soldering copper, or the following will be found satisfactory:

Zinc Chloride crystals..........	42 parts (by weight)
Alcohol	33 parts (by weight)
Glycerine	25 parts (by weight)

Dissolve the zinc chloride crystals in the alcohol, then add the glycerine. Apply with a brush in the usual manner.

Having a suitable copper and method of heating it, the next consideration is the solder itself. The common soft solder sold in hardware stores is composed of lead and tin in varying proportions. Lead and tin solders will answer for most uses in the gunsmithing trade, nevertheless there are times when a solder of lower melting point is desired, and this usually means a lead and tin solder to which Bismuth has been added to reduce the melting point. The following tables* give the melting points and percentages of various lead-tin, and lead-tin-bismuth solders to read—giving the melting point and percentages:

LEAD-TIN SOLDERS

Lead	100	90	80	70	60	50	40	30	20	10	0
Tin	0	10	20	30	40	50	60	70	80	90	100
Melting Point, Fahr.	619	563	529	504	464	428	374	365	392	421	450

LEAD-TIN-BISMUTH SOLDERS

Lead	32.0	25.8	25.0	43.0	33.3	10.7	50.0	35.8	20.0	70.9
Tin	15.5	19.8	15.0	14.0	33.3	23.1	33.0	52.1	60.0	9.1
Bismuth	52.5	54.4	60.0	43.0	33.3	66.2	17.0	12.1	20.0	20.0
Melting Point, Fahr.	205	214	257	262	292	298	322	358	360	453

* "Modern Welding Methods" by Victor W. Page.

329

By studying the percentages in the above tables the gunsmith can prepare a solder that will melt at any desired temperature. Thus, a solder composed of lead, 32 parts; tin, 15.5 parts; and bismuth 52.5 parts will melt in boiling water, the temperature of which is 221 degrees. Parts soldered with such a mixture could not be blued, as the bluing heat would melt the solder. Such an alloy, however, could be used to attach parts already blued where it was desired not to damage the finish by heat—just gently warming over a mild heat would do the trick. There is little danger of damaging either the finish or the physical properties of the steel, however, at temperatures below 300 degrees, so one of the alloys having a somewhat higher melting point would usually be selected because of their greater strength. Generally speaking, softness and weakness and low melting points go together, and vice versa; yet even the softest solders are surprisingly strong, and serve admirably for attaching barrel bands and similar work where the solder itself does not have to hold all the strain.

In ordinary soft soldering, the parts are usually clamped or wired into position after the contact surfaces have been scraped or filed bright. The proper flux is then applied, and the heated soldering copper rubbed on the bar of solder, which picks up a drop of the molten metal. This is applied to the joint being formed, and flowed well into it at all points. When wire solder is used, the end of the wire and point of soldering copper are brought together at the point being joined, and the solder melted and flowed in.

Wire solder is very convenient and may be had either solid, or hollow, the core containing either powdered rosin or an "acid" flux. I have found this "acid-core" wire solder perfectly adapted to 90 per cent. of all gun work. It flows and adheres perfectly on steel, and is both convenient and economical to use. Moreover, when solder was not handy, I have used pure block tin on steel with entire success, fluxing either with powdered sal ammoniac or rosin.

SWEATING: But the uses of common soft soldering in gunsmithing are relatively few. Broken parts cannot be repaired by this method, for the solder will not stand the strain. Sweating has far more use in gunsmithing than almost any other means of joining metals. By this process the barrels of double guns are joined together, and ribs attached; sight ramps are affixed to rifle barrels; swivel bands, forend screw bands, rear sight bases are firmly and accurately attached, and many other jobs readily accomplished that would not be possible by any other method.

One of the advantages of sweating lies in the low heat required to melt soft solder. The liability of damage to barrel or action is practically nil at temperatures below 500 degrees, and as all soft solders melt below this temperature, they suggest themselves as a logical medium.

The equipment for sweating is simple, including only a blowtorch,

a file or scraper for cleaning the parts, suitable soft solder, flux, and in some cases small clamps for holding the work together. A piece of felt or woolen rag will also be needed for wiping. The soldering copper is seldom needed, although occasionally it may come handy, while a gas burner may replace the blowtorch on many jobs.

A description of my own method of sweating on a barrel band and sight ramp will include details applying to many similar jobs. After the band and ramp have been finished and fitted as described in Chapter 24, their respective locations should be marked on the barrel. Assuming that we are attaching a band for quick detachable sling swivels, mark with a scriber a light line on bottom of barrel at its exact center, and a center line on the swivel stud of the band. Slip the band on the barrel and note its position. Now at this point the barrel is to be cross-polished with medium coarse emery cloth until bright and clean. Heat barrel at this point until hot enough to melt solder. Apply flux, then the solder, rubbing it clear round the barrel until the spot is well tinned. Re-heat the barrel slightly so that solder is in a melted state, then with the woolen rag or felt folded in the band, quickly wipe the excess solder off. If you use acid-core wire solder, no fluxing is necessary—just rub the solder on the heated barrel. Wiping off the excess leaves the barrel tinned only at the point where band is to be fitted—a coating of no perceptible thickness.

Now lay the barrel aside while you tin the inside of band. With an old knife blade, or scraper made of a file or hacksaw blade, scrape the inside of band bright and clean. Be careful not to scrape the extreme edges, or there will be gaps where the solder will show. Hold the band in tongs or pliers, heat it until it will melt the solder, then apply solder all over the inside—first using flux unless you have a self fluxing solder. Apply the solder thickly, and be sure it flows well over the inside. (In holding the band with tongs or pliers, do not make a mistake of holding it above the hand, or the melted solder will run down on hand or wrist, giving a bad burn). When the inside is well tinned, reheat until solder is melted, throw out the excess with a quick shake, and "wipe" the inside with a pine splinter that is rich in rosin.

Now clamp the barrel bottom side up in the vise. The barrel will be pretty well cooled off, while the band is still hot. Slip the band into position, or as near to position as it will go. With the torch heat both band and tinned spot on barrel together until the coating of solder is in a melted state, then with a piece of brass or copper tap the band to place, so that the center lines you previously marked on band and barrel coincide. If the band goes on slightly out of line, a little additional heating will permit of the swivel stud being tapped a trifle to right or left as required.

Chances are that the heat of the barrel will have kept the solder melted during this fitting in place. If not, heat again until you are

sure the solder is all melted, then tap the band back a sixteenth inch or so to assure a snug fit, and allow to cool.

Next comes the ramp. Slip it on the barrel, and with a sharp scriber mark around the lower edge of the rib where it rests on barrel also mark around rear edge of band. Remove ramp, and file or scrape the barrel lightly within these marks, using care not to take off enough metal to make the ramp fit loosely. Tin the barrel within these lines, and wipe off excess solder as before; then tin the entire inside of barrel ring and concave bottom edge of rib, wiping off excess with a pine splinter. Set barrel right side up in vise, warm ramp to expand it, and slip over barrel, tapping it to

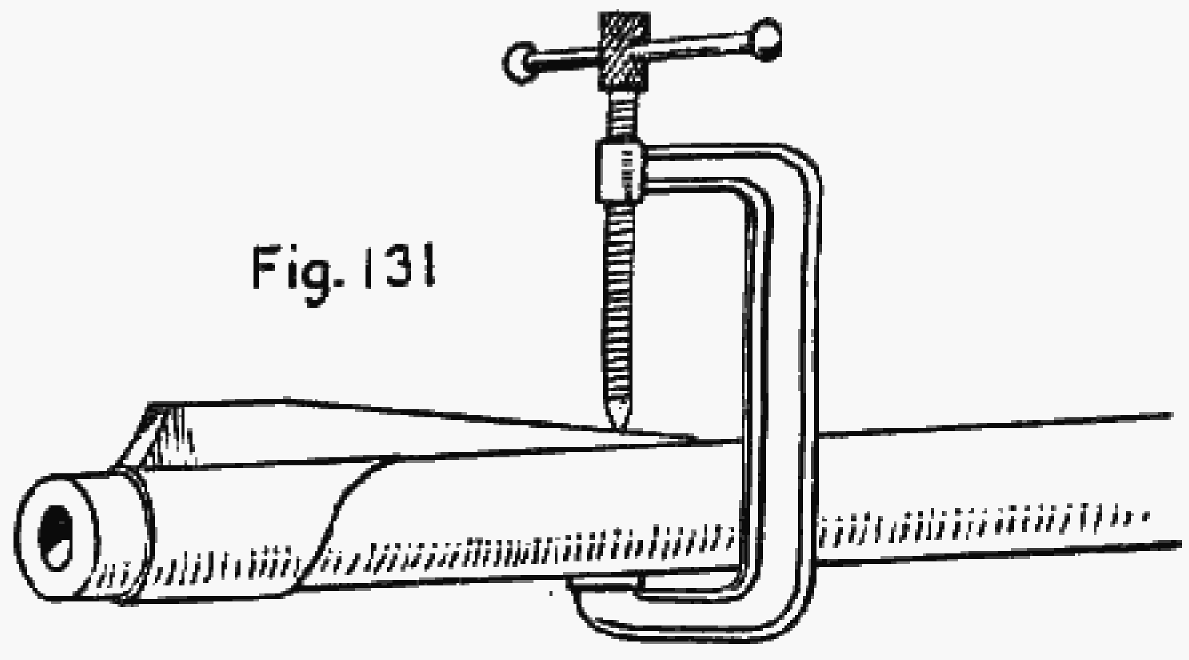


Fig. 131

position with a piece of brass or copper. Line it up carefully by setting the barrel and action temporarily into the stock and looking through the rear sight. Regardless of whether a special fixture might show the ramp to be upright or leaning, you would never be satisfied unless it *looked* straight to you; so I find that this eye method is perfectly satisfactory. A good test is this: if the ramp seems to lean a trifle to the right one time, then a trifle to the left next time, it is almost sure to be perfectly upright on the barrel; while if the eye shows it leaning the same way each time you look at it, you can believe your eye. Heat it sufficiently to melt the solder (no danger of its running out and spoiling the joint) and tap it in the direction required. Then set a small clamp on the rear end of the rib to hold it firmly to the barrel, and let cool. (Figure 131). When cool you are ready to remove the excess solder and repolish barrel for bluing, as described in Chapter 18.

SWEATING SCOPE BLOCKS: Scope blocks and mounts may be sweated in a similar manner except that it is not necessary to mar the finish. With the blocks or mounts located and temporarily screwed into position, mark around their edges with a scriber, then remove them and carefully file or scrape barrel or receiver, keeping well inside of the outline. Scrape underside of blocks and

tin them, also tin the bright spot on barrel, but instead of heating up the barrel in this instance, use the soldering copper and apply as thin a coat of solder as possible right on the spot. Quickly wipe off the excess with a woolen cloth or felt, and if a small quantity of solder gets on the blued portion it will not stick, but may be quickly brushed off. Fit the mounts back into position, set in the screws moderately tight, then lay the heated soldering copper on top of blocks and hold there until you see the melted solder running out of the edges. Quickly tighten up the screws, which being hot, will shrink in cooling, and together with the solder will hold the blocks until a certain oft mentioned locality freezes over. Wipe the excess solder from around the edges before it hardens, and the job will be perfect. This method of sweating may be used successfully with Griffin and Howe or Noske scope mounts on bolt action rifles, in addition to the pins and screws. (See Chapter 29.)

Swivels which attach to the barrel, but do not have the encircling band, such as are seen on many foreign rifles, may be sweated into position in the same manner without marring the rest of the barrel, although, having no screws to hold them in position, they must be clamped very accurately. On such swivels it is advisable to drill one or two small holes (about 1/16") into base of swivel, and drill corresponding holes from 1/32" to 1/16" into the barrel. Tight fitting pins are then made of drill rod and driven into the swivel base, where they serve as guides in locating the swivel into position before clamping. The pins, short as they are, also serve to take much of the strain from the solder joint.

Another and one of the most important uses of sweating is in the joining of shotgun barrels, and of attaching the ribs between the barrels. This is described in detail in Chapter 31.

BRAZING, sometimes called hard soldering, is indicated for joints that must withstand considerable mechanical strain. The use of brazing is limited in gunwork by reason of the high heat to which the parts must be subjected. This eliminates it pretty largely for attaching sight bases or other parts to barrels, for, while the bore may be protected against scale formation as will be explained later, there is always danger of causing the barrel to take a permanent bend.

Although the terms hard soldering and brazing are often used interchangeably, there is this difference; hard soldering employs a silver-brass alloy usually placed between the parts to be joined, which are then heated together; while brazing is really a process of uniting two surfaces by means of spelter, or by flowing in molten brass.

Silver solder is a mixture of pure silver and brazing spelter in various proportions, the percentage of each determining the melting point. Thus alloys can be produced with melting points from 700 to 2000 degrees Fahrenheit. And of course the higher the melting point the stronger the job. The best silver solder for the gunsmith

333

to use is that made in a thin ribbon, used primarily for joining the ends of bandsaws. It can be melted with a common gasoline blowtorch provided the parts being joined are not too large, although an oxy-acetylene torch with the flame properly regulated, is more desirable for all work.

In addition to a suitable source of heat, you will require a pickle bath of one part sulphuric acid with 20 parts of water; a quantity of borax for fluxing; a block of charcoal on which to rest the work (this serves to return the heat to the work and greatly facilitates matters); a piece of slate and a short wire for handling the borax, and a can of clean water with a small brush completes the outfit.

When joining two parts together, as, for example, a bandless sight ramp to a barrel, or the grip-safety extension for .45 Colt automatic pistol described in Chapter 32, a small piece of the hard solder ribbon is cut to fit the surfaces being united. With the brush mix a little of the borax with water on the slate to form a paste; both surfaces having previously been scraped bright they are coated with this borax paste and clamped together with the ribbon of hard solder between. Now apply the torch until the parts are red hot and the solder flows; quickly tighten up the clamps as tight as possible. When cool the parts will be found permanently joined, with little if any solder showing at the edges. The borax, however, will be baked as hard as stone, and must be cleaned off by immersion in the acid pickle. This pickle may also be used to clean the parts before joining. When attaching any part to a barrel by hard soldering or brazing, the bore *must be protected* against scale formation with one of the two formulas given in Chapter 21, which are intended primarily to protect file teeth during the hardening process.

Under no circumstances should hard soldering or brazing be employed on any hardened or heat treated parts unless the shop is equipped to re-harden and heat treat them as was done at the factory. The attaching of scope blocks and mounts to Springfield, Mauser, Winchester 54, Remington Model 30, or other high power rifle receivers must be limited to soft solder having a comparatively low melting point.

Brazing proper has little or no use in the realm of gunsmithing, at least on parts of guns themselves. In brazing, the parts to be joined are fitted together as closely as possible—often in special jigs designed for the particular job. The parts are then heated red-hot by means of an acetylene torch, and brazing spelter, usually in the form of fine filings, applied to the joint. Molten spelter has the property of finding its way into the most minute crevices—and the closer the parts are brought into contact, the stronger the resultant joint. On old and decrepit weapons I have seen hammers, sears, extractors and other parts broken and permanently repaired by brazing—yet a much better plan would have been to make new parts from suitable steel.

334

Borax is the proper flux to be used for brazing, and it is used in the same manner as for hard soldering. Boric acid is also used in some shops.

Spelter is easiest handled in granular form, like fine filings, and in this form is sometimes mixed with the proper amount of borax, but the proportions can only be determined by experiment—a difficult thing to attempt where each job is different from the other.

An important use for brazing is in fitting new lugs on the bottom of shotgun barrels, or making repairs in places where the resulting streak of brass will be hidden, for of course it will not take the blue when the barrel is refinished. Brazing is also employed for attaching long shanks to drills and reamers for use in barrel work. For this work a spelter having a high melting point is advisable, so that the tools can afterward be heated to the hardening temperature without affecting the joint.

There are many formulas for spelter and hard solder, but as their preparation is outside the scope of even the larger shops, and the quantities needed relatively small, it is always advisable to purchase these materials ready prepared from a large supply house. Tell them the work for which the spelter is required, and depend on them to supply the right grade for the purpose.

Where a torch giving sufficient heat is not available, brazing can often be done in a clean coal or charcoal fire, by using a bellows. A coke fire in a blacksmith's forge is both hot, and clean, and excellent brazing can be done in it. The blower or bellows should be operated until all visible gaseous matter is driven off, and a clean hot fire results. With a poker work a crater in the center large enough to hold the work; the parts, clamped or wired together are then lowered into this crater and the fire blown until the proper red heat is reached. The spelter will of course have been applied before the work went into the fire.

Common spelter usually used for miscellaneous work is a half and half mixture of copper and zinc, having a melting point of about 1660° F., and produces a good strong joint on iron and steel. Coppersmith's spelter is three parts copper and one part zinc. "Gray solder" is a popular spelter made of, copper, 44 parts; zinc, 50 parts; tin, 4 parts; lead, 2 parts. It is free flowing, with a slightly lower melting point than the half-and-half spelter. Another good alloy known as white solder is made by adding 15 parts tin to 85 parts coppersmith's spelter; another good one is made as follows:

A2:1 brass (copper 2 parts, zinc 1 part) spelter.....	82 parts
A1:3 lead-tin solder (lead 1 part, tin 3 parts)......	18 parts

Still another is:

Half-and-half hard spelter	92 parts
Lead-tin solder (lead 1 part, tin 3 parts)...........	8 parts

335

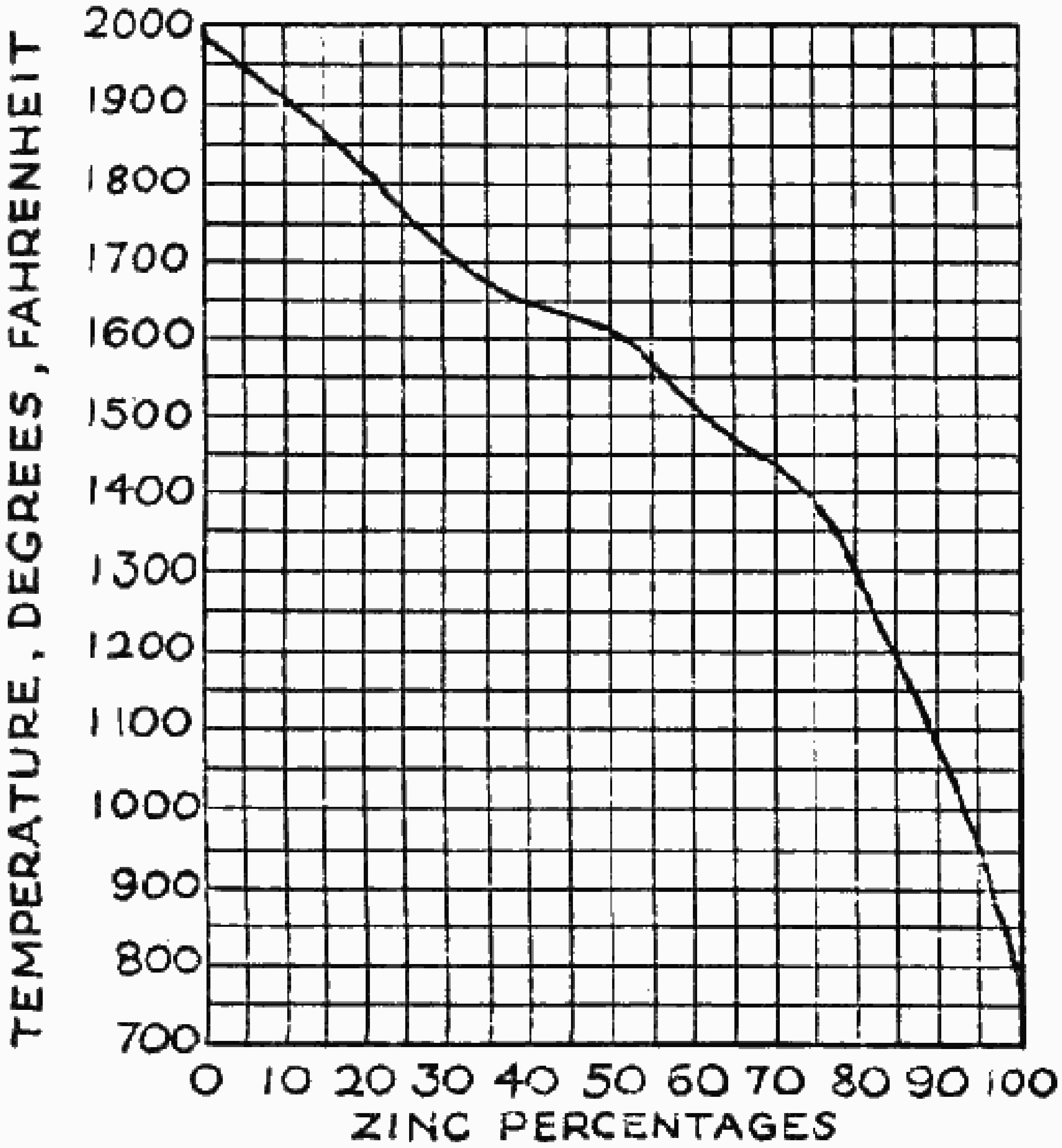
The following table illustrates the melting points of various copper-zinc alloys, while the graphic curve will be convenient to the worker of an experimental turn of mind. To find just what mixture will produce a given melting point, lay a ruler parallel with the horizontal line at the desired melting point. The ruler will then cut the curve at a point near the vertical line passing through the proportion of zinc to be used. Thus, for an alloy melting at 1250 degrees, we find we need 80 parts zinc and one part copper.

PAGE 458 RIFLE PHOTOS
460
463
ARE RIFLE PHOTOS ON
PAGES ( ) ( ) ( )

ALLOYS OF COPPER AND ZINC

Percentages in the solder

Copper	100	90	80	70	60	50	40	30	20	10	0
Zinc	0	10	20	30	40	50	60	70	80	90	100
Melting Point Fahr.	1983	1904	1823	1706	1652	1616	1508	1436	1292	1076	786



336

For joining German silver and steel, or for articles made of German silver, use the following:

Copper	35 parts
Zinc	55.5 parts
Nickel	9.5 parts

Other very good German silver solders are:

Copper	38 parts	or	Copper	36 parts
Zinc	50 parts		Zinc	56 parts
Nickel	12 parts		Nickel	8 parts

When mixing brazing alloys using lead and tin in composition always melt the brass and other metals with highest melting points first. When the softer metals or alloys are added, stir the mixture thoroughly, cover the surface with powdered charcoal and bring to almost a red heat.

WELDING may be defined as the joining together of two pieces of similar metal by autogenous fusing, in which the two parts are heated to the melting point and molten metal of like character run into the joint.

In the blacksmith's method of anvil welding, which may be stated as a metallurgical process, the surfaces to be joined are brought to melting heat or just short of it, and worked together by hammering.

Electric arc welding is a process by which the surfaces to be joined are heated to melting point at one spot by an electric arc formed between the surfaces and a rod of similar material held close to it. The heat from the arc fuses the end of the rod, and the metal therefrom is deposited in the joint.

Forge welding, as practiced by blacksmiths, is the oldest known form of welding—so common that instructions on the subject would seem superfluous, but for the fact that a machinist or gunsmith is not necessarily familiar with it, and a study of the fundamentals may prove of some value in the repair and manufacture of certain tools.

The success or failure of a forged weld depends on the fluxing. The film of oxide, or "scale" must be immediately washed away and forced from between the surfaces being welded. The metal must be worked only at the proper heat, which in iron and steel is indicated by their vigorous sparking as they are removed from the forge. Sometimes a number of heats is necessary to complete a large weld.

The early gunsmith made his rifle barrels by bending flat bars of iron around a mandrel and welding the edges together, and the perfection of his work is seen on the many fine specimens of flint and percussion arms now so treasured by their owners. In many of them the weld is practically invisible. He used a charcoal fire—the very best for anvil welding, and he "struck while the iron was hot."

337

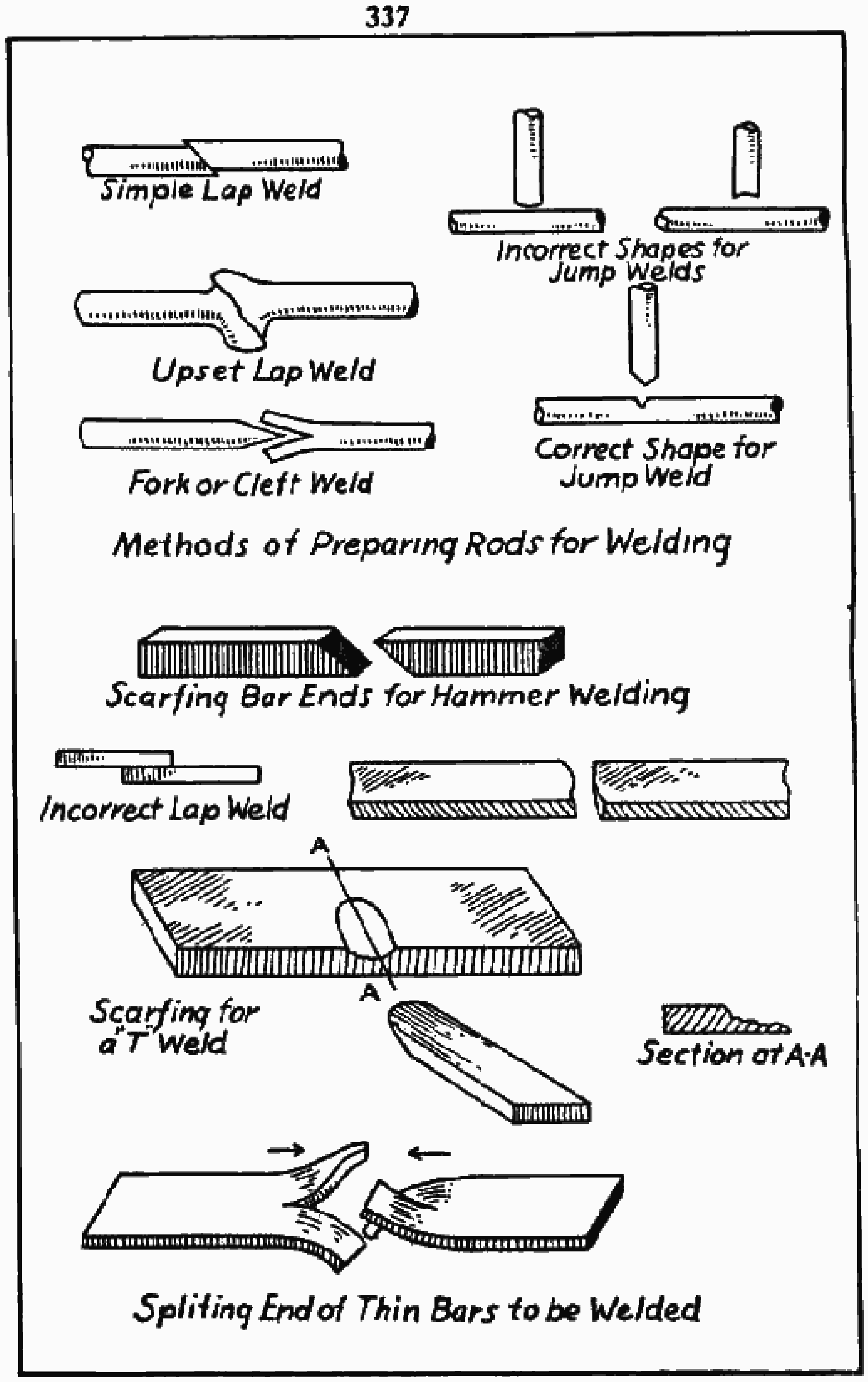


Fig. 132

338

The principal disadvantage of forge welding is the large area of metal which must be heated, and the distortion or in some instances the physical changes in the metal, which results from this heating. For example, short reamers and bits used in barrel machines are not adapted to any form of welding because of the danger of burning out the carbon from the steel. For this reason the long shanks of such tools are usually brazed onto the cutters, as the red heat of brazing will not burn them.

Preparation of the work is the first consideration. Figure 132 shows various standard welds, and the method of shaping the ends of parts. For a simple lap weld the pieces are beveled and slightly rounded at the point of union. This rounding permits of the scale that is loosened by the flux being worked out by hammering. In an upset lap weld the parts are hammered out to a larger area than the original stock—this to gain strength because a forge weld has not more than three quarters the strength of the original metal. The fork or cleft weld is popular for joining two rods together. A jump weld is used for joining the end of one bar to the side of another, and the right and wrong methods of preparing the pieces for this weld are shown. Never attempt a lap weld between the ends of flat bars without scarfing them as shown.

A good forge and anvil, with two or three tongs and hammers, anvil chisel and fuller, constitute the equipment needed. Charcoal makes the best fire; next comes coke. Fine coal may be used, by wetting it down around the edge of the fire so that it forms into coke. The fire should be rather deep in the center and should be blown until all visible gases are burned out.

Place the two ends to be welded in the fire, cover with coals and blow with bellows or fan blower until the two ends are bright red, then drop on them the flux, which may be borax, sand, powdered marble or sal ammoniac—or one of the commercial welding compounds. A mixture of borax and river sand, about half and half, makes a good flux for welding. Return the parts to the fire and bring them to white heat, so that they are emitting sparks; lift them in the tongs, and strike them smartly on top of the anvil, which will knock off most of the scale. Bring the ends together as desired and hammer until nearly cool, bringing them to the shape desired.

There is a knack about forge welding that can only be learned by long experience. Some old-time blacksmiths can weld steel at very low heats—scarcely more than cherry red; while some men never learn to make a good weld. If the reader has ambitions along these lines, he can do no better than to cultivate the village smith and study his form and methods. But blacksmithing is apparently becoming a lost art—the garage now occupies the place of honor under the spreading chestnut tree.

AUTOGENOUS WELDING, usually by means of the oxy-acetylene torch, is the most useful to the gunmaking trade. Yet it

339

is a highly specialized trade in itself, and most gun shops find it advantageous and economical to send their welding outside. An oxy-acetylene torch is, however, almost a necessity for many odd jobs of bending, such as bolt handles, etc., where it is desired to keep the heat localized as much as possible, and for this work an investment in a torch and outfit will probably pay dividends even if the shop does not do its own welding. The equipment needed consists of a tank of oxygen and one of acetylene, with suitable gauges for each, several feet of heavy rubber tubing, and the torch. This equipment is shown in Figure 133, and the cost complete will be around two hundred dollars.

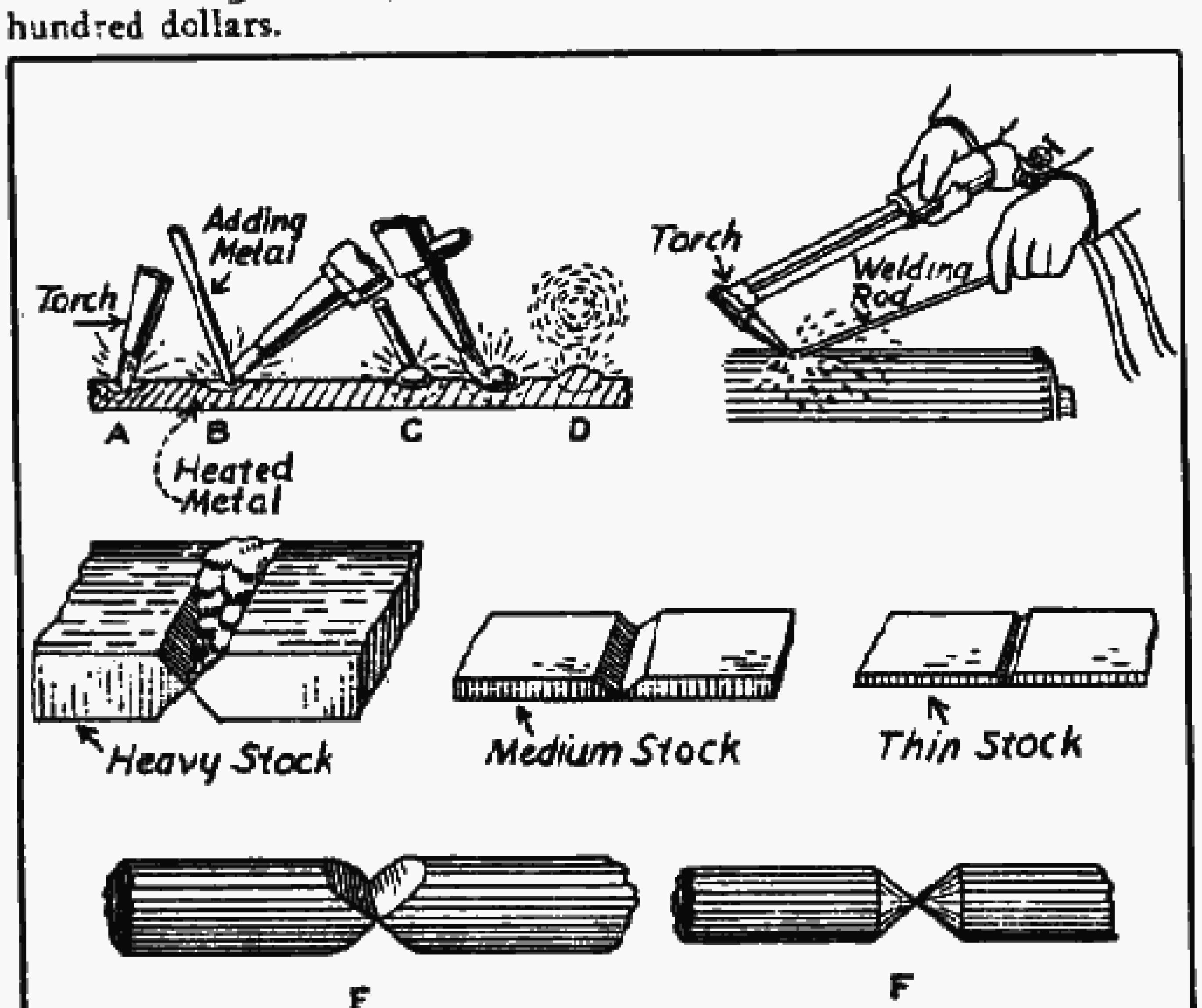


Fig. 134

Figure 134 shows the method of scarfing edges to be welded and various ways of manipulating the torch and welding rod. In every case the metal must be filed or ground well back from the edge, forming a wide notch or groove into which the metal is flowed. This method being entirely different in principle from forge welding, there can be no lapping as is practiced in the latter method. When preparing work for the welder, leave plenty of space for him to fill in new metal. This preparation of the work is important to the shop that sends its welding out. When properly prepared, and clamped or held in suitable jigs, the welder proceeds without loss of time, and cost of the work is kept down to a minimum.

340

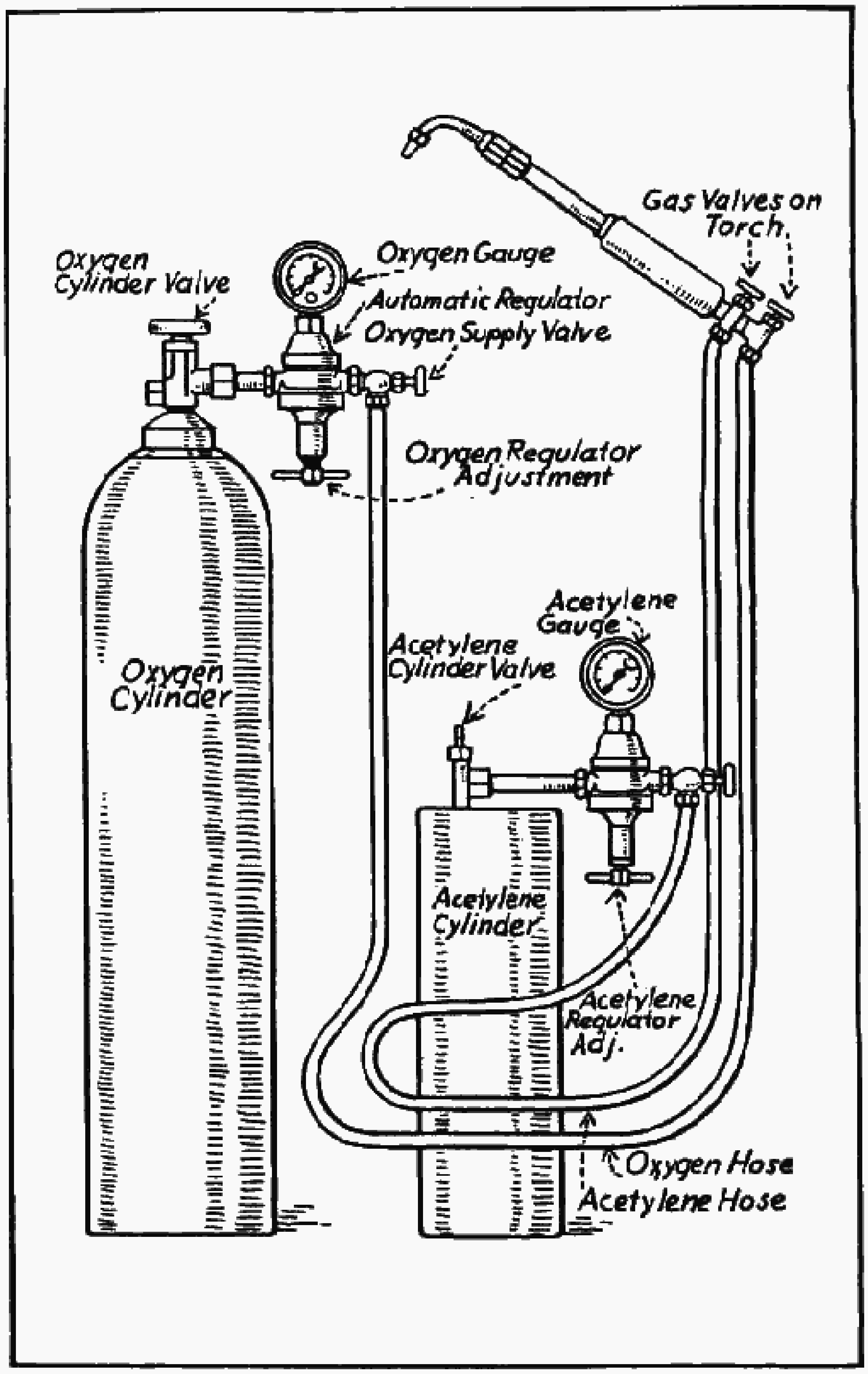


Fig. 133

341

ELECTRIC ARC WELDING AND ELECTRIC WELDING differ somewhat in the technique and apparatus employed. The seams of gas tanks on automobiles are often electric welded—but not arc welded. The method employed in the Ford plant is to run the seam, after it is pressed together, through the two copper rollers which form the contacts. These bring the edges of the tank metal into contact, while welding heat is generated at the point of contact, and the two pieces are made into virtually one piece.

"Spot welding" is similar, except that the two pieces of sheet metal are held between the ends of two copper rods carrying current of the right intensity to generate welding heat at point of contact. This is a most useful process commercially, being quite rapid, and the joints permanent. An example of its use may be found in the metal stools and chairs used at soda fountains the legs being thus "tacked" or "spotted" to the metal rim of the seat.

Arc welding may best be understood from Figure 135, which

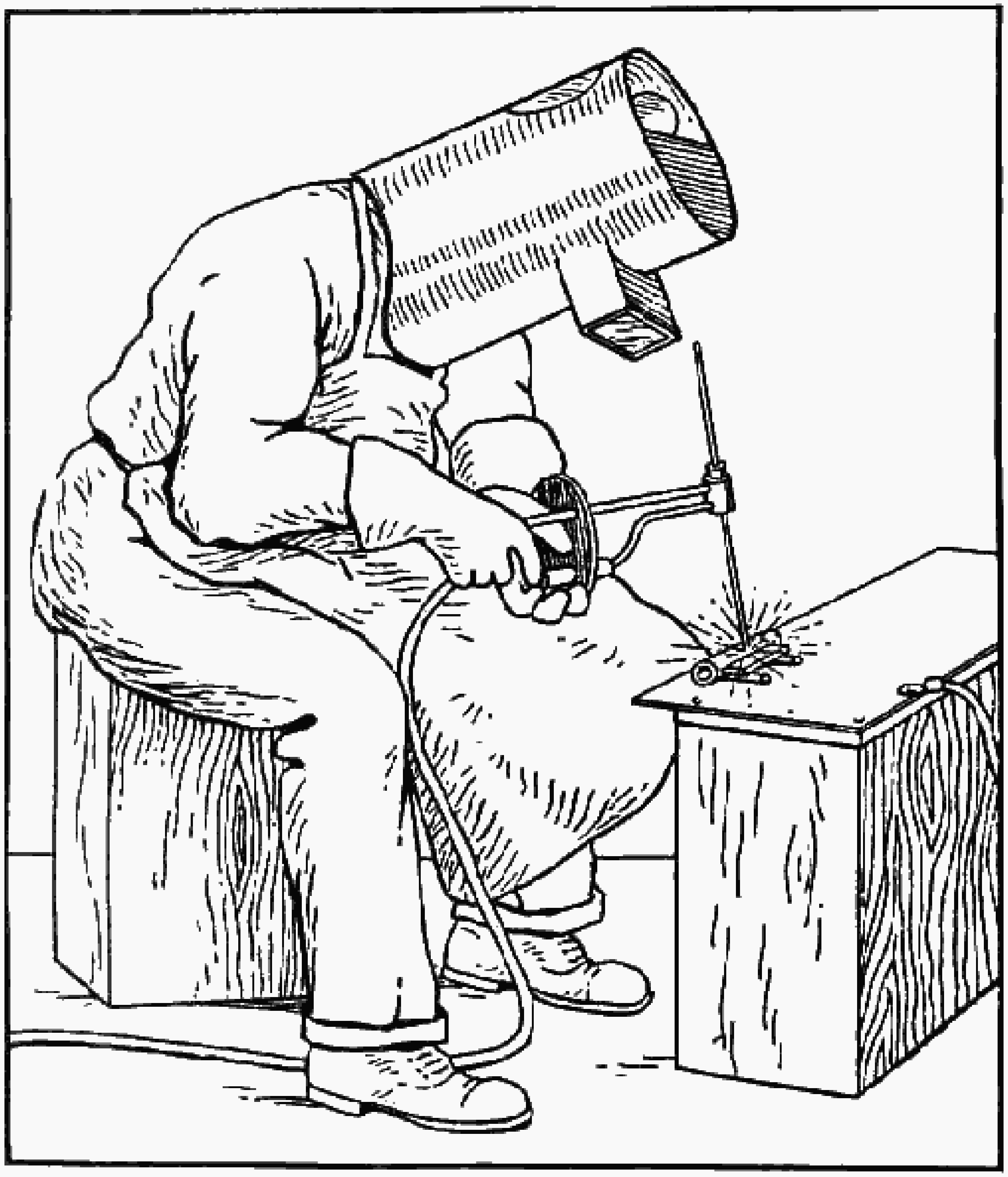
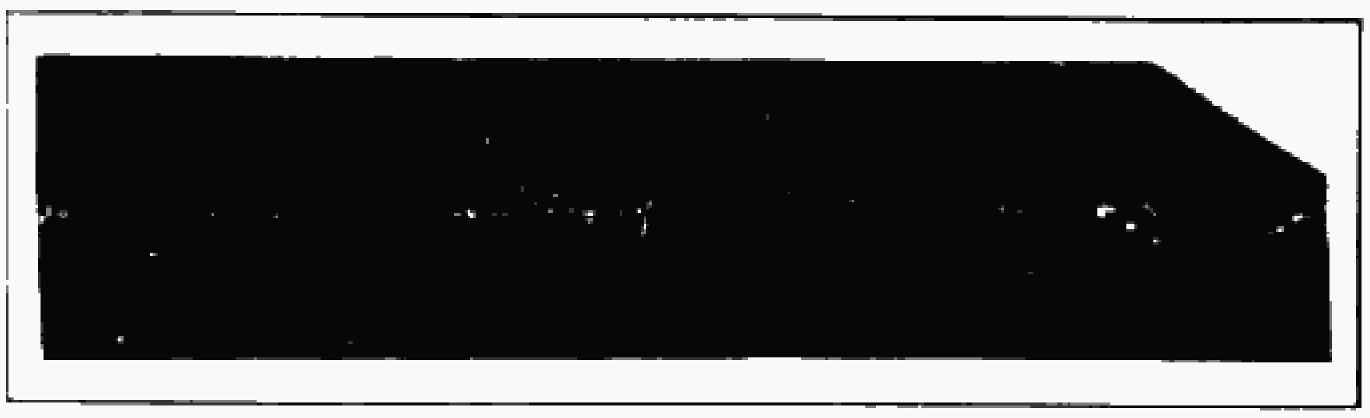


Fig. 135

342

shows an arc welder at work and illustrates the operation clearly. As for acetylene welding, the edges must be widely scarfed, and the welder touches the work with the welding rod at short intervals, forming an arc which deposits the molten metal each time it is lifted. The illustration below shows a piece that has been arc welded, before the excess metal has been dressed off.



When sending work out, the welder should always be instructed to not dip the job to cool it after welding. Let it cool gradually, otherwise the joint may harden so that annealing is necessary before it can be finished. When doing any welding or bending on bolt, receiver, or other hardened or heat treated part, the portions subject to wear or pressure (locking lugs, lug recesses, cams, etc.) must be protected by wrapping with wet rags or waste.

The various specific alterations and repairs involving the use of soldering, brazing and welding are discussed in detail in the next chapter.

343

Chapter 24

MANUFACTURE AND SUBSTITUTION OF SMALL PARTS

Modern gunsmithing, particularly that branch of the work applying to custom-built arms and remodeled military rifles, as well as special target pistols and rifles, has brought into accepted use many small parts not formerly known on the standard factory products. Many of these are not necessary to the functioning of the arm, nor do they affect its shooting qualities—their principal use is that of convenience in handling, and in improving appearance. The private gunmakers are loath to part with any of these "gadgets" for the use of amateurs desirous of adding them to their own factory and military arms; besides they take the attitude—and a very sensible one it is in many instances—that the man purchasing such parts lacks both the tools and mechanical ability to fit them properly; and they do not care to see their pet "rinctums" cobbled onto guns lower in quality than their own products.

Our logical course, then, if we are determined to have our pet shootin' iron equipped with sun parlor, sunken bath tubs, disappearing beds and all the latest gadgets, is to make and fit them ourselves. And happy to relate, their making is not beyond the reach of even the amateur after he has acquired reasonable familiarity with his tools, provided he follows instructions carefully.

Much of the material needed for barrel bands, and the like will not be found in the ordinary hardware store, but must be purchased from machinery supply houses; among these may be mentioned the Cleveland Tool & Supply Company, Cleveland, Ohio; Standard Supply & Equipment Co., Philadelphia, Pa.; the Ellfeldt Hardware & Machinist's Supply Company, Kansas City, Mo.; and the M. L. Foss Machinist's Supply Company, Denver, Colo. There are doubtless a number of others able to serve equally well—I merely mention these firms as I happen to know that they carry large stocks and are thoroughly reliable.

344

PLUNGERS AND THEIR USES. The simple plungers shown in Figure 136 have a variety of uses, particularly in remodeling. Their construction is quite simple, and the method of fitting also, particularly if one has a good drill press with suitable vise on the table for holding the work. One or two V-blocks with clamps are also useful.

In Figure 136, A shows a ball end plunger, which is useful for taking up the jump in a bolt handle when the gun is fired; also for forcing the bolt firmly against one side of receiver to assure alignment of a cocking piece sight, and similar uses.

The Krag rifles, for example, usually have a fault common to the Model 30 Remington, some Springfields, and many Winchester 54's and other bolt actions—that is, when the gun is fired, the bolt handle jumps up an eighth inch or so. This fault may be entirely eliminated by setting a small ball-end plunger in the edge of the right receiver wall at rear end, and drilling a small depression in the front edge of bolt handle where it touches the plunger. The spring forces the rounded end of plunger into this depression holding the handle down firmly until it is raised by the shooter. A similar plunger may be set into some bolts near the rear end to bear against the inner wall of receiver, or else into the receiver wall to bear against the side of bolt, forcing it tightly against the opposite wall, and giving assurance that the cocking piece sight will be correctly aligned each time the bolt is closed.

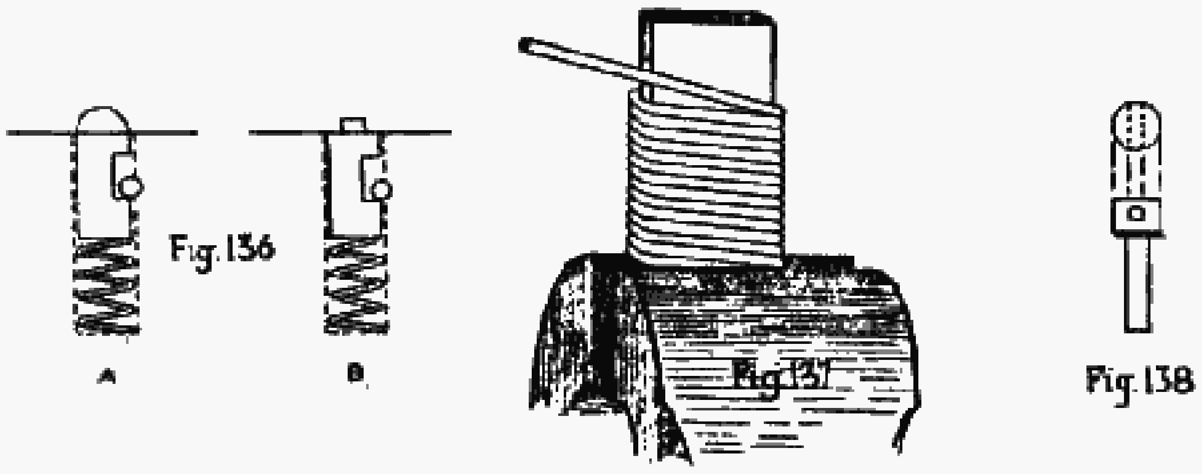
B, Figure 136 shows a plunger that is useful in connection with caterpillar sights when fitted into a ramp, and for other uses. A tenon is turned on upper end of plunger, the plunger setting vertically into upper edge of ramp under the forward end of the sight. When inserting the sight the plunger is forced down out of the way. A hole large enough to receive the plunger tenon is drilled in the flat tail piece at front end of sight. When sight is fully in place in its slot, the plunger snaps up, the tenon going into this hole. The end of tenon should be filed flush with upper surface of the sight tail. To remove sight, simply press in plunger with match, pin, or bullet point, while pushing sight forward out of the slot. Be careful to hold thumb over plunger as sight is removed, so that plunger and spring do not jump out of the hole. This cannot occur if a pin is used to hold the plunger, as shown at B, Figure 136, but the pin may be omitted on a sight plunger if desired.

Plungers should always be made of good steel, and should fit the hole very closely, but not too tight to slide freely. Drill rod of the right size makes good plungers with a minimum of turning or filing. The square notch is cut with a file, to accommodate a transverse pin which prevents the plunger jumping out when the pressure is removed. It is easiest to shape up the bottom end of plunger on a piece of stock several inches long; cut the notch and fit it into the hole on the spring, then mark and cut to length, afterward shap-

345

ing the upper or outer end as required. Any plunger subject to much wear must be well hardened or it will soon become useless.

Even if made of drill rod the best method is to case-harden them in cyanide, then polish the wearing end smooth with an Arkansas hone.



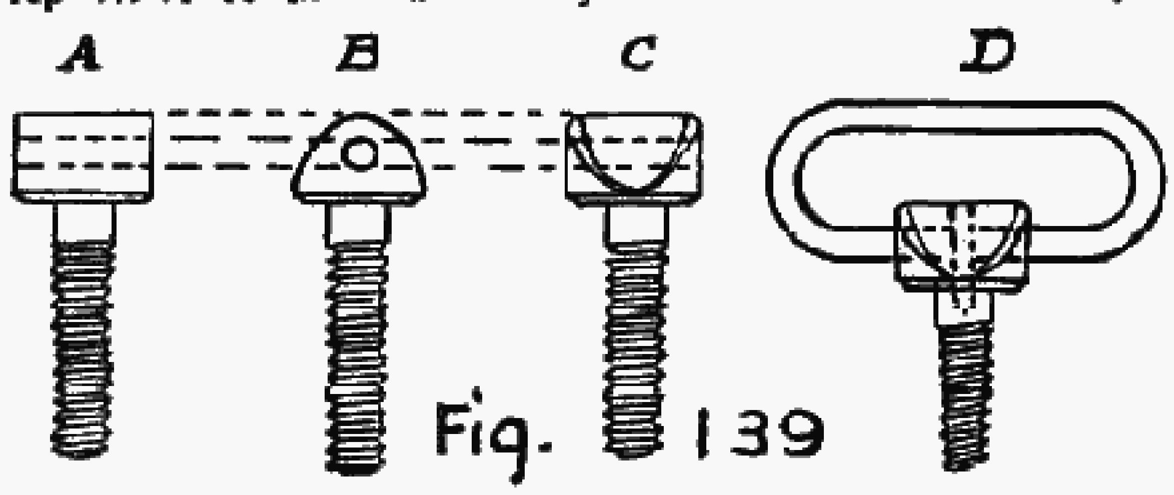
In Chapter 5 I have mentioned round Bessemer steel rods as being the best material for MAKING SWIVELS AND LINKS FOR SLING STRAPS. The size rods ordinarily selected for this use is 9/64 inch, and the method of making the swivels and links is as follows: First, rub off the copper coating by drawing the rod back and forth through emery cloth held in the fingers. Next make up the bending form by taking a piece of flat bar cold rolled steel and rounding the edges by grinding or filing. This bar need be no more than six or seven inches long; its width and thickness to be the dimensions desired for swivel or link. A swivel to take the 1 1/4 inch government sling should be 1 1/4 inch by 5/16 inch inside—so make the form from this size bar; a 7/8 inch sling calls for swivels and links bent on a 7/8 by 5/16 inch bar. Set this bar upright in a strong vise, with one end of the Bessemer rod caught by the vise; then wind the rod around the forming bar in a close spiral until all of it is wound up—see Figure 137. Strike each coil on the flat side with a hammer after bending over the rounded edge. When the entire rod is wound like a spring on the forming bar—or when you have as many coils wound as you expect to need cut the coils down the center of one flat side with a hacksaw, when they will drop off the bar. The coils will be perfectly formed links except that the ends are twisted sideways an amount equal to the diameter of the stock. They may be blued at this stage, or the entire swivel assembly may be blued together. If making links for sling, bring the ends together smoothly by holding the closed side in a vise and bending the ends toward center with straight jaw pliers. Then buff them on the wire buffing wheel, and blue by the heat and oil method described in Chapter 20.

SWIVEL SCREW. The loop or link is only half the swivel; but before going into details of a finished swivel with screw and link permanently joined, we must consider the type of screw necessary for use with detachable swivels. As these swivels (Figure 151C) are just a trifle over 1/2 inch between the side bars, we need a

346

screw with head 1/2 inch in diameter. Any machine shop can make this in a few minutes. The head should be about 3/8 inches in depth, and should have a No. 25 hole drilled through it from side to side. The threaded portion should be 1 inch long, and may be cut short as required after it is finished. 7/32 x 32 is the best size if the screw is to be attached to a barrel band through the forend. If a butt swivel screw is needed, use the coarsest possible thread, so that it will hold in the wood without pulling out.

Figure 138 shows the screw blank before it is threaded, and front and top views of the head. If you have no lathe and buy these



from a machine shop, have them leave the head cylindrical as A, Figure 139. Then you can file it to the shape shown in Figure 139B, or shape it up on the emery wheel. An easy way to do this is to slip a No. 25 drill through the hole in head. Hold the drill in right hand, with head of screw resting on tool rest of grinder, point of screw held in left hand. By rocking the point up and down while the head is held against the wheel by means of the drill, the grinding can be perfectly controlled, and the head almost finished on the grinder.

A cheap substitute for these lathe made screws is a 5/16 inch hexagon head cap screw (S. A. E. standard). This head is just 1/2 inch diameter between the flat sides. By grinding or filing it round, and drilling the hole through it for the swivel it does very well, although the screw portion is really a bit too large and thread too coarse for best practice. This will cause the swivel to loosen and turn sideways if the strain on the sling is in that direction, but it cannot of course make more than a quarter turn.

A screw of the type described may be fitted through a hole in the forend and into the stud on underside of barrel band. The detachable swivels may be instantly snapped on or off, and when the sling is not being used, the heads are small and inconspicuously "streamline" in appearance.

But suppose we want to use the wider strap, for which detachable swivels are not available. A fixed swivel is easily made from the same screw, as follows: Take one of the links already prepared, and spread the ends sufficiently so that one end can be pushed clear

347

through the hole in screw head; then bend the ends until they meet in a straight line, and slip the swivel back until the two ends are in the center of the head. Now drill a 1/16 inch hole through center of head and drive in a pin made from drill rod; this pin entering between the open ends of swivel holds it in place, and gives the swivel slight tension so that it will not work loose and rattle. The screw head around the pin should be peened lightly to keep the pin in tight, after which the head is ground to shape, filed smooth, polished and blued. The method of pinning in the swivel is clearly shown in Figure 139D.

A good substitute for the swivel screw for use with detachable swivels may be made from an old government swivel from Springfield or Krag. Cut the swivel in two and pull the pieces out of the base. There is a pin through the center of hole in base. Run a No. 25 drill through the hole to cut out this pin—and there you are. The base is just the right width for the detachable swivel, the bar of which fits through the hole nicely—and this type of swivel base is even less conspicuous on the rifle than the screw head previously described.

If a swivel base of this type is to be used for the forend swivel the barrel band should be of the type shown in Figure 147, with filister head machine screws through the holes in swivel, extending through forend and into the block to which band is attached. On a target rifle with heavy, stiff forend, it may be preferred to omit the barrel band entirely, the swivel base being merely attached with wood screws.

Here's an easy way to fit these swivel bases into the stock: hold base in position and mark around it with a sharp scriber; also scribe outlines of screw holes. Center these holes accurately, and bore in with a 1/2 inch augur bit—just enough to cut the outline to the required depth with lips of bit. Use a flat, or slightly hollow chisel to cut out the wood between bit cuts, and even up the bottom with the bottoming tool used in stock inletting. With a very little trimming up of the edges the swivel base will flush perfectly.

In remodeling a military or obsolete rifle one may desire to use the old outside barrel band because it fits the barrel perfectly, yet this band may have no swivel and no place to put one. This can easily be overcome by taking one of the swivel screws already described, and after shaping up the head, cut off the threaded shank leaving just enough to reach through the bottom of band and project slightly on the inside. Drill and tap a hole in band and turn the screw in tightly, taking care that the hole through head stands crossways when the band is on the barrel. The inside of the hole should be slightly countersunk, and the projecting end of screw peened or riveted tight. To do this, stand the screw and band on a block of lead to prevent marring, and use a drift punch to reach to the inside end. This end after being riveted, should be filed

348

off flush with inside of band. If the band requires bluing, it is a good idea first to heat it red hot and flow in a little brazing spelter from the inside onto the end of screw. The spelter will go into the threads making a solid brazed joint, so that the screw can never loosen.

A still better way is to take the band to a good welder, and have him melt on some mild steel to form a good sized lump on bottom of

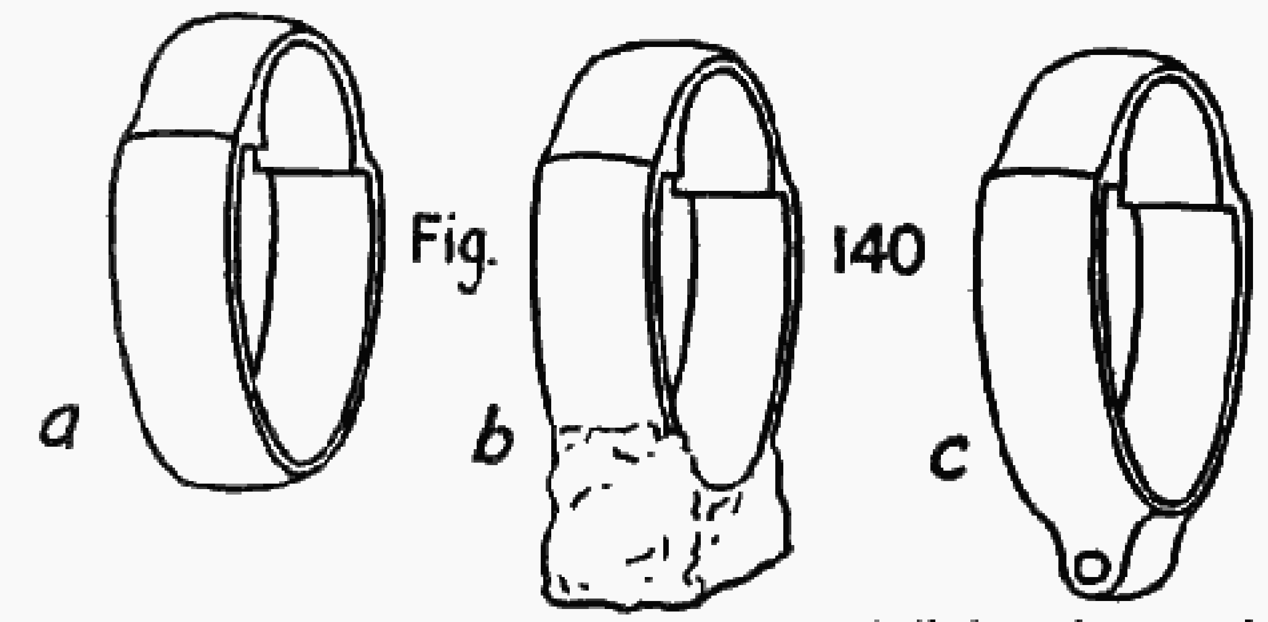


Fig. 140

band, which is afterward filed, ground and drilled to shape to form a swivel stud, as shown in Figure 140. This may be used for detachable swivels, or may be fitted with a fixed swivel, by pinning it in as described for attaching swivel to screw head.

This stunt is of value in remodeling some of the Krags which have a band with cavity for handguard, and are minus swivel. W. Stokes Kirk also sells good outside bands similar to the lower band on the '73 model Springfield, which lacks a swivel. These bands are thick enough to permit their being fitted to different barrels.

MAKING BARREL BANDS. It used to be, that whatever had to be fastened to a rifle barrel was fastened with a screw turned into the barrel, or else by a dovetail slot; and because we didn't know any better, the scheme worked like cats fightin'. But since styles must change, even in shootin' irons, we know now that such antiquated methods are so destructive to accuracy that we can't hit a flock of barns with a barrel so fastened—if we know it. So we use barrel bands instead, as a means of attaching swivel screws, and to hold barrel and forend together, and to provide bases for sights mounted on the barrel—and sometimes to cover up screw holes and other defects in the barrel itself, as well as to provide handguard fastenings.

The very best and most workmanlike bands are made from solid thick-walled Shelby tubing; the band and the stud to which the screw is attached, or which in some instances forms a sight base, being made in one solid piece. Other bands, which answer equally well, in many cases, are made from thin stock soldered, pinned, brazed, or screwed to a thicker block of steel.

Before going into details of barrel band construction, it must be

349

remembered that most barrels taper, hence the inside of band must have a slight taper also. Shelby tubing and other soft steels will stand considerable stretching, therefore we select our tubing with inside diameter slightly less than the barrel diameter at the point band is to fit. If possible, select tubing with an inside diameter about the same as the barrel thickness some two or three inches ahead of the final location of band.

First we will make a simple inside band with stud for a swivel screw to go through the forearm; details of this band are shown in Figure 141. Cut a piece of tubing of the proper size about 5/8 inch long; the wall should be from 1/4 to 3/8 inch thick. Hold the piece in a large vise, and with a rather coarse cut hacksaw, lop off excess metal as shown in Figure 142. Now work off the corners on emery grinder, or with a coarse cut bastard file, until the band portion is about 1/16 inch thick. Shape up the base or stud portion so as to keep the sides parallel, and shape up fillets where the base joins the band with a small rattail file. Hold the band in vise so that the jaws press against the edges, not on the sides.

The next step is to locate the point for the screw hole in center of base, center punch it, and drill and tap the hole for the swivel

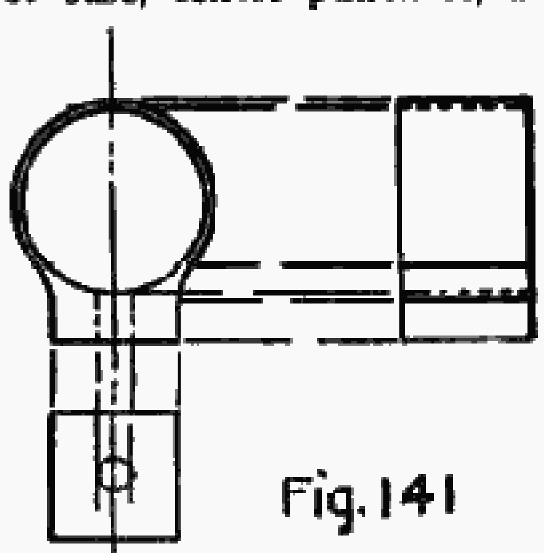


Fig. 141

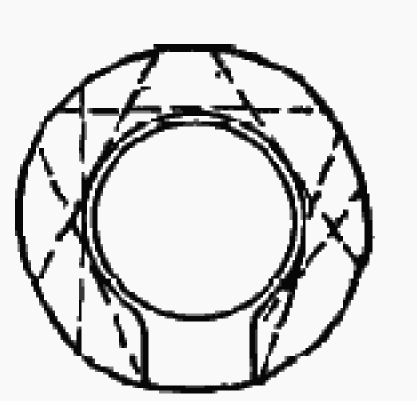


Fig. 142

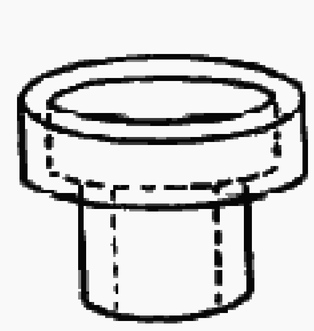


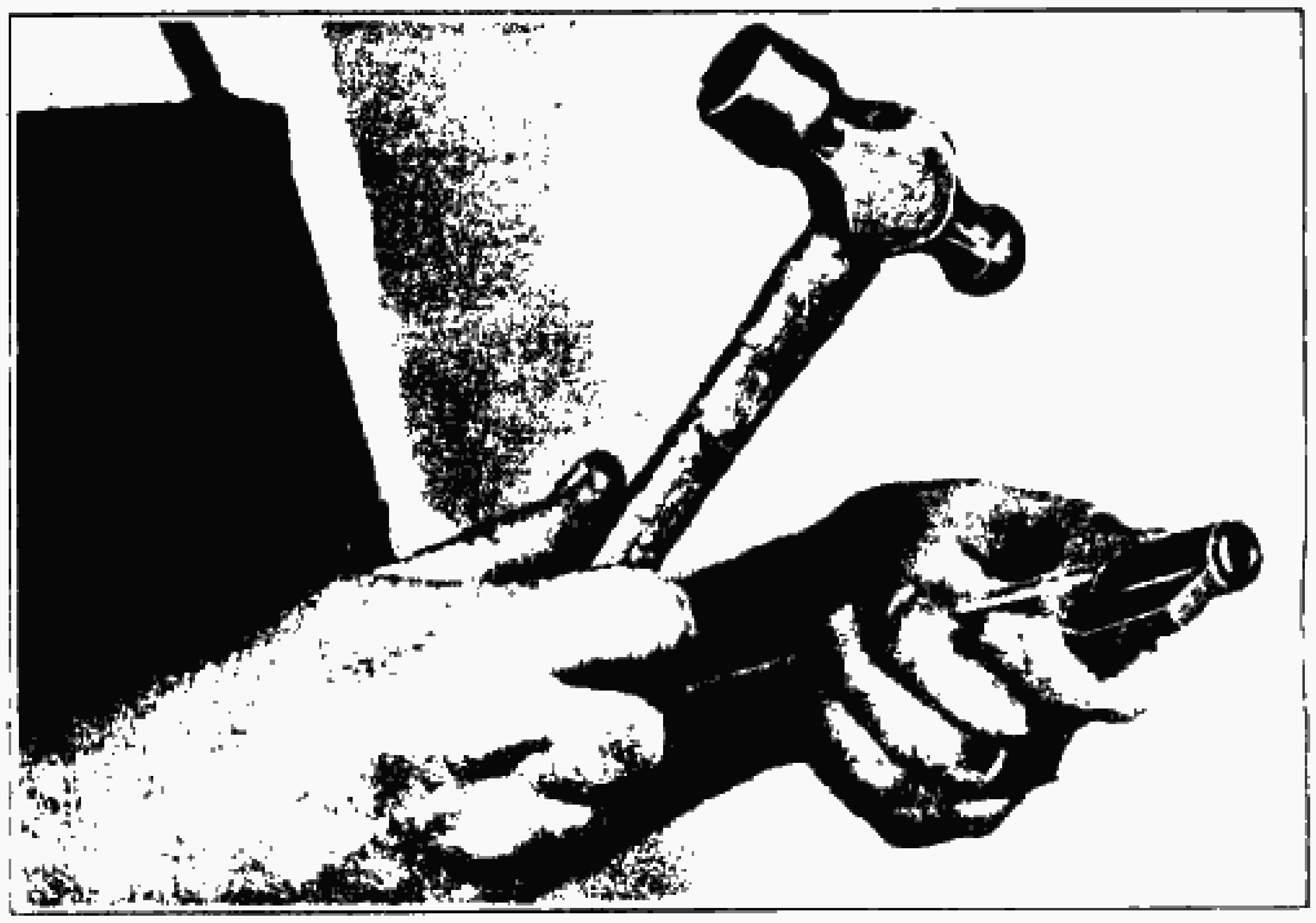
Fig. 143

screw. Use care to get this straight in line, otherwise the swivel will set at an awkward angle. Now we are ready to fit the band to barrel and form the taper. It may be fitted right on the barrel, or if you have an old damaged barrel of the same size and taper, use it instead. Save all old discarded barrels, as they make good forming bars for bands. Another way is to have a number of short arbors turned up with various tapers likely to be needed, and keep them for this work. This is really unnecessary, however, as the band can be fitted right on the barrel without hurting the barrel if you use reasonable care. The only damage possible is to the finish, and if a band is being fitted to a new barrel that is not to be reblued it is sometimes difficult to prevent scarring it slightly.

If the band is very rough inside—and most Shelby tubing has slight marks and ridges left by the drawing process—smooth it out

350

a bit with a straight reamer and polish lightly with fine emery cloth wrapped around a stick or iron rod. Wipe out all grit, and slip the band on the barrel as far as it will go. Now measure and make a light scratch mark on underside of barrel at the exact point where the center of band is to come. With a piece of brass or copper, drive the band toward this mark until it is tight on the barrel. Now hold the barrel under the left arm, with hand grasping it near the band, and with a ball peen hammer, peen the band over its entire surface, striking heavier blows along the rear edge where it fits the



Peening on a ramp front sight

barrel tightly. After a few moments of this you will note the band is loose. Drive it further on the barrel until again tight, and continue peening. Gradually the rear portion is enlarged until the band is equally tight at both front and rear edges; now continue peening with equally heavy blows over entire surface, driving the band on further as it is enlarged, until it can just be driven snugly to the mark—or rather, so that this mark on barrel is seen *through* the screw hole in band. Now peen lightly over the band again to stretch it enough to relieve the strain. You should now be able to slide it off and on by a push with the fingers, the band coming to a definite stop at exactly the right point. It may now be set in the vise and the surface of band carefully smoothed with a fine mill file, and the outer edges slightly rounded. In finishing, bring the band to about 1/32 inch thick with a fine flat Swiss file, such as a 6 inch pillar file; and use it in the direction of the barrel's length—not across the band—in the same manner as in striking barrels.

351

Then polish with emery cloth in the same direction, as this makes the band appear much thinner and less conspicuous than when the polishing is done across it. No. 0 emery cloth, if used after it is well worn down, will give a sufficiently bright finish to the band. It is now ready to blue and put in place on the barrel.

A band of this type must be put on before the front sight or its base is fitted; such a band is usually used when the entire barrel has to be reblued, in which case it may be blued with the barrel. Leave it loose on the barrel, so that the bluing covers the barrel's entire surface; if the band is pushed to place before bluing, the portion of barrel under band is not blued, and if it is found necessary later to change the location of band slightly, there will be an unsightly bright ring showing on barrel at the edge of band.

If the stock is already made, the next step is to inlet the band into forend, which is easily done by pressing it down firmly to get the impression of the corners of stud. Cut out the square cavity with a chisel, then coat under side of band and stud with lamp black and oil, and spot it into place with fine chisel cuts. Very great care is necessary to avoid gaps at edge of forend where it meets the band. Also, be careful to secure absolutely equal pressure against the band on all sides. It is usually advisable to relieve the wood just enough so that it does not quite touch the band on sides, except at extreme upper edges. The cavity into which the stud rests should also be 1/16 larger all round for safety from side pressure. The bottom surface of stud should just touch the wood with the same pressure as the barrel exerts against the bottom of channel.

Coating the bottom of stud thickly with lampblack will locate the position of swivel screw hole, which is drilled from the inside; as soon as the point of drill shows on bottom of forend, finish the hole from the outside. Ream the hole larger than the screw to avoid any strains. An escutcheon or bushing set into the wood is not necessary with the swivel screws previously described, but may be used if desired. They are easily made from brass rod or thick walled tubing, turned to shape as shown in Figure 143. Shallow notches or teeth should be filed in the edge of the shoulder, to prevent it turning after it is fitted into the forend. This escutcheon should be set in flush with the surface of the wood, using a counterbore to cut the space for the shoulder, or cutting it out carefully with a half round chisel of the right size.

In my opinion it is not necessary for a band to be fitted with a noticeable gap showing between it and the barrel. A snug push fit is not going to affect the shooting of the barrel in the least, nor will it cause constriction. The thin band will expand with heat even faster than the barrel does, and bands fitted in the manner described have never given me one bit of trouble—and they surely look better than a band sticking up away from the barrel, as some fit them.

Figure 144 shows a type of special band that has proven particu-

352

larly valuable to me. It is cut from tubing in the manner already described, but has a slot or keyway cut to one side of the swivel screw hole, of a size and depth to permit of its being slipped over the Springfield fixed stud. This band is most useful on the D.C.M. sporters when the owner desires the forend shaped up a little, and an inside band fitted. The band should have the keyway cut out first, then the outside roughed to shape, and peened to size over an old barrel. It is then finished and blued, the movable stud taken off the barrel, the band slipped to place, and movable stud put back. A screw for use with detachable swivels may be used in connection with this band if desired.

Figure 145 shows a band made in two pieces, the band being attached to the base block with four small screws, two in each end of

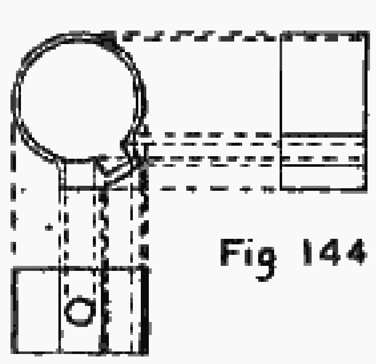


Fig 144

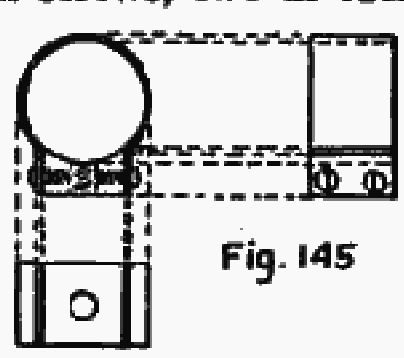


Fig. 145

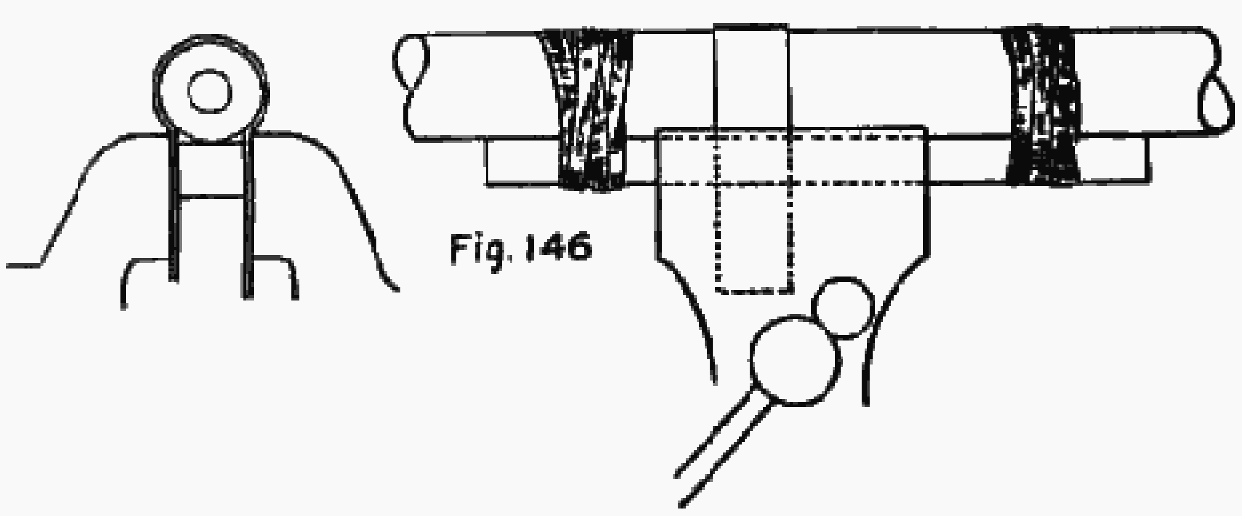


Fig. 146

the strap. The method of forming the band is clearly shown in Figure 146. A piece of square steel the same width as the base of band is to be made is taped or wired to the barrel as shown; a U bend is made in the band stock, and the piece then "straddled" over the barrel, and the vise set up tight. The base is made by milling or filing a hollow approximately the same as the curve of the barrel in a piece of cold rolled steel 1/2 x 3/8 inch. Two holes are then drilled in this and tapped for 2 x 56 machine screws, and corresponding holes of "body" size for the screws drilled in the ends of band. The screws are cut off so that they will not quite meet in the center of the block. Use filister head screws, but file the heads to about half their original thickness. Some use rivets instead—which makes things rather tough in case you want to remove the band some time.

This band is made from 1/32 by 5/8 inch cold rolled steel, and it should be fitted to barrel a couple of inches ahead of its final loca-

353

tion, then peened to a perfect fit after it is assembled. It should then be filed smooth, polished and blued before putting it on to stay. This type of band looks simpler than those made in one piece—but actually there is about as much work in one as in the other, and the one piece band is much to be preferred.

A variation of this band, for use with standard swivels or swivel bases is shown in Figure 147. The base block is made longer, and is attached to the band with two screws instead of four. Holes are drilled and tapped in each end to take machine screws which hold the swivel in place. If desired the swivel loop may be removed from the base, and detachable swivels used, as already explained. This

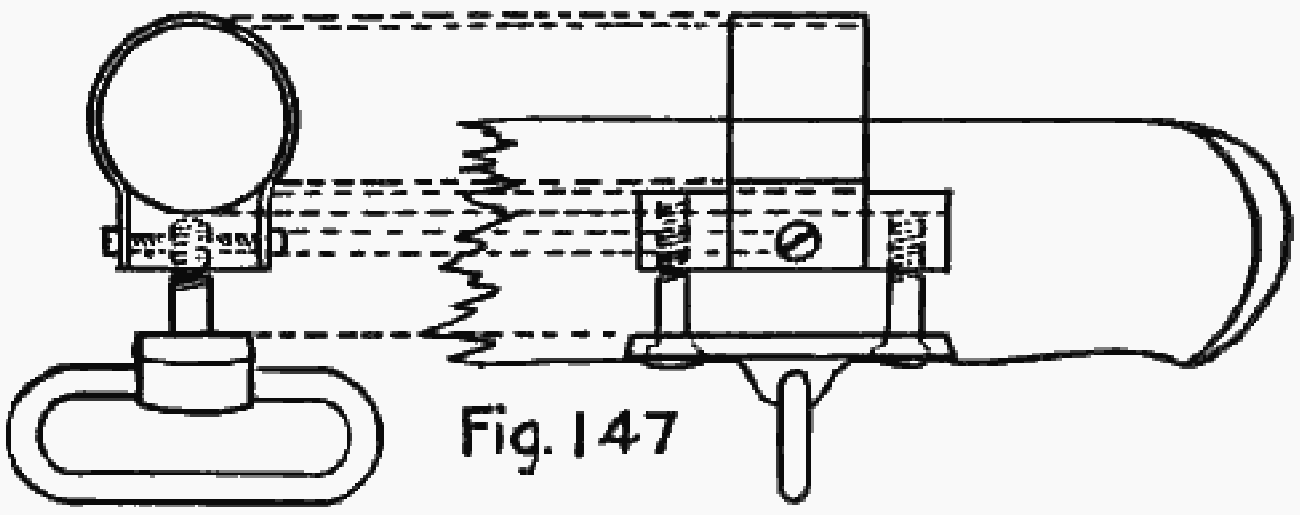


Fig. 147

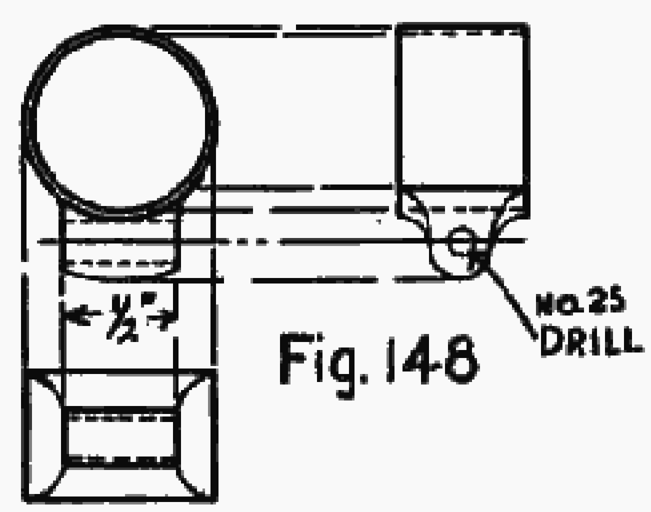


Fig. 148

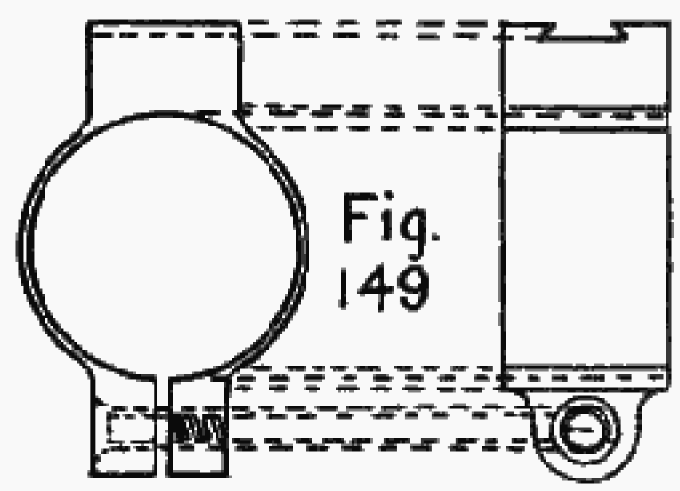


Fig. 149

is really better than the single swivel screw, as the latter may loosen and turn sideways from the pull of the sling, while a base of this kind is always in line.

Figure 148 shows an excellent swivel band for use on rifles where the forend is not fastened to the barrel. This band is stretched and peened to fit the barrel two or three inches ahead of the forend, and sweated into place as described in Chapter 23. The stud portion is made 1/2 inch wide and drilled with a No. 25 twist drill. The shaping of this stud by filing requires careful work, but the appearance warrants the effort required. Make the band of thick walled Shelby tubing, in the same manner as other solid bands are made. It may be soldered to the barrel before the final filing, the band dressed down to 1/32 inch thick or less, and barrel and band polished to-

354

gether before bluing. The removal of excess solder and the polishing operations are described in Chapter 18.

The gunsmith having a number of calls for bands of any particular type will find it both convenient and economical to have tubing of the right size roughly milled to the outer shape of the bands required, and keep it on hand, sawing off a 5/8 inch length whenever a band is needed. This work can be done on a milling machine or planer to within 1/64 inch of finish measurements, and will save a tremendous amount of hand work. For bands like that shown in Figure 148, the tubing should first be turned to the contour of the swivel stud, then the excess metal milled off, leaving the row of finished studs with about 1/8 inch of space between them allowed for cutting off and finishing.

There's more than one way of killing a cat. Not long ago a man wanted this type of band mounted on a Single Shot Winchester with a No. 3 round barrel. Although he had used the rifle for years, the bluing of barrel was in perfect condition, so he demanded a band fitted without soldering and rebluing. Due to the thickness of the barrel, the caliber of which was the .25-20 S.S., this was easy. The band was made and shaped to exact size on an old barrel. A hole was drilled straight in from outside through the exact center of the swivel stud with a No. 22 drill until the drill struck the solid metal above the swivel bar hole; the hole was continued through the band with a No. 31 drill, and this inner portion tapped for one of the 1/8 x 48 screws furnished for attaching the Lyman 48 sight. The band was pushed tightly to position on the barrel and firmly seated with a couple of light taps with a piece of brass. The No. 31 drill was then inserted and the hole continued into the barrel about 5/32 inch, then tapped clear to the bottom.

The screw head was cut off and the end slotted, then the screw turned into the hole tightly, so that it projected into and blocked the swivel bar hole in the stud. A No. 25 drill inserted into this hole cut the projecting end of the screw out of the way, and the job was complete. With the swivel in place it is of course impossible for the screw ever to loosen, and the band is on to stay.

The band was of course blued before being set in place, and while the hole in outer portion of stud shows, it is not particularly objectionable.

Another way to fit such a band without refinishing the barrel is to fit the band and carefully mark its location on barrel; then carefully file off the bluing from barrel where the band covers it, keeping slightly inside the lines; tin this place with a very soft bismuth solder melting at between 200 and 300 degrees; also tin the inside of band with same solder; fit it in place and apply just enough heat to melt the solder, and quickly wipe off any that runs out from under the band—the bluing of the barrel will prevent it sticking, and this much heat will not affect the color in the least. The

355

fact is, on a small caliber barrel as heavy as a Winchester No. 3, one would be perfectly safe in merely shrinking the band in place, seating it while hot with a few sharp blows with a heavy piece of brass or copper. It would surely stay put, and such a heavy barrel shooting light loads would not be constricted with the heat of firing.

SIGHT BASE BANDS. Many shooters having rifles equipped with peep sights, wish a folding leaf sight on the barrel also. It serves to check the alignment of the peep sight, and would also come into good use if the latter were broken. Figure 149 shows a sight base band to serve a two-fold purpose on a Springfield sporter, and details of its construction will suffice for all bands of the same general type and purpose. This one, fitted to the breech of barrel at the receiver, conceals the unsightly notch or groove where the wedge shaped pin fitted under the military sight base, in addition to providing a new base for the Lyman No. 6 folding leaf. It may be either milled, or sawed and filed from thick walled Shelby tubing having an inside diameter of 1 1/8 inch. (See Chapter 5). The stud forming the dovetail base for the sight should be left full height until after the band is fitted; the method of ascertaining the correct height to cut it to bring the leaf sight to proper height, is fully explained in Chapter 29. The two studs or bosses into which the set screw fits are first shaped up as one, then split by a hacksaw cut which does not go clear through the band until after the screw hole is drilled and tapped. After locating the position of this screw hole and center punching, use a No. 18 drill until the sawcut is reached; then drill on through the other half of boss with a 29 drill, and tap this hole for an 8 x 32 screw. Countersink the No. 18 hole for the screw head, which may be filed down a little to flush it. Then saw on through the band. This may be attached without removing the front sight by merely spreading it slightly with a screwdriver and fitting into place, then tightening up the setscrew. The band and lower projections must then be spotted and inletted into the stock.

The lower stud and set screw may be eliminated by making the band solid and drilling a hole for a headless screw in the sight base portion; however, if the band is loose enough to go on without scratching the barrel, the setscrew will force it slightly upward, raising the sight a trifle, and leaving a small gap between band and barrel. Another way would be to turn or ream the band to a tight fit, and shrink it on, after first bluing it. This plan is objectionable because of the necessity of first mounting the band temporarily in order to ascertain the height of sight base. Once shrunk on, its removal would be very difficult, perhaps impossible. The clamp method is undoubtedly the best of the lot.

On rifles which originally had rear sights attached to the barrel ahead of receiver by one or more screws, it is not necessary to make a split band. The set screw studs should be eliminated and the

356

band made solid. Peen it to size and taper, and ascertain the height required for the sight base; cut to correct height, file in the dovetail and fit the leaf sight. Now remove the sight, and in the center of the dovetail drill straight down, a hole that is "body" size for a screw that will fit the old screw hole in barrel. It goes without saying that the sight base band was located so that its exact center came over this screw hole.

Fig. 150

Blue the band and slip it in place. Insert the screw through hole in sight base, turn it into the hole in barrel, and with a small file mark the screw level with bottom of dovetail. Remove screw, cut it to length, slot for screwdriver and turn into place. Drive in the sight, and "thar she be." It is permissible to make the base portion of band a trifle narrower than the base of the sight itself, so that the latter can be moved slightly right or left to zero it, without the difference being too prominent.

When fitting a band of this kind, the screw from the military sight may be used if desired. I prefer to save this special screw with the sight when possible, using a machine screw if it will fit the hole in barrel. It happens that the Krag and '73 Springfield military sights were attached with 8 x 32 screws, so this simplifies matters.

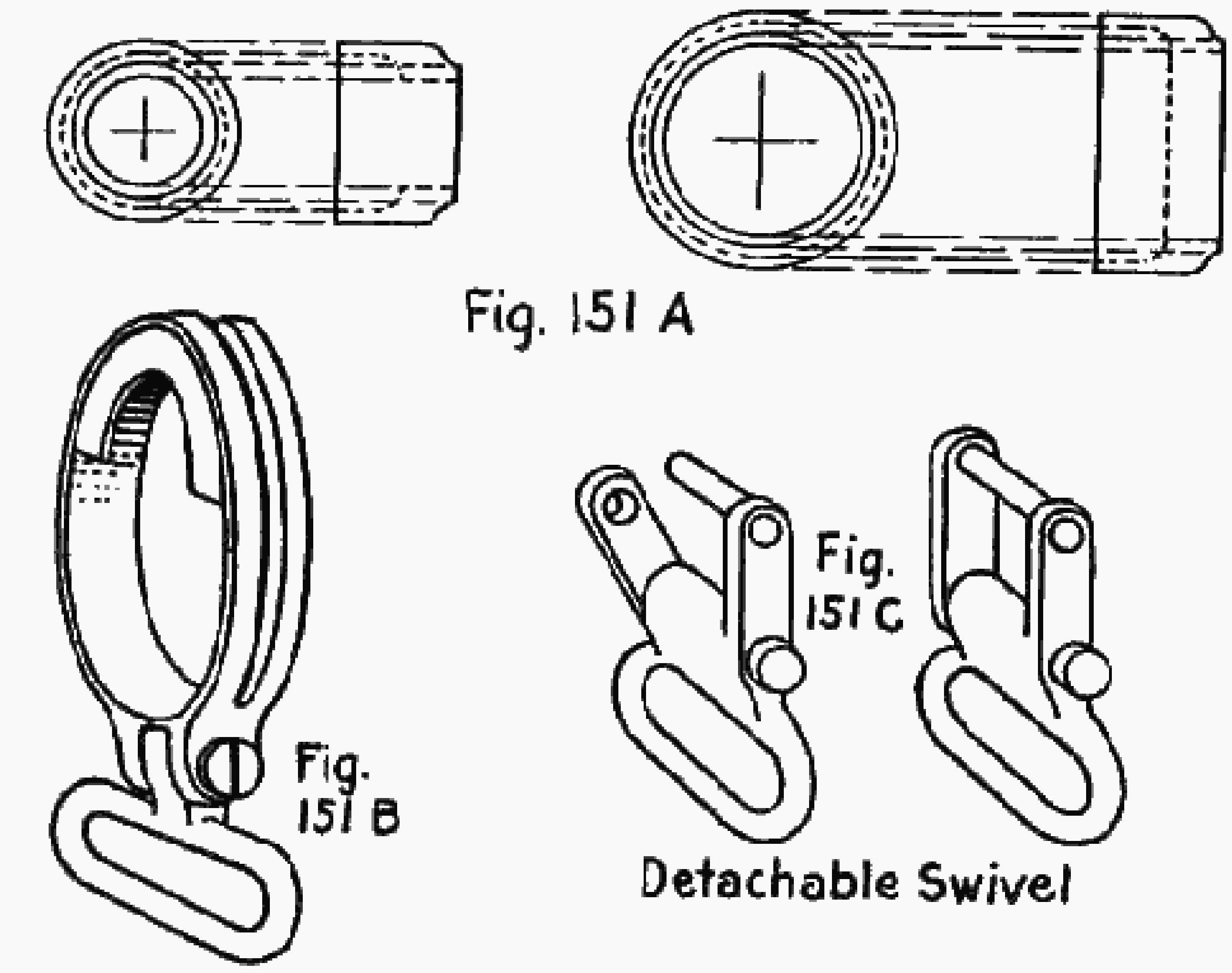
When remodeling the Krag, Springfield, or perhaps other military rifles, it is sometimes desirable to use a plain smooth band at the breech; for example, to cover up the notch on Springfield barrel previously mentioned; or to ease the sudden "jump-off" of the sharp shouldered Krag receiver to the barrel. Figure 150 shows three such bands. "A" merely a piece of 1 1/4 inch Shelby tubing with 1/16 inch wall (giving 1 1/8 inch or exact inside diameter), cut to 3/4 inch length and the forward edge filed as shown; "B" is a more ornamental band turned to shape; both are for the Springfield. "C" is a collar for the Krag, and is turned to shape from tubing. Any of these may be made to a rather tight fit, then blued, then heated just enough to expand them slightly and shrunk on. It is not necessary to spoil the bluing by heating the band red-hot and shrinking it on like a wagon tire. Moderate heat will expand it sufficiently, particularly if the barrel has been kept as cold as possible. In fact, even if the band is rather loose it can be shimmed up snugly with paper, and when closely inletted into the stock, it could not be moved from its position.

357

Figure 151A shows a pair of turned collars for use in keeping a handguard in place. One of the simplest ways to remodel a Springfield, if one does not care to reblue it, is to either make a new stock, or cut down and re-shape the military stock; then make a handguard to cover the rough rear portion of the barrel, and tenon the ends to fit tightly under these collars. It is not necessary that they fit the barrel tightly—in fact it is best to have them a trifle loose. The tenon of the band guard wedges under the collar, holding it firmly in place. The forward collar may be drilled and tapped on the lower side for a swivel screw, and the lower half of both collars may be dressed down until only a thin band remains—the overhanging portion being only necessary above the forend, to hold the hand guard in place.

Figure 151B shows another type of handguard band, made from a regular lower band of a Springfield service rifle. A piece of sheet steel 1/32 inch thick was fitted carefully into the upper half of band, and brazed from the inside. This piece was then filed to fit over the barrel, just clearing it without touching. This makes a much neater job than using the old band and letting the end of wood show under it.

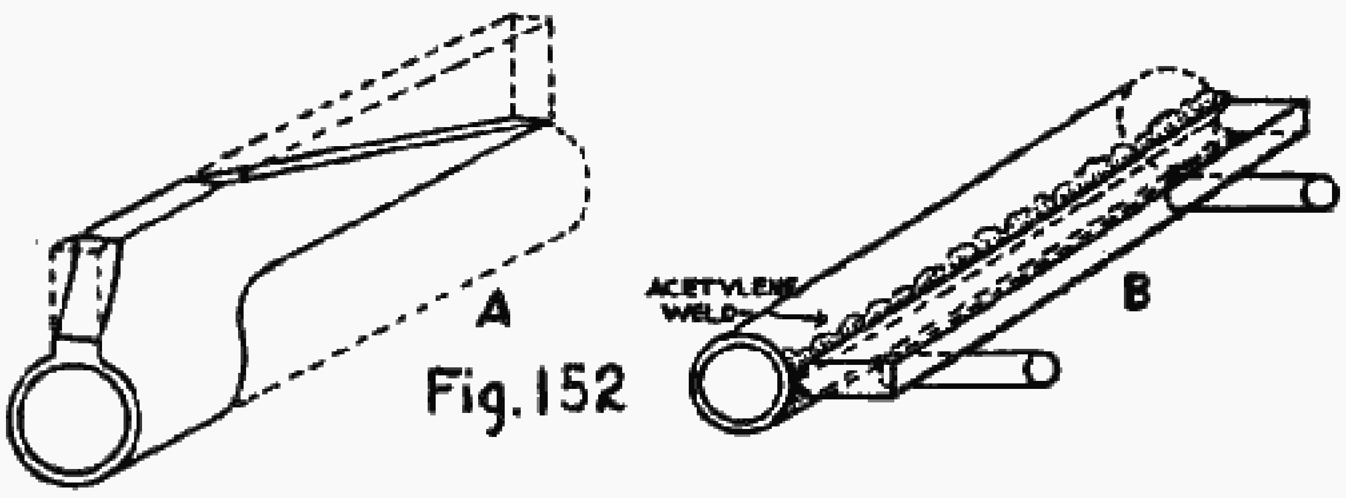
FRONT SIGHT RAMPS. Whether or not a ramp does any real good is an open question; but in the eyes of most shooters it



adds a touch of distinction to the arm, and moreover, it helps to prevent barrel mirage from disturbing the aim, while permitting a

great variety of front sights to be used. With the ramp one is not limited to the use of blade sights made for military bases, but may use any of the dovetail base sights having a rather short dovetail; or he may use the caterpillar sights made by Lyman and Marble if he prefers that type. (See Chapter 29).

Figure 152A shows a type of ramp that is becoming pretty well standardized, the solid lines showing the finished shape, while the broken lines show the original blank. The blank should be made by a machinist who knows his business—it is no job for the apprentice—and it may be made on either the milling machine or shaper.



It can be cut from thick walled tubing if the right size is available, or from solid flat stock, using cold rolled or machinery steel. The hole should be drilled and reamed to the exact size of barrel at a point 3/8 inch from muzzle, and it should be a straight hole—not tapered. The trifling taper of barrel at muzzle will assure a snug fit with good contact at rear end of ramp where it is not held by the band. The excess metal of both band and blade should be sawed and filed away, and the ramp brought roughly to shape before fitting. Then start it on the barrel, holding the blade down firmly, and peen lightly until stretched just enough to permit of its being slipped on. Chapter 23 gives detailed instructions for sweating on the ramp, and for pinning if desired. After it is mounted, solder on a temporary front sight, and sight in the arm as outlined in Chapter 29; then follow instructions for ascertaining height for dovetail; cut the dovetail and fit in the permanent sight. This may be mounted before or after bluing—it makes no difference.

A milled blank for front sight ramp will cost from three to five dollars in a machine shop. A cheaper one which is nearly as satisfactory if properly made, is illustrated in Figure 152B and described in detail under the welding instructions in Chapter 23.

The photo in Figure 153 shows a very attractive ramp made and fitted to a 39 Marlin. The original front sight was removed from the barrel slot, and filed down level with the surface of the barrel. A hole was drilled in this base, and a screw through it held the ramp, which was simply a piece of cold rolled steel 1/4 inch thick sawed and filed to shape. Between ramp and sight base a piece of ribbon

silver solder was placed, with necessary flux, and heated redhot, then the screw was set up tightly in lieu of a clamp. The ramp was then cleaned up and polished, after its correct height had been ascertained, and the top dovetailed for the Sheard bold bead sight made for the Mannlicher-Schoennauer. The whole assembly was then blued, and the dovetail base of ramp driven into the barrel slot. This stunt is only possible on octagon barrels, as the round barrel would show gaps at edge of ramp.

On rifles requiring a very low ramp, the band may sometimes be eliminated. Many Mauser sporters imported into this country have low ramps merely soft soldered to the barrel. Personally I wouldn't carry one of them into the woods, for fear a blow would knock the ramp into the middle of next week—but the Heinies get away with

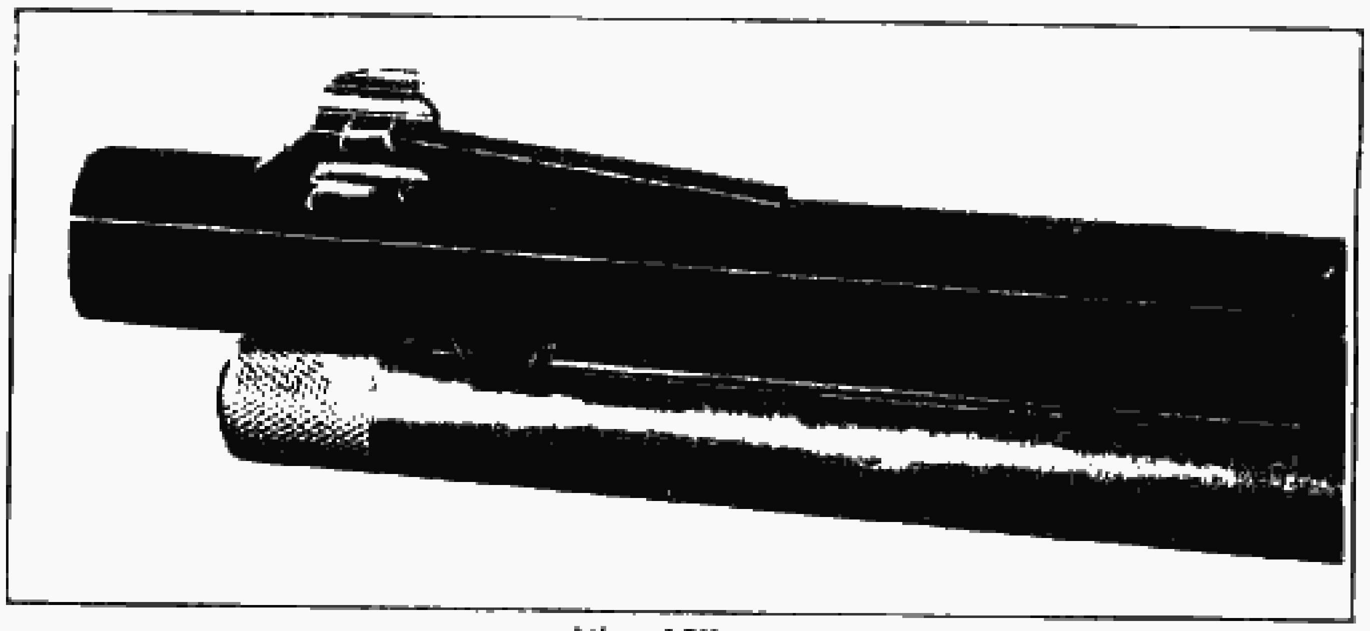


Fig. 153

it somehow. To make and fit a ramp of this kind properly, the ramp should have its lower edge milled hollow, to the exact radius of the barrel at forward end of ramp—in other words, about 3/8 inches from muzzle. A long bar of 3/4 x 5/16 cold rolled can be run under a 5/16 radius cutter on milling machine at small cost—and ramps for the Springfield or other barrel that is approximately 5/8 inch at muzzle can be sawed off as needed. Such a ramp should be silver soldered to the barrel after being clamped firmly at both ends, and unless you want to ruin the bore absolutely, coat it with the file hardening compound described in Chapter 21; this coating must dry slowly for several hours before the brazing is done. Theoretically, there is some danger of warping the muzzle slightly in the brazing process, and the real crank will choose a banded ramp attached with soft solder.

I note that at least one firm is offering a ready-made ramp at about ten dollars designed to be attached to the Springfield barrel. In justice to all concerned I would suggest that the prospective purchaser study the catalog illustration carefully before parting with his ten iron men. The ramp in question is supposed to fit perfectly

over the spot where the original fixed stud was attached. From experience I know that this size varies quite a bit with different barrels and studs. Moreover, a ramp fitted over the lettering and ordnance insignia stamped on the barrel near the muzzle is going to look like the very devil. Before a ramp is fitted this lettering should be "struck" off and the barrel polished—and if this is done, the "store" ramp will then prove to be too large. The only way a ramp can be fitted—I mean *really fitted*, so that there is no streak of solder showing along the edges, is to make it slightly smaller than the barrel, and fit it *tightly*. Another thing—the ready made ramp is just about half as high as can be used on a Springfield; thus it requires a very high front sight which sticks way up above a ramp, making it fall far short of its purpose. One of the best things about the right kind of a ramp is that it can be made so high that you use a very low front sight, which is thus better protected, stronger, and easier to shoot accurately than a thin, flimsy affair hovering in mid air half an inch or so above the top of ramp.

The entire upper surface of the ramp should be matted, and this process is described fully in Chapter 19.

With a complete machine shop at his disposal, the gunsmith is in position to make a splendid FRONT SIGHT COVER to be attached to the ramp. Such a cover is illustrated in Figure 154, made from 5/8 inch Shelby tubing with 1/16 inch wall. To form, take a piece of 1/2 inch steel drill rod, and mill a flat 3/8 inch wide on one side. Force this into the tubing, and hammer one side of tube flat against the flat portion of rod. The flat portion is then slotted as shown, either with hacksaw and file, or by milling. The closed end may be knurled or finished smooth as preferred. One side of

Fig. 154

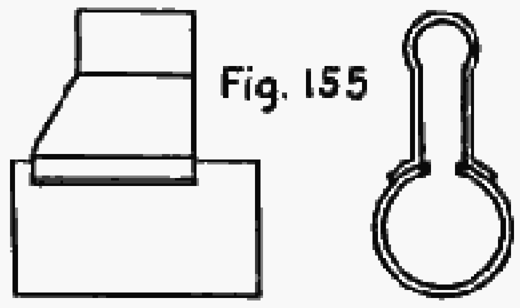


Fig. 155

this cut near the closed end should be notched as shown, and the point relieved slightly.

The barrel with ramp attached (after the rifle has been sighted in and slot cut for front sight) is now mounted on the bed of milling machine and slots 1/16 inch wide and 1/16 inch deep cut in the sides. The distance of these slots should be figured from the front sight bead, so as to about center the bead in the sight cover. A hole is now drilled in the slot on left hand side of ramp, and a round end pin of drill rod driven into it, the rounded end projecting into slot not more than 1/32 inch. When the sight cover is pushed into place, the edges slide in the grooves in ramp, while the left hand edge rides up over the projecting end of pin, which snaps into the notch in edge

361

of sight cover, holding it in place by its natural tension, yet permitting easy removal when desired.

Detailed instructions for setting up and doing this job are not given, for the set-up would vary somewhat with the type of equipment available; moreover, a first class machinist will readily understand what to do from the drawings—and only a first class machinist could do the job.

Figure 155 shows a "tompion" or muzzle cover, with sight cover in combination. It may be made of thin Shelby tubing or hard brass tubing as preferred, to fit almost any rifle. The piece of tubing which slides over the muzzle is partly cut away for the sight base or ramp; and a small projection left on either side snaps over the front edge of sight base, to keep the tompion in place. The muzzle end is closed either by brazing in a round piece of sheet stock, or by threading in the end of a piece of rod equal to the inside diameter; screw this in about 3/32 inch, saw off the rod, file it flush. The sight cover portion is made of sheet brass or steel bent over a round rod in the vise just as you bent the stock for the two-piece barrel band. The lower edges are bent out for about 1/8 inch, and brazed to the tompion. The muzzle end of the tube portion of sight cover may be closed, or left open as desired. Better to leave it open. A gadget of this kind had better be made of brass, and polished—one is more likely to see it in time to avoid shooting it off if an unexpected shot presents itself. I have never shot a tompion off a rifle, and don't know whether the barrel would be damaged or not—don't think it would. But you sure would have the devil's own time trying to find that tompion!

MUZZLE PROTECTOR. Rifles that must be cleaned from the muzzle need a protector to prevent the rod wearing the edge of muzzle. This *should* be made in a lathe. Chuck a piece of steel bar at least 1/8 inch larger than the muzzle diameter, and drill a hole through it endwise barely enough to allow the cleaning rod to slide through. Now counterbore to a depth of about an inch and lap out smoothly to a sliding fit over muzzle. Then mill or saw away enough of one side to clear the front sight. Case-harden, and polish out the inside, to prevent marring barrel. No drawing is shown, as the protector would vary considerably for different rifles and sights. In this day of rustless, smokeless, dirtless and pitless ammunition and bolt action rifles, only the cranks who insist on using the old time weapons are likely to be interested in a muzzle protector. But when needed in a hurry, a good one can be made very easily if you can get hold of a piece of Shelby tubing that will just fit snugly over barrel. Cut it about an inch long, file away enough of the side to clear the front sight. Solder or braze a piece of 1/16 cold-rolled steel over the muzzle end. Center and drill this for the rod—and "thar she be!" Brass tubing is all right, but the hole will soon be enlarged, permitting it to wear the muzzle.

362

PISTOL GRIP CAPS. Good ones are hard to find. The cheap hard rubber ones of factory manufacture, as seen on many shotguns are about useless, being small, flimsy and ugly. The best ones are made of cold rolled steel, but the supply is limited to the few made up by the larger custom gun makers for their own use. These plates are expensive, as they are cut out from solid stock on a profiler—which is a milling machine with a vertical cutter that can be moved in all directions. An oval shaped piece of steel is mounted on the bed of the machine as a pattern; a special formed cutter is used, having its end shaped to the edge design wanted on the finished cap, and this cutter is brought against another oval piece from which the cap is to be made. A "finger" bearing against the pattern piece guides the cutter around the stock, shaping the plate as desired. Thus it is necessary to make a special cutter, costing fifty dollars or so, for every edge design wanted, and a special hardened pattern plate for each size and shape to be manufactured. And likely as not, the grip cap of this type purchased (if one is able to purchase it at all) will not conform to the purchaser's ideas of size and shape.

A good plain grip cap may be made from a piece of bakelite or celeron radio panel 1/4 inch thick. Simply mark out the oval to size and proportions desired, cut the bakelite roughly to shape with a scroll saw or coping saw, file carefully to the outline, then drill and countersink the screw hole. In this condition mount it on the grip of the stock, and work the wood down to it, filing both grip and cap until the edges are perfectly even. Then with a medium coarse file, start in near the screw and round off the cap, thinning it toward the edges to about 3/32. Polish with fine sandpaper, then pumice, until smooth and bright.

Grip caps of horn and steel, made for Mauser sporting rifles, can be purchased from firms importing these arms, at a cost of about 50 cents each. They should never be carried in the pocket on Sunday, as their small size involves an ever-present danger of their being accidentally dropped into the collection plate instead of the customary two-bits. They are also fine for operating slot machines. But—they have possibilities. Take the horn cap, and rub the under side smooth and flat on a sheet of coarse sandpaper held on the bench; take a piece of thin horn, bakelite, or even black fibre, say 1/16 or 3/32 inch thick, and larger than the cap. Roughen its surface with sandpaper, and cement the cap to it with du Pont cement, clamping it in the vise for 48 hours. Now dress down the edges all around to the size wanted, the projecting edge of the bakelite or fibre forming an extra bead and increasing the size and shape desired. Drill the screw hole through this piece, and fit it in place.

The Mauser steel caps (which are merely thin sheet metal stampings) can be similarly remodeled, by first filing them to the form of oval desired (they usually have a very clumsy shape, being too round on the ends) and sweating or brazing them to a piece of 1/16

363

inch cold rolled steel. Grind or file the edges as desired, round outer edge, scrape and polish off any solder or spelter that shows, and blue. Use the nitre or the heat and oil process if you brazed the pieces. If you soldered them, use a rusting solution, either hot or cold.

The amateur who has pretty definite ideas of his own may not be content with a remodeled grip cap; the thing for him to do it to secure a piece of soft pine, about 5/16 inch thick; cut it to the desired oval, drill a screw hole through the center, and mount in so that it can be revolved on the end of a piece of wood, which is held at any convenient angle in the vise. With file and chisel the edge is shaped up to the desired bead design, sandpapered smooth, and shellaced. Send this pattern to the nearest brass or white metals foundry, and have it cast in aluminum—the cost will not be much. This aluminum pattern can then be filed and polished very smooth and accurate in shape. Finally buff it to a bright finish. This can now be used for the cap, being finished in black as described in Chapter 20; or it can be sent to a foundry and cast in brass, bronze or copper, and given a beautiful black, blue, red, verde antique or other finish. Or it can be cast in malleable iron, carefully file finished, polished and blued. The man with some artistic ability will enjoy working up a grip cap in modeling clay or plaster, with a game head or other figure in relief, and this can then be cast in bronze, the surface engraved, and given any finish desired.

Some shooters will desire A GRIP CAP WITH A TRAP for a spare front sight. If the hole in end of grip is not so large and deep as to weaken the stock, there is no objection to this. The simplest and easiest way to make this is to first make a cap of bakelite as first described. Fit this to perfect contact and cement it with du Pont cement, using the screw to hold it until dry. Remove the screw and drill through the cap and the required distance into the grip, starting with an augur bit and finishing the bottom of hole with a Forstner bit. The size of the hole will depend on the size screw you will use to close it—somewhere around 1/2 inch. Secure a threaded bolt or large machine screw with a fairly fine thread, slightly larger than the hole. Cut off a piece of the threaded end of bolt about 5/16 to 3/8 inch long. Tap the hole in grip cap for this screw, letting the threads go into the wood of grip for only a short distance. Take the short piece of bolt, and round off the cut end slightly, polish it, and cut a screwdriver slot wide enough to take a small coin. Blue this, and the job is complete. The screw should turn into the hole tightly when its outer end is nearly flush with surface of grip cap, and the slot should be in line with center line of stock. This makes a neat job, and a thoroughly practical one, at practically no cost. A better way would be to make a special screw to close the hole, with a wide thin head having a narrow shoulder.

This same idea can be carried out with the remodeled Mauser grip

364

cap already described. The cap, being of thin sheet steel, should have the space between its inner surface and the added piece filled up solid with brazing spelter. Then drill the screw hole to required size, and make and fit the screw. Since it is impractical to cement a metal cap to wood, a piece of brass tubing about an inch long and 1/2 inch inside diameter is then brazed to under side of cap; the upper end of tube is closed with a piece of brass brazed on, and in the center is drilled a hole for a short wood screw, which holds the cap in place. A well of this type can also be fitted to a solid cap of iron, steel, bronze or other metal.

Figure 156 shows clearly the method of working out the two methods just described. Very good steel grip caps with a trap door held open or closed by a jack-knife spring, similar to buttplate traps,

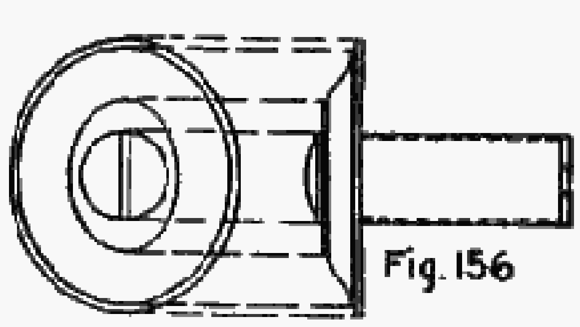


Fig. 156

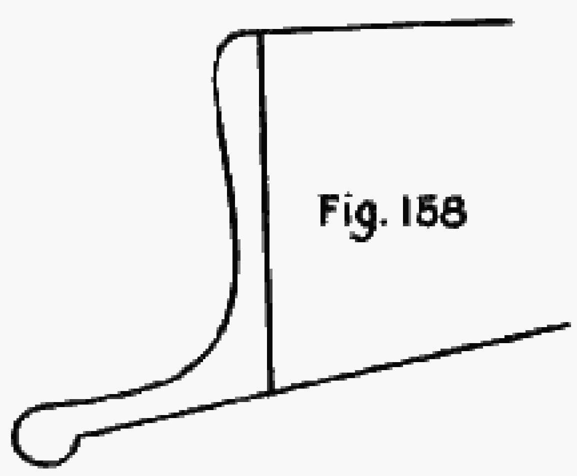


Fig. 158

can be purchased from one or two English firms handling gunsmithing supplies. The screw trap as described, however, answers every purpose, is neat in appearance, and comparatively easy to make.

BUTTPLATES. About the most difficult problem the amateur designer has to face is that of securing a suitable buttplate. Formerly very little thought was given to the hinders of a gun's anatomy, almost any old piece of iron that would prevent the wood from splintering being considered satisfactory. The deeply curved crescent shaped plate was very satisfactory on the old lever actions having only moderate recoil, the shape of the plate keeping the butt to the shoulder while the lever was worked. But with the coming of bolt actions the horns of such a plate were not needed to keep the butt from slipping down, and the increased recoil of modern loads necessitated a type of plate that would distribute the blow over the largest possible area of shoulder, and with no sharp projections to stab and gouge.

The shotgun type of buttplate was found to be the best of all for use on the new day rifle. Its larger size—usually 5 inches or longer, and at least 1 5/8 inches in width, and its nearly straight shape and rounded edges made it the most comfortable as well as the most efficient. Unfortunately, these plates are usually made of the poorest kind of hard rubber, or else of horn, which is somewhat more durable, and good steel plates, which are the only kind suitable

365

for the rough use that a rifle usually is given, are hard to find. Winchester makes a very good steel shotgun buttplate for about 60 cents. It is about 1/8 to 1/4 inch narrower than called for by the best rifle design, and an extra 1/4 inch in length would not hurt it any. Belding & Mull make a special buttplate which was designed for the B. & M. Model 30 Remington sporter, which more nearly approaches ideal lines. Neither of these plates has a trap for cleaning materials or what not, and recent custom has brought us to the point of demanding such a trap on the better grade rifles.

Sometimes one can remodel a military buttplate very satisfactorily. The Springfield plate is really too short; a Krag plate, which can be bought from Bannerman for a quarter, works up much better. It has a small round trap, not as desirable as the long oval traps on the expensive imported plates, but far better than none. A man should have acquired reasonable skill at forge and anvil to do a first class job of reshaping this plate. First remove the trap, trap spring and screw. Then heat the toe and straighten out the forward bend. Heat entire plate and curve it very slightly from heel to toe. Heat it again and round the plate slightly from side to side over the horn of the anvil, taking care to preserve the heel to toe curve while doing this. Next heat the trap, and bend it slightly from side to side, and refit it into its hole. This requires very careful work, and it will very likely be necessary to do some filing, due to the hole having been misshapen by the bending of the plate. Work it down carefully until the trap fits close all around the edge, and is snugly seated against the beveled edge of the hole. Now assemble the trap and plate, and file down their surfaces smoothly; round edges of plate and grind or file outer edges to exact shape desired. The long round-end lip at heel can be cut off, leaving only about 1/4 or 3/8 inch projecting, and this ground to a point. The square edge at heel should also be well rounded, and a screw hole drilled and countersunk near the heel, the original hole in lip having been removed. The plate and trap should then be polished, and the surface either file-checked or sharply stippled, as described in Chapter 19.

It's easy to say "file-checked"—doing the job is another matter. I have never found any dependable method for spacing file cuts accurately enough to call it checking; if one has plenty of time and patience, a good sharp 3 square file can be used to turn out a fine job, simply gauging the spacing of the lines by eye; but it is a slow process, and really amounts to engraving with a file. Knurling is usually out of the question without a very costly set-up of special fixtures, so the stippling method, using either a dental engine or a prick punch and hammer, offers the readiest solution.

It is possible to take the B. & M., the Winchester, or any similar steel plate and make and fit a trap in it as desired. The round trap is of course easiest to fit, and may be taken from a Krag or Spring-

366

field plate. The buttplate you purpose using is carefully set up in a four jaw lathe chuck, so as to center exactly the point at the center of the hole to be cut. The hole is then turned in, and its edges beveled at an angle of about 45 degrees. The slot for the hinge of trap is filed in, and the trap heated and bent slightly to conform to the curved surface of plate. Careful filing then fits the trap into its seat smoothly. The hinge pin rests at each end in small depressions cut in the under surface of the plate on each side of the hinge slot. The easiest way to cut these depressions is with a dental engine and round burr. Lacking this, make a shallow indentation with a drill just back of the edge, and chip out the metal at edge with a small

Fig. 157

sharp cold chisel. When the ends of hinge pin are correctly seated in these depressions, the trap is held in place by pressure of the spring.

Figure 157 shows a rather unique method of making the Springfield Sporter buttplate removable, giving access to a hollow in the butt. A slot was cut in each end of the plate with a hacksaw. Into this was fitted a key made of clockspring, bent over short at the outer end. This spring key fitted tightly under the lug brazed to the inner plate which was made of sheet steel 1/16 inch thick. This inner plate was smaller than the butt, permitting the buttplate to set down over it, and the plate was attached to the butt with several small wood screws. The two screw holes in buttplate were filled with the cut-off heads of the screws, riveted into the holes.

The crank with definite ideas of his own as to what a buttplate should be, will not hesitate to make it by whatever means seem best adapted to the job. One way, if he is skillful at the anvil, is to forge the plate from a bar of steel, shaping it roughly as desired, then grinding and filing to final dimensions. Another way is to

367

make up a pattern in soft wood, working out the curves until they suit, and checking the surface with a rather coarse checking tool. This is then sent to a foundry and cast in aluminum. The aluminum pattern may be used, but it is best to use it only as a pattern. With a 3-square file, carefully clean up and sharpen the checking or corrugations; true up the shape, and polish all but the checked area; drill and countersink the screw holes; then send this pattern to an iron foundry for a few malleable castings—they cost little and it's just as easy to get several while you're about it. A little filing and polishing gets the plate ready to blue, and it is exactly the way you want it—not the way some manufacturer thought you should want it. The screw holes can be cast right in the plate, so that they only need to be cleaned up with a rose countersink bit.

Good malleable castings made in the finest of molding sand, are quite as good as drop forgings for articles of this kind. They come out very smooth, requiring a minimum of filing to finish; and they can be blued by heating red hot and dropping into oil, or by the nitre or hot solution processes.

The aluminum pattern is always advisable, as it can be shaped more accurately, and the checking or corrugations worked up better than in wood. Do not make the mistake of making your original wood pattern too thick—remember that iron is heavy and 1/8 inch is plenty thick for the thinnest parts, even counting the metal that will be removed in finishing. Allow only about 1/32 inch in overall dimensions for shrinkage, as this will be slight in small castings.

Remember that ordinary gray iron castings in coarse sand are utterly worthless for this class of work—send your patterns to a foundry equipped to make the best malleable castings and specializing in this work. If you know of some pattern maker, by all means consult with him while making your pattern as he will give you many valuable hints relative to the way the pattern must be removed from the mold, and in what position it will "draw" best—possibly enabling you to avoid wasting an entire job. Good buttplates can be cast in hard brass or bronze, if desired, and finished either in black or in colors.

Figure 158 shows the "free rifle" type of buttplate made of aluminum. The pattern should be made of clear white pine, in two pieces, the "horn" being a separate piece morticed and glued into the buttplate. One may follow pretty much his own fancy as to shape and design, remembering the limitations of the foundry, and the fact that the pattern must be of a shape that can be drawn from the sand. Wooden patterns must be heavily shellaced, and rubbed down with fine sandpaper and oil until very slick, to prevent the sand sticking and crumbling. Unlike cast iron, aluminum and brass castings stand considerable cold bending, so that the horn of this plate can, if necessary, be reshaped a little after finishing, in case you do not get your pattern just right. The rough casting as

368

it comes to you from the foundry should be filed smooth and the shape trued up; then polish with aloxite or emery cloth from coarse to fine, then buff to a high polish on cloth buffer with Tripoli compound. The plate may be left bright or it may be blackened as described in Chapter 20.

PALM REST. A buttplate of this type naturally suggests a palm rest for the same rifle. Figure 159 gives details of one that is easy to construct and fit. The ball is a regular water polo ball of solid cork, obtainable in sporting goods stores. Order from the Director of Civilian Marksmanship an extra magazine floor plate, to which the palm rest is attached. Changing floor plates then enables one to use the rifle with or without palm rest as desired. No special instructions are needed for making this rest, as the drawing is self-explanatory. The parts may be made of cold rolled steel, brass, or aluminum.

CUTTING OFF RIFLE OR PISTOL BARRELS. Frequently, due to a damaged muzzle or in order to make an arm light or handier to use, shortening the barrel will be indicated. And there's

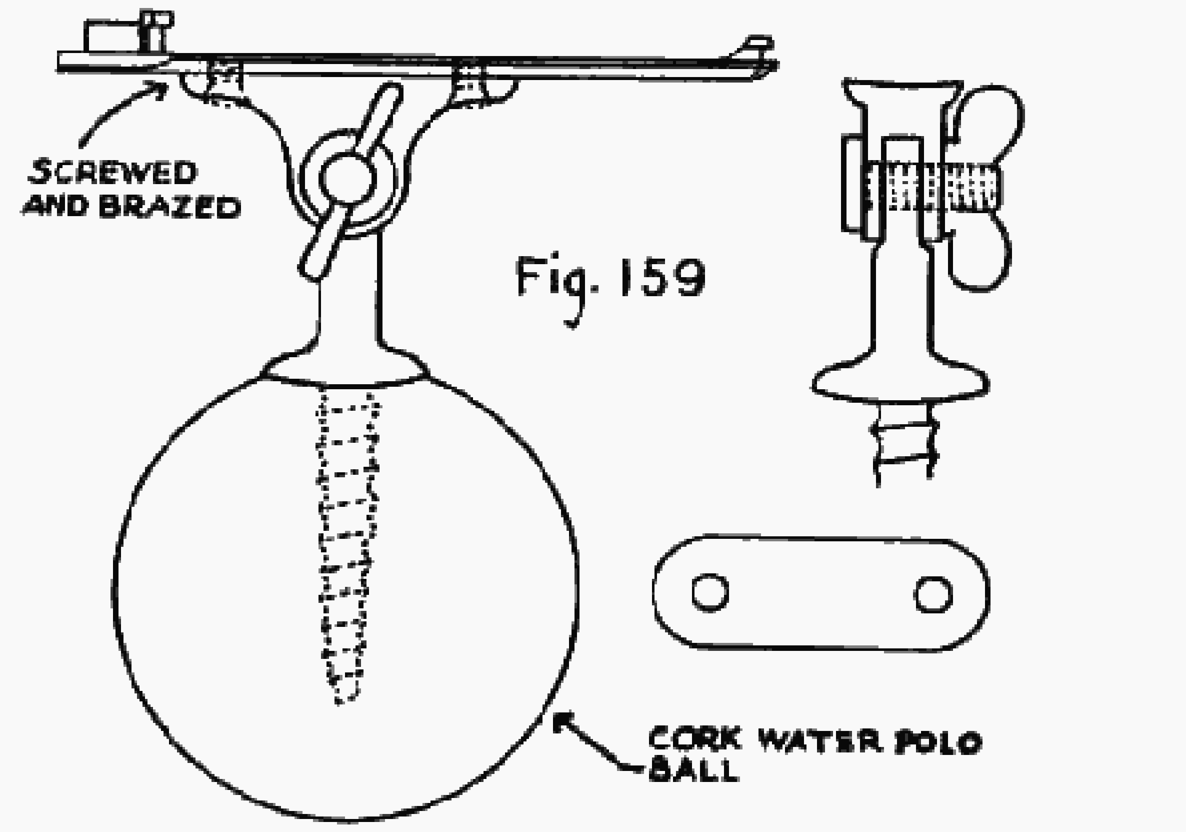


Fig. 159

just about as much bunk prevalent on this subject as you'll find in a day's journey. It isn't necessary to cut off a barrel in a lathe—in fact that is one of the poorest methods, for the parting tool usually leaves a burr on edge of bore which the crowning may not entirely remove. So it becomes necessary to file the muzzle anyhow—why bother with a lathe setup?

Mark the barrel where it is to be cut, and cut it off about 1/32 inch ahead of the mark with a hacksaw. Set barrel upright in the vise, and with a good sharp mill file, dress the muzzle flat and as nearly square as possible. Use an adjustable square if you like, or use only your eye—and don't worry about it not being perfectly

369

square. The *edge of bore* will be square all right when you finish the lapping operation to be described.

But first take a countersink reamer and countersink edge of bore to a depth of about 1/32 inch—this is just to get rid of surplus metal, and hasten the lapping.

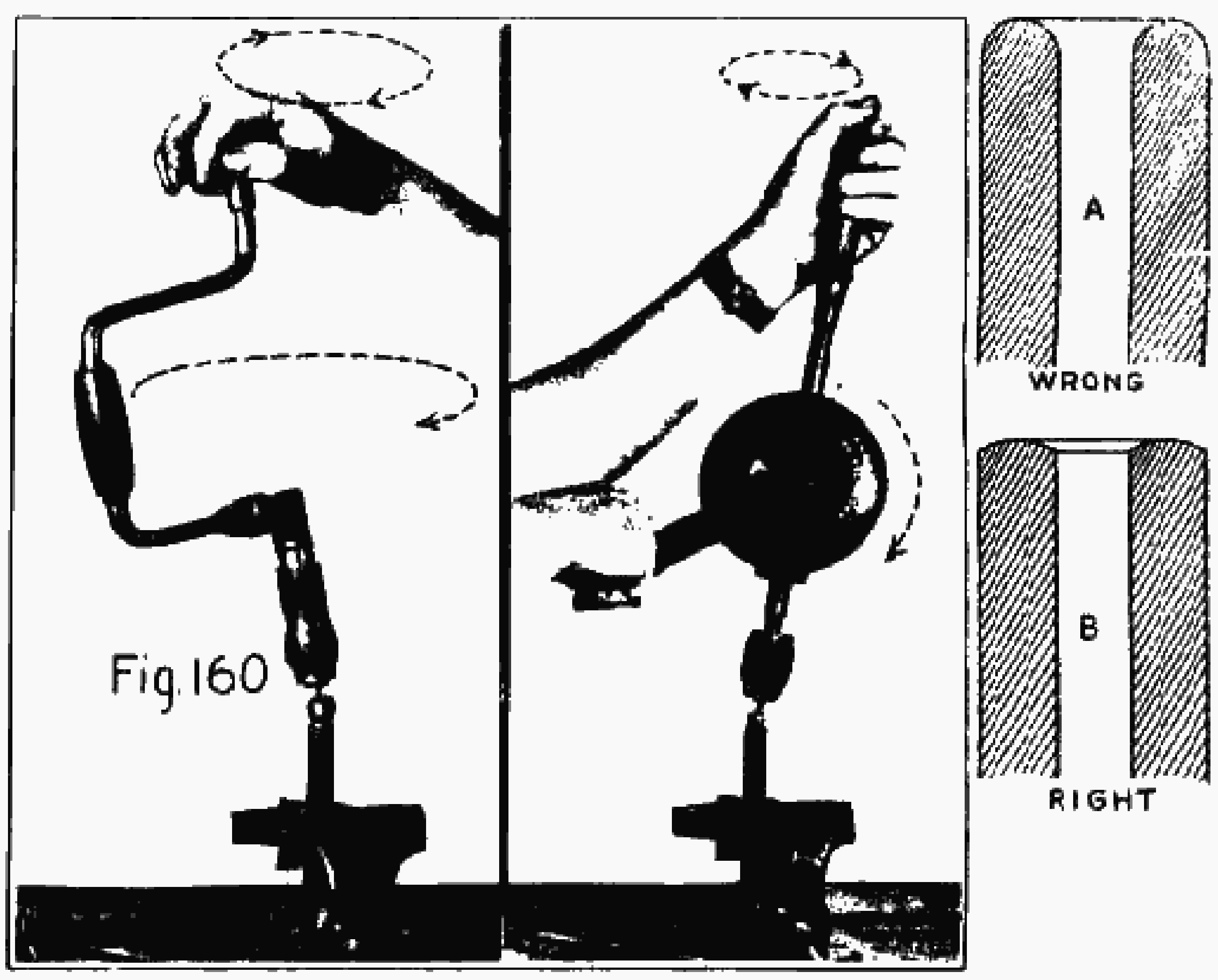


Fig. 160

Secure four brass balls measuring respectively 3/8, 1/2, 5/8 and 3/4 inch in diameter. These may be secured from Ellfeldt Hardware & Machinist's Supply Company, at Kansas City, Missouri. I find that these are not regularly stocked by many large supply dealers. Drill about half way through each ball and tap for an 8 x 32 screw, which should be turned in tightly. Cut the head off and use the screw for a shank. Start with the smallest ball. Chuck it in a breast drill or brace, and with a small quantity of valve grinding compound lap the ball into the muzzle as shown in Figure 160, the lapping occurring on the extreme inner edge of bore. Continue with the 1/2 inch ball in the same manner, then with the two larger sizes until the inner half of barrel wall is well rounded. Round off the outer edge with a file to a corresponding shape, then polish the edge, first with No. 00 emery cloth, then crocus cloth held on the ball of thumb.

A muzzle lapped in this manner cannot be otherwise than square—for the simple reason that the surface of a sphere will not touch the

370

edge of a cylinder at all points until their axes absolutely coincide—in other words, until the end of cylinder is square.

When a number of barrels of the same size and caliber are to be cut off and crowned, a crowning tool may be made as described in Chapter 7. Generally speaking, however, any sort of pilot reamer is a bad thing to put into a muzzle, due to the danger of small particles of grit or cuttings sticking to the pilot and scratching the bore. If you use such a tool, be sure the bore is perfectly clean and lightly oiled, and have the pilot a snug sliding fit.

Do not crown a muzzle too deeply, rounding off the inner edge as at A, Figure 160; leave the edge sharply defined as shown at B.

REPAIRING A DAMAGED BARREL MUZZLE. When the muzzle of any barrel—either rifle, shotgun or pistol barrel—has been damaged by dropping, or otherwise, there is but one known cure—amputation of the damaged portion. Quite often only a quarter inch or so need be cut off; in other cases, two or three inches may be necessary. Sometimes a slight obstruction in the muzzle will cause a bad "ring" or swell which ruins the accuracy of the barrel; when the portion carrying the ring is cut off, the barrel shoots as well as ever. Major Robert H. Lewis was just telling me about an old '95 model Winchester which he used in Texas before entering military service. On his return to the ranch after several years, he ran across the old rifle, rusted and battered, poked away in a shed with other discarded articles. On questioning the major domo, he was informed that the gun "no good—him no hit notting now"—so he took it along and got busy with a stiff cleaning brush, bottle of Hoppe's, and a hacksaw. After cleaning the accumulated rust from the bore he tried a few shots which scattered all over a quarter section, more or less. Inspection showed the rifling all worn out of the muzzle for half an inch back. He cut an inch from the muzzle, crowned it, and proceeded to shoot a 2 inch group at 50 yards. The old gun is still in service on the Lewis ranch near San Antonio, and has many head of game to its credit since the amputation was performed.

BENDING TANGS. When remodeling a single shot or other straight grip rifle so that a full pistol grip stock may be fitted, the bending of the tang often looks like a tough job—but it isn't if you go about it right. The action should be completely stripped of all screws, pins, springs—every removable part that will come off. But before doing this make an outline drawing, full size, of the gun "as was," noting by dots and crosses the location of trigger, guard, ends of tangs, tangscrew holes, etc. Then on this same piece of paper lay out the shape you want the new stock to be, so as to show the new position of lower tang, lever, guard, and other parts. If the lower tang is removable, as is the case with the single shot Winchester, it should be removed.

The amateur usually makes his big mistake by bending both tangs.

371

Usually the upper tang should be left straight as is, and only the lower one curved to form the grip. Bending down the upper tang reduces the size of the grip, and also makes the comb stick up just that much more above the handhole, when, as a matter of fact, the high comb usually wanted in the new stock is going to stick up more than will look well, without making matters worse by bending down the upper tang.

If desired the lower tang may be heated and bent by careful hammering on an anvil, but as most of them are easily bent cold, I prefer to do it that way. If hard, heat it to a dull red to anneal it; if not hard, proceed without any annealing.

Cut three pieces of round brass rod three inches long and 3/8 inch diameter, and bend one end of each at a right angle, so they will hang on the vise jaws—two on one jaw, and one on the other. Insert the tang between the three rods, so that the single rod is on the inside of the curve to be formed. Tighten the vise, making a slight bend. Loosen the vise, and move the tang or the rods to a different position as required to increase the bend, and again tighten the vise. Continue until you have exactly the curve desired. The tang will be marred very little by this method, and any slight dents may be easily filed out. Cold bending leaves the metal under stresses which must be relieved. Heat the tang to a dull red, and allow it to cool.

Be careful not to make a sharp bend at one of the screw holes—this is very easy to do. A good clean curve is what you are after. Test the shape on the layout sketch previously made until you have it just right.

When the lower tang is not removable it is not always practicable to bend it in the vise. But by setting the receiver firmly in the vise, the two notched steel bars described for bending bolt handles may be used to advantage. Set a thick piece of sheet copper in the notch to prevent marring the tang more than necessary, although a few slight dents cannot be avoided.

When a tang has been so altered it will be found in many instances that it is too long for the grip desired—in that event, simply saw off as much of the lower end as necessary, round it up, and drill a new hole for wood screw to hold the tang in place in the grip.

Very likely this bending will also damage the threaded hole into which the tang screw was originally fitted. The only workmanlike way of getting rid of this defect is to have a first class welder fill up the hole with melted steel, after which you can dress it off smooth by filing. To provide a base for the new tang screw hole, file out a small wedge shaped piece of steel, so that when fitted to position on inside of tang, its surface will be at right angles to the tang screw. Braze or hard-solder this in place, and drill the new screw hole through it. A better method, I believe, is to have the welder, when he fills up the old screw hole, also build up a good

372

sized lump of metal on inside of tang in the position of the new hole. This may then be grounded and filed to shape, and the new hole drilled and tapped in it.

FIRING PINS. A common fault of the otherwise excellent low-priced single shot rifles is the frequency with which broken firing pins and faulty extractors occur. Firing pins should be made of drill rod in size equal to the largest diameter of the pin. They must be turned up true so that they will not bind or stick. If you have no lathe, file the pin carefully to shape, leaving it slightly oversize; then hold it in a chuck on the end of your grinder spindle and turn it to final dimensions with a file held against it while turning at top speed.

Flats or notches required in the side of the pin must be carefully filed in by hand, and the easiest way to hold the work is in the same chuck on the grinder spindle; lacking the grinder, check the pin in breast drill, hand drill, or even a tap wrench, which may be held in the vise. This avoids marring the pin with the vise jaws, and holds it in the most convenient position for shaping.

To harden, heat the pin to a bright cherry red and quench in oil; *and,* be sure to heat the thick end first, so that the point may not become overheated. After hardening, polish bright, then heat very carefully to an even blue color and quench in water or oil.

The importance of correct shaping and tempering of firing pins cannot be overestimated. The point must be well rounded—hemispherical—in center fire guns, and slightly rounded or flat for rim fire guns. Even a flat end firing pin must have the sharp edges "eased" off on a stone, and the end must be polished smooth. Mr. Seth Wiard of the Lyman Gunsight Corporation describes an accident which came to his notice when he was with the Remington Arms Company which may serve as a warning:

"The gun in question was of uncertain parentage, being put out under the trade name of one of the large hardware jobbers and upon one occasion, —it is not known whether or not it was the first time since repairs were made—the then owner fired it with a regular medium 12 gauge load. The firing pin drove back into the shooter's eye-ball, entirely destroying the sight of the eye, of course.

"Upon investigation I found that the firing pin was of home-made construction, evidently from some soft material such as a wire nail, and had an exceedingly sharp point. The firing pin was of the conventional type with a notch in the side of the shank so that the nose of the check screw would fit in this notch to prevent its falling out. Examination showed that the firing pin stock, being soft, and the end of the check screw beijng burred over due to abuse and the point being too sharp, when the gun was fired the sharp point punctured the primer and the gasses generated in the shell impinged upon the firing pin point and drove it to the rear in a manner similar to the mechanism used in the Garand semi-automatic shoulder rifle.

"Undoubtedly the firing pin acquired enough momentum through its inertia so that after its travel of the fraction of an inch necessary to bring it back against the check screw, it had enough energy to rub by the check screw and then blew back through the stock."

373

The above is but one of many instances that might be related of serious accidents due to faulty firing pins. The greatest care must be exercised in the development of the firing pin profile, particularly of the point. The shank must fit the hole in frame easily, yet without excess clearance. The pin must be made of good tool steel, polished, hardened, and then the temper drawn to a point that will eliminate the possibility of breakage,—which means temper it at blue, which is the right color for all percussion tools. Blue temper in good steel means that the part will batter or dent slightly before it will break, yet it is as hard as is practicable for such work. And be sure the check screw or pin is in first class condition also.

I was about to recommend that a firing pin job should be entrusted to none other than a first class gunsmith; but having seen some gunsmiths who claim, by reason of forty years' experience, to belong in this classification, file out pins from any old piece of scrap that came handy, with little attention to shaping, and none to hardening or tempering, I think it's a safe bet that the average amateur, after he has attained reasonable proficiency with tools, is likely to do a better job, once he understands what is required to assure safety and proper functioning.

When the EXTRACTOR of one of these single shot rifles breaks, or becomes otherwise damaged to the point of uselessness, the best plan is to secure a new factory-made extractor if possible. It will require some file fitting, but not a great deal. If the extractor cannot be obtained, make á new one of tool steel, and harden and temper it the same as the firing pin. Blue temper is plenty hard enough. Have the stock for the extractor considerably oversize. Measure the chamber carefully, then drill a hole nearly the same size as chamber in upper end of the stock from which extractor is to be made then ream to exact size. Make a flat counterbore bit with pilot to fit this hole snugly, and counterbore so that the cartridge rim enters easily its full thickness—in other words, so that head of cartridge sets flush with surface of extractor. Then cut away the excess metal leaving upper end of extractor shaped as required, with a round notch which fits the cartridge rim *perfectly*. The balance of the extractor is then filed to shape, fitted and finished.

TIGHTENING THE TAKE DOWN ACTION. Many of these old single shot rifles, such as the Stevens Ideal, are takedown, the barrel screwing into the frame, and held in alignment by means of a set-screw under forward end of receiver. After some use the barrel becomes loose in the frame, and accuracy suffers. Remove the barrel and inspect the shallow hole into which the set-screw turns. If the profile of hole is damaged, clean it out and deepen slightly with a new, sharp twist drill or countersink reamer. Then grind or file the point of set-screw so that the taper of point is slightly narrower than the taper in the hole in barrel. Extreme point of set-screw should be blunt or slightly rounded. When shaped so that it holds

374

barrel rigid in receiver, harden the set-screw in cyanide. It may develop looseness again after long use, but is easily tightened up again.

SPECIAL SCREWS: Are often easily made by slight alterations to head of an ordinary machine screw. For example, a flat head countersink screw can be changed to oval by turning or filing the head to shape. Sometimes the "special" screw in a gun merely has a smaller head than the standard machine screw. Sometimes beveling the underside of a filister head, to fit a countersink hole, will produce exactly the screw needed. If the screw hole is cut with a bastard thread, and the right screw cannot be obtained, the hole may be reamed and re-threaded for a standard screw. Pinion screws having an unthreaded portion at the point, can be made by turning down the end of a larger screw. And so on.

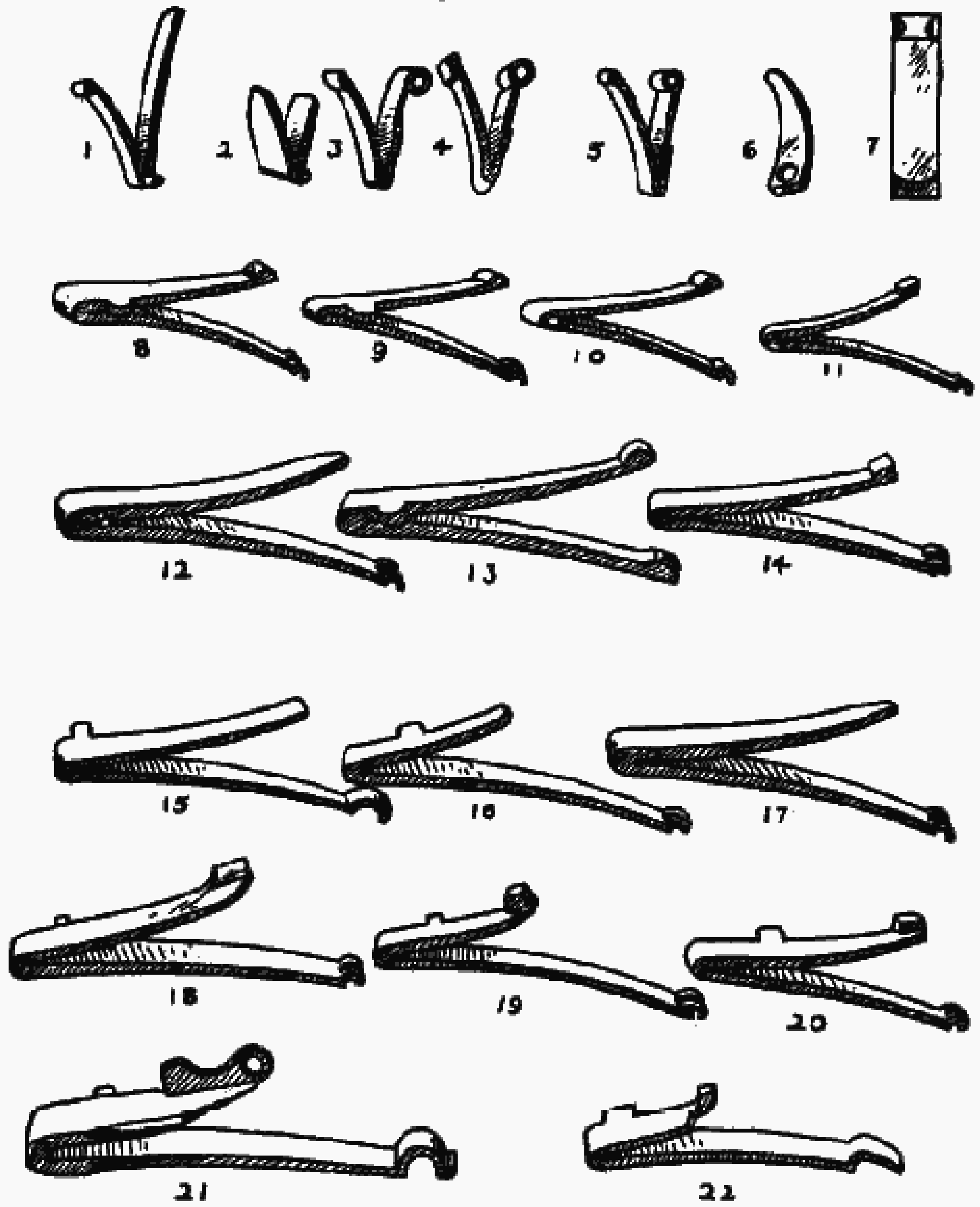
There are not many times when a spring intended for the one gun will work in another—but sometimes they can be adapted by a little careful filing and reshaping. This applies particularly to old style flat lock springs, and different types of shotgun springs. The few dealers who carry springs in stock usually illustrate them full size in their catalogs, and by carefully comparing the picture with the broken part you want to replace, you can usually select something that will do, in event an exact match is impossible. In that case, choose a number that is slightly larger than the original spring, so that there will be an allowance of metal for fitting.

MAKING SPRINGS. A few words on the subject of forging, filing and finishing flat springs may prove of value, in those rare instances when ready made springs cannot be obtained in the correct shape and size. The plate on opposite page shows a number of flat mainsprings, lever springs and others used in various guns.

If you are not sure of the quality of the steel you are able to purchase, it is safest to use some old tool, such as a file, or a buggy spring, or something which you know is made of good carbon steel. If you are using new bar stock, have it considerably thicker than the finished spring is to be, as steel is often decarbonized for some little distance below the surface in the annealing or rolling operations.

Heat the bar to a medium cherry red for a distance a little greater than the total length of the spring, and forge it all over to "tighten" the fibres and make the strucure as compact as possible. Forge it on both edges as well as the flat sides, hammering it out to a trifle more than its finished thickness at the bend. Reheat to good cherry red and bend to a right angle over the square edge of the anvil. The thin metal cools very quickly, so do not try to make the complete bend at one heat, or you will break the fibres; the strength and action of a flat spring depends on the fibres being carried unbroken around the bend. So, reheat, and finish the bend, inserting a thin strip of steel between the two limbs, to provide the necessary space. Note that most springs have from 1/32 to 1/16 inch of width in the crotch, rather than forming a sharp "V."

375



GUN SPRINGS SUPPLIED BY GUS HABICH

Nos. 1 to 7 inclusive: Top Lever Springs. Nos. 1 and 2 for Belgian guns. Nos. 3, 4 and 5 for English guns. No. 6 for Belgian Side Lever. No. 7 for English Side Lever.

Main Springs for Breech Loading Guns. No. 8 Bar Action English or Belgian. No. 9 Bar Action English or Belgian. No. 10 Bar Action, Lock Plates, spring sets back of hammer. No. 11 Bar Action English or Belgian. No. 12 Back Action, Belgian, one spring, rebounding lock. No. 13 Back Action, English or Belgian. No. 14 Bar Action, English or Belgian.

Main Springs, for Muzzle Loading Guns. No. 15 Back Action Hook, main and sear. No. 16 Back Action Swivel. No. 17 Back Action Swivel, main and sear. No. 18 Springfield Musket Swivel. No. 19 Forward Action, Rifle. No. 20 Bar Action, Gun. No. 21 Springfield Musket, Hook. No. 22 Forward Action Hook, Rifle or Gun.

376

The preliminary forging of the bar should have brought the two limbs to nearly their finished thickness, tapering very slightly toward the ends. By no means should a spring be thinner in the bend than it is on the ends—this is the reason so many flat springs break. After forging to as nearly as possible the finished shape, file the spring to exact shape, gradually tapering the thickness toward the ends, and leaving on metal for any studs or projections on the sides.

Some springs have a closed eye formed at the end of one of the limbs. This may be formed by bending the end of the limb over a rod, or a lump of metal may be left at the proper point in the forging, and the eye drilled after the spring is filed to shape. Use your judgment, from the way the spring functions in the action.

Some springs have a round stud or pin sticking out from the side of the crotch. Do not make the mistake of drilling at this point and driving in the pin—the pin must be made integral with the spring, by leaving the metal wide enough in forging so that the side may be filed away, leaving this pin, which is shaped up with the file. The action of a flat spring comes very largely from the bend, and drilling a hole for a pin at this point will ruin it.

In the forging process, never cool springs in water so that you can go ahead with the finishing. Lay them on the anvil and let them cool in the air.

When finish filing, try the spring often for fit, but do not compress it, or it will be bent out of shape. If you have the old broken spring, try the new one beside it for shape and dimensions. When finished, but still a trifle thicker all over than you think it should be, harden and temper as described in Chapter 21. Try the spring very carefully for compression, comparing its strength with the old spring as you recall it. Fit it in place and try the action. Note whether it is sluggish, or quick and snappy. If sluggish, it may have been drawn too much in tempering, or the ends may not be tapered thin enough. The taper should be gradual, and constant from the bend toward each end. File it slowly and carefully, testing frequently in the action. It should cut without difficulty with a good sharp file, but should show its hardness, cutting much more slowly than it did before tempering. If you decide the temper is too soft, heat the spring to a dull red and let it cool in the air, first; then heat to a good cherry red, harden, and temper, drawing less than before. Sometimes two or three attempts on thin springs are necessary before the right temper can be obtained.

The temper will have to be gauged to some extent by the grade of metal used. For example, a spring made of a file must be drawn more than one made of a buggy spring, it being a much higher carbon steel, hence harder before tempering. Extreme care is essential to avoid burning the steel. Never use more than a cherry red heat for both forging and hardening. If the spring becomes nearly white hot —save time by throwing it away and making another.

377

CHAPTER 25

HARD FITTING OF SMALL PARTS

WHEN the gunsmith is called upon to fit new factory parts to the mechanism of a gun, he usually finds that such parts are slightly oversize here and there, to allow for variations in size of other parts. Similarly, when making new parts in the shop, they should be left slightly oversize throughout, the file shaping and preliminary polishing leaving them from .001 to .002 oversize. They are then hardened and tempered, or case-hardened, as required, after which the final or "hard" fitting begins.

Factory parts for cheap guns are often not properly hardened. The gunsmith should first fit such parts but leave them a little full at contact points, then harden as already described, and finally hard-fit them.

First, polish the contact surfaces with clean dry emery cloth until bright. Then coat them with a saturated solution of copper sulphate (Blue Vitriol) until a thin copper plating shows. This plating will be so extremely thin as to make no difference in the fitting—its purpose is to show clearly the points to be worked down.

Assemble the new parts in the gun, and work them as required in the action. They may be so oversize that they will not function, or they may merely work "stiff." Remove them, and note carefully the bright spots left on the coppered surfaces. These spots are then carefully and slowly worked down with stones, ranging from fine carborundum to the very finest, smoothest hard Arkansas slips. After each polishing, rub the spot with crocus cloth to remove any trace of oil or grease, and again coat with copper sulphate before trying in the gun.

Hard fitting of action parts requires care and patience—and lots of time. It is this that makes the difference in cost beween a cheap gun and a high priced one. Perfect fitting, by eliminating unneces-

378

sary play, prevents excessive wear and broken parts. Try the action of a cheap, lossely fitted revolver in comparison with a Colt Officer's Model, or a Smith & Wesson Military Target Model, and you will understand what makes the latter guns worth the difference in cost.

Pick up a $30 machine made shotgun, open the action, then close it slowly. Note the grating together of parts, the ringing of springs, the vicious snap of the top lever as you close the gun.

Now open and close the action of a fine handfinished gun costing $200 or more. Not a sound of friction—no grating of parts together —no ringing of springs—no sharp snap of lever or locking lug; just a soft, mushy, cushioned "thump" as the parts move together—that's what comes of proper hard fitting!

The uninformed hunter may think perfect fitting of parts makes no difference in the shooting qualities of the gun. *It makes all the difference in the world!* For accurate workmanship in one part usually means accurate workmanship throughout. A perfectly fitted lock mechanism is not found on a gun with poorly fitted breech; nor is a well regulated bolt found on a rifle with excessive headspace or poor chambering. The bolt's faults may be concealed under a beautifully chased surface—but the real test of workmanship is the sound of the action when the parts are worked together.

In hard fitting parts of lock and action mechanisms, use care to keep all flat surfaces flat and all edges square and true. Flat surfaced parts should be fitted by placing the parts on the stone and rubbing back and forth without lifting, rolling or tilting them. If working to a definite dimension, set the lock sleeve on the micrometer to this dimension and then try the mike on the part frequently, until it will just slip over every point on the part you are finishing. As you approach the final fit, use only the finest hard Arkansas stone, and polish always in the same direction so far as possible. When trying the parts in the gun, first try them dry, then with a drop or two of clean light oil. Nyoil, Rem-Oil and Marble's Nitro Solvent are all good for oiling closely fitted mechanisms.

As already stated, keep all edges square, and sharp enough to cut. No beveling or rounding off, except to conform to some other part in the gun. When parts are fitted, a few strokes of the finest stone on edges and corners are permissible to take off extreme sharpness.

The final polish, after parts are fully fitted, is given with crocus cloth used dry—and it should be stretched over a flat piece of steel and all flat surfaced parts rubbed on it, rather than rubbing the crocus cloth on the parts. Sometimes inside parts are given a chased finish, as described for rifle bolts in Chapter 18. While this is permissible, and improves the appearance of parts which do not show, the chasing must be done with the very finest abrasive, or the smooth working of the parts will be impaired. A little dust scraped from the surface of a soft Arkansas stone is all the grit that should be used for chasing inside parts.

379

Suppose we have a shotgun that has seen better days, and which we want to rejuvenate. After tightening up the hinge joint and breech as described in Chapter 31, we may find we did a little too good a job, so that the barrels, in closing, bear against the standing breech with excessive friction, or perhaps refuse to close completely. Now we may also want to case-harden the frame of this gun, so we will first do a little soft fitting, by carefully polishing out the semicircular notch in barrel lug, until barrels will close, but are still considerably too tight. Now, after case-hardening the frame by one of the several methods explained in Chapter 22, we next polish off the hinge pin and try again for fit. The case-hardening may have caused some slight warping in the frame which we will now polish out as we do our final fitting. First polish and copper the forward surface of standing breech, also upper surface of action body where breech of barrels rest, should be lightly coated with Prussian blue. Now try to close the barrels, and where they rub against the standing breech, carefully polish off action body with a fine stone. Continue polishing until barrels close readily, but with a snug fit, and to be sure of contact at all points, coat the surface very thinly with Prussian blue. Note also the fit between barrels and action body underneath, and stone off as required. In fitting a breech, a place to watch is the rounded corner between standing breech and forward part of action body—this should be fitted perfectly to lower edge of breech, extractors, etc. Do just as little polishing as possible on end of barrels, as they are soft, and will quickly wear down. The ends should be brightly polished with crocus cloth, also both surfaces of action body; and these surfaces may be given a chased finish.

In remodeling the Springfield and other military and bolt action rifles, the smooth operation of bolt is of prime importance. The average rifle bolt "as issued"—and as turned out by the factory also —works in the receiver with the pleasing smoothness of a harrow dragged across a cinder pile; while the final raising of the bolt handle often reminds one of trying to pry open an outside cellar door after a rain.

The first thing to remember is that we cannot polish the bolt without reducing it in size—so our work must result in removing as little of the surface as possible, and further, *we must remove no metal whatsoever from the rear end of locking lugs.* If we do, we increase the rifle's headspace, perhaps affecting accuracy, and maybe endangering our own safety.

When a Springfield bolt is finished by Parkerizing, the surface is left dull and somewhat rough, but the finish does not alter the size of the bolt. Parkerizing simply changes the character of the metal at the surface, by changing the steel into a phosphate—in other words, no actual coating occurs. The polishing we do must necessarily reduce the diameter of the bolt, but this slight reduction will make no difference, unless we are grossly negligent.

380

The first step, therefore, is to strip the bolt of all parts, including the extractor and extractor-collar. Hold it in the vise, with jaws padded, and with a strip of No. 1/2 carborundum cloth, used with light contact, cross polish it wherever possible, and rub it lengthwise in spots where cross-polishing cannot be done, until the finish has barely been removed, and the bolt is bright. All surfaces of the locking lugs except their rear bearing surfaces may be polished. Now assemble the bolt, leaving off extractor and collar, and coat its entire outer surface (except lugs) with very fine valve-grinding compound, or No. 120 emery and oil. Insert bolt in action and work it back and forth, turning the handle up and down each time. Wash off the grit frequently, and try the bolt dry for smooth working. When you think it runs as freely as it can be made to run in the receiver, wash off all grit, and oil the bolt. Now, place a very small amount of water-mix valve grinding compound on the cocking cam, spreading it evenly with a splinter, and allowing no grit on any other part of bolt. Hold back the trigger, and raise and lower the bolt handle forty or fifty times. Wash out the grit and oil the cam, and try it. The handle should raise much easier than before, but additional working with the grit will continue to improve it.

Sometimes the grit will cause the bolt handle to "freeze" so that it cannot be raised. When this occurs, cock the action by pulling back on cocking piece, wash off the grit, and apply new. When it occurs on a rifle having no cocking piece knob, swear.

Now dismount the bolt completely, and polish all surfaces bright, using No. 00 emery cloth that is nearly worn out, with oil, then use crocus cloth to make it as slippery-smooth all over as possible. Next take a thin, hard Arkansas slip, and carefully polish the edge of cocking cam until it is as smooth as time, work, and patience can make it. With the stone, also polish off the point of cocking piece which runs on this cam. Next polish up the extractor and collar, completely assemble bolt, and you will find it works more smoothly than you ever dreamed a bolt could work. The bolt and extractor may now be chased as described in Chapter 18, but the better plan is to blue it, particularly if used on a hunting rifle.

Do not forget the magazine follower. Unimportant as it seems to the smooth working of the action, it has a lot to do with it. The follower is hard, and should first have the finish rubbed off with carborundum cloth, then the surface polished very bright and slick. If rear end is beveled to make the cut-off inoperative, (See Chapter 30) the beveled edge must be well rounded and polished very smooth. The follower may be buffed with a well rouged cloth buffer, but buffing the bolt will make it very hard to blue.

The foregoing, while referring chiefly to the Springfield, applies equally to almost any other bolt action arm, as well as other types. Pump shotguns that work hard may be wonderfully improved by

381

careful polishing of breech block and other parts, particular cam notches in actuating bars, etc., where friction retards the action.

Never change the angle of a cocking cam in the least, or the entire mechanism will be thrown out of "kilter." Neither should the edges be beveled—leave them sharp and square. The one exception is on the cam surface in receiver of the Model 23 Savage sporters, which usually come from the factory with a very short, abrupt slope. The lower point of this slope can be filed down even with upper surface of bolt handle when closed (the metal is not hardened, and files easily), thus greatly easing the cam and causing the bolt to close with about half the pressure originally required. The surface of this cam, after filing, should of course be polished very smooth.

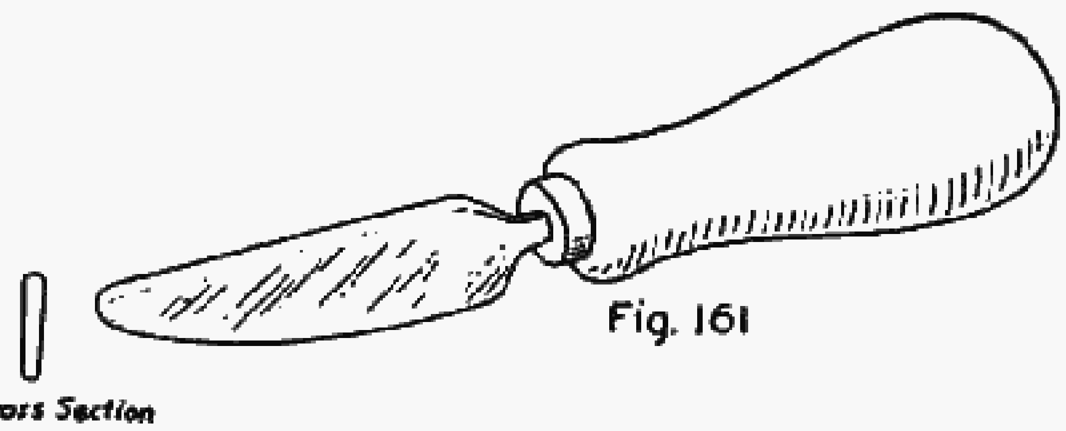


Fig. 161

If one has unlimited time and desires to carry this polishing of parts to the nth degree, make a burnisher out of an old flat file, as shown in Figure 161. This should be about 2 1/2 inches in length, with the teeth completely ground off all round, taking care not to "burn" the file. The efficiency of a burnisher depends on its extreme hardness. Grind the edges round and polish them very smooth. When you think they can be made no smoother, rake the edge across a piece of soft copper, and note the scratches—then do some more polishing. Nail a thick piece of leather, flesh side up on the bench, rub a little very fine rouge into it, and use this for a strop. Rub the burnisher vigorously on the leather from time to time while using.

To burnish parts, hold them firmly and rub the curved edge of burnisher across the surface with good pressure. Note how the metal takes on a brighter finish, which is perfectly even if you cover every point of the surface as you work. This burnishing smooths the surface and closes the pores of the metal, even making the surface slightly harder. No polishing of any sort with abrasives should be done after a part is burnished.

382

Chapter 26

CLEANING BORES AND REMOVING OBSTRUCTIONS

I HAVE stated elsewhere that the average shooter who is not entitled to be classed with that ultra super select and specially favored fraternity commonly called "gun-cranks" usually takes his firearm, if any, to the gunsmith to be cleaned; and since in most cases, a considerable period of time has elapsed since the shooting occurred, the gunsmith's inspection of the bore is quite likely to result in rather startling disclosures. Of course the gun "didn't need much cleaning—it was only shot a few times a couple of weeks ago"—but for some unaccountable reason there is, nevertheless a pretty complete coating of red-brown rust running the length of the bore—this is the *least* that can be expected. More than likely there will also be rich deposits of lead, or perhaps metallic fouling in the case of rifles shooting metal jacketed bullets; and it is not impossible that there will be lovely stallactites and stalagmites of rust projecting from the walls of the bore, giving a most charming effect.

For a wonder, however, due to the excellent material used in most American made barrels, the damage is often far less serious than it appears at first glance. While the gunsmith's job is no sinecure, he can as a rule put the barrel back into fairly good shooting condition—although in the eyes of the real crank the bore is ruined.

CLEANING NEGLECTED BORE. The first step, on encountering conditions such as I have described, is to feel out the bore with a bare cleaning rod, removing therefrom any foreign objects that may be encountered, such as broken pieces of cleaning rod or sticks, boot laces, old files, a suit of underwear, or a page from the Scriptures. The uninitiated are likely to resort to almost anything in the line of cleaning material and implements. During the gala days of the world war, when the use of the festive "pull-through" was encouraged in the Marine Corps, it was an axiom

383

that if a man insisted on dragging his overcoat through his rifle bore, he should first remove the buttons.

Having ascertained that the barrel is free of such equipment not usually carried in rifle barrels, the next step is to push through a cleaning rod with a common 10 cent brass wire brush on the end. Draw this back and forth several times, and most of the loose rust will be knocked out. After that, the operation depends entirely on conditions as you find them.

Dip the brass brush into Hoppe's No. 9 solvent and scour the bore a few minutes. Wipe out with a flannel patch on the regular cleaning tip, then with another patch saturated with the solvent; then dry thoroughly with dry patches and inspect.

If the barrel was neglected only a day or two and the humidity was low, probably the rust will not have pitted the barrel deeply. In that case give it a good scouring with brass wire brush dipped in solvent; then dip muzzle into a pan of *boiling* hot water and pure white soapsuds, and pump the cleaning rod back and forth with a tight fitting patch on the tip. Continue this until the water coming from the bore no longer shows rust; then rinse with clean boiling water, and dry.

The bore will now probably show some lead or metallic fouling. In the latter instance, remove it in the usual manner, using the standard ammonia dope given in the Appendix if the fouling is heavy, or the regular ammonia swabbing solution if it is merely a light plating.

LEADED BARREL. If the barrel is leaded, plug it at breech, pour in a few ounces of mercury, hold finger over muzzle and tilt and roll barrel about until the mercury has amalgamated with the lead, when it can be poured out and saved for the next case. Afterward, swab the bore with several patches greased with that well known and justly famous preparation known as "blue" or mercurial ointment, then clean out with thin oil or solvent, and dry with clean patches.

Many old time gunsmiths used common vinegar for the removal of lead fouling, although a dilute solution of glacial acetic acid would be even more effective. It is used in the same manner as the metal fouling solution—by plugging the barrel and filling it with the vinegar, leaving it until it stops bubbling; then pour it out and wash bore thoroughly with boiling water, using a brass bristle brush to loosen any adhering flakes of lead. Afterward dry thoroughly and oil.

Now the bore will appear clean, but perhaps slightly roughened by the etching effect of the rust, so a little bore polishing is in order. Winchester Rust Remover or Stazon Rustoff will help its appearance if used with plenty of "Armstrong." If results are not fast enough, try a thin oil, such as Marble's Nitro Solvent, with a little very fine pumice sprinkled on the patch. Renew patches frequently but do not continue this treatment too long. In mild cases of rust

384

damage, I have used Bon Ami successfully, rubbing an oiled patch on the cake, and using it in the usual manner. This should be followed by polishing with Tripoli rouge scraped off the cake and applied on an oiled patch with plenty of elbow grease; then with rotten stone used in the same manner.

PITTED BORE. If the preliminary scouring with common brass brush does not remove the loose rust, or if the bore seems rather badly pitted and the rust old and hard, try winding on a bit of fine steel wool on the brush. Yes—it will wear the rifle some, and it will round off the sharp edges, too. But not enough that it can be observed with the nude eye, and remember the bore was practically ruined to begin with. Unless the rust can be cleaned out entirely it's no good at all, and drastic treatment in such cases is essential. If the steel wool doesn't help matters, try next a Parker's "Crescent" wire brush made of mild steel wire, dipped in Hoppe's No. 9. If this fails, try a Parker "Dreadnaught" wire brush. with either bronze or soft steel bristles, and if results are still lacking, get busy with Parker "Scourer" brush with steel bristles. In my humble opinion, anything that cannot be raked out of a barrel with this last named implement was intended by the good Lord to stay there. The Parker brushes are made in Birmingham, England, and are sold in this country by Paddy O'Hare, 552 Irvington Ave., South Orange, New Jersey. See Figure 162.

Having thus scraped out the rust and thoroughly cleaned and polished the bore, it may still show some roughness by reason of its past wrongs. Before deciding on anything further, measure the bore with a lead slug as described in Chapter 16. If it runs close to the minimum for its caliber, it may be possible to lap it out a half thousandth or so without impairing accuracy in the least. Or, it may be lapped two or three thousandths and its accuracy improved, provided bullets correspondingly larger in size are obtainable. If it appears, however, that lapping will make the bore too large, or if bullets of larger diameter cannot be obtained, better use the barrel as is and be satisfied that it's no worse.

SCOURING OUT OLD BARRELS. Often the crank who derives his pleasure from frequent rounds of the pawn shops and second hand stores in a search for good guns for little money will pick up something really worth while. It is astonishing what splendid shape some old charcoal burner will be in, once the encrusted residue is removed from the bore. Of course one always takes a chance in buying such relics, and it is bad policy to let your delight show in your countenance while the dealer is looking on. But if you want to take a chance, like the well known Steve Brodie and the guy who always orders hash, you'll come out winner about as often as you lose—and maybe oftener.

Before deciding to scrap an old black powder barrel as worthless, plug up the breech and pour it full of boiling water—a quart more

385

or less according to caliber. Let it soak a few minutes, pour out the water, and refill it again several times. Then get busy with a good wire brush and see what you shall see. If dry crusts show after the first scouring, soak it some more. If they still show, slip a foot or two of rubber tubing over the muzzle, and hold the barrel filled with water over a gas burner until the water boils hard—hold the end of tubing up high to prevent the water running out. A few minutes boiling will loosen a surprising quantity of filth and corruption and other assets of the Republican party—and it won't

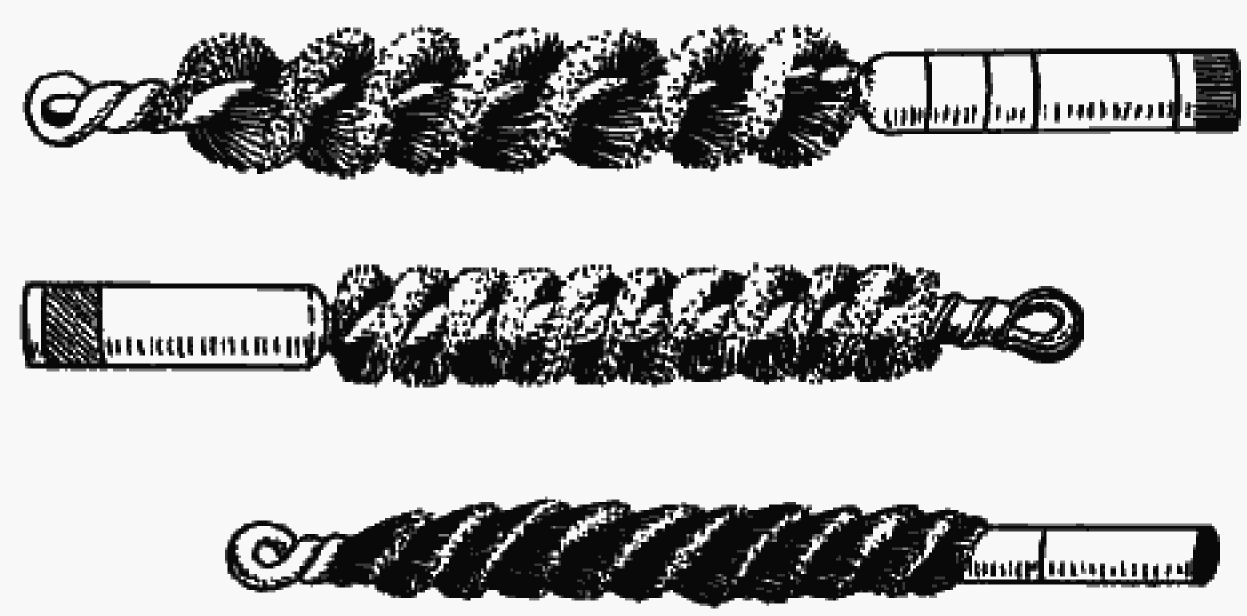


Fig. 162

hurt the barrel a bit. After boiling, scour out again with the brush, clean thoroughly with oil or solvent, dry, and wash in hot water and soap. Then rinse and dry, and swab the bore with the well known pickling solution of 1 part sulphuric acid in 9 parts water. Then rinse again with clean hot water, dry, and oil. Most likely you'll find you've taken the pawnbroker to a first class trimming—which is as it should be.

If the barrel then shows lead, clean it out as already described, and lap the bore if necessary—provided you think it will stand it, or can get bullets the correct size.

SHOTGUN BARRELS. Mighty few men give a shotgun barrel much if any cleaning—and few consider shotgun cleaning sufficiently important to warrant taking the gun to a smith to have the bore cleaned out. It is important, of course, and a shotgun barrel should be kept just as bright and spotless as a rifle or pistol barrel if one wishes to throw an even pattern with a minimum of deformed pellets. When a barrel has been badly neglected it can often be polished out good as new, without seriously altering its shooting qualities—in fact, likely as not the slight enlargement toward the breech may in effect increase the choke and improve the pattern.

A rusty or pitted shotgun should be handled in about the same manner as described in Chapter 31 for overboring. Before rigging up a revolving polisher however, try draw polishing with a good tight

386

flannel patch coated with grease and No. 120 emery. The other polishing may not be necessary—you can't tell until you try the first method. If the pits are very deep, it may not prove practicable to remove them entirely, for not more than five to eight thousandths enlargement of the bore should be allowed. Better to have the shooting qualities slightly impaired, by a few pits, than ruined entirely by excessive overboring.

Whatever is done, a shotgun barrel should—in fact must—be given a mirror like polish inside, otherwise there will be excessive leading, with poor patterns the inevitable result.

REMOVING BARREL OBSTRUCTIONS. Whelen says there is no excuse for a trained rifleman ever getting an obstruction in the bore of his rifle or any other weapon; yet I seem to have a sneaking recollection of a certain ordnance officer some years ago while hunting in California getting first a foot or so of rich black mud, then a willow switch, lodged as firmly in his rifle barrel as preforordestination in the mind of a Presbyterian; which merely goes to prove that accidents *will* happen in the best of families, and that the infantry wins all the wars.

Anyhow, the fact remains that the removal of various obstructions becomes the frequent duty of both amateur and professional gunsmiths.

The first step in the delivery operation consists of pouring in a liberal quantity of any thin, penetrating oil, and letting it soak for an hour or so, or even over night. If the oil does not run through and out the other end of the bore, pour some in from the other end and let it soak a while. Remove the barrel and clamp it firmly in the vise; then try to push out the obstruction with a square end rod, having a tip like B, Figure 163. If this doesn't start it—and it probably won't—try tapping the rod with hammer or mallet. If this fails, pour in more oil and let it soak a while longer, then heat barrel at the point where obstruction is located, being careful not to get it hot enough to discolor; place it back in the vise and drive out the obstruction with good hard blows. Usually it will come right along with this treatment.

Sometimes a wad of rags will be so tightly wedged that it cannot be driven out, and attempts to do so may ruin the barrel. In such case, braze a two inch wood screw to the end of the rod, grinding off the edge of the screw head smoothly, and pick out the rags. Turn the rod until the screw has a good grip, then yank—and out comes a piece of rag. Keep it up and in time you'll get the entire wardrobe.

There are mighty few cases of CARTRIDGE HEADS BREAKING OFF, leaving the body of the shell in the chamber. When it does occur, however, it's a tough break. As a rule pressures that would so rupture a shell will also expand the brass very tightly in the chamber, making its removal difficult; and, brass that is soft and

387

weak enough to break will also grip the chamber walls very tightly. Either the Marble or the Ideal broken shell extractor will usually prove effective—and if these fail, make up your mind to go into a real job.

An "Ezy-Out" made by the Cleveland Twist Drill Company is very likely to take hold of that case and get it. But Ezy-Outs are costly tools and you may not have one of the right size available. Another way is to turn up a steel rod a trifle larger than the inside of the case neck—say about 6 thousandths larger. Cut a very fine sharp V thread on it, and screw it tightly into the case neck. Insert a stiff steel rod from the muzzle and drive out the rod, and if the threads hold, the case is likely to come along also.

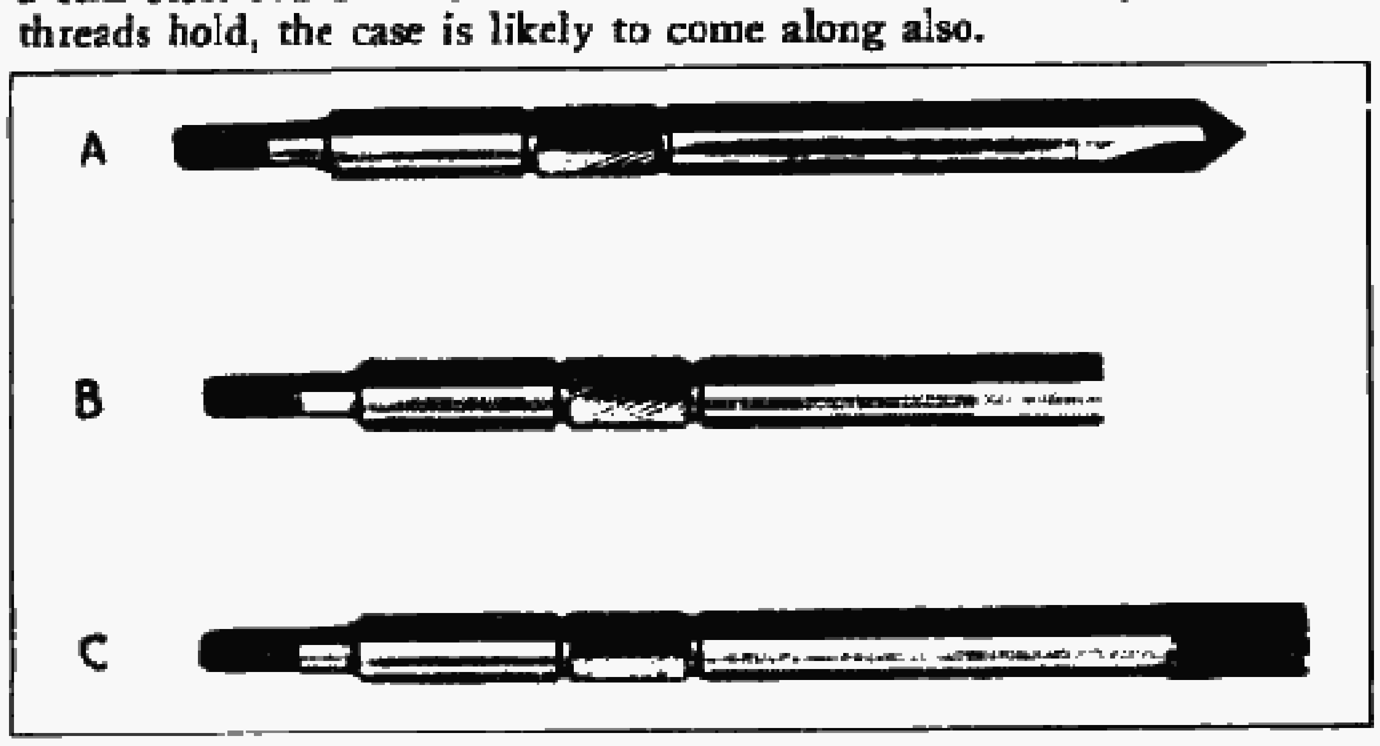


Fig. 163

Another way that is very effective when carefully done is as follows: First scour the inside of case bright with emery cloth wrapped on a small stick. Be careful not to let the emery touch any part of the chamber or bore. Push a small cork or wooden plug well down into the neck of cartridge case, the end of plug projecting about 1/16 inch into the throat of barrel. Coat the inside of case with ammonium chloride (See Chapter 23); then melt up a small quantity of lead and tin solder in a bullet ladle and pour it into the case. Do not fill the case quite full of solder or it will run over the edges and stick to the chamber. In cooling the solder shrinks and draws the brass slightly away from the chamber wall. When hard, insert a rod from the muzzle and drive out case, solder, plug and all.

When a case ruptures at the neck, and the neck is driven partway up into the rifling, it is easily driven out from the muzzle using the square end tip on the rod. The very best tip for this purpose, however, is one shown at Figure 163 C. This is cut as a female to the rifling, the lands of the tip fitting into the grooves in the barrel. These can be procured for .30 caliber rifles only, from the Director

388

of Civilian Markmanship. They would have to be made up specially for any other calibers, however.

Figure 163A shows a special cleaning rod tip for boring out a bullet or similar obstruction lodged in a barrel. This should be made by a first class machinist, and the point carefully ground to an exact center. The cylindrical portion should be an easy slip fit in the bore, and the rod should be removed every few turns and the chips cleaned out of the barrel.

A friend recently brought to me two barrels from a 16 ga. Browning Automatic shotgun, with rags stuck in both barrels. He is a man who takes care of his guns, and these barrels had both been carefully cleaned and oiled with some light, very thin oil, and the rags packed loosely in the bore. When he tried to push them out again a few days later, they packed and stuck about the middle of the barrels, and could not be budged in either direction. Using a small mirror to reflect light down the bores showed long streaks of red rust, indicating the cause of the rags sticking. They were removed by pouring in a quantity of "penetrating oil" sold for use on automobile springs, and letting this soak all day, then reversing the barrels and pouring oil in from the other end, and leaving them over night. Boiling water was then poured on the barrels at the point where the rags were wedged; they were then held in a vise, and the rags driven out from the muzzle with a large dowel rod fitting the bore closely. Fortunately the rust had not been in long enough to penetrate deeply, and it was entirely removed without leaving a pit, using a Tomlinson cleaner and plenty of Hoppe's No. 9 solvent, followed by a little oil and crocus on a tight fitting wool swab.

This man could not understand why the barrels had rusted—yet the reason is not hard to locate. The thin bodied oil poured on the rags had partially evaporated, leaving the rags dry in spots. With the barrels so plugged, the air could not circulate through them as it should. Changing temperature in the room overnight caused condensation of moisture within the barrels, and the rags held this moisture in contact with the surface of the metal. Gun barrels should never be plugged up with anything, and only a good heavy bodied oil or grease should be used to protect them.

389

Chapter 27

LAPPING BARRELS AND BORE POLISHING

LAPPING is an operation involving the cutting of a piece of metal by rubbing it with a softer piece of metal coated with an abrasive. The operation of grinding automobile valves is not lapping, but grinding; for both the valves and the block are of similar hardness, and both are cut by the valve grinding compound. If the valve were made of lead or soft brass, the grit would bed itself in the metal, actually cutting it very little, but would cut the valve seat even faster for that reason.

Lapping a rifle or a pistol barrel involves the casting of a soft lead slug in the barrel; and this slug, when coated with fine abrasive, really becomes an abrading tool, accurately fitted to the bore, and because of its softness and the manner in which the abrasive clings to it without cutting, the lap wears much more slowly than the harder metal of the barrel.

Most rifle barrels are improved by careful lapping. This is not saying, however, that any finished barrel can be thus improved. Because accuracy is to a large extent dependent upon correct bore diameter and proper bullet fit, and the factory barrel that has been finished to maximum bore size without lapping, might be so enlarged by lapping later on that accuracy would be ruined. The barrel that in process of manufacture is brought to its final diameter by slow, careful lapping, is likely to be a more accurate barrel than one that is not lapped. Having a factory made barrel that fits the bullets tightly, and which does not approach maximum dimensions too closely, one may often improve its shooting qualities materially by lapping just enough to smooth out any faint traces of tool marks, and to remove any tight spots such as are often encountered. But the job must be approached advisedly, and only after careful bore measurements have been taken, as outlined in Chapter 16.

390

Even a barrel that runs close to maximum bore diameter may be improved by lapping, provided there are cross reamer marks on the lands—and provided the lapping is carried no further than the removal of these marks, which often result in leading or metal fouling. Again, an old barrel that was tight when first made, may be somewhat worn or pitted from rust; and while lapping the bore smooth will result in this instance in considerable enlargement, careful selection of a tighter fitting bullet will give surprisingly better results. Even an oversize bore may sometimes be lapped out larger and accuracy increased by the use of larger bullets. For example, one may have a Krag that is inaccurate and largely useless by reason of a bore measuring .3095 groove diameter instead of .308 as it should be. By lapping it to .3105 or .311, the .303 British or similar bullets may be used with excellent results, and a rifle that was formerly useless may be made serviceable and accurate. In addition to factory bullets, one may use cast bullets sized to the larger diameter required, or even use them as cast, without sizing, in some instances. The Squib-Miller bullet, for example, will give excellent results in sub-loads in such a barrel, without sizing, and so will the Squibb gas-check bullet.

The equipment needed for barrel lapping consists of a lapping-rod, a small iron pot for melting lead, an Ideal or Bond dipper for pouring, some cotton string or waste, some good light oil, a few ounces of the very finest grade emery flour obtainable, also some fine powdered pumice, fine crocus powder, and powdered rotten stone. Most of these materials will already be on hand in the amateur gunsmith's workshop.

Figure 164 shows details of a lapping rod which is splendidly adapted to the work. The handle assembly involves considerable machine work in the making of the ball bearing ways, and this may be avoided by buying a bicycle front hub and axle complete and brazing or welding the lapping rod to the end of the axle. A handle is then made of wood or metal and attached to the outer shell of the hub by clamp screws, or by brazing or welding if a metal handle is used. A handle made of 3/8" cold rolled rod, bent round the hub and brazed to it is perfectly satisfactory, and is made more comfortable to use by pulling a short piece of thick rubber tubing over each end. Rubber milking machine tubing is excellent for this purpose, as it is thick and soft. The handle must be large enough to grasp with both hands, as considerable force is often necessary in using the rod.

Clean the barrel thoroughly, using ammonia dope to remove any metal fouling, and a wire brush, mercury, or whatever proves necessary to remove leading. Every particle of foreign substance must be removed. Examine the barrel carefully from both ends and mark with chalk on the outside the position of any tight and loose places, rough spots, pits, reamer marks, etc. Measure the

391

barrel with a lead slug as previously described, noting the bore and groove diameters carefully, and deciding on the maximum diameters permissible after lapping. After cleaning, swab the barrel with a good light oil, then swab dry with clean patches.

Wrap a bit of cotton string or waste around the lapping rod just back of the tapered jagged tip in the cannelures. Insert rod through barrel from breech, so that tip is an inch or so below the muzzle. Warm the muzzle over a gas burner until it is about as hot as you would have a bullet mold for casting, then quickly set barrel muzzle up in vise and pour in melted lead even with muzzle. This prevents excessive shrinkage and gives a good full lap. When the lead has cooled somewhat, push the lap partway out of muzzle, and file off the fin of lead where it ran over the muzzle, tapering the

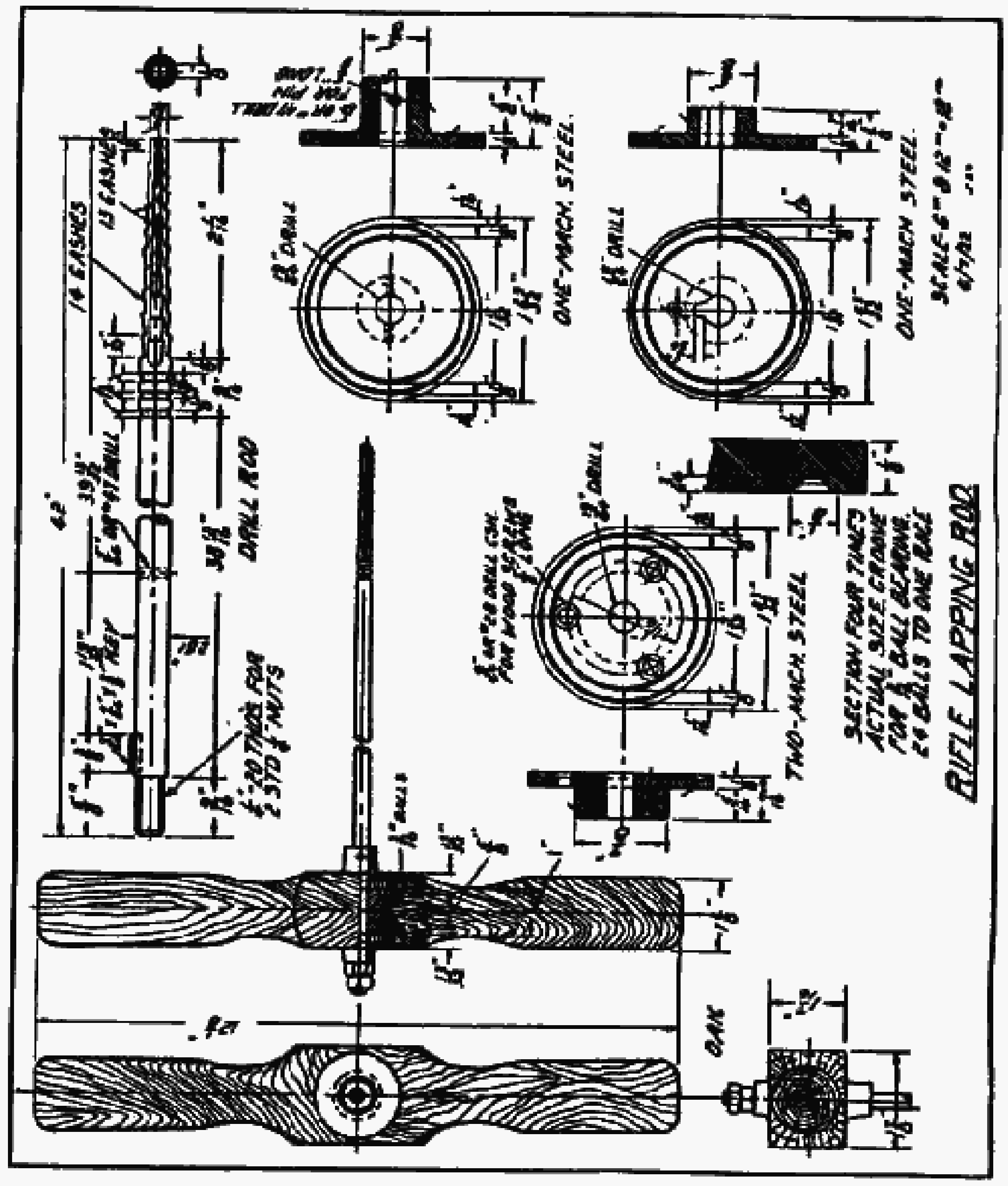


Fig. 164

392

lap slightly at point. The impression of the lands and grooves should be full and sharp, with very few air holes.

Now, leaving the lap in the barrel, set barrel horizontally in the vise, using brass, leather, or felt padded jaws to prevent marring barrel. Push lap about two-thirds of its length out of the muzzle, and coat it lightly with emery flour mixed with oil. Use lots of oil and very little emery at first. See that the vise is firm and rigid. Grasp the handle and draw rod toward breech with a steady, continuous motion, until the wrapping of string is exposed, as the string should be removed at once. Withdraw the lap partly from breech and coat the rear end also with oil and emery flour. Attach a block of wood well padded with rags about an inch ahead of the muzzle, to act as a stop and prevent the lap being pushed out the muzzle. Then proceed with the lapping, by grasping the handle of rod firmly in both hands, and pushing it back and forth with full barrel length strokes. The lap should project from the muzzle to strike the stop each time, and should also be partly withdrawn from the breech on every back stroke. *But at no time must the lap be entirely withdrawn from the bore,* and if accidentally withdrawn, dip it in the melting pot and melt it off, replace the rod in barrel as in the beginning and cast a new lap.

Rifle bores are like fingerprints and women—no two are exactly alike. Moreover, no two lands or grooves in the same barrel are exactly alike; and while a lap may be replaced to apparently a perfect fit, be assured it does not fit, and the corner of one or more lands is likely to be rounded, or the bottom of a groove made uneven.

This warning may bring forth a smile of derision from certain barrel makers, who, when nobody is looking, are in the habit of using one lap in three or four or half a dozen barrels, inserting it by the feel of the lands, and giving the barrel "a lick and a promise" in the belief that the purchaser will never know the difference anyhow. These fellows may consider such methods as good shop practice, but I don't. In my opinion it's a jackleg system, does no good, often does harm, and it's plain dishonest. That's my story and I'm going to stick to it.

Flour of emery cuts rather fast, and the bore should be carefully watched so as not to lap it too large. However, one is perfectly safe in re-coating the lap with emery and oil three or four times before it is removed for measurement. Then carefully flush out the bore with kerosene, mop out with a loose patch, then with patches wet with thin gun oil, then dry. Be sure every particle of emery is removed, then measure the bore with a lead slug to ascertain how much the first lapping has enlarged it. If it is desired merely to smooth up the bore, probably one lap will be sufficient.

393

If a thousand or so enlargement is desired, three or four laps may be necessary. After considerable lapping the lap becomes loose due to wear, and a new one is necessary.

In lapping a barrel that has tight spots, these spots should be given more work than the rest of the bore. About three short strokes in the tight place, then one or two the full length of the bore, then more short strokes followed by more full length, will gradually bring the bore to the desired diameter. Do not take more than three or four short strokes in the tight place at one time however, as you may make matters worse. One quickly learns to tell by the "feel" of the lap in the bore when the diameter is pretty well equalized.

After removing the tight places always clean out the bore and cast a new lap with which to finish the job, for the lap that removes the tight spot will then be too small. For a perfectly even job a new lap is necessary.

When you are satisfied that the lapping has proceeded far enough, as shown by bore measurements and removal of spots or pits, clean the bore thoroughly and cast a new lap for polishing. First it is permissible to use the finest powdered pumice mixed with oil. This may enlarge the bore a very slight amount, but hardly enough to measure. If the lapping has left it fairly bright and smooth, the pumice may be omitted if desired.

A new lap is again cast in the bore, and crocus powder mixed with oil is used for some time. This cuts practically none at all, but produces a very smooth surface. If crocus powder is not available a little Tripoli or rouge may be used. Scrape it from the stick, mix to a thin paste with oil, and apply a thin coat to the lap. Too much lapping with these polishing mediums is hardly possible, but to play safe, better measure the bore occasionally.

A final lapping with powdered rotten stone and oil may be carried to the limit of your endurance—you can't do too much of it—and the result will be a mirrorlike bore that will scarcely hold lead or metallic fouling under any circumstances. Calcium Phosphate is an excellent bore polishing medium also, and as this is the abrasive used in Pepsodent tooth paste, it is easily obtained. Many riflemen use this paste to remove leading from .22 rifles, as it cuts lead rapidly but breaks down on steel.

Before starting in on any lapping job, the following points should be considered carefully:

Don't attempt the lapping of a barrel unless you have plenty of patience. It will take from two to eight or ten hours to do it right—and this is one job that cannot be rushed. Several days may be employed before you consider the lapping and polishing completed to your satisfaction—remember the job is for yourself—not for the customer of some factory. The cost in material is trivial, and you can't count the cost in time.

394

When warming a muzzle before casting a lap, consider the front sight. If attached to a ramp or band that is sweated on with solder, use care to avoid melting the solder. Better warm the barrel, in such case, with rags wrung out of boiling water.

When pouring the lap, maintain a steady stream until the muzzle is *full*. If you stop pouring for an instant the lap may be in two pieces.

Keep a sufficient quantity of lead melted all during the job, and change laps frequently. A full tight lap is the secret of a good job.

After two or three strokes the lap runs much easier in the barrel, and one may receive the impression that the abrasive is not cutting—but it is. A lap should be good for five to ten minutes of continuous work with emery flour, and several times that long with the polishing abrasives.

If considerable enlargement of the bore is desired, it will be found practicable to start the job with the finest grade of water-mix valve grinding compound, obtainable from auto supply dealers and garages. Do not use this for more than five minutes, then cast a new lap, and lap with fine emery flour before measuring, as the valve grinding dope leaves a somewhat rougher surface difficult to measure with a lead slug. If the measurement shows more enlargement is needed, use the valve dope again, until within 1/2 thousandth of desired diameter. Then finish with emery flour and the polishing agents.

Stazon Rustoff and Winchester Rust Remover are very good for the first polishing following the final lapping with emery flour.

Always clean out the barrel perfectly clean after each lapping, before casting a new lap, or starting on a finer abrasive.

Clean the lapping rod with oil and wipe dry after each lapping.

Never, under any circumstances, lap a barrel from the muzzle.

Make the lapping rod from tool steel drill rod, of the maximum diameter that will pass easily through the bore. A thin or weak rod will buckle under pressure and rub against the walls of barrel, damaging the rifling.

LAPPING CHAMBERS: Generally speaking, this is a job that should never be attempted either by the amateur or the professional gunsmith, except under unusual circumstances. There are exceptions, however, as will be explained.

A friend of mine procured, at bargain price, a three-barrel gun, the rifle barrel measuring about .303 caliber, but chambered for some sort of "bastard" cartridge which we could neither identify nor locate. The .303 British cartridge would almost—but not quite enter the chamber. A sulphur cast disclosed that the chamber was just slightly smaller than the regular cartridge at the shoulder, the neck and head dimensions being practically the same. Chamber reamers were not available in this caliber, but the following simple expedient proved effective:

395

Bullets were pulled from half a dozen new .303 British cartridges, the powder removed and the primers snapped. The heads were drilled and tapped to take the threaded end of a piece of 1/4 inch drill rod 2 inches long. This was then screwed into one of the empty cases, and the other end of the rod squared with a file. Another piece of rod three inches long was chucked in a hand drill, with the projecting end squared, then the two rods connected by a piece of heavy rubber tubing slipped over the ends, giving a flexible connection. Water-mix valve grinding compound was then applied only to the shoulder of the case, which was carefully inserted in the chamber and revolved by turning the drill handle. The drill must be drawn back frequently, and very light pressure used, otherwise the tapered case may "freeze" in the chamber. When the case showed any considerable wear it was discarded and a new one used. Finally, when a case had been lapped in to within 1/32 inch of being fully seated, a new one was used with emery flour and oil, this being lapped in until the action would barely close on an empty case, but requiring excessive pressure. Winchester Rust Remover, pumice and oil, Tripoli and rotton stone were then used in order named until the loaded cartridges just seated correctly. The chamber was very highly polished by this operation, and ejection was perfect. Thus a useless gun was put into service at very small cost, the whole operation not requiring more than an hour and a half.

After the first case had been lapped in, the necks were cut off the other cases to prevent enlarging the neck of chamber, and every time a new case was used the chamber was washed out clean with thin oil.

Unless head-space gauges are available I would not recommend lapping the chamber of any high power rifle using rimless ammunition, as it would be a simple matter to increase head-space to the danger point without realizing it. If attempted, it should only be done with the finest polishing abrasives, and should be carried only far enough to remove any reamer marks and polish the chamber walls. The best plan is to forget it.

Chamber lapping may sometimes be profitably employed in revolver cylinders. It is well known—to handloaders at least—that very often the chambers in one cylinder will vary sufficiently in size so that the case that has been fired in one chamber will *not* readily enter some of the others. This necessitates full length resizing each time the cases are loaded, and the resulting fatigue greatly shortens the life of the brass.

A sulphur cast should first be made of each chamber, and each cast carefully measured with the micrometer. The operation then is to lap all chambers to the same size as the largest. The same arrangement is used as described for lapping the rifle chamber, except that fired cases are used instead of new ones.

396

Select the case fired in one of the chambers that is about midway in size between the largest and the smallest. Using only emery flour and oil, lap it into the smallest chamber. Then lap into this same chamber the fired case from the largest chamber. By careful selection of fired cases you can lap all chambers to the same size, then cast a lead lap in the largest chamber, and coat it with emery flour and oil, going clear round the cylinder and using this lap three or four revolutions in each. Wash the lap clean—or better, cast a new one, and go the rounds of all chambers using the finer polishing compounds. This simple treatment will result in the fired cases from any chamber fitting all of the others, and will eliminate the tiresome operation of full length resizing entirely. Care must be taken not to enlarge the largest chamber at all—only polishing it with the same lap used in the others to assure all being exactly the same size.

When lapping a cylinder it should of course be removed from the revolver and held with breech end upright in the vise.

The amateur doing his first job of chamber lapping may be tempted to attach the lap to a motor shaft in the hope of speeding up the job. My advice is—*don't*. Lapping of any sort should proceed slowly—and the speed of a handdrill is plenty fast enough—too fast in some instances. And set the drill for its *slowest* speed.

397

Chapter 28

ADJUSTING TRIGGER PULLS

A JOB frequently required of both amateur and professional gunsmiths is the adjustment, usually for the purpose of lightening and shortening, of the trigger pull. Most rifles, shotguns and pistols as they come from the factory or armory, require such adjustment. Some men have such a perfect sense of touch that they can use a very light pull to advantage; while others need a heavy pull due to a nervous tendency to "loose off" prematurely. The experience of many target and game shooters over a long period of years has shown that the best trigger pull for all round use is one requiring pressure of from 2 1/2 to 4 pounds to discharge the piece. The pull should be clean and crisp without the least suspicion of drag or creep. There should be absolutely no perceptible movement in the trigger until the hammer falls. As the pressure of the finger is gradually increased, the trigger should suddenly release, like the snapping of a thin glass rod.

There is a deal of misinformation in the minds of certain shooters, acquired as a result of the limited training they received during the World War, or later in the Civilian Training Camps. All service rifles, as issued, have long, heavy trigger pulls, with considerable creep on the final take-up. Plainly it is impossible to give these rifles the fine adjustment which the individual bestows on his own gun. So the rank and file are taught to overcome this mechanical defect by slowly squeezing out this final drag when firing on the range—in other words, they are taught to endure what cannot conveniently be cured.

In every walk of life there is a large percentage who have never learned, and never will learn, to think for themselves; and these brethren will stand up and tell you they like a pull with plenty of creep in it, because that's the kind of pull they had on their rifle at

398

Camp Whoozis last summer which they were told was "the best rifle in the world," and moreover the range instructor told them to squeeze it off gradually, so they wouldn't know when the piece was going off, etc., etc., etc. What a sorry thing is a little learning!

TRIGGER ACTIONS. Triggers, both from the standpoint of their mechanism, and their action under the impulse of the trigger finger, are divided into three classes—(1), The Plain Trigger, (2), The Bolt Action Trigger, and (3), The Set Trigger—the last named being divided into sub-classes, the Single Set and the Double Set.

Before going further into the matter of reducing trigger pulls, let us understand thoroughly the nomenclature of trigger mechanisms. These usually consist of three essential parts, not including springs, viz., the hammer, the sear, and the trigger. In bolt actions, and in some hammerless guns, the "hammer" is replaced by a cocking piece, a striker, or plunger actuated by a heavy spring—all of which may be temporarily considered as "hammers" for purposes of explanation. The hammer is held in the cocked position by the sear engaging in a notch. The sear may be a separate part, or it may be the upper end of the trigger itself.

In the plain trigger which has the sear made integral, the trigger is pivoted by means of a pin or screw between the upper end which forms the sear, and the lower end to which the pressure is applied by the finger. Thus, the trigger becomes a lever of the first class, the tension formed by pressure of the hammer notch on sear forming the "weight;" the pivot in pin or screw forming the "fulcrum," while the finger supplies the "power" at the lower end.

When a separate sear is interposed between trigger and hammer, a double system of leverage is formed, and the trigger is usually a lever of the second class, i. e., with the weight located between the fulcrum and the power—the weight in this instance still being supplied by the pressure of the hammer, and transmitted to the trigger through the sear. The sear may be a lever of either the first or second class, according to the design of the mechanism.

Figure 165 illustrates the three types of levers known to physics. In a lever of the first class, it will be evident that if the fulcrum is located midway between the weight and the power, the power required must be equal to the weight. Consequently, were a trigger designed in this manner, that is pivoted midway between the point of the sear and the point where the finger presses in firing, the finger would have to supply a pressure greater than that exerted by the hammer. Now the pressure of a stiff hammer spring, stiff enough to assure against misfires, is considerable. (Try cocking your rifle by means of weights suspended from the hammer or cocking piece). Such a pull would not be conducive to good shooting, to say the least; so, the required "power" or finger pressure is reduced by locating the trigger pivot much nearer the sear point than to the finger point.

399

But in physics, nothing is gained without some loss. The nearer we move the pivot toward the sear point, the less power is required to fire the gun, but the movement, the travel, of the lower end of the trigger, is increased in direct ratio. Likewise, the shorter the distance the sear must move before it is released from the hammer notch—or, putting it inversely, the less support the hammer receives from the sear.

ADJUSTING "HAMMER ACTION" TRIGGERS. Taking it by and large, the *average* man, woman or child is a fool with

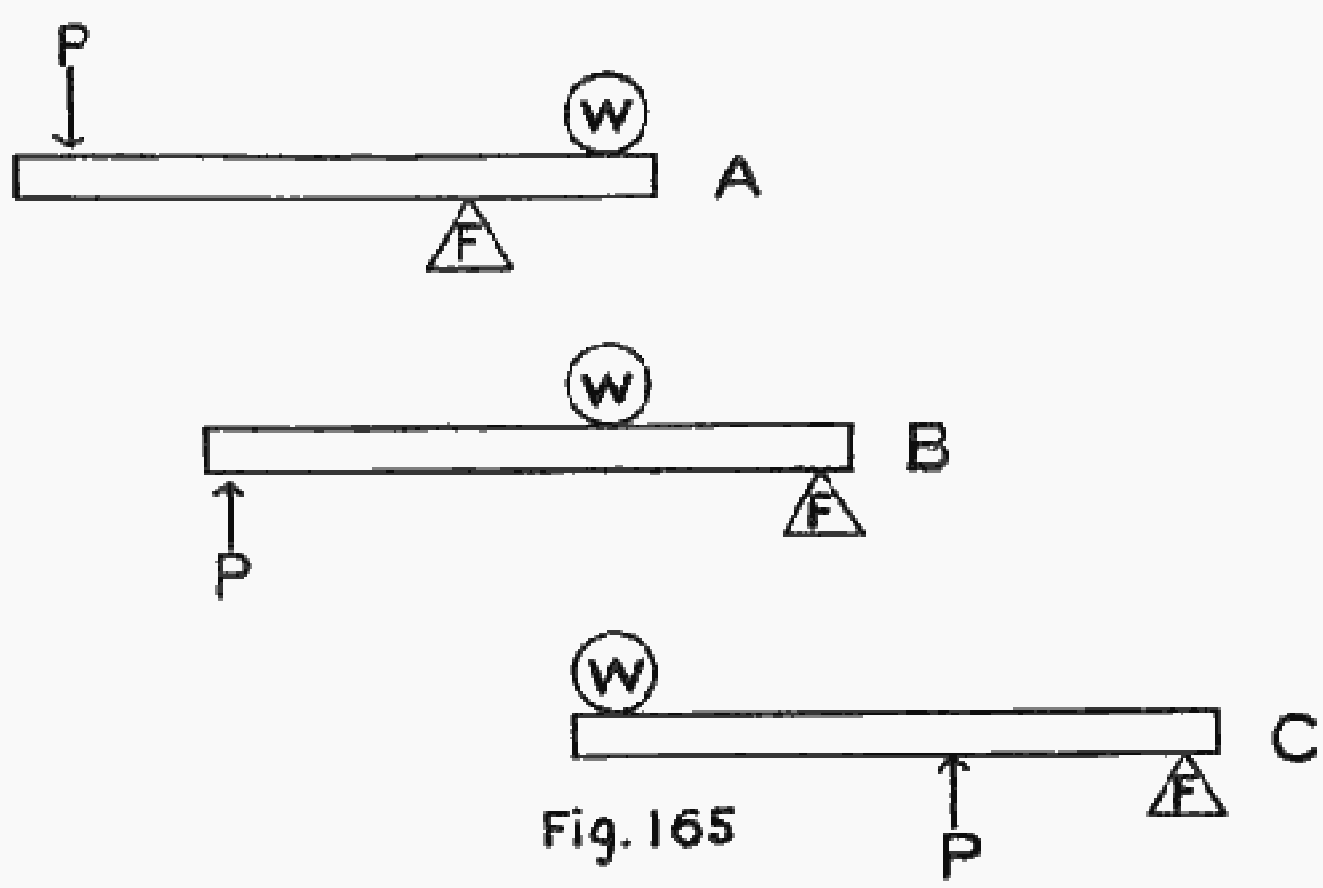


Fig. 165

a gun, and so the factories, making their guns to be sold to this average man, woman or child, must increase the safety factor as much as possible by making the gun reasonably hard to discharge by accident. So the hammer notch is cut much deeper than necessary, and deeper than it would be cut, could the factory but know that the person using the gun is an expert with firearms. A gun must not discharge itself by a sudden jar, such as dropping the butt upon the ground, so the hammer must be well supported by the full width of the sear nose; and the leverage of the trigger must be increased. This in effect, magnifies to the finger the travel of the sear point on the hammer notch, hence the creep or drag. Our problem is two-fold: to reduce the finger pressure required within the desired limit of 2 1/2 to 4 pounds; and to eliminate the perceptible creep.

To accomplish this, several things may be necessary. Plainly, we cannot move the trigger pivot closer to the sear point to increase the leverage and reduce the necessary power. Our first step, therefore, is to study carefully the shape of the sear point, and its relation to the hammer notch. Figure 166 "A" shows the angle of the hammer

400

notch as most rifles come from the factory. Here is a very heavy trigger pull—heavy because when the trigger is squeezed, the sear in its forward travel against the hammer notch has to cam the hammer back somewhat, before it is clear; it is operating against the full force of the mainspring under tension. Now if we reshape the hammer notch like "B," in Figure 166, so that the sear point and the surface of the notch bearing against it are exactly parallel, and at right angles to a line from the trigger pivot to sear point, our pull is greatly reduced—for in squeezing the trigger we do not increase the pressure of the hammer against it.

The amateur will often make the dangerous mistake illustrated at "C," Figure 166. Beveling the hammer notch in this manner permits the hammer to cam the sear forward until it is clear. Naturally

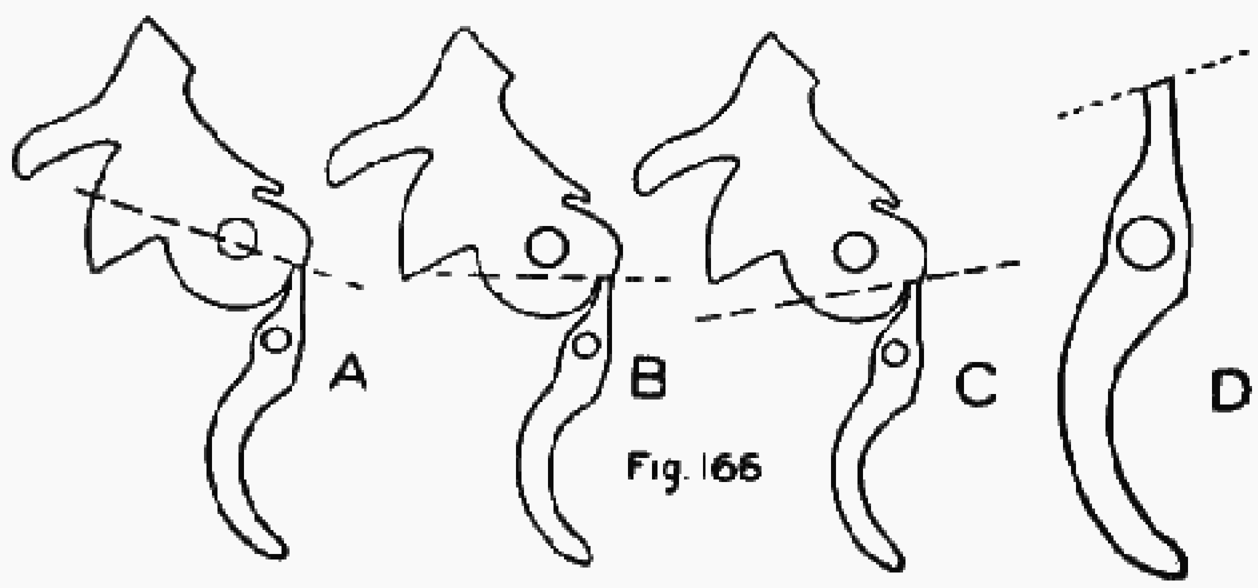


Fig. 166

the gun can be fired with the slightest pressure—and quite often it will fire itself with no pressure at all. The slightest jar may result in accidental discharge.

Going back to "B," Figure 166, it is evident that while reshaping the hammer notch has reduced the pressure required, it has not reduced the length of the pull—in other words, the creep. The first step in accomplishing this consists of polishing both the hammer notch and the point of the sear with a hard Arkansas slip hone as shown in Figure 167. In this polishing a *very* slight beveling of the hammer notch is permissible, but it should be so little that the eye cannot see it. A jeweler's magnifying glass with a 2 inch focus is indispensable for use in adjusting trigger pulls—a true perception of the shape of a very small notch is not possible with the naked eye.

Before changing the shape of the hammer notch in the least, however, it is well to polish it with the slip hone and note the effect on the pull. Often this polishing is all that is required, depending on the weight of the hammer spring. Watch the hammer as you squeeze it off; and if the sear is forcing it back a trifle as you squeeze, this will readily be seen as well as felt. In that exent, changing the angle of hammer notch will almost surely be necessary.

For changing the notch, I prefer to use a small file. A 6 inch

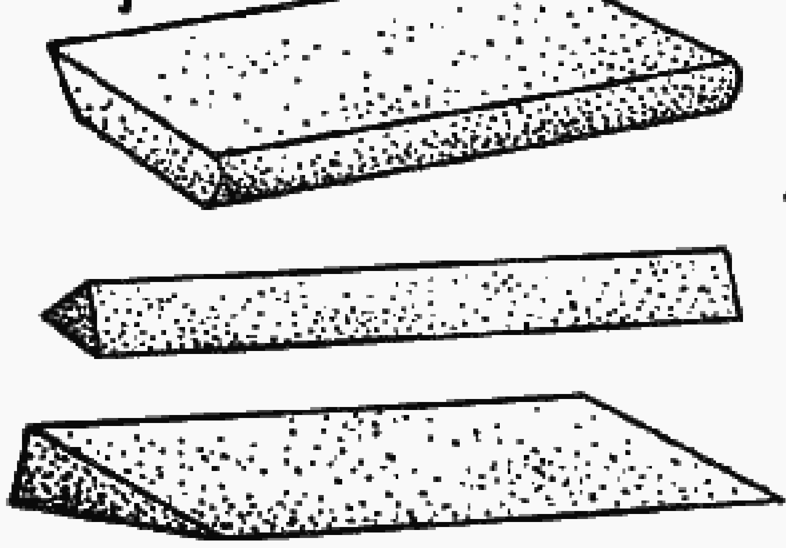
401

American-Swiss Pillar file 1/8 inch wide, with No. 3 (super smooth) teeth is just right for this job. The edges are square and sharp, and there are no teeth on the edges. This file will cut even quite hard steel, and its use permits more accurate shaping than does the stone. Many hammers, particularly in the cheaper arms, do not appear to have been hardened at all. When a soft one is encountered, it is best to shape it up with the file, then case-harden both hammer and sear as explained in Chapter 22 then finish the work on trigger pull with the slip hone.

As already stated, the sear point should be square, and its surface parallel to the surface of hammer notch. You may find on a new rifle that the sear point has no regular shape at all, being carelessly and unevenly beveled or rounded. Two or three light strokes with the pillar file will give a flat surface at the correct angle, after which it should be case-hardened at the point only, and final fitting done with the hone.

Before the final polishing, assemble the parts and try them by snapping the trigger quickly while pressing the hammer forward hard with the thumb. This will show you a bright mark on hammer notch where the sear point pressed. This pressure should be equal the full width of the notch—but you may find only a narrow bright

Fig. 167



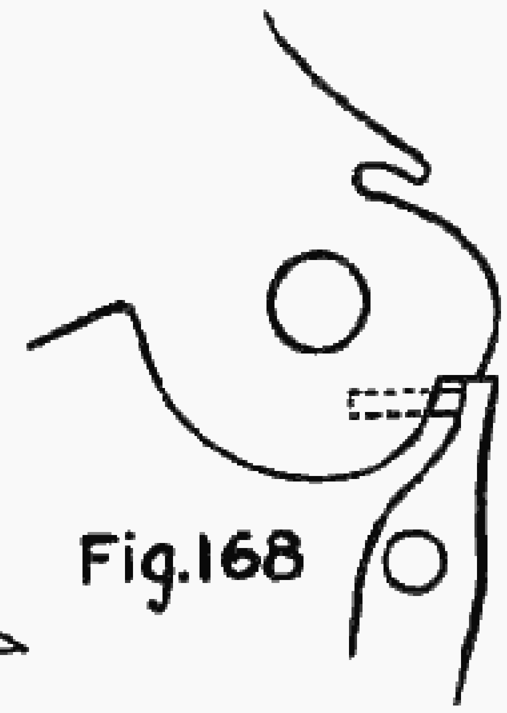


Fig. 168

streak on one side. This indicates that the sear point is a bit lopsided, and it must be dressed down until it bears its full width. In honing the sear point, hold it in the right hand, with its surface at the proper angle resting on a small oilstone, and stroke it on the stone in one direction only, taking care not to rock it or change its position.

If this polishing has not eliminated the creep and reduced the pull to the desired weight, try burnishing sear point and hammer notch by snapping the trigger while pushing down hard on the hammer to increase the pressure. Two or three times will often reduce the

402

pull as much as a pound. However, the creep may still be there, indicating too long a travel of the sear in hammer notch, or in other words, too deep a notch.

At this point the inexperienced is likely to make one of two serious mistakes—or perhaps both. He may file the sear thinner, or he may make the hammer notch shallower, by filing or grinding off its front edge. *Both methods are wrong.* A moment's reflection will show that reducing the thickness of the sear has no effect whatsoever, because it does not change the travel *of the rear edge of sear point to front edge of hammer notch.* Filing off the front edge of hammer notch will undoubtedly eliminate the creep, and give a very quick pull; but it will also prevent the sear from moving forward sufficiently to clear the safety or half-cock notch as the hammer falls, and this notch striking the sear point either breaks or mutilates the sear, or else breaks off the safety notch. The thing to do is to polish and round off, *very slightly,* the rear edge of the sear point, but do not round the edge of hammer notch any more than is necessary to take off the burr and leave it smooth. This edge must be distinct and sharp.

It is a mistake also to bevel back the point of sear sharply, as in "D," Figure 166, for while this causes the hammer to fall at the slightest movement of the sear, the hammer in falling cams the sear forward sharply, causing the trigger to jump back away from the finger with considerable disturbance to the aim. The finger should have perfect contact with the trigger before, during and after the hammer fall.

When none of these methods bring the required freedom from creep, excessive depth of the hammer notch is undoubtedly the cause, and "pinning" the hammer is indicated. Pinning is a simple and sure method, and is permanent. Figure 168 shows the result. A 1/16 inch hole is drilled in hammer just below the notch, and a pin made of drill rod driven into the hole. File off this pin a little at a time, until the sear is permitted to engage the hammer notch just the right depth to give a clean, crisp pull, but deep enough so that the hammer cannot be jarred off. To test for safety, cock the gun and hold at the point of balance in the left hand, and strike butt smartly on all sides with the right hand. If it is possible to jar off by any means whatsoever, file off the pin a little more, even at the expense of smoothness of pull. Safety is the prime consideration—*always.*

The foregoing instructions apply to all guns having inside or outside hammers, whether the sear is made integral with the trigger, or as a separate part. The sears in shotgun locks usually operate in very shallow notches, so that a little careful polishing is all that is needed to give the required pull. Remember that most shotgun safeties merely lock the triggers, and not the sears, which may be readily jarred off if the pull is reduced too much.

403

After lightening up the triggers of a double shotgun, and before taking the gun afield, load one barrel and fire it with both barrels cocked—and note carefully whether the jar of discharge knocked off the other lock. Then load the other barrel and make a similar test. Then load both barrels and fire them singly several times to be sure. "Doubling" in a shotgun is not looked upon with favor—and it is very easy to cause a gun to double if the triggers are too light.

The same applies to the automatic shotgun. When you think the pull is right, load one shell into chamber and one in magazine, and fire the gun. Test in this manner several times, and if the gun ever fires more than one shot to each pull of the trigger, *make the pull heavier*.

Similar tests should also be applied to any automatic rifle or pistol.

While on the subject of trigger and hammer mechanisms, a few comments on specific jobs may be in order. Word seems to have gone forth that it is nearly impossible to reduce the creep in the '73 model Springfield action, due to its stiff mainspring and big heavy hammer, and the margin of safety they necessitated. This pull may be improved materially by careful honing of the sear point and hammer notch; and it may be made as fine as any on earth by a simple method which I used when remodeling the Springfield .45-70 illustrated in Chapter 30. When inletting the action into the new stock, the guard and trigger plate was set about 3/16 inch forward of its original position. This caused the upper end of trigger to come clear of the rear end of sear, so that pulling the trigger did not fire the gun. The trigger was then removed, and its upper end heated and drawn out by hammering until about 1/8 inch longer, when it engaged the sear and the change in leverage greatly reduced the length of pull, eliminating practically all creep. However, changing the leverage increased the finger, pressure required, and this was reduced by carefully honing and polishing sear point and hammer notch, the final pull being 3 3/4 pounds, and without any creep.

Setting the guard forward of its normal position of course threw the tang screw hole out of register. This made no difference, however, because the upper tang which is attached to the breech plug, was lengthened by welding on a piece of tool steel, so as to form a base for a Lyman No. 103 sight—the one supplied for use on the '99 model Savage. When welding on this tang extension the original tang screw hole was welded up at the same time, and a new hole drilled 3/16 inch forward of the old one, to register with the new location of the guard.

Most pump and automatic shotguns of the "hammerless" persuasion really have a hammer located within the breech action; and the process of reducing the trigger pull is fundamentally the same as on outside hammers. Care must be exercised, however, not to get the pull too light, particularly on automatics, as the jar caused

404

by functioning of the action may cause the hammer to fall voluntarily, making a machine gun of your favorite fowling piece!

This applies also—and even more so—to all makes and models of AUTOMATIC PISTOLS. Due to the distance of the trigger from hammer in this type of arm, and the necessary bars and links connecting the parts, it is not possible to eliminate all of the creep. Very careful honing of the hammer notch and sear point will bring the pull on most automatics to between 4 1/2 and 6 pounds—and this is about as light as one should try for. The Colt factory, when specially requested to do so, puts the best pull on their .22 Automatic that I have ever seen on any automatic pistol, and it will pay anyone owning this splendid little arm to avail themselves of the opportunity of having the pull adjusted at the factory. My own pet when it comes to trigger pulls is the .45 Colt Auto. I can work this down until it suits me a lot better than the best factory job I have been able to get, although it is not safe to try to eliminate all of the creep, or the gun may empty itself on the first squeeze. I have less success on other automatics, as there seems to be a knack in the matter, the cause of which I have not discovered.

TARGET REVOLVERS may well have lighter trigger pulls, the U. S. R. A. allowing a minimum pull of 2 1/2 pounds in the "Any Revolver" Match, while the minimum for single shot pistols is 2 pounds, and for military and pocket revolvers is 4 pounds.

The danger in reducing the pull of a double action revolver lies in the possibility of dressing down the forward edge of the hammer notch, permitting the point of trigger to slip between the point of sear and hammer at the instant of firing. This may result in failure of the arm to function, and in broken parts also. Major Hatcher gives some splendid "dope" on revolver trigger pulls in this book "Pistols and Revolvers" and this, as well as all the rest of the book, should be carefully studied by all hand-gun devotees.

On many arms the trigger has an unnecessarily long travel rearward after the hammer has been released. Thus, the finger is jarred and the aim disturbed by this back "slam" of the trigger at the instant of firing. This fault can easily be eliminated by drilling a small hole in the trigger and screwing in a steel pin projecting to the rear. This pin is filed so that it stops the trigger's back movement at the point of release. Another method is to drill the rear of the guard and screw in a pin against which the trigger strikes after releasing the hammer.

Sometimes it is difficult, when reshaping a sear point and hammer notch in order to lighten the trigger pull, to visualize the exact position of the parts as they stand in the action, so as to decide on what is the correct angle of hammer notch. Much time may be saved and trouble avoided as follows: Take a piece of brass or other easily drilled metal plate a quarter inch or so in thickness, and drill holes corresponding exactly to the hammer, sear and trigger

405

screw or pin holes in the receiver. This may be done by clamping the metal plate to the receiver and drilling through the holes in some instances; or it may be done by careful divided measurements taken from centers of holes in receiver. Into these holes in the plate, drive steel pins that will just fit the hole in hammer, trigger and sear. The parts are then set in place on these pins, so that their action is readily observed, giving the workman a true understanding of just how they stand in relation to each other in the action; and he can see at a glance the best angle to cut the hammer notch, and the best way to shape the sear point for best results. Moreover, he can actually test the pull while the parts are on this plate, by placing hammer in cocked position, with sear point in notch, and pushing against hammer spur while pulling back on trigger. This will save assembling the action parts many times, only one or two trials being necessary for final adjustment.

SET TRIGGERS, both single and double, are usually very finely adjusted by the maker, and the best thing to do with them is to let them alone. A set trigger is really a combination of a trigger and a small hammer, the trigger when released, allowing the hammer or "striker" to rise and strike the sear in the action a quick blow, releasing the hammer proper. Sometimes one will find that set trigger parts, particularly in some of the cheaper imported weapons, are not properly hardened, and the notches in a short time wear until they will not hold. Such a mechanism is both annoying and dangerous. The mechanism should be dismounted and all parts except springs carefully case-hardened, following instructions laid down in Chapter 22, then the notches and points may be carefully honed, and the pull will "stand up."

Almost all set triggers have a small screw by means of which the pull may be lightened or increased. A common fault is that this screw, not being hardened, soon wears loose in its hole, and the tension varies. Sometimes it is possible to find a screw having a similar thread which runs a bit oversize, giving a tight fit in the hole. The new screw and the trigger plate should then both be well hardened with cyanide, the screw ground to correct length, and little if any difficulty will then be encountered. When a new screw cannot be obtained, dismount the set trigger mechanism, and with a small ball peen hammer peen around the screw hole close to the edges, but not so as to batter the edges. Careful work will reduce the hole sufficiently to make the screw fit tightly, after which both screw and plate should be hardened.

BOLT ACTION RIFLES require an entirely different trigger action from the hammer or hammerless types. Here the hammer is replaced by a cocking piece, and there is no half-cock. When the bolt is forced forward and shut, (a very quick and forcible operation, as a rule) the cocking piece comes hard against the sear, as in Figure 169, and the contact surfaces of the two must be large and strong

406

to stand wear, and to prevent the cocking piece by any chance slipping by the sear and firing the arm while the bolt is being closed. So the sear must engage the surface of the cocking piece notch for about 1/8 inch at least, for safety; and obviously, this means a painfully long drag in the trigger pull.

Now study Figure 170, which is a Springfield trigger and sear, and is typical of all bolt action trigger mechanisms. Here we have a lever of the second class, the weight being located between the fulcrum and the power. The two projections "a" and "b" form two fulcrums. When the trigger is first squeezed, that is, on the preliminary pull or "take-up" fulcrum "a" bears against the under-

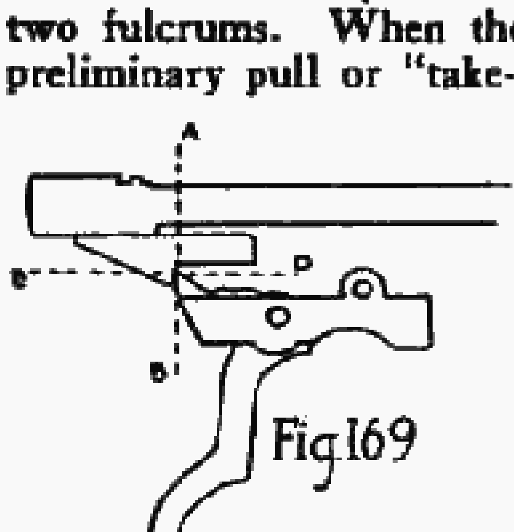


Fig.169

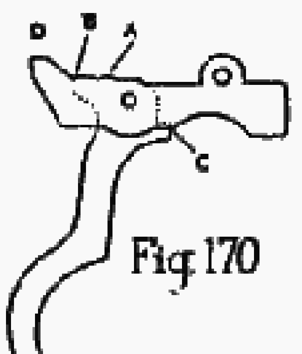


Fig.170

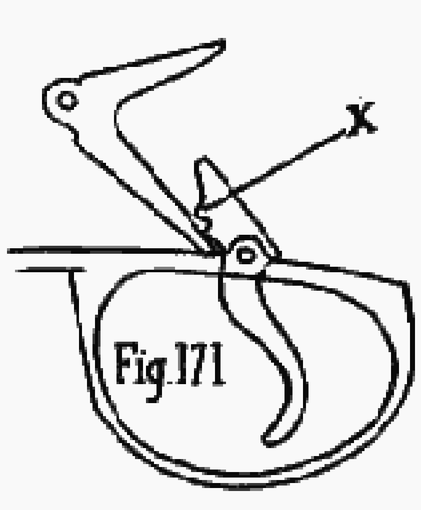


Fig.171

side of receiver and draws the sear downward. The position of fulcrum "a" near the trigger pivot provides considerable leverage, so that only about a pound pressure is required on this take-up, until fulcrum "b" strikes the bottom of receiver when fulcrum "a" becomes inoperative. This change in the position of the fulcrum increases the pressure necessary for the final pull, to release the cocking piece.

The first operation in reducing the trigger pull is to carefully polish the contact surfaces of sear point and cocking piece notch where they come together on line A—B in Figure 169. Get these as smooth as possible with the slip-hone, but do not change their angles nor round their faces. Leave them both square, sharp and flat. The upper point of the sear may be found somewhat rounded, and this should be brought to nearly a sharp edge by carefully polishing off the surface C—D in Figure 169, using a fine grained carborundum stone. Hold the sear flat and rub it on the stone, but take off no more metal than is absolutely necessary to sharpen the point, and do not bevel this surface. Finish by polishing with the hard Arkansas slip-hone. Now assemble and try the mechanism. You will probably find the trigger pull somewhat reduced, and much smoother in its action, but with considerable creep still remaining. Most gunsmiths remove this creep by grinding off more of the upper surface of sear on line C—D, Figure 169, and if you do it this way you must exercise extreme care lest the cocking piece be released before the

407

take-up or preliminary pull is completed. I've seen the pull reduced in this manner on many a jack-leg job. A method which seems to me more sound is to carefully grind off a little of the upper surface of the fulcrum "b," Figure 170, which increases the length of preliminary pull before fulcrum "a" becomes operative, thus shortening the final pull. By this method the bearing surface between point and cocking piece notch is not in the least reduced, and if the two surfaces are properly polished the parts will slip back to their full position should the slack be taken up and the trigger then released. This is essential in any bolt action.

I use the above method on Springfields, Krags and Mausers, and it has always given first class results. By this means the final pull can be made anything from five or six pounds on down to a dirty look. It may be used also on the Lee-Enfield Action in which the same principle is applied in a slightly different manner as shown in Figure 171, the upper projection marked "X" being the one ground down.

When grinding down this part of a trigger, use very light contact with an emery wheel,—just one or two very light cuts. Then round off the corners and shape up with a carborundum stone (a file will not cut these parts), and assemble and try the mechanism. Take the metal down very slowly and try frequently. Should you be unfortunate, and take off too much, so that the gun fires before this part of trigger comes against the receiver, the mistake is easily corrected. Just grind a small amount off of fulcrum "a" (Figure 170), and be more careful thereafter.

TAKING OUT DOUBLE PULL. Some shooters, usually those who are shot-gun trained, or accustomed to shooting hammer rifles, never learn to like the double military pull and will have none of it. Theoretically this pull is necessary to complete safety. I believe this to be so, and practice what I preach on my own rifles. Yet in justice to the opposition I must confess I never heard of a Springfield cocking piece slipping past the sear while closing the bolt. If you want a quick, single pull, do your stuff on the trigger. Dr. Hudson used to employ a simple but very effective method, which consisted of fitting a strip of brass, or piece of hacksaw blade under the forward portion of the guard before placing it in the stock. The end of this piece was cut to a length to bear against the trigger, holding it back sufficiently to take out all the slack. If this is done the strip of metal should be drilled and attached to underside of guard with a screw, or it may slip and spoil the pull. At best it is a makeshift. Another way to use the same idea would be to fit the strip over rear of guard, with a hole through which the tang screw passed to hold it in place. A rectangular slot would be cut for the trigger to pass through, the front of this slot so located to hold trigger back the required distance. Another way is to solder a small piece of brass to the lower shoulder of trigger, at C, Figure 170, filing it down just enough to stop the forward motion of trigger.

408

But a more workmanlike method is to alter both trigger and sear as shown in Figure 172. First grind out all of the fulcrum A, which lets the sear spring force the trigger back so that fulcrum B is in contact with receiver. This gets rid of the take up or preliminary pull immediately. Now we have a single pull, but a goshawfully long, draggy one, due to the contact between sear and cocking piece. We now grind off top of sear point, beveling it forward slightly as indicated by dotted lines at D, Figure 172. Work slowly

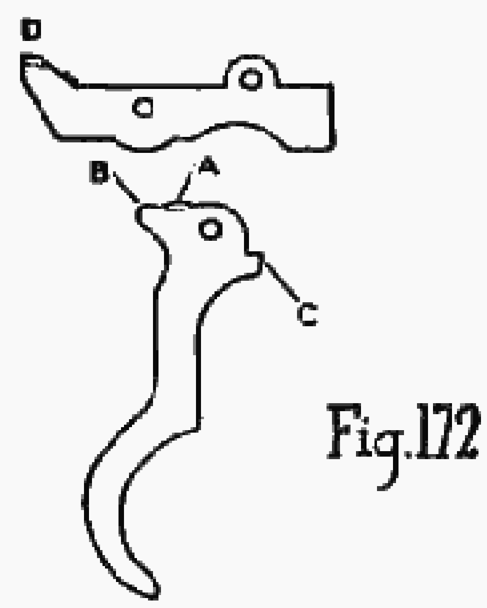


Fig.172

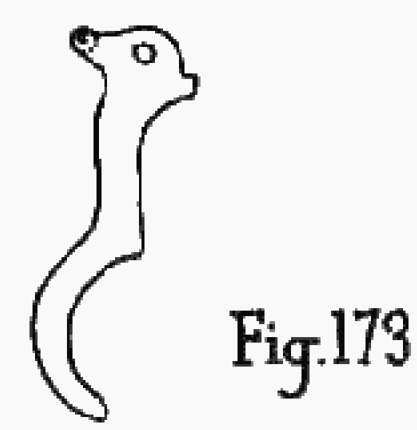


Fig.173

here, and try the parts frequently. Finally, when the pull has only a little drag, it is stoned out by polishing off both contact points on sear and cocking piece.

To further improve this type of pull, some gunsmiths have used the roller stunt shown in Figure 173. The end of trigger is annealed, and a slot milled in the end, into which is fitted a small hardened steel roller, on a hardened steel pin. The roller should turn freely without being tight. The sear point should not be ground off until the roller is fitted, as the roller has the same effect as building up trigger slightly, or of pulling down the sear.

The roller is really an unnecessary rinctum—more of a talking point than anything else. If the end of trigger where it bears against the receiver is polished smooth—and the receiver surface also—no roller is needed. Mighty few shooters ever look for trigger trouble on the bottom of receiver where the trigger bears. Sometimes a few strokes with a stone at this point will work wonders—and the shooter will wonder how on earth you ever did it!

SPEEDING UP LOCK TIME. Having adjusted the trigger pull to his satisfaction, the gunowner will next desire to regulate the action of the rifle for easiest operation and quickest possible lock time. If a bolt action arm, the polishing of the bolt and cocking cams as previously described is the first step. In other types of action, similar polishing and careful hard fitting to eliminate friction will make the action work much more smoothly and easily. Speeding up lock time is accomplished in a number of ways, depending upon

409

the type of action, the underlying principle being that the stiffer the mainspring and the lighter the hammer or firing pin, the quicker the action, and vice versa. Naturally, also, the shorter the hammer fall or the stroke of the firing pin, the quicker the ignition.

Flat or V springs have much faster action than coil springs of piano wire; yet the latter have come into favor by reason of their great durability, and the fact that they seldom or never break, while the stiff flat spring is very easily broken. In a rifle action having flat springs and outside hammer, the speeding up process should consist, first: of substituting a somewhat stiffer mainspring of the same type, carefully fitted and tempered; (See instructions for making, fitting and tempering springs, Chapter 24) second: of lightening the hammer; and, third: of shortening its travel from full-cock to firing pin. This last named step is practicable in some instances but not in others.

The usual plan for lightening a hammer is to drill holes in it in such a position as will not interfere with its strength or action—usually in the part that is concealed within the receiver. Sometimes the sides of hammer which project outside of the action may be undercut and several grains of metal removed. Every particle of weight that can be taken off will help; but good judgment is necessary in order not to weaken the hammer at a point of strain so that it will break from use. If the hammer is hard it must of course be annealed before it can be drilled or filed, and it should be carefully hardened again, and tempered, as described in Chapter 21.

The distance the hammer travels in its fall may be considerably shortened in many instances, by filing the sear notch to a higher position. This must be done slowly and carefully, with frequent firing tests to avoid the possibility of constant misfires. If the stiffer mainspring has already been fitted, and if the tension is adjustable, set it so that it is not quite on maximum tension, then shorten the hammer travel so that you get about one misfire every five shots, after which the spring tension is tightened up so she busts 'em every pop. If there is no mainspring tension screw, better shorten the hammer throw before changing the mainspring—then the heavier spring will eliminate the misfires.

Sometimes it is quite practicable to stiffen a weak flat spring by the addition of an extra leaf made of clock spring or thin spring steel, acting on the principle of the multiple leaf automobile spring.

On bolt action rifles the firing pin travel can be shortened slightly by grinding back the sear notch on cocking piece as far as its shape permits, and by slightly grinding the rear surface of the sear nose forward. Care must be exercised to maintain the original shape of these parts. On the Springfield this alteration can be used to shorten the firing pin travel from 1/16 to 3/32 inch. That isn't much—but as my friend Jack Little said when I asked him how he managed to support his nine kids—"Every Little helps."

410

Cutting the "door knob" from the Springfield cocking piece will lighten it nearly an ounce, effecting a considerable saving in lock time. The headless cocking piece can now be obtained on special order from the Director of Civilian Marksmanship, but there's no need to spend the price of a new cocking-piece for this purpose alone. The cocking-piece is very hard, and must be annealed before it can be cut with saw or lathe tool. By working carefully with acetylene torch, and wrapping the portion which engages the sear with wet rags, it is possible to anneal the head without affecting the hardening elsewhere. Then the pin may be chucked and head cut off in the lathe, or it may be cut off with a hacksaw and afterward rounded slightly and smoothed up by filing or grinding. Re-hardening is not necessary provided the annealing was carried no further than the head. A somewhat safer method, if one is provided with a good grinder, is to cut off the head without annealing, using a very thin-edged carbonundum wheel known as a "cut-off" or "parting" wheel. Wrap the cocking piece in wet rags during grinding so that the heat will not affect the temper, and dip it in water at frequent intervals.

Sometimes a new firing pin spring of the regular type will prove stiffer than the old one, greatly speeding lock time; or a spring may be wound of slightly larger piano wire, or in some instances one may use the same size wire and make the spring with a few more coils,—but not many, or it will not compress sufficiently to cock the firing pin. The special springs supplied by the Director of Civilian Marksmanship on the International Free Rifles were made of wire that is square or "keystone" shaped in cross section, and these springs are probably the best of all if they can be obtained.

One thing to watch in a target rifle where quickest possible lock time is sought, is the lubrication of the mechanism. Never use any but the lightest oil, as it is astonishing how much "drag" some good lubricating oils can put on a firing pin. Marble's Nitro Solvent Oil is the heaviest that should ever be used, and I doubt if anything heavier than watchmaker's fine oil is ever necessary inside a bolt. And if the parts are well fitted and polished as they should be, they should be wiped entirely dry before going into a match.

The 54 Winchester is worked down in much the same manner as the Springfield, as is also the Model '17 Enfield. The Remington Model 30, however, has not the double pull usual on bolt actions—a serious mistake, to my mind. Fortunately, however, for those who like this arm, the regular military pull may be supplied by purchasing from the Director of Civilian Marksmanship through the National Rifle Association, the trigger and sear for the Model 17 Enfield, and replacing the Remington parts with these; after which the pull may be worked down as desired.

The Russian rifle does not have a double trigger pull, and must be reduced by merely stoning the sear point and cocking piece notch. By working carefully, however, it is possible to develop a very good

411

pull on this rifle, although it is not safe to work out all of the creep. The Model 5 Ross also has a single pull, which owing to the leverage employed may be worked down very satisfactorily without danger of jarring off as the bolt is closed. I believe it would be possible to make a new trigger to give the regular military double pull, but at this writing have not had time to try it. I have shot quite a

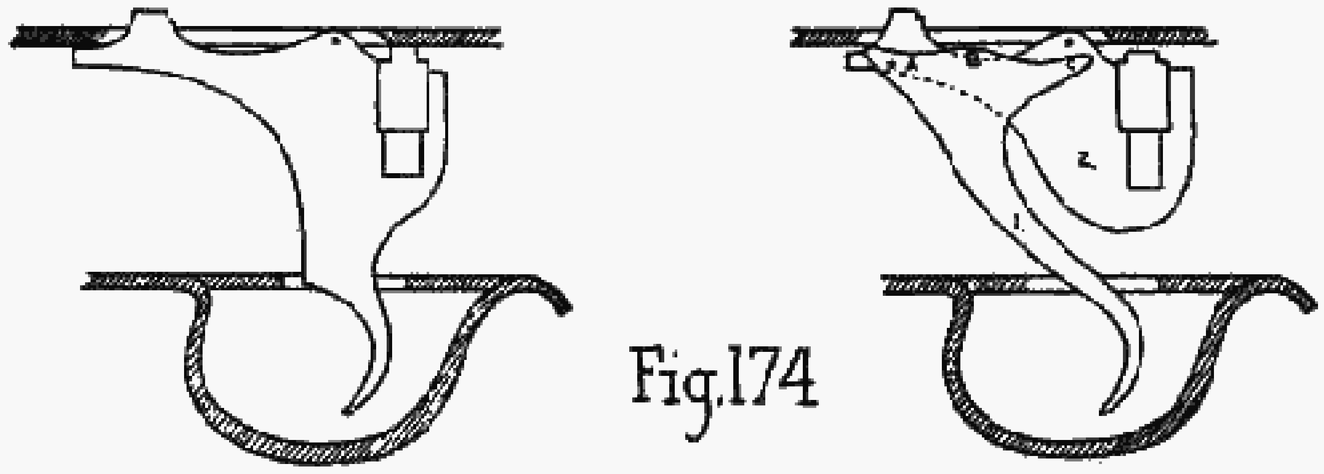


Fig. 174

ORIGINAL TRIGGER IMPROVED TRIGGER

number of Ross rifles, some of them with pulls reduced pretty fine, and none have ever failed to stay cocked even when the bolt was worked very rapidly.

Figure 174 shows an ingenious alteration made to the Model '19 N. R. A. Savage and described in the American Rifleman, to give it this same double pull. The original trigger was worked over as shown into a sear, and a new trigger made. This should prove a real improvement by permitting a much finer pull than is now possible on these arms.

412 -

Chapter 29

SIGHTS AND TELESCOPES

THE simplest job of sight work, and the one most often desired by the gun owner, is that of exchanging the factory sights for others more to his liking, and as most factory sights are simply driven into the dovetail slots they are easily driven out again. The only danger lies in the possibility of springing or bending the barrel and this is easily avoided.

Suppose you have a '99 Model Savage rifle with front and rear sights dovetailed into the barrel. The front sight is a German silver "knife blade" type, the rear a buckhorn. Your choice let us say, is a Lyman gold bead front, a folding leaf sight on the barrel, and a Lyman No. 29 1/2 tang peep sight. You first of all secure the new sights, before touching those on the rifle. To assure getting the front sight the right height, however, it is a good plan to send the old one as a sample with your order. Before removing it from the slot, scratch a fine mark on surface of barrel, at a point as nearly as you can judge under the center of the old sight. Now wrap a thick piece of saddle skirting, or light sole leather around the barrel just back of front sight, and screw it snugly in vise so that only the part of barrel on which sight is fixed projects from the vise. All danger of injuring the barrel may be eliminated by assuring yourself that it is held rigidly. If held loosely, it may easily be sprung. Since only the muzzle of barrel is held, the butt of gun must be supported. Nail a piece of board temporarily on the bench, letting it project forward enough so that butt can rest on it. If the rifle is a takedown, it is not necessary to support breech of barrel—just be careful not to bump against it while in the vise.

BARREL AND TANG SIGHTS. All sights are driven into their slots from right to left—muzzle pointing from you—and driven out from left to right. Old sights may be driven out with

413

a 1/4 inch brass or copper rod, but I have a liking for hard red fiber rods, as they cannot mar the sight in the least, while even brass or copper will leave a mark. A piece of 3/8 inch red fiber round rod will stand nearly as much hammering as the soft metals.

Tap lightly at first to "feel" of the sight—that is, to see how tight it is,—increasing the hammer blow just enough to start it about half way out, when it can be removed with the fingers. Too hard a blow will send it "kitin' " clear across the shop, to be lost, perhaps among the shavings—if you're that kind of housekeeper. Always save old sights and other parts and keep them in the odds-and-ends box. Never can tell when they'll come handy.

The rear barrel sight is driven out in the same manner—but be sure to grip the barrel in the vise as close to the sight as possible.

Before knocking out the rear sight, however, fit the new front sight. If it goes in too hard, note where edges of barrel dovetail bite into sight base, and file off base of sight slightly—don't file the barrel slot. If sight fits too loosely, use a thin brass or copper shim under it. If still too loose, peen over edges of barrel dovetail slightly, —and make up your mind to get a sight with a larger base at the earliest possible moment. Another good way is to tin under side of sight base with a layer of solder, then file solder smooth. This will usually give a good tight fit.

Dovetail sight bases as they come from the factory are often poorly shaped, the edges being rounded instead of beveled off sharp and straight. This fault is seldom found in Lyman sights, and not often in Marble's; it is most noticeable in the otherwise excellent Watson sights made by Belding and Mull. This seems a pity, too, since these sights have so much to recommend them.

When the base is not true and sharply beveled, be sure there is plenty of extra width before you start filing it—otherwise, when shaped to suit you, it may be loose in the slot. As soon as it will start in the slot, hold up to light and see if the angle of barrel slot corresponds with the bevel on sight base. Use a small, very sharp 3-square file for shaping sight bases, and preferably one having the teeth ground from one side, to avoid risk of cutting into the blade or rib of sight. A common 3-cornered saw file is useless for sight work—the edges are too thick, and besides very few sights have a 30 degree angle on the bevel. One of the handiest files for sights is a 6 inch mill file with one edge ground to the proper angle. Get this angle by the "cut and try" method, then keep this file to use for nothing but sight work. The smoothly ground edge is placed flat in bottom of slot—when cutting a barrel slot—or against the sight rib, while the teeth on sides are thus held at the correct angle with sight base or bottom of dovetail.

Drive in the new sight until its center almost—but not quite reaches the center mark previously made on barrel. Then fire a few shots to align, gradually driving sight to left until the shots are

414

centered. Ten or fifteen yards is sufficient range for this. Were the sight driven clear to the center mark before testing, and you then found it necessary to drive it slightly to the right, the dovetail might be expanded sufficiently to make the sight loose.

Now attach the tang sight by screwing it on, the screws fitting into holes already drilled in the tang, and filled with dummy screws at the factory. Turn in both screws loosely and tighten them together, a turn or two at a time. Look through the aperture, and see if it is in line with front and rear barrel sights—first making sure the windage is set at zero. If not in line, shim up one side of base with thin, hard paper until all three sights are lined up, and lower the elevation stem until, as you look through aperture you can see the front bead clearly centered in rear barrel sight notch. Then tighten screws, and again check alignment.

Now you can drive out the rear barrel sight and replace it with a slot blank, or a Lyman No. 6 folding leaf, or one of Marble's, King's, or Western's. The very best leaf is the Lyman No. 6 that is made for the 54 Winchester—it has two flat top leaves without any white triangles or other foolishness, and both leaves have a small U-notch. I hope I live to see the day when Lyman make all their No. 6's this way, instead of that infernal wide V-notch in the front leaf.

If the No. 6 as made for 54 Winchester happens to be the right height for your rifle, or if you can make it do by using a higher or lower front sight, you're not so bad off. Fold down both leaves, then sight in the rifle for the range to be used most with the aperture sight. I use a double newspaper page for sighting in, and find it makes the best target of all for adjusting sights. The printing on the page gives it a light gray tone at a little distance which shows up the sights more clearly than does a white target, and eliminates glare. The target I use is an inverted "T" the vertical bar running from the center of sheet to top edge, and the cross line running clear across the page. The lines are put on with black paint or ink. Aiming is done at the angle where the two lines meet. The new "minute of angle" target is also an excellent one for adjusting sights.

When sighting in, one may disregard elevation entirely until the shots are hitting somewhere along the center vertical line. Then set the sight stem up or down as needed until hitting the point of aim, if using a hunting rifle, or a sufficient distance above it to center in the bull, if a target arm.

Having the tang sight adjusted to your satistaction, raise the lowest leaf of the folding barrel sight, and move sight in its slot until the notch is in line when looking through the peep. If the leaf is a bit too high, (let's hope it isn't too low!) fold it part way down so the bead will show when looking through peep. Then, when properly centered, the leaf may be removed from the base by taking out the small screws in either end, and filing it down the required amount—even cutting a new notch if necessary to file out

415

the old one. Bevel edge of blade slightly forward and downward, and leave rear edge sharp. When cut to proper height, heat-blue it as described in Chapter 20.

If desired to have the second blade adjusted for a longer range—say 200 or 300 yards, first sight in the rifle to the required distance using the tang sight only—then line up the higher blade with this range just as you lined up the first one.

As soon as the tang sight is adjusted for your shortest range, carefully mark the elevation on the stem, and file down the small pin that comes with the sight, until, inserted in lower end of sight stem, it will just permit the stem to be set down to this range. This prevents the sight accidently being set too low for point blank range.

The foregoing instructions will apply to any sights set in dovetail slots cut in barrel, or in raised bases milled on the barrel; also to practically all tang sights, as most modern rifles have the tangs drilled for sights and the holes filled with dummy screws. Fortunately the leading sight makers have gotten together and agreed on the size base screws and distance apart on various rifles, so any standard make of sight may be used on any arm. The only variation of above will be found on certain Winchester rifles, on which it is necessary for the base of sight to extend over the tang screws. Lyman settles this matter very neatly in such cases by supplying a special tang screw with head fitting the countersink in their sight base, and screw long enough to reach through sight base and tangs of rifle. Thus the screw serves a two-fold purpose.

Some rifles, notably the Savage featherweights, have front sight bases milled integral with barrel, and instead of the dovetail, have a narrow slot milled lengthwise of the barrel, into which the new sight is inserted and held by a pin. To remove the old sight, hold barrel in vise as before described, and drive out the pin with a small drift punch. I find it advisable in such cases to throw away the pin, ream the hole slightly, and tap it for a 2/56 machine screw. Countersink the base a trifle on one side for the screw head. File down the head so it comes flush with base—deepening the slot if necessary—and cut off other end of screw flush. Thus an extra sight may be carried for emergencies, and easily changed in the woods with only a small screwdriver.

Front sights for Springfield rifles are attached in this manner, and it is a very good idea to replace the sight pin with a screw, as just described. In this instance, the sight is fitted into the movable stud which is separate from the barrel, and to avoid the possibility of injuring barrel, or of shearing off the screw which holds the movable stud in the fixed stud, it is best to remove the movable stud and hold it in vise while driving out the pin. Another mighty good plan is to get a new movable stud from the D. C. M. and use it in place of the old one. It will be noticed on most service rifles that the stud has been set off center to zero the rifle, and the stud

416

screw hole, being to one side, makes it impossible to center the stud. By fitting a new stud it may be centered, and the hole drilled by inserting a drill through the screw hole in fixed stud. Thus a smooth job is possible, without having the front sight perched off to one side like a stepchild, and the zeroing is taken care of on the rear sight.

Frequently one will desire a folding leaf sight on a barrel which is not slotted for a rear sight—and good gunsmithing practice advises against cutting such slots. A special band having a base for the folding leaf sight may easily be made as described in Chapter 24, which fills the bill quite completely.

Some shooters pooh-pooh the idea of a folding barrel sight. But I have seen many accidents happen to both tang and receiver sights out in the woods, and while often possible to repair them, it is then necessary to re-sight the rifle to tell where it is shooting. With a folding leaf on the barrel properly adjusted to the most commonly used range, the complete wrecking of the rear sight need not cause serious concern; and the leaf would also prove valuable in re-setting the aperture sight after being repaired, without the necessity for sighting in.

RECEIVER SIGHTS. Many rifles, notably the bolt actions and some of the lever actions, are not well adapted to tang sights, and for these Lyman has provided excellent receiver sights, which are easily attached. A few other makers also produce a few receiver sights, but the Lyman line is best known, and are, I believe, the best all round sights in the world. Practically all receiver sights are alike in principle,—a solid steel block forming the base, being screwed permanently to receiver, and an elevation slide set into this base, with some means of raising and lowering it. An arm on upper end of elevation slide carries the aperture over the center of the action, and on some models both the elevation slide and the lateral position of the aperture are given positive control with micrometer screws. The screws are provided with a click, each click giving a change on the target of one minute of angle—or in some cases, of half minutes.

The most representative and perhaps the best known of all receiver sights is the Lyman No. 48, which is adapted to a great number of bolt action arms, but is best known for its almost universal use on the Springfield. A description of the method of attaching it to the Springfield receiver will answer for all others.

Since the Springfield receiver is hardened—the hardening extending clear through the metal in most instances—the first thing to do is to anneal the spots where the screw holes are to be drilled. There are two ways of doing this. The first, and best, is to first wrap the receiver in wet rags, leaving exposed only the lower part of ring on right side where sight is to be fitted. First, however, locate the position of screw holes roughly, with a light file scratch. Now lay a

417

piece of sheet asbestos 1/8 inch thick, with a 1/4 inch hole punched in it over this mark, and heat through the hole to a dull red with an acetylene welding torch. Spot both holes in this manner, lay the asbestos over them, and let them cool. This anneals the spots without affecting the heat treatment of receiver.

An easier method, and one which Lyman recommends, is described in the circular packed with every Lyman 48 sight, and is briefly as follows: First mark the position of screw holes, and grind surface of receiver bright at these points. Then tin the spots heavily with melted solder. Then take a good big heavy soldering copper (weighing 2 pounds or more), heat it nearly red hot, (not recommended as improving the quality of the soldering copper,) and hold it over the spots of solder pressing it down firmly until the solder and copper are well cooled and solder begins to set. Now clean off the solder and the spots will be found soft enough to drill. Polish the spots with emery cloth, coat with copper sulphate, hold the sight base in correct position, and with a sharp awl or scriber mark the position of one of the holes. Drill this clear through, using the drill that came with the sight, then tap it out carefully, using short turns of the tap, and plenty of oil. Place the sight in position, and turn the screw in fairly snug. Then scribe the position of the other screw hole accurately through the screw hole in sight base; remove the base, carefully center punch, drill and tap this hole. In this manner the holes are made to register exactly with the holes in sight base, whereas if both holes were drilled before the sight base was fitted, they would probably be out of register.

Should this ever occur, the best way out is to set in one of the screws tight, then scribe the correction line through the other screw hole—this will be a mark just to one side of the hole in receiver. File the side of hole to this line, and also file out the side of hole in sight base to correspond. True up both holes with a small reamer and tap receiver hole for a larger screw. Such a botch need never occur, however, if the proper method is followed, and one screw set in before the position of the other is marked.

The same method of fitting will apply to practically any receiver sight on any rifle—except that on .22 caliber arms, and also some of larger caliber, the receiver is not hardened (more's the pity!). Always test the hardness of receiver with a small file mark before attempting to drill, otherwise a broken drill point will be the reward of your thoughtlessness.

For certain old models of lever action rifles, there are receiver sights made almost the full length of the receiver, the base pivoted at front end and swinging up at the rear for elevation. These and other models are always packed with a circular and necessary templets for drilling holes, and no other special instructions are necessary.

After the sight is fitted to receiver, the stock must be notched to accommodate sight base, and instructions for doing this will be

418

found in Chapter 11. When all finishing has been done on the gun, and you are ready to put the sight on for keeps, heat the screws nearly red hot and turn them in firmly. In cooling they will shrink and hold the sight rigidly, with little possibility of ever working loose. The projecting ends of screws inside receiver must be filed off smoothly, or the bolt will refuse to enter. A 1/4 inch medium fine rattail file about 8 inches long is convenient for this purpose. After filing off screws, wrap a piece of emery paper around file and remove any burrs or roughness that remains.

When fitting a receiver sight, such as a Lyman No. 33, 34, or 48 to a Krag, note that the upper base screw hole is drilled at a slight angle downward. It is important to drill the hole in receiver at a similar angle, or the screw will not fit well. Most Krag receivers are merely case-hardened, so that spot annealing is seldom necessary—a few sharp blows with a hammer on a sharp center punch will break through the skin and give the drill a good start.

COCKING PIECE SIGHTS—Our next concern is the fitting of cocking piece sights—though why any man should want a cocking piece sight on a rifle is not clear to me. There never was a cocking piece that would go to the same position every time the bolt is closed, unless altered at the cost of several hours work. Moreover, the sight jumping away from the eye each time the gun is fired is not conducive to calling the shot, and always gives me a foolish feeling—like finding sand in oysters. But anyhow, here's the dope—use your judgment.

To fit a Lyman No. 1-A, or 103, to Springfield or Krag cocking piece, first dismount bolt and remove cocking piece. Wrap all but the knob with wet rags, and heat the knob red hot in an acetylene torch. The acetylene torch is recommended for all such work, as the heat from the small and very hot flame can be localized, while an ordinary gasoline blowtorch is pretty apt to draw the temper from the whole part before red heat is reached.

Now grind or file end of cocking piece head perfectly flat—or if you have a lathe, chuck it and face off the surface of head. Coat this surface with copper sulphate and reassemble bolt in rifle. With a small steel rule and scriber, mark a line across the face of knob through the exact center, and exactly horizontal. Dismount bolt, and hold cocking piece head up in the vise. Measure the narrowest part of sight dovetail, and lay it out on surface of knob, parallel with the center line. Make several shallow hacksaw cuts between the two lines, as close together as possible, then rough out the remaining metal with the edge of a coarse flat file. Now take a 3-square file, one side of which has the teeth ground off smooth, and with the smooth side resting on bottom of the shallow groove just made, undercut both sides slightly. Do not finish the cut with this file, as the angle is not quite correct. Grind off one edge of a small mill file until it has the same angle as the sight dovetail, and use this

419

to finish the undercutting of the slot. A very fine-cut, die-sinker's knife blade file will be useful for finishing the slot. Try the sight often to be sure the base fits evenly, with the sight standing upright, not leaning to one side. If you have bad luck and get it crooked, pray that it leans to the left, and if anybody makes a nasty crack about it, tell 'em that's to allow for drift! If it leans to the right, don't show it around.

The above is the method available to most amateurs and small gunsmiths. With machine shop equipment available, however, it is an easy matter to set up the cocking piece accurately in a milling machine, and mill out the slot at just the correct angle.

When the slot is a good tight fit for the sight base, it is a good idea to case-harden the knob again, using the simple cyanide method described in Chapter 22. Keep the sear notch well wrapped in wet rags all the while, unless it was accidentally softened during the previous annealing—in which event case-harden the entire part.

There are several methods of taking out the side play in a cocking piece, so the sight will be more or less accurate. The simplest of all, if the receiver happens to be soft, is to peen the rear corners so that they bear firmly against the sleeve. I have done very well by this method on the Russian 7.62, on which a fixed peep sight was dovetailed into the cocking piece. Another method possible on some rifles is to mill a small slot about an inch long into the left side of sleeve, and fit into it a stiff spring which will bear against the side of receiver. The spring should be flushed at one end, and held with a small countersunk screw. Another way possible on rifles like the Krag, having rather thick receiver walls, is to drill a 5/32 inch hole into receiver wall at rear, into which is fitted a small plunger made of tool steel and hardened. The projecting end of plunger is rounded, and is held in firm contact with sleeve by a short coiled spring in bottom of hole. Various uses of plungers and methods of fitting them are described in Chapter 24.

Still another way of keeping the sight in line consists of beveling one side of the face of sear point, and beveling the sear notch on cocking piece to correspond. Usually the bevel comes on left side, and takes an angle of about 15 degrees. Theoretically, this causes the cocking piece to be forced firmly to right as the bolt is closed—and it may do so. But in my experience I haven't found that it improved the trigger pull any, nor does it prevent the sight being pushed out of line by dirt, piece of bark, sand, etc., which might get into the action. I can't feel right about a sight unless it is set up as tight as a native of Glasgow.

Figures 175A and 175B show two cocking piece sights for the Krag. "A" has no adjustment after it is fitted, being intended solely for hunting use, and to be sighted in with one load at one range. Elevation must be found by filing down a dummy front sight, as previously described. The dovetail base of the aperture is

420

made extra long at both ends, so the aperture may be driven right or left as required, then the ends filed off even and the sight blued. The aperture was made by drilling in just the point of a 3/8 inch drill in the stock, which was afterward shaped up by filing. To attach, a hole is drilled in top of bolt sleeve, and tapped out for an 8/48 screw, the head of which is countersunk in the sight. The screw should be set in hot to assure a tight fit.

The drawing 175B shows a better sight made by Mr. John C. Harris, and described in the American Rifleman of May 15th, 1925. This sight has both elevation and windage; elevation being provided by the small tension screw set about the middle of the base, which is dressed thin at this point, and spring tempered. Windage is provided in the usual way with a transverse screw operating in a stud under the aperture dovetail, the screw being held at both ends against the base of sight. This sight would possibly be improved by having the aperture tapped for a small Lyman or Watson disk.

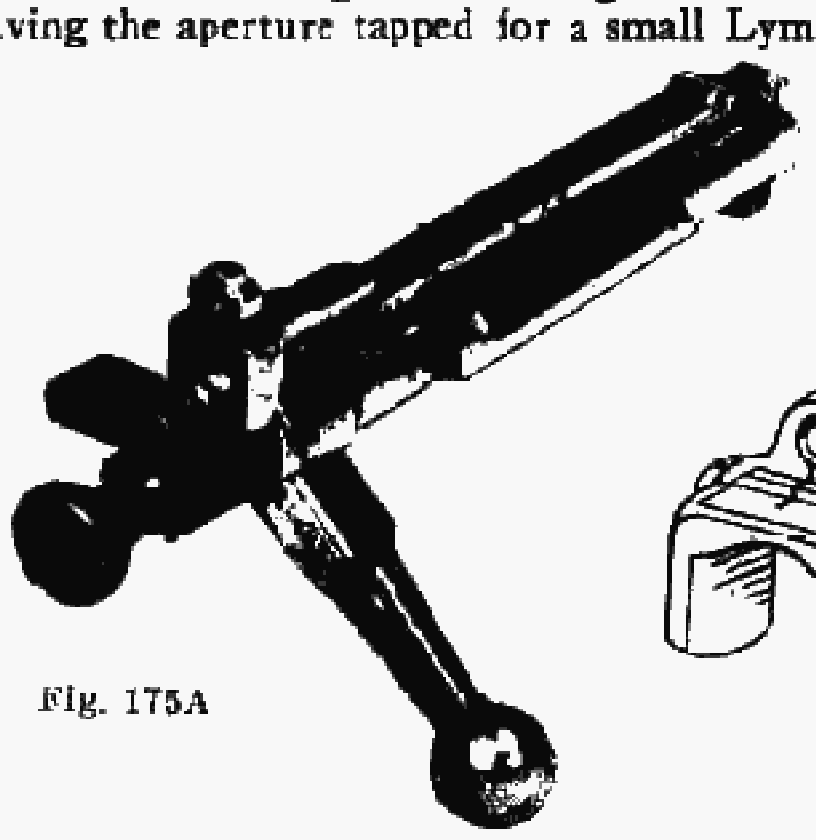


Fig. 175A

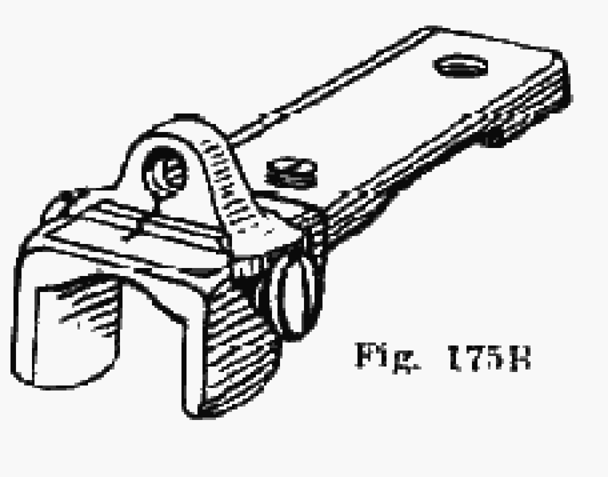


Fig. 175B

Cocking piece sights made for the Haenel-Mannlicher 9 mm., the Newton, Mannlicher-Schoennauer, and Mauser rifles are provided with a special nut for attaching to the cocking piece, and this nut has the sight base dovetail cut in it. It is necessary to drill and tap the cocking piece for the nut, for which purpose Lyman provides a special tap and drill, with full instructions.

When all is said and done, the best way to fit a cocking piece sight, is to send the cocking piece to Lyman and let them do it for you. There is but one better way—use some other kind of sight.

BOLT SLEEVE SIGHTS. There are several recent developments in bolt sleeve rear sights, and this type bids fair to become increasingly popular. One of the best designed, and poorest made is the Howe-Whelen, shown in Figure 103. (Chapter 14.) The elevation slide and windage arm are almost identical with the Lyman

421

48, and the same adjustments are used. The base of sight is milled from a block of steel which has the same inside cuts as the bolt sleeve, which it replaces. To fit this sight it is only necessary to dismount the bolt, and discard the sleeve; then reassemble, using the sight base as a sleeve—it interchanges perfectly. The only fitting required (and it is seldom needed) is a bit of stoning on the point of the sleeve latch, to make it fit easily into the small recess in end of bolt.

Whelen and Howe did a mighty good job when they worked out this sight—a much better job than the manufacturer did when it was put into production. For, due either to soft, un-hardened material, and partly, I think, due to the elevation slide being much narrower than that on the Lyman 48, the slide quickly worked loose in the base, and could not be tightened enough to prevent its wobbling. For this reason alone I discontinued using the Howe-Whelen sight, much as I liked it otherwise.

The new Belding & Mull Bolt Sleeve sight has much to recommend it, particularly for use on a hunting rifle. See Figure 176A. This sight is "bull strong," being well bolted through holes drilled in the bolt sleeve. There are two flat springs on the base, or rather one spring with two lips, which ride on top of the tang on either side, bringing the sight positively to position when bolt is closed. Being attached to the sleeve and not the cocking piece, the sight is stationary and does not move when the rifle is fired. The principal objection to the B. & M. sight for target use is the method of adjustment. The screws have small heads with wide coin slots, which does not facilitate quick adjustment, and the clicks apparently do not have a definite value on the target like the Lyman 48 and the Howe-Whelen. There are in addition lock screws for both windage and elevation, which makes this a good hunting sight for use with one load, and with adjustment for one range. It looks somewhat clumsy, however, due to overhanging the forward portion of the grip.

The Belding & Mull sight is not adapted to ready attachment in the home workshop, but the makers fit it without additional charge—only the firing pin and striker assembly and bolt sleeve are needed.

Figure 176B shows the latest design for a strictly hunting rear sight—to my mind the most practical, most substantial and best appearing sight ever made for any rifle. It was designed by Mr. Elmer Stahl, of the Niedner Rifle Corporation. The sight itself is built into a special base which takes the place of the regular bolt sleeve. Both elevation and windage are adjustable by means of screwdriver head screws, and both adjustments can be rigidly locked—so firm, apparently, that nothing less than a sledgehammer would alter the adjustment or damage the sight.

The sleeve portion of this sight has no safety lock—this part being eliminated to permit of mounting a scope very low on the rifle

422

if desired. Heretofore, scope mounts were made high enough to clear the safety lock when turned up, which made the scope sight line higher than would have been necessary otherwise. Mr. Stahl's cleverly designed sleeve eliminates this objection to a low set scope, giving riflemen just what they have been asking for, these many years.

To provide for locking the action when rifle is cocked, a safety lock is built into the forward portion of the trigger guard, similar to the safety used on some Remington rifles. This not only locks the firing pin and sear, but also locks down the bolt—a most valuable feature hitherto lacking on the Springfield, and appreciated by the hunter who has had his bolt pulled open when going through brush. This same bolt locking feature is found also on the Howe-

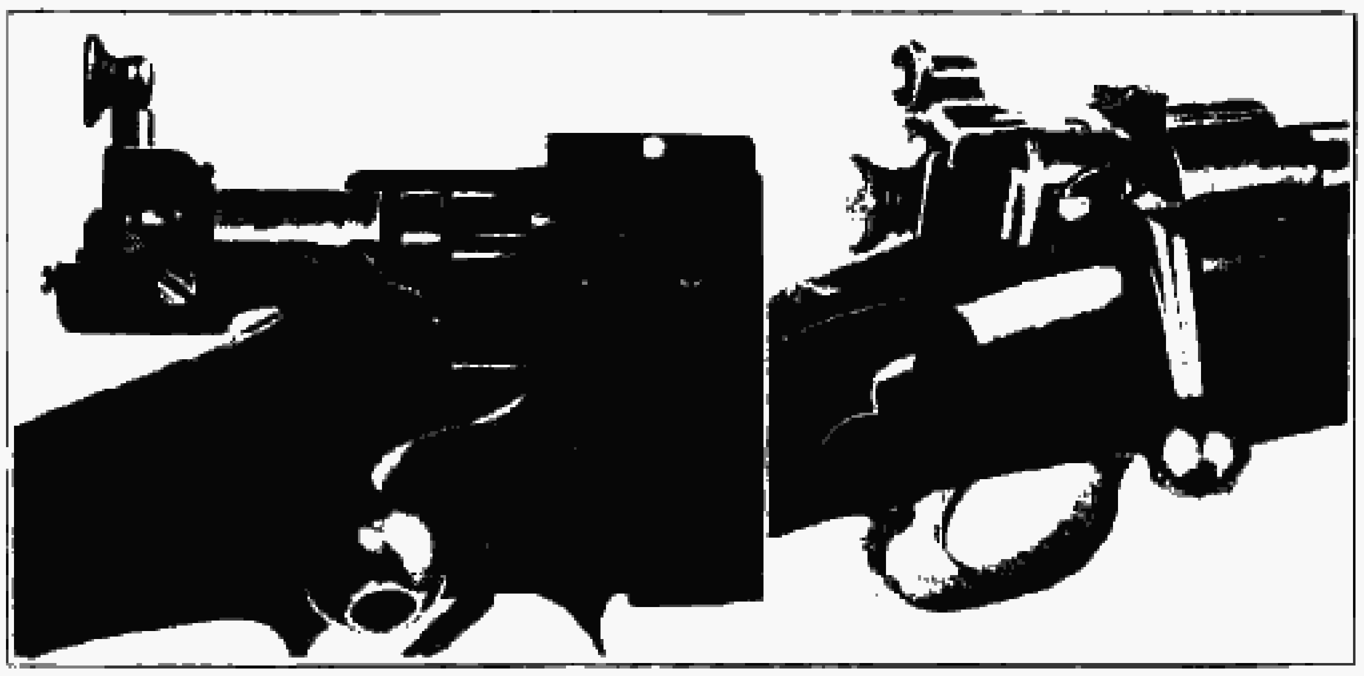


Fig. 176A Fig. 176B

Whelen, but as that sight is really better for target use than for hunting, locking the bolt is less essential.

Now comes the fly in the ointment. This really splendid Stahl Sleeve Sight and Bolt Locking Safety combination costs only $50.00 installed, at the present writing. Which means that yours truly, and a lot of others afflicted with beer incomes and champagne appetites in the matter of guns, will have to possess our souls in patience for the immediate present, or until this equipment is in regular production. At this time it is made and fitted to order only, it being necessary to send Mr. Stahl the entire rifle to be fitted.

FITTING FRONT SIGHT BASES. When a barrel has been cut off to shorten it, or to remove a damaged muzzle, as described in Chapter 24, it is necessary to make provision for a new front sight. Usually the better plan is to provide some kind of base, such as the Springfield fixed stud, which is about 5/8 inch inside diameter, hence readily adapted to a number of sporting size barrels.

When the barrel has been cut to the required length the fixed stud is started on the barrel and peened to a snug fit. It is usually best

423

to fit the stud to barrel before cutting barrel to length. Slip it on as far as it will go, give it a tap or two with a piece of brass, then tap smartly all over the barrel band with the ball end of a light hammer. This stretches the band so it can be driven on a little further. Continue the peening and driving on until the sight is in its final position, then cut off and crown the barrel.

The band of this fixed stud may be sweated or pinned to the barrel, or both. First place the barrel and action in stock, and tap the sight base right or left as required to line it up vertically. (See detailed instructions for fitting sight ramps in Chapter 24.) Tin barrel and inside of band as described for ramps, and sweat band in place. Take a small "mouse-tail" file and insert it through hole near rear end of fixed stud. File barrel surface inside this hole, then insert a drill a trifle larger than the hole and drill it out smooth, then drive in a pin made of a piece of drill rod one size larger than the drill you used, and the job is ready to be cleaned up and polished for bluing. If desired to merely heat blue the sight and muzzle of barrel, do not sweat the band on—merely pin it. The best job is done with both pin and solder, then the barrel and action should be completely reblued.

The parts usually required for fitting a Springfield sight base and the price are:

1 stud, fixed	.37
1 stud, movable, assembly	.35
1 pin, front sight	.01
1 sight, front	.07

These may be purchased from the Director of Civilian Marksmanship by any member of the National Rifle Association. Send 5 cents extra to cover postage.

After the fixed stud is attached, fit the movable stud in place, insert the sight blade and pin. Now set the rear sight at the lowest possible position, and sight in the rifle for the desired range. Probably it will shoot low, so file down the front sight blade gradually until you have the required elevation. If the rifle shoots too high, file a higher sight blade out of a piece of sheet iron or brass, then dress it to correct height when sighting in. This filed sight may now be sent to Lyman, Marble, or King as a pattern, and a new gold or ivory bead sight the same height will be supplied. These companies make sights for the Springfield in several different heights, and will also make up any special heights required at a small additional cost.

A very attractive and practical front sight is the Western Full Block sights made in Denver. This has the movable stud and sight blade with bead, all made in one piece, and is furnished in several heights at $1.50. Sight in your rifle with the regular Springfield assembly, then remove the movable stud with sight blade attached, and send it in when ordering the full block sight.

RAMP FRONT SIGHT. The ramp, or inclined plane lead-

424

ing up to the front sight is steadily becoming more popular on American arms, although the idea was originated in Europe. At least one manufacturer in this country is furnishing some of their rifles with a small neat ramp into which the front sight is fitted, as standard equipment. The ramp not only gives a pleasing appearance to rifles requiring a high front sight, but it also provides a dull matted surface in front of the sight which reflects no light, and to a large degree removes the disturbing influence of heat waves from the barrel.

The manufacture of sight ramps is fully covered in Chapter 24, while the method of attaching them by sweating or brazing, will be found in Chapter 23. Our principal concern in this chapter is the fitting of the sight itself to the ramp. The easiest method is to cut a cross dovetail in the top of ramp, and fit in any of the standard dovetail base front sights. Due to the fact that the ramp is narrow, usually 1/4 or 5/16 inch, the sights having short bases should be selected, so that the ends may not project too far over the edge of ramp. The sights made for the 52 Winchester, the Newton, the Mauser, Mannlicher-Schoennauer, etc., all have such bases. Or, any sight you select will be supplied with short base by the makers on request.

To ascertain the correct height of the sight when attached, first solder a piece of soft metal—brass, copper, or zinc—to the flat top of the ramp after it is attached. Dress this up with a file to form a sight blade, at least 1/8 inch higher than you think it should be. Set the rear sight as low as possible, and shoot the rifle on the range, filing down the temporary sight blade until you have the required elevation. Lateral adjustment may be disregarded, provided the rear sight has windage adjustment.

Now measure with calipers the over-all distance from the top of sight blade to bottom surface of band. Figure 177A. Better yet, measure this with a micrometer if you have one large enough. From this subtract the over-all dimension of your front sight, from top of bead to bottom surface of base. Set the hermaphrodite calipers for this new measurement, and scribe it on front end of ramp. Figure 177B. Now project this mark around both sides of ramp, the marks on each side representing the depth of the dovetail cut. Measure the thickness of the dovetail base of your sight. Scribe a line above the first one made on sides of ramp, this distance from it. This gives the top surface of ramp. Figure 177C. Now file or grind off the temporary sight blade and dress down top of ramp to the last line marked on the side. Between this surface and the remaining line, lay out the shape of the dovetail slot, measuring and cutting the dovetail in the manner described for fitting a cocking piece sight. Be sure to use a square across top of ramp to keep the sight dovetail square with bore. When fitted, the top of sight bead will be very nearly the same height as the temporary sight blade was.

425

There will of course be a few thousandths inaccuracy, which may be taken up with the rear sight adjustment, and this inaccuracy in fitting will amount to no more than the variation between different lots of ammunition.

After the sight is in place the sloping surface of ramp should be filed down to final shape and the surface matted. (See Chapter 19.)

Caterpillar type front sights are made in both Lyman, Marble and Sheard, and are very desirable on a ramp, but more expensive to fit. They are supplied in heights varying by .010 inch, which makes it easy to secure the correct elevation. The approximate height should be first determined by sighting in with a dummy sight as just described, then select the height of caterpillar desired, and mark the depth of the dovetail on front end of ramp. The barrel is now clamped to the bed of a milling machine on V-blocks set on base, with the ramp vertical. A milling cutter must be made to cut a dovetail slot same width or slightly narrower than the base of sight.

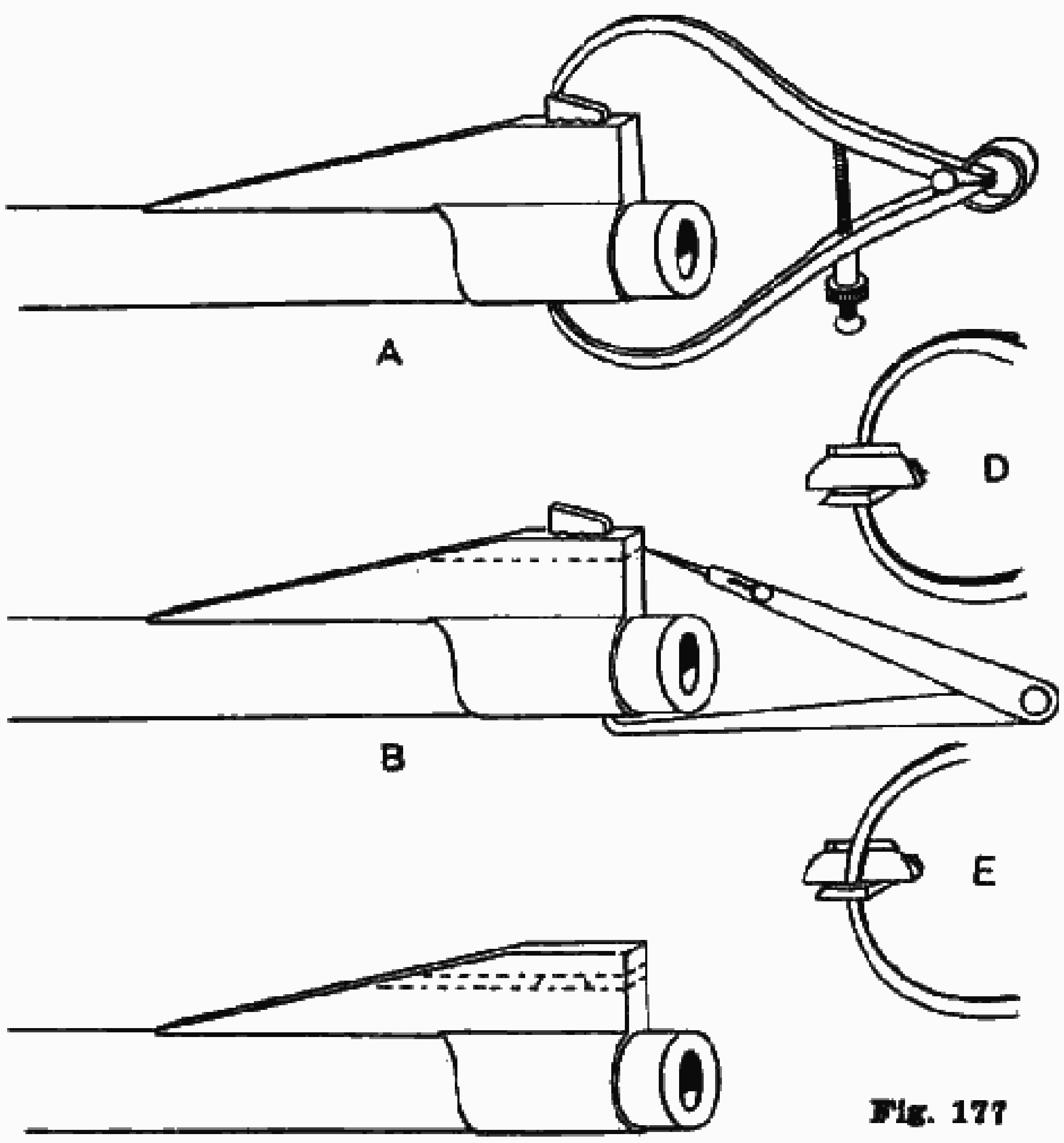


Fig. 177

426

The ramp is fed against the edges of revolving cutter until the dovetail is the required length—usually somewhat shorter than the base of sight, which is made extra long, to be cut off flush after it is fitted. This is a job to be attempted only by an expert machinist or toolmaker with good equipment. The gun owner, or the shop that is called only occasionally to turn out a ramp job, will find it convenient to send the barrel with ramp fitted in the rough, and dummy sight filed down to the correct height, to the Marble Arms & Equipment Company, Gladstone, Michigan, and let them cut the slot and fit the proper height of sight.

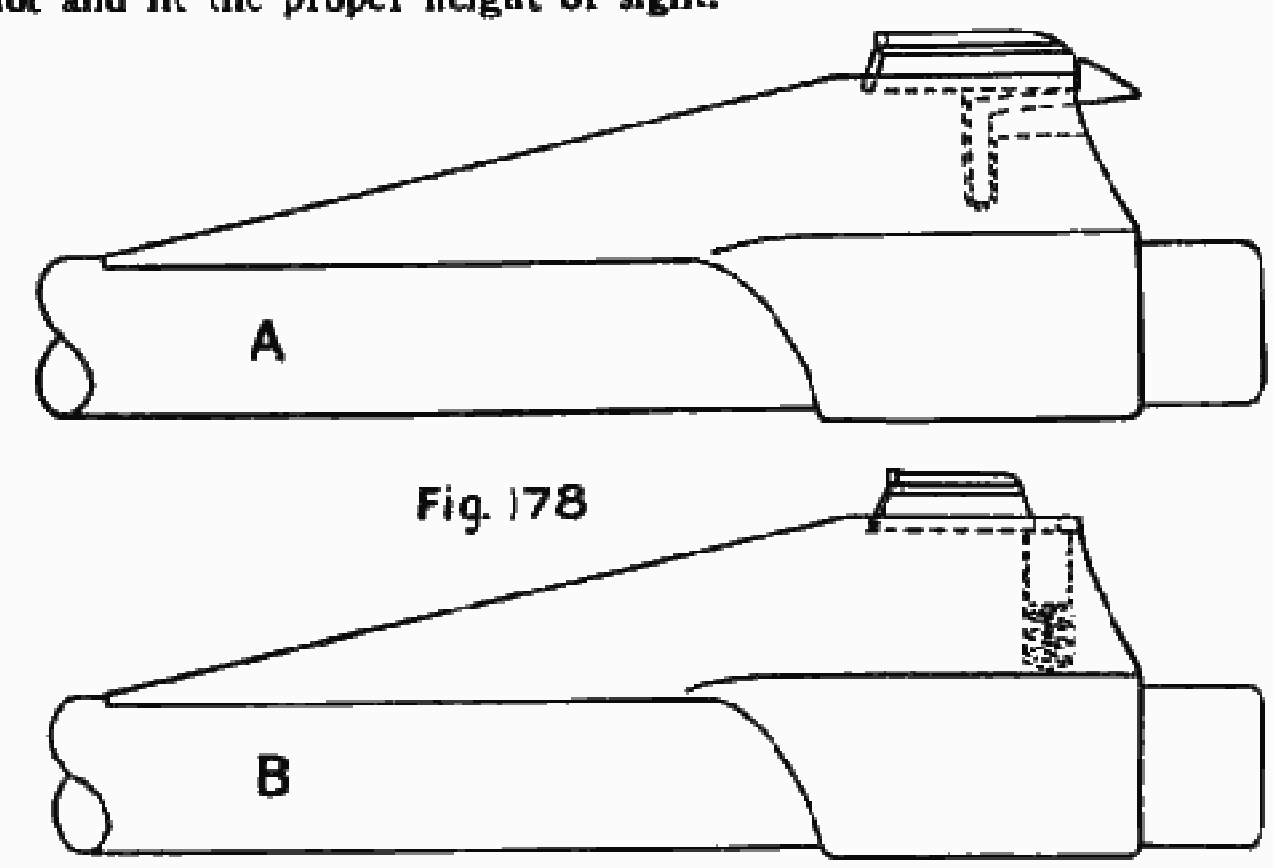


Fig. 178

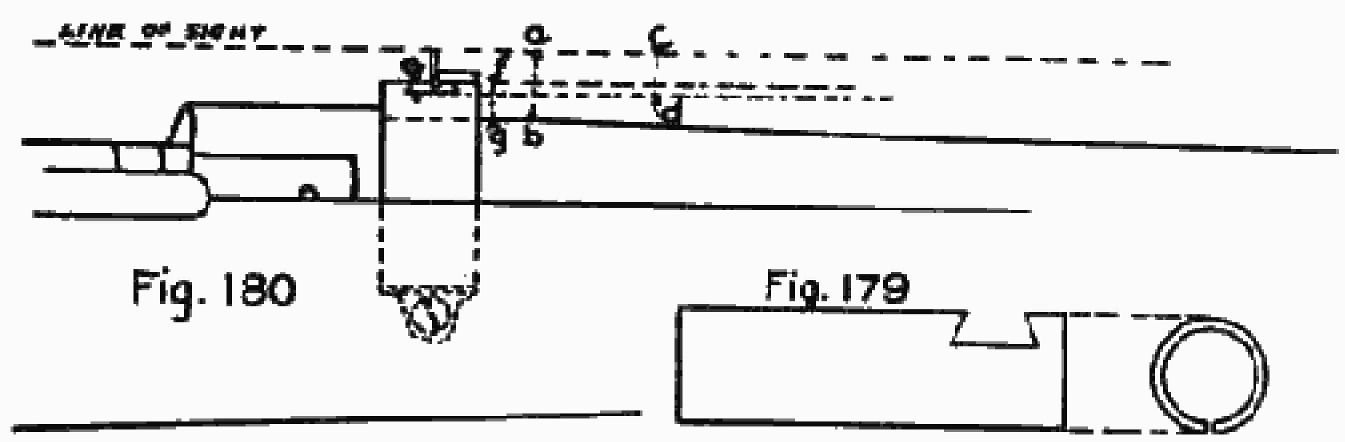
The caterpillar sight may be a snug driving fit in the slot, with no other means of holding it in place. Or it may be dressed off on the base to an easy sliding fit, and held in position by either of the methods illustrated in Figure 178. The drawings are self explanatory, and a good mechanic can make either of the catches without difficulty. The plunger catch at "B" is the easiest, and in my opinion the best. It requires no extra milling operation like the catch at "A," all that is necessary being merely to drill the hole for plunger and fit it in place, on the coil spring, then slide the sight in over it. The plunger should be turned from 5/32 inch drill rod.

The Watson No. 2 and No. 8 sights are very desirable for mounting on a ramp. They should be ordered with the lowest bases obtainable, and after fitting the projecting ends of dovetail may be dressed off flush with sides of ramp. The No. 2 Watson is a combination target and hunting sight, with interchangeable discs or reticules giving the shooter his choice of several beads mounted on either a post or a thin horizontal wire, or aperture disc or flat top post for target work. Some shooters find a sight enclosed in a hood too slow

427

for hunting, and for them the beads without hood will give better results. It is not the purpose of this chapter to tell a man what sights to use, or why, but merely to tell him how to fit the sight he prefers.

SLOTTING BARRELS. When a quick and simple job is desired, it may be considered unnecessary to go to the trouble of making and fitting a ramp or other front sight base, but merely to dovetail one of the standard sights into the barrel. The method of cutting the dovetail has already been described. Round barrels present some difficulty in getting the dovetail cut square across and to the proper depth on each side. One way to do this is to set the muzzle of barrel in a vise with just enough of upper barrel surface



projecting above the jaws so that the jaws will regulate the depth of the cut. The barrel should be turned until the rear sight is level before tightening the vise.

If a number of barrels the same size are to be slotted, it will pay to make the simple filing jig shown in Figure 179. This is merely a piece of Shelby tubing 2 inches long to slip snugly on barrel, with a straight sided slot the width of upper portion of sight dovetail cut in one side, and the lower side split with a hacksaw cut. This sleeve should be well case-hardened to make it file proof. Slip it in place on the barrel with the slot in tube over the spot where barrel slot is to be cut, and tighten up the vise jaws on this sleeve. Then file barrel through the slot in sleeve until the file touches both edges of sleeve. Slip it off the barrel and undercut the dovetail.

LAYING-OUT SIGHTS AND BASES. In Chapter 24 we have described barrel bands with a dovetail sight base on their upper surface, to take the Lyman No. 6 or other folding leaf sight. Figure 180 illustrates the method of determining the proper height for this sight base when fitting the sight. The illustration shows a band fitted to breech of a Springfield barrel, but the general instructions might be applied to any other.

It is assumed that both the front sight and the rear aperture have first been fitted and sighted in. Set the rifle in vise and stretch a stout thread from top of front sight through center of aperture; measure distance from thread to top surface of barrel (at the point where band is to be placed) with sharp pointed dividers or inside

428

calipers. Now measure the distance between divider points with micrometer, or if you have no mike, use a scale, getting the distance in 64ths at least. Now measure height over-all of your leaf sight, from top edge of lowest leaf, to underside of base. Next measure thickness of the dovetail base, and subtract this measurement from the over-all measurement of sight. Subtract the result from the first measurement (distance from line of sight to surface of barrel) and the resulting figure gives you the required thickness of the sight base portion of your band, or rather the distance from its inside to outside surface at center—f-g, Figure 180.

Example, (referring to Figure 180) a-b is the distance from line of sight to top of barrel, and measures .524 inch; over-all height of Lyman No. 6 leaf sight with lower leaf raised, is .395 inch—c-d; base of this sight, e, is .102 inch thick; .395 inch—.102 inch=.293 inch, which is the height of the Lyman No. 6 not including the base. .524 inch—.293 inch=.231 inch, which is the thickness required for sight base portion of band,—f-g.

Set a pair of sharp dividers as nearly as possible to this figure by using the mike, and mark off the distance on band; file down the required amount and cut the dovetail slot. The inaccuracy resulting from this method will be slight, and can be corrected by slightly filing down the sight leaves slightly after fitting, if you took the precaution of leaving the base slightly thicker than required. If you cut the base down too much, it's just "too bad."

When the open rear sight is removed from a barrel slot and it is not desired to use a folding leaf, the slot can be filled with a blank obtained from the sight manufacturer for this purpose. Western Gunsight Company have the most attractive blanks, made in an ornamental shape with a mountain-sheep head engraved. If the barrel is to be reblued the slot may be blanked out and ends of blank dressed off even with the barrel, making the slot invisible after bluing.

SIGHT SCREWS: Occasionally we hear complaints that the screws in the sight base "worked loose and allowed the sight to slip out of place, causing me to miss the only buck I saw on the whole trip." The sight manufacturer, of course, gets the blame. Investigation usually discloses that one of the original screws has been lost, and replaced by a standard machine screw; or, that the enterprising gunsmith who fitted the sight, didn't have the correct tap as furnished by the sight maker, and used the nearest thing to it he could find. Consequently the screw either did not fit the thread, or else too coarse a thread was used—for neither of which the sight manufacturer was responsible.

The screws used for attaching tang and receiver sights have finer threads—usually 40 to 48 threads per inch—than standard machine screws. The narrow-gauge mind instantly jumps to the conclusion that the maker has chosen a "bastard" thread in order to force the

429

owner to buy the screws from him. Wrong! The maker knows from experience that the vibration of a rifle—even a .22—quickly tends to loosen any screw, and the coarser the thread, the more quickly it is loosened. Consequently he supplies fine thread screws with his sights, to overcome this tendency. He does not expect to sell you more screws—and unless you are clumsy enough to lose the ones that come with the sight, you won't need any more. If you do, they cost you a trifle—perhaps from one to five cents, according to size. The special taps for these screws cost but little more than the regular commercial sizes, and there is absolutely no excuse for any gunsmith using "off" sizes. Use the screws the manufacturer recommends, tap the holes with the taps he supplies, set the screws in tight as previously explained, and your sights will not be continually dropping off and rolling down the hillside. The following tables give the screw and thread sizes for most standard American made tang and receiver sights, also barrel sights when attached with screws:

TAPS AND DRILLS USED FOR MOUNTING LYMAN REAR SIGHTS

No.		Inches	Tap Drill No.	No.		Inches	Tap Drill No.
36	Russian 7/62	.140....48	31	41	Win. 05	.0935...56	47
31		.3/16...36	19	42		.27 ...40	35
33		.140....48	31	43	Stev. O.H. Pistol	.127 ...40	35
34		.140....48	31	44	Stev. O.H. Pistol	.127 ...40	35
35		None		45		.0935...56	47
36	Mannlicher	None		48		.140 ...48	31
38		.3/16...36	19	50		.125 ...48	36
40	Sav. 40 & 45	.127....40	35	53	Win. Musket	.140 ...48	31
41	Win. 95	.140....48	31	54		.140 ...48	31
41	Mar. 93	.140....48	31	1*A	Mauser Nut	.0935...56	47
41	Mar. 95	.140....48	31	1*A	Mann. Nut	.0935...56	47
41	Win. 07	.125....48	36	1*A	Russian Nut	.0935...56	47
41	Win. 10	.125....48	36	1*A	Marlin 38	.3/16...36	19
41	Rem. Auto	.125....48	36				

On all other combination rear sights necessitating new mounting screw holes the Stevens tap .127-in.—40 is used. No. 35 Drill.

TAPS AND DRILLS USED FOR MOUNTING MARBLE REAR SIGHTS

	Thread Size		Thread Size
Winchester		*Savage*	
Short	.185—35½	Short	.166—40
Long	.203—23	(Receiver Sight .156—32)	
Receiver	.140—48	NRA Leaf	.187—36
Marlin		*Stevens*	
Short	.166—40	Short	.125—40
Long	.218—26	*Colts*	
Remington		Short	.187—26
Short	.175—32	Long	.218—24
Long	.196—23		
Model 8	.182—40		
Model 12 & 14	.140—44		

FITTING TELESCOPE MOUNTS AND BASE BLOCKS.

The job most often desired by the amateur will probably be the fitting to the barrel of dovetail blocks for the mounts of Winchester, Fecker, or similar target scopes. This is not a particularly difficult job, especially since most target barrels are heavy, hence there is little danger of drilling through into the bore.

430

Assuming that the rifle has iron sights correctly aligned, take a long thin steel straightedge, and after chalking the approximate location of the blocks on barrel, hold one end of straightedge even with the center of front sight, the other on center of rear sight, and scribe the center line lightly on barrel where blocks will go.

A pair of hardened V-blocks with clamps and a sheet of heavy plate glass about 6 by 18 inches are needed. Rest the glass on a smooth level table or bench, and the V-blocks on the glass, and rest the barrel in the V-blocks, as in Figure 181. Now find some flat surface—usually on the receiver, and turn the barrel until this sur-

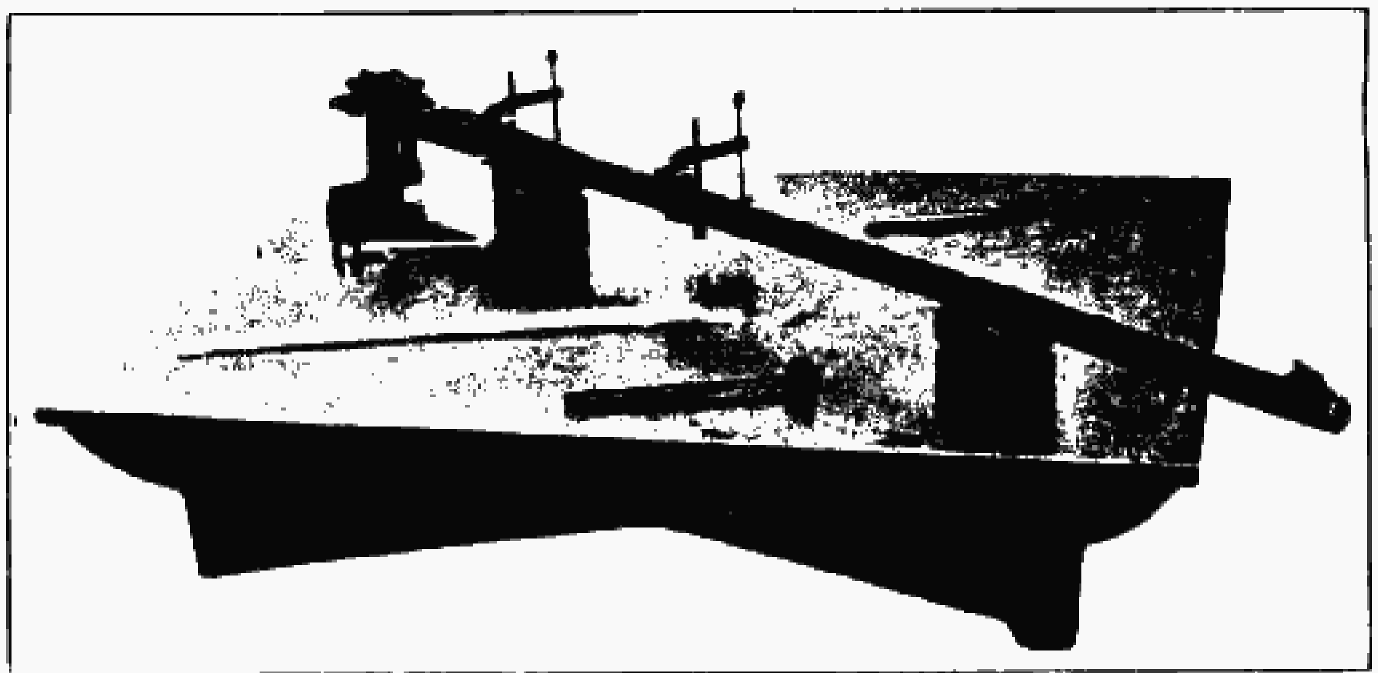


Fig. 181

face is either parallel or at right angles to the surface of the glass. Two small try-squares should be used, one on the surface of receiver, and the other on the glass. When the barrel and receiver are as nearly vertical as you can get them, tighten the clamp on one of the V-blocks to keep it from slipping.

Now place one of the scope blocks in position on barrel and fasten it with a small hand clamp (parallel clamps are better than C-clamps for this job). Place the head of a try-square on surface of scope block, and another square on the glass surface plate, with blades touching, as in Figure 182B. Loosen the hand clamp and move the block on barrel until the two blades are exactly parallel. Now change the two squares to the position shown in Figure 182A, and with inside calipers measure distance from edges of scope block to blades of squares. When the block is centered as truly as you can get it, set the clamp up tight, re-check the alignment and scribe the position of one screw hole. Drill this hole very carefully with a new sharp drill, measuring its depth frequently. If the barrel is thick you need not worry about getting the hole too deep. On a very thin barrel it is best to drill the hole to about 1/32 inch less than its final depth, and "bottom" it out square with an end-mill the same size as drill.

431

If an end mill of the proper size is not available for bottoming out the hole, make a flat drill of the proper size. This is made by taking a piece of drill rod same size as drill used, and filing both sides flat. Grind end square, and file a very slight relief on point.

If you ever go too far and drill into the bore, don't try to say anything,—words are weak and futile. Just toss the whole works out in the alley and go jump in the nearest deep body of water. An anvil or two hung on the neck will assure best results.

Another thing to avoid, after the hole is drilled and tapped in the barrel, is forcing the screw through the thin metal at the bottom

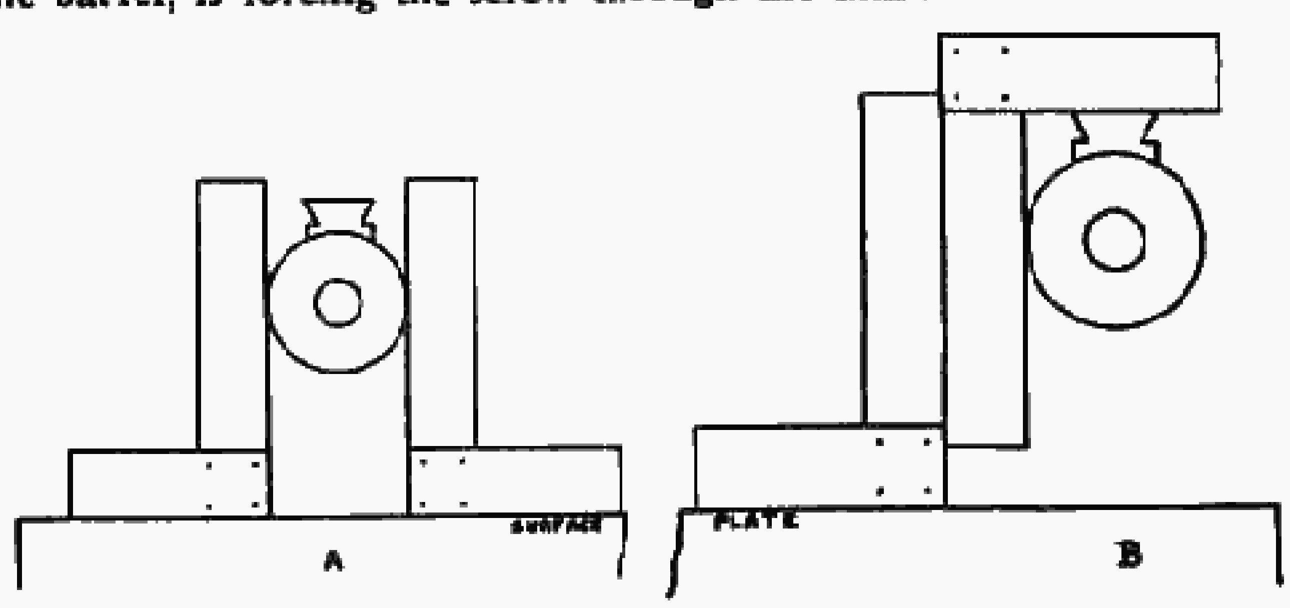


Fig. 182

and into the bore. While this is not a common accident, it has nevertheless occurred in shops which should have known better. When trying the screw in the scope block, note whether it begins to tighten up before the head is down tight in the countersink. If so, withdraw screw and carefully grind off a little from the point. To get the full holding power of the screw the end should not touch the bottom of the hole.

After the hole is drilled comes the tapping. *Now be careful!* The tap is tapered at the point for relief, and it will do no more than start the thread in such a shallow hole. You should have three taps,—starting, middling, and bottoming. Use the regular tap as it comes for starting. Grind off the point of another until it has a very little taper—this is the middling tap. The bottoming tap has every bit of taper ground off.

Do not try to force the tap. Begin with the starting tap, turning it forward about 1/8 turn, then backing it up and advancing a trifle with each movement. Be satisfied with one or two clean threads from this tap. Then take the middling tap and work the thread deeper, till point of tap is felt to touch bottom of hole. Next turn in the bottoming tap, cutting the thread clear to the bottom. If there's the slightest doubt as to whether the tap has really struck bottom or is merely turning hard, take it out and inspect carefully. Breaking off a tap in the hole is not conducive to one's hope of a

hereafter. If this should happen, sometimes the tap can be worked out by light blows on its edges with a small prick punch, but usually it is necessary to leave it in the hole, grind off any projecting point, and drill another hole a quarter of an inch away.

Having successfully tapped out the hole with no accident, set the block in place and turn in the screw. Now mark the position of the second screw hole, remove block, drill and tap hole. Set block in place again with screws in snug, and scribe line all around block on barrel. Remove block and file or scrape under surface bright, and tin with very soft solder. Scrape bright the spot within the outline of block on barrel, keeping about 1/16 inch away from the line all round. Cut a hole in a piece of thin leather, the same shape as the outline of block; place this on barrel, and tin the spot through the hole. Get as thin a coating of solder as possible on the barrel—if it piles up, scrape it down when cool. Place the block in position, heat the screws to a dull red and turn them in fairly tight. Heat block over gas flame until the solder just melts and shows at edges. The solder will not stick here because of the bluing, and the finish will not be harmed. The hot screws will shrink in cooling, making the union of block and barrel as solid as if they were one piece.

The second block is attached in exactly the same manner, with care to see that it is properly lined up with the other, and their top surfaces parallel.

Seven and two-tenths (7.2) inches between centers is the best distance to space the scope blocks on most rifles, this distance giving true half-minute of angle values on the mount adjusting screws.

Some of the special mounts supplied by Belding & Mull require very careful fitting of the bases, and such work should always be sent to the factory. Then, if the job should not prove satisfactory, the makers alone must take the blame. Better to be safe than sorry.

FITTING RECEIVER SIDE MOUNTS. There is a new type of hunting scope that has become quite popular the last year or so, which is attached to the receiver of the rifle by a mount which dovetails onto a base plate set on side of receiver. The most popular scopes of this type are the Zeiss Zeilklein, Helsoldt Dialyt and Zeilklein, and the Noske. The only mounts worthy of consideration for bolt action rifles for use with these scopes are those made by Noske and by Griffin and Howe. The Noske mount is the older, and perhaps a bit stronger of the two—also the more clumsy. In principle the two are somewhat similar. The G. & H. mount has one advantage—the bands which encircle the barrel of scope are split, with a screw on each side, so that the bands may be entirely separated and the scope set in the mount without dismounting any part of the instrument. While with the Noske, it is necessary to dismount and remove the elevating disc and other parts attached to the outside of the instrument. However, this is quite simple, and no damage will result if you handle your screwdriver with care.

Instructions for dismounting the elevating mechanism of both the Zeiss and Helsoldt scopes is given further on, and no further dismounting is necessary, nor should any be attempted. If the scopes for any reason need repairs, they should always be sent to the makers.

Having the scope set into the desired position in the mount, we are ready to fit the base plate onto the receiver of rifle. A description of the method of fitting the G. & H. mount to a Springfield will answer for all others.

The mount comes completely blued with the exception of the base plate, which is merely polished. On the side of this plate five holes are marked and centered, but not drilled. The first, third and fifth are screw holes, the second and fourth are for taper pins which help to take up the jar and prevent the screws working loose. The screws and pins come with the mount.

Remove the rifle from the stock, and place barrel in vise, left side up. On barrel and front end of receiver there is a small index mark, used as a guide for screwing the barrel in. With scriber and straightedge, continue this mark back along side of receiver about four and one-half inches. The screw holes are all to be centered on this line, which is, or should be equivalent to the upper edge of stock at this point.

The under side of receiver plate is milled hollow to fit the curved side of receiver. (On the Noske this surface is flat—a most asinine mistake!) Lay this plate on receiver, with its front end about 1/4 inch back of barrel ring, and try it for fit. If there is any "wobble" between plate and receiver, spot it with lampblack and dress off under side with file until it lays up flat and snug. Now drill No. 2 hole in plate with No. 20 drill; place it in position on receiver and mark position of hole in line previously mentioned. Center punch it exactly on this line and drill receiver. (If hard, spot anneal by either of the methods previously described.) Place plate in place and ream plate and receiver together, with a No. 0 taper pin reamer. Now drill No. 5 hole in plate, center it on line on receiver, drive the taper pin lightly into No. 2 hole, and scribe the position of No. 5 on receiver. Drill and tap this hole for a 10/32 screw. In like manner, we next drill No. 4 hole, ream it for its pin, and then drill and tap screw holes Nos. 1 and 3.

The screws supplied for this plate have heads about 1/2 inch thick, the idea being to cut them down after they are attached. When through with the drilling and fitting, the plate should be sweat soldered in place, with the screws set up moderately tight, and the pins driven in *very* tight. Grind off protruding ends of pins flush with surface, and polish plate, first taking out the screws. The screw heads may then be cut down to about 3/32 inch in thickness and re-slotted, or they may first be set in very tight (hot), and the heads filed down afterward, omitting the slot. The plate may be left bright, or chased, or it may easily be blued with the No. 1

basic solution (Chapter 20) without affecting balance of receiver.

The projecting ends of screws and pins must be dressed down inside the receiver, and for this purpose the dental engine with small carborundum wheel is indispensable—in fact, I know of no other way of doing the job. The screws could easily be filed off, but the pins are hard and must be ground.

The Noske mount base is attached in exactly the same manner, except that it usually comes with the holes already drilled, which makes it a little harder to get them lined up to register with the holes drilled in receiver. Moreover, due to the under surface of this plate being flat, it is much more difficult to get it lined up vertically against side of receiver, and it is necessary to use V-blocks and squares as already described.

Both the Noske and the G. & H. mounts have lateral adjustment only, the former by means of two screws set up against each other, the latter by a single screw. Elevation is provided in the scope itself, by raising or lowering the reticule.

While these mounts have much to recommend them, they also leave much to be desired. Their cost—$35.00 each—is in many cases more than that of the scope; hence the total cost of scope and mount often exceeds the cost of the rifle, besides being prohibitive to many. To this cost must be added a charge of $5.00 for attaching the mount, which the gunowner may consider high until he does the job himself—then he'll wonder how they do it for $5.00!

The perfect scope mount has not yet been made; but riflemen are awakening to the value of the scope, and the demand will undoubtedly result in some very satisfactory developments in the near future. Even now I understand that both Fecker and Niedner are working on improved hunting mounts, which the shooting public awaits with keenest interest.

The Noske and Griffin & Howe mounts are at fault in not having all parts hardened to resist wear. Without such hardening, there is bound to be some change in the point of impact of the rifle sooner or later, to say nothing of the possibility of looseness developing in the mount itself. The lateral adjustment, moreover, is not positive on either mount. The Noske is very hard to align on the target for any given range, due to the difficulty of loosening one screw just the right amount, and setting the other up against it. In the G. & H. mount, the single windage screw does have backlash, any reports to the contrary notwithstanding. And there is no means provided for locking this screw in place, once it is set. Yet in criticising, we must also remember that these represent the best available to date, and we will make them do until their makers, or some others, give us better mounts. And it is to be hoped that the demand will warrant a volume of production that will cut the cost in half.

Belding & Mull have done a pretty good job to date on their

mounts, which are of the sliding type, not adapted to scopes intended for rigid mounting like the Zeiss and Hensoldt. Moreover, their mounts are reasonably priced, despite the precise workmanship which is unsurpassed by any mounts on earth. I should like to see them bring out a good rigid mount for these two scopes.

TO DISMOUNT THE ELEVATOR OF THE HENSOLDT SCOPE. First loosen the small lock screw on front. Now notice that the elevator disc is in two parts. Remove the two small screws near center of upper disc and lift it off. Underneath you will find a large screw in the center of the next disc. Remove this screw. The inner disc fits the pivot very tightly, and is keyed to the pivot with two small pins. Turn this disc as far to right as possible, then carefully pull straight out, pulling disc off the pivot. The upper end of this pivot is slightly tapered to fit tightly in the hole in disc. If the key pins come off with disc, drive them out with small punch. If they remain in the pivot, let them alone. Lift off the round flat tension spring. Now you will see two more screws holding the frame of elevator to scope barrel. Remove these and lift off frame. Remove elevator screw by turning to left with the fingers. Replace parts in reverse order.

TO DISMOUNT ELEVATOR OF ZEISS ZEILKLEIN SCOPE. Remove the three small screws in elevator disc, and lift off disc. Note one of these screws is longer than the others. Remove the two screws in either end of elevator frame or plate and lift this plate off. Unscrew elevator to left with the fingers and remove. Remove the small top screw just back of elevator screw hole. Replace parts in reverse order.

When dismounting any part of scope, note the grease or wax put in to waterproof the instrument, and be careful not to remove this from any part.

The longer of the three top-plate screws in the Zeiss is intended to prevent the disc being given more than one full turn, this screw striking against the stop screw set in barrel of scope. If necessary to move the reticule more than one revolution permits when sighting in, remove this long screw; after sighting in, place this screw in whichever of the three holes will permit of its resting against stop screw at point blank range.

SPECIAL SCOPE MOUNTS. An adaptation of the B. & M. sliding system mounts to the Zeiss Zeilklein scope, designed by Colonel Whelen, is shown in Figure 183. This is their regular T-H mount with D-C screws, the front and rear rings being integral with the base strip, and all milled from the same piece of heavy tubing. There is a collar clamped to the scope with a stud engaging a groove in mount base, to prevent the scope turning. Whether the scope is permitted to slide in the mounts, or whether this stud also holds it against forward motion I am not sure—either plan would doubtless be satisfactory. This was designed for a 52 Winchester, but would

work equally well with a Model 30 Remington, or a single shot rifle.

Experimenting with sights, scopes and mounts is a very fascinating pastime for the gunowner. Variations of eyesight, and methods of aiming prevent the possibility of all sights suiting all shooters, or of any sights suiting some shooters. The very best of our existing types

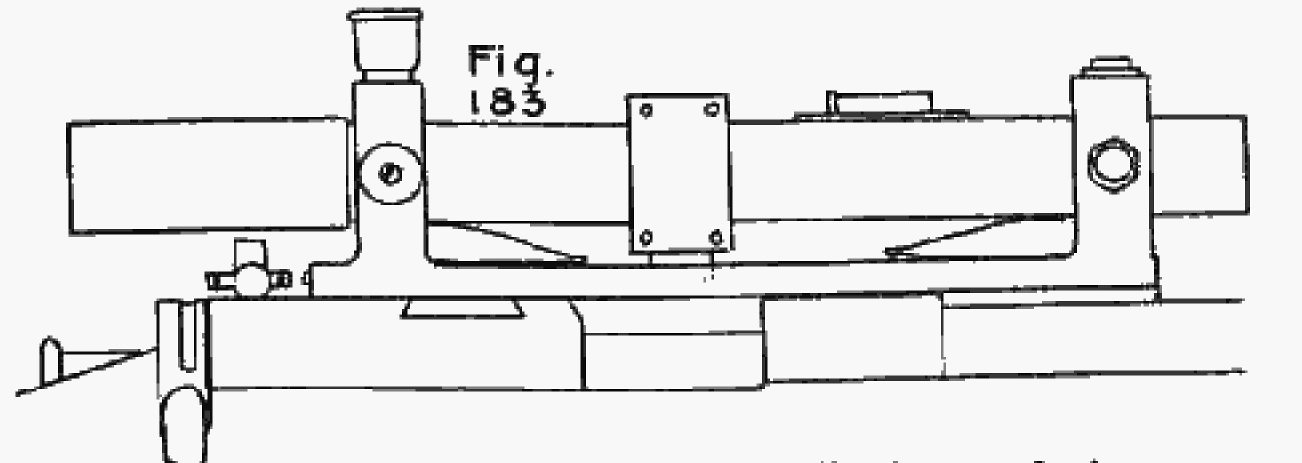


Fig. 183

may have sprung from somebody's "nutty" idea, and the amateur should feel encouraged to do all the experimenting he likes in this direction.

In closing this chapter, I submit for public bombardment or acclaim one of my own "nutty" ideas which I have used with success and satisfaction on several rifles, but which I do not use habitually, partly because of the wise cracks which usually accompany its appearance, and partly because I have not yet settled on final dimensions. Several models of this "inverted" type of sight are shown in Figure 184. The idea (nutty or otherwise) is that when aiming at game it is quite necessary if not more so to see what is below the bead, than it is to see what is above. We seldom want to hold

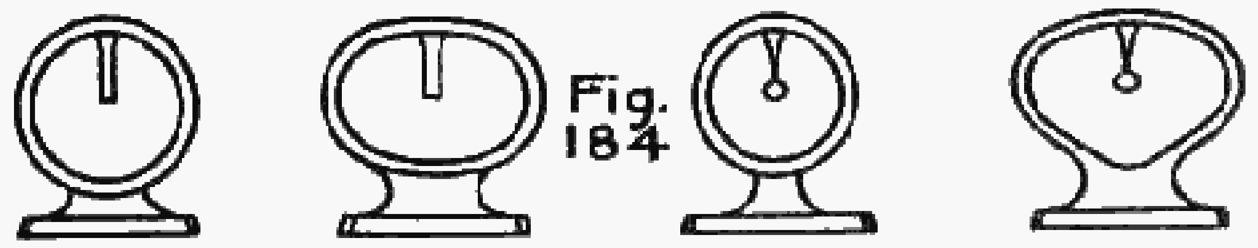


Fig. 184

under, but frequently desire to hold over. With this sight, holding over does not in the least obscure any part of the animal, and one can gauge to a nicety just how much higher he is holding. Such a sight must of course be used only with an aperture rear sight. Naturally it would not be approved by those who find the hood a drawback in the woods, particularly if the hood is made large enough not to obscure the field. It seems to me that I catch my aim a bit quicker with this sight than any other, but time will tell. The sight is not on the market, and has only been made experimentally. It might be called the "hold-over" sight—possibly on the assumption that the designer should be confined in the holdover.

Chapter 30

REMODELING MILITARY AND OBSOLETE RIFLES

IF the reader is of the type who invariably reads the tail end of a book first, he may find it desirable to reverse his usual custom in this instance, and familiarize himself with some of the preceding chapters before going seriously into the subject of remodeling military and obsolete rifles. For to cover such a broad and all embracing subject in a single chapter, giving detailed operations on each and every rifle mentioned would clearly be a task suited to mighty few men—and no boys, and the chapter would lengthen out to an extent exceeded only by some of the shorter sentences in German literature, besides involving much needless repetition.

Having already discussed at length and in detail the various subjects of making, checking and finishing stocks, fitting sights and telescopes, altering barrels, bluing, browning, polishing, and numerous other operations which enter into the making of any firearm, this chapter naturally resolves itself into a general discussion of the remodeling possibilities of various rifles; while the reader, if he has assimilated a reasonable portion of what has gone before, will have no difficulty in understanding what we are talking about, and will grasp the necessity for this or that operation at a glance.

So far as I am aware—and I trust nobody will accuse me of making this as a downright flat footed statement—about the first military rifle to be thus remodeled into a sporting arm in the United States, was the Springfield, which Stewart Edward White carried with him on his first African hunt. Roosevelt used a Springfield in Africa prior to this, but to the best of my knowledge his gun was the straight service model with few, if any, alterations—possibly nothing but sporting sights. The White rifle was remodeled by that illustrious and immortal gunsmith Adolph Wundhammer, late of Los Angeles, following suggestions offered by Captain Crossman, Mr.

438

White et al., and with possibly a few of his own ideas thrown in for good measure. Whoever may have been responsible for its development, the fact remains that the resulting arm set the pattern for many others to follow; and barring perhaps a few improvements in stock formation, and of sighting equipment, it has scarcely been surpassed by any of the more costly jobs of recent years.

About this time, or possibly a little later, Colonel Whelen had been writing in some of the outdoor magazines concerning the effectiveness of the Krag on big game, he having been using an "as issued" rifle for hunting in the Philippines. His statements so interested Dr. Paul B. Jenkins, then shooting editor of "Outer's Book" which later was re-christened Outdoor Recreation, that he, being already an ardent admirer of the Krag action and cartridge, forthwith hied him to old Steve Munier, the veteran gunsmith of Milwaukee, and ordered what is believed to be the first Krag sporter.

White's rifle consisted of a service barrel and action mounted in a sporting stock, and fitted with a Lyman No. 34 receiver sight,—which I have always maintained was superior to the Lyman 48 for hunting purposes, due to its greater strength and the fact that there is less danger of its coming out of adjustment. The barrel was held to the forend by an inside band such as is still being used. The regular military front sight base was used, although the blade was replaced by an ivory or gold bead. The military rear sight fixed base was left on the barrel, the movable base being merely screwed out, to be replaced when and if wanted. The stock was beautifully shaped, finished and checked, and fitted with sling swivels. The trigger pull was tuned up, and the sights adjusted for the desired hunting ranges.

Dr. Jenkins' Krag job did not include a new stock, the military stock being remodeled and used instead. The alterations to this arm (which was a carbine to begin with, having 22 inch barrel) consisted of removing the rear sight and base, filling in hole in handguard with a piece of walnut, replacing the military front sight with a Lyman gold bead, fitting a Lyman No. 34 receiver sight (Derned if the old timers don't seem to agree with me about the 34!), smoothing up the action, and remodeling the stock. The grip was reduced in front of the comb, deepening the hand hole to make the comb appear higher, and the stock then worked down to the same dimensions as the owner's favorite Parker shotgun stock, so that the two guns handle exactly alike. The stock was checked and refinished, the butt being fitted with a rubber recoil pad. The action was smoothed up, the slack taken out of the trigger, and a set-screw added to make the pull adjustable. Butt stock and forend band were fitted with eyes for sling hooks. This carbine was remodeled in the fall of 1908, since which time it has killed seven deer besides much other game—its best shot being on a deer running at 280 measured yards.

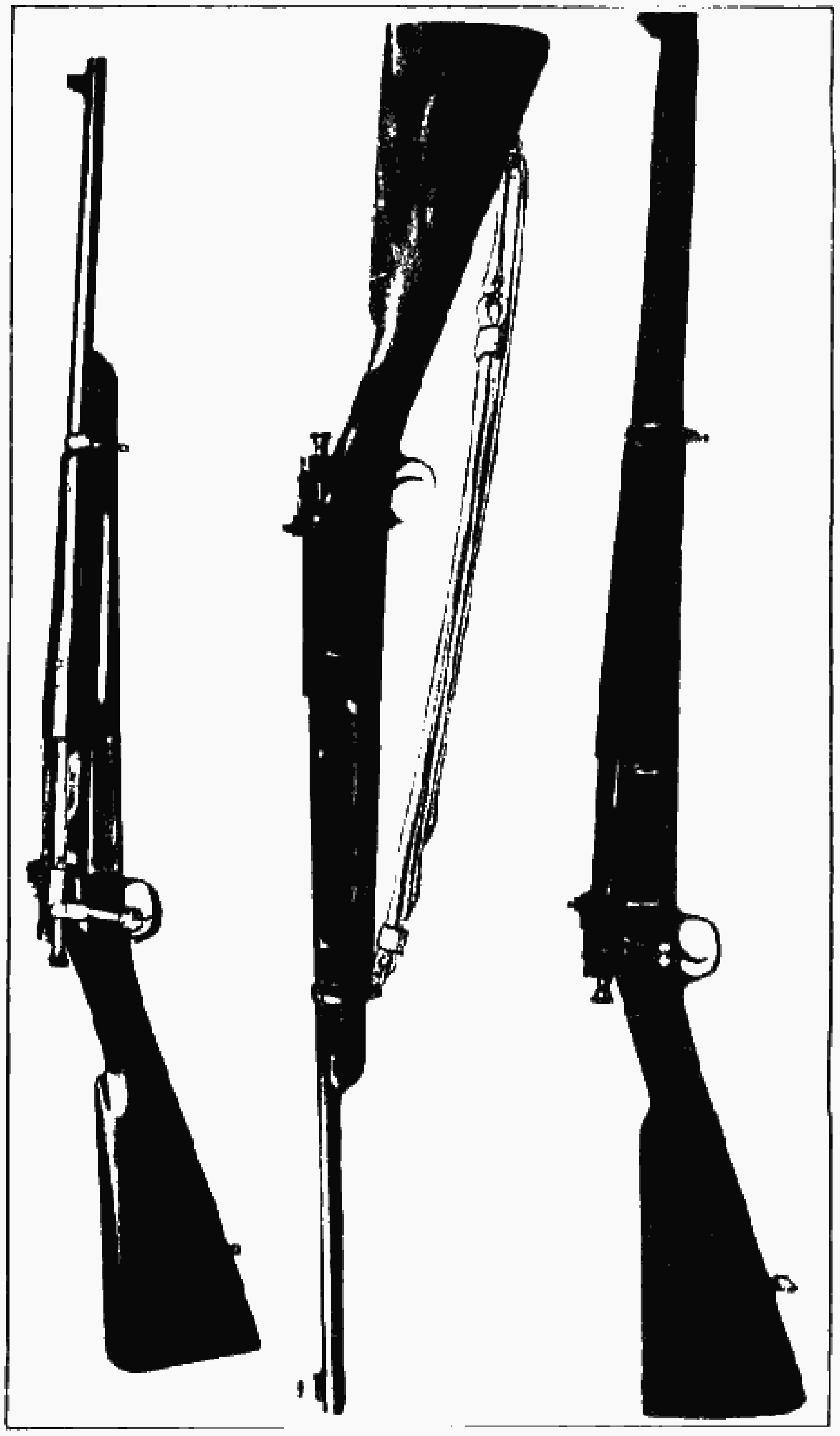
440

Since these rifles were remodeled, the cranks in all parts of the country have taken strongly to the idea of building their hunting arms from modern or obsolete military rifles, and have vied with each other in the matter of stock design, sight equipment, fit, balance, and decoration—until it is safe to say that the finest and best all round hunting and target rifles today are based on military actions.

The reason for this is quite evident. Development in the field of ammunition has been largely centered on loads for military use. Our best hunting cartridges are but modifications of those originally worked out for the armies of the world. Increases in velocity and energy, with accompanying flat trajectory, have been first presented in the cartridges made for use in army rifles—and experience has taught that, barring slight differences in bullet construction—these military loads are also best for big game. Without a doubt the two best all round big game cartridges in the world today are the .30-06 and the .30-40. Both have proved their worth under actual hunting conditions in competition with others; and while there are instances when one of the magnum cartridges might prove better adapted to some special use, the two mentioned will hold their own in any company, and successfully account for their fair share of clean kills on all game found in America, and much African and Asiatic game besides. It is a fact worthy of note that most African hunters, while recognizing the need for a very large caliber rifle for the largest game, invariably takes along a lighter arm of about the power of the Springfield or Krag, with which he will fire a hundred shots at game to one with the larger arms. The Englishman is partial to his .303 for all-round work, and the similarity of its ballistics to those of the .30-40 constitutes further evidence of the general desirability of this type of load for all round use.

To own a sporting Springfield is a dream that was unrealized by many riflemen who felt they could not afford the cost of having the service arm remodeled by a high class gunsmith; then Col. C. E. Stodter, then Director of Civilian Marksmanship took things in hand and turned out a plain, substantial sporter, without frills or furbelows, yet possessing all of the essentials, and at a price to compete easily with the standard run of factory guns.

The D. C. M. Sporter has brought to hundreds of riflemen a class and quality of arm that they never could have afforded otherwise; it is ready to take to the range or hunting field just as it comes to the buyer. Yet the man who plans to have it further remodeled and "dolled up" a bit, or who perhaps plans on doing the work himself, finds it the best adapted of any military type of arm available. The barrel is already polished and blued—and a good job it is, too. The Lyman No. 48 sight is already fitted, and the arm sighted in at 100 yards. It has the military blade front sight—ideal for target work, although the hunter usually substitutes a gold or ivory bead. It has a plain and somewhat rough stock, with full pistol grip 3 1/2 inches from the trigger, and dimensions that will come pretty close to a perfect fit for 99 men out of a hundred; yet the stock is purposely left very full so that the owner may, if desired, trim it down slightly to correspond with his own ideas. The barrel is star gauged and carefully tested for close grouping; the action is hand finished and all working parts polished to give smooth operation. The trig-



Upper: The Krag sporter designed and made for Dr. Paul B. Jenkins. Center: Another sporter job made by using the rifle "as issued," adding sporting sights and checking the service stock. Lower: A "Mannlicher" style Krag with peep sight.

441

ger pull is usually crisp and clean, requiring a pressure of about 4 pounds—which is from 1/2 to 1 pound heavier than most riflemen desire. It is, however, a far better pull than is usually found on any factory made arm.

The man desiring a specially stocked sporting or target arm of highest quality, without the necessity of mortgaging the old home place to buy it, will make no mistake in investing forty-six dollars in the D. C. M. Sporter, and discarding the stock, which has a selling value of only five dollars—and anyhow, you can keep it for a "spare" or sell it to a friend. By buying the sporter instead of the service arm you not only get a better, more accurate, and slightly heavier barrel, you also avoid the necessity for polishing and bluing, which adds something like nine dollars to the cost of the job, and you get the Lyman No. 48 sight, which would cost you $11.50 if bought separately. In other words, the original forty-six dollar investment represents about the sum total cost of the arm provided you make the new stock yourself.

Outlined briefly, the remodeling of the D. C. M. Sporter into a rather more handsome, but not necessarily better shooting rifle, will consist of the following operations, all of which have been explained in full details in previous chapters.

1. Remove military front sight and attach Lyman, Marble, King, Sheard or Western gold or ivory bead; or, remove front sight movable stud, and attach Lyman No. 7 or Watson No. 2 hooded front sight, or the Watson No. 8, or the Western Full-Block sight.

2. Discard old stock and make new stock from fancy grained walnut or other wood to your own dimensions, with or without cheek piece; checking and finishing it in any manner desired. You may use the original barrel band, or you may make an inside band with stud screw for detachable swivels as described in Chapter 24; and you may use the original buttplate, or a Mannlicher-Schoenauer plate, a Mauser, or any other plate desired, or fit a rubber recoil pad. The forend tip may be plain, snobble, or horn tipped.

3. The Lyman 48, being the best for both hunting and target work, will usually be retained. Its micrometer adjustments give accurate values for each click on the adjusting screws, and to date a better all round target sight for the Springfield has not been produced. For an arm to be used only in the hunting field, the Lyman No. 34 is better in the hands of the practical shooter who cares nothing for hair splitting adjustments, and who does not understand them, because its construction makes it less liable to damage from accident or abuse. But since the 48 is already on the rifle, and since the elevation may be firmly locked, and since with this sight it is easy to make adjustments for variations in ammunition when and if desired, there is very little reason for discarding it in favor of the cheaper sight.

442

The magazine cutoff is of little or no use on a hunting arm, and the usual practice when remodeling the Springfield is to make it inoperative. Omit the cutoff notch in left side of stock, and round upper edge of stock so that cutoff may just be turned horizontally as required to remove bolt. Grind rear end of magazine follower to a bevel extending forward about 5/8", so that the bolt, in closing, rides up this bevel, forcing follower down, instead of being held open by the follower. The beveled portion of follower must be polished very smooth, and corners well rounded.

The foregoing are absolutely all the changes needed to make an arm fit for the most "highbrow" company of the D. C. M. Sporter. Additional sighting equipment if desired, should consist of a Hensoldt or Zeiss Zeilklein or similar glass on Noske or G. & H. mount, for hunting only. If the arm is to be used largely for target work, the glass should be a Winchester A-5, or a Fecker scope and mounts.

As a general rule, when remodeling a D. C. M. Sporter, the front sight ramp is omitted, since its attachment necessitates rebluing the barrel. My suggestion would be to pass up the ramp, then, when a year or so of use has marred the finish and it needs bluing, is the time to think of a ramp.

A sporter as above outlined will weigh somewhere in the neighborhood of 8 1/2 pounds—which is about light enough for any man with sufficient muscle and guts to go into the woods for big game. If he can't carry this much gun, he should stay home in bed and have a nurse feed him his milk through a straw. It's fine to talk about "that nice little featherweight"—and it sure is fine to carry on the trail; but when you sight the big buck unexpectedly at the end of a steep climb, when the old heart is hammering away and the breath coming—like the little boy—in short pants—then the heavier gun settles down quickly for the shot while the featherweight wiggles and wobbles all over hell's half acre. For which the said buck should give thanks—and probably does.

There is something to be said in favor of the light rifle for the man who makes a pack trip alone, and where every ounce counts. The man who does this, however, has very likely had sufficient experience to teach him the limits beyond which a rifle cannot be reduced without seriously impairing its efficiency; and he will not order his Springfield or other rifle of equal power, to weigh less than seven and one quarter pounds.

The owner of a service Springfield "as issued" or of a National Match rifle with military stock has a good foundation for a splendid sporter; however it will require more work to convert it, and if the job is turned over to a good shop, the cost will necessarily be greater than for the job on the sporter.

If one is interested only in efficiency, and considers good finish as of secondary importance, he can easily remodel his service Springfield at comparatively small cost, as follows:

443

1. Remove the folding drift slide from the rear sight movable base by driving out the pin, and replace with the King folding leaf sight which is made for that purpose. This permits lateral adjustment by means of the regular windage screw, and the leaf sight is adjustable for zeroing elevation by means of a small screw in the notched slide. Replace the military front sight with any standard make gold or ivory bead.

2. Cut off forend about 2 1/2 inches ahead of lower band; fill in the channel with a piece of walnut, and shape forend tip as desired. Cut off hand guard flush with forward edge of lower band. Build up the comb of buttstock as described in Chapter 14, and add a pistol grip if desired. Lengthen stock by means of a rubber recoil pad. Reshape and refinish stock.

If one desires to remodel the service rifle without polishing and rebluing the barrel and action, the following will turn it into a serviceable hunting arm at a minimum of time, cost and labor:

1. Purchase the following parts from the Director of Civilian Marksmanship:

1 Pistol grip stock, Model 1922, Sporting type, for Model 1903 rifle, without rear sight base	$15.00
1 Buttplate, Model 1922, with screws	1.[illegible]
Packing charge	[illegible]14
Total	$[illegible]7.14

2. Make, or have a machinist make two collars as shown in Figure [illegible], Chapter 24; one to fit the barrel at breech just ahead of receiver ring, the other to fit it about where the forend swivel is to be located. Remove front sight movable stud, and notch the smaller collar so it will slip over fixed stud, and drill collar for a forend swivel screw, made as described in Chapter 24.

3. Make a handguard from a piece of walnut, roughing out the groove slightly larger than the barrel; make this piece with a tenon on each end to slip under the overhanging edge of the two barrel collars. The fixed base of the military rear sight is of course removed before putting on the breech collar. The lower half of both collars are inletted into the wood of the forend. Drill a hole for the forend swivel screw, then dress off the shoulder at front of forend, shape tip as desired, polish and oil. The handguard covers most of the roughness of the barrel and makes refinishing unnecessary.

4. Remove military front sight from movable stud, insert gold or ivory bead as desired, and replace movable stud. Attach Lyman No. 48 or No. 34 or other suitable receiver sight.

The foregoing covers all of the essentials. Probably the owner will decide to reshape the entire stock somewhat, and give it a good oil finish, he may also want to check it at grip and forend. He should study the wood of the stock carefully, however, before attempting a checking job, as many of these stocks are so soft that the wood "fuzzes" up and will not check cleanly. Use a spacer cutting not less than 16 lines to the inch.

A rifle made up as above described will weigh a few ounces less than the regular D. C. M. sporter, as the service barrel is slightly thinner just forward of the breech.

Now we are ready to consider the making of a really first class sporter—that is, completely remodeling the arm from start to finish. If you have a service or National Match rifle to begin with, and want to use it, all right. It is poor economy, however, to buy the

444

entire rifle and then discard many of the parts. If you desire only enough parts to make up a high grade sporter, or to send to a gunmaker for assembling and stocking, order the following from the Director of Civilian Marksmanship:

	N. M. Grade	Service Grade
1 barrel and receiver assembly	$15.33	12.16
1 bolt assembly	2.78	2.43
Extra for fitting bolt to receiver and adjusting headspace	......	1.05
1 bushing, guard screw	......	.07
1 Catch, floor plate	......	.25
1 cutoff	......	.39
1 Ejector	......	.20
1 Follower	.38	.38

1 Guard, trigger	......	2.20
1 Pin, ejector	......	.03
1 Pin, firing, assembly (Service) *or*	......	.69
1 Pin, firing, assembled to headless cocking piece, (N. M.).....	.85	
1 Pin, floor plate catch	......	.01
1 Pin, sear	......	.02
1 Pin, trigger	......	.02
1 Plate, floor	......	.82
1 Plunger, cutoff	......	.02
1 Screw, cutoff	......	.03
1 Screw, guard, front	......	.03
1 Screw, guard, rear	......	.05
1 Sear	......	.34
1 Spindle, cutoff	......	.06
1 Spring, cutoff	......	.01
1 Spring, floor plate catch	......	.01
1 Spring, magazine	......	.11
1 Spring, sear	......	.02
1 Trigger	......	.32
Total	$25.16	21.65
Packing charge	1.34	1.34
	$26.50	22.99

This includes all essential parts, and nothing that is not needed. The general proceedings in building up the rifle are as follows:

1. First strike and polish the barrel, polish receiver, magazine, floor plate, and other working parts. If you buy the National Match bolt assembly, it comes already polished.
2. Make new stock to specifications desired. Fit buttplate, forend tip (if one is used), and pistol grip cap.
3. Fit Lyman 48 or other receiver sight to action, and notch stock to receive the sight base.
4. Start oiling the stock, and continue this job while finishing up the metal work.
5. Make and fit swivel band to barrel.
6. Make and attach front sight ramp. Solder a temporary lead or brass sight to ramp.
7. Assemble rifle, even if stock oiling is not completed, and sight in for elevation. Disassemble, and continue the oiling of stock.
8. Cut dovetail in ramp and fit front sight to correct height.
9. Repolish barrel where discolored by soldering ramp, band, etc., and blue all metal parts.
10. Check stock as desired, complete the oil finish, and assemble rifle.

By doing the work yourself, the actual cash outlay for stock blank, sights, buttplate, grip cap, oil, sandpaper and all necessary parts and materials will probably not exceed $25.00 to $30.00—which includes the cost of having a ramp blank milled out at a machine shop.

445

Thus you have a high grade beautiful and efficient sporting Springfield, for around $50, the price of a perfectly plain factory made arm. This does not include any allowance for your time, which of course would be considerable—but then think of the fun you will have doing the job!

A similar arm, built to your specifications by a competent gunsmith will cost from $60 to $150 or perhaps $200 in addition to the cost of the original Springfield parts. The man who has never built his own sporter may think the gunsmith is "holding him up" on the price. If any one feels that way about it, he is cordially invited to build his own. With care and patience he will, in all probability turn out a good job, and one that he will have cause to feel proud of. But never again will he think of the gunsmith as a financial pirate; he'll realize that the job is worth every cent charged for it—and he'll earn the gun if he builds it himself.

It is not necessary to dwell at length on the various alterations made upon Springfields by their owners to adapt them to their ideas of what's what. The accompanying illustrations may offer some helpful suggestions, the carrying out of which will be fully understood if you have read the rest of this book.

One thing not touched on previously is the bending and otherwise ALTERING OF BOLT HANDLES. Generally speaking, such alterations are not to be advised, due to the danger of ruining the bolt by heating. Often, however, it is necessary to either bend or grind away part of a Springfield bolt to enable it to clear a telescope sight. Figure 186 shows a lever made for bending the bolt handle down and back as required. This is made of a bar of 5/8 x 1 inch cold rolled steel, notched as shown, and the edges of notch filed smooth and rounded. Two of these will be required. The bolt should be well wrapped in soaking wet rags, and firmly clamped in the vise. It will be necessary to use one or two short lengths of square steel stock in the vise jaws to hold the bolt as required. Have an assistant stand by to renew the water on the rags near the bolt

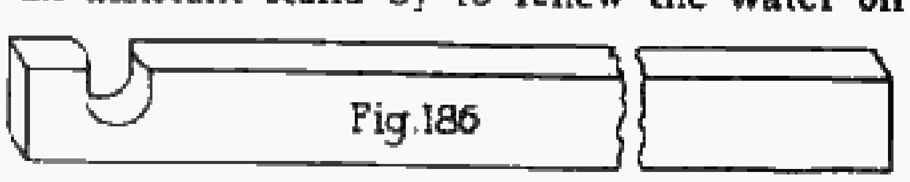


Fig.186

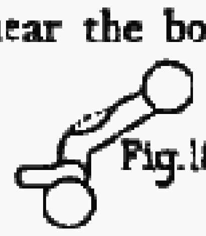


Fig.187

handle. Use only an acetylene torch to heat. Heat bolt handle to cherry red. Then take the two notched levers, one in each hand, and bend handle as desired. There must be no bend or twist in the flat portion where handle joins the bolt. Hold this portion firmly in the notch of one lever, while bending the lower part of bolt handle with the other. If desired the knob may be bent down very close to the stock, and the under side of knob ground flat for

446

clearance. This is sometimes done when the rifle is to be carried in a saddle scabbard. After bending, let the handle cool for several minutes before dipping in water to cool it completely—but keep the rags wet constantly, to prevent the balance of bolt from heating up.

The heating has left the bolt handle soft, so the knob may be file checked or stippled if desired. Often the underside (particularly if it has been ground flat) is checked, and the round side left smooth. All this is purely a matter of choice—personally I prefer a full round smooth bolt knob which rolls easily in the hand.

Do not make any attempt to re-harden the bolt handle, or your efforts may result in cracking the bolt. Leave it soft—there's no wear on it anyhow. Just dress it up smooth with a file, polish and blue it. Blue the entire bolt if you like, or blue the handle only, using the No. 1 Hot bluing solution given in Chapter 20. Some of the solution will run onto the body of bolt and make spots, but these are easily polished off afterward.

Some gunsmiths, particularly those who go in for light weight "de luxe" Springfields, are given to filing down the bolt handle to about half its original size. I would most emphatically advise against this. In the first place, the heating naturally removes some of the stiffness of the handle. The thin, skinny handle may look a little better on a very light rifle—but what if a shell sticks sometime, and you have to use your shoe-heel or a stick of stovewood to open the bolt? I have had to do this very thing more than once. *Leave that bolt handle as nearly its original size as you possibly can.*

Figure 187 shows a bolt handle with a round notch ground in it to clear the large eyepiece of a Hensoldt Zial Dialyt scope. This

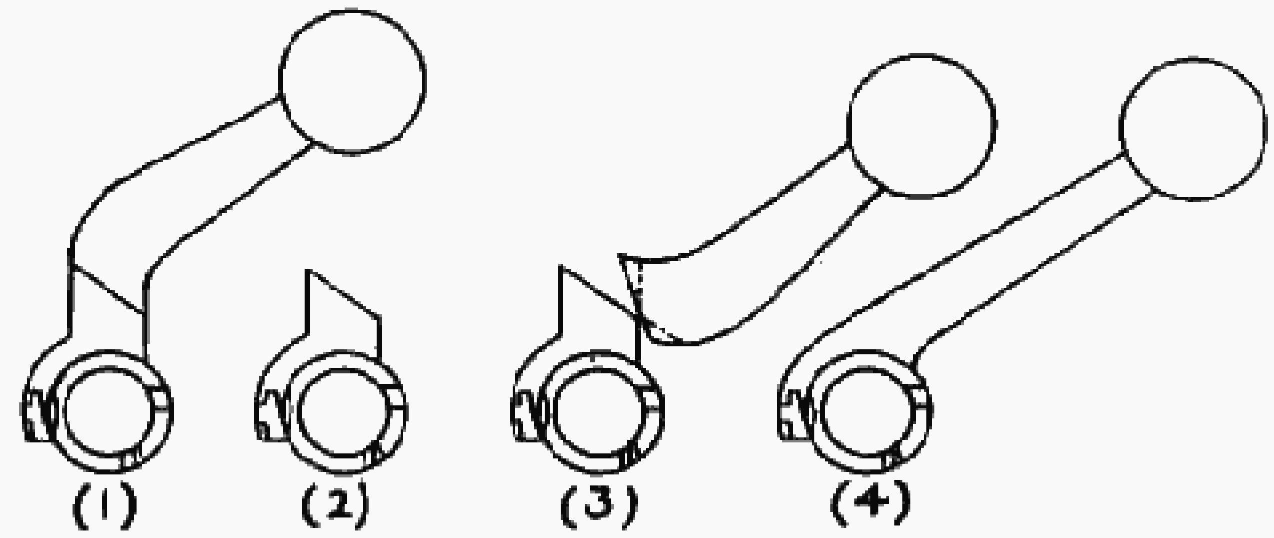


Fig. 188

is ground in on a round edge emery wheel, without heating the bolt at all.

Figure 188 shows an alteration described some time ago in the American Rifleman by H. A. Stillwell, to permit the use of a lower scope mounting on a Springfield. The bolt must be wrapped in wet rags as before mentioned, and the handle heated to anneal it. Then saw off on the line as shown in the drawings (1) and (2). Reverse the handle as shown in drawing (3) and weld with acetylene

447

torch, building in new metal with good carbon steel welding rods. The pointed projection is then ground off as shown by dotted lines in drawing (4), and the handle filed smooth and polished.

I am showing this alteration for what it may be worth to the reader, and would not hesitate to do the job for anyone who wanted it done. The strength would be somewhat reduced, of course, but the handle should be amply strong for ordinary use. Personally, my bolt handles will not be heated. The softening of the cocking cam, while not materially affecting the work of the bolt, will in time result in wear which will prevent the smooth, fast opening action possible only in a well hardened bolt.

The foregoing instructions will apply generally to almost any bolt handle that is to be slightly bent from its original shape. It is seldom necessary to bend the Krag handle back, although it may in some instances be desirable to turn it a bit closer to the stock on a saddle gun, and the same may apply to the Remington Model 30, the 54 Winchester, the Newton—in fact any bolt handle that

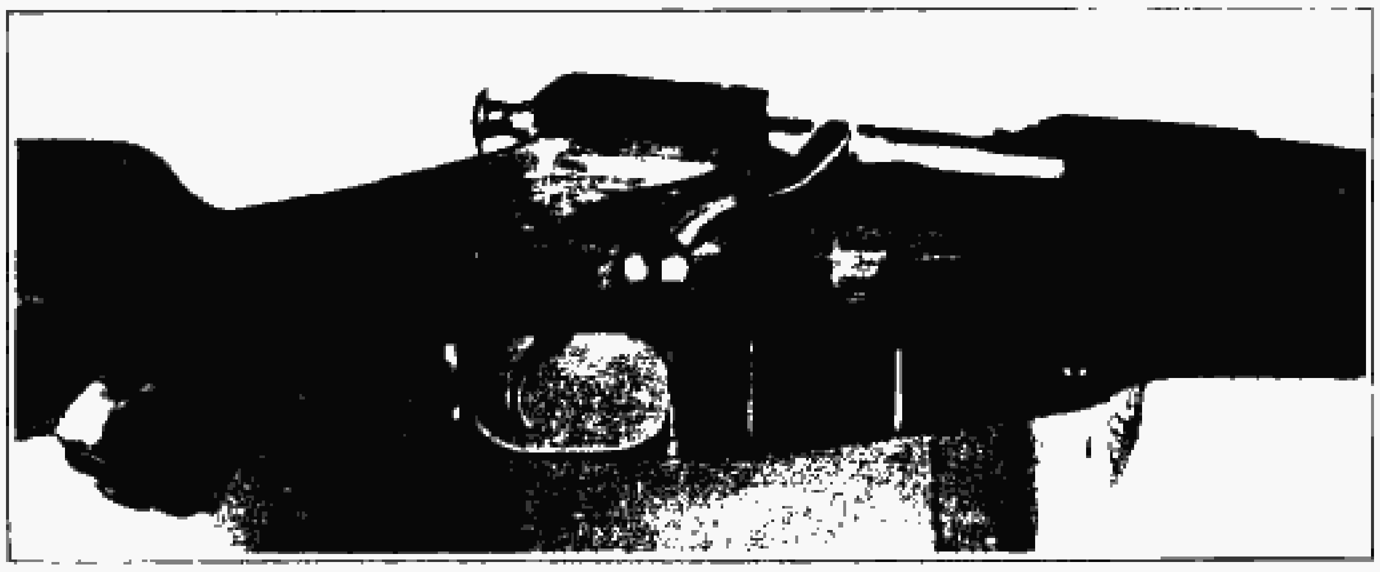


Fig. 189

does not suit the owner can be considerably altered within reasonable limits. In this, as in other alterations, *MODERATION* should be the order of the day. Don't run things to extremes or you will soon become sick of the gun.

Figure 189 shows a simple, yet very effective alteration on the bolt handle of the Russian 7.62 mm. rifle. In this case—and in some Mausers and Mannlichers as well—the handle sticks straight out from the receiver like the springboard down at the old swimmin' hole; and it is so far forward that only a man with gorilla arms can reach it without taking the piece from the shoulder. Bending down the handle helps but little—it should be lengthened and bent back toward the trigger far enough so that it may easily be reached without taking the arm from the shoulder.

On some rifles this is accomplished by cutting the bolt handle in two between knob and bolt, and welding in a piece of steel. On

448

the Russian, however, I find it best to cut the handle off right up against the bolt, and make and fit a new handle. The handle is attached to a rib which lies on the right side of bolt when closed. Saw off even with the rib, then drill and tap a hole in rib—which hole should not go clear through into the inside of bolt, but will not hurt the job if it does. Saw off the knob from the old bolt, drill and tap it for a 3/8 to 7/16 inch rod with 24 to 32 threads. Before shaping the rod for the new handle, bend a piece of heavy wire to the desired shape, and use this as a guide in forming the handle. Drill rod may be used for the handle, but cold rolled steel will do as well. Cut to length, bend it to shape, and thread both ends—the one to screw into the knob, and the other into the bolt. Set the knob on with a rust joint, or solder. Set the other end into the hole in rib on bolt, so that it is very tight when handle is in desired position. This joint should then be soldered. Heat the bolt near the hole hot enough to melt the solder and keep it melted for a few minutes. Tin the inside of hole; also tin the threaded end of handle; screw it into place and when the solder cools it is there to stay. Clean off excess solder, polish and blue. The appearance of handle will be improved if it is slightly tapered toward the knob.

This heating of the bolt does no harm on the Russian, as the locking lugs are made on a separate piece which attaches to the forward end of the bolt proper. It is of course necessary to *completely* dismount the bolt before heating.

REMODELING THE KRAG: Like the Springfield, the Krag Jorgensen is easily remodeled in a handsome, serviceable sporter, with much or little work or expense, according to the desire of the owner. Next to the Springfield it is perhaps the most practical hunting arm available today for all round woods use, and certainly one of the cheapest in cost. At this writing the Director of Civilian Marksmanship is selling good, serviceable Krags to N. R. A. members for $1.50 each! And while some of the barrels show a very small amount of wear, they also bear unmistakable evidence of that thorough and frequent cleaning which is exacted of all of Uncle Sam's boys. Of the many Krags that I have owned, handled and remodeled for others, I have never seen one sold by the D. C. M. on which the barrel was not in pretty good shooting condition—and some of them are still good as new!

There's something about the old Krag that a real rifleman can't help loving. It's strong and substantial; stands abuse that would wreck many high priced guns; the bolt is easier working than the best match Springfield, and plenty strong enough for any load it was designed to handle up to 43,000 pounds breech pressure. Its design also permits a much lower mounting of telescope sight than any Mauser type action unless it is the Model 30 Remington. The lines of the receiver are clean and graceful, and there are several good receiver sights adapted to it.

449

As the Krag comes to the purchaser from the D. C. M. it is rather long and ungainly, but it need not remain so for very long. The simplest remodeling job consists of merely cutting it down to a carbine, the general details of which are about as follows:

1. Cut off enough of the barrel to get rid of the front sight base. Then slip on a Springfield fixed stud and peen and stretch the band to a snug fit on the barrel at a point 1/4 inch back of the length desired—22, 24, 26 inches, or whatever length you decide on.
2. Saw barrel to desired length and crown muzzle.
3. If inside barrel band is to be used, make and fit band in place on barrel. The regular military band with swivel may be used, in which case it is not put on until the job is finished and the rifle finally assembled.
4. Sweat or pin Springfield fixed stud in place as described in Chapter 29.
5. Remove military rear sight and fill holes with dummy 8 x 32 screws, headless. If preferred the regular military rear sight may be used in lieu of a receiver sight.
6. Attach Lyman No. 33, 34, or 48 receiver sight, Marble No. KR receiver sight, or a Lyman or Marble cocking piece sight. (Latter not recommended, due to inaccuracy resulting from unavoidable play in cocking piece.) Or, make and fit a fixed peep on bolt sleeve, as described in Chapter 29. There is very little play in the sleeve, and unlocking the safety usually forces the sleeve to the same position each time.
7. Lighten trigger pull as desired. The action of a Krag needs little if any smoothing up—they all work like greased lightening.
8. Cut off forend two or three inches ahead of swivel or barrel band, and shape up tip as desired, after filling in the hollow under barrel with wood as described in Chapter 14.
9. Remove marks, dents and scratches by lightly rasping, filing and sanding stock all over, then oil finish.

A more complete job that will result in a finer appearing, better fitting and better handling rifle, will involve the following:

1. Cut barrel to desired length, strike and polish barrel, polish receiver and all metal parts.
2. Make and fit band for holding a Lyman No. 6 or similar folding leaf sight, and fit this band over rear sight screw hole. Fill other screw hole with dummy screw filed down smooth with surface of barrel and polished. Make and fit swivel band; make, fit and attach front sight ramp.
3. Attach receiver or other rear sight desired. Attach scope blocks if wanted.
4. Build up higher comb and pistol grip as described in Chapter 14; fill in grooves in handguard. Shape up stock as desired, oil finish, and check.
5. Reblue all metal parts.

"The world is so full of a number of things" as the poet says, which can be done to a Krag, that it is not necessary to enumerate them; one of the beauties of home gunsmithing is that a man may turn himself loose and plan his gun to be a bit different from the other fellow's. The attached illustrations will probably suggest other changes that may suit the reader still better.

A word of explanation of the one stocked flush to the muzzle, Mannlicher style, may be in order. This is merely the service stock worked over slightly, as the owner likes a straight grip, and did not care to go to the expense of a new stock.

450

A Springfield fixed stud was attached so that its front edge was exactly at the 22 inch mark on barrel; the barrel was sawed off flush with end of band, and band and barrel crowned as one. A ramp can be attached and finished in the same manner if preferred, and will greatly improve the appearance of the rifle. A steel muzzle cap for the Mannlicher-Schoennauer carbine was then enlarged inside slightly to fit over the sight base band, which was filed down somewhat thinner than it was originally. The forend was sawed 1/4 inch back of muzzle, and the hollow under barrel filled with walnut. The muzzle cap was then fitted to end of forend. A 2 x 56 countersink head machine screw holds the cap in place, the screw turning into a small brass nut let in flush with inner surface of the forend. The forend was then dressed down to a straight taper from swivel band to muzzle cap, and entire stock smoothed up and refinished.

The Krag receiver is square and sharp at its forward end, somewhat detracting from the appearance of the finished rifle unless this shoulder is rounded, or else covered up. The handguard is easily remodeled as shown in Figure 106 (Chapter 14), by blocking in the rear sight opening with walnut. File the edges of this hole straight and flat and undercut at each end with a 3 square file. Bevel the ends of a thick block to fit snugly; clean handguard of grease and oil with hot lye or sal soda solution, rinse, dry, and set in the block with du Pont Cement, and clamp in vise 48 hours to dry hard. Be careful not to give it too much pressure in the vise as the handguard is just a thin shell of wood and easily broken. The projecting outer portion of the block may be held in the vise while the inside is shaped with a hollow chisel to conform to the inside shape of the guard. Then snap guard onto the barrel, after sawing off most of the projecting wood, and shape up with rasp, file and sandpaper. The top of handguard may be finished smooth, or scored or checked if desired. A row of parallel lines running lengthwise on top are easily cut with the checking line spacer, giving an attractive appearance.

If the handguard is not desired, the sharp shoulder on receiver is easily removed. Chuck the barrel in the three jaw lathe chuck, the barrel being inserted through the hole in spindle, leaving the receiver and about 6 inches of barrel ahead of the chuck. If the receiver is very hard use a high speed cutter to turn off the shoulder, or use the grinding attachment to round it up as desired.

In Chapter 24 two types of band are described which may be easily made and fitted around the barrel where it joins the receiver, thus eliminating the objectionable shoulder without turning it off.

The Krag having a worn out or rusted barrel is not at the end of its career by any means. Simply order a Springfield barrel from the D. C. M. preferably choosing the sporter type of barrel, costing about ten dollars. Send it with your action to Neidner or any other

451

reliable barrel maker equipped to do the work, and have it cut off slightly at the breech and rechambered for the .30-40 cartridge, and fitted into the action. *Don't trust some jackleg who thinks he can do this job.* The correct headspacing is just as important in a Krag as in any other rifle, and the job is one for experts only. Neidner's price is only $6.00, and it is worth the cost.

Now, if you want a really fine, flat shooting, high velocity small bore rifle, have Neidner make you a special barrel chambered for the .25 Krag-Neidner cartridge, which is really a .30-40 case necked to 25 caliber, loaded with a 100 grain bullet. Here is a thoroughly modern load, ample for anything up to deer, and splendidly adapted to open country shooting by reason of its very flat trajectory. This must not be confused with the Roberts load recently developed, as the latter is made by necking down the 7 mm. cartridge, and can only be used in the Springfield, Mauser, 54 Winchester, or Model 30 Remington action.

A tip: Whenever you plan a job involving a new barrel, get the old barrel out the action, and inlet the action only into the stock before the new barrel is fitted. It is much easier to inlet a stripped action, and you will get a more nearly perfect fit. After the barrel is in the action, it may be gradually bedded, working the channel forward from the receiver mortice toward the forend tip.

Figure 190 shows a simple method of making a Mannlicher style Krag stock devised by Major R. H. Lewis, U. S. A., in which the regular Krag upper band was used. The band was cut in two as shown in the sketch below, and only the forward half used, the

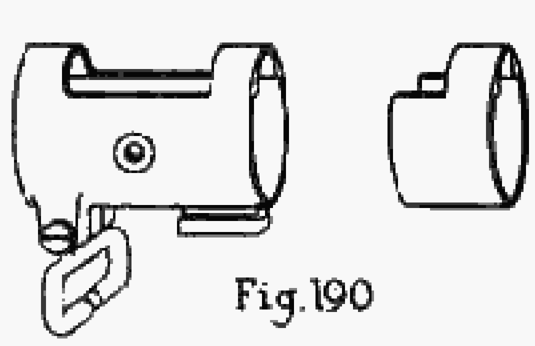


Fig.190

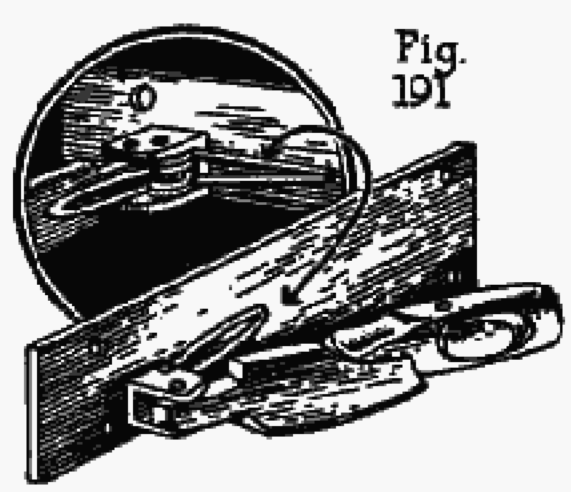


Fig. 191

bayonet stud being cut off and bottom of band rounded up and polished. The band is held in position by a small wood screw underneath. Major Lewis used a Marble Duplex front sight dovetailed into the barrel. A Springfield front sight base or a ramp could be used as well, if desired.

Some shooters object to the projecting box magazine on the side of the Krag, claiming that it interferes with carrying the arm in the field. I do not find this much in the way, but then neither do I particularly object to the Lee type of magazine such as is found on the Lee Enfield and the Russian rifle—while others cannot tolerate

452

it. Anyhow, if the Krag magazine takes the joy out of life for you, by all means get rid of it—no trick at all if you work carefully and have patience. Figure 191 shows an alteration suggested by Mr. John C. Harris in the American Rifleman.

First remove the magazine and all working parts. The projecting hinge portion of receiver is then ground down flush, and a side plate made of 3/32 inch cold rolled steel. The hinge for the magazine follower is then filed from tool steel or drill rod, and screwed or spot welded in position. The end of the follower is cut off and pinned into this hinge, with the spring, which is made of piano wire bent as shown in the sketch. The side plate is attached to the opening in the receiver with 8 x 40 countersink head screws. The

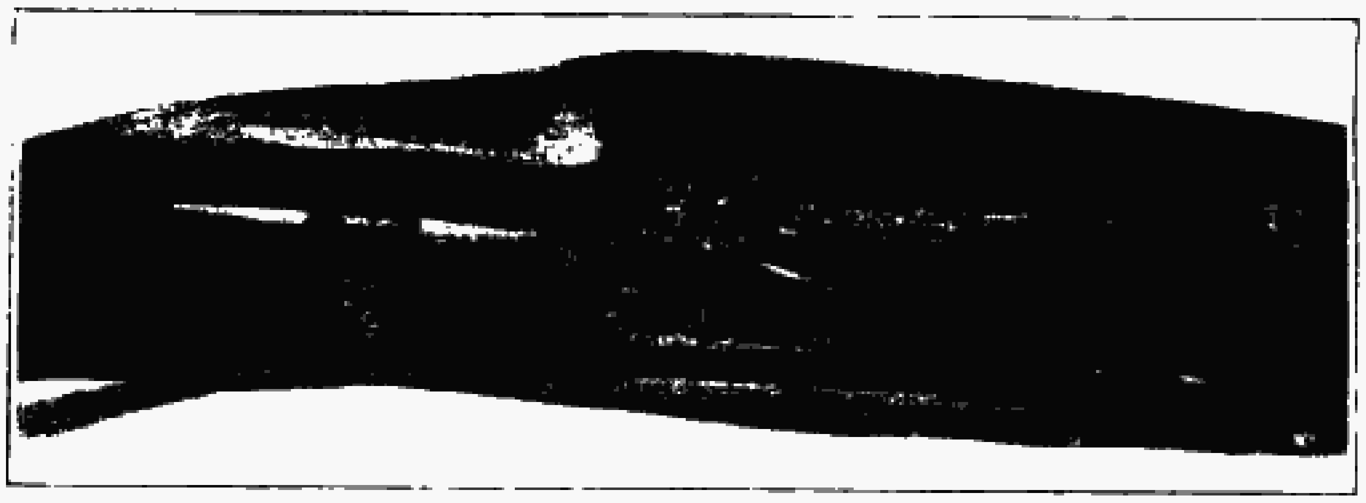


Fig. 192

completed action is then inletted in the usual manner, except that the wood is not cut away on the right side. The cutting away of the left side of stock may also be omitted if desired.

Figure 192 shows a stock which I made for a party who objected to the left hand side plate showing, claiming it weakened the stock. I doubt if the thin shell of wood over the side plate really strengthened it much, but it is satisfying to know the stock can be made in this manner if desired. At least, the stock is somewhat stiffer than the one made in the orthodox manner, but it is still necessary to tie the forend to the barrel with a barrel band.

The principal difficulty encountered in "flushing" the Krag magazine as just described is that of locating the exact position of the follower hinge on the side plate. Unless this is in exactly the right place the cartridges will not feed correctly. After making the side plate, and drilling the screw holes, make the hinge piece, but do not drill the hole in plate for attaching hinge. Instead, soft solder the hinge to the plate in what looks like the correct position, screw on the plate and try it. It may be necessary to shift the position of hinge and re-solder several times before getting it just right. Then a small hole may be drilled through plate into hinge, and a pin inserted as a guide. After which remove the follower, pin and spring, and attach the hinge permanently by screw, spot welding, or hard brazing.

453

THE RUSSIAN 7.62 MM. RIFLE, or Three-line Nagant. Some few years ago there were two companies—the Remington Arms Company, and the New England Westinghouse Company, building the above rifle on contract for the Imperial Russian Government, and everybody was happy as the day is long. Then, sad to relate, the long whiskered gentry known as the Soviet went in and sort of took things in hand, and the companies found themselves possessed of many thousands of finished Russian rifles and un-assembled parts that they couldn't very well dispose of, together with certain contracts that might have been useful for shaving paper if they had not been so stiff. Shortly afterward, our own government having decided that peace at any price wasn't worth what it cost, Uncle Sammy began mixing it with the Dutch, the while facing the sudden and unexpected problem of arming his newly recruited fighting men. Springfields could not be built fast enough for all the troops. Remington and Winchester were tooled up for the new British Enfield, so contracts were placed with them for Enfield rifles slightly altered to handle the .30-06 cartridge—the newly born rifle giving splendid service throughout the war. But both Enfields and Springfields were needed in the field, and could not be spared for training all the new units—at least it was feared they could not. So Uncle Sammy, having the interests of home industry at heart, promptly made a deal with the aforenamed concerns to take their surplus Russians off their hands—at a most reasonable figure,—with the idea of using them for preliminary training of troops. Happily the Marines won the war before it became necessary to use any of these crowbars, for which let us pause and give thanks. Now the same Uncle Sammy is dispensing them to us at the very modest sum of three dollars and thirty-four cents—for which let us give thanks once again!

For while the Russian Rifle is without a doubt the gosh-awfulest looking contraption that ever burned powder, it nevertheless constitutes the foundation for a splendid hunting arm, if one cares to take the trouble to rebuild it.

It uses a rimmed cartridge firing a bullet of 145 to 150 grains weight, 7.62 mm. or about 30 calibers; at a velocity of 2900 f. s.; and the Remington Arms Company and the United States Cartridge Company both make ammunition for it with good hunting bullets. The groove diameter is about .313—a little large for the 150 gr. Springfield service bullets, although these do quite well in it. The bolt is very strong, the lugs being noticeably larger than our Springfield or Enfield lugs,—a splendid idea, since the Russian receivers do not seem to be hardened.

The bolt handle sticks out like a sore thumb, and is awkward to use, but can easily be altered as desired, this having been explained earlier in this chapter.

The Lyman Gunsight Corporation has adapted their No. 36 re-

454

ceiver sight, (originally made for the Mannlicher) to this rifle; and while it may seem foolish to pay $10.00 for a sight for a $3.34 rifle—it isn't nearly so foolish as it sounds. ***Any Lyman sight is worth its price on any rifle,*** regardless of race, color, or previous condition of servitude—and that's that.

One can do almost anything he wishes in the way of remodeling the Russian. Build up and reshape the old stock, as described in Chapter 14 or make a new stock if preferred; cut the barrel to any desired length; leave on the military rear sight, or strip it and put on a Lyman 36 as a Christian and a gentleman should. To remove the rear sight base, heat in blow torch until the solder melts, and drive it toward the muzzle; there is a dovetail milled on the barrel which must be filed off and polished, after which the bright spot may be blued by "lamping"—See Chapter 20. Put on a Springfield front sight base with a Western Full Block sight or a Lyman or Sheard gold bead, or use any of the standard base sights dovetailed into the barrel; carry the wood to the muzzle, or cut it back in a regular sporter forend.

One word—forget about "Russian-Springfields," and such like advertising phrases used by certain junk dealers. A Russian is a Russian—and a Springfield is a Springfield—and never the twain shall meet. I can't imagine the said junk dealers knowing much—or caring much either—about little matters like headspace adjustment; and besides the Springfield barrels they use on their Russians are worn out. "Ask the man who uses one." If you want a Russian, and can't afford a Springfield—then buy a Russian and use it as such. It's a good cheap rifle, and a good dependable cartridge. If you want a Springfield, don't kid yourself—but buy a Springfield and pay the price. Don't be like the Scotchman who, seeing himself about to be run over by a steam roller, turned on his side, so that his pants would be pressed for the funeral.

THE ROSS MODEL 5, Caliber .303 British. Just how and why the United States Ordnance Department happened to have these arms on hand and for sale I do not know; presumably they were purchased second hand as reserve rifles for training troops early in the war. They have been used, but most of them are in as good condition as the Krags.

The Ross action is a "straight pull," i. e., it is not necessary to raise the bolt handle to unlock the bolt. Instead it is pulled straight back, and pushed straight forward to eject and reload. The bolt operates inside a spirally fluted sleeve on the well-known principle of the spiral screwdriver; and the forward motion of the sleeve turns the two large strong lugs into their recesses in receiver as surely as turning down the bolt handle of a Springfield turns the lugs into place.

The Model 5 Ross is an entirely different mechanism from the Model 10. In that model there were once some rifles made that

455

were not fool proof, in that the bolt could be assembled with the lugs in the wrong position so that they were not locked when the bolt was closed. Some faces and other things were blown off, as a result, I understand—since which time certain parties have been carping on the general undesirability of all Ross rifles, alleging that they were more dangerous to the man behind than to him in front.

I have no argument with those who believe the Ross Model 5 to be unsafe. I don't know whether it is safe or unsafe. I never saw it used in action, and have no firsthand record of any Model 5 bolt blowing out and killing or injuring anyone. The sum total of my experience with the Model 5 covers about a dozen rifles, five of which I have owned and shot, and three of which I still have. The others I shot also, and witnessed their shooting by their owners. In no instance have I seen one of the bolts blow out, nor have I known of one blowing out, nor have I observed any signs of one threatening to blow out. The nearest thing to an accident with a Model 5 Ross I ever saw was a bolt which partly opened after having been shot all day. Investigation disclosed that the shooter had been dipping his bullets into vaseline to prevent metal fouling; and when I examined the bolt and chamber I found everything thickly coated with grease, so that the back thrust of the cartridge against the bolt head must have been at least 50% greater than normal. A Springfield, or even a Mauser (which some of our alleged experts claim is so much stronger) would be expected to let loose under such circumstances. In fact, the blowing up of several Springfields was traced to the use of Mobilubricant some years ago, and the practice discontinued for this reason. When the shooter above mentioned cleaned out the grease from chamber and action of his Ross, the bolt stayed "put" and no trouble has been noticed through hundreds of rounds fired afterward.

The .303 British Cartridge is almost identical in ballistics with the .30-40, which means, that with suitable hunting bullets it is a fine load for all American big game. The ammunition is made by all cartridge companies in this country. Moreover, the action of the Ross Model 5 will handle the .30-40 cartridge perfectly, so it is an easy matter to have a Krag barrel fitted, or a Springfield barrel rechambered for the .30-40 cartridge. It is highly important that the work be done by a competent barrel maker, and headspace adjusted to .004" or less.

The same suggestions applying to other military rifles apply to the Ross when it comes to remodeling it into a Sporter. The barrel is 28 inches long, and may be cut to 22 inches without greatly affecting accuracy. In this length it makes a handy saddle gun. The Springfield fixed stud is too large for the Ross barrel, so it is necessary to make one from Shelby tubing, or to ream the original sight base a trifle and use it. Or, make a ramp of the correct size to fit the shortened barrel.

456

The military stock is rather better than most in shape and size, and may be dressed down to a fairly good sporting stock with a little work, and checked and polished as desired. Next to the German Mauser, the Ross is perhaps the best shaped of all military stocks.

The forend can be cut off a couple of inches ahead of swivel band, or carried out to the muzzle as desired. The upper band can be altered into a muzzle cap by cutting it in half as already explained in connection with the Krag. To remove the Ross upper band intact it is necessary first to remove the front sight base. This is soldered to the barrel and may be removed by heating until the solder melts.

If you want to get rid of this upper band entirely without removing sight base or cutting off barrel, the band must be filed in two—and be sure to work carefully and use a fine sharp edged fil

Fig. 193

I have before me a Ross with a perfect barrel that has been almost ruined by sheer stupidity and clumsiness—evidently a horse rasp was used to file off the band, and there are ridges nearly 1/16 inch deep filed across the barrel!

The military rear sight of the Ross is rather better than most military sights; so if you like open sights you'll not be far wrong in leaving it on. Lyman makes a receiver sight for the Ross for eleven dollars. Figure 193 shows the military rear sight which the ingenious owner has moved back and sweated to the top of the bolt, giving the advantage of a receiver sight at no cost but a little work. It was necessary to file the under side of base to a larger radius, which the owner did by holding the sight in his hand and working on it with a half round file from the ten cent store! And it is as perfect a job of fitting as I ever saw.

If one cares enough for his Ross to make a special stock for it he will find it well worth the time and labor. Moreover, the Ross is one of the easiest of all the bolt actions to stock. The barrel and receiver are let in first; then the guard screw holes are bored; then remove the magazine from guard, and use the guard as a templet to outline its location on under side of stock. Inlet guard, then

457

cut the hole for the magazine. Next mark out and cut the groove for magazine follower-arm, taking all measurements for this from the old stock. Shape up stock to desired form, with recoil pad or steel buttplate as desired. The magazine cutoff, as well as the swivel attached to trigger guard, should be removed, as both are useless.

SHORT MODEL LEE ENFIELD, Caliber .303, Mark VII. This was the service arm of the British troops in the World War, and gave an excellent account of itself at Verdun, the Somme, the Marne, and other famous battle fronts. This arm is not regularly sold in the United States, but is available through representatives of the Birmingham Small Arms Company, and quite a number of them are in use in various parts of the country, particularly in Canada. It is now the official service arm of the R. N. W. M. P., and is a most suitable arm for rough usage under all conditions of service. It makes up into an excellent hunting rifle.

The rifle illustrated on page 458 is now being remodeled for a chap who does not greatly enthuse over the Lee Enfield at all and who is particularly opposed to two-piece stocks. I therefore set about (with some misgivings I must confess) devising ways and means of consolidating the forward and after portions into one, on the time proven theory that in union there is strength. A surreptitious letter with some rough sketches addressed to the victim brought forth the glad tidings that in his opinion the thing was feasible; so, committing my spirit to its Maker I said "here goes nothin' " and let drive with the hacksaw, taking off socket at rear end of receiver, and then welded on receiver and guard tangs.

The safety, which originally was attached to the side of the socket, was merely swung forward and attached alongside of receiver, being set in a little closer by filing down the washer that goes in under the spring. *It works.*

The high and unwieldy receiver bridge, whose sole purpose is to provide a way for the cartridge clip, was sawed off and ground down smooth on both sides of receiver. Front and rear military sights were stripped off, and a front sight ramp made and fitted, after a swivel band had been fitted at the proper point on barrel. Removal of the military rear sight left a hole straight through the barrel from side to side, missing the bore by a scant margin—yep!—believe it or not—that's the way the bloody thing was pinned on. But the same pin, driven back and filed off smoothly concealed the dirty work. There was another hole about 1/8 inch deep in top of barrel, to accommodate the end of a screw in the military sight. This hole was blanked out by tapping it and turning in a small screw which was then filed off flush. The proof marks and other impedimenta were filed from forward end of receiver and breech of barrel, the marks being very shallow so that their removal did no damage. Top of receiver and flattened portion of breech were then matted to match

459

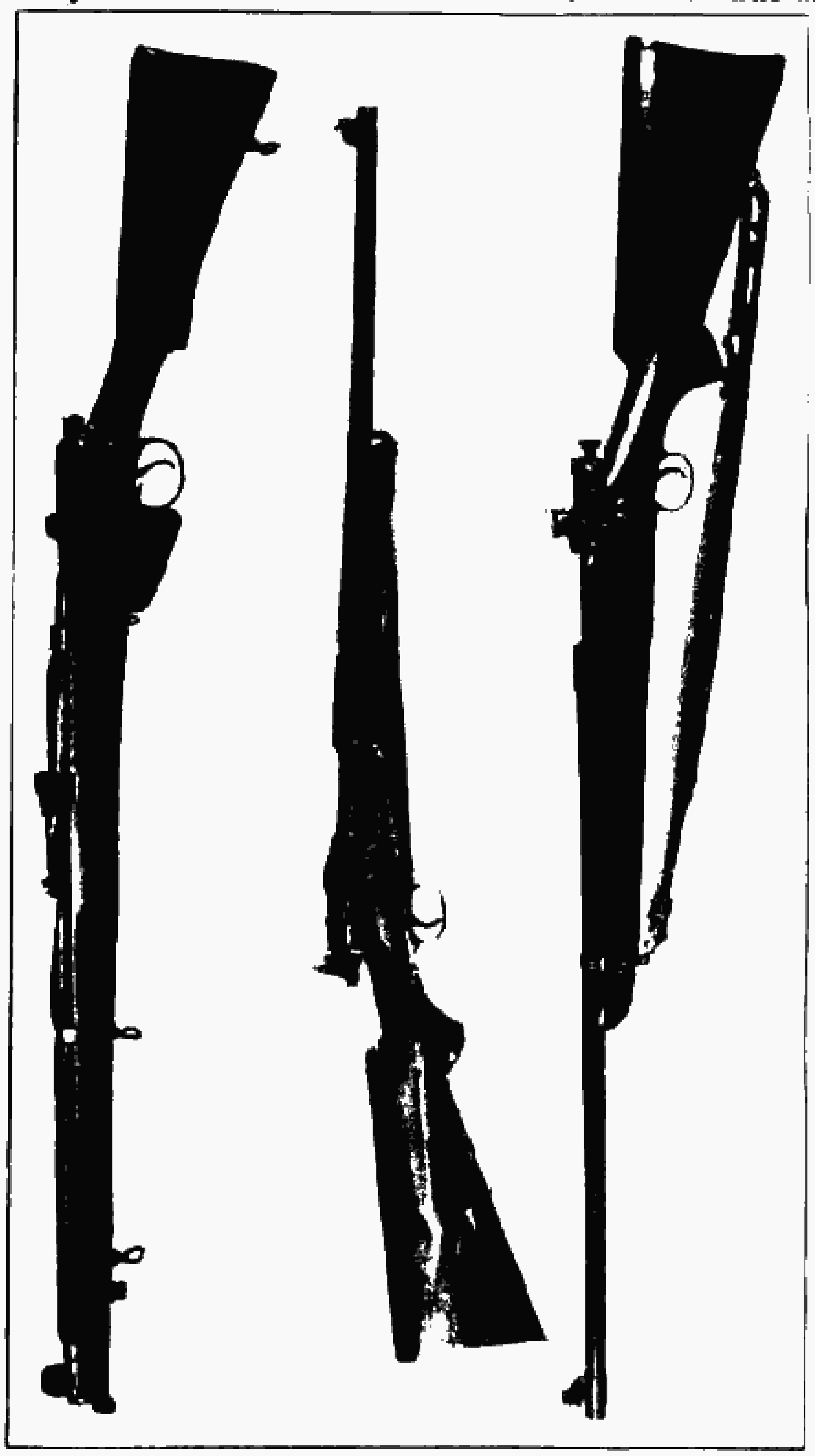
surface of front sight ramp, after which entire action and barrel were polished and blued and a Lyman No. 48 sight fitted to receiver. The barrel was left its original length—about 25 inches.

The rifle is being stocked in about the same manner as a Ross would be stocked—by letting in the barrel and action first, then the guard. The illustration shows the rifle "as is" today. The only change in the mechanism, outside of easing up the pull a bit, was the addition of a small flat spring to bear against the rear portion of the trigger to take up the rattle. Before that was done the trigger served a two-fold purpose—firing the gun, and calling the chickens.

THE 1873 MODEL SPRINGFIELD, Caliber .45-70. Here's a real he-gun! A good old punkin-slinger in its day—and its day is not over yet. The .45-70 load is still one of the best for knocking down game at comparatively short range in heavy brush and timber, and is preferred by many for this work.

With its long barrel the rifle as issued by the D. C. M. for $1.25 is a bit unwieldy for most of us. By cutting the barrel to 24 or 25 inches the handling is much improved; and the stock may also be cut down to a carbine with little work.

Figure 194 shows a special remodeling job done for Dr. Paul B. Jenkins, who is a great admirer of the '73 Springfield and the load it shoots. In this case no effort was spared to modernize the old gun as far as was humanly possible. The trigger pull was lightened as explained in Chapter 28. A piece of tool steel was welded to the upper tang to lengthen it sufficiently to provide a firm base for the rear sight. The Lyman 103 was chosen in the model supplied by the makers for the '99 model Savage, as the base of this sight fitted the rifle tang quite as well as the one it was made for. The trigger guard was cut down to about 5/8 inch in width, and the guard swivel cut off. A Lyman No. 6 folding leaf sight was attached by a band around barrel. Another band holds the forend snugly against barrel, the stock being held otherwise only by the rear tang screw. A special sight ramp was made, and fitted with a Sheard gold bead made for the Mannlicher-Schoennauer. Top of ramp and top of barrel ring of receiver were matted, and entire gun polished and re-blued. The hammer was ground away slightly at the back under the spur, and also on the lower part, and skeletonized to further lighten it. This was done by drilling a string of holes and filing away the metal between them with a rat tail file. The action was



Upper: The British Enfield, a rifle which has great possibilities for converting into a sporter; has a ten shot magazine and is an easy working, fast action. Center: A custom built sporter having bolt sleeve peep sight. Barrel and action should have been inletted deeper into the stock. Lower: The rifle that can hold its own in any company. The Springfield Sporter sold by the D. C. M. for $46.00; stock has been worked down slightly all over, grip curve deepened, grip cap fitted and stock refinished. Checking would improve it greatly.

then stocked in good dark American walnut, the stock fitted with steel grip cap, horn forend tip, and a Mannlicher-Schoennauer buttplate with long trap. The shape and dimensions of this stock are not adapted to many shooters, but they suited Dr. Jenkins, who has long arms and rather large hands. Studs were attached for detachable swivels.

In stocking this rifle the receiver plug, of which the upper tang is a part, should be removed before inletting the barrel and receiver.

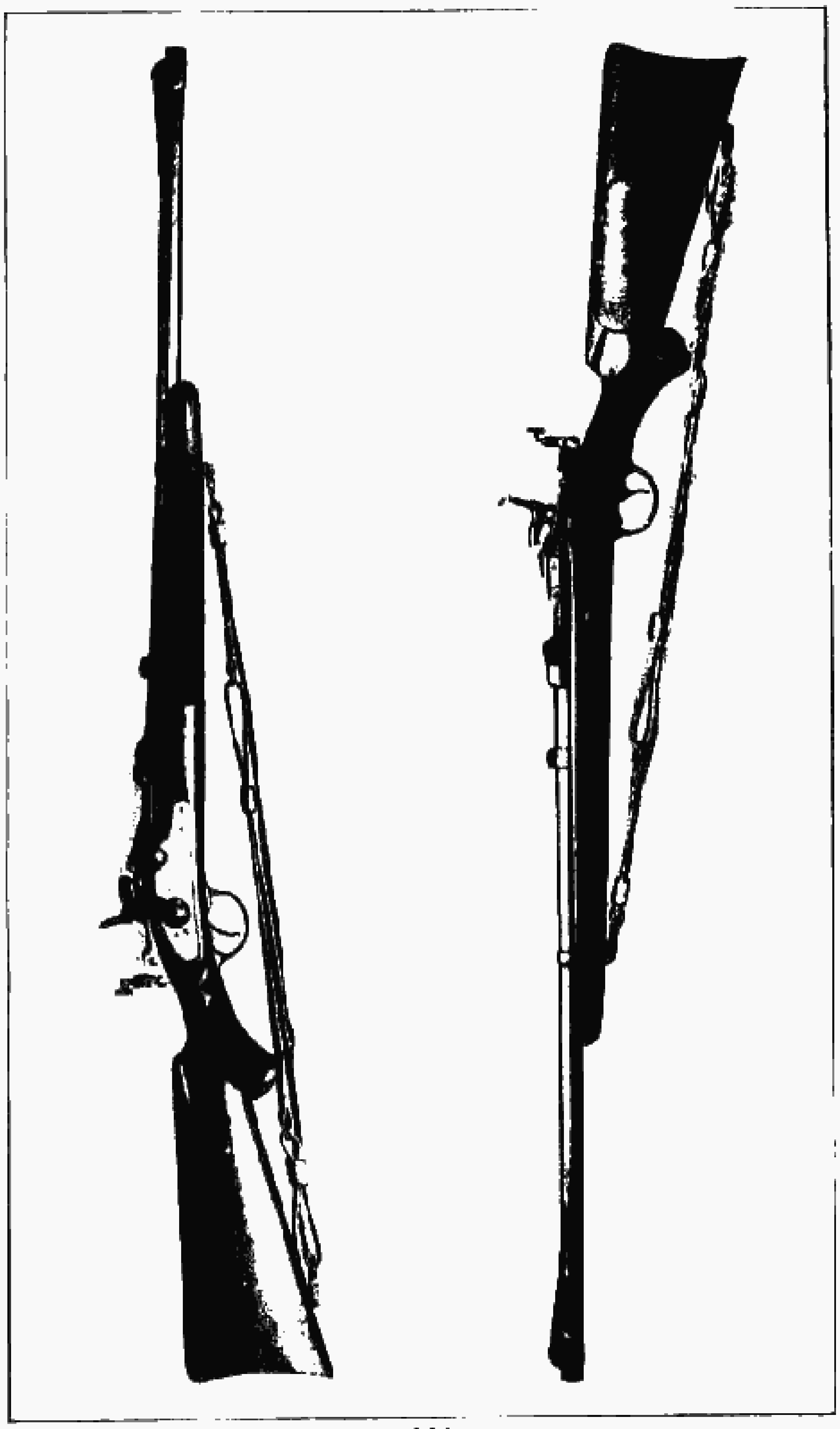


Fig. 194. Dr. Paul B. Jenkins' .45/70 Springfield after being modernized.

461

Then fit in the tang after it has been lengthened as described. The only difficulty encountered was in locating the two screw holes on the left side, for the screws holding the lock plate. These should not be drilled until the lock plate has been inletted, after which the drill may be run in through the holes in plate, from the right side. A small half-round chisel was used for countersinking these holes on left side of stock for the screw bushings.

OBSOLETE SPORTING RIFLES: One of the greatest joys of the gun-crank lies in working over and rejuvenating some old gun, perhaps picked up in a pawnshop for nearly nothing, and making it into a handsome and useful modern arm. A brief perusal of the classified ads in any outdoor magazine will show a steady demand for old Ballards, Sharps, Winchester Single Shots and perhaps others. And most of them will richly reward the experimenter. The Ballard action is just as good today as it ever was, and while some may believe there are better actions for a .22 caliber match rifle, the Ballard enthusiast cannot be convinced of the error of his ways—it's a Ballard or nothing for him. He'll have a fine barrel made and fitted, then he'll get busy on the action, tuning it up and polishing the parts, making new parts where necessary, adjusting the set triggers, and finally stocking it to the queen's taste!

The admirer of big calibers will perhaps unearth a Sharps-Borchardt action, with a barrel for some obsolete cartridge, and will either move heaven and earth to find ammunition for it, or else have a new barrel made to shoot some cartridge he can get. For several years I have been hoarding an old Borchardt action in hopes of someday getting round to having a .45-70 nickel steel barrel made, and then making a modern stock for it.

Both the Sharps-Borchardt and the Ballard have the stock held to the receiver by a long screw through the butt—in my opinion the very best way, as it permits no looseness between stock and action. The Borchardt is particularly good for modern stocking, as, having no tangs, the pistol grip may be shaped up as close to the trigger and with as full a curve as desired.

When these old actions, originally intended for black powder, are rebuilt to be used with smokeless, the firing pin hole should be bored out and bushed with tool steel, and a new firing pin of high grade alloy steel supplied. A. O. Niedner of Dowagiac, Michigan, is equipped to do this work, and understands it. As a rule these old actions are in pretty good shape, requiring few if any new parts, most of which are easily filed out by hand. Either chrome vanadium alloy steel, or a 90 point carbon steel should be used for working parts, the latter being also good for flat springs, if any must be made.

Figure 67 shows a single shot Winchester action remodeled for Colonel Townsend Whelen. This rifle is fitted with a .25-20 barrel chambered for the .25-20 repeater cartridge—always a favorite with

462

the Colonel,—and a splendid little load, now that it is available with non-corrosive priming and lubaloy or copper bullet. This action was originally the straight tang model, without pistol grip. The lower tang was bent cold in the vise, 3/8 inch brass rods being bent at right angles and hung on the vise jaws, spaced as required to put the bend where desired. This bending of course threw the tang screw hole out of position; so this hole was welded up and extra metal built up on the tang to form a small shelf parallel with the upper tang, or at right angles to the tang screw. A hole was then drilled in this shelf for the screw. The screw hole in end of lower tang was also welded up, as it was necessary to cut off a little of the tip, and square the end of this tang. The tip of upper tang was also slightly shortened, to permit setting the comb as far forward as possible.

The lower tang was then filed flat across its outer surface, instead of rounded, as it was originally. The lever was straightened out by heating and bending in a vise, and a piece of cold rolled steel welded to its lower end and shaped as shown in sketch, Figure 67. Additional welding steel was flowed onto the lever at the bend just behind trigger, and the guard re-shaped as shown by grinding and filing. This gave considerably more finger room, and in effect, a longer grip. The upper side of lever knob was notched to receive the turned down end of a spring catch fitted in above the grip cap as shown. The upper side of lever was filed flat to fit smoothly against the flattened outer surface of tang.

Probably the catch at lower end of lever is not necessary, but it was specified in the order, consequently it was made. It could be omitted, as the natural tension of the action spring will keep the lever closed normally, but the extra catch is of value in preventing its being knocked open if caught against brush, etc.

A good example of a remodeled Winchester SS is shown in Figure 195.

There are a lot of old single shot Winchester actions kicking round the country, and a better action was never made, I believe. It will handle any load up to and including the .30-40, and has been used with the .30-06. When used with a heavy load, the firing pin hole should be bushed, and the Mann-Neidner firing pin fitted.

The suggestions contained herein are not intended by any means to cover the entire field of remodeling—they merely show what has been done in some instances, by way of suggesting what the amateur gunsmith may do with old rifles he has or may acquire in future.

It would not be correct to include the 1890 model Winchester in the list of obsolete arms, yet in view of later design, this splendid little arm would be considered obsolete by many cranks. Admiring the action, but not satisfied with the handling qualities, Mr. R.

Bonar, of Pine Bluff, Arkansas, has improved the handling of his 1890 Winchester at least 200 per cent by restocking as shown in Figure 197. In the letter accompanying these photographs Mr.

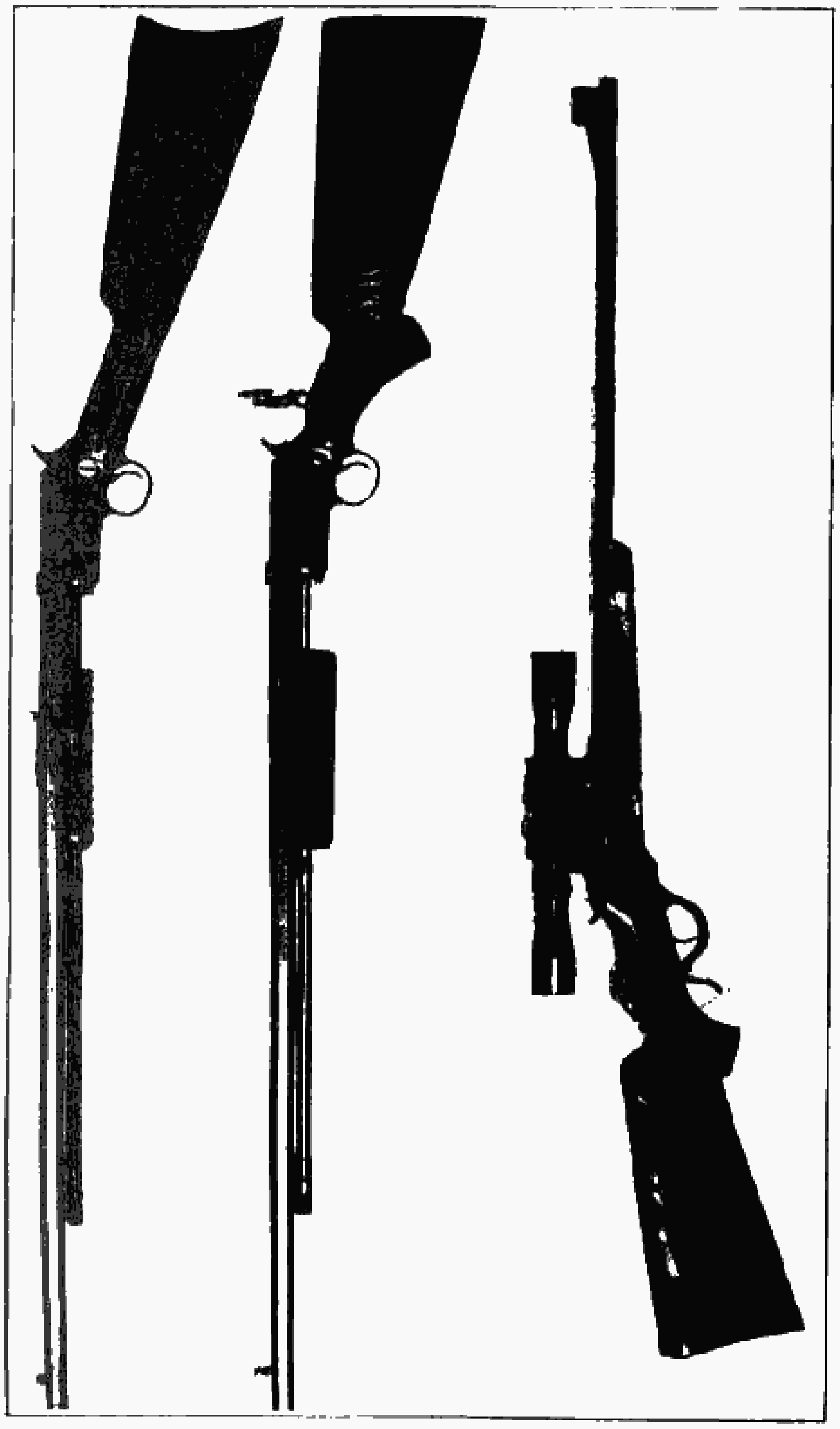


Fig. 196—Upper. The 1890 Winchester .22 in original boy-size factory job. Fig. 197—Center. The Winchester after being remodeled by R. Bonar. Fig. 198—Lower. A Winchester SS action touched up a bit and fitted with a special stock and hunting scope.

464

Bonar expressed some very sensible thoughts so I present both his letter and a view of his work:

"It seems to me that in modern gun-writing, too little space is devoted to what is often termed the 'tin can rifle,' a .22 for general small bore shooting, but not in the strictest sense of the word, a true target rifle.

"Such a rifle could be any of the standard small bore repeaters of which all are at their present development excellent pieces, but their chief fault as I see it, is that they are nearly all stocked and balanced for the juvenile trade only.

"The make and type are largely matters of personal preference. In my own childish mind, I think there is no finer example of the .22 rifle design than the 1890 Winchester, though it, in all its perfection, is frowned upon by many on account of the hammer which I regard as one of its good points rather than a fault.

"But like the rest of its klan, it is cursed with the typical boys' stock and screwdriver handle action slide, so I have attempted to make more 'gun' out of it by restocking it with a pistol grip, cheek piece, and larger action slide.

"Also you will note that the lower tang was curved downward; a 'V' shaped piece of steel was fitted on top and riveted to it in order to form support for the rear end of main-spring. Adjustment on main-spring was taken care of at the usual place by a screw long enough to go through the block. The upper tang was cut off one-half inch to permit carrying comb forward, and the Lyman sight base set as far forward as the movement of hammer would permit. Buttplate is one for standard Winchester 54, with a trap built in.

"The larger action slide handle did not present much of a problem, except the alignment of the holes of two diameters, which was accomplished by inletting the action slide first, then using it as a guide for continuing the hole at a smaller diameter. Teeth were filed in the end of the magazine tube and same placed in a vise to bore out wood, as no bits of the correct size are available.

There's a gun-crank after my own heart! He took a rifle of undeniably sound mechanical design and construction, but one which most people cuss because of its small stock and poor grip, and made it into a real work of art. The stock is well shaped, and the checking and finish would do credit to many a professional gunsmith. And I must say that I admire a man who will stick up for a rifle he likes when other folks have it down and are jumping on it—then go ahead and prove himself right by making something worth while out of it.

There are a lot of tin-can rifles—Remingtons, Marlins, Winchesters, Savages, Stevens, and others, that would be vastly more valuable to their owners if they would do a little head work and a little hand work on them. Why not?

465

Chapter 31

SHOTGUN REPAIRS AND ALTERATIONS

IN the whole field of gunnery the high grade shotgun undoubtedly outranks all other classes of firearms for superiority of workmanship, and finish. A shotgun of the better sort produced by one of the recognized makers is not only a work of art, but it is also an example of the finest sort of mechanical skill. The lock and other parts are fitted up with all the precision of an expensive watch; the smallest possible tolerances are observed in the fitting of all parts, and they are well polished and finished in keeping with the outside of the gun. In the more expensive grades, the working parts of the locks are sometimes gold plated—which by the way seems a good deal like gilding the lily; for high grade steel properly fitted and polished, owes no apology to any other metal. The plating of parts, while of some value in preventing rust, certainly does not tend toward smooth, quick working.

In considering the class of workmanship and finish on such high grade guns, one would expect to see shotgun repairs and adjustment confined to the better class of workmen who specialize in this one branch of gunsmithing. Yet such is not the case. The average "jackleg" gunsmith with a hole-in-the-wall shop does perhaps a hundred shotgun to one rifle or pistol job. The shotgun is his bread and butter, just as the sale of shotgun ammunition is the mainstay of the sporting goods dealer. For practically every man and boy who ever fires a gun of any kind, owns a shotgun,—and the cheaper guns of course receive abuse which necessitates frequent repairs.

So it would seem, with all the experience he has that the average gunsmith should develop a high degree of skill in shotgun work. But he doesn't. In most cases he is a rough-and-ready sort possessed of an infinite number of rough-and-ready kinks to make a gun shoot. And he will unhesitatingly undertake to raise or lower the pattern

466

of your barrel, re-stock the gun for you, or repair the mechanism, open up or increase the choke, or lengthen the chamber. He will with entire confidence tackle a job from which the factory that made the gun would shy off; and if he falls down, and ruins the gun, he'll have an air-tight alibi all ready for you. Yet chances are that he'll do a pretty fair piece of work—rough, perhaps, but effective to a degree,—and the price he charges you won't necessitate putting off the purchase of a new flivver.

The man who merely owns a gun for shooting purposes rarely pays over $50.00 for it—and the type of gunsmith just referred to will do all the repairing he requires in a way that will satisfy him. But the chap more greatly blessed with this world's goods, who takes real pride in the appearance of his guns, and who spends from $175.00 to $1,000.00 or perhaps more for them, should steer clear of this type of workman. Such a gun should in most cases be sent to its maker for repairs or adjustments—of which few will be needed, if the owner properly appreciates it, and gives it the care it should have.

There are men, however, who never learn that a gun was not intended to hold down barbed wire fences, nor to be stood up in a leaky woodshed uncleaned during a rainy night. I have in mind a man whose financial statement is such that he need never consider the cost of a gun; and the total value of his firearms runs well up into thousands. Yet, apparently, he has no more appreciation of their beauty or quality than he has of a six dollar rabbit gun—he treats them just the same. I recall that this man once borrowed a $600.00 shotgun from a gun manufacturer, and took it out duck hunting. A day or so later he walked casually into the office and set the gun in a corner. After he had left, the manufacturer took one look at it and began to swear; then he looked closer, and swore harder and louder; then he stripped off the lock plates and dismounted the gun, and at sight of the water, sand, and whatnot contained therein, he cussed for twenty-seven minutes without once repeating himself—I held the watch on him, so I know. Besides water and filth in the action, the checking on forend was all ground off, the stock was marred and battered, the barrels were worn along the sides and covered with streaks of green point. Investigation ultimately disclosed that his friend had lost the oars and had used the gun to scull the boat! And when confronted with evidence of his guilt, the culprit merely grinned and said "Hell, I thought you made good guns that would stand a little service!"

But getting back to gunsmiths, there are but a few in this country who have developed the skill, and who appreciate the necessity for such skill, to enable them to work on the better grade shotguns. The average American gunsmith is educated to the fact that the average American gun owner wants a gun to shoot, and that's about all; and further that he will not pay for any unnecessary work.

467

All this is written by way of warning to the owner of fine guns, not to entrust them to the tender mercies of old Bill, the town locksmith, no matter how good Bill may be at wiring up a busted stock or raking out the rust from the barrels at the end of the duck season. Bill's a good man in his line, but his scope of usefulness ends with the crude, practical job on the inexpensive gun.

This is no slam at the average gunsmith. He does the work there's money in—the work the public wants—and he does it the very best he knows how. Moreover, he seldom charges even as much as the job is worth, and in a pinch his ingenuity will assert itself to the point of making by hand a missing part for some obsolete model, and will have the gun working top-hole fashion while the factory tool-maker would be figuring the cost of jigs and fixtures for the job. This kind of gunsmith is an asset to the community—just don't ask him to get out of his class.

Exacting as shotgun work of the better sort is, there are a lot of jobs that the aspiring amateur will want to do for himself—jobs which, if thoroughly understood, he will do better than most gunsmiths would do them, because time will be no object; he doesn't have to stop the work when he thinks he's done as much as he can get paid for. For be it known that the amateur gunsmith who counts his time, is going to be alarmed at the "cost" of the jobs he does for himself. The quality of the finished job, the pleasure derived from the work, and the satisfying knowledge that it is done *right*—these are the real reasons for home gunsmithing.

The gun owner can afford to completely refinish his stock after fitting a recoil pad—the gunsmith, knowing he can get only a couple of dollars for the same job, must merely patch up the finish near the butt. The owner will not object to spending his evening hours for a week smoothing up the action parts, getting the triggerpulls exactly right, etc.,—but if watching the clock as the gunsmith worked, he would most likely say "That's all right—let 'er go at that—no use putting a lot of time on that old pot-iron!" And so it goes.

The jobs which the shotgun owner of fair amateur mechanical ability can hope to accomplish satisfactorily will include: Restocking, altering the stock, or refinishing it; checking or otherwise decorating the stock; rebluing barrel and action, and hardening and hard fitting parts subject to wear. All these have been covered elsewhere in the book. But he can also, by the exercise of care and patience and a study of the needs of the job, remove dents from his barrels, make minor alterations in chamber and bore, open up a choke, cut off damaged muzzles and re-choke the barrels to a degree, solder back a loosened rib, fit sights as desired, and make and fit essential action parts in old models for which parts are no longer available.

The first—*the very first*—essential to satisfactory shotgun work

468

is plenty of good screwdrivers in sizes to fit all the frame screws. Nothing so quickly spoils the appearance of any gun as gouged and battered screw heads. Screwdrivers cost little to buy, and are easy to make; and one should not hesitate to grind the point of a driver to the exact size of a particular screw slot. The tool will not be injured, but may be re-ground a number of times; and it's quite possible a new screw might cost you more than several screwdrivers.

DISMOUNTING LOCKS: To the man who has never had occasion to dismount his shotgun, the process is somewhat vague, so a bit of instruction on that point may not come amiss. First of all open the gun to cock it; then remove barrel and forend. Remove wood screws from rear end of guard and unscrew the whole guard from the frame, turning it counter-clockwise. In some guns, the guard instead of being threaded into frame, has its end shaped like a bayonet lock, to be removed by a quarter-turn; in others, the guard pushes forward or back, and unhooks. Never force anything on a shotgun—try it gently until you are sure how it works.

If the gun has side locks they may now be removed. Usually they are held by a single screw set in near the rear end and extending through both plates. Remember that nearly all the wood is cut away in a side-lock gun, so be careful not to chip off the edges of stock around the locks. Insert a small brass rod having its tip end bent into a short hook through the screw hole, and lift up on this while tapping the stock very lightly around the plate. The plates will now move backward a trifle, releasing their front ends from the action body. Next remove the trigger bar, by taking out the wood screws at its rear, and the large screw which goes in from the top under the top lever. Hold the lever to one side while removing this screw, which usually is set in very tight. It is best to have the stock clamped firmly in the vise while dismounting the action. Also remove the tang screw, and the screw holding the plate on bottom of action body. Lift out trigger plate with triggers attached, and stock can be removed from action.

If dismounting a box-lock gun, after the trigger plate is removed it is necessary to remove the sears before the action will come free from the stock. Usually the sear pin can be pushed out with a drift punch; sometimes a light tap is necessary. Keep the thumb over the sears to prevent the springs from jumping out. Lift out sears and springs, and action will come off stock.

When the bottom plate of action is removed, look for screws and other loose parts, such as the lever-lock and its spring. Lift these out before you thoughtlessly turn the action over and lose them.

Side locks should always be removed and replaced with tumblers or hammers cocked. With box-locks the hammers must be down, i. e., not cocked.

Inspect all working parts carefully for breaks, rust, etc. If the

469

action is gummy or rusty, place the parts to soak in a pan of gasoline with a little thin cylinder oil added. If necessary scrub them with a stiff brush, and dry carefully. Scour off any rust on a sheet of fine emery cloth, using care not to reduce the size of any bearing surfaces, and polish with crocus cloth. Take triggers and spring from trigger plate and clean them up also. Now check all parts for damage. Note the sear points. Sometimes they become nicked or broken off at the corner, giving a mean, draggy pull. If the damage is slight it may be carefully ground out on an oil stone, but if great it is best to secure a new sear, as shortening it very much will also shorten the fall of tumbler or hammer, possibly causing misfires. To fit a new sear, set it beside the old one, and push the sear-pin through the hole in both sears, then set them together in vise with edges together all round. File and stone the new one to the exact outline of the old one, leaving the point which engages hammer or tumbler notch just a trifle longer on the new one. Then assemble the new sear in action and try it, working down the point as required on an oilstone. (See Chapter 28 for adjusting trigger pulls.)

Weak MAINSPRINGS are sometimes found which give very slow lock time and occasional misfires. As a rule the remedy is a thicker mainspring; sometimes, however, old springs may be improved by re-forming and tempering. Never try to change the shape of a spring while cold. Cut a piece of thin steel a shade thicker than the crotch of the spring; heat spring to dull cherry red and drive this between the ends, forcing them further apart. The curve in the longer limb of spring may also be straightened a trifle. Then the spring must be rehardened and tempered. See Chapter 21.

Possibly the only fault in the spring lay in the temper—and this treatment may make it quick and snappy. On the other hand, the steel may be of poor quality, or your tempering may not turn out well, in which case get a new spring. Buy the spring from the factory where the gun was made if possible. If obsolete, a spring may be obtained from Schoverling, Daly and Gales, New York City, or from Gus Habich, Indianapolis, Indiana, or elsewhere. Firms handling miscellaneous parts for old guns usually catalog them with full size illustrations which make selection easy. If you can't find exactly the right size, buy one a little larger, and dress it down by filing. Leave both limbs a trifle thick after fitting ends of spring so it will go into the action, then try it and dress it down slowly until the action suits you. The middle portion of spring where it is bent should be the thickest point, with a gradual taper toward the ends. Filing a thin place in the middle of one limb will weaken and ruin any spring. After fitting a new spring, assume that the maker tempered it properly until you have proved otherwise. Usually springs bought from a reliable firm are properly tempered and not to be improved by efforts at retempering.

470

Weakened or broken coil springs should be replaced with factory springs if possible, or new springs made in the lathe, from piano wire. If a lathe is not available, very satisfactory coil springs may be made by winding by hand around a steel rod. Flatten the rod slightly at one end, and clamp this end, with end of piano wire, in the vise. Draw the wire tightly in both hands and wind the coils with as even spacing as possible. Due to expansion of the spring after winding, the rod used must be considerably smaller than the spring desired, and the exact size for the winding rod can be determined only by experiment. Wind on a coil or two, note the expansion, and if too much, start again with a smaller rod.

Piano wire springs wound in this manner need no tempering, particularly if of small size. For larger springs that must be wound by hand, it is often better to anneal the wire carefully in a gas flame, when it will wind readily with minimum expansion. Then harden and temper in oil.

PINS: Sometimes a pin used to hold parts in action body will be damaged in removal; or it may be too loose in its hole, making a new and tighter pin desirable. Pins should be made of drill rod. To ascertain the size stock required, try the old pin in a drill and wire gauge, just as you would try a drill for size. The gauge shows the number of drill rod needed, also its diameter in thousandths of an inch. If the old pin is too loose, order a piece of rod three to six thousandths, or say, one size larger on the gauge. Cut a piece of rod to length needed for pin, round the ends with a fine file, and polish them smooth. Harden at cherry red in oil, then draw to straw color in water. Then if too large for the hole, polish to size with fine emery and crocus cloth. If a pin is lost and it is desired to get the size for making a new one, select a drill the shank of which just enters the hole. The number of drill is usually marked, or its size can be ascertained with the drill gauge. In a pinch, you can cut off the shank of the drill and make pin from it—may be better than waiting for a new pin or piece of stock if the ducks are flying.

DAMAGED SCREWS usually mean damaged screw holes also—but not always. If a screw like the old one cannot be found, ream the hole slightly and tap for a size larger screw—and use a standard machine screw size, so it can be replaced if lost or broken again. Always case-harden the screw in cyanide when it is all fitted and head dressed down to shape,—about one or two dips being sufficient. Surface hardness only is required in screws—too deep hardening, especially in small screws, will make them break easily.

Often the wood screws used in tang, etc., will have their heads badly marred. And as the heads of such screws are often "engraved" the owner may despair of obtaining others to match. But inspection will show that the "engraving" usually is nothing but a few short file cuts made at different angles radiating from the center. Take

471

an ordinary wood screw of the proper diameter. Cut the point off blunt like the old screw. Turn it in snug, and dress the head down flush, then decorate as desired. Case-harden slightly, and quench in linseed oil, which will darken the color to match the tang.

If screws turn into the holes too easily, and will not tighten, showing that the threads in the wood are damaged, ream out the hole lightly with a taper pin reamer; whittle walnut plug to fit snugly in the hole. Put a few drops of du Pont Cement in the hole, also coat the plug, and drive in. *Take care not to make the plug with too sudden a taper, so that driving it in splits the stock.* Cut off projecting end of plug with a sharp chisel, center and drill new screw hole in plug, and turn in screw. Do this immediately before cement dries, as the screw will then force the plug tightly against sides of old hole, reducing danger of splitting.

Occasionally BROKEN PARTS in old guns can be repaired by welding. Some smiths will braze them,—a practice which should never be followed. Brazed parts are almost certain to spring out of shape slightly in use, and the soft metal in the joint promotes excessive friction with other parts. When parts are properly welded by an acetylene welder who knows his business, they may be almost as good as new parts. The break should have its edges scarfed open by filing leaving a gap at least 1/8 inch wide on both sides, the broken edges touching only in the center. (See Chapter 23.) If necessary to send them away for welding, get a lump of fireclay, and holding the broken parts carefully in position, press them into the clay to give a full impression. Turn them over, and take a similar impression of the other side. Dry the clay slowly in the shade, and send this mold along with the broken parts to the welder, who can lay the parts in exact position in this mold, so that after welding, you can shape them up with a minimum of work.

Always specify acetylene welding for the repair of broken parts. Electric welding is excellent for some things, but not for this kind of work. The acetylene torch heats the broken parts themselves to welding heat, and the welding metal mixes with it to form one homogeneous mass. In electric welding the work itself is not fully melted, hence the joint is not so strong. Moreover, it is necessary to leave on some of the excess metal after an electric weld, while with a torch weld it can be dressed off flush and smooth, and the entire part case-hardened if necessary.

Broken hammers should be replaced by new ones, although in some cases they may be successfully welded. Various size hammers in the rough may be had from either of the firms already mentioned, and they can be fitted with a minimum of filing, after which they should be polished, hardened, and very carefully tempered. Draw the temper from the lower end toward the hammer nose, which should be blue, shading off into dark blue toward bottom end. Better to have the hammer a trifle soft than too brittle. If a hammer can-

472

not be obtained, the ingenious workman will file one out of a piece of good tool steel, fitting, hardening and tempering it to suit. Both the hardening and tempering should be done in oil, to give added toughness. The inside hammers, or "tumblers" of hammerless guns may usually be secured from the factory where the gun was made, or they too may be filed out by the careful workman far from a base of supply. They too must be carefully hardened and tempered, and if able to control the colors, temper the percussion end, or nose, at blue, and the sear notch at straw yellow. This assures sufficient hardness to prevent wear changing the pull, with the nose soft enough to prevent breaking.

Some guns have the FIRING PINS made in one piece with the hammers—and sometimes they break off. The better plan of course is to secure or make a complete new part. Sometimes, however, it is practicable to dress off the face of the hammer where the point of firing pin broke off, and attach a new pin. A standard taper pin reamer should be used to ream out the hole drilled in the hammer nose, and the shank of new firing pin turned to a tight drive fit in this hole. It should have a shoulder which bears on the surface of hammer nose, to take up the force of the blow. After the pin is driven in tightly, with full bearing against this shoulder, drill a small hole through hammer from side to side, biting half its diameter into the side of the firing pin shank; drive a pin tightly into this hole.

It would seem logical to first turn the point of the new firing pin to shape and size in the lathe—but due to the difficulty—almost an impossibility,—of locating it exactly in the hammer nose, it is best to leave the firing pin point full and thick, then after it is attached to hammer, it may be shaped up by careful filing to match its mate—the other hammer. Finish fitting by coating pin lightly with Prussian blue, and trying it in the gun, noting where the blue is rubbed off by friction against the side of firing pin hole in action body.

Separate firing pins on both hammer and hammerless guns are often broken by snapping the gun on empty chambers. New firing pins can easily be turned up to size and shape from drill rod, or even filed out, if you have no lathe. Choose a piece of rod the same size as the largest diameter of the old pin, using the drill gauge to get the size. After the pin is shaped up and fitted it should be hardened in oil at cherry red (use care not to heat the point hotter than body of pin) then draw the temper to blue.

The proper shaping and tempering of firing pins is very important and the instructions given in Chapter 24, pages 372 and 373, should be read over and carefully followed.

A LOOSE FOREND is a constant source of trouble, particularly in the cheaper guns. These may often be tightened permanently by careful work, or a new forend iron may be secured and fitted.

473

Schoverling, Daly and Gales carry forend irons of various types fitted into walnut blanks. The old forend complete should be sent as a sample when ordering the new one.

Cheaper guns usually have the "snap-on" type of forend, in which a curved spring steel lever about an inch long is pivoted into the forend iron at one end, the other end bearing against the end of lug on barrel. Such forends can often be tightened as follows:

Remove the spring lever, and with a sharp pencil carefully outline its shape on a piece of paper. Heat to a low red and straighten it out. Then "cold forge" it by hammering until it is stretched out about 1/16 inch. Heat and bring it back to its original curve—it must be exactly the same shape as before, only longer. Now carefully harden it in oil at cherry red, and flash off the oil twice to draw the temper. Replace it in forend and try it for fit. Carefully and slowly file down the point until forend will just snap back into place with stiff pressure. Examine the spring to be sure the pressure has not beat it—if so, the metal is defective, or the temper is drawn too much. Rehardening and tempering will correct the fault in the latter instance, or a new piece may be filed out of good steel and properly tempered.

Sometimes the inside sliding catch in the forend will be worn, causing the looseness. Remove the catch, heat and forge it to draw it out, re-shape by careful filing, harden, and draw temper to straw yellow. If this does not cure the looseness make a new catch of tool steel.

Forend looseness may be caused in some instances by wear on the barrel lug. Try laying this lug on a block of steel and hammering lightly on both sides—often this will stretch it sufficiently to give a tight fit. It should then be smoothed and shaped up with a fine file.

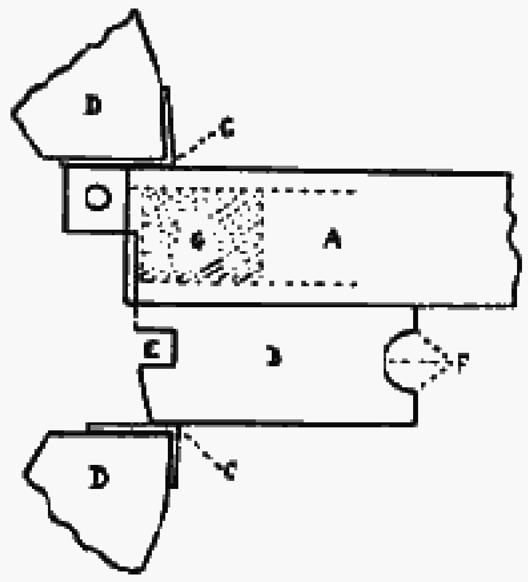
If necessary to fit a new forend iron, you have a job on hand—not an impossible one by any means, but one requiring the most careful filing and fitting. The circular hinge at rear of forend iron must first be fitted to conform with the shape of hinge joint at front of action body. Coat the hinge joint with Prussian blue and spot the parts into perfect contact. For this purpose the best files are known as "warding files." One side has a rather full curve, the other being more nearly flat, but slightly curved also. An American Swiss warding file No. 1 cut, 8 inch length to start with, and a similar file with No. 4 cut for finishing, will do the job nicely. Be careful to avoid rounding off the corners on inside of this curve. Bring them up sharp and true, maintaining contact at all points.

Now coat the center strap of forend iron near the lug slot with blue, and carefully fit it to the lug. The blue will show where the lug refuses to enter. This fit must be very tight and close. Use small, very fine cut pillar files for this fitting, also to smooth up the lug.

474

LOOSE ACTIONS: The hinge joint of a good shotgun seldom comes loose, despite the fact that the barrel lump is not hardened. This does happen on cheaper guns, however, and can be remedied by taking a hammer and peening lightly the lug or lump near the semi-circular cut in its forward end—the cut which fits against the hinge pin in action body. Do not hammer too close to the edge of this cut—the idea is to draw out the lug slightly rather than battering edges of cut. The lug should rest firmly on a block of steel while peening. When you have a good tight fit, smooth off the sides with a fine cut pillar file.

When barrels do not fit the action body tightly at bottom, first try dressing off, *very slightly*, the underside of barrel lug at rear. Coat bottom of lug and also its rear end with Prussian blue, and try it for fit—sometimes a slight unevenness in the cut in action body will prevent it closing tightly. If this frees up the fit so the barrels can be pushed down, but will rise slightly when released, the fault is with the lower locking lug. Try peening around the notch in rear



A. Barrels C.C. Brass Plates.
B. Barrel Lug D.D. Jaws of Vise
E. Cut to be slightly closed by vise.
F. Pene to bring barrels against standing breech.
G. Steel plugs in chambers.

of barrel lug, and if this fails to get results, use the method illustrated in sketch above. First turn up a couple of steel plugs to a tight push fit (but not a driving fit) in the chambers. These are to prevent mashing the barrels out of round. Now set the barrels in vise as shown, with jaws protected by sheet brass, and set the vise up carefully, a little at a time, until the notch in lug is sprung upward sufficiently to give a tight fit.

The danger of this method lies in the possibility of springing the extension rib where it is let back into the standing breech. If this occurs on a gun having a cross bolt, the bolt will not fit through the rib. To prevent this happening, an extra piece of brass may be inserted over breech, just forward of rib extension, to remove pressure at this point.

Another method followed by many gunsmiths is to remove the hinge pin in the front of the frame, and fit a larger pin, then file out the semi-circular notch in the barrel lug to fit it closely. I can see

475

nothing in favor of this method except in the hands of an expert, due particularly to the danger of the new pin being made of material lacking in strength. A good deal of the strength of the entire breech action depends on this pin, and if it should by any chance break or shear off, the bloomin' gun would shed its barrels, and things would likely happen to the shooter. Nevertheless a lot of gunsmiths go blithely ahead with the job, making the new pin of drill rod or what have you, and apparently get away with it.

The removal of the old pin is sometimes a tough job. Usually it has been driven and shrunk into the frame and must be drilled out. Likely it is very hard.

Locate and accurately punch center on both ends of old pin. Set a high speed drill in the lathe chuck. Set the tailstock of lathe up close to chuck, with the dead center in tailstock set in punch-mark on one end of the hinge pin. Set the drill point in the punch mark on other end, and drill through the pin, pressure being provided by means of the hand feed on tailstock. The drill should be about 1/16 inch smaller than the old pin. Then ream out the balance of pin very carefully, so as to enlarge the original hole as little as possible.

Chrome-vanadium steel should be used for the new pin, although some gunsmiths use ordinary carbon steel, which really lacks the strength needed. Turn the pin to about .001 larger than the hole after it has been smoothly reamed, which reaming should have made it from .005 to .010 larger than it was originally. Taper the pin slightly so that it will start in the hole.

File a block of steel so that it will just slide tightly into the slot in front of frame, and drill through it a hole somewhat larger than the pin, cutting out the metal so as to form a U notch. Put the new pin into ice cold water, and heat up the frame until it is almost beginning to change color—this to expand the holes as much as possible. Be sure the piece of steel is in place in the slot to prevent the edges from springing together. Quickly wipe the pin dry and drive it clear through the frame so that it projects on each side. When cool grind off the projecting ends and file smooth, then polish entire frame, and re-finish if desired.

Now fit in the hinge lug on barrel by carefully dressing out the notch as required with a straight round file, using Prussian blue or copper sulphate to "spot" it in as described elsewhere.

When the barrels lock down tightly against action body—perhaps a bit too tightly—their under surfaces and the upper side of action body should be polished to a perfect fit (See hard fitting instructions, Chapter 25).

Broken or DAMAGED EJECTORS should always be replaced by new factory parts, as elaborate machine shop equipment would be required to make them. The repair and adjustment, timing, etc., of automatic ejectors is a job for the expert, and should never be

476

attempted by the amateur, nor by many of the average run of gunsmiths. A gun with ejectors is worth sending to the factory in case of ejector trouble—and the same applies to single triggers. Parts such as these are very delicately constructed and adjusted, and only those who make a business of this class of work are competent to handle it. The same goes for such gadgets and rinctums as firing pin indicators, etc.,—let the fellow who started the trouble in the first place figure out the answer.

SHOTGUN BARREL ALTERATIONS: The commonest, and also the simplest barrel alteration is the cutting off of the muzzle—sometimes necessitated by splitting, bulging, or ringing the barrels at muzzle by firing with some obstruction in bore. When the gun owner contemplates cutting off the muzzle he must remember that this is sure to remove most, if not all of the choke. Nevertheless, barrels without choke are better than no barrels at all, and if a muzzle becomes damaged the barrel is worthless until cut off.

Measure the required distance from the muzzle and mark the barrels at several points. Then bend a thin strip of sheet brass or spring steel around, so that the edge touches all the marks, and scribe a line clear round. Hold the barrels in a vise with padded jaws, and saw barrels just outside the mark with a very fine toothed hacksaw blade. Use a small adjustable head square and file off barrels with a wide, fine-toothed pillar file until square all around. (The adjustable head square being set to allow for the slight taper of barrels.) After filing polish off muzzle with an oilstone, then with crocus cloth wrapped round the stone. Round off outer edges very slightly with file and stone, and remove burr from inside with a countersink reamer twirled in the fingers, taking the lightest possible cut.

This leaves the space between the upper and lower ribs open, and this is to be filled with solder. It is better to fit the front sight before doing this, as it is much easier to tap the hole in rib if the space below it is open. Use the old sight from the cut-off muzzle, or use the Marble or Lyman shotgun sight, or make a special sight if preferred. Measure the exact center of rib with dividers, and take care to drill the hole vertically. Tap, and turn in the sight. Then take a small wad of cotton waste and pack it tightly into the space between the ribs, about one inch from muzzle. Apply chloride of zinc into the hole, and pour out the excess liquid. Then holding barrels muzzle up in vise, pour in melted solder until full, then dress off smooth and even.

Fitting shotgun sights is usually a simple matter, full instructions accompanying the sights. The thing to watch is getting the hole drilled exactly in center of rib. Some sights screw in, while others are tapered, to be driven in friction tight. Use only the reamer supplied by the sight maker, which will be exactly the right size.

RE-CHOKING: Having shortened the barrels, thereby re-

477

moving the choke, our next wish is to re-choke the gun. This is sometimes possible, particularly in guns originally bored rather close, and really amounts to enlarging or over-boring the barrel back of muzzle. There are several methods of doing this, but the following is, I believe, as good as any, and within reach of the amateur or small shop.

Secure a Tomlinson shotgun cleaner of the proper gauge for the barrels. Thread a steel rod to fit the screw end of cleaner. Remove the brass wire gauze from wood strips of cleaner, and cover their round sides with rubber cement. Cut pieces of No. 1/2 Carborundum cloth to fit, and coat back of cloth with rubber cement. When cement is nearly dry, press the cloth onto the wood strips, when it will stick firmly, then fit sticks back into cleaner. On the steel shank, about two inches from the Tomlinson cleaner, paint a bright colored ring or stripe. Now chuck the other end of this rod in a high speed breast drill, insert the cleaner into the muzzle until the painted ring on shank is even with muzzle. Now turn the drill rapidly, thus polishing out and enlarging the bore at a point from the muzzle the distance the painted ring is from the cleaner. When the carborundum cloth is worn out, peel it off the wood strips and replace with new cloth. Measure the bore frequently with inside calipers, carefully transferring the diameter to the micrometer, and comparing the reading with the measurement before you started polishing.

The rounded ends of the wood strips on cleaner will taper off the choke thus formed, preventing a sharp shoulder. When the measure is two or three thousandths larger back where you are polishing than at the muzzle, stop the work, and substitute a long shank with which you can reach through the barrels from the breech. Fit the cleaner with new abrasive cloth to this shank, insert it from the breech until it is in the same spot where the first polishing was done (not reaching clear to muzzle). Fasten a small clamp or stop collar of some kind on rod to prevent it going in further. Now fasten rear end in drill chuck and polish out the entire length of bore, from front of cone to choke. The idea is to gradually enlarge the rest of bore back of the choke, bringing the sides to straight lines. You can tell when they are straight, and without humps, by holding barrel to the light with a straightedge set vertically in front of them, and noticing the line of shadow in bore—the same as when checking the straightness of a rifle barrel. When the enlarging is as straight as you can get it by drawing the revolving polisher back and forth, stop the work and you are ready for the draw polishing.

Take a long steel rod with a comfortable handle (a cleaning rod will do), and turn up a hardwood head to fit it. This head should be about three inches long, slightly tapered at both ends, and about 1/32 inch smaller in diameter than the inside of barrel

478

back of the newly formed choke. Cement a piece of No. 1/2 carborundum cloth to its surface, letting the edges meet without lapping. Use this like a cleaning rod, drawing it back and forth the length of the barrel, but not touching the cone or forward end of chamber. Push it forward until stopped by the "shoulder" of the choke, so as to taper it off gradually toward muzzle. This draw polishing should be continued until all humps and uneven places are worked out of the barrels to the point where the choke begins. If you fear you are enlarging the bore too much, it will pay to stop at intervals and make a sulphur cast and measure it. When you think you have it right, make a cast of the new choke and measure it carefully. The taper should be at least 1 inch long, and the largest part of choke should not be more than two to five thousandths larger than muzzle—but hold it a little smaller for the present, to allow for next polishing.

This is done with the wood cylinder in the same manner as before, only use No. 0 carborundum cloth. Follow this with No. 00, and when it is well worn, oil it and keep on using it. When the bore is as smooth as you can get it with this, use 000 emery cloth, well oiled, then follow with crocus cloth used dry. Before cementing the crocus cloth to the polishing cylinder the latter should be padded with a layer of soft thin paper to assure good springy contact. Carry the polishing well up into the choke. Finally polish out the muzzle in the same manner with a slightly smaller plug used on a short handle.

There is but one test for correct choke in a shotgun—and that is the pattern. And it is impossible to give instructions for further polishing to improve pattern. I have always maintained that a good shotgun barrel man had a sort of sixth sense that told him what to do to improve patterns. If the pattern is ragged and patchy, it may be that the choke tapers too suddenly. Carrying it forward a bit may help, and it may not. Any changes made from this point on must be done with very fine abrasive, and the gun patterned frequently as a check on the work. Use the load you expect to do most of your shooting with—and remember that a different load may give a greatly improved pattern in the same barrel. If the bore is enlarged too much back of choke, this may cause crowding of the shot charge, and deformation of the pellets—in which case polishing out the muzzle ahead of choke should help.

The method of polishing out and enlarging barrels by using a breast or hand drill is not easy. The work is hard and takes time. I give this method first because I am writing primarily for the chap with limited tool equipment. The man with a machine shop to fall back on will set his barrel up in an improvised rest in a lathe, mounting the polishing rod in the headstock, and do the work easier and quicker, but not necessarily any better. Or, another may attach the polishing rod to the end of an emery grinder shaft, using a piece

of heavy rubber tubing to make a universal joint, and hold the barrel in his hands, greatly reducing the time and work of polishing.

BORE POLISHING: When satisfied with the pattern, or when satisfied that it cannot be improved by further labor, the inside of barrels should be very highly polished. Take the Tomlinson cleaner and cover the wood strips with thin sheet lead. Coat this with B.S.A. Cunirid, and swab vigorously back and forth. A half hour or so of this treatment will do no harm. Now remove the sheet lead, and cover the strips with thick cloth or felt which is first oiled, then coated with rouge or Tripoli, and the bore again swabbed full length. You can't do too much of this polishing—two or three hours of it won't hurt anything but your back!

This bore-polishing with abrasive cloth may be used for other things than enlarging the bore. Sometimes one will pick up an old gun on which the barrels seem hopelessly rusted and pitted—often the pits are not as deep as they look, and an hour or so of polishing will do wonders. In this instance the Tomlinson cleaner may be run clear through the barrels from breech to the muzzle, slightly enlarging the entire bore without changing shape of choke materially. Some alteration is bound to occur, of course, and the gun should be patterned several times before the final polishing.

After using the rouge, a final rubbing out for as long as you care to, with rotten stone and oil on the felt, will further improve the polish. Be especially careful to leave no cross scratches from the first cutting around the taper of the choke, or the gun is sure to lead badly. The brightly polished bore will not lead.

ENLARGING THE CHOKE: When a barrel throws too close a pattern, the thing to do is take out part of the choke. This is best done by reaming, and while a fine toothed spiral fluted reamer is best, I have had very good results with a six-bladed expansion reamer. Carefully used, I believe it is as good as any. The reamer should be straight, without any taper except that it should be relieved for about half an inch at end of blades. About six inches from muzzle, plug the barrel with waste. Set the reamer so it will just slip into muzzle past the taper of blades, then move the adjusting nuts about 1/8 of a turn. Measure bore at muzzle with calipers, and transfer the reading to the micrometer, and note it on paper. Hold the reamer in a large tap wrench or other suitable handle so it can be turned with both hands. Lubricate it freely, and turn slowly and carefully to avoid its twisting or chattering. It is important that the reamer be very accurately ground, and it is best to keep special reamers for barrel work only.

The following is a very good LUBRICATING MIXTURE FOR BARREL REAMING: Dissolve one pound hard white soap in a little water over a slow fire. Let come to a boil and add slowly 1/2 pint lard oil; add, while boiling enough strong soda water to make it the consistency of cream. Keep this in a bottle

and shake before using. Use the mixture freely for all barrel reaming operations.

After the first reaming cut in muzzle, again measure the bore. From one to three thousandths will usually make a big difference. Now polish off the taper of choke as before described, so that there will be no sharp angle between the straight section and beginning of choke. Test the gun by patterning. A second or even a third reamer cut may be necessary, but usually one cut, with subsequent polishing, is sufficient.

Chamber reaming should never be attempted by the amateur, nor by most gunsmiths unless they are experienced barrel makers. If not satisfied that your gun is chambered correctly, take a sulphur cast of chamber and cone, and measure it up. In bore polishing it is important that the cone is not altered, and the polishing should end at or very near the front end of cone.

The following are average diameters of standard shotgun bores, although makers will vary slightly from these. This average measurement should not be enlarged at the point just ahead of cone even though balance of bore may be enlarged somewhat in polishing:

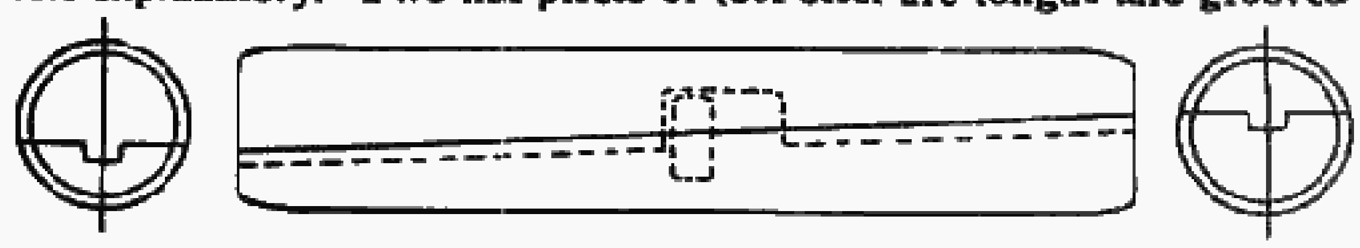
4 gauge	.935 inch	16 gauge	.662 inch
8 gauge	.835 inch	20 gauge	.615 inch
10 gauge	.775 inch	28 gauge	.550 inch
12 gauge	.729 inch	410 gauge	.410 inch

REMOVING DENTS FROM BARRELS: The man who persistently drops his gun, slams it around in an automobile, bangs it against fences, and uses it to beat his dogs is going to have dents in his barrels. There's no excuse for barrel dents, but sometimes they happen just the same. Most gunsmiths carry on hand a number of steel plugs for removing dents. Usually they do not fit very well in the particular barrel he is working on, and some makeshift method is resorted to. In most cases a plug should be turned up to the

exact size of the bore, which size is ascertained with a sulphur cast taken just back of the dent. The plug should be tapered slightly at both ends as shown in above sketch and should be polished smooth and hardened. This plug may be made of steel drill rod, or it may be of machinery steel, and case-hardened in cyanide. Measure on outside of barrel the distance of dent from the end, deduct half the length of plug from this measurement, and mark the distance

on a heavy steel rod nearly as large as the bore. Insert plug from breech and drive it into the barrel up to the mark on the rod, partially removing the dent and wedging the plug tightly in bore. Now hammer the barrel over the dent with a lead hammer until dent is entirely smooth and plug may be pushed out. It may be necessary to use a copper or brass hammer—if so be careful so as not to mar the barrel.

The best dent removers I ever saw were in the hands of an old gunsmith who must have designed them himself, as I have never seen any others. About three of these, graduated in size by .005 inch for each gauge, would set a man right up in business when it came to removing dents. The drawing that is shown below is almost self explanatory. Two flat pieces of tool steel are tongue-and-grooved



on planer or shaper, and the tongue-and-groove surfaces sweat-soldered together. They are then placed in the lathe with ends 3/32 inch off center above and below the surface, and turned into a plug to fit the barrel, with ends relieved as shown. They are then heated until they come apart, and the solder cleaned off, and surfaces well polished. To use, they are placed in the barrel as shown in the isometric drawing, so as to just clear the dent. A heavy rod is held against one end, and another driven against the other end, wedging the two together like a printer's quoins, and pushing out the dent; then a little light hammering over outside of dent will loosen them and let them drop out of barrel. A hardened steel stop pin should be fitted as shown by dotted lines to prevent excessive wedging which might bulge or crack the barrel.

Two or three of these "barrel quoins" for 12, 16, and 20 gauge barrels, hardened, ground and lapped to size, and well polished, would be worth their cost to any gunsmith doing very much shotgun work, because removing dents in barrels is one of the commonest of the small jobs—and these gadgets would do it at a profit.

SOLDERING SHOTGUN BARRELS AND RIBS. The method of joining shotgun barrels together and of attaching the ribs, which is followed by leading manufacturers of double guns, and by

experienced gunsmiths also, may prove of interest even though the average amateur gunsmith may never be called upon to re-solder a loose rib. Here's the way they do it up at "Ithicky," most other factories employing substantially the same method:

The barrels, or "tubes" are first cleaned, then dipped into melted tin so as to completely coat each barrel all over, barrels being closed at both ends with wooden plugs. Next, both upper and lower ribs are dipped in tin and completely coated also. The two barrels and ribs are then placed in a form which holds them temporarily in their correct position with respect to each other, and wrappings of soft iron wire—about eight or ten strands to each wrapping,—are put on at intervals of four or five inches, the entire length of barrels. The wire is laid on evenly, with no strands crossing, and ends twisted tightly together on top. Long, narrow iron wedges, which are made from 16d wrought iron nails, are then driven under the wire bindings, forcing the ribs into contact with the barrels their entire length. The barrels are then set on a rack over a long gas burner which heats them all over until the solder is melted. Powdered rosin is sifted along the line where the ribs join the barrels, and a thin ribbon of solder is drawn along the joint, the heat from the barrels melting it instantly, so that it flows in completely sealing the joint. When cool, the solder is struck or draw-filed from the outside, and the barrels are ready to polish and blue.

TO RE-SOLDER A LOOSE RIB on a barrel that has been in use, the wire windings are laid on and wedges driven under them at the place where rib is loose, in the same manner as new barrels are prepared for soldering. A steel or iron rod large enough to almost fill the bore (two rods are used in the case of a double gun) are heated to dull red on the ends and inserted into the barrels, so that the heated ends come even with the loose place in the rib. Small pieces of solder, mixed with powdered rosin, are placed along the edge of the rib, and the heated rods moved back and forth until the solder melts and flows in—and the job is done. The rods are kept moving so that the barrels may not become hot enough in any one spot to mar the finish. In many cases it is impossible to re-solder a partly loosened rib without mussing up the outside finish so that rebluing or rebrowning is necessary; but if the rib is separated for only a few inches, it is possible to do a good job and leave no trace.

In another plant this wiring and soldering of barrels is done when the barrels are "first bored" with about a 1/2 inch hole. The tubes are placed together on rods which are pointed and accurately set on centers, to properly align them. Then, after they are soldered, any differences in alignment which develop are compensated in the final boring, reaming, and polishing operations.

RAISING AND LOWERING SHOTGUN PATTERNS. We hear a lot said now and then on this subject, which to most shooters is a deep, dark mystery—gunsmiths having done what they

could to keep it that way. Every time a trapshooter misses a bluerock he thinks he should have his pattern raised or lowered—at any rate, some of them do. The method employed at the Ithaca factory to raise a pattern is the very common-sense one of lowering the rib at muzzle and incidentally the front sight—the same principle as lowering the front sight of a rifle. This is done by loosening the rib and cutting it slightly narrower, so that it will set lower between the barrels, then re-soldering it. The height, of course, is not changed at the breech.

Many gunsmiths who lack the equipment found in large factories, have two other methods; one is to scrape out a little metal from the top of bore, really making it slightly oval. If this doesn't really raise the entire pattern it at least permits part of the charge to fly higher, though not improving the density of the pattern one bit. A reamer fitting the muzzle closely and having the cutting edges rounded and polished on one side so they will not take hold is needed here. If carefully done by one who knows, it is very satisfactory.

The other way is to bend the barrels up a trifle some six or eight inches back of the muzzle. Great care is necessary, of course, to prevent denting or "kinking" the barrels. One way is to plug them tightly after filling them with very fine sand; another is to cast a long lead slug in the barrel at the point where it is to be bent. The bending is usually done by the time-honored method used for straightening barrels—by laying the barrel across two blocks of lead and striking it with a lead hammer. The real trick lies in knowing just how hard a blow to strike to produce the desired result—and that is knowledge which comes only with long experience. To lower a pattern, a reversal of either of the above methods is indicated.

There is still another method which I have seen practiced, and I believe this is the first time it has ever been published. I strongly recommend it as being easy on the gun, and easy on the gunsmith.

The gunsmith receives the gun from its owner with a knowing air; squints through the barrels; pricks up his ears as if suddenly discovering something of a startling nature, and holds it to the light for closer inspection, the while murmuring "Um-m-mm—yeah," or something equally enlightening. Then he disappears with it into the holy of holies, where he stands the gun in the rack, lights his pipe, and sits himself down to peruse the latest copy of the American Rifleman. After a decent interval, during which the gun's owner has been anxiously pacing to and fro like a skipper on the quarterdeck when the glass is falling, the gunsmith appears with the weapon in hand and a triumphant smile on his face. "Try her now," he says heartily, as he thrusts it into the eager hands, "You'll think you're shootin' a different gun." Back goes the happy owner to the trap, after parting with the customary two or three bucks; makes a lucky hit the first shot, and shouts gleefully "That's the stuff! Boy, she's right now! This old gun ain't for sale!" Oh, well.

Chapter 32

PISTOLS AND REVOLVERS

THE subjects applicable to all types of firearms, such as fitting and adjusting sights, adjusting trigger pulls, etc., are covered elsewhere in this book under their respective general heads, hence this chapter will deal only with those problems peculiar to handguns.

Due to the splendid quality and workmanship evolved by our leading manufacturers through many years of experience, pistol and revolver troubles are comparatively few. Undoubtedly the best handguns in the world are produced in the United States—this statement is made advisedly, and with due regard for the several excellent specimens produced abroad. And because of their highly specialized knowledge, and unexcelled facilities for doing the work, it is advisable in most cases to have pistol or revolver repairs made in the factory that produced the gun. Sometimes, of course, this is not convenient; there is many a small job which can be done successfully by the owner or by a competent gunsmith; and there are many unique alterations which the factories do not care to handle. But there are also many jobs which should not, in the interest of safety, be entrusted to anyone other than an experienced factory mechanic, even though the delay of shipping the gun back and forth may sometimes prove annoying.

CHANGING REVOLVER BARRELS: This is a job which can be done in the small shop, but which really should be done at the factory. This applies particularly to double action revolvers, in which the left side of frame is cut away to receive the crane. Revolver frames—the double actions at any rate—are not hardened; and it is quite easy to spring the frame badly unless the job is gone at in the right manner. The Colt Single Action Army and Bisley models have case-hardened frames, and there is none of the frame cut away, hence there is far less likelihood of their being sprung.

The factories of course have fixtures for holding both the barrels and frames, and can do the job without possibility of damage—and if any damage should occur it would be repaired or the damaged part replaced without cost to the owner—and more than likely without his knowledge.

There are times, however, when a man is in a hurry for his gun, and decides to try putting in a new barrel himself, or having it done by a local gunsmith. The first problem encountered is that of removing the old barrel—and its difficulty depends largely on how the gun has been used, and the condition of the barrel. If the threads are likely to be rusted, then you have a job on your hands. In such case, soak the entire gun in a can of kerosene overnight, then wipe off the oil and warm the frame thoroughly where the barrel is screwed in. Get it good and warm, but don't heat it enough to damage the temper of the metal.

While the barrel is soaking in kerosene, take a couple of hardwood blocks—preferably maple, and cut a half round groove in each, so as to fit snugly against the barrel. Make the blocks three or four inches long, and spot the barrel channels to fit with lampblack, just as the barrel is inletted into a rifle stock. (See Chapter 10.) If the new barrel is the same diameter and shape as the old one, one set of these blocks will do for both—otherwise, make a set for each barrel.

Now when ready to remove the old barrel, dust the grooves in the two blocks with finely powdered rosin, and set them on the barrel. The faces of the blocks should be planed down so they lack about 1/16 inch of meeting. Set them in the vise with the barrel between, and clamp as tightly as possible. The cylinder and other parts, including the crane, if a double action revolver, should of course be removed. Insert a stout piece of hardwood, such as a heavy hammer handle into the cylinder opening in frame, close up against breech, and bear down on stick with steady pressure, but without jerking; at the same time tap the part where the barrel is screwed in with a lead hammer, giving several sharp taps while gradually increasing the pressure. Unless the barrel is unusually tight, this will generally start it, but sometimes the wood blocks will not grip it sufficiently tight.

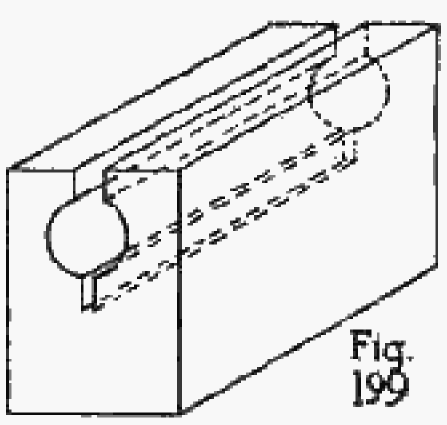
Of course, if the barrel is in such bad condition that it must be discarded, there is no objection to holding it in a vise with pipe jaws, or to holding the frame, properly protected with leather, in the vise, and screwing the barrel out with a Stillson wrench. Such treatment, of course, mars the outside of barrel beyond redemption.

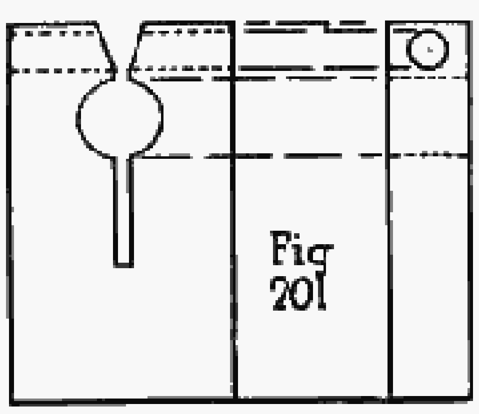
Sometimes when a barrel starts with difficulty, it may be loosened by further heating the frame where it is screwed in with a blowtorch—but be careful not to heat it hot enough to change the color.

When it is desired not to mar the barrel, and it cannot be loosened by the first method, secure a block of cast iron about 1 1/2 x 2

486

inches, and three inches long. Square it up on planer or shaper, and face both ends square. Drill through it from end to end and ream the hole to the same size and taper as the barrel, cutting a slot in upper edge through which the front sight may pass. The inner surface of the hole should be polished out very smooth. Slip this snugly on barrel and set it in vise, clamping the jaws tight. This will hold the barrel against any pressure you can put on it. Figure 199 illustrates this barrel clamp.





Any of the foregoing methods will answer for removing the barrel of the Colt .22 Automatic, or other arms having barrel screwed into frame.

Never try to hold a barrel in a flat jawed vise with one side of front sight resting against the vise jaw. The sight or sight base is almost sure to give way and bend, or be sheared off, before the threads will start.

FITTING NEW BARRELS: Having removed the old barrel, the threads in receiver should be washed out clean with gasoline on an old tooth brush. Also clean the threads on end of new barrel, and oil them lightly with a thin oil. Screw the barrel into receiver by hand until the shoulder touches, then note how much the front sight lacks of being properly lined up on top. Probably it will require about a quarter turn to bring it to place. Remove the barrel, and file off end of receiver where it meets barrel shoulder. Use a very fine "dead cut" pillar file wide enough to cover the surface at one stroke. Lay the file flat and take a very light cut. Then try barrel again, holding the barrel in clamp or wood blocks in the vise, and setting the receiver up as tightly as possible with the wooden bar. Remove the barrel, and file off end of receiver where it meets barrel shoulder. Use a very fine "dead cut" pillar file wide enough to cover the surface at one stroke. Lay the file flat and take a very light cut. Then try barrel again, holding the barrel in clamp or wood blocks in the vise, and setting the receiver up as tightly as possible with the wooden bar. Remove barrel and note the bright spots on end of receiver, made by pressure of the barrel shoulder. Dress down these bright spots very carefully, using the finest file you have and continue thus until barrel can just be seated with a final hard push on the lever. This "spotting" or dressing

487

off the bright spots to give the barrel shoulder an equal bearing all round is highly important, particularly in target pistols. The .22 is very sensitive to unequal barrel vibrations, and a firm bearing all round is conducive to best accuracy. This of course applies to larger calibers also, though they are less affected than the .22.

The newly fitted barrel will usually be found projecting too far to the rear of frame to permit cylinder to be closed. Use a 1/2 by 6 inch pillar file, Number 4 cut, to dress down the end. Hold the file perfectly flat, then rock it very slightly toward the side on which cylinder opens, and work slowly and carefully. When cylinder will start past the barrel, but cannot be closed fully, change the angle of cut slightly until cylinder will just close past it. Now polish the end of barrel with a very fine oilstone until the clearance is correct, and equal on both sides. When a .003 inch feeler gauge will just enter between cylinder and barrel from either side, and a .004 inch gauge goes in with a very tight fit, you have about as good adjustment at this point as anyone could ask.

When a new barrel has been fitted to a .22 Colt or other automatic, be sure the extractor cut in barrel is properly aligned with cut in frame. This cut must be properly located even if the sight seems to be off center. The end of barrel must then be carefully filed down so that the slide closes fully, with equal pressure against breech all round. Use a thin smudge of Prussian blue to spot the end of barrel to perfect contact.

With the most careful filing and polishing on end of barrel there is likely to be a small burr left on edges, which must be carefully removed or the barrel will lead badly. A very sharp countersink bit considerably larger than the bore may be held against it and twirled in the fingers, using just enough pressure to remove the burr without beveling the edge. Follow by touching up the edge carefully with the point of a fine oilstone.

REFINISHING REVOLVERS: This is fully covered in Chapter 20, which also tells how to "lamp" small spots in the finish caused by wear. Frequently one will pick up a good second hand revolver which has been nickel plated, and it is very difficult to blue such a gun, because the nickel sometimes goes into the surface of the steel, and resists all efforts to remove it completely. If determined to blue the gun at home, the best plan is to polish until you think all nickel is removed, then apply a coat or two of quick hot bluing solution (Solution No. 1, Chapter 20), which will show up the remaining streaks of nickel plainly, as they will not be affected by the solution. Polish off the spots thoroughly, then repolish entire arm, and blue by the nitre process, finishing with two or three coats of Solution No. 1.

As a rule the better plan in such cases is to take the gun to a first class plater familiar with the Black Nickel process and have the gun finished by that method. The color is excellent, and the

488

gun is rust proof, and should not wear bright if it is properly finished.

Revolver barrels may be cut off by the same method used for shortening and truing up rifle barrels; Chapter 24. Shortening the barrel of course necessitates fitting a new front sight, which is covered fully in Chapter 29, as well as the method of changing an ordinary blade front sight to the "Call" type.

When a revolver or pistol barrel has been cut off for any reason, there remains the problem of providing A NEW FRONT SIGHT and a suitable method of fitting it. The most common practice is simply to cut a dovetail in the barrel, and fit any rifle sight desired. A better way, and one which results in a much more attractive job, is to make a barrel band similar to the Springfield fixed stud, then make a sight, with its lower portion shaped to fit

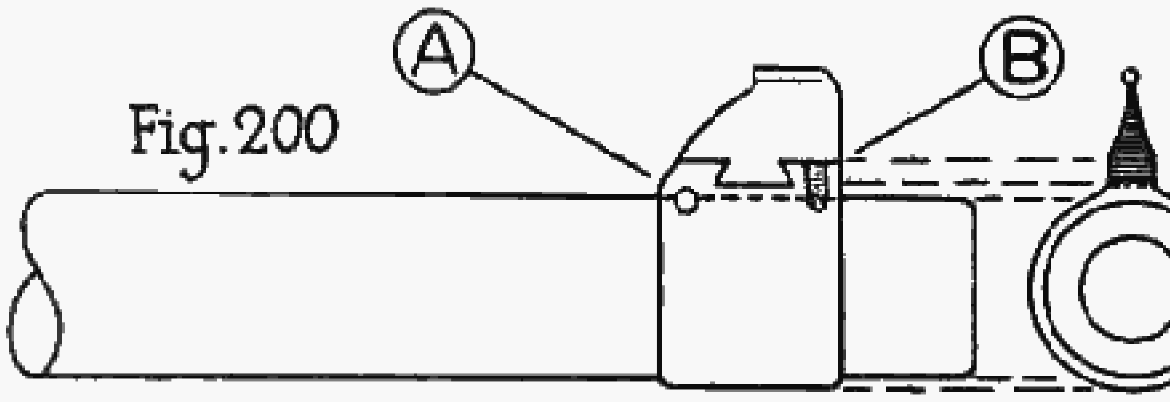


Fig. 200

the dovetail, as shown in Figure 200. The band or fixed stud may be made of Shelby tubing, or may be bored from solid metal and ground and filed to shape. The sight may be shaped up and finished in any manner desired,—a round bead, a flat top blade or Patridge, or a gold dot inserted similar to the Call sight. The fixed stud may be attached to the barrel by sweating, or it may be made a snug fit and pinned with a transverse pin biting half its diameter into the barrel, as at A, Figure 200, or a small headless setscrew may be set vertically into the thick portion of the stud, the point entering a shallow depression drilled into the barrel, as at B, Figure 200. Before finishing, the sight should be fitted temporarily on the barrel, and filed to correct height by shooting on a target; then it should be removed and the parts carefully fitted together, polished, and blued, after which they are replaced to stay.

There is no objection whatever to using a low, short ramp on a pistol or revolver—in fact a ramp 2 inches long looks decidedly snappy on a long barreled target gun, and permits the use of any type of front sight desired. The ramp may have a band, and be sweated on in the same manner as on a rifle, or it may be made without a band and soldered to the barrel. Good half-and-half solder will hold more strain than it will ever receive—but if desired, the bore may be coated with file-hardening compound to protect it against oxidation, and the ramp silver-soldered. Use the ribbon solder prepared for brazing bandsaws.

489

THE CALL FRONT SIGHT, as supplied to order on Smith and Wesson revolvers is gaining in popularity with many shooters, while others claim they see little advantage in it. This is a wide square blade of the Patridge type with a round gold dot set in the face of the sight near the top edge. In some lights the gold dot shows up bright and distinct against a dark background, while the square edge of black steel gives sharp definition. When using the sights from a darkened firing point the gold is not visible, the sight appearing as a regular flat top blade or Patridge.

There are several ways of adapting this idea to a regular blade front sight. The edge of blade next the shooter should be filed straight and flat; it may be vertical, or may slope forward at an angle of 10 to 15 degrees. Then the hole should be accurately centered so that its outer edge will barely miss the top and sides of blade, and drilled carefully to a depth of about 1/16 inch. A fine jeweler's drill or dental engine will be required—jobs this small cannot be done with a hand drill. The jeweler will either tap the hole and put in a gold screw, or he may melt in a drop of gold solder with his torch. The dentist will doubtless undercut the hole on the bottom and put in a gold filling. I can't see any reason why gold amalgam wouldn't do the trick nicely, but since I'm not a dentist, I may be wrong.

The surface of blade which has been filed must of course be reblued, and this can be done without injury to the balance of the gun, by lamping.

CHANGING THE GROUPING. Sometimes a revolver as sent out from the factory will group its shots to right or left, or high or low. When the sights are adjustable, the grouping may be changed as desired, by raising the rear sight if the gun shoots too low, or by lowering the front sight; and by lowering the rear sight or raising the front sight if the gun shoots too high; by moving rear sight to right, or front sight to left, the gun may be made to group its shots more to the right; while moving rear sight to left, or front sight to right, moves the group to the left. In "Pistols and Revolvers," Major Hatcher has given some excellent dope on pistol sight adjustment which should be carefully studied.

On guns having non-adjustable sights the group may be lowered by fitting a higher front sight, or raised by filing down the front sight on the gun, or by substituting a lower one. When such guns shoot to one side, however, the remedy is to move the front sight in the opposite direction.

If it is desired to move the front sight to the left, this can be accomplished sometimes by setting the barrel a trifle tighter in the frame. Usually, however, it is necessary to bend the front sight, and I have found the following method very good:

Take a piece of machine steel about 5/8 inch thick, and drill a hole in it, then ream the hole so that the barrel muzzle may be

490

just slipped in easily. Polish inside of hole to prevent marring the barrel, and file out one side as shown in Figure 201. Drill a 1/4 inch hole through from side to side so that a brass rod may be inserted through it against the side of sight. To use, put the barrel through the large hole and clamp in vise, with the small holes opposite center of sight blade. Put the brass rod through the hole and tap it with a hammer, bending the sight as required. By this means the barrel is held rigid and the bend in sight occurs down next to the barrel; and as only a very slight bend is required, it is scarcely noticeable.

On the .45 Colt Automatic, the grouping can be changed laterally by moving the rear sight in its slot. Cutting down this rear sight a trifle will lower the group, while cutting down the front sight will raise it—changes which are seldom necessary. Occasionally one of these guns will be found which throws very large groups, and this can often be remedied, and the gun made to shoot very close, by securing from the factory a new and tighter barrel bushing—this is the small bushing which holds the barrel in the slide at the muzzle. Or the hole in the old bushing may be bushed with tool steel by a competent machinist, then lapped or reamed to a tighter fit on the barrel. There must be sufficient clearance however, so that it can slide easily, or the gun will not function.

Sometimes these guns shoot to right or left because this barrel bushing is slightly eccentric, i. e., the bushing is slightly thicker on one side than the other. A new bushing, or bushing the hole in the old one, will in such cases bring the group to position.

A good many .45 Colt Automatics, particularly those of war-time vintage, are noticeably loose in their construction, particularly in the fit of slide on receiver. This looseness, while necessary to a degree, is not conducive to best accuracy, and much of it can be eliminated with immediate improvement in scores.

Look at the rear end of slide where the grooves fit into grooves in receiver. It will be observed that the grooves fit quite loosely, and that the slide may be "wobbled" from side to side with the fingers. Now remove the slide and strip it of rear sight, firing pin and extractor. Set it carefully in a smooth jawed vise, one jaw of which (protected by sheet brass) rests against top surface of slide, and the other jaw, (bare), resting against the two bottom edges. First, however, "mike" the thickness of slide from side to side, and jot down the micrometer reading. Now very carefully tighten up the vise, so as to squeeze in against the grooves in lower part of slide. Go slowly, tightening only a little at a time. Remove and try for fit on receiver frequently. When the slide will just move in the receiver grooves, but with difficulty, stop. Now mike the thickness of slide from side to side, again, and note whether it has been widened by the squeezing. Probably it will be two or three thousandths wider. Protect both jaws of vise with brass or

491

copper, and squeeze sides of slide in until they are the same as before.

Now put a *very little* of the finest emery flour and oil in the grooves, and work slide back and forth on receiver until it just works freely, and with minimum clearance, then carefully wash off all the emery and oil.

Now take a very light brass hammer, and carefully tap all along the grooves in slide, trying it frequently until it will just ride the receiver snugly with no side play. Finish by putting a thin coating of Winchester Rust Remover, or Stazon Rustoff in grooves, and working slide in receiver until it runs with no bind at any point. Then wash off clean, oil, and assemble.

MISFIRES. A gun that is addicted to frequent misfires usually needs a stronger main-spring or firing pin spring,—the latter in the case of hammerless automatics operating by a stiff spring driving the firing pin. The trouble may be the result of leaving the gun cocked for long periods, and may be often remedied by stretching out the coiled main-spring to about 1/4 or 1/3 longer, then hardening and tempering it as described in Chapter 21. When this does not prove the remedy, secure a new spring from the factory, or have one made in a machine shop from piano wire, using a size larger wire than the original spring.

Misfires in revolvers are often due to somebody's misdirected efforts to make the gun cock easier, by filing down the flat main-spring. The only remedy is to buy a new main-spring from the factory, or make one yourself from good steel, temper and harden it, and file gradually to a thickness that gives positive ignition. Target shooters sometimes go to extremes in skeletonizing the hammer, to lighten it and speed up lock time—and this lightening of hammer sometimes causes misfires. One remedy is a new hammer; another is a stronger main-spring—this further speeding up the fall of the hammer, though making it harder to cock.

Sometimes in old revolvers having firing pin separate from the hammer, misfires will occur as a result of wear or damage to the point of firing pin, which in some instances may be too short. Secure a new firing pin, or make one from tool steel and harden it, drawing it to a blue color. (See Chapter 21.) If the old pin appeared too loose in the hole, the new one should be made oversize, to fit the hole smoothly. Now carefully round off the end on an oil stone, using a jeweler's magnifying glass to get it properly shaped. Try it frequently in the gun by snapping on primed empty cases, holding the barrel vertical with a small coin laid over the muzzle. Note how high the coin is driven into the air, and whether to the same height each time, and also note the impression of firing pin on the primers. The dent should be full and hemispherical, but not so deep as to puncture the primers. Get some fired shells from a good gun and compare the firing pin indentation. When just right, the point should make a good full impression in primer, without any tendency

492

toward puncturing, and should drive the coin two or three feet into the air—and to the same height each time.

If a firing pin is in good shape, but the hole in the revolver frame worn too large, this will often cause misfires, the pin striking near the edge of primer instead of in the center. This may be eliminated by drilling out the firing pin hole to about twice the diameter of the primer, and fitting in an accurate bushing of tool steel, in which the firing pin hole is accurately centered. Such a job should be attempted only by an expert machinist or toolmaker.

CHANGING CYLINDER. Owners of the Model 1917 Colt and Smith & Wessen revolvers often wish to change the cylinder to handle the regular .45 Colt cartridge, instead of the .45 Automatic or .45 Auto Rim cartridges. The change can readily be made, despite the fact that the .45 Colt is a slightly longer cartridge than the ones for which this gun was built.

When you have the new cylinder, measure its length carefully and compare it with the cylinder in the gun, noting the exact difference in length. Now remove the crane and take off the side plate, on which you will note a small projecting lug which holds the cylinder from moving to the rear when swung out for loading. Put the new cylinder into the crane and replace it in the gun. Very likely you will find that cylinder will not close, striking its front end against rear end of barrel where it projects into the frame. If the difference here is slight, it is permissible to file off the rear of barrel slightly, as when fitting a new barrel. Keep the end of barrel square and smooth, and finish it off with a hard oilstone, then carefully remove any slight burr from inner and outer edges.

Now the cylinder, when swung in (closed), must have sufficient clearance between its rear end and rear of frame to accommodate the heads of the cartridges. Some ammunition companies make their cartridge heads thicker than others; so if the cylinder proves a tight fit, try different brands of ammunition. If the cylinder will not close and turn freely with any make, it may be possible to adjust it by moving it further forward. Before starting this, however, note the position of the cylinder lock in the cuts milled for it near rear of cylinder, and be sure they are large enough to permit moving cylinder forward a trifle. If they are, then file off the rear end of barrel as required, and it may also be necessary to file a little off the rear end of crane where front of cylinder bears against it.

Now, when the cylinder closes smoothly, and with just sufficient "headspace" at rear so that it turns freely when loaded, open the gun and note the small lug on sideplate which is intended to prevent cylinder from sliding to rear when it is open. This must be filed back a little so that the cylinder drops in front of the lug, barely clearing it. Do this with a 1/4 inch pillar file and you will run no risk of marring the gun. The bright spot on lug after filing may be "lamped" as described in Chapter 20.

493

CYLINDER ADJUSTMENTS. When fitting a new cylinder —and sometimes on the old cylinder as well—it will be noted that the cylinder lock drags, as cylinder is turned, leaving a bright line around it. To eliminate this, carefully polish off the upper surface of cylinder lock, so that it just clears the surface of cylinder. This may be done with the Arkansas slip hone used for adjusting trigger pulls. If the cylinder does not lock tightly, but may be forced out of position with the fingers, it will usually be found that upper edge of cylinder lock is so thick that it is not entering the recess in cylinder. Carefully, and very slowly stone off the sides of cylinder lock, until it will just enter the recesses full depth. When a cylinder has considerable side play even when locked, it is because the cylinder lock is too thin, or perhaps worn down, or the recesses in cylinder are worn at the edges, or perhaps both. The remedy is a new and thicker cylinder lock, which in fitting may be stoned down to fit the recesses very snugly.

CHECKING TRIGGERS AND OTHER METAL PARTS. Triggers, back straps of revolvers, hammers, etc., are often improved by checking to prevent slipping. The principal difficulty encountered in checking steel with the file is that of spacing the lines evenly. One cannot use a checking spacer, since the single light scratch would not guide the tool properly—the checking must be filed in, and about the only way to space it evenly is to gauge it by eye. This is not nearly so difficult as it sounds. Use a 3-square escapement file or a 6 inch needle file with about a No. 0 cut. File in one line and be sure it is straight. Space the other lines from this, cutting them just deep enough to show up clearly, so that succeeding lines may be similarly spaced.

Before starting the checking, the part should of course be polished and coated with copper sulphate solution as explained elsewhere—then the silvery lines show up clearly against the dark copper background.

Having the lines correctly spaced one way, cut the cross lines in the same manner, then go over all lines several times and deepen them until the diamonds are well pointed. Buff on a stiff wire buffer to remove extreme sharpness, then blue.

Slight variations in spacing are more easily corrected in steel than in wood; by simply bearing harder against one side of the cut, a considerable change may be made, because the first cut is quite shallow. With practice a good workman will produce file checking almost as accurate as knurling. There are mighty few parts that are shaped so that a knurling tool can be used on them, which makes reasonable skill at file checking a valuable asset of the amateur.

Deeply curved triggers, and other parts having inside curves are very difficult to check with a file—impossible, in many instances. There are two ways to get around the trouble. Either heat the trigger cherry red and straighten it out, check it as desired, then

494

heat and bend it back to original shape and re-harden; or, be satisfied with corrugations filed straight across.

But one of the best trigger surfaces is produced by matting with a very sharp prick punch and hammer, or with the hammer attachment in the dental engine, used in the same manner as when matting a ramp or rib. The sharp stipple surface is attractive, blues perfectly, and provides a splendid non-skid grip to hand or finger. When matting a trigger in this manner, remember that very likely it will be slightly stretched in the process, and the point of trigger may bind in the guard, necessitating filing or grinding off a trifle when the job is finished.

The reader may recall having seen various Colt revolvers or automatic pistols on which straps and trigger have been diamond checked on special order. Close inspection will show this to be hand work in most cases; and while I have not seen it being done, I am convinced that this is graver work. I recall a trigger on a .22 Colt Automatic, which is sharply checked, the checking stopping at a deep outline around the edge; clearly this is no job for a file, but for a graver in the hands of a very skilled workman. The slight variations incidental to even the finest workmanship are clearly evident.

When checking or grooving small thin parts, triggers particularly, it must be remembered that the checking is subject to practically no wear, and need not be deep nor coarse. It doesn't take much to keep the finger from slipping off a trigger.

EJECTION TROUBLES. In rare instances the .45 Colt Automatic will develop a habit of throwing the empty cases straight up into the shooter's face. Whenever possible it is best to have this corrected at the factory. If the owner must tackle the job himself, however, the first thing to do is to remove the extractor, and carefully hone the lower edge of hook to a slight bevel, causing that edge to release the case head first. This will usually result in throwing the shells well to the right, away from the shooter. Work slowly, assemble the gun and try it often, so as not to cut away too much. A very slight change in the hook will sometimes make a big difference. If you don't get proper results after stoning the hook all you think it will stand, then try beveling the front face of ejector back slightly to the right and down, causing the case to be tripped out of the extractor at a different angle. Be careful, or you will ruin the entire adjustment, causing a jam at every shot. If neither method corrects the fault, give Mr. Colt himself a chance at it, and beg his pardon for monkeying with the gun.

The owner of a large caliber revolver may wish a similar gun to handle the .22 L. R. Cartridge. It is entirely possible, for example, to take the frame of a Colt Officer's Model, and fit it with a specially made .22 caliber barrel; and to turn down the cylinder to proper length and bush the chambers and rechamber for the .22 L. R.

495

The amateur who is determined to have such a gun must do one of two things—either be content with a Camp Perry Model S. S. Pistol, or make up his mind to pay somewhere in the neighborhood of $100 for the job; for it is entirely beyond the ability of anyone other than a toolmaker of the highest order, and a barrel man who thoroughly understands his business.

The barrel must be specially made with the quicker twist required for pistols. Turning down a rifle barrel to size will not answer, as the twist is too slow. This fact was ignored by one factory, in my experience, to the supreme disgust of the owner after he had paid his good iron dollars to have an 8 inch barrel fitted to a .22 Colt Police Positive.

When the Colt factory decided to lengthen the "horn" on the grip safety of the .45 Automatic, they rendered a real service to the chap with a large hand which was pinched and gouged between the hammer spur and short grip safety each time the gun was fired. But—they reckoned without knowledge of my good friend Carl Schilling, whose hand looks just about like any other man's hand when he is not shooting the .45 Auto. In that case, after emptying

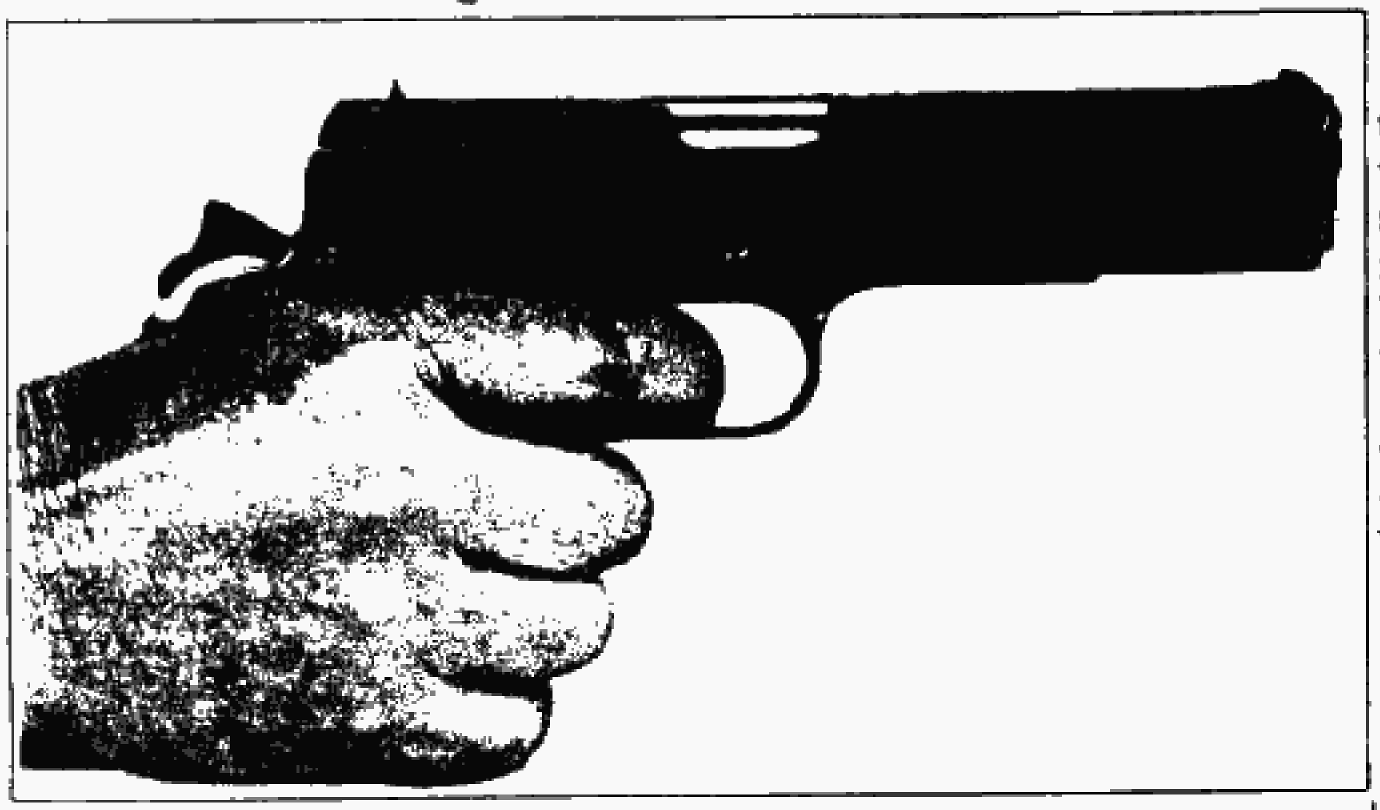


Fig. 202

one magazine, it looks more like something the cat had dragged in after it was run over with a harrow. Carl's hand is very heavily muscled in the crotch of the thumb, and the improved grip safety didn't help him a bit—if anything, it gouged out the flesh even worse than the old model. Despite his liking for the .45 Auto. he had definitely decided to discard it for good, when I suggested the remedy illustrated in Figure 202. The photo shows how the gun looked when the job was finished, while Figure 203 shows the

496

job in process. "A" is the original grip safety; "B" shows it with the lower side of spur filed out to receive the extension; "C" shows the extension roughly filed from cold-rolled steel and fitted, with an 8-32 countersink-head screw to hold it in place. A piece of thin ribbon silver-solder was then fitted between the two pieces and the screw set up snugly, then the assembly heated redhot with a blowtorch causing the silver to melt, firmly brazing the parts. The screw was then set in as tightly as possible, and the head, which was slightly countersunk, was peened in tight, then head and point of screw filed off flush, as at "D," and the extension filed to shape; after which

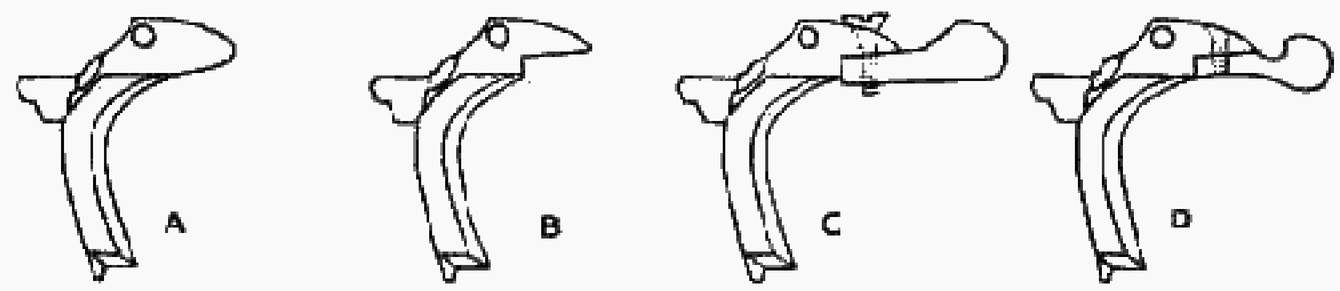


Fig. 203

the part was nitre blued. After trying the gun with this alteration Carl was so tickled he immediately bought another which underwent a similar grafting operation before it was fired; and while some think this "fiddle-head" looks funny, Carl swears by all that's holy that the way it presses into his hand holds the gun much more firmly; and the hammer spur is absolutely prevented from doing any damage to his "mitt."

"BUSTED" REVOLVERS. Accidents will happen, even in the best of families! Figure 204 shows a Colt Officer's Model that "let loose" in the face of some ten or more grains of Bulls-eye—the result of an adjustment screw having slipped on a powder measure. Happily the pieces of brass and cylinder which blew off missed the owner completely, the only damage noted, outside the gun itself, being to his peace of mind and his undies!

Of course the usual claim of "faulty gun" was presented to the folks in Hartford, but they, being wise to the ways of this wicked world, promptly denied the allegation and defied the alligator. Moreover, they kindly offered to repair the gun with a new frame and new cylinder, for the trivial sum of thirty-nine dollars and fifty cents. Just how they "figgered" is beyond my ken, since $40.75 will buy a new gun, and the total value of barrel and action parts, grips, et cetera, none of which were damaged, is quite a little in excess of $1.25 according to the parts price list. So old man Beals sat himself down to cry and to curse, and bemoan his fate—until he happened to remember of one George Titherington of Stockton, California, whom he met at Perry. Accordingly and forthwith, a photo of the busted gun and particulars thereof were posted to George, who allowed as how he might do it some good, since he was sure he couldn't make it any worse.

497

The insert in Figure 204 shows the gun as it looks today, after the aggressive "Native Son" finished with it. The top strap of frame was straightened out, and the break, which occurred in the rear sight dovetail, welded, then a new dovetail cut for the sight. A new cylinder fitted perfectly, as the frame was bent into line again. The gun today seems as good as ever, having been shot considerably with full loads with no sign of weakening or giving way. I may remark that I have never seen a finer job of welding than was done on this gun. The weld is absolutely invisible, and appears one piece of metal, although Mr. Titherington merely heat blued the strap,

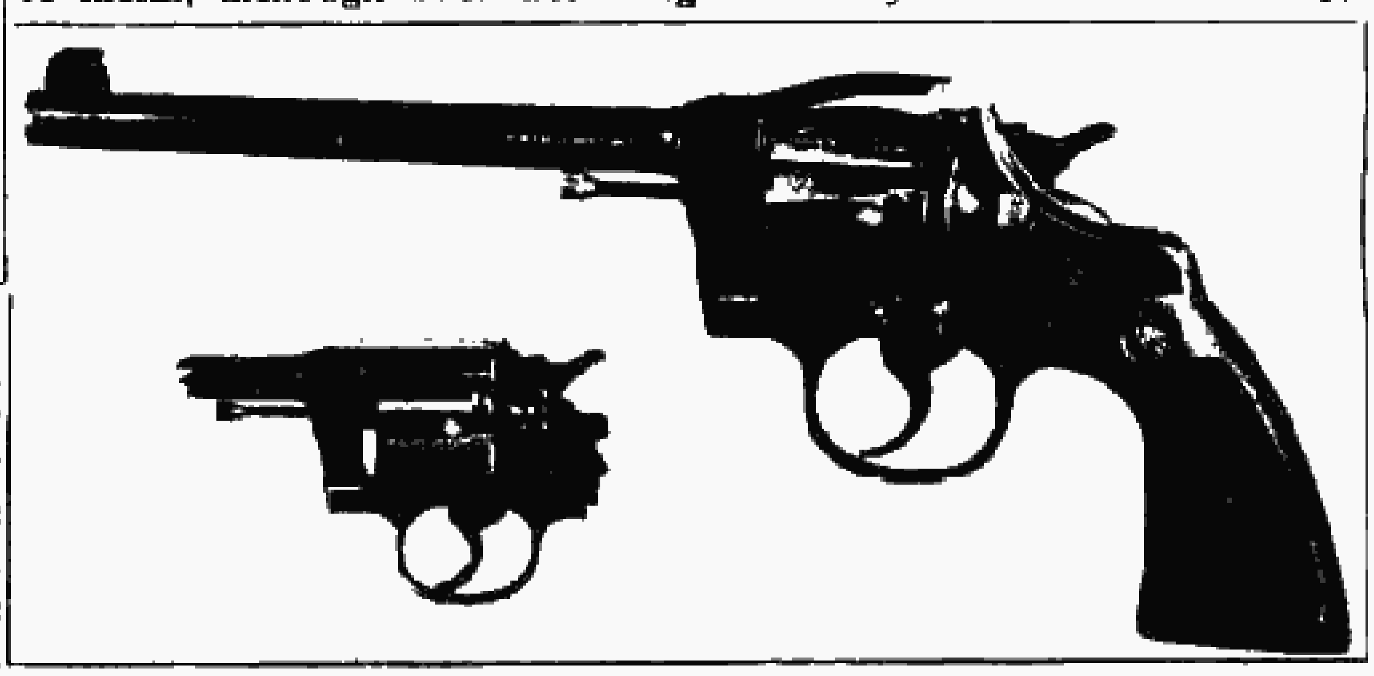


Fig. 204

which would tend to show the break unless the weld was perfect. Incidentally this repair cost the owner of the gun about $12.00 including the new cylinder.

Complete details of the job, as reported by Mr. Titherington, are as follows:

"I took an acetylene torch and carefully heated the top frame strap to a low cherry red and very carefully hammered it down to place, first cutting off a little of the broken end of strap about 1/16 inch, as it was slightly stretched. Then I welded this broken end at the rear sight slot, afterward dressing down the frame smoothly, doing a little filing at rear of frame to get proper headspace.

"Where the front of frame was bent (in the thin part where front of crane touches), I found the barrel was about 1/16 inch higher than center, so this was bent down cold in the vise. The hardest job of all was to get the short kink out of the crane stem just in front of cylinder, which was caused by the downward thrust of the chamber when the top of cylinder hit frame strap, when the cylinder walls let go. This was accomplished by fitting a pin inside the stem down to where the first kink was, to prevent the stem from getting mashed together and made out of round. I then heated the kink with the torch and drove a wedge between crane stem and crane hinge, until the stem was again straight.

"The frame was also bent so that side plate fitted poorly. This was straightened and sprung back cold, in the vise."

498

Grips for revolvers and pistols are excellent objects for the amateur gunsmith to try his skill and inventive genius on. For one thing there is very little material to spoil, and experiment can be made with a number of walnut grips without running into much money. In cutting out rifle or shotgun stock blanks, one usually has a quantity of scrap left, and often this will be of the most beautiful curly grain. Saving this scrap affords the worker an unlimited quantity of pistol grip material at no cost.

No expensive outlay of tools is required, for one or two chisels, a rasp and a file are about the only things needed. A small iron vise which may be clamped to the kitchen table will serve in a pinch, although a good bench and heavy vise are desirable to any job.

And this work promises much, for a well-fitting set of grips moulded to the shooter's hand will greatly increase his skill with the weapon. The fit of the handgun stock is of quite as much importance to the shooter as the fit of rifle or shotgun stock. One can also exercise all his artistic ideas in grips, carving or decorating them as he sees fit—and he can't spoil the gun, for the old grips are easily replaced. Some wonderful works of art are seen in grips on pistols and revolvers, particularly those from the Orient and our Old West.

I am reminded of some lines which I once saw beautifully engraved on the ivory handle of a Peacemaker carried by a deputy sheriff in south Texas some years ago:

"Be not afraid of any man,
No matter what his size;
When danger threatens, call on me—
And I will equalize!"

So impressed was I with this sentiment that I formed rosy pictures of this old timer some day passing out with his boots on in a blaze of glory and a cloud of powder-smoke. But alas for human frailty! The old chap cashed in by the very prosaic process, of getting drunk and turning his flivver over in the ditch, breaking his neck.

Grips may be made of hard rubber, bakelite, aluminum, walnut, rosewood, ebony, maple, apple, cherry—in fact, any hard, close grained wood; they may also be made of buffalo horn, stag horn, cow horn, mother-of-pearl, ivory, walrus ivory, or many other materials. The shooter may desire to copy one of the old steer-head stocks often seen on six-shooters in the west; or he may wish to depart entirely from the conventional shapes and model his grips to conform exactly to his hand, with grooves for each finger.

One method of arriving at the perfect hand-fitting shape is to take a large lump of dental wax or modeling clay on each grip, and grasp it firmly as in shooting. The wax or clay will then model itself exactly to the hand, taking the impression of each finger, and when

499

dry, forms a perfect mould or pattern to follow in making the new grip.

Another way which I like better is to first make and fit on a couple of thin slabs of soft pine; then spread on them a thick layer of Plastic Wood. Oil the hand slightly to prevent sticking, and grasp the handle of gun, then let the wood dry, when the shape will remain. Plastic Wood may after drying, be filed or sanded as required to get the shape just right, and the gun may be fired on the range until one has the grip just as he wants it. Additional Plastic Wood may be added at any point, as required—for actual shooting sometimes shows up faults that are unnoticed when merely pointing the gun. When you have the grips exactly right, you can then copy them in walnut or other material, or send them to a gunsmith to be duplicated.

If walnut is used for grips, select a piece of the hardest, closest grained wood you can find. Scraps taken from stumps, or near the stump, are always better, and besides have fine figure as a rule. Soft, easily split wood is worthless for pistol grips. Circassian walnut of good quality makes excellent grips—when you make your rifle stock, very likely you can saw off a pair of pistol stocks from it.

Blanks for grips should be very much oversize all round, and each pair should, if possible, be made from one piece of wood, particularly if well figured. Saw the piece roughly to shape, and have it at least twice the thickness required. Then split the piece with a ripsaw, using the two halves "inside out" which will make the grain identical on outside of each grip.

If the outline of grip is to be larger than the frame of the gun, the front and back straps must be inletted into the wood just half their depth. Follow the same general methods used for inletting rifle actions, cutting the outlines straight into the wood with straight or hollow chisels as required, and scooping out the excess wood with a slightly curved chisel. "Spot" in the straps with lampblack and oil, and when the two edges of wood must meet outside the straps, be sure the edges are in contact all over their surfaces—otherwise when the outside is shaped up there may be an ugly gap appear between them.

When the slabs are fitted, drill the hole for the screw which holds the grips, and let in the small escutcheons or bushings taken from the old grips—or use new bushings purchased from the factory. If the grips are to be thicker than the old ones, these bushings must be sunk below the surface, or a longer screw procured or made. Having the slabs fitted to the gun, the grips are shaped up with rasp and file. The easiest way is to hold the gun in a vise by the barrel, which should be well protected from the jaws by a wrapping of leather or felt. Be careful not to let the file or rasp touch the gun at any point. Work as close as you dare; trim along the edges with a very sharp chisel, and remove the grips for final shaping.

500

Use a small wood screw to attach the grip to the edge of a narrow piece of wood, which may be held in the vise.

After shaping, sand the grips, smooth, then wet them and sand off the "whiskers" as described in instructions for finishing stocks in Chapter 13, after which they may be oiled and checked, carved or otherwise decorated. (See Chapter 12.)

Figure 205 shows a pair of "free pistol" style grips made for a .38 Colt Military Model automatic. Here is an excellent cartridge, but with one of the most poorly designed guns ever made from a

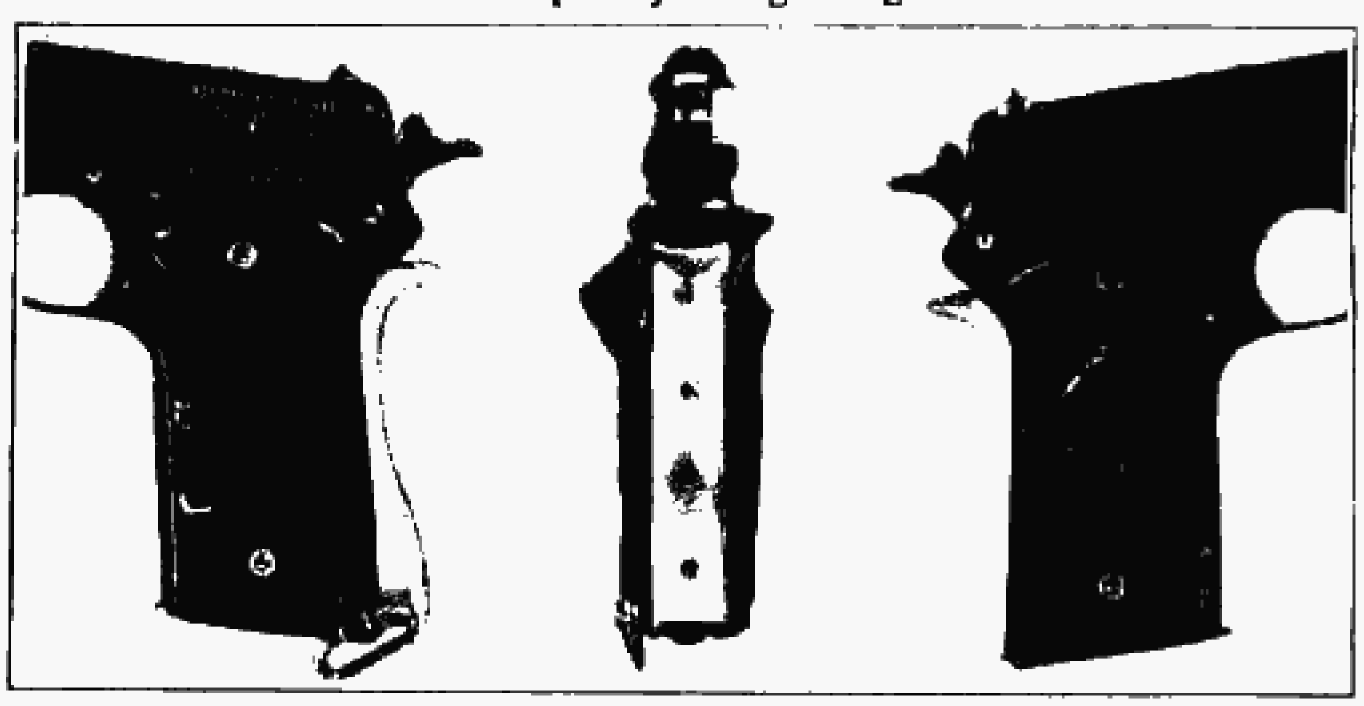


Fig. 205

standpoint of hang and balance. The new grips, while of course not changing the angle of the grip, greatly improved its hang and handling qualities by changing the position of the shooter's hand, and providing a firmer hold.

A friend of mine showed me a pair of smooth walnut stocks he had made for a S. A. Colt. He told the gunsmith who made them that he wanted no checking or carving, wanted a smooth finish, yet one that would not slip in the hand. The gunsmith finished the grips with orange shellac, into which he mixed a little finely powdered pumice. The grips had a very brilliant finish which showed off the beautiful grain to perfection, yet one could have struck matches on them if necessary!

This same party was troubled by frequent misfires in his favorite pocket weapon—a Remington double derringer. He has corrected this fault by taking the hammer to a brazing shop, where a good sized gob of phosphor bronze was melted onto the hammer spur, then rounded off and filed smooth. It now makes little difference how old or stale the .41 rim fire cartridges—when this hammer is driven down by the main-spring, assisted by the weight of that chunk of bronze, things happen!

Getting back to grips, the space back of the trigger guard, between

501

guard and grip, on some revolvers, permits the shooter's hand to slide up too high for a steady firm hold. By fitting new grips, letting the wood extend forward to the guard, the grip may be greatly improved. Some shooters use the improvised method of filling in this space with a piece of wood or rubber, held by wrappings of tape. A better way is to file out a block of machine steel to the shape desired, and fasten it in place with a filister-head screw set in flush with the surface. A still better plan, if the gun needs rebluing anyhow, is to braze or weld this piece in place, dress it off smooth, and refinish the gun.

A word about aluminum grips. This is an excellent material, with possibilities that are frequently overlooked. Sometimes one may merely want a pair of unbreakable grips same shape as those that came on the gun. The factory grips may be used by an aluminum foundry as patterns, and new grips cast which exactly duplicate the walnut ones, even to the metal medallion and the checking. Much progress has been made in the casting of aluminum, and a first class foundry will produce castings so smooth that very little finishing is needed. Just retrace the checking with a three-square file, and smooth up the edges. To allow for shrinkage, glue a very thin layer of soft wood, or piece of cardboard (about 1/32 inch thick) to back side of grips, and bevel the edges to correspond with edges of grips with a very sharp file.

The checking on aluminum grips does not wear smooth like wood, and the natural color of the metal on a revolver is not unpleasing. The grips may be given a black finish if desired, by the process described for blackening aluminum in Chapter 20.

"Handful" grips of aluminum are easily made by first working up pattern grips from plastic wood as previously described, then sending them to the foundry for castings, which can be scraped and filed smooth, polished, and file-checked as required. It is not necessary to check aluminum grips unless desired, however, as this metal sticks to the hand well even when finished smooth.

BROKEN PARTS such as sears, triggers hammers, hands, etc., are best replaced with new factory parts. In a pinch they can be made if not too complicated in shape, from high grade tool steel, and hardened and tempered as described in Chapter 21, but the factory parts are easily secured, and usually require little fitting. When filing out a hammer, trigger, or similar part having a pivot or screw hole, the hole should be drilled in the stock before it is shaped up. Then insert the drill through hole in new stock and old part to keep them properly aligned, and hold both parts in the vise while filing the new one down to size. This will save a lot of time and many cuss words.

Figure 206 shows two Stevens Model 35 single shot pistols, one with the original hammer and trigger, the other with new parts made of tool steel. The owner of the first gun wanted a 3 1/2

502

pound pull, and was satisfied with the handling of the gun otherwise. The pull was worked down as desired, but due to the softness of the parts, it will probably wear lighter in a short time, although it has held up very well through about 600 shots.

The pull on the second gun was similarly lightened, and the parts then hardened in cyanide, as they appear to be made of nothing better than machinery steel. However, the sear end of trigger is very thin, and the hardening was carried too far, resulting in the sear point breaking off. Since the owner had complained about the small grip and the trigger setting back too close to his hand, I made the new hammer and trigger from 85 point carbon steel, hardened them and tempered at medium brown straw color. The hammer was made twice the width of the original hammer and cut

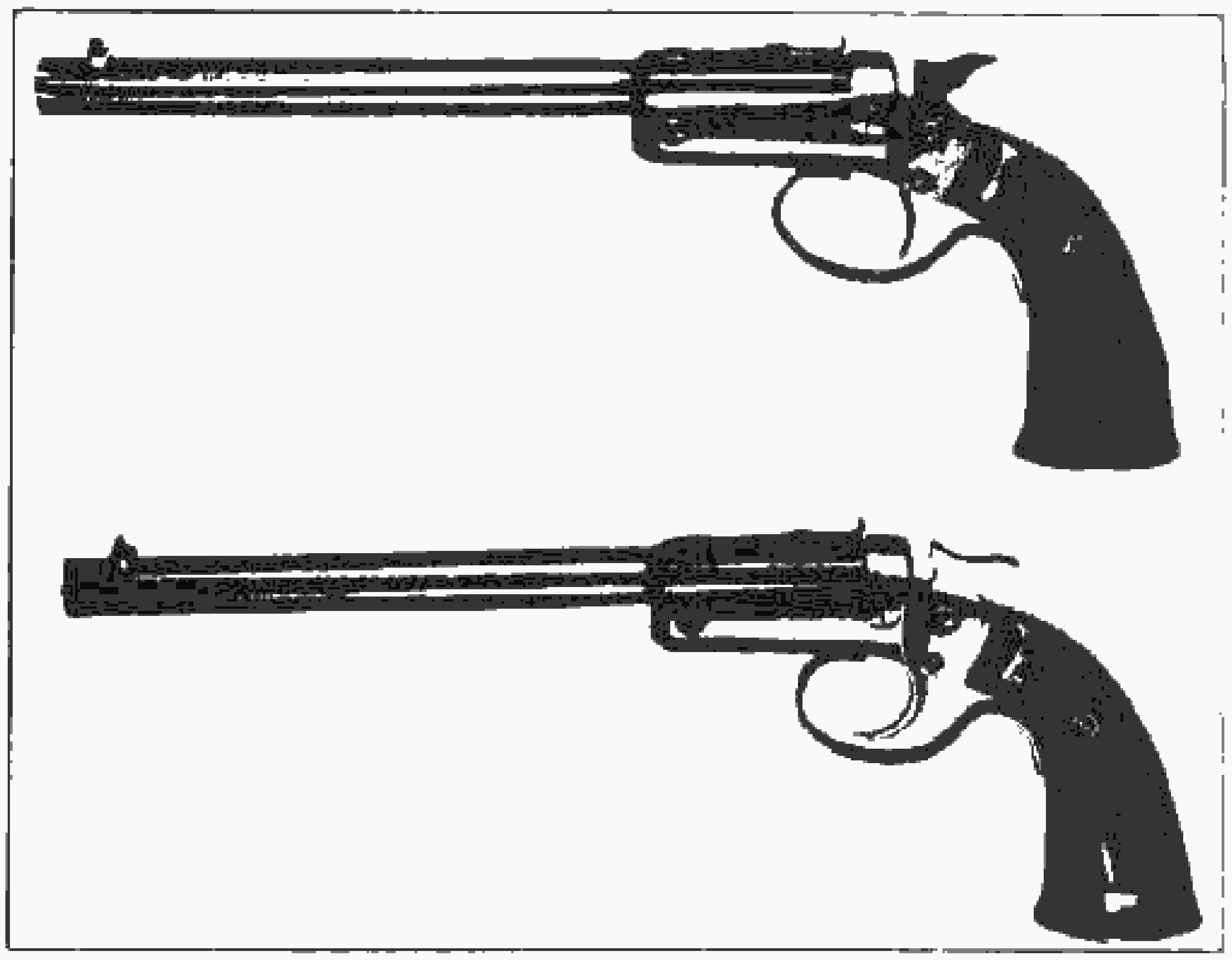


Fig. 206

away on the sides to fit closely in the frame. Trigger notch was cut higher to shorten the fall, and the spur was lengthened and set lower, so that it does not cross the line of sight—the original hammer showed up slightly in the rear sight notch. The trigger feels much better in a man-size hand, and it has a permanent pull of 8 1/4 ounces—and is guaranteed to plumb ruin a man for shooting any other gun having a normal pull. But great Jupiter!—how you can lam the bull-frogs with this old potiron.

These parts were made entirely by filing and the screw holes

503

drilled with a breast drill, and, discounting the exceptionally light pull, they improve the handling of the pistol at least 100 per cent.

The Peacemaker addict is a natural born tinkerer. Likely as not he will object to the big high spur on the hammer of his Single Action, and want to bring it down out of the line of sight, so he can call his shots. To do this, first remove hammer and drive out the drift pin which holds the firing pin in place. Then drive out firing pin from the rear. Clamp lower part of hammer firmly in vise, the jaws of which have false jaws of sheet brass, to prevent marring. Then heat the hammer spur where it joins body of hammer with a welding torch, to a bright red. Keep tip of spur below this heat if possible. Do not pound on the spur, but press it down with a piece of brass shafting, to the position desired. When cool, the hammer will be soft and the sides may be dressed down smooth with a file and polished, after which it should be thoroughly case-hardened. See Chapter 22. Due to the bending the firing pin may not enter to proper depth. The rear end of pin may be ground off slightly, or the hole in hammer may be drilled deeper, using a drill the same size as hole was originally—this of course must be done before hardening the hammer. When hardening, be sure to do a good job on the trigger notch, otherwise the pull will not remain permanent.

Sometimes the hammer spur is cut down smaller before bending, but this is not necessary. Figure 207 shows the Colt S. A. hammer spur as Colonel Colt designed it, compared with two well known al-

Fig. 207

terations, "b" being the Peret, and "c" the Newman hammer, the latter designed to slip from under the thumb, the trigger being removed from the gun.

When the spur is altered the line of sight is not obstructed except momentarily, by the nose of the hammer in falling. A small amount ground from hammer nose will eliminate even this small objection.

ALTERING COLT S. A. REVOLVER TO SHOOT SHOT. Bud Dalrymple, U. S. Hunter, started it all out in Wyoming some several years ago, and wrote so enthusiastically about his six-shooter scatter guns, that he got a lot of mouths to watering for some of the same. I don't know what Bud's method was, exactly, but the following worked out O. K. for me and doubtless will for others:

504

First, secure an old revolver of large caliber, with a barrel that has seen its best days. The .45 Colt S. A. is best, with the .44-40 running a close second. Don't expect satisfactory results from a barrel shorter than 7 1/2 inches. Ten inches would be better, and an old rifle barrel of the right size can be utilized if you have a lathe that will cut the thread. However, the regular 7 1/2 inch Peacemaker barrel gives very satisfactory results.

Remove the barrel and set it firmly in the vise in any convenient position. Measure the bore with a lead slug as described elsewhere, then using the micrometer as a guide, set a 6-blade Critchley adjustable reamer to as nearly as possible the same diameter. Use a die-holder as a handle for the reamer, and use plenty of the soda-water-and-oil cutting compound as a lubricant. Probably the No. 19 or 20 reamer will be required, depending on size of bore and its condition. At first the reamer should turn through just scraping the lands, cutting little or none. After this first scrape cut, set back the adjusting nuts of the reamer not more than 1/16 to 1/8 of a turn, increasing its cutting diameter very slightly. Make all cuts from breech to muzzle, and make the cuts *as shallow as possible*. Remember the reamer blades are nearly half as long as the barrel, and this isn't like reaming a hole in thin stock. A reamer "frozen" in a hole is about the biggest cuss producer I know of. It should take from six to fifteen or more cuts to remove the rifling, and when this is removed, stop. Cast a slug on a short rod and lap the bore freely with No. 120 emery and oil, using long even strokes from breech to muzzle. Then measure carefully the cutting diameter of reamer at rear end of blades, and also at front end. These reamers have from five to eight thousandths taper for about half of their length, to permit easy starting. Whatever the taper on your reamer proves to be, set it that much larger for this last cut, and turn it through the bore until front end of cutting blades are barely even with the muzzle. Thus the bore is choked an amount equal to the taper of front end of reamer.

If the taper is considerable, say seven thousandths, it is best to do this choke reaming in two or three cuts, never letting the front end of blades pass the muzzle—otherwise the deep cut may cause the tool to chatter, or perhaps to stick. Take a final cut without enlarging the reamer, to burnish the hole and help eliminate marks. Then cast a lap about two inches long in muzzle end, so the lap will have the taper of the choke; coat it very lightly with finest emery flour and oil; chuck it in a breast drill, with a rubber hose connection in the rod, as described under instructions for polishing shotgun bores (Chapter 31), and whirl it inside the barrel, at the same time drawing it backward and forward, until the main portion of bore is from seven to twelve thousandths larger than the muzzle, and the tapered choke from one to two and one-fourth inches long. Now polish the bore lengthwise, using this same lap

505

at first, and later another lap, also cast in the muzzle so it has the taper of the choke. Use emery flour at first, until all cross marks and reamer marks are out, and the bore brightly polished; then use the various finer abrasives recommended elsewhere for bore polishing.

Apparently a shot charge fired from a pistol barrel is more easily affected by a damaged muzzle than when fired from a shotgun barrel of average length; so it is recommended that the muzzle be carefully crowned to assure its being square and true.

Before putting in the barrel, remove the cylinder and ream the chambers carefully to remove the slight shoulder at the forward end. Use an expanding reamer of the proper size and be sure not to enlarge the body of the chamber one bit. Set the reamer so that it barely cuts in the neck portion; expand it a very little each cut; use plenty of the cutting lubricant, and when the blades show signs of touching the chamber walls in the larger end, stop. Follow instructions given in Chapter 27 for lapping and polishing chambers to same size, using great care to enlarge them the least possible amount. Most Single Action chambers are sufficient oversize to begin with, without making them larger.

Now check up on the action of the gun, make any necessary repairs or adjustments, see that the cylinder aligns properly, and screw in the barrel. But first measure the bore at extreme breech, and "throat" it to about fifteen thousandths larger than front end of chambers. The best tool for throating is the G. T. D. spiral fluted burring reamer No. 246, with T handle, tapering from 1/4 to 2 inches; and the best way to use it of course is in the lathe, with the handle removed; but lacking a lathe turn it by hand. The throat should extend forward into the barrel about 1/4 inch. After reaming, polish out the throat with a lead lap cast to fit it, and a little fine emery and oil. No great amount of polishing is necessary here—just smooth up the cut and get rid of tool marks.

Do not set the barrel tightly in the frame yet. It makes no difference if the sight does lean off to one side. Pattern the gun with different size shot at ranges of 10 to 25 yards and see what it does. It may be necessary to lap the muzzle a bit larger, or perhaps to increase the choke by enlarging the main portion of the bore. Keep at it until it suits you, at the same time experimenting with loads until you have the right combination of shot, powder charge, bore and choke to enable you to bowl over the festive bunny up to twenty yards or more, or to shatter the head of a diamond-back at forty feet, and you'll say the fun is well worth the trouble. When you are satisfied with the pattern, set the barrel in tight; bring the pattern where you want it by bending the front sight right or left, and filing it down as required—or put in a Marble or a Lyman ivory shotgun front sight.

Any large caliber revolver may be adapted to shoot shot in this

506

manner, and in addition to the fun it provides in woods or field, it should prove excellent medicine for the midnight intruder—without endangering the neighbors in the next block. Ammunition must of course be made up special, which will make one of these six-shooter shotguns an attractive proposition to the handloading nut of an experimental turn of mind. To provide sufficient pressure to burn the powder charge cleanly, it will be necessary to crimp the case muzzle heavily over a stiff card wad. Experiments should start with black or semi-smokeless powder, or bulk shotgun smokeless, although I imagine a load could be worked up with du Pont No. 80, and perhaps with Bullseye or No. 3 or 5. I have altered but one gun in this manner, and the owner is now doing the experimenting with loads.

I have often been asked for a dependable method of preventing the frame screws from working loose in the S. A. Colt. I know of just two ways of overcoming this difficulty. One way would be to tin the screws and sweat them into their holes so they couldn't work loose—and the other, which I follow with my own guns, is to carry a small screwdriver and tighten the screws every few shots. If anyone has a better suggestion, it will be thankfully received.

507

CHAPTER 33

RESTORATION AND REPAIR OF OLD FIREARMS

THIS is always an attractive subject to the dyed-in-the-wool gun crank, and one in which even the most skillful mechanic can make serious mistakes. The acquisition of some old-timer from the attic or the pawnbroker's window immediately releases the imagination, conjuring up pictures of how the ancient weapon must have appeared in all her youthful glory, and an uncontrolled yearning to restore her pristine vigor. Yet the misguided efforts of well-meaning gunowners frequently bring about results as ghastly as a snowy-haired grandmother in lip-stick and mascaro smoking gold-tipped cigarettes. Modernization *can* be carried too far, for while Daniel Boone undoubtedly possessed the stamina to enable him to make a very respectable drive from the first tee—we do not care to think of him in tweed knickers and fancy sox. As a friend of mine stated it recently, "Adam would have looked like hell in a plug hat."

Some splendid thoughts along this line have been expressed by Captain John G. Dillin in his book "The Kentucky Rifle"—the which should be in the hands of every lover of firearms, by the way. Captain Dillin writes from the standpoint of the collector when he states:

"Should the collector, discovering inherently fine examples in such condition pass them by or, acquiring them, feel a hesitancy in restoring them and regarding them as fit for inclusion in his collection as originals? There would seem to be no good ground for such a course, *provided that the restoration is accomplished by honest replacement with old parts, whenever available, and that the period of the piece is faithfully retained.*"

"In instances where the collector is desirous of putting the piece into shooting condition, as many of them do today, it may be considered permissible to remedy such small defects as missing frizzens, springs and even pans by the fitting of new parts, if the parts are honestly hand made, and not mere cast iron junk."

I have frequently refused (to the extreme disgust of the inquirer) to accept a job of altering or remodeling an old firearm which would cause it to loose its original identity. Not long ago a man was somewhat put out because I strongly advised against his pet idea of remodeling an ancient cap-and-ball Colt to shoot the .38 Special cartridge! He had the details all planned, and wrote me long letters full of sketches and explanations of welding, drilling and bushing operations. I begged him to give the old gun a square deal; to retire it honorably from service, as it deserved. I explained carefully that the work he demanded would run into more dollars than the cost of an Officer's Model, or an S. & W. Military, target grade. He shed all arguments like a duck sheds water, and has no doubt by this time found some chap with a lathe in the back end of a garage who will jump at the chance to desecrate the honorable weapon.

When I have fired my last shot and passed on to my everlasting reward or punishment as the case may be, it is my fond hope that I may be able to return to this "vale of sorrers" long enough to plug up the barrels of the guns I leave behind me, should they fall into the hands of those morons who wish to adapt them to use in a future century.

THE RECONDITIONING OF AN OLD GUN, provided it is not wholly beyond repair, is perfectly legitimate both from the standpoint of the collector and of the practical crank who wants to shoot the gun. Whatever work is done on it however, should be with the idea of making it truly typical of its period. If the finish is to be restored it should follow the original finishing process, if this is known, or at least one of the processes of the period in which it was built. The grafting of a pistol grip to the stock of a fine old percussion rifle is nothing but sacrilege, for it disposes of the ornamental brass guard which served the first owner in lieu of a pistol grip, and gives no conception of the feel or handling of the arm in its days of service. Yet I have seen a man proudly display a high grade and perfectly authentic flint-lock rifle, to which he had fitted a Lyman peep sight.

It is entirely permissible, of course, and often most interesting and practical, to remodel certain obsolete types of arms making them useful as more modern sporting weapons. But a gun that is rare, and of real historical value as representing the type in use during a certain period, should have its original condition preserved. Many a man who lacks appreciation of an old gun's worth, will want to "have dad's old musket made over into a britch loader," in the common fallacious belief that "they used better metal in them days." The fact is that the converted muzzle loader is about the most useless and unreliable piece of hardware a man ever carried afield. Its barrel and breech action lack the strength necessary for shooting modern ammunition—yet its owner may proudly boast of its superior

quality to the best products of the factories today. I had occasion recently to see the result of shooting a heavy charge of Ballistite in a fine old Damascus barrel; it simply unwound itself as from a mandrel. The only bright spot of the occasion was that the erring owner received a rather severe cut on his cheek as a fitting retribution for feeding hard licker to an old timer that should have been on a milk toast diet.

The collector who secures a really good antique arm, will be desirous of bringing it into the best possible state of preservation, and possibly putting it into shooting condition. He should enter upon the task advisedly, and after mature deliberation. Often a real treasure may be found so encrusted with rust and the dirt of years that its identity is hidden—and hasty or injudicious use of harsh cleaners may quickly ruin it.

The first step should be a careful and minute inspection of all parts of the gun with a good reading lens, or, better, a jeweler's magnifying glass. Look particularly for cracks in the stock near the breech. This seems to be the weak point of most of the old stocks. If cracks are in evidence, the greatest care must be exercised in DISMOUNTING THE GUN, to avoid increasing them.

Having become familiar with the gun's exact condition, remove the stock by first taking out the wedge pin or pins in the forend. Use a piece of hardwood to drive with, and be careful—the pins may be rusted fast. The breech pin tang may or may not have a screw extending down into the forward portion of grip. Remove this carefully with a strong well fitting screwdriver. Then lift out the barrel. Sometimes the underside of barrel will be rusted, causing it to stick in the wood. A few light taps with a block of hardwood should loosen it without damage.

Next remove the breech pin using a smooth jaw wrench, and holding the barrel firmly in vise, with the jaws protected by sheet brass. Now carefully inspect the bore. Very likely it will be so covered with loose rust as to make any definite idea of its actual condition impossible. Secure a strong steel rod long enough to reach clear through, and thread one end to take the brass wire cleaning brushes. Give the barrel a thorough brushing dry, and shake out the loose rust. Now dip the brush in Hoppe's Nitro Solvent, and scrub it thoroughly. Swab with several dry rags, and inspect carefully.

This scrubbing with brass brush and No. 9 may be continued for hours in many old barrels, the rust, like Tennyson's brook, seeming to go on forever. Much labor may be avoided by corking one end of bore and pouring in a bottle of the oil, letting it soak for several days, following this by a good scrubbing, and further swabbing with cloth patches, until the true condition of the bore may be noted. If desired merely to clean up the gun, this is about all the cleaning the bore should have, except that it should have several quarts of

boiling water poured through it to kill further rusting action, after which it may be polished with oiled patches and finely powdered pumice.

If you want to put the barrel in shooting condition, further work will be necessary. First wrap a small quantity of fine steel wool round an oiled patch on the cleaning rod, and scour the bore a few times with it. This gets to the bottom of the pits, knocking out any more rust that remains, and gives you an idea of their depth. It is now up to the owner to decide whether or not to lap the bore—and the decision will be governed partially by its size. Measure the land and groove diameter carefully, and look for some source of ammunition. If you have a mold about the right size, find out if the ball it casts can be used in the rifle. If it just slides down the bore loosely, it may be right with the proper thickness of patch. If the ball is too tight, you will be safe in lapping the bore considerably. If too loose, or if it appears that it will be too loose after lapping, a thicker patch may solve the problem.

Having decided to lap the bore, follow instructions as outlined for more modern arms as explained in Chapter 26. In very rough barrels it is permissible to start the lapping with rather coarse valve grinding compound made of carborundum. Follow this with further lapping with finer abrasive, and finish with No. 120 emery and oil, casting a new lap as the ones you are using become too loose.

RECUTTING A BORE. When a barrel is in very bad condition it may prove quicker and more satisfactory to rebore and rifle it. This can be done without any special equipment such as the gunsmith used in making the barrel; even a lathe is not necessary. Use a lapping rod about 1 foot longer than the barrel, and with a strong swivel handle. Turn up a steel head for the rod as shown in Figure 208, with a slot milled in the flattened portion to hold the cutter or "saw." This head should be a smooth sliding fit in the bore. The saw is made of tool steel, the cutting edge slightly rounded as shown, and its thickness should be equal to the grooves in the barrel. The shank above and below the cutting head should be roughly jagged to hold lead.

Before fitting the cutter into the slot, insert this head, which should be strongly welded or brazed to the lapping rod, clear through the barrel so that its upper end stands 1/4 inch below end of bore. Pour in melted lead to form a lap on this end. Now draw the rod toward other end of barrel, until the head stands three or four inches below the end, and holding the rod carefully centered, pour in melted lead, forming a second lap, as shown. These two laps are merely guides to assure the cutter following the grooves. The cutter slot may be milled in the head after the two laps are cast, the lands on the lead forming an accurate guide for the location of the slot. The first laps used for this purpose should be melted off and new ones cast as just described for the actual work of rifling.

511

After the final laps are cast, withdraw the rod just enough to expose the cutter slot; insert the cutter, coat laps and cutter liberally with oil (preferably lard oil), and push through the bore until the end of cutter partly projects from the opposite end of barrel. Now draw the rod carefully the full length of barrel. Note whether the cutter has "taken hold." If not, shim it up with thin paper until it does. The sloping bottom of the slot in head permits a release of pressure on cutter during return stroke, thus preventing wear to the teeth. When the cuter will just start cutting, count carefully the number

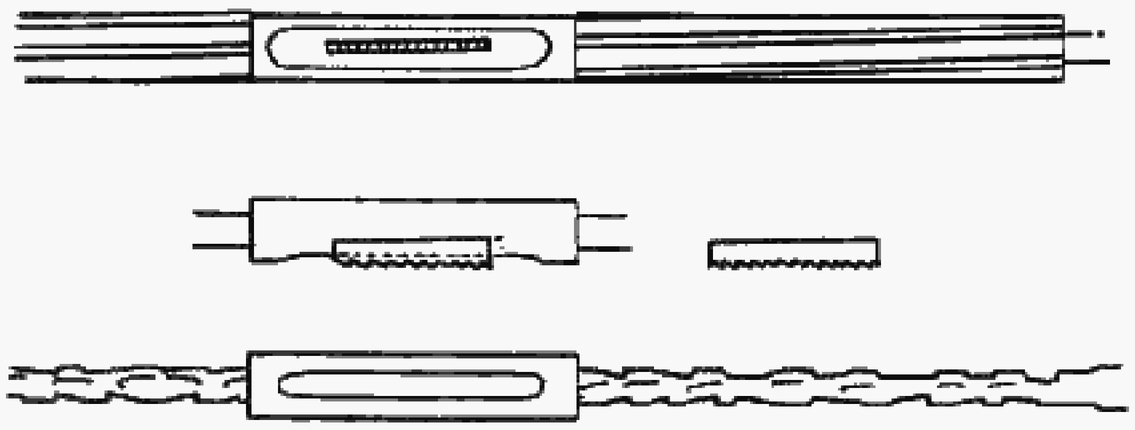


Fig. 208

of strokes made with it to deepen the groove the required amount. And be sure that you use the same number of strokes in each of the other grooves.

But to get back to this first groove we are working on. You can tell from the feel of the rod when the cutter is jumping over deeply pitted or corroded spots. The moment you get a full smooth cut, remove the entire head very carefully, after marking on muzzle of barrel the exact point at which the cutter came out. Inspect the groove you have been cutting, and if clean and smooth from one end to the other, stop working on it. If pits still show, and you think it will stand deepening a bit, replace the cutter carefully in the same groove, and continue a few more strokes. An extra thickness of the shimming should be used whenever the cutter stops taking hold.

Now remove all the shims and in like manner start in on the next groove. From now on you cut the exact number of cuts in every groove, regardless of whether all are properly cleaned up or not. When all grooves have been cut, if pits still show, select the groove having the deepest ones, and make a sufficient number of cuts in it to remove them, then a like number of additional cuts in all other grooves.

I should have mentioned that the better plan, when changing the cutter from one groove to another, is to melt off the old lap and cast a new one each time. This is not always necessary, but many old rifles do not have the grooves spaced evenly, and the new lap is advisable to avoid running the cutter against the side and widening the groove.

512

Before you started cutting, you should have made a small sulphur cast of the bore at the muzzle, and measured the full groove diameter. Now make another cast and measure groove diameter after the cutting. The bore should now be enlarged a corresponding amount, more or less, so that the grooves may be about the same depth as they were originally.

A straight spiral reamer should be ground to about .0015 less than the final diameter required. This reamer should be six inches long if possible, and should be relieved for a distance of 1 1/2 inches to enter the bore smoothly. Wrap the reamer in soaking wet rags, and braze the shank firmly to a long steel rod almost the full diameter of the reamer. Attach a strong handle, and ream the bore carefully full length, using the soda water and lard oil cutting compound mentioned in Chapter 31. There is little space between reamer head and the large part of shank to receive the cuttings, so the reamer should be removed frequently and chips carefully brushed off. *Use plenty of cutting compound.* Be sure the reamer is not oversize for any point in the barrel, and if it stops do not try to force it. Remove it, and you may find a cutting or two jamming the cutting edge or clogging the grooves. Do not cut for more than an inch or so before removing the reamer and cleaning off the cuttings.

When you have reamed clear through the bore, wash out with boiling water and dry thoroughly. Cast a regular lap and lap the bore for as long as necessary to remove all cross marks from the lands, and give it a bright polish. Thus you have rebored and rifled a barrel without changing the original pitch or rifling, and very little special equipment has been used on the job. Before the final polishing you should check up on the bore diameter and its suitability for the ball you purpose using. It may be necessary to either find a new mold, or to lap the bore a trifle larger.

The reason for cutting the grooves before reaming the bore is that the old grooves provide a certain means of guiding the cutter for the new cuts; while reaming the bore might eliminate the grooves, leaving you with no cutter guide, if the reaming were done first. This method is entirely practical in old style barrels having very narrow grooves; but I would question its practicability in a barrel with wide grooves and narrow lands. Undoubtedly the lands would be damaged by the reamer. It will not work in a rifle with "gain" twist.

CLEANING OFF RUST. Having either cleaned, or re-cut the inside of barrel we next turn our attention to the outside. Often it will be encrusted with rust, and the original finish completely obliterated. If it is desired not to rebrown the barrel, try liberal applications of Hoppe's No. 9 followed by careful scraping with a scraper made of soft or half-hard brass, with edge filed square like a cabinet scraper. A piece of printer's brass rule is fine. This may be followed with a brass wire brush, using plenty of No. 9, which

513

is the best rust solvent I know of. This treatment will leave a slight deposit of brass from brush and scraper, which is removed by vigorous rubbing with curled hair such as is used in stuffing upholstery, or a piece of coarse woolen cloth, with plenty of oil. If the barrel smooths up nicely with a good deep brown color, very light buffing on a soft steel wire buffing brush will burnish it and improve the finish. Then heat the barrel by pouring boiling water over it until it is as hot as the water will make it. Dry quickly and rub with a woolen cloth and linseed oil. When cool, wipe off the oil and rub barrel lightly with a dry cloth.

This method of cleaning may also be used on lock plate, hammer, and other steel or iron parts.

If one is desirous of imparting a brand new finish to the entire arm it will be necessary to strike the barrel and polish barrel and all parts as described in Chapter 18, then reblue or rebrown. For old muzzle loaders the Zischang bluing solution mentioned in Chapter 20 is the best I know, as it gives a finish comparable to that used by the best makers of the old days. On soft iron barrels it will give a deep brown rather than blue or black, which is just what you want. Or you can follow the method of many of the backwoods gunsmiths, of rusting the barrel by repeated applications of pure, strong cider vinegar,—scratching off the rust each day and applying more vinegar until the color is as desired. A final boiling is necessary to stop the rust.

The breech plug should receive careful attention, as well as the threaded portion of barrel into which it screws. Scour the threads clean of rust with a stiff brush dipped in Hoppe's No. 9, wipe dry, and oil. The threads on breech plug may be cleaned by buffing on steel wire buffer. You are likely to find that the removal of rust has made the threads somewhat loose, so that the plug can be turned past its normal stopping point. The practice of the old gunsmith was to place a thin sheet lead washer between shoulder of plug and end of barrel, and tighten the plug up firmly against this washer, which was then trimmed down smoothly on the outer edges.

The flash-hole and pan of a flint-lock should be freed of rust by scraping with brass and careful brushing, using plenty of Hoppe's No. 9. Brass scrapers should be filed or ground to shapes that will reach into all curves and hollows. It is permissible to polish out the inside of pan and the bottom of frizzen which covers the priming with fine emery cloth, liberally oiled. Clean out the touch hole with brass wire, being careful not to enlarge it. If badly enlarged by rust, it will be necessary to drill the hole clean with a twist drill, and bush it. This is easily accomplished by reaming the hole to fit a standard taper pin. The pin should be annealed by heating red hot; then chuck it in the lathe and drill the touch hole usually about 1/16 inch diameter. Reharden the pin and drive it snugly into the reamed hole, then dress the upper end down flush with surface of

514

pan. The dental engine and carborundum points mentioned in Chapter 4 will make a perfect job at this point.

Check over the lock mechanism carefully for broken or damaged parts. Soak the parts in Hoppe's No. 9, scour them with a steel wire brush, and if absolutely necessary, polish them with fine emery cloth and oil. In most cases the springs will not be badly rusted, their hardness and the fact that they were kept well oiled, having protected them somewhat. *Do not use a file on the springs.* Merely polish them clean. If a spring is broken, either make a new one exactly like the old one, or better still, obtain a genuine old spring of the same type. Many old gunsmiths and some collectors and dealers have large stocks of parts picked up in the course of their work. Mr. George L. Moore, Route 3, Rushville, Missouri, has a very large assortment of such parts, including cast brass and silver fittings, complete locks, set triggers, and old tools of all kinds. He has purchased the complete layout of tools and supplies from several old shops, whose owners have died long since, leaving their treasures to the tender mercies of unthinking heirs.

Sometimes THE MAKING OF MISSING PARTS which cannot be secured by any other means, involves a job or work that will stump the best mechanic. The filing out of a flintlock "cock" is a piece of file sculpture calling for perseverence and ability; and the harum-scarum chap who is inclined to become impatient, should keep in mind a picture of the backwoods gunsmith with his crude home-made tools, whose skill and patience enabled him to produce the entire gun with much less efficient equipment than is possessed by the average amateur.

The replacement of damaged screws can sometimes be accomplished by the use of standard machine screws. More often, however, it will be found necessary to have some of them made on a lathe, in which case the size and shape of the original screw should be faithfully followed.

Often there will be found some small broken part in the mechanism of an old gun which it is not intended to put into shooting condition. In such instances it is usually best to repair and use the original part. The average jeweler is well equipped to hard-solder such small parts as the cylinder hand in an old revolver, for example, and such work had best be entrusted to him if you are not certain of your own ability to turn out a good job.

Brass trigger guards, brass or silver inlays and other decorative pieces should be handled judiciously. They often acquire, through age and from atmospheric surface oxidation, a rich, dark "patina" that is much admired by collectors; and this appearance of age will surely be destroyed by polishing the surface. If gummed and dirty, try first washing the metal with a little ivory or castile soap suds on a rag wrapped around the fingertip. If the gummy coating persists, scour if off carefully with rottenstone and linseed oil. The

515

reason for using linseed instead of a thin oil is that it will not damage the wood around the parts. After cleaning, wipe the remaining oil off with a soft cloth, then rub with a soft chamois.

One should enter advisedly upon the cleaning up or REFINISHING OF AN OLD STOCK. Like various metals, wood also acquires a rich dark "patina" with age and use; and its appearance is far more appropriate on an antique arm than a finish that looks like it might have been done yesterday would be. Quite likely the stock will be badly gummed with dirt and grease. It is often a good plan to carefully wash the surface with a rich white soap lather on a rag; do not have the rag dripping, but have the lather thick, and do not rub too hard or too long. Rinse out the rag in clean water, wring it nearly dry, and wash off the soap immediately. Dry with a soft clean cloth. This washing must be done very quickly, so that no water may soak into the wood. Then hold the stock near a blaze for a few moments to remove any remaining moisture, but do not get it hot.

If this leaves a coating on the stock, or if it fails to bring out the original finish, dip a small wad of cloth in linseed oil, coat it with the finest powdered pumice, and rub lightly until all accumulated dirt and gum have disappeared. Wipe off the oil and pumice, then go over it with linseed oil only; wipe this off entirely dry. Then mix: White shellac in alcohol, 1 part; raw linseed oil, 1 1/2 parts; light gun oil, 1 part; color if desired with alcanet root or oil soluble red; add two teaspoons turpentine and 1 teaspoon acetone to one pint of the mixture. Shake well, and apply a very small quantity with a wad of soft cloth, rubbing briskly, and taking a clean place on the cloth as it becomes dirty. It is surprising what a quantity of dirt this mixture will remove after you think the stock is clean. Rub fast and there will be no sticking or gumming tendency; the oil in the mixture will leave a light moist coating, which should be rubbed in with the bare hands (wash the hands first), then polished dry with soft woolen cloth.

There are few stocks that are improved by complete refinishing—this cleaning up process removing the dirt and gum, and actually deepening the rich tones that have come with age, without impairing the finish in the least. On a stock that is in very bad shape, use the finest steel wool obtainable, and have it well oiled with a thin gun oil. If done carefully and lightly, this will not injure the old finish. Complete the job with the above described mixture.

OLD PERCUSSION GUNS are usually of less value in a collection than flintlocks; one may be warranted in making more changes to put them in shooting condition. New tubes or nipples are nearly always needed, and these can be obtained from gunsmiths, or from Schoverling, Daly and Gales, New York City; Gus Habich, Indianapolis, Ind.; or Geo. L. Moore, Rushville, Mo. Old percussion hammers are often "burned" and corroded on one side where they

516

strike the cap, and when in this condition they should be replaced if possible.

BROKEN STOCKS. Old stocks that are badly damaged can often be repaired almost good as new; in some instances the repair being nearly invisible. The first thing to do is to place the stock in a tight closet with two formaldehyde candles (obtainable from most drug stores) and allow the candles to burn until all consumed. Do not open the closet for 24 hours. The fumes will kill off any worms, borers or other insects that may be in the wood, and will not damage the silver or brass inlays, if any. Worm holes should be filled with small walnut or maple pins whittled to fit, and set in du Pont Cement, then filed off smooth with a very fine file, and the place polished over.

A stock that is broken or split at the grip should, if the break extends deep, be broken entirely in two, then cemented with du Pont cement and firmly clamped for several days until dry. Be sure the clamp or vise is well padded to prevent marring the wood. If the shape is such that it cannot be clamped, bind it firmly with wet green rawhide, which in shrinking will hold as tightly as a vise. When using rawhide, first cover the stock with a layer of adhesive tape so the moisture from the rawhide will not damage the finish. Or, the stock may be coated with a thick layer of rubber cement which after drying will protect the finish. The layer of cement peels right off later.

Sometimes it is possible to use one or more screws in the stock, as described in Chapter 14.

Where the wood is nicked or chipped or has pieces broken out and missing, it is necessary to inlay similar wood. Building up with Plastic Wood is not advised, as it will not match the stock so well. Pieces of scrap walnut or maple, or whatever wood the stock is made of should first be aged to match the stock as well as possible. Rig up a small box with a tight fitting lid, and seal all cracks with strips of paper or tape. Put the wood scraps in the box, with a small bowl of stronger ammonia (26 to 28 per cent gas) and leave for several hours until the fumes have aged and darkened the wood. Another way is to make up a small quantity of Zischang bluing solution (Formula No. 5, Chapter 20), and while the wire nails are dissolving in the two acids, place the wood pieces in a wire basket and hang them in the top of the mixing jar, where the thick vapors from the mixture will surround them. When darkened sufficiently, wash the wood thoroughly in clean water, and let dry several days before using. The patches or inlays should be cut almost to size and shape before this artificial "aging" as the color may penetrate only a little way below the surface. Sulphuric, Nitric, Hydrochloric and various other acids, both straight and in solution, may sometimes give just the color desired. They should be used quickly, however, and washed off thoroughly when the color or shade desired is obtained.

517

Ferric oxide, or red iron rust, dissovled in a little ammonia, and painted on often proves to be just the ticket.

Fit the patches or inlays carefully, using a sharp file to shape the edges, and bring them to as tight a fit as possible. Any rotted or splintered wood must of course be cut out of the old stock, and the patch shaped to fit. Cement with du Pont cement, and clamp or bind until dry. Finish the patch to shape by filing with a fine file, then polish with finest sandpaper, then crocus cloth. Get as high a polish as possible on the bare wood. Then take a scrap from the same piece used in the patch, and oil it with boiled linseed oil. Compare the color with the old stock. Chances are it will be much lighter. Let the oil soak in over night and again compare it. This test should be made before you attempt to finish the patch. If the oil on the sample piece does not darken it sufficiently, it may be necessary to stain the patch. Use Johnson's Wood Dye or Ad-El-Ite Stain—and try it on a scrap before risking the patch. After the patch is the right color and the stain has dried for a least a day, rub over the patch with: orange shellac in alcohol, 4 parts; boiled linseed oil, 1 part; spirits turpentine, 1 part; spar varnish, 1 part. Rub fast, and immediately wipe off all surplus and rub with bare hand. If the spot shows up light, darken the mixture with alcanet, oil soluble red, burnt umber or any other suitable coloring, and repeat application until the color is right. Let dry, and polish the whole stock, after which the patch will scarcely show at all.

The foregoing contains, I believe, all the essentials for cleaning up almost any antique firearm and putting it, if not into shooting condition, at least into shape to present the best possible appearance in a collection. There is no occasion for relining of barrels on such pieces, nor for more extensive alterations which would cause the gun to lose its identity. Old shotguns with barrels badly rusted had best be left with merely a careful cleaning, as lapping or polishing out the bore is likely to make the barrel walls so thin as to run toward the danger point. These old shotgun barrels were thin enough in the first place.

IN CLEANING UP OLD STOCKS, under no circumstances should colored varnish of any description be used. This sort of work is the mark of the rankest amateur who neither knows nor appreciates the gun's value, nor the beauty of original finish. All he is after is the "shine"—and he probably considers the finish of a new John Deere plow as superior to the finest gun in the world.

Sometimes one will pick up a fine old gun on which the stock has been covered with shellac, colored varnish, or even paint, concealing a piece of wood of rare beauty. Such a coating should be carefully removed as follows: Use either a standard paint remover, or mix 3 parts acetone with 2 parts grain alcohol; spread this on a small spot about as big as your hand, and leave for a few minutes

518

until the finish softens, then scrape it off carefully with a blunt edged table knife, and immediately wipe off the remover. Take another spot in the same manner and continue until all this coating is off, then go after the small streaks and spots that remain. Using the remover in this manner will not seriously affect the original finish, whereas if used according to instructions and the entire stock well soaked with remover, the finish underneath will likely be ruined. After this cleaning, wash the stock lightly with white soapsuds, then with clean water, dry thoroughly and finish as described.

Speaking of painted stocks—I, believe the maddest gentleman I ever saw was a collector friend of mine, to whom an old lady down in the Ozarks had promised a fine old spinning wheel that had been stored in the attic for half a century. On his return a week later to get it, he found that in her eagerness to please him, she had given it a lovely coat of pea-green enamel, with gilded rings on the legs, and a basket of flowers "transferred" on the side of the wheel! This party was still cussing roundly as he drove into town with his "new" spinning wheel some six hours later, and who can blame him? The idiot who will perpetrate such an outrage on an old gun undoubtedly deserves no less than hanging, and if drawn and quartered into the bargain he will get no more than his just desserts!

Often an old muzzle loader will be found with RAMROD, THIMBLES, AND RAMROD SOCKET missing. The new ramrod, if a genuinely old one cannot be found, should be planed nearly to size from a straight-grained split of white hickory, then scraped to final size with broken glass, sanded, and finally polished with pumice stone on a rough cloth. Then it may be darkened with ammonia, and some orange shellac, with 10 per cent. of linseed oil added, rubbed in with a rag. Work fast, and with long strokes, and the rag will not stick, and the shellac will be dry before you stop rubbing.

Thimbles are made by bending sheet brass around a steel rod as shown in Figure 209; the turned out edges are trimmed down narrow, their surfaces carefully tinned, and sweated to the barrel. Sometimes sheet silver is used, or German silver. Ordinary soft solder may be used in either case, but a good jeweler's medium hard solder will be found superior. The spot on underside of barrel where the thimbles are to be soldered must of course be scraped bright. Very good thimbles may also be made by cutting a short piece of thin brass tubing of the proper size, flattening it slightly on one side, and soldering to the barrel. When the wood of the stock extends clear to the muzzle, the thimbles should be bent from sheet metal as first described, the lips or wings being left sufficiently long to insert through a slot cut in forend. They are then spread back on both sides, and countersunk their full thickness into the wood, the pressure of the barrel holding them firmly in position.

519

The socket or tip on the forend into which the ramrod is inserted is usually a brass, silver or German silver casting. If such a tip cannot be had from one of the dealers already mentioned, a pattern may be carved from soft pine and sent to a brass foundry; or if one has a forge or other suitable means of heat, he may make his own casting, using a mold of fine sand, stiff clay, or plaster of Paris. The casting is them filed to shape and size, drilled, polished, and finished to the color desired (See Chapter 20). A butt plate can be cast in the same manner as well as a trigger guard. I have seen a number of these parts in Mr. Moore's collection which show that they are crude sand castings, made in the smith's forge.

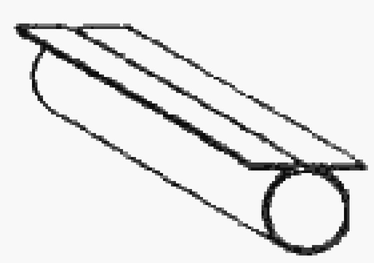


Fig. 209


Fig. 210

The tip of the forend at muzzle was usually covered with a lead cap in the older guns. If missing, this lead piece is easily replaced. Sometimes the wood will be damaged or broken at this point, in which event an inch or so may be cut off and a new tip cast in place. The wood should be shaped up into a tenon, and the tenon undercut as shown in Figure 210. Then wrap barrel and forend with stiff strong paper, letting the paper wrapping extend an inch or so above the muzzle. Spread a layer of soft clay or plaster of Paris over the outside of paper, and pour in a sufficient quantity of melted lead to fill the space between paper and underside of barrel, completely covering the end of wood tenon. Remove the paper, and file the lead smoothly to shape.

RE-CONDITIONING ACCOUTREMENTS. Often the fortunate collector will find with an old gun the powder-horn or flask, leather hunting bag containing mold, pick and other implements. In other instances he will be able to assemble these things by picking them up from various sources. They too should be carefully gone over and cleaned and reconditioned, with due regard to their natural deterioration after years of disuse.

The powder horn may show cracks; if not bad, let them alone. Sometimes it is possible to force a little du Pont cement into the cracks, joining the edges firmly. Clean the horn by washing in white soap suds (cold), same as you did the stock. With toothpicks clean out the accumulation of dirt in the engraving or carving, if any. Polish the horn with fine powdered pumice rubbed on with the palm of the hand; wipe off with a damp cloth and polish dry; then rub briskly with the hand with a very little neat's foot oil, which will relieve the brittleness.

520

The mold, pick and other small items should be cleaned free from rust, but complete polishing had best be omitted. If desired to use the mold for casting bullets, soak it a few days in Hoppe's No. 9, and scour the inside with a brass wire brush. If badly rusted, cut a 3 inch piece of drill rod, file one end rough and jagged, insert it partway into the mold with the screw-cutter turned to one side, and cast a bullet around it. With this as a lap, the other end of rod being held in the breast drill, you can easily lap out the inside of mold to a good smooth surface, although this will of course enlarge it slightly. Use fine valve grinding compound for the first lapping, then cast a second lap and finish with the finest emery flour and oil.

The old leather hunting bag will doubtless be hard and brittle, both the bag and strap ready to break if the leather is bent or folded. Empty bag carefully and clean out all dust and litter, then immerse it for three or four hours in a pan of warm (not hot) water. Shoot a couple of squirrels or other small animals and put their brains in a cheese cloth bag; stir this in the water and squeeze out the brains until the mixture is milky. As soon as the leather begins to soften, work it gently in the hands, always under water, until soft and pliable. Then remove from the water and dry slowly, away from artificial heat, working it in the hands occasionally while drying, to prevent hardening. When nearly dry, apply neat's foot oil liberally, working it clear through the leather. Let stand a few hours then wipe off surplus oil. Wring and work the leather, wiping off oil as it comes to the surface, until it is as dry as you can make it. After a few days, clean with English saddle soap, which will give a good surface appearance and make the leather nearly like new. It is astonishing how much of the original strength can thus be restored to old leather that is ready to break and fall apart due to drying out of the fibres.

This method of using brains in dressing leather is one that was often employed as a tanning process by the backwoodsmen of a century or more ago, resulting in a very soft, tough, flexible leather. If squirrels are out of season, and the neighbor's tomcat crawls under the house, try a few hog brains from the butcher shop.

Chapter 34

EMERGENCY AND FIELD REPAIRS

THE man who has the misfortune to break or damage his rifle in the middle of his trip is in a bad way, as a rule. Unless the damage is such as can be repaired in the field, and unless he has at hand a few emergency tools and repairs, the hunt is over for him right there and then. The repair need not be of a permanent character, but it must be such as will enable him to use the gun for the balance of the trip. With this in mind, the thinking sportsman, unless he is able to afford and carry along more than one gun, will be sure to include in his duffle a few tools and materials for use in such an emergency.

Just how much of a repair kit can be carried depends on the length and nature of the hunt. The man out for only a few days and "going light" must cut the list down to fundamentals. If the trip is to last a month or longer, and if there are several in the party, with packhorses or burros or other suitable means of transportation, then it will pay to include a small but rather complete tool chest.

The individual who hunts alone, or with only a guide or friend, and packs his own equipment, will find the following equal to most emergencies, and requiring minimum space.

1 Starrett Combination hand vise No. 86, with clamp. This may be converted into a small bench vise, and clamped onto a fence, a board or other convenient place.
1 Starrett No. 162 B pin vise.
1 8 inch flat mill file, 1 6 inch 3-square file.
1 6 inch side cutting pliers.
3 or 4 short pieces of small drill rod in sizes needed for pins, etc.
1 small hammer, 2 hacksaw blades, 8 inch.
1 large short-handled screwdriver, 2 or 3 small screwdrivers.
1 small roll acid-core wire solder, 1 small radio soldering copper handle cut off.
1 small roll 24 ga. copper wire, 1 small box assorted brass wood screws.
1 stick prepared glue.
1 10 yard roll 2 inch surgeon's adhesive tape.
2 ft. length rubber tubing with metal tube in end.
Spare parts, such as springs, sights, strikers, extractors, etc.
1 good strong pocket knife.

This may sound like quite a list of stuff—but it will pack into a space no larger than your lunch or camera, and weigh only a couple of pounds or so. The combination hand vise is almost essential if you have a really serious repair to make on a sight, or any filing of parts to do. The pin vise enables you to make any size drift punch needed by merely cutting off a short length of drill rod and setting it in the chuck. The hammer should be very small—a four or five ounce ball peen machinist's hammer with handle cut to 6 or 8 inches; for heavier hammer work, use the small axe which is a part of your regular equipment. The screwdrivers should be selected according to the size screws used in your gun. The hacksaw blades may prove essential—they can be used without the frame as one uses files for small repair work, and take up practically no room. The soldering copper should be the small one sold in ten-cent stores, and the handle cut off leaving the total length about 6 inches. The shank should be sharpened. Then it is easy to whittle a handle from a piece of green wood, drive it on, and discard the handle when through using it.

The rubber tubing, into the end of which is fitted a 6 or 8 inch length of light brass tube, makes a forge of your open campfire—just get a good bed of coals between some rocks, insert the metal tube into base of fire, and blow through the rubber tube. The soldering copper is quickly heated for use. This is also a good stunt for starting a campfire when the fuel is damp and the fire cranky.

Prepared stick glue is made as follows: Take a quantity of white flake glue and cover with cold water. Let soak over night in the gluepot, then heat until it is simmering slowly, but not boiling hard. Let simmer until it has the consistency of thick cream. Roll tubes of parafined paper about 3/4 inch in diameter, pour in the glue, and let it set. A tablespoonful of glycerine added to the glue and well mixed just before pouring will improve it. About 4 inches is a handy length to make the sticks.

To use this glue, as for instance in repairing a broken stock, first warm the broken ends of the wood; peel the paper from the stick of glue for about an inch; heat this end by dipping in boiling water, or holding in a clear flame until it runs like sealing wax; rub it quickly on the wood, and bring the two ends firmly together, holding them until cool.

A stock broken through at the grip is a common accident, and a very disconcerting one also. Yet such a break can in most cases be repaired in the field to give good service, although the appearance will of course suffer.

The nature of the repair will depend on the break. If nearly square, some sort of dowel or pin is almost essential. Colonel Whelen described a repair which he made by filing a large nail to a point at each end, drilling holes for it in each broken end of the stock, and forcing the nail into these holes as a dowel. In some

instances it will be found very difficult to line up the holes so that the broken ends will come tightly together, and at the correct angle. The best way is to first make the hole in one piece, blacken the spot around the hole with soot, and press the two parts together. This will then show where to drill the hole in the other piece.

I included no drills in my list of emergency tools, for the reason that any sort of hand drill or breast drill is too heavy and large to go conveniently in the "go light" pack; of course it should be in the kit of the larger party out for a long trip.

Small drills for wood are easily made by filing a piece of drill rod flat and pointing it. Hold it in the pin vise while using. Larger holes may be burned, using a nail somewhat smaller than the hole required.

Another method of repairing a broken stock which Whelen describes is to break off a couple of table knife blades and inlay them into the sides of stock across the break, after which they are wrapped with fishline, wire, tape or what have you. But since the average lone hunter is quite likely to have no table knives in his outfit, it might be a good idea to prepare in advance two strips of brass about 1/16 x 5/8 inch and about 5 inches long; drill three or four holes for screws and countersink them deeply for the heads. Should such a break occur—as it probably never will if you have the wherewithall to repair it—inlay these strips across the break; glue the ends together as already described, set in the strips, set short brass screws in tight, and wrap the whole business with adhesive tape. Better still, wrap it with copper wire, and coat the wire with solder as described in Chapter 14.

A split or shattered forend is easily repaired by wrapping tightly with adhesive tape or with windings of copper wire well soldered.

The efficacy of green rawhide is well known in making temporary or even permanent stock repairs—but how in thunder are you going to shoot a critter for his hide if the gun is out of commission? It develops into the old question of which came first, the chicken or the egg?—unless you have been fortunate enough to kill something before breaking the stock—or unless you can sneak up close enough to the animule to beat it to death with your gun barrel. Anyhow, assuming you have found a way to procure a hide—for example that of a muley cow that wandered away from the home pasture and kindly permitted you to knife her—soak the said hide in warm water and wood ashes from your campfire until the hair will slip. Scrape it smooth on both sides and cut into strips. Wipe the strip fairly dry and bind around the break, stretching the rawhide as tightly as possible. In drying it will shrink until you could almost drive fence posts with the stock if necessary. This makes a good repair for a stock having a long diagonal break. The break should be glued before winding on the rawhide. Adhesive tape or copper wire will do about as good a job as the rawhide.

524

Getting things stuck in the barrel is a well known source of annoyance and danger. If any accident occurs, such as falling off a horse, or sliding down a gully, make it a point to unload your gun immediately and peek through the bore. Likely as not it will be plugged with mud, sand gravel, leaves, twigs, snow or other impedimenta, the immediate and complete removal of which should be your first concern. Otherwise, the searching party sent after you a month or so later when you fail to return on schedule, may have the pleasure of carting back your well picked bones in a market basket.

A good strong steel cleaning rod should be a part of every hunter's equipment, for which reason it was not mentioned in the list of emergency tools. It is as necessary as the rifle itself. Personally I have no use for those rods made in 6 inch joints. In theory they are fine; in practice, not so good. I never saw one yet that was so accurately machined that it would joint up straight—squinting down it reminds one of the old stake-and-rider fences once so popular in our rural districts. Such a rod tucked snugly into a trap in the butt, adds something like a pound to the weight of that end of the rifle, throwing it badly out of balance and making it feel as though the barrel had been left at home. A rod with 12 inch joints is stronger, straighter, and takes up mighty little room in the pack; and a pull-through in the butt weighs nothing to speak of, and gives one a legitimate excuse for that six dollar, trapped buttplate.

With such a rod it is easy to poke obstructions from the bore after which the barrel must be thoroughly cleaned with oiled patches.

Sometimes in the woods one will get a cleaning rag or patch stuck in the bore. If this cannot be removed by soaking with oil and warming the barrel as described elsewhere it can be picked out, with a screw tip on the cleaning rod. This tip is just a 3 inch length of drill rod a little larger than the cleaning rod—it should be nearly bore size. On the end of tip is brazed a 2 inch wood screw with very coarse thread. The overhanging edge of screw head is then ground or turned off even with the rod. Turning this into the rag and yanking will remove it bit by bit. Such a tip should be a part of the regular cleaning rod equipment.

Sometimes when away from camp one will have recourse to an improvised cleaning rod made from a sprout—and more often than not the stick may break off and lodge in the barrel. The safe plan is to go back to camp and get the steel rod and push it out. I am not recommending that anyone do otherwise. But—in a similar emergency I have *shot* the obstruction out, after first prying the bullet from the cartridge and throwing it away, along with about half the powder. I advise no one to follow this method; but as I say I have used it, and the rifle showed no ill effects

525

whatsoever, the bore measuring the same afterward as it did before. I *believe* this to be perfectly safe, even with the full powder charge of a .30-06, because of the greatly increased air space which extended several inches up the barrel, after the bullet was removed, to the point where the rod was stuck. But half a charge removed it, so why take chances?

Nothing puts a rifle out of the game more quickly than a broken, bent or otherwise damaged sight, either front or rear; and many are the methods employed by ingenious hunters in such an emergency. The thoughtful pessimist will of course carry along one or two spare sights—either in his kit, or in a recess in butt, or under the pistol grip cap, some types of caps having a small well provided for this purpose. With the Springfield, or any rifle having sight base on the barrel into which the sight is pinned, it is advisable to discard the pin and ream and tap the hole for a 2-56 machine screw—and carry along a few extra screws as well as sights. Then the sight can be changed when and if necessary by merely turning out the screw. If held by a pin, however, and the pin drops out as they will occasionally, make a new pin from a piece of drill rod, and drive it in with the new sight.

If the front sight becomes lost and you have no spare one, there are lots of things you may do before deciding to call off the trip. Most any old scrap of iron will do for material from which a new sight may be filed out; and you'll be thankful for the vise when this occurs. A sight may be cut from tin, brass, or filed from a copper or silver coin, and soldered to the barrel. Rather than nothing at all, one may build up a lump of solder on the barrel and file it to shape afterward—and if you are careful to avoid knocking it against things it will last out the trip. I've seen a mighty good emergency sight made by building up a solder base, and setting a small brad in the top of it for a bead. And I've seen a good one carved out with a pocket knife from a piece of leg bone of a deer.

I hope I may live to see the day when we will have a peep sight as strong as the balance of the rifle—the sight is at present one of the weakest parts. Dropping the rifle on the sight will nearly always put the latter out of commission. Because of this I like to have a Lyman No. 6 or similar folding leaf sight on the barrel; it serves the dual purpose of enabling me to check up on the aperture should anything happen to the gun, and of providing a dependable rear sight if the aperture is damaged so that it has to be removed.

The man without such an emergency sight to fall back on, however, need not be disheartened to the point of dropping his gun over the nearest cliff and jumping over after it. There are several things possible before deciding on such a step. About the easiest and quickest is to first open a can of beans or sardines, and eat the beans or sardines as the case may be. Then cut a piece of tin

526

from the can approximately the width of the average rear sight. Bend it at right angles and solder it to the barrel four or five inches from receiver. A few shots looking at the front sight over this should give you the elevation. If the tin is only a little too high, bend it back slightly to lower it, rather than cutting it down. When you have the elevation, run some solder in behind it to make it fairly rigid. Now locate the place for your notch by firing a few shots by sighting over different points on the edge of this tin, and when you think you have the right point located, file the shallowest possible notch and try it. It may be necessary to try two or three places, before the gun will shoot accurately enough to give you a fair chance with it. When sure it is right, file the notch to required depth, and file out the shallow test notches. If this makes the sight too low—bend up a little.

Now there's nothing to prevent using such a flimsy affair during the remainder of the hunt, if you handle it carefully; or, there's nothing to prevent making a stronger sight from a coin, piece of brass or iron, and soldering it close to this tin one, after filing it to the same height, and then removing the tin. Soft solder has a lot of strength if you first scrape the metal bright and put on plenty of solder at good heat.

If the barrel happens to have a rear sight slot, your task is easier. File a sight from metal, bone, horn, or anything you have—even a piece of hard wood—and drive it in; then file down to correct height and cut the notch.

I saw a front sight in which the gold bead had dropped out repaired as follows: The hole where the bead had been was filled with a drop of solder. The soldering copper was held against it to keep the solder molten, while a pinch of filings from the soldering copper was dropped onto the solder—and they stuck. A tiny piece cut from copper wire would have been as good—probably better—and could have been set in solder in the same manner.

I read a description in one of the outdoor magazines of a method one man used to replace the stem from a tang peep sight, the original stem having been damaged or lost. He cut off the head of a common safety pin, bent the two legs together and forced them into the sleeve of the sight. The loop of the bottom end formed the aperture which he reduced in size and made show up more clearly by winding through the loop with fish line or thread. Doubtless the party who originated this idea was a father.

Another very good substitute for a peep sight is to twist a short piece of copper wire into a small eye or ring, spread the ends, and solder them to receiver bridge or other suitable place. This aperture may be bent up or down, right or left as needed to sight in the gun, after which additional solder around the base will stiffen it enough to give good service if you are careful.

There are few action parts of the modern firearm liable to

527

damage through ordinary use. Firing pins or strikers sometimes break, and I have heard of their being filed out of a nail, but never saw it done. The safe plan is to carry spares for all parts likely to break, including a spare extractor. The recess under the trap butt plate is as good a place as any to carry them. An extra screw or two, duplicates of screws likely to have to be removed in the woods, should also be carried in case you "jim" the head of one in removing it.

The target shooter who plans to attend the National Matches, or who goes in for competition to any extent, should, if he is able to do his own repair work, take along a small compact kit of tools and a few spare parts. While at the larger matches there is usually an armorer or gunsmith on the ground to handle emergency work, the real crank has a bit more confidence in his own work than he has in anyone else's. And he will probably be more careful, also, about marring the gun in the process—at least, he thinks he is more careful. A steel fishing tackle box of the right size makes a splendid repair kit container. I believe the Company Repair Kits mentioned by Colonel Whelen are no longer available. At all events, the large hunting party, or the small party out for an extended trip, and the target shooter at an important match,—all are likely to find a rather complete kit well worth the trouble of assembling and carrying along.

The selection of tools which it contains will depend largely on the individual, and the needs which he anticipates. The same tools used on the home workbench may be used, although if one makes frequent trips it will pay to duplicate the tools needed, and avoid the likelihood of having some tool at home when you need it in the field or on the range. One thing that should not be overlooked is the small screwdrivers, for sight screws—and an extra supply of screws also, for one will lose out occasionally, or the threads will wear from long use, making a tiny screw perhaps stand between the shooter and first prize—whether it be a loving cup or ten point buck.

One thing I have neglected to mention that may well be included in the field repair kit, is a small can of New Method Gun Bluer. When putting on temporary sights of tin, solder, etc., this lacquer offers a ready means of blackening them—is, in fact, about the only convenient means of doing so in the field. No need to carry a brush—use a match, twig, piece of paper, leaf or cloth.

One thing I have always carried and never have needed, is a broken shell extractor. If the head breaks off a .30-06 or other modern high power cartridge, the action is pretty apt to let go with far reaching results that will make the shooter forget about trivial matters for the time being. But in the cheerful hope that if it ever happened to me there might be no untoward results (whatever untoward may mean) I faithfully tote the old extractor, and hope to gosh I never have to use it.