A Master Gunmaker's Guide to Building Bolt-Action Rifles

Bill Holmes

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.50 Caliber Rifle Construction Manual: With Easy-to-Follow Full-Scale Drawings
Home Workshop .50 Caliber Sniper Rifle (video)
Home Workshop Guns for Defense and Resistance, Vol. I: The Submachine Gun
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Home Workshop Prototype Firearms: How to Design, Build, and Sell Your Own Small Arms
Home Workshop Weaponry: A Video Guide to Building Your Own Guns (video)

I respectfully dedicate this book to the following persons and organizations whose help gave me comfort and encouragement during the long period I spent writing it:
Anheuser-Busch, Seagrams, Post Wineries, Mom's Place, Debra Willis, the Honorable Wayne P. Morris, and Sen. George Crawford. Thanks again.

A Master Gunmaker's Guide to Building Bolt-Action Rifles
by Bill Holmes

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TABLE OF

Contents

Warning

Although at the time this book was published, it was perfectly legal for an individual to manufacture a firearm for personal use, experimental purposes, or research and development, the laws may have changed since then. It is the reader's obligation to carefully research all pertinent laws before attempting any construction.

Technical data presented here, particularly data on the construction, use, adjustment, and alteration of firearms, inevitably reflect the author's individual beliefs and experiences with particular firearms, equipment, and components under specific circumstances that the reader cannot duplicate exactly. Therefore, be advised that since neither the publisher of this book nor I have any control over the materials or workmanship used in the manufacture of this firearm by others, we can assume no responsibility whatever for the safety or reliability of such. Build it at your own risk. *The information presented here is for academic study only.*

Introduction

Around 50 years ago a top gunsmith by the name of Roy Dunlap wrote a first-class book titled *Gunsmithing.* Since then that book has been the standard text for most beginning gunsmiths, with a number of experienced ones learning from it as well.

This .416 Rigby on a P14 Enfield action has a Bastogne walnut stock, a drop magazine with hinged floorplate, a eoek on the opening bolt with a new handle, new trigger and safety, quarter rib, and muzzle brake.

I got my first copy of the book in 1950, if I remember correctly. And, although I was already doing most of what was covered in the book, I learned ways to improve the quality of my work. Over the years I have owned at least a dozen copies of that book. Somehow I always wound up loaning them out, and as usually happens with loaned articles, I didn't get them back.

In the time since that book was written, many innovations and modifications have become desirable when building a custom rifle. While some of these modifications have been described in gun magazines, most are never mentioned. The purpose of this book is to show how to manufacture or modify a custom-made bolt-action rifle.

There are many who call themselves "gunmakers," but very few have actually *made* a gun. Most buy parts wherever available and simply assemble them, usually threading and chambering commercial barrel blanks and fitting them to existing actions. They then "make" stocks by fitting a machine-inletted and -shaped stock. Although this sometimes results in a fine rifle, it hardly qualifies someone to call himself a gunmaker.

Likewise, the mechanic who obtains a military action, forges the bolt handle lower to permit the use of a scope, puts on a commercial trigger and safety, fits a preturned barrel and machine-made stock, and convinces himself that he has built a "custom" rifle is only kidding himself. The only thing custom-made about such a gun might possibly be in the choice of recoil pad or buttplate.

If what I have written here sounds somewhat arrogant, I'm sorry. However I would point out that over the past 50 years I have built, in their entirety, numerous rifles, shotguns, and pistols. The rifles ranged from .17-caliber to .50-caliber Browning Machine Gun (BMG) and just about every caliber in between. And although some of these were mediocre, some were pretty good—not because I say they were good (which would prove nothing) but because others said they were. This is the deciding factor: when other people say they are good.

Please note that the instructions given here do not necessarily represent the only way to build or modify a rifle; they are simply a way to accomplish the end result. Undoubtedly there are many others who have better methods of doing these things than I do. Most of what I have done was developed independently, with no one to copy. So, to those of you who have a better way, let it be known so that others may learn from it.

It should also be noted that I am almost 73 years old, my fingers are bent from arthritis to a point where I can hardly hold a pen or pencil, and my hands shake due to Parkinson's disease. I have also been accused of being senile, as well as almost blind, so my drawings are somewhat ragged and some of my photographs blurred because of my failure to attach my camera to the tripod. One of the good things about diminishing vision is that my work starts looking better to me.

I must also point out that certain components described in the book (e.g., receivers, bolts, sears, triggers) require quality materials and precise heat treatment. Since neither the publisher of this book nor I have any control over works performed by others, we cannot be responsible for any problems experienced. I will repeat this caveat because I want everyone to understand it.

For instance, if you acquire the specified material to build the bolt and receiver, take them upon completion to a reputable heat-treater for the prescribed treatment (even though the small parts can be heat-treated in the shop), handle other parts in the same manner, and adhere to the general dimensions and design provided, the finished firearm will likely function in the manner desired.

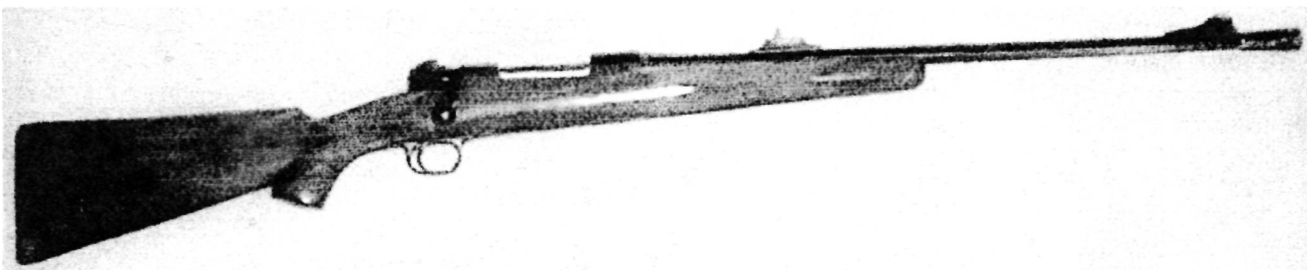
On the other hand, the know-it-all who already knows all about such things, even though he has no practical experience, picks up whatever pieces of round stock of sufficient diameter he comes across. With no knowledge whatever of the composition of the steel, he proceeds to fabricate the parts while making "improvements" on the design and changing the indicated dimensions. He skips the heat treatment altogether. He can expect trouble and may even lose some body parts in the process. This is the kind of person who makes this disclaimer necessary.

Many people have written to me through the years asking the best way to learn the gunsmithing trade. I probably don't know the *best* way. One way is to enroll in one of the gunsmith schools now in existence. Chances are you won't be an expert when you graduate, but you will have a good start. Another way is to work for someone who actually is an expert and learn from him. Still another way is to simply buy yourself the necessary equipment and start doing it. Don't practice on other people's prize guns while learning, however. Work only on your own stuff until you gain experience and proficiency.

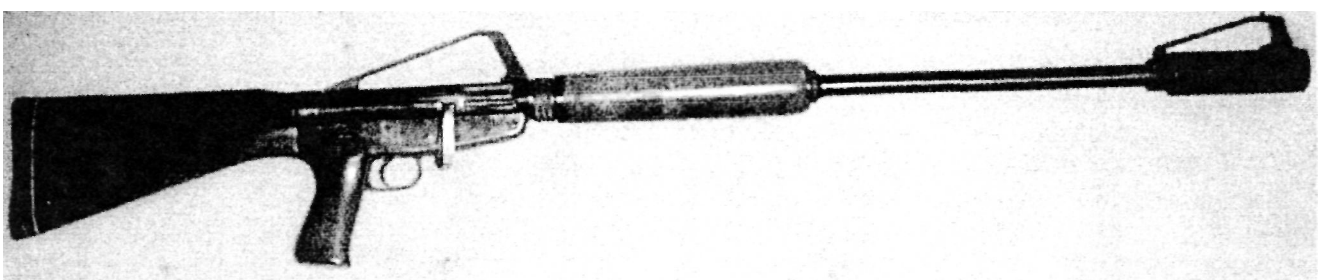
After spending most of my lifetime in the trade, I no longer work on other people's guns. I get my enjoyment from designing and building prototypes. Many, many times I have built parts to my own designs only to find that they didn't work the way I envisioned. I had to go back and redesign them and make the parts all over again. It was time consuming, but I usually learned from it. Usually I have to build three or four guns of any one design, since I always find ways to improve on it by the time the one is finished. But when the final design is achieved and working the way it was intended, and equally important, other people like it, it becomes worthwhile.

The designs and methods shown in this book are intended for use in a small shop, using single-point tools. The large-production shop will have CNC machines, capable of turning out more parts in a day than I could hope to in a month. As I said, there are other ways to obtain the results that I have outlined here. The one I include arc simple ways that have worked for me. You must decide for yourself how you want to go about achieving the results you seek.

I used a professional photographer to illustrate the finished parts and guns. Most of the other photos, especially the ones showing fabrication sequences, were shot while building the parts. Some of these photos turned out better than others; the inferior ones were mostly due to my own ineptness. I am usually unaware that the photos are inferior until after the film is processed. By that time it is too late to reshoot since the operation has already been finished. So, on occasion, I am forced to include substandard photos even though I dislike doing so. I apologize to the reader for this.



This .338 Winchester Magnum on a Mauser action has a Claro walnut stock, blind magazine, new trigger and safety, new trigger guard, and featherweight barrel with open sights.

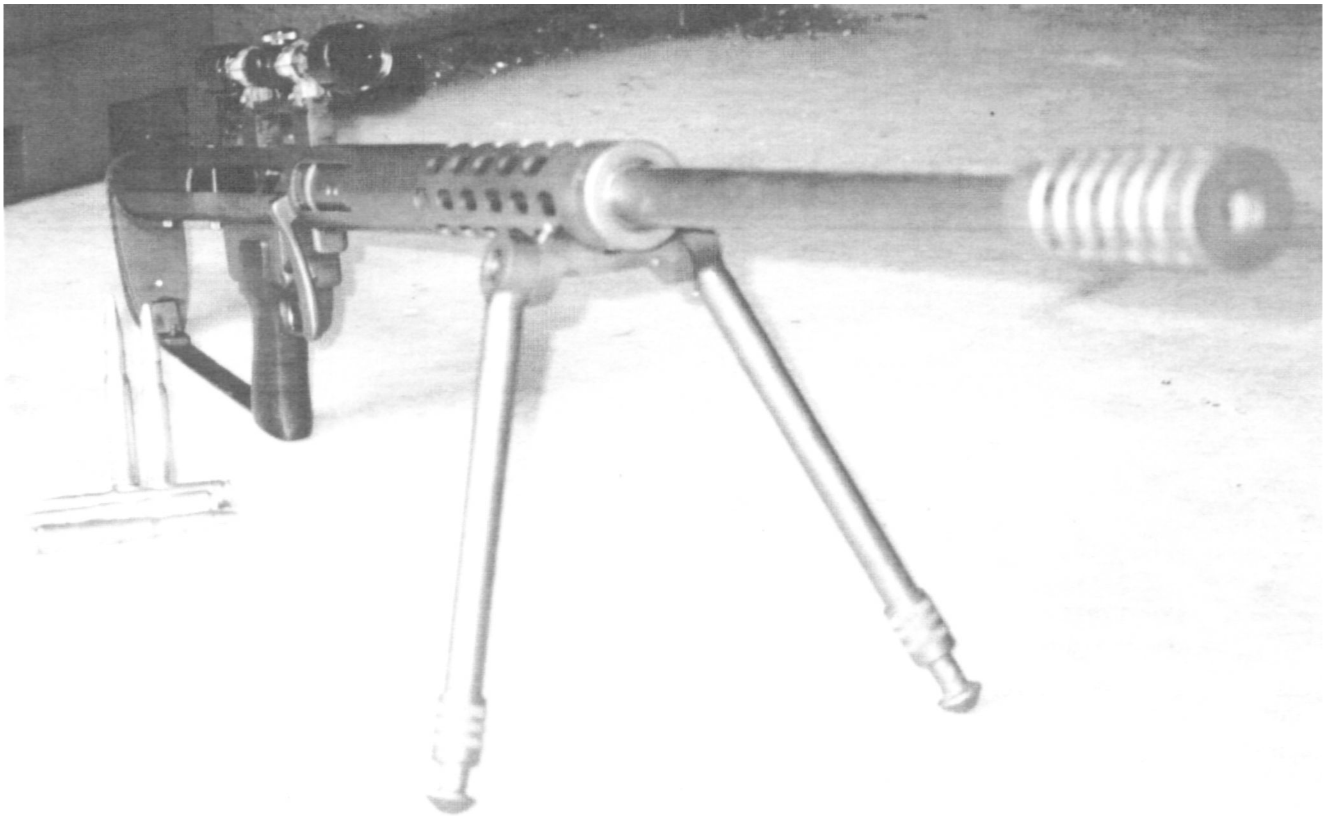


This 12-gauge single-shot trap gun has a similar basic action as the rifles shown. It has very little recoil.

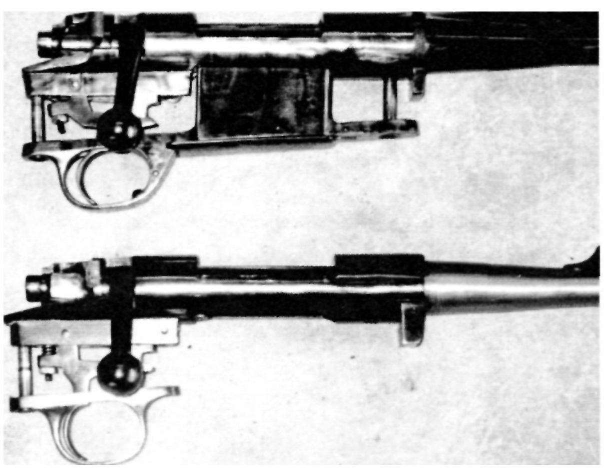
This 7.62mm sniper-type rifle uses the same basic action as described in the text. It has a 4-shot magazine, muzzle brake, and folding bipod.

At the top is the 7.62x39mm rifle shown in the drawings. It has an English walnut stock, a quarter rib, a hinged-floorplate magazine, an M70 type trigger and safety, and 24 lines per ineh (lpi) eheekering. The lower rifle in .250/3000 ealiber has similar features.

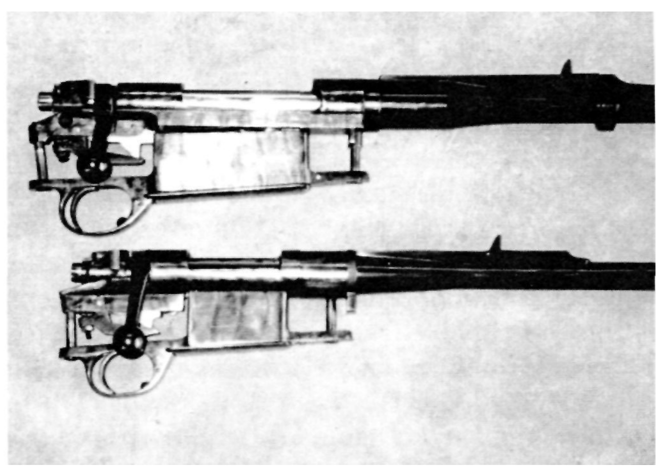
This .300 Winehester Magnum on a Mauser aetion, French walnut stock, quarter rib. M70-type trigger and safety, muzzle brake, skeleton buttplate. and 24-lines per ineh eheekering.



This .50 Browning Automatic Rifle is basically the same action design, except nearly double in size.



The metal parts of the actions portrayed in this book.

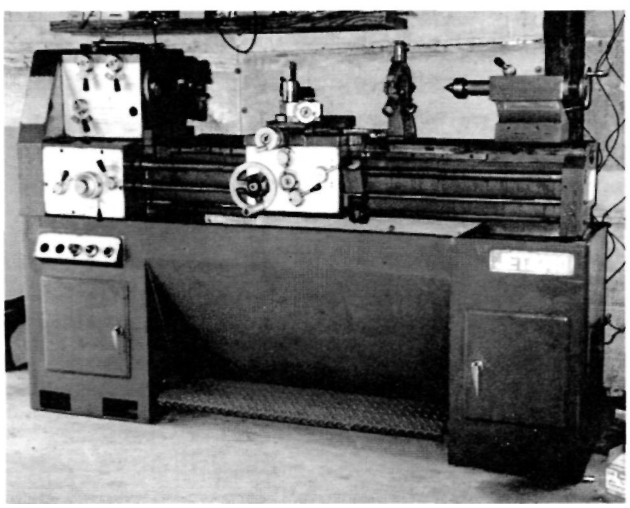


A long Magnum-length action, above, contrasted with the short action, below.

CHAPTER ONE

Tools and Equipment

Shortly after one of my other books was published I began receiving letters from readers complaining that they couldn't afford to buy the lathes, milling machines, and other equipment advocated. When I suggested that some work might be farmed out, one correspondent called me asinine because, he wrote, the machinist doing the work might recognize it as gun parts and report him to the police. Still, he said, even though it would take him at least a year to accumulate enough money to buy even a small drill press, he wanted to design and build guns. I wrote back, saying that I didn't think my suggestion of hiring work done was any more asinine than his thinking he could do the work without tools and equipment.



This 12 x 40-inch lathe is adequate for most gun work.

At the risk of sounding like a smart aleck, I must say that building complete guns can't be done without the right equipment. If you can't afford it, you should take up some other hobby or vocation.

Keep in mind, though, that a good lathe and milling machine, properly taken care of, should last the average gunsmith a lifetime. By being properly taken care of, I mean the machines must be kept level, cleaned at the end of the workday, and lubricated regularly. Oil is one of the cheapest things you can buy as far as preventive maintenance goes.

If possible, the lathe should have at least a 12-inch swing with as large a hole as possible through the spindle. Most quality lathes now come with a 1

1/8- to 1 1/2-inch spindle bore. This is adequate for most gun work, but there will be times when you will wish it was bigger. Some time ago I turned several .50-caliber BMG barrels to a smaller contour and threaded and chambered them for installation on a rifle of my own design. How I wished for the .311 bore on a lathe that I had sold some time ago. As it was, I had to swap ends with the barrels several times before they were completed. If barrel work is contemplated, a length of at least 40 inches between centers is desirable because it is sometimes handy to work out on the end of the barrel with the other end caught in the chuck. Small lathes are available for considerably less money, but they are severely limited in the work that can be performed on them.

The milling machine can be of whatever size suits you, provided it has the capacity to handle the work you want to do. My own milling machine is a 3-horsepower job with a 10 x 54-inch table. The long table is essential because I use it to machine octagonal rifle barrels and long shotgun ribs. This machine weighs around 3,400 pounds, which makes for solid, vibration-free operation. Those who contemplate doing only action work don't need more than 10 inches of table travel, so a much smaller machine is adequate. Of course, I would have preferred a Bridgeport, an Excello, a Lagun, or similar make, but I expect this one to last me for the rest of my working life. I bought a belt-driven machine with a two-speed motor instead of the more popular variable-speed-hcad machine. I did this, not because the former is slightly cheaper but because variable-speed mechanisms have been a source of trouble to me in the past. Several other people I know have experienced similar problems.

I bought a 6-inch swivel base "Kurt"-type vise, a set of collets, and a longitudinal power feed at the same time I bought the mill. If I decide to do repetitive work I will add a digital readout. For one-of-a-kind parts I don't need it. A right-angle head, arbor, and support, which allows horizontal milling, will also be added if needed.

Several people have expressed the opinion that one of these three-in-one type lathe, mill, and drill machines would be just the thing for gun work. Since I had reservations about this, I wrote the suppliers of one of the more widely advertised brands and asked them to let me use one for a video and book I was about to do. They didn't even bother to answer me, so I went with the equipment I had on hand. Later a friend of mine purchased one of these machines and allowed me to try it out. In short order it became apparent why the manufacturers had ignored me. This little machine cost more than $2,000 by the time the freight was paid, and several other parts or accessories had to be purchased to obtain the versatility advertised. The lathe chuck had to be removed before the mill could be used. Further, high-priced Morse Taper collets were required, and a special planetary-type pulley was required to reduce the speed for threading, which was done by some sort of off-breed threading attachment that I didn't bother to try to figure out.

This three-in-one machine is even less desirable when you figure that you can purchase a small 9 x 20-inch lathe—complete with quick-change gears, two chucks, a steady rest, and tool post—and a table-model milling machine with a 2-horsepower motor, R8 spindle, and a table capacity quite a bit larger than that of the three-in-one machine for slightly less money. This seems a better value by far, provided such small machines are your only alternative.

No drill press is needed if you have a mill, which can be used to locate and drill holes with more precision than any drill press ever made. It should be noted, however, that if ownership of a milling machine is out of the question, milling attachments are available that can be mounted on the lathe carriage. One of these, together with a good drill press, will allow many milling and drilling operations to be done. Do not try to use a drill press as a milling machine or to use end mills in a hand drill.

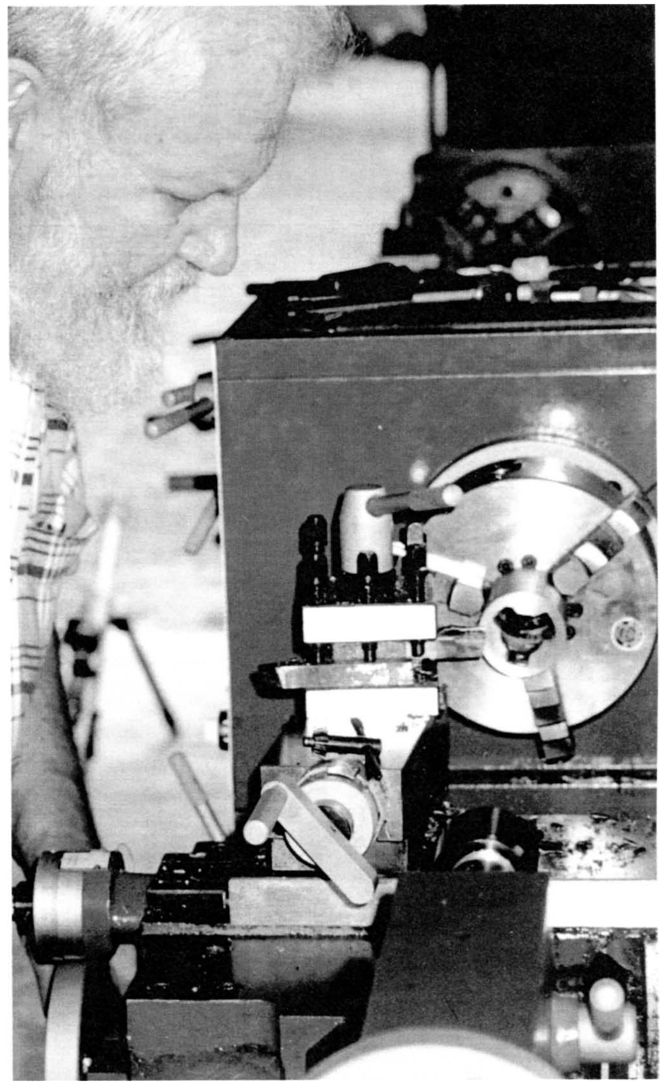
Several years ago a friend of mine asked to borrow a 3/16-inch-diameter end mill to use, he said, to cut a slot in the breech block of an autoloading to convert it to full automatic, as described in a now defunct Arizona-based magazine. Knowing that he had no mill, I asked him how he intended to use it. He informed me that he intended to use it in 3/8-inch hand drill, as the magazine recommended. When I told him that such a procedure was not only impractical but downright dangerous, he suggested to me that an established magazine obviously knew more about such things than I did since it represented experts in their field. Who could argue with such logic?

I gave him the cutter, and he went his way, only to return a few hours later with a bandaged hand and the stub of the broken end mill. It seemed that the unsupported end mill had a mind of its own. Instead of cutting the slot he envisioned, it simply skated off the part he wanted to cut; walked across the back of his hand, chewing it up in the process; and broke when it came in contact with his vise. The magazine is no longer in business.

While a metal-cutting band saw is not an absolute necessity, even a small one like mine will save a lot of hard work. Not many shop operations are more tiring than trying to cut a thick piece of tough alloy steel with a hand hacksaw. The little 4 x 6 saw I have owned for several years is slow, but it works as long as the blade is sharp. Let it begin to get dull or lose its set, and it jumps off the drive wheel. Buy a bigger one if you can afford it.

A good heavy-duty bench vise is one of the most important tools you can own. If you expect to use it much, get the biggest one you can find. Make sure it is made of steel; the cheap cast-iron jobs break. My own vise, which was owned by my father before I was born, weighs a couple of hundred pounds and is of all-steel construction. I have used it as an anvil, a press, and a sheet-metal brake, as well as to swage heavy sheet metal. I have hooked 6-foot lengths of pipe over the handle for added leverage and put my entire weight on the end. (Such is required for some of the operations I have needed to do.) A cheap, junk vise would have been in pieces if subjected to treatment like this.

A bench grinder is a necessity both for sharpening tools and rough-shaping parts, as well as many other uses. It is also nice, but not essential, to have a lathe tool post grinder. One of the little high-speed hand grinders is handy for polishing feed ramps and other small, internal grinding jobs.



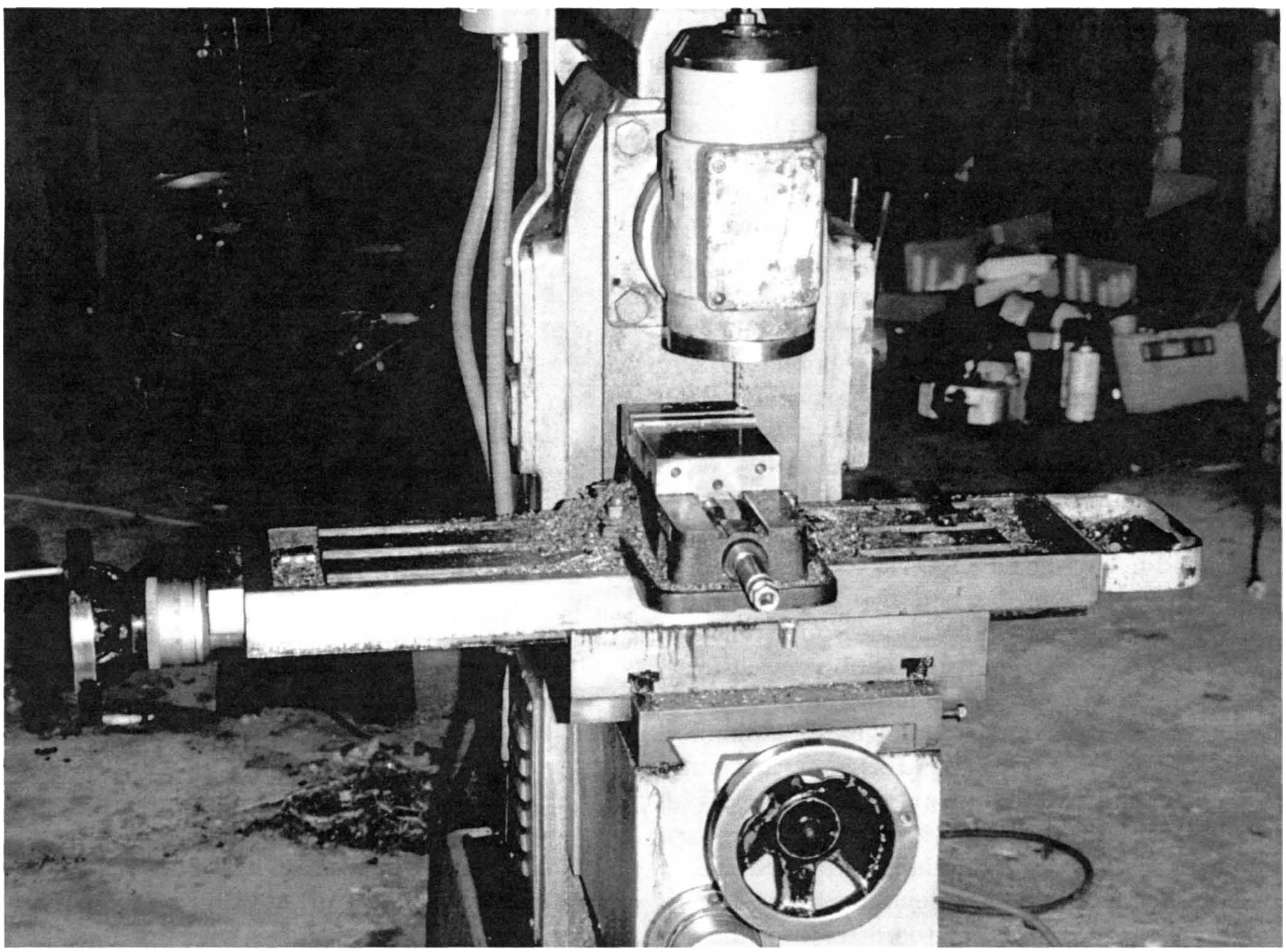
This 14 x 60-inch lathe has a 3-inch hole through the headstock spindle. This is an ideal size for all gun work.

A gas welding outfit is useful for silver soldering, heat-treating small parts, and certain cutting jobs. Gas welding has more or less given way to tungsten inert gas (TIG) welding, which, when done by a capable operator, results in almost flawless welds, penetrates well, and spreads heat less than most other processes. In my own case, my hands shake and my eyesight is so poor that I find it necessary to farm out any welding jobs I need done. Fortunately about 200 yards from my shop there resides the best welder I have ever seen. He did aircraft welding for years before going into business for himself. He now takes care of any welding jobs I have.

You will also need measuring equipment, including micrometers, calipers, dial indicators, a machinist's square, and an ordinary 12-inch rule, as well as files, screwdrivers, chisels hammers, a hacksaw, and maybe a hand drill.

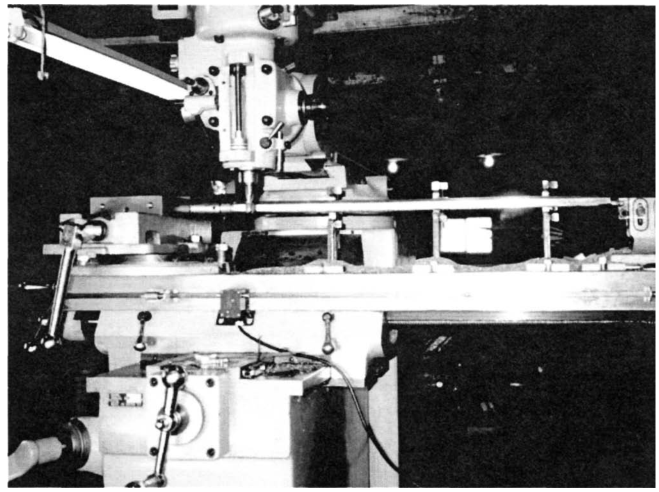
Drills, milling cutters, and lathe cutting tools are also required. It is more economical to buy high-speed drills instead of cheaper carbon-steel drills because they will last much longer. I use mostly carbide end mills and lathe tools, even though they are more expensive than high-speed cutters, because they last several times as long and permit higher cutting speeds.

Please don't blame me for the fact that most of the equipment described here is essential to do the work described. Likewise, I am not responsible for the fact that the equipment costs considerable sums of money. Without it you won't be able to do much, and that isn't my fault either.

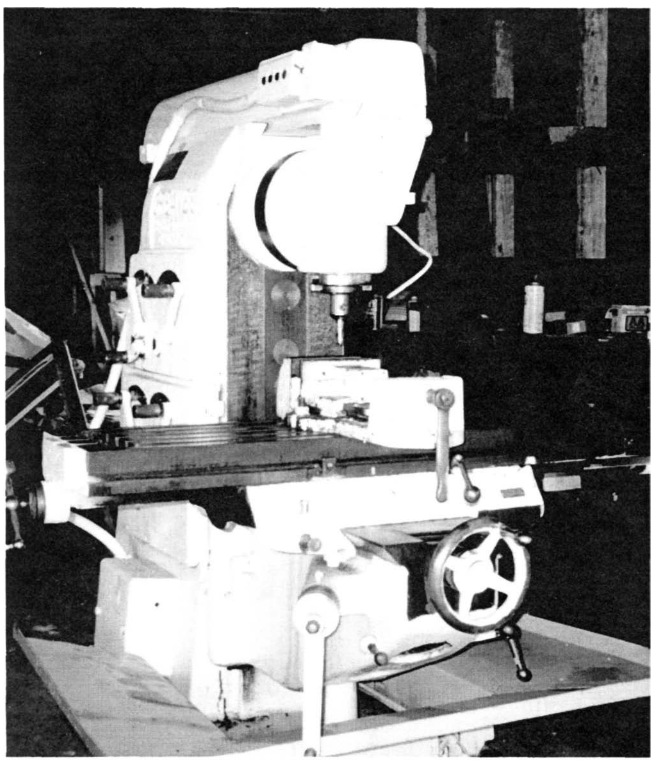


Smaller machines, such as this 8 x 32-inch table, can be used for most operations but not for long-barrel work.

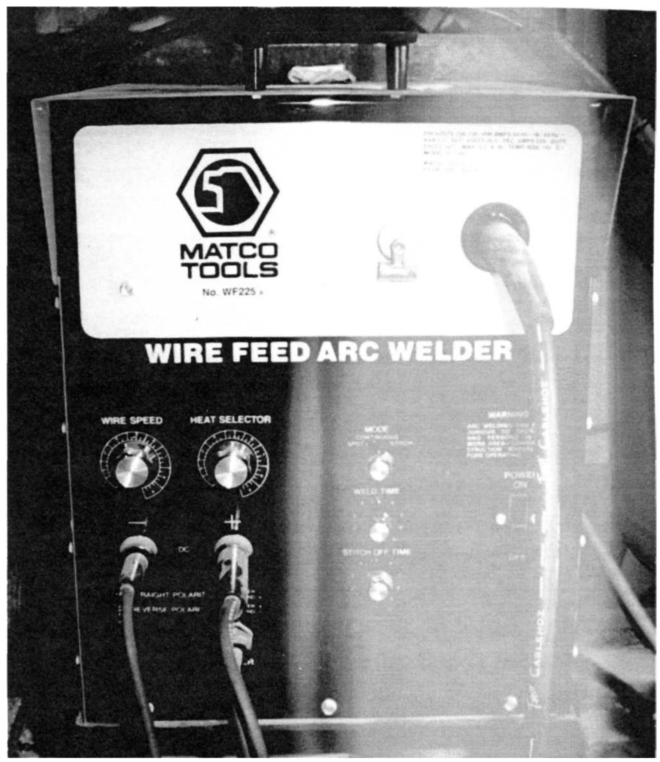
This shop contains a bare minimum of equipment needed to actually manufacture a firearm.



A long table mill is necessary if barrel work such as this is contemplated. The table shown here is a 10 x 54-ineh model.

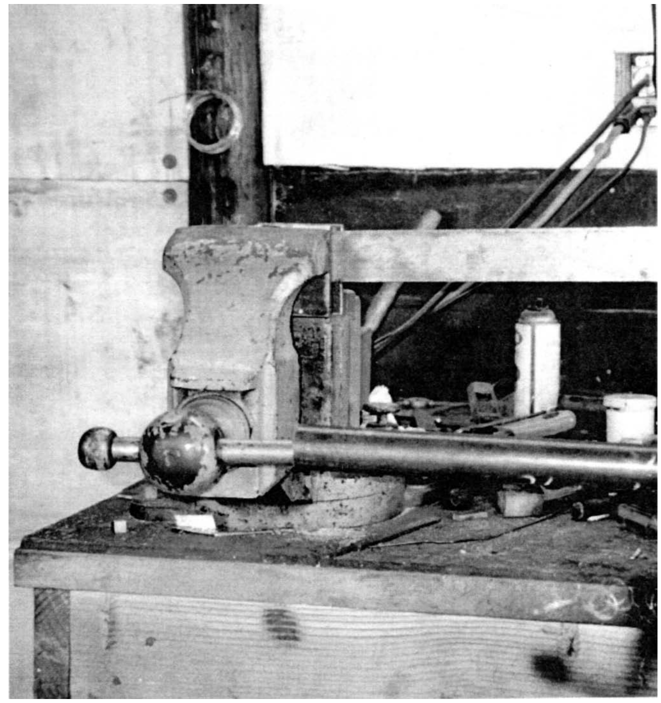


Older machines are sometimes found at bargain prices. The 12 x 60-inch table machine shown here was purchased for #600.

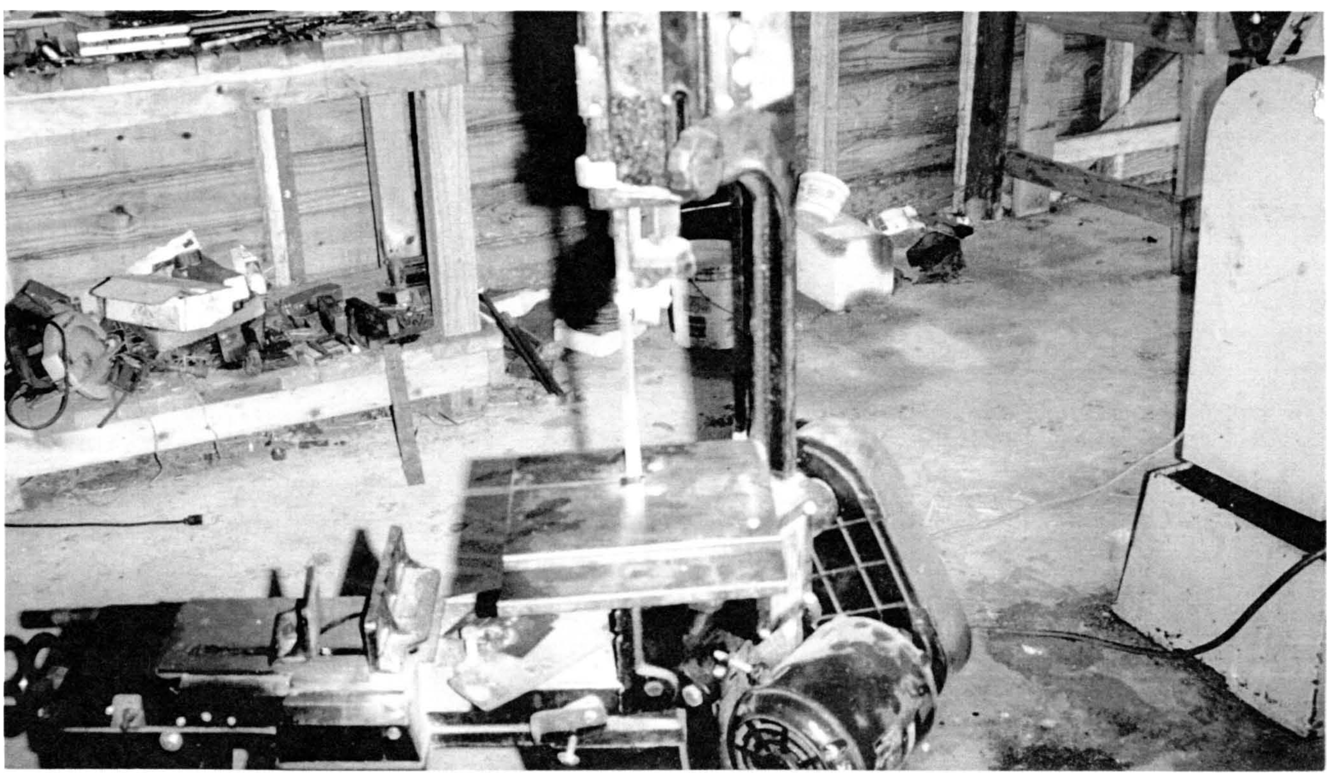


This machine is equipped to do stick, metal inert gas (MIG), and TIG welding.

A welding outfit is used for brazing, silver soldering, and heat-treating small parts, as well as bending operations.



A heavy steel vise, sueh as this one, is essential for swaging and forming parts.



A metal-eutting band saw, even a small one sueh as this, will save a lot of hard work.

CHAPTER TWO

Materials

Since we are dealing with guns using high-intensity, high-pressure cartridges, the materials must be selected more carefully than when used for low-powered, blowback-type weapons. It is possible, even desirable, to use salvaged materials (e.g., automobile leaf springs, shock absorbers, shafts) for small parts, but it is advisable to obtain quality materials of known composition from reputable, knowledgeable suppliers.

Since I have used, and had good results with, such chrome molybdenum alloys as SAE 4140, 4340, and 4350 in most of my own fabrications, these are what I recommend. Although I am sure there are other types that are equally desirable, these are the ones I have used in the past and will continue to use in the future.

Unfortunately such material stocked and sold by metal supply houses and large machine shops is expensive. Usually the supply houses don't even want to talk about selling in any quantities under a full-length bar, which can be anywhere from 12 to 20 feet long. Also, if the suppliers have to cut it into shorter lengths for shipping, they add a hefty "saw charge." Occasionally you can find a machine shop that will sell a short piece, but the shop will usually add a saw charge too. Recently I needed a 2-foot-long, 2-ineh-diameter piece of 4140 for the manufacture of two .50-caliber rifles. A local machine shop condescended to sell me the material but also added a saw charge, which made it cost $70. Since I had to have it, I went ahead and bought it, but I cried all the way home.

You must take the round-bar stock wherever you can find it and pay the price. But when it comes to round seamless tubing and flat bar stock, my favorite source of supply is the following:

Wicks Aircraft Supply
410 Pine Street
Highland, IL 62249

These people will sell you whatever length of material you desire, with no mention of a saw charge or minimum length. In fact, when I asked the gracious lady who takes phone orders if the firm minded my listing it as a source of supply in books and videos, even though it might result in a number of short-length "nuisance" orders, she said that Wicks welcomed such orders because it helped get rid of the short-length material on hand. It's a pity there aren't more companies like that. If you do order from Wicks, however, order enough to make it worthwhile for the company to ship it. Wicks deserves consideration too.

There are times when it is advantageous to have round stock with an existing hole through the center, especially for fabricating receivers. Thick-walled seamless tubing is ideal for this because it can be acquired in the same composition as the solid stock. One source of supply that I have had experience with is the following:

Kilsby-Roberts
P.O. Box 9500
Brea, GA 92622

The above address is the corporate headquarters. The company maintains branch offices and warehouses in locations all across the United States and Great Britain as well. Don't be surprised if the company insists on selling a full-length stick, though. Kilsby-Roberts is not as sensitive to the small operator's needs as Wicks is. It will also hit you with a hefty saw charge.

Around 1950 I started buying chamber reamers from Fuller Manufacturing Company. My dealings were always entirely satisfactory, so I never looked anywhere else. Sometime later Clymer took over and maintained the same high quality and honest dealing I had come to expect, so I continued to obtain reamers from it. Today the company offers a wide variety of reamers, choke tools, and other equipment. The address is:

Glymer Manufacturing Gompany
1645 W. Hamlin Road
Rochester Hills, MI 48309

There are times when it is uneconomical to buy reamers in a certain caliber. One such occasion might be if you expect to use it only once or you can't afford the purchase price. In such cases you might consider renting. There is one firm that I know of that rents reamers and head space gauges:

Whiterock Tool and Die
6400 N. Brighton Ave.
Kansas Gity, MO 64119

The proprietor of this establishment, Keith Rice, has reamers in virtually every caliber that Glymer makes. The 30-day rental period should be long enough to finish any barrel job, and the rental price is reasonable.

Presently there are a number of barrel blanks available, ranging from the lower priced blanks sold by Gun Parts Inc. through medium-priced blanks from E.R. Shaw and Wilson, and slightly higher priced ones from Douglas and Shilen to the higher priced cut-rifled blanks from such makers as Kreiger and Obermeyer. The old adage that you get what you pay for doesn't always apply here, since there have been times when the very cheapest barrels have grouped as well, or better than, the higher-priced ones. I knew a rather unscrupulous fellow for a number of years who obtained the very cheapest barrel blanks available and fitted them to whatever action his customer supplied. It didn't matter which barrel the customer asked for, this was what he got. Surprisingly, or maybe not, almost all his customers were satisfied with what they received. In the couple of instances when they complained, he cheerfully replaced the offending barrels with others from the same source, and they went away happy. Such a practice is, of course, equal to stealing and should not be condoned, but it demonstrates that price doesn't always ensure quality.

Stock wood is also available from numerous sources. Much of the better wood comes from California; some comes from other countries. What I consider the hardest and strongest is Bastogne (Belgian) walnut, with English and French kinds running a close second. Here again, there are certain unscrupulous individuals who will attempt to pass off inferior wood as top quality. For years I obtained stock blanks from Jack Burres in California. Jack was a conscientious fellow who usually sent me a slightly better grade of wood than I'd ordered. He always told me that if I wasn't satisfied with what he sent to send it back for refund or replacement, but I never sent back a single piece. Some time ago Jack retired and sold his remaining stock of wood to Edward Hargrove, who can be reached at the following address:

Edward Hargrove
P.O. Box 599
Cotulla, TX 78014

Mr. Hargrove serves as county attorney of LaSalle County and, as I understand it, plans to retire in the near future and devote his time to supplying quality stock blanks. From my dealings with him it is obvious that customer satisfaction is also his goal. Most of the stock wood I purchase in the future will come from him.

Springs, screws, drill rod, etc., can usually be found in automotive supply houses and hardware stores. Checkering tools, polishing equipment, and bluing salts, as well as other required items, are available from gunsmith supply houses such as these two:

Jantz Supply
309 West Main
Davis, OK 73030-0584

Brownells Inc.
200 South Front St.
Montezuma, IA 50171

Although small, noncritical parts can be heat-treated in the shop, such larger components as bolts and receivers must receive heat treatment from firms with the knowledge and equipment to do it correctly. The only one I have had experience with that was absolutely satisfactory is the following:

Hinderliter Heat Treating
P.O. Box 480
Tulsa, OK 74159-4830

These people know what they are doing and do it correctly, unlike several pseudo-experts I have had experience with.

Please understand that my recommendation of the above-listed firms and individuals is not intended as a slight or condemnation of others. Doubtless, there are others who offer satisfactory products and services. Those listed are the ones I have dealt with repeatedly and satisfactorily.

Also, the addresses shown were correct at the time this went to press. If they have changed, please don't blame me or the publisher.

CHAPTER THREE

Design

As far as I am concerned, the best bolt-action rifles ever made were the 98 Mauser and the pre-1964 M70 Winchester. Most efforts to "improve" them have left much to be desired, and today most so-called improved actions are designed more to lower production cost than to actually improve quality.

Manufacturers have conned some gun magazine writers into believing that plastic stocks, castings, and sheet metal stampings are an improvement over wood and machined steel. Make no mistake: the reason for this is cost, not quality, as many consumers are beginning to realize.

The action design shown in this book, which I had hoped would actually be an improvement over existing actions, is no better than most of the others. The only improvement I could possibly claim is that it is simpler and easier to fabricate in a small shop, while retaining my preference for fabrication all from machined steel.

The three-lug bolt might be considered slightly stronger than a design with two opposed lugs, since there is more locking surface and the feed ramp is between the lugs and not cut away as with the two-lug action. Only 60 degrees of bolt lift is required to open the bolt, in contrast to 90 degrees with the two-lug bolt. This 60-degree lift allows more clearance between a scope body and the bolt handle. The bolt lift is somewhat stiffer because of the increased angle of the cocking cam; this can be offset by using a longer bolt handle. The extraetor position falls just where one bolt lug is positioned when unloeked: this requires the extractor to be contained in the bolt lug. Properly done, this won't weaken the lug to a great extent; however, it won't improve it any either.

The best excuse for using a three-lug bolt lies in the fact that the receiver lug slots are short and can be cut far easier than the full-length raceways in a two-lug receiver.

There are those who will try to tell you that the bolt sleeve should be solid at the back end, which supposedly protects the shooter from escaping gas in the event of a pierced primer. This assembly also requires some sort of protruding cocking indicator to let the shooter know when the piece is cocked, since the end of the cocking piece or firing pin cannot be seen. But if adequate gas vents are incorporated into the bolt design, as they invariably have been for the past hundred years, such a danger hardly exists, and the sometimes bulky bolt shrouds or sleeves are therefore unnecessary. The designs included in this book, then, are similar to the 98 Mauser and M70 Winchester, as are most of the more popular custom rifles.

The safety, as shown, while not a direct copy of the M70 Winchester safety, is quite similar. Such a safety is much harder to make in the small shop than other types of safety. But it looks nice and allows working cartridges through the action with the firing pin locked in the cocked position. This is not possible with certain other types that require disengaging the safety before the action can be opened. Retracting the safety to the rear position locks the bolt closed, as well as engaging the safety.

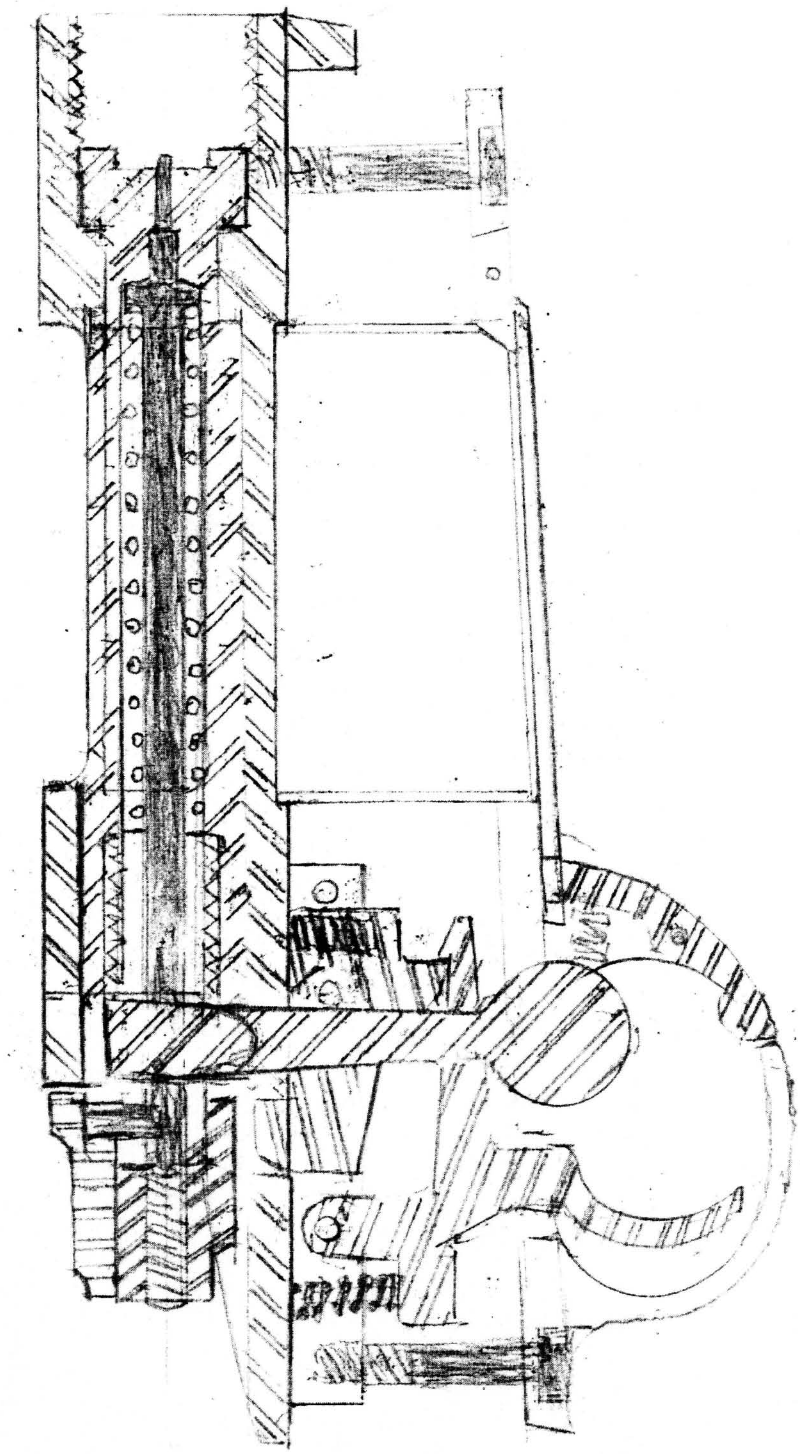
I have included a design for a sliding button-tang safety for those who prefer it. Many shooters like this one because it is easy to reach with the thumb by both right- and left-handed shooters.

The trigger shown is also of similar design to the M70. In my opinion this is one of the safest, most foolproof systems in existence, which also provides a smooth, light, single-stage trigger pull without creep or overtravel. Here again, this one requires more time and effort to make than some of the others, but the end result is worth it.

I have used a simple, coil-spring-loaded bolt stop in this design, which only requires depressing the release with a thumb to release the bolt. Two ejector designs are shown. The one I consider the better of the two is a blade type operating from the same hinge point and using the same spring as the ejector. The other is the same spring-loaded-button type encased in the bolt face as used in numerous commercial rifles. The spring pressure exerted against the cartridge head can be felt when opening and closing the bolt, which is disconcerting to some users. There have been numerous eases of rust and debris (e.g., metal shavings) binding these ejectors and keeping them from retracting completely, which prevents closing the bolt on a chambered round. If this happens while on a hunting trip—as it has in the past—the results can be disappointing to say the least.

I have included a one-piece magazine/trigger guard assembly with a hinged floorplate in this design. I have also included a blind magazine type in which there is no metal box, only a stock cavity in the wood, which is sometimes desirable when building a lightweight rifle. The hinged floorplate, as shown in the first design, is slightly heavier but is useful to unload the magazine quickly or to clear a jam in the event of an overlength cartridge's hanging up in the magazine.

The actions depicted here are short actions. I wanted rifles that were different from most others. So I built the one just long enough to handle the 7.62x39mm Russian cartridge, which is similar ballistically to the .30-30. The other was designed around the .250/000 Savage cartridge. Either of these is adequate for most hunting purposes in the hands of competent marksmen. Both are lightweight, short, rifles of moderate recoil. Either action can be adapted to other larger, more powerful calibers if desired by increasing the dimensions to accommodate the cartridge to be used.

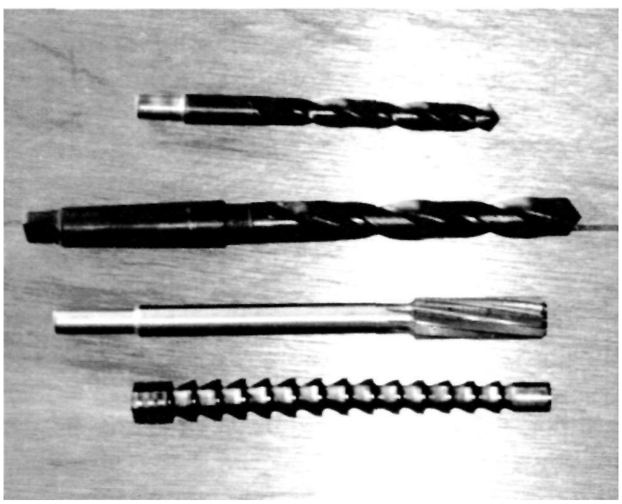


PROTOTYPE ACTION, LEFT SIDE

G HAPTER FOUR

Receiver Manufacture

Before the receivers shown can be fabricated a broach must be made up to cut the bolt raceways. Tool steel, composed of material that includes tungsten, chromium, vanadium, molybdenum, and a fairly high carbon content, should be used for this. Needless to say, such material is expensive but necessary because the finished broach should have a hardness of Rockwell G65 to 68 without being brittle. This material is available from various supply companies as 18-4-2 or 18-4-3, as well as other designations.



Extra tools needed to form the interior of the receiver: (top) drill of the smallest bolt diameter, (second from top) drill slightly smaller than reamer diameter, (third from top) reamer the size of the largest bolt diameter, (bottom) broach to cut lug raceways.

To build such a broach in a small shop, the material is mounted in the lathe and turned to the largest required diameter for its entire length. A pilot is turned on one end to a diameter that is a slip-fitted through the smaller inside receiver diameter. The location of each set of teeth is determined and, using a lathe tool, ground to the contour required to form the radius and face angle; each set of teeth is cut to the same depth as the pilot diameter.

Each set of teeth is turned to the required diameter, with each set slightly larger than the previous one. Although most books on the subject recommend that each set of teeth cut only .002 to .003 inch, the length of the raceways is short, so I made each set of teeth .010 inch larger than the set in front of it. This causes each tooth to cut approximately .005 inch. This may seem excessive to some, but it allows a shorter overall length, which reduces the chance of warping during heat treatment. A clearance angle of 1/2 to 1 degree is formed just behind the face of each set of teeth as they are turned to the required diameter.

With the blank formed as to diameter, it is set up in the milling machine and three longitudinal grooves cut, 120 degrees apart, around the circumference of the blank. The sides of the lands must be straight and perpendicular to the bottom of the grooves. The bottom of the grooves must have the same radius and diameter as the pilot. By using a small 3/16-inch end mill and rotating the blank slightly while making several light cuts, you can shape the radius to a point where very little file finishing is required.

If a tool and cutter grinder is available, the broach should be made slightly oversized and finish-ground after heat treatment. If, as in my case, no such grinder is available, all cutting edges should be cut to the finished size and polished smooth.

If at all possible, the finished broach should be taken or sent to a heat-treatment facility that specializes in treating material of this type. This does not mean that you should turn it over to some punk with a small oven, who thinks he is a metallurgist. Choose someone who not only talks a good game, but also follows through on it. Since the material used here is hardened at 2,200 to 2,500 °F and drawn (tempered) at 1,000 to 1,050°F, it is obviously not a job for an amateur.

In my case I am lucky enough to live close to a large manufacturer of top-quality cutting tools, and, even luckier, several people who work there are friends of mine, including several members of top management. They not only gave me the material to make my broach, they heat-treated it for me after it was finished. To date, I have built seven actions in which this broach was used to cut the bolt raceways. It remains as sharp as it was before the first use and has no cracked or chipped teeth or other deformations. This is ample proof that the company's heat treatment was correct and proper. It should also be pointed out that most tool steels used for this purpose can be straightened in the event that they warp, but only for a short time after the heat treatment is completed—usually 30 minutes or so. After this period, elasticity fades and any attempt to straighten the steel will probably break it.

The receiver blank is chucked in the lathe, the ends squared, and the center drilled. It is now turned to the desired diameter. A hole, slightly smaller than the minor diameter of the bolt, is drilled entirely through the length of the blank. The forward end is then bored to the minor thread diameter with the bottom, which will form the receiver lugs, cut square or perpendicular to the bored portion. The blank is next reversed in the lathe chuck and bored from the rear end using a drill somewhat smaller than the finished diameter. This is followed by another drill .010- to .015-inch smaller than when finished and is reamed to size. If a new, sharp reamer is exactly centered and in line with the bore, and is used with an abundant amount of cutting oil, very few tool marks will be evident. It should be bored or lapped to a slick, smooth finish.

The broach, built earlier as described, is pushed through the receiver blank from the rear end. This will cut and form the bolt raceways. Obviously, the simplest and easiest way to push the broach through is with a hydraulic or mechanical press. Most machine shops and auto body shops have such presses and will perform this operation for a nominal fee. It is also possible (as a last resort) to drive the broach through with a heavy hammer.

Quite a bit of the excess material to be removed in the operation just described can be done by marking the location of each slot on the outside circumference and clamping the receiver to the side of the tool post. A 3/8-inch end mill is mounted in the lathe chuck and used to cut a semicircular slot where the broach cut will pass through. The receiver is fed into the cutter with the lathe carriage. The receiver is rotated 120 degrees and the procedure repeated twice more, causing all three slots to be cut.

The spacing of these slots can be determined by wrapping masking tape around the outside of the receiver and marking the exact length of the distance around it. The tape is removed, extended lengthwise, and measured. This dimension is divided into three parts and marked on the tape, which is again wrapped around the receiver. An index mark is made on the tool post and used to align the division marks on the tape. This will space the slots cut by the end mill accurately enough to coincide with the broach used to finish the slots.

Following this, the receiver is once again chucked in the lathe and threaded inside to match the barrel threads. The diameter and thread pitch can be whatever the builder decides. I favor a diameter of .9125 (0-inch threaded at 16 threads per inch [tpi] for smaller diameter cases, such as a .308, .250/300, etc.). For larger diameter "Magnum" cartridges, such as .338, .375, and similar, I like a diameter of 1 inch, threaded at 16 tpi. There are several schools of thought concerning barrel threading and fitting, but I prefer a snug-fitting barrel-receiver union, with some effort required to screw the two together. I believe that this affords a stiffer assembly than the loose, sloppy threading used by some others, with which the receiver can be wiggled in every direction right up until the final tightening.

A centcrline is established along the bottom of the receiver. This should also center on one of the bolt lug raceways, which must also be located on the exact bottom side. This lets the cartridge feed from the magazine through the bolt-lug slot, requiring only a minimal of metal to accomplish it. The magazine opening, sear slot, and front and rear screw holes are located and cut using this centerline as a reference point.

Since the action screws will be 1/4 inch in diameter with 28 tpi, the screw holes are drilled with a .2187- (7/32-) inch drill and threaded using a 1/4x28 tap.

The sear opening is cut using a 1/4-inch end mill. If available, a ball or radius cutter should be used to cut this slot because a plunge cut can be made at one end of the slot and continued to its full length without changing the cutter. If a standard flat-ended cutter is used, however, a hole must first be drilled with a twist drill and finished with the milling cutter.

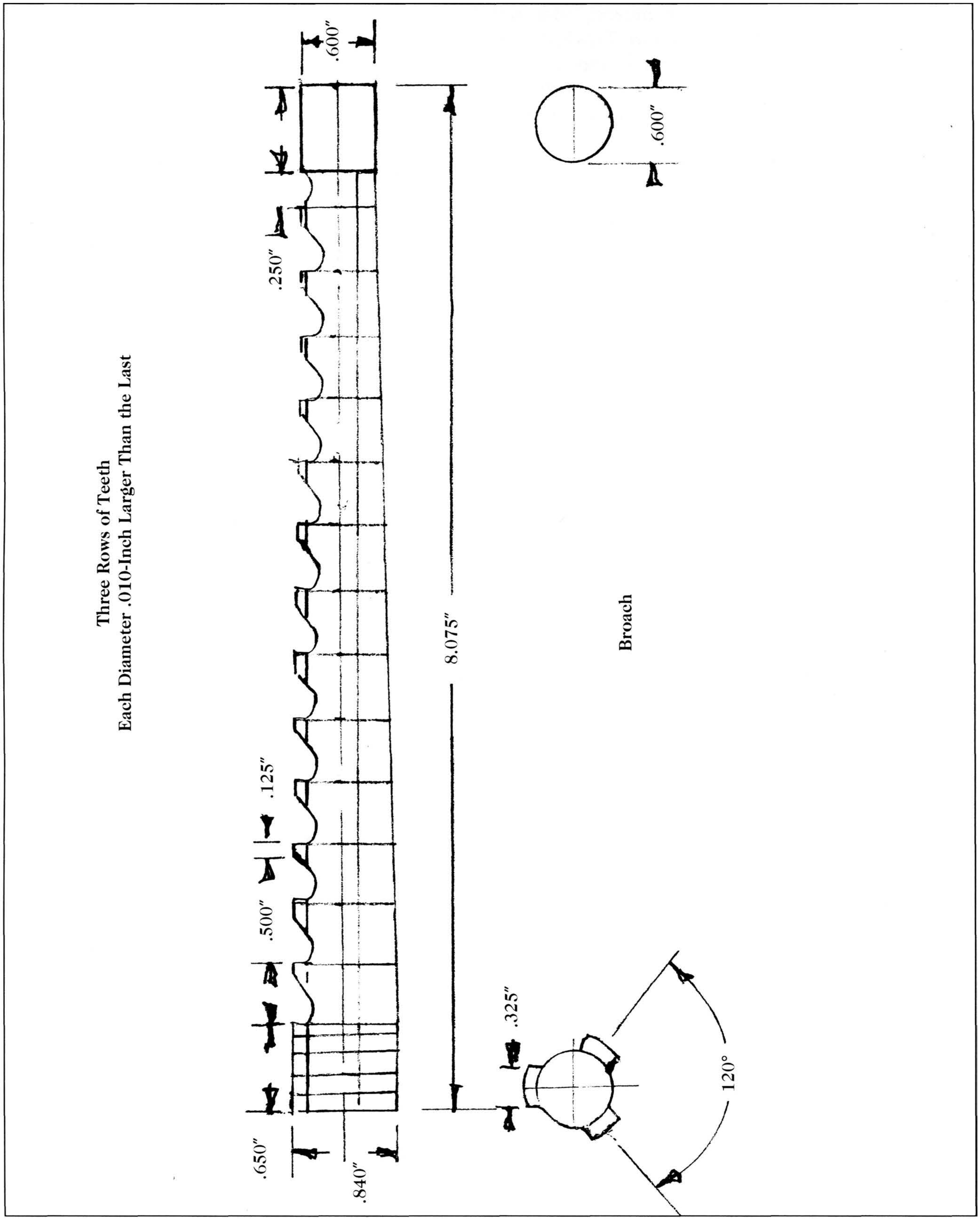
The magazine opening is formed using the same 1/4-inch ball cutter. The slot is cut full length and to a width just slightly wider than the largest diameter of the cartridge used. Once this is done the feed lips are formed, using the same cutter, by extending the width as shown in the drawings. Note that the dimensions given are for the .762x39mm cartridge. When larger cartridges are used, the dimensions must be increased accordingly.

A short length of 1/2-inch-square material is cut with a radius on one side to fit against the receiver and a 1/4-inch slot cut down the center. This is welded to the bottom rear of the receiver just behind the magazine opening.

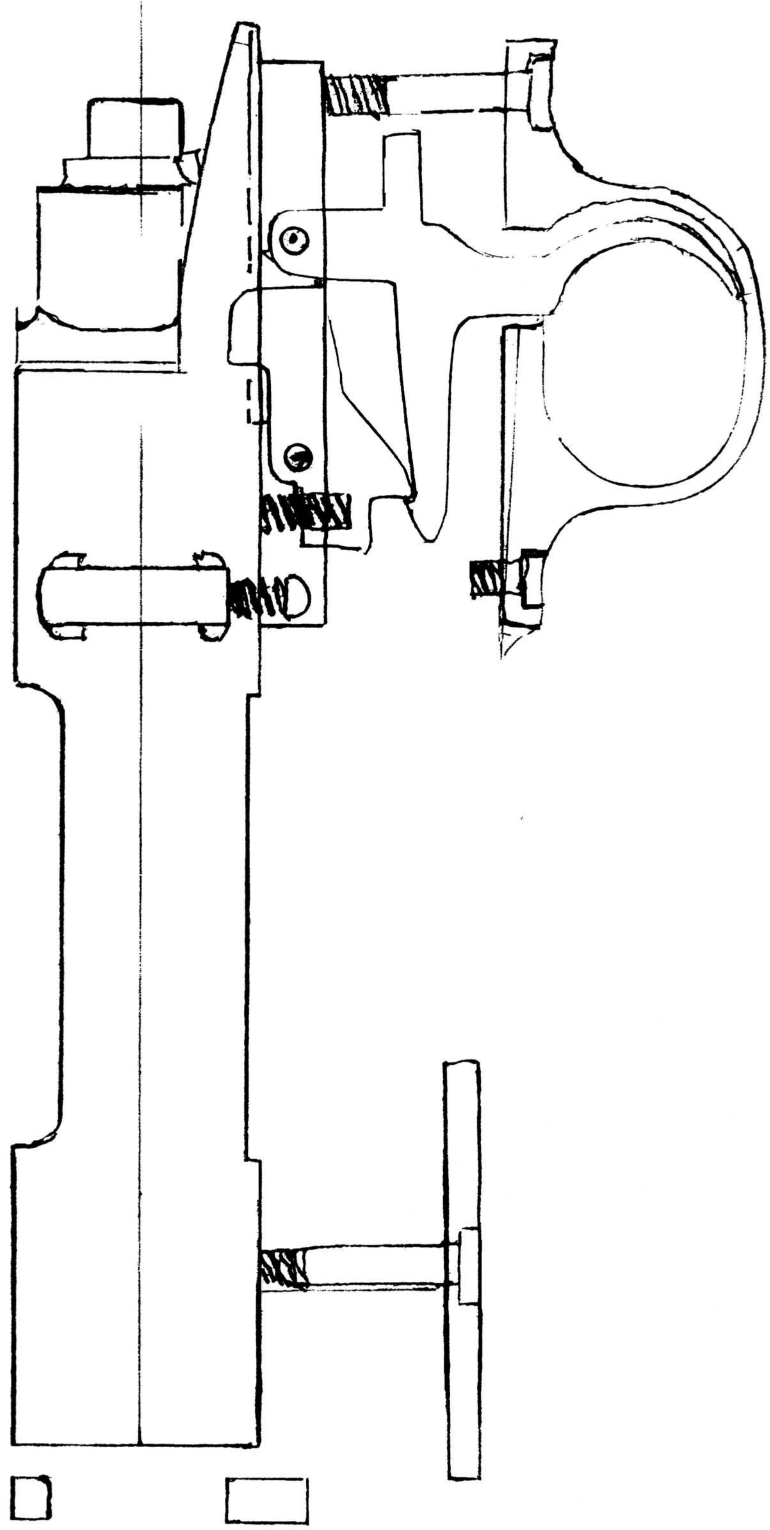
The part is turned upright in the milling machine, and the excess material is cut away to form a loading and ejection port, rear tang, and bolt handle slot. It will be necessary to rotate the receiver 90 degrees with the right side up to do a portion of this. It is true that with more material left above the ejection port, the stiffer the action will be, and it will also be more difficult to load. The configuration shown allows easy loading of the magazine.

The receiver is turned with the left side up, and a dovetail slot is cut for the bolt slot. Although most people already know this, it is well to point out that dovetail slots should first be cut to depth and almost to width with a standard end mill before finishing with the dovetail cutter. The milling machine quill lock must be secured, as well as the table clamps: cutters have a nasty habit of trying to dig deeper as the cut is made, which can easily spoil the work.

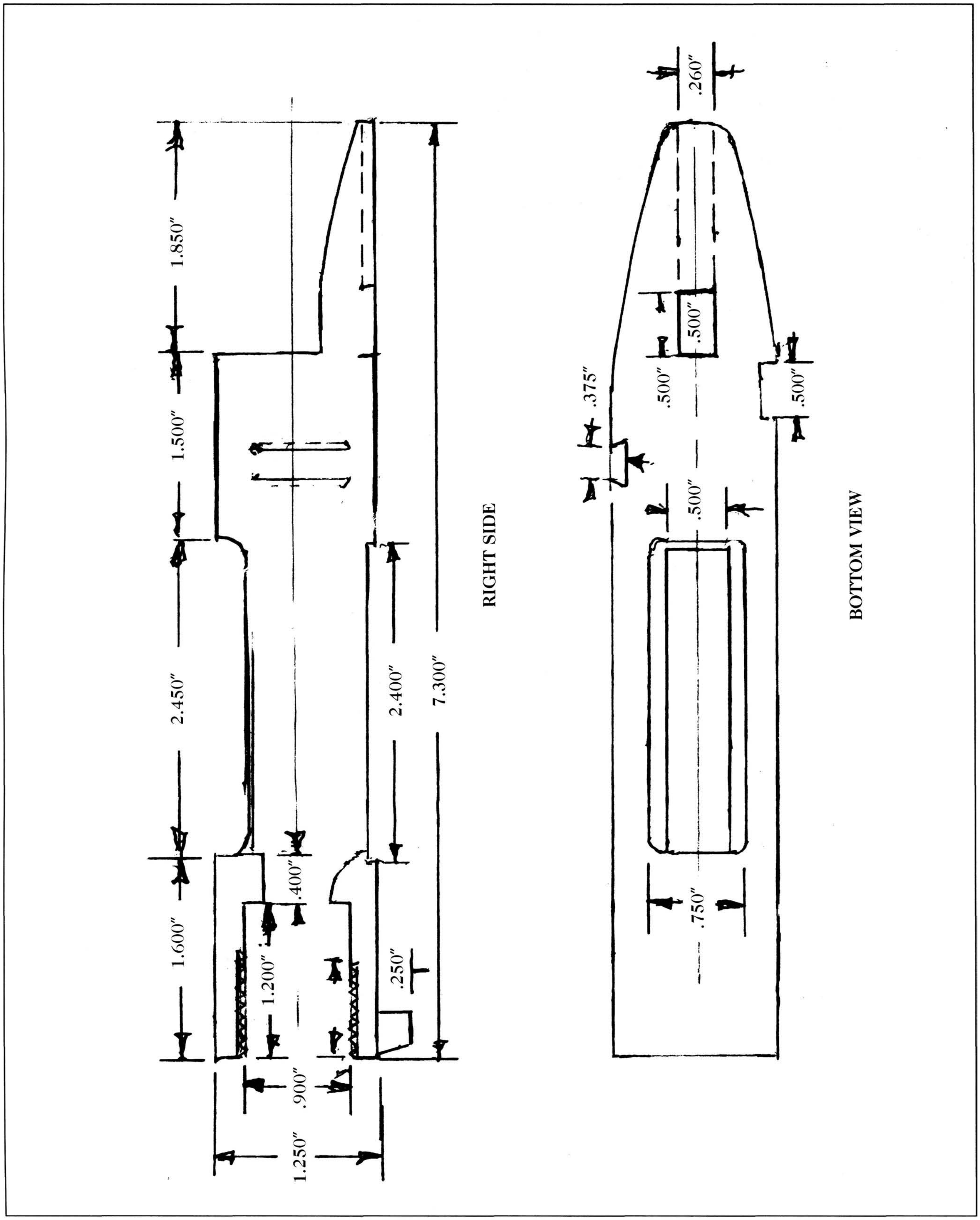
The part is now put aside until the bolt and other action parts are fabricated, then they will all be fitted together.

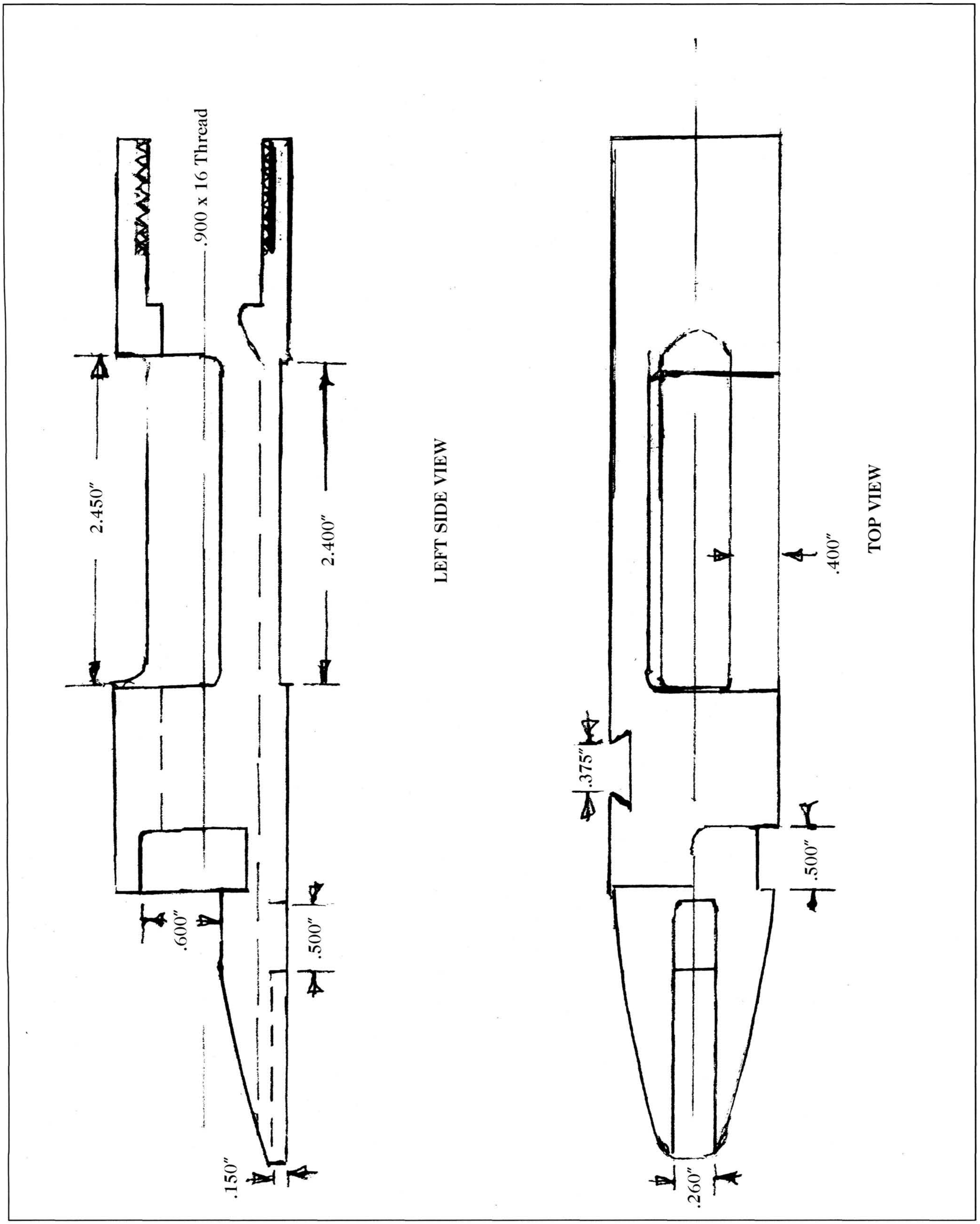

Three Rows of Teeth
Each Diameter .010-Inch Larger Than the Last
.600″
.600″
.250″
.125″
.500″
8.075″
.325″
120°
.650″
.840″

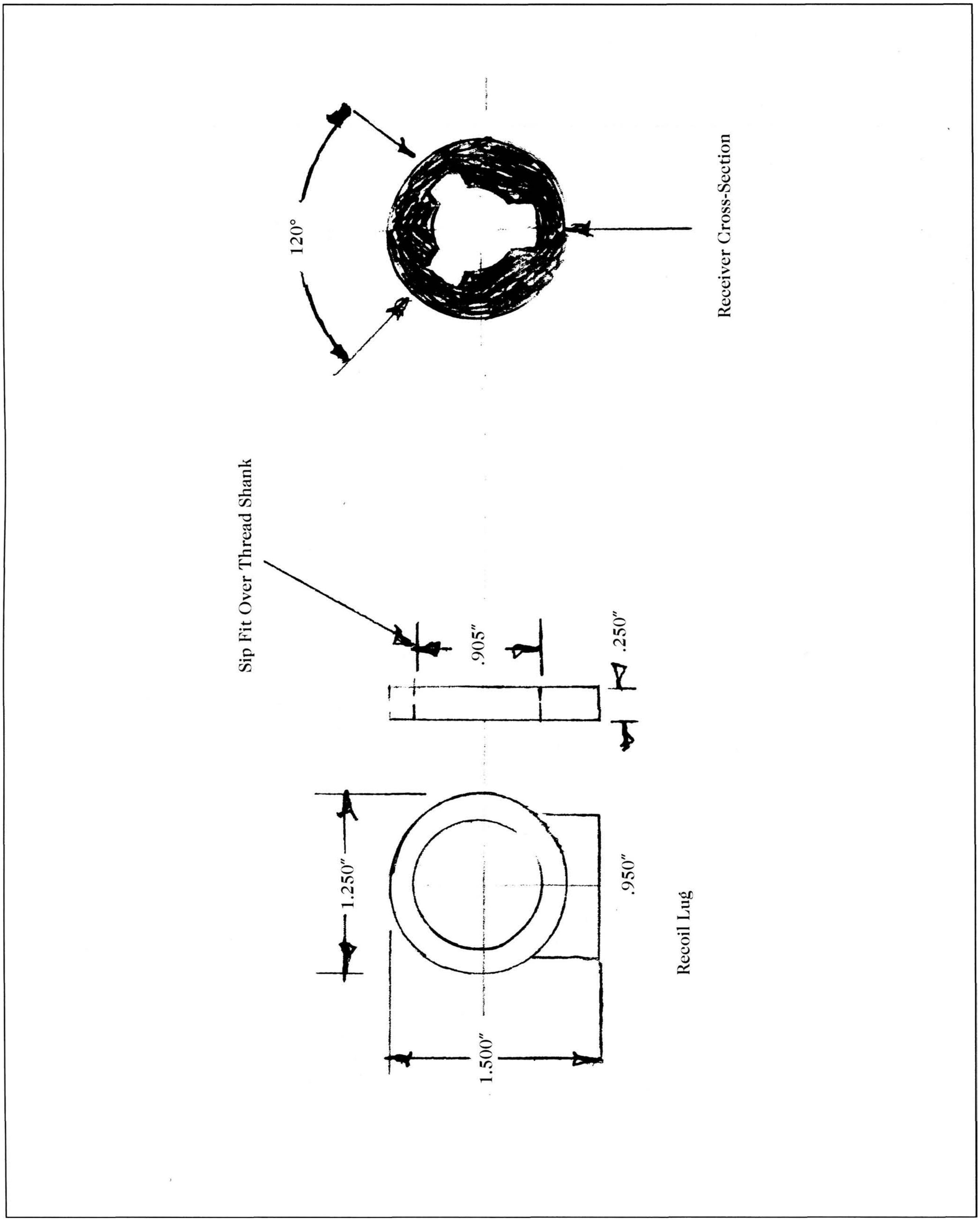
Broach

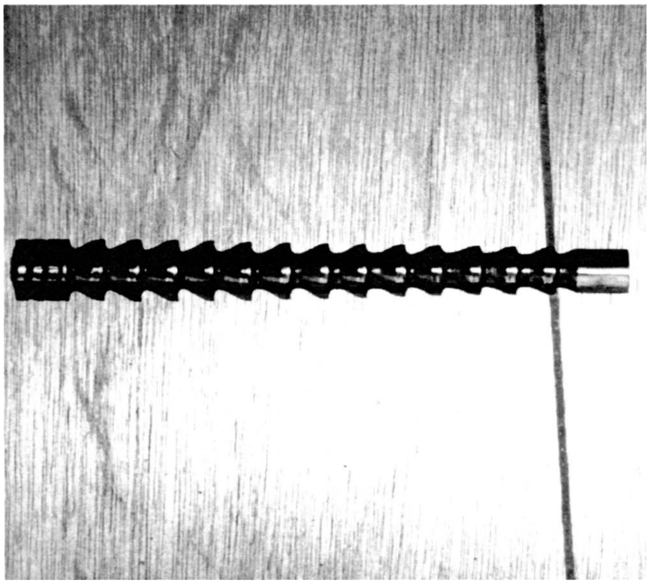


PROTOTYPE ACTION, RIGHT SIDE SHOWING CONCEALED MAGAZINE AND SEPARATE RECOIL LUG

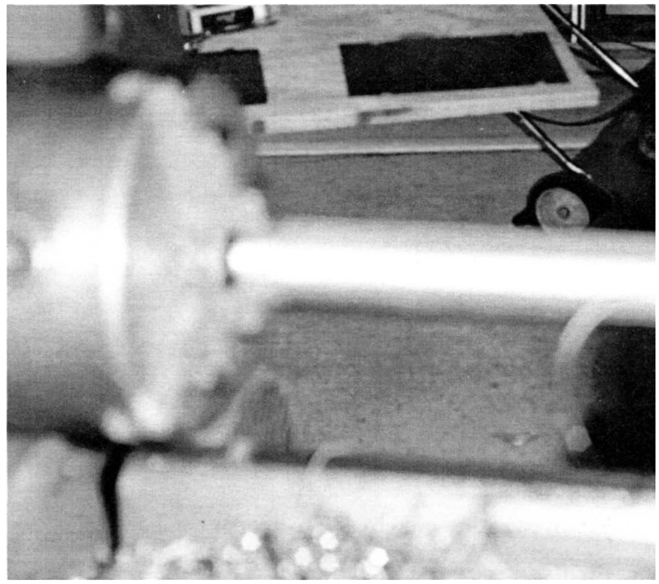

RIGHT SIDE
BOTTOM VIEW
1.850″
1.500″
2.450″
1.600″
1.200″
.400″
.900″
1.250″
.250″
2.400″
7.300″
.260″
.500″
.500″
.500″
.500″
.375″
.750″


.900 x 16 Thread
2.450″
2.400″
.600″
.500″
.150″
LEFT SIDE VIEW
.400″
.375″
.500″
.260″
TOP VIEW

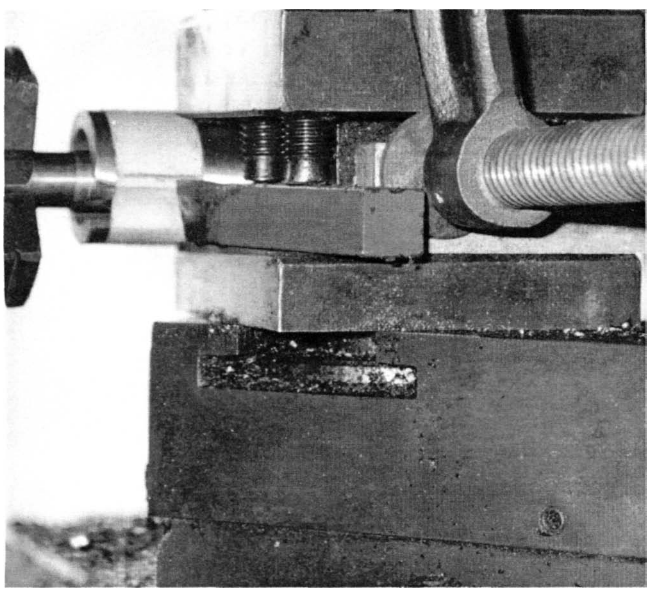

120°
Receiver Cross-Section
Sip Fit Over Thread Shank
.905″
.250″
1.250″
.950″
Recoil Lug
1.500″



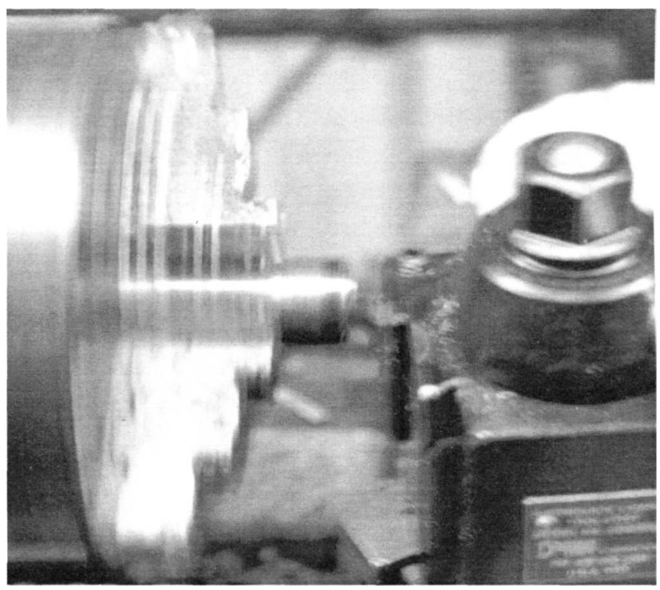
This broach, made from tool steel, is used to eut lug raceways at the forward end of the receiver.



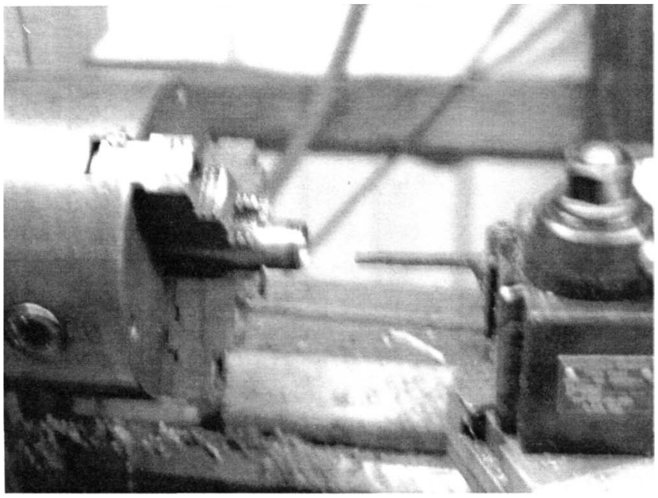
The receiver body is turned to the outside diameter.



Surplus material can be removed from lug slots by clamping the receiver to the tool post and using the end mill in lathe chuck, as explained in the text.

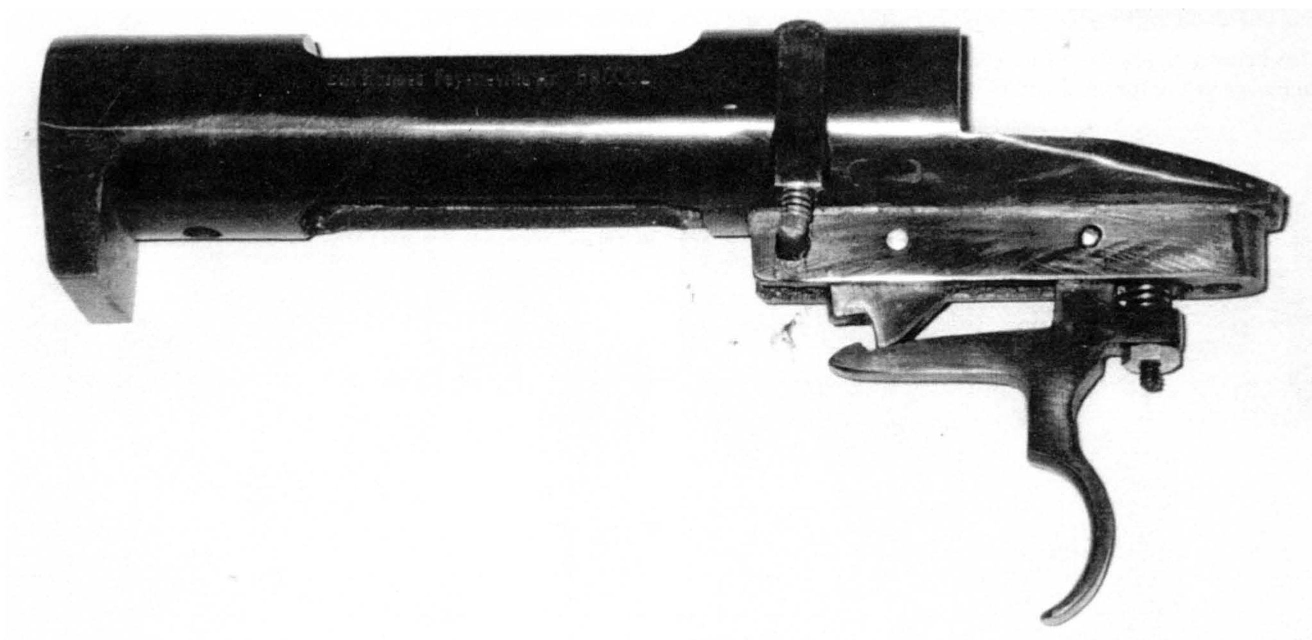


The end of the receiver is turned flat and square.



The receiver is threaded inside to accept the barrel.

The left side of the receiver.

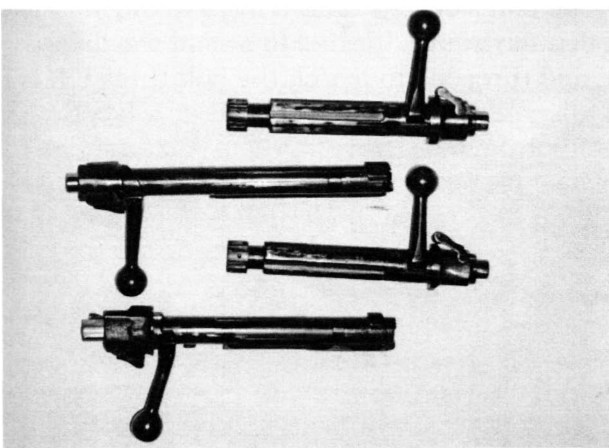


The right side of the receiver.

CHAPTER FIVE

Bolt Manufacture

The bolt is made by cutting a section of round stock to length and squaring the ends in the lathe. A small hole for the firing pin is drilled in one end to a depth of 3/4 inch. This should have a diameter of .076 inch, which is made using a number 48 drill. Start the hole with a center drill and feed the small drill in very slowly using plenty of lubricant, withdrawing and cleaning it frequently. If chips are allowed to load up in the drill flutes, the drill will likely break off in the hole. If that happens, it is easier to discard the part and start over than to spend the time required to remove the broken drill.



The top bolt is for the prototype rifle. The seeond down is for an Enfield. The third is for another prototype. The bottom is for a Mauser. All were either built or modified in my shop.

This same end is counterbored to a diameter just larger than the cartridge head and to the depth shown in the drawing.

The part is reversed in the lathe chuck and bored, first with a 1/4-inch drill to the depth shown. This should intersect and line up with the smaller hole previously drilled from the other end. This is followed with a 1/2-inch drill to a slightly lesser depth, which provides clearance for the main spring and enlarged firing pin flange. I suggest that new, sharp drills be used here. It is imperative that this hole, consisting of three different diameters, be straight and exactly centered. Even slightly dull drills have a tendency to wander off center, so don't take chances. Drills don't cost all that much.

The end is bored out to a diameter of .600 and .500 inch deep. A section .750-inch deep just forward of this is threaded .587 inch by 16 tpi to mate with the threaded portion of the bolt sleeve.

A section .500-inch wide must remain at full diameter at the front end of the bolt body. This will form the locking lugs. Just behind this, a section .525- to .530-inch wide is turned to a just slightly smaller than the smallest inside diameter of the receiver. This will allow clearance for the receiver lugs. The rear side of the bolt lug portion must be cut exactly square and perpendicular to the bolt body.

Location of the three locking lugs is laid out around the circumference of the bolt body. This is best done using a dividing head or indexing fixture. Lacking either of these, it is possible to do this by wrapping a layer of masking tape around the bolt and marking the exact distance, just as was described for the receiver lug location. This measurement is divided in three equal parts, which locates the center of each lug at 120 degrees apart. Then, with the bolt secured in the milling machine, a cut is taken on each side of the lugs center line to the depth of the smaller relief section. This is repeated to outline the other two lugs. By rotating the bolt slightly and taking repeated cuts to the same depth, most of the surplus material between each bolt lug can be removed. What remains is removed and shaped with a small file and finished with abrasive cloth.

The bolt should now fit into the receiver and rotate to the locked position. If it doesn't, whatever material preventing it from doing so must be located and removed. This is fairly easy to do by coating the bolt head with some sort of marking compound and trying it in the receiver. Smoking it with a candle will leave a black coating on the metal, as will a thin coat of quick-drying spray paint. Bright spots in this coating, when the bolt is tried and removed, indicate places where the binding occurs and should be relieved.

When the bolt opens and closes smoothly, a hole is drilled near the left rear of the receiver as shown, and the slot for the guide pin is marked through this hole with the bolt forward but in the unlocked position. The bolt-handle location is also marked at this time. The guide pin slot is cut with an 1/8-inch end mill.

A bolt handle is turned from 3/4-inch round stock. If possible, this should be made from the same material as the bolt, but almost any steel available will do for this. The handle can be shaped as shown or to whatever suits you. The upper end, which will form the root of the bolt handle, must be left oversized and flats machined on two opposing sides as well as the concave portion, which fits against the bolt body. Relief cuts are made on the top and both sides to facilitate a deep weld joint, and the handle is clamped in position on the bolt's right side and welded in place. TIG welding is best for this because it penetrates well with less heat spread than other types. Properly done, this weld will be undetectable when dressed to size and polished.

The bolt sleeve is turned from round stock to the contour shown, drilled to accept the firing pin, and threaded to match the bolt thread. It is cut to length and, when threaded in place, the exact bottom centerline marked. A .250-inch-wide slot is cut along the centerline to clear the cocking piece and the sides relieved to mate with the receiver tang.

A safety lever is made up as described in Chapter 7 on safeties and the bolt sleeve drilled to accept it. The curved portion that clears the cocking piece can be formed exactly by taping the safety lever in place in the forward position, securing the threaded end in the lathe chuck, and boring it with a 1/2-inch end mill mounted in the tailstock drill chuck.

The retaining pin hole is drilled with the safety lever in place in the bolt sleeve. If the drill is run through this hole with the safety in its forward position and again with the lever in the rearmost position, the location of the retaining groove will be marked at both ends and can be cut with a small triangular file.

The plunger hole is drilled in the position shown and the plunger and spring fitted. The position of the three plunger detents are marked with a drill from the front side. These are finished with a slightly larger drill and triangular file.

The cocking piece is made from 4140, or similar, 1-inch round stock. Start by drilling a hole for the firing pin with a 7/32-inch drill and thread it with a 1/4 inch x 28 tpi tap. One end is bored with a 1/2-inch end mill to a 3/4-inch depth. The opposite end is turned to a .500-inch diameter by .350-inch long. Next, a section .250-inch wide is located on the exact center and, using a fixture to rotate the part, the remaining material is cut away. This will leave a series of small flats, which is dressed to the same contour as the already turnedl/2-inch round portion. The end that engages the sear is cut and shaped with a nose angle as shown.

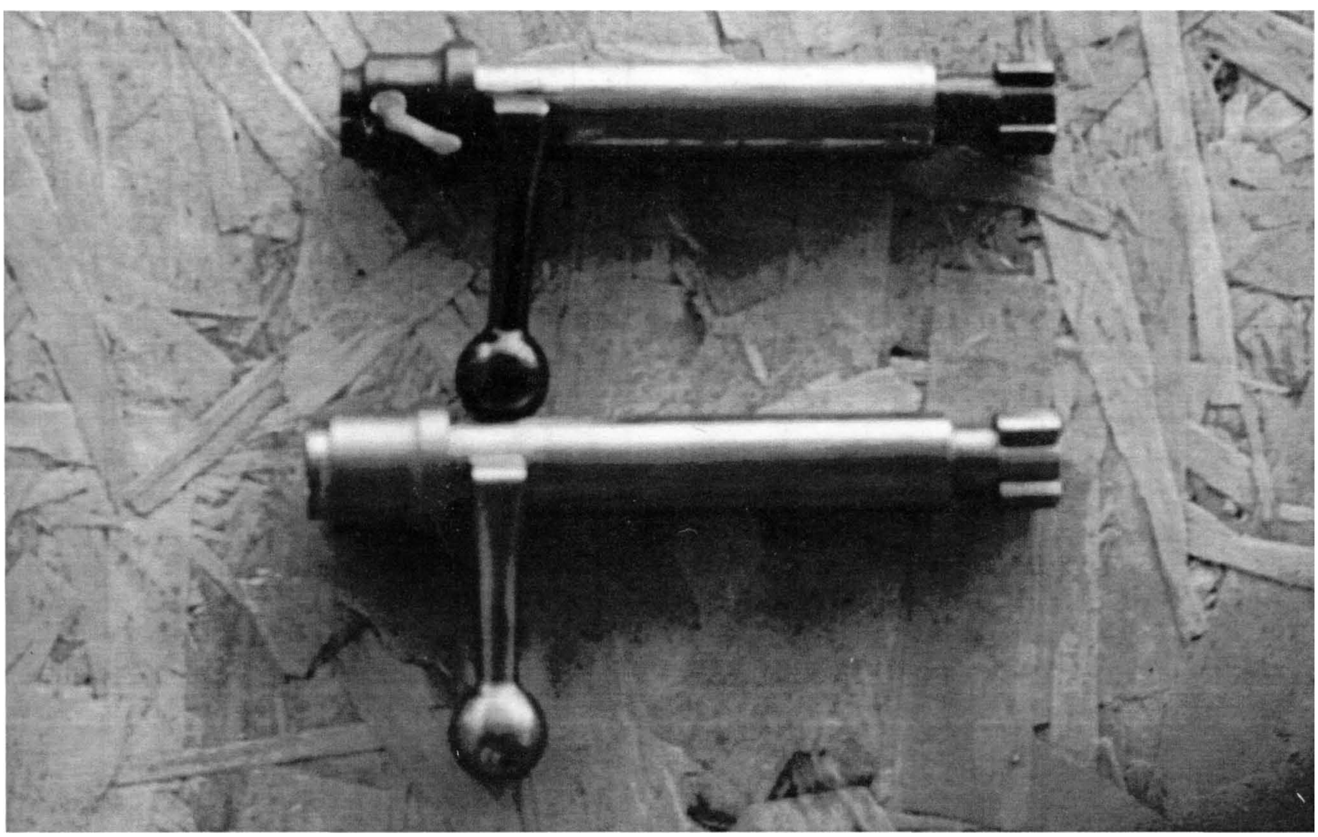
The firing pin is turned from 1/2-inch round stock. This too should be quality material. I have in many cases used the piston shaft from automobile shock absorbers for this with good results. Certain types of drill rod can be used but may prove to be brittle.

With the bolt in place in the receiver, a mark is made through the sear slot on the one side with the bolt in its closed position and another on the opposite side with the bolt unlocked. This will mark the cocking cam location, which can be roughed in with a small end mill and finished with a file and abrasive cloth.

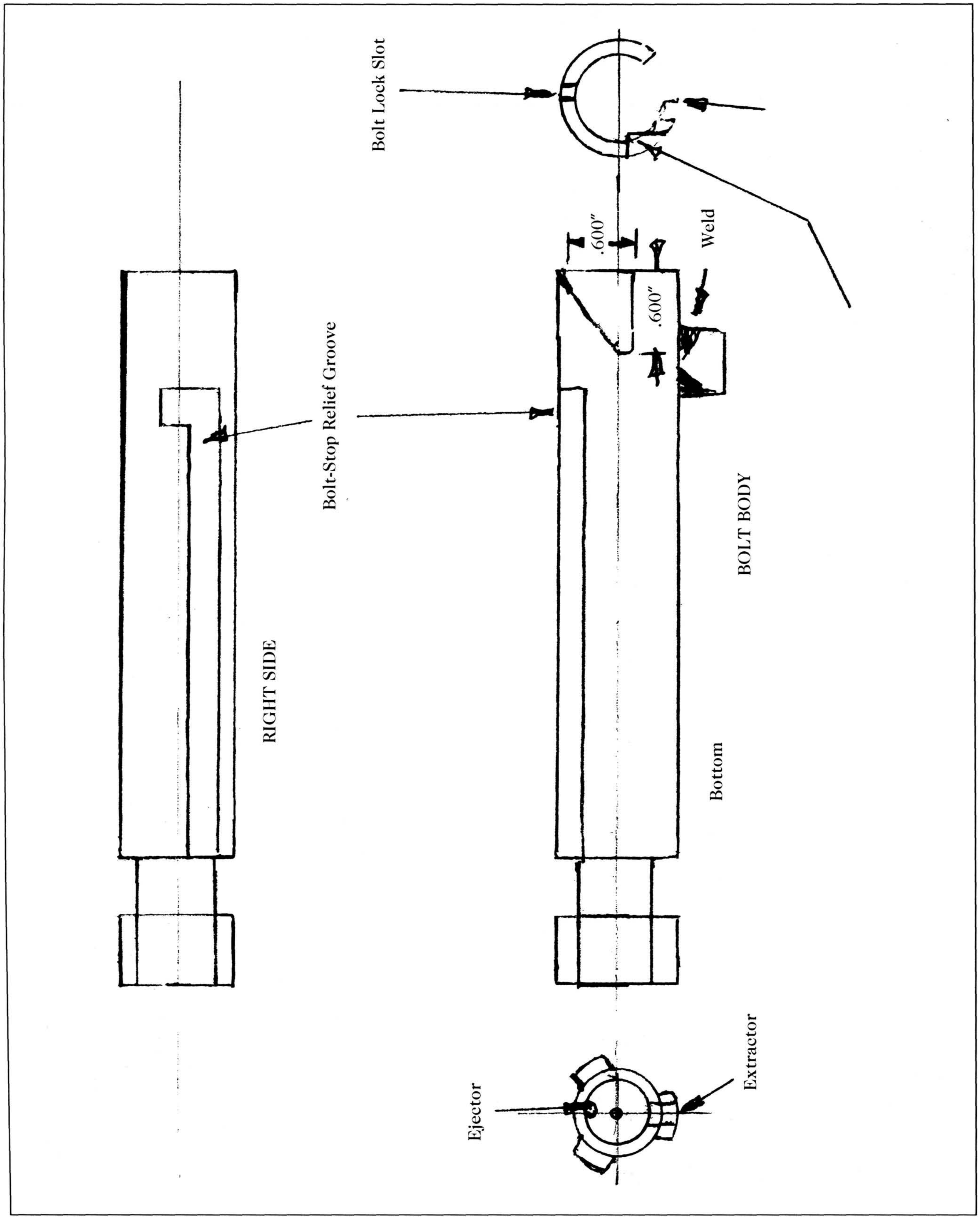
A cut is made in the upper right-hand bolt lug and an extractor made as shown. The hinge pin hole should be drilled with the extractor in place to ensure proper alignment. A small 1/8-inch diameter spring is used here.

Two types of ejector are shown. The spring-loaded type, which is contained in the bolt face, is simply inserted in the hole in the bolt face and pinned in place. The other, a leaf type, is made as shown and hinged to the receiver. This one requires a slot in the bolt face to let the end of it contact the cartridge head.

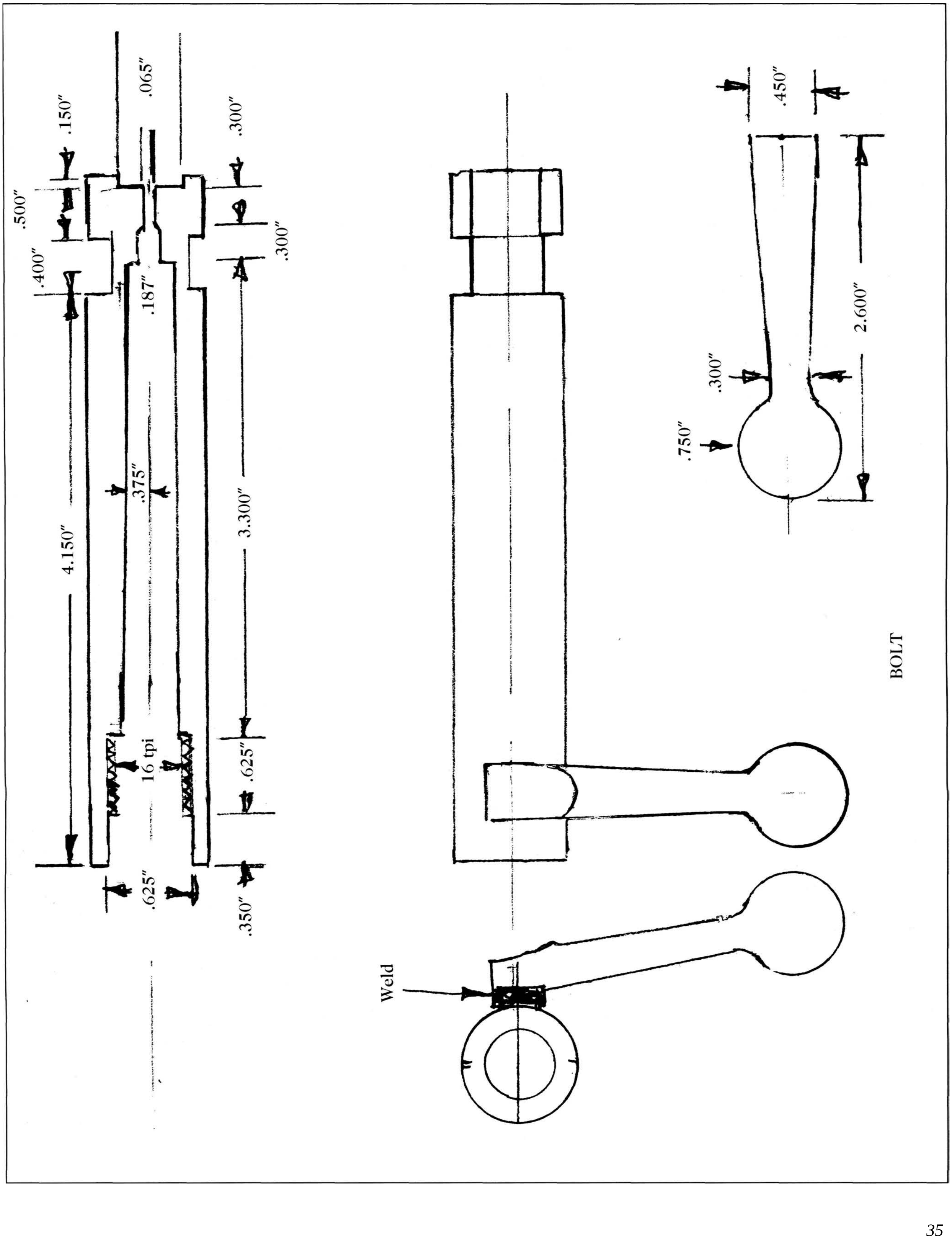
The parts can now be assembled, but final fitting may be required after the other parts are made and in place.



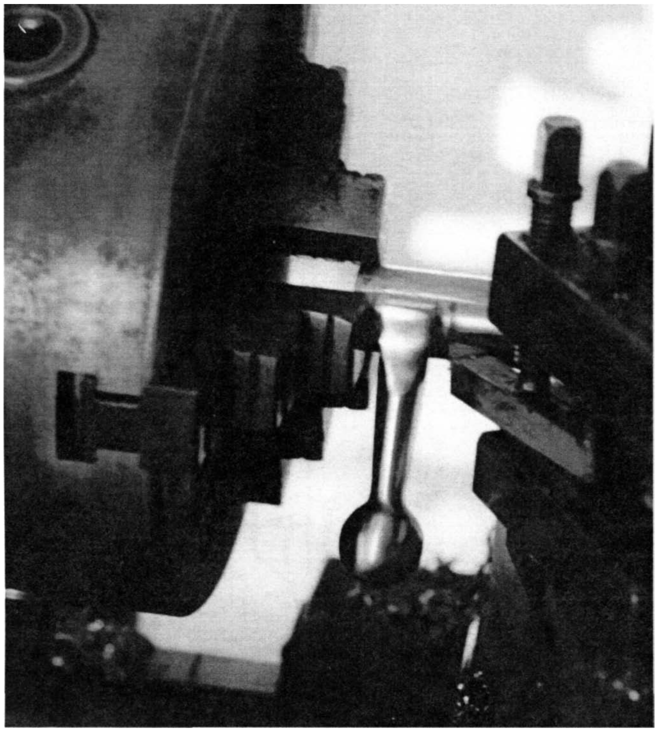
These are bolts for the prototype rifles. The one at the top is finished.



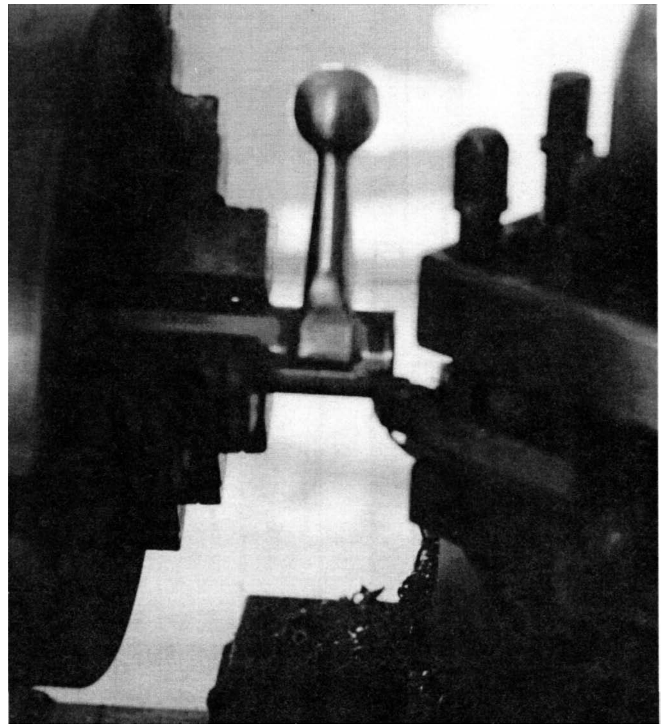
Bolt Lock Slot
Bolt-Stop Relief Groove
.600"
.600"
Weld
RIGHT SIDE
BOLT BODY
Bottom
Ejector
Extractor


.150"
.500"
.400"
.065"
.300"
.300"
.187"
4.150"
.375"
3.300"
16 tpi
.625"
.625"
.350"
.450"
2.600"
.300"
.750"
Weld

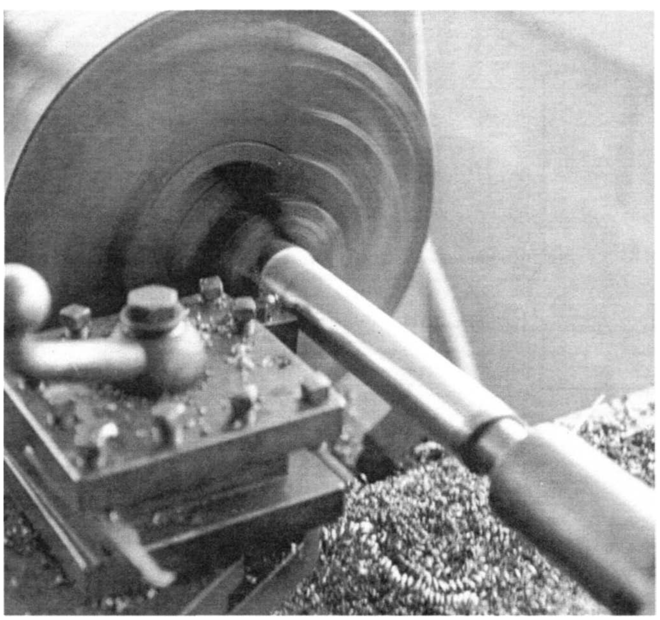
BOLT



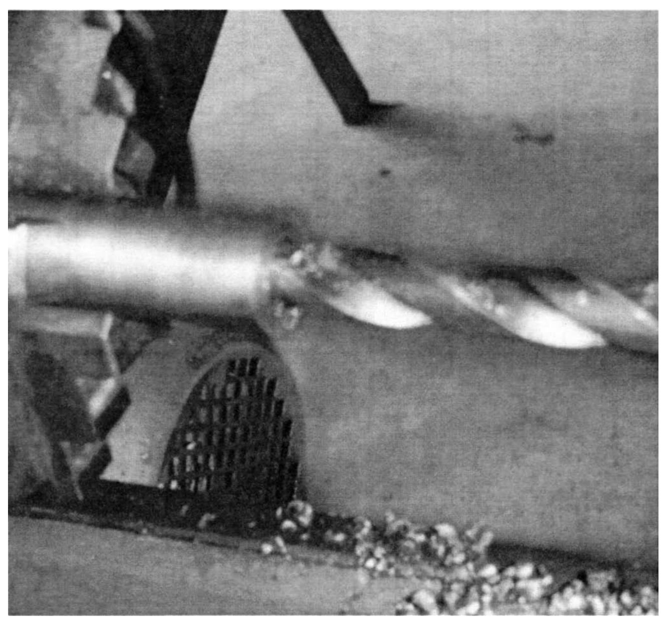
Excess material from the weld is removed in the lathe, leaving a flat, square shoulder.



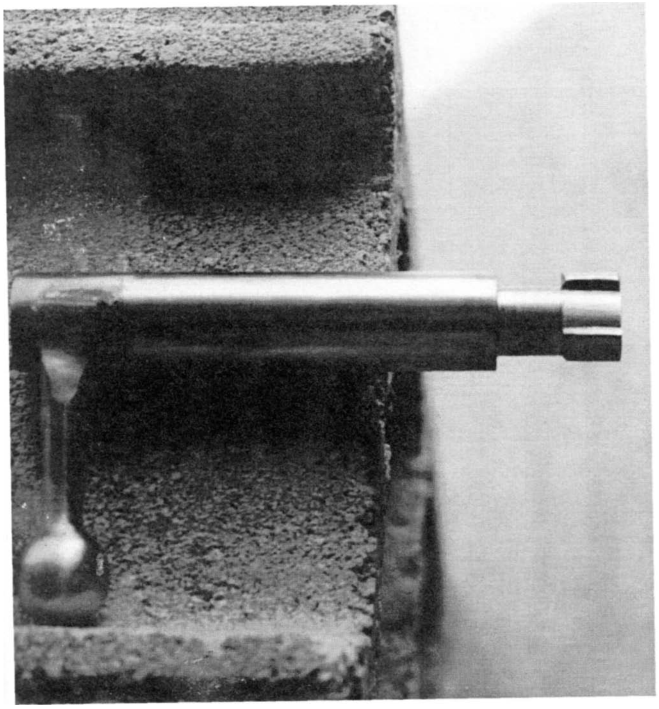
The same procedure is done on the rear side. A concave curve in the front side is shaped using a small drum sander.



The bolt body is turned to size.

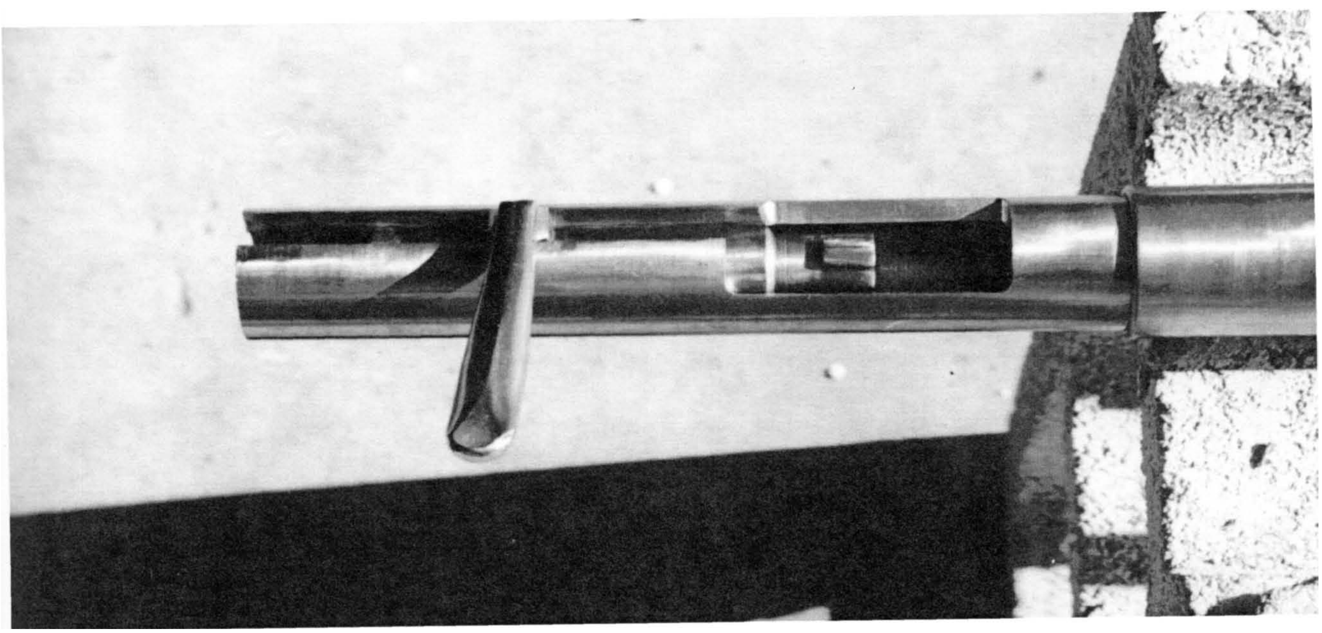


The bolt body is bored for firing mechanism.

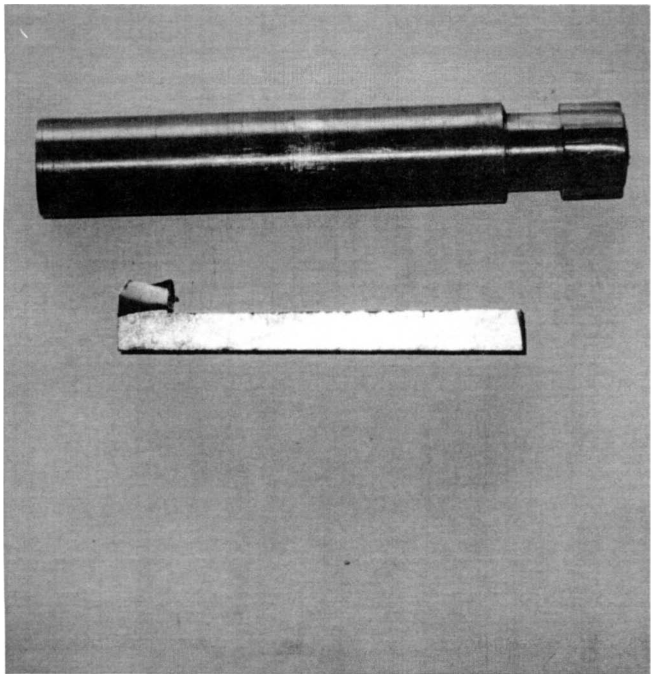


Locking lugs are located and cut at the forward end of the bolt. In practice, this should be done before the bolt

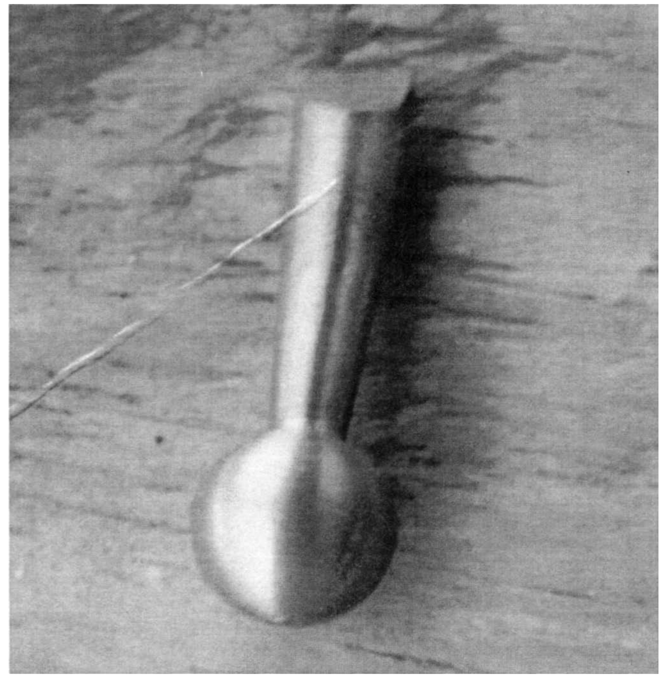
An end view of the bolt head showing the firing pin hole.



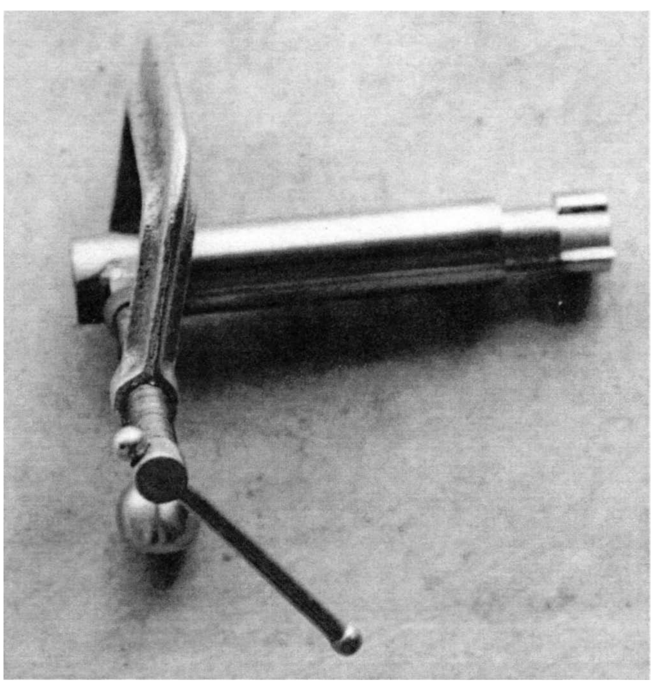
The bolt used in the sniper rifle is the same basic bolt described here. It differs mostly by using a flat bolt handle.



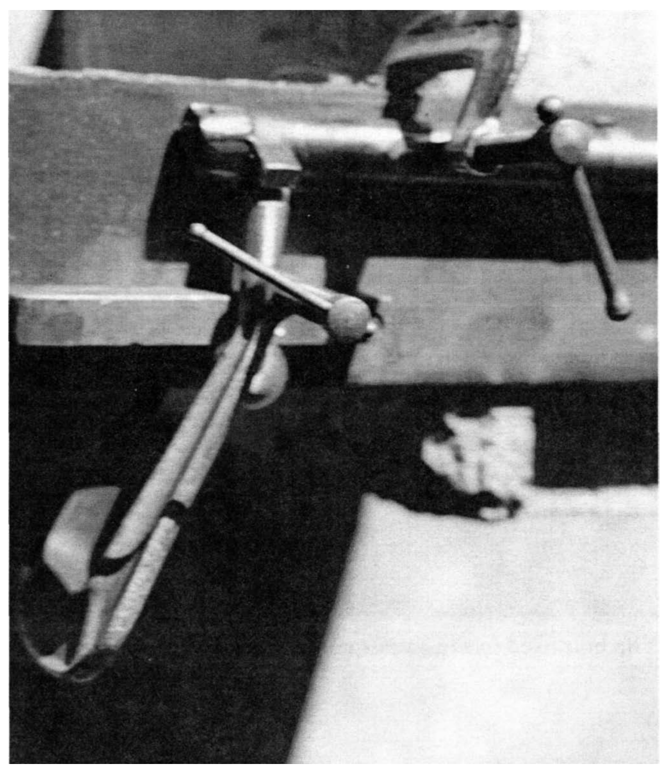
The bolt used in the rifle. The spoon-type, flat handle is rough shaped, ready to weld in place.



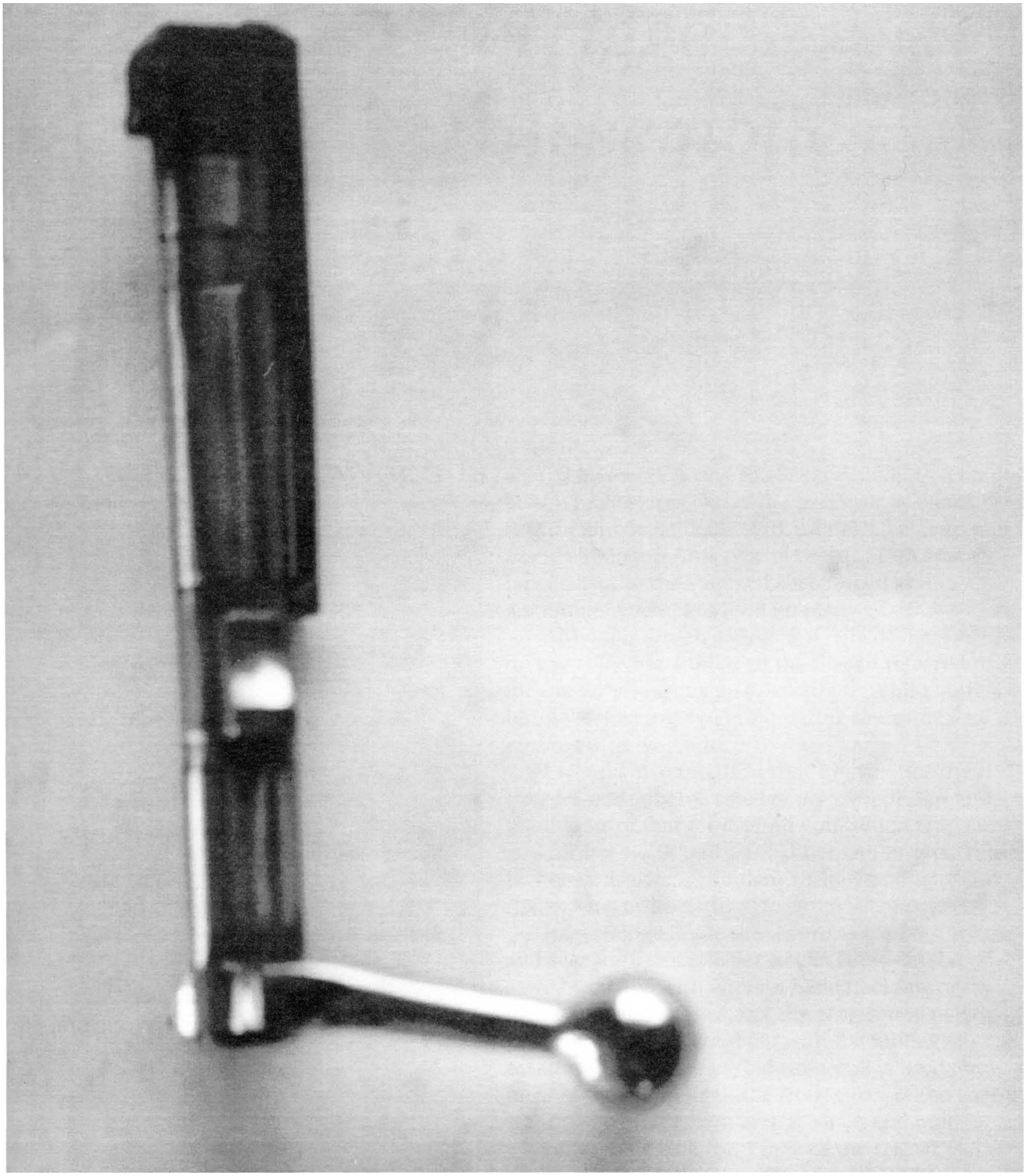
Bolt handle, turned from round stoek. This one is made to be welded to the bottom of the original bolt-handle stub. Those to be welded to the side of the bolt should be longer and contoured to fit the body closely.



The handle is clamped in place on the bolt body and is ready to be welded in place.



A military bolt body and new bolt handle are held in place for welding by clamping both to a flat plate.

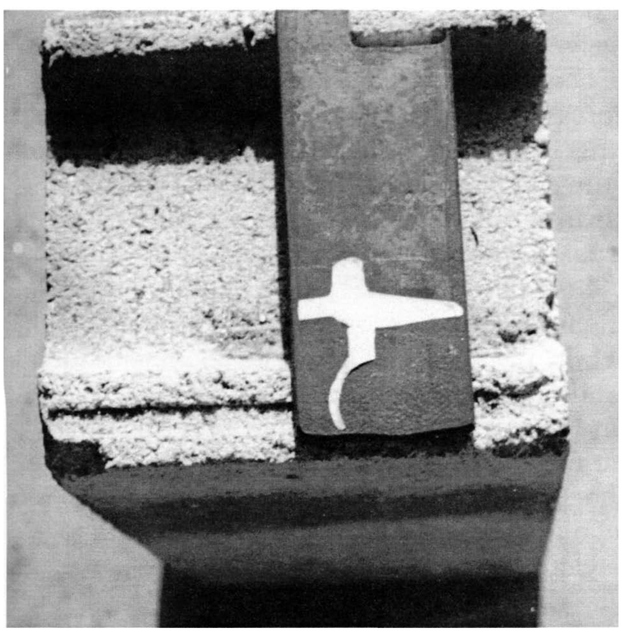


An .03 Springfield bolt with new handle in place. This bolt was made in wartime. Those made in peacetime were mostly smooth bodied, without the step surrounding the safety lug.

CHAPTER SIX

Trigger Assemblies

My own opinion, which is shared by many, is that the firing system used on the M70 Winchester is one of the best ever designed. Rugged and dependable, with a safe, light, crisp pull easily obtainable, this type of trigger mechanism is far superior to the stamped sheet metal and aluminum assemblies used on many rifles.



Trigger template in plaee on a pieee of truek leaf spring.

Although not an exact copy, the designs used on my rifles are similar to the design referred to for the very reasons just described. While quite a bit of work is involved in building the same, the end result is worth it.

I should also mention that I have built these triggers not only for rifles of my own design and manufacture, but for several bolt-action trap guns and for both .30- and .50-caliber sniper-type rifles. If there was ever a problem with even one of these, I never knew it.

It is a fairly simple procedure to cut both trigger and sear from suitable flat stock. These can be sawed to shape with either a hand hacksaw or metal-cutting bandsaw, but the easiest and most precise way is to form them with the milling machine. A 1/4-inch carbide end mill is used for most of the outline, but the front curve of the trigger is formed with a 1-inch or 1 1/4-inch end mill.

In practice, the front face of the trigger is rough-shaped with the small end mill, and the curved portion finished with the larger cutter. The back side of the curve can be rough-shaped freehand, using the small end mill and the remainder cut to on the back side can using a disc sander, crown on the trigger face.

The sear is cut the same way, by forming the outline with the small cutter, then clamping it upright in the mill vise, and cutting the straight, flat surfaces with a 3/8-inch end mill.

Flat spring material, as taken from leaf springs used on older automobiles and light trucks, is the prime source of material for these parts. It is too hard to machine as it comes, but it can be softened by heating it and allowing it to cool slowly. Actually it isn't necessary to completely anneal it as is done by heating it to a high temperature, usually a bright cherry red, and cooling slowly. Heating to just a hint of a red color and cooling will usually soften it to a point where it is workable. Suspending it over a bluing tank burner for 30 minutes or so will usually accomplish this.

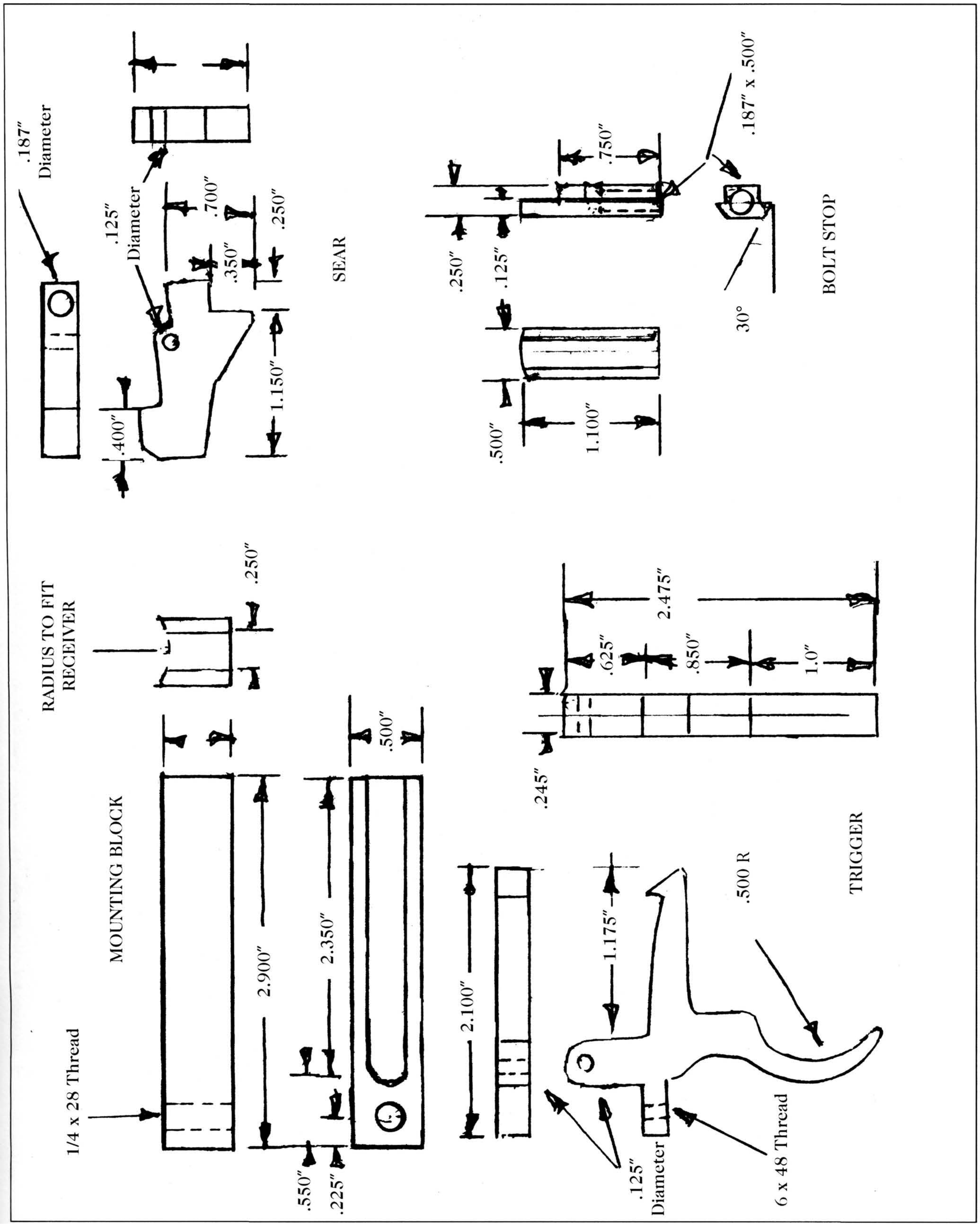
Location of the holes is crucial. Both the sear and trigger should be put in place in the action and the hole locations marked through the pivot pin holes. A hole is drilled and tapped vertically through the rear arm of the trigger to accept a 6x40 adjusting screw, which limits overtravel and serves as a spring guide. A .187-inch diameter spring pocket is drilled from the top side at the forward end of the sear to house a sear return spring.

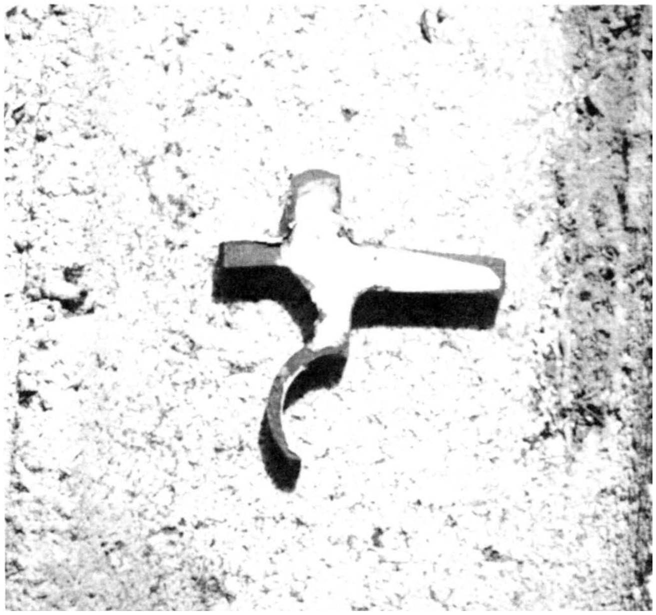
Final fitting is done by installing both parts, with springs in place, in their respective positions. The sear should move upward to block the cocking piece as soon as opening the bolt cams it to the rear. The notch, or groove, at the front of the trigger must snap upward and engage the lower front edge of the sear, holding it in the cocked position. It is a good idea to leave these parts slightly oversize and remove metal from the sear face and trigger notch, using files and stones until they mate correctly.

With only a slight redesign this trigger assembly can be used on Mauser, Springfield, or Enfield actions. A mounting plate 1/4-inch-thiek by 1/2-inch-wide, with a 1/4-ineh-wide-slot down the center must be welded or silver-soldered to the receiver tang on both the Mauser and Springfield to provide mounting points, and the sear slot in the receiver tang must be lengthened.

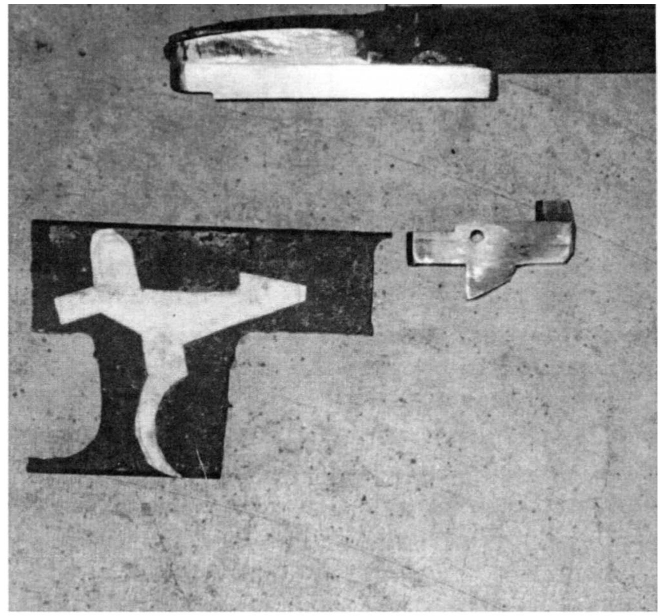
The Enfield can be used without the additional mounting plate, provided the existing slot is milled deeper and the curved section just in front of the rear stock bolt is machined flat. The existing sear slot must be lengthened at the front. The reason for this is to allow the portion of the sear that extends upward through the receiver tang to be lengthened to a point where the cocking piece keeps it pushed down or depressed when in the forward (fired) position. If this is not done, the relief cuts in the bottom of the cocking piece can let the sear move upward until the trigger engages before the firing mechanism is cocked, thus binding the action.

Note that the exact shape of these parts is of little importance as long as the sear contacts the cocking piece at the end of the cocking motion and the trigger notch engages the sear at the same time. It is also important that the lower sear face be almost directly under the pivot pin. If not, it will try to cam the trigger leg downward and out of engagement, which will require a heavier spring to counteract.

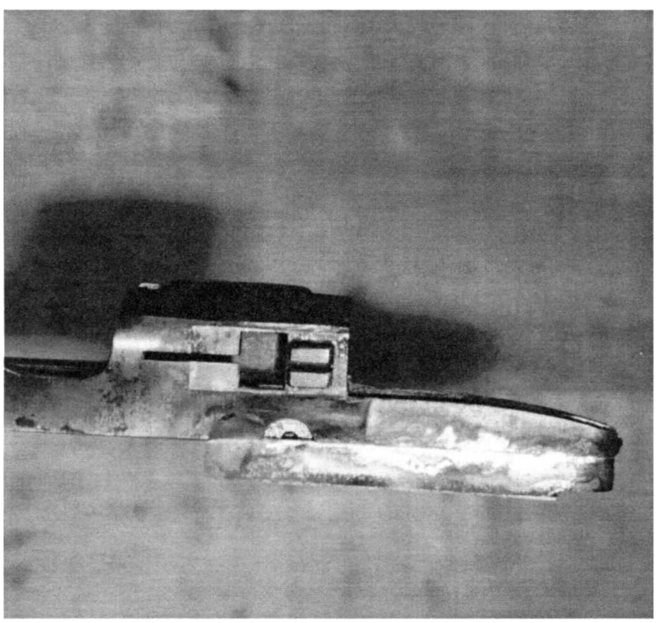

.187″
Diameter
.125″
Diameter
.700″
.250″
.350″
SEAR
1.150″
.400″
.750″
.187″ x .500″
.250″
.125″
.500″
1.100″
BOLT STOP
30°
RADIUS TO FIT
RECEIVER
.250″
MOUNTING BLOCK
1/4 x 28 Thread
2.900″
2.350″
.500″
.550″
.225″
2.100″
.245″
2.475″
.625″
.850″
1.0″
1.175″
.500 R
TRIGGER
.125″
Diameter
6 x 48 Thread



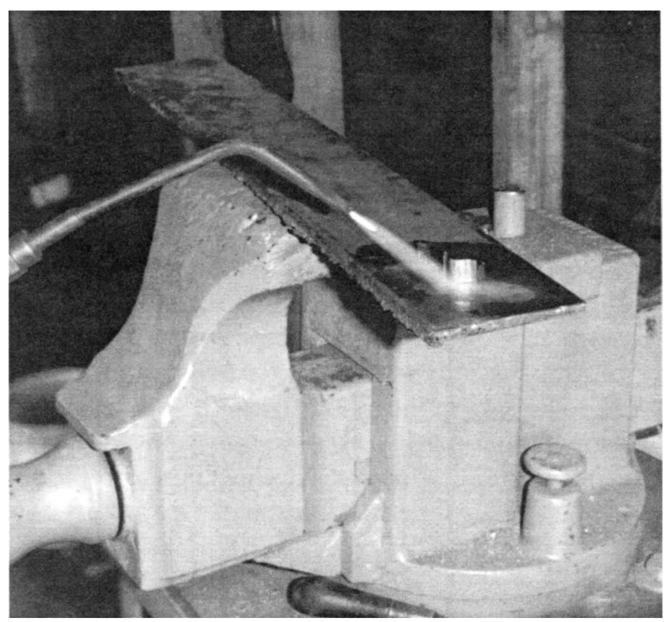
Trigger cut to profile and ready for forming to finished shape.



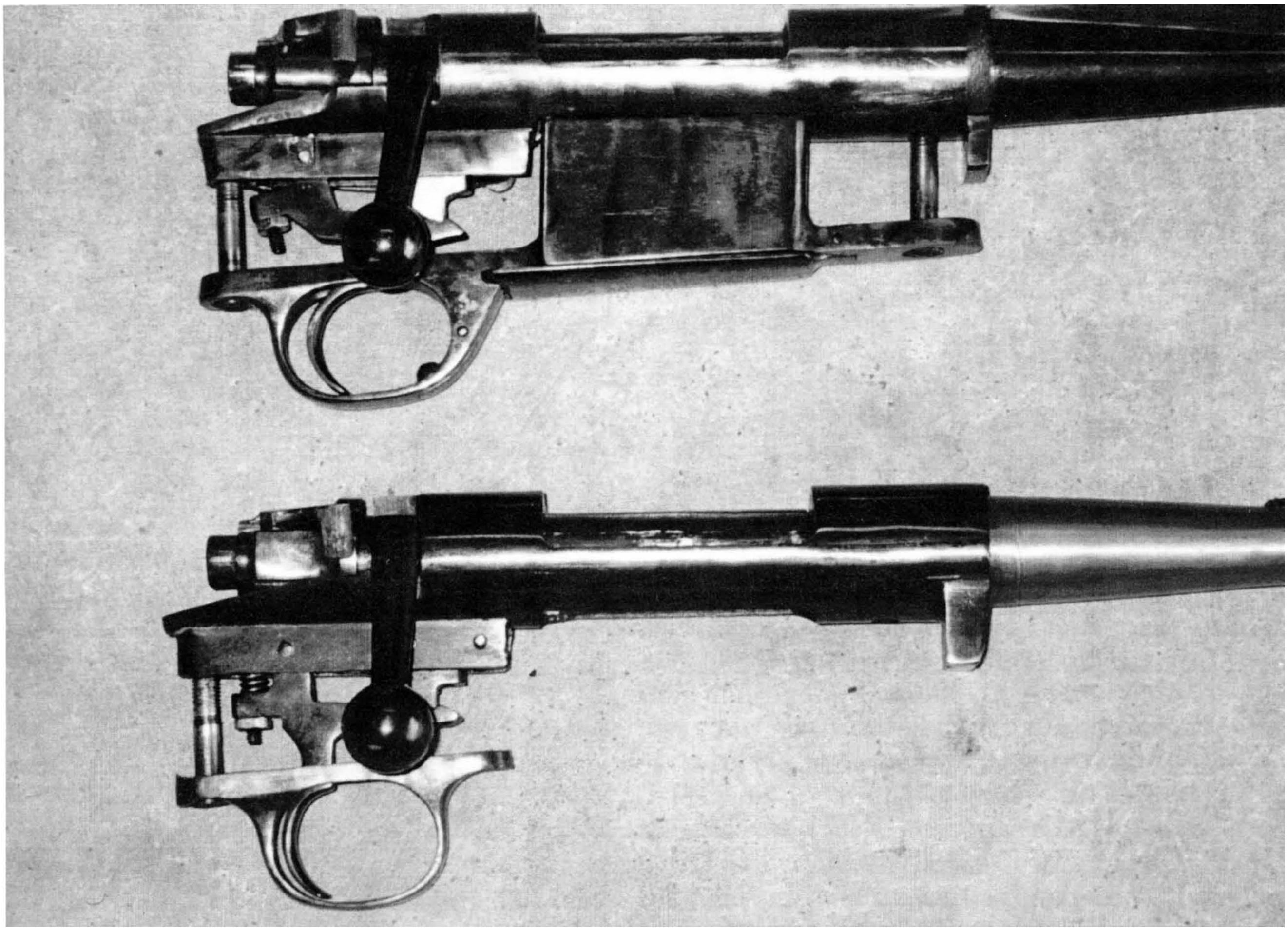
The pattern is eemented to metal for tracing the outline. Also shown are the finished sear and the mounting plate in place on the receiver.



Mounting plate for trigger and sear, silver-soldered to the bottom of the reeeiver.

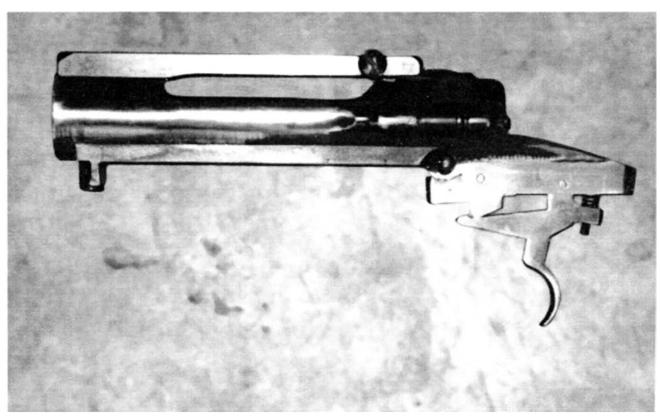


Drawing temper of the sear. Heating on a large plate ensures even distribution of heat.



Finished triggers and sears in place on rifles. These are the actions shown in the drawings.

Trigger assembly in plaee on the prototype.

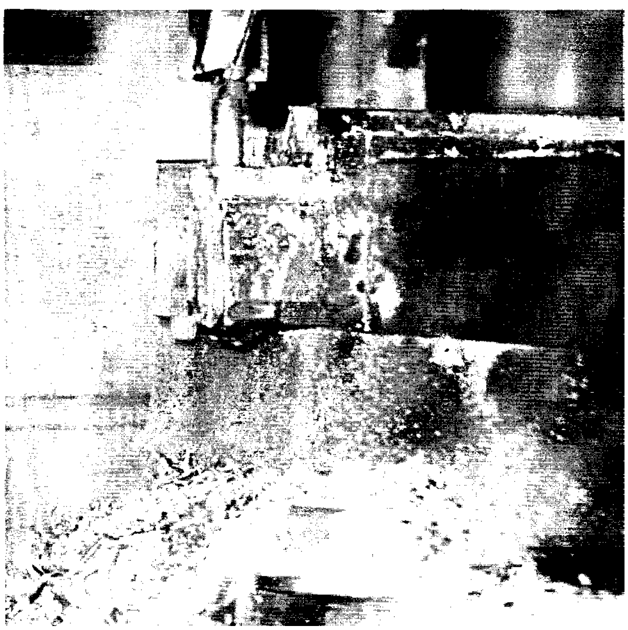


Trigger assembly installed on a Springfield.

CHAPTER SEVEN

Safeties

The side-swinging, three-position safeties shown here have long been considered as among the very best by those who really know and use guns. These safeties are also time-consuming and difficult to build in the small shop. A good CNC mill permits rapid production of them, but in a small shop, where only single-point tools are available, it takes time. However, the end result makes it worthwhile.



The safety shaft is formed using the inside of a counterbore that originally used a 1/4-ineh drill as a guide.

The safety lever, the part that extends from the right side and swings back and forth, should be made from tough enough to withstand the friction of its movement against the cocking piece without wearing away. The rear edge of the extended shaft of this part must cam the cocking piece far enough to the rear to disengage it from contact with the sear each time the safety is engaged. Low carbon steel (e.g., 1018) would wear rapidly in such a situation. A tough alloy (e.g., 4140,) should be used for this.

The shaft proper is formed by clamping the material in the mill vise and cutting away material with a small end mill, leaving an upright slightly over 1/4-inch square and slightly longer than the finished shaft will be. Counterbores are available that use a 1/4-inch drill as a center guide. Using one of these, without the drill in place, it is positioned directly over the upright and fed downward. If the drill guide is well lubricated and fed slowly, this will result in a smooth 1/4-inch-diameter shaft. Note from

Illustration K that a smaller .100- to .125-inch projection is required at the very tip end. This will support the lower end of the shaft in the bolt sleeve, allowing the larger diameter shaft to rotate. This can be formed by using an open-center milling cutter that has a center hole of the desired diameter. The mill table must not be moved in the horizontal plane while this is done. The table can be lowered to allow changing cutters and raised again, but both diameters must remain concentric.

The remainder of the lever can be shaped as desired and the outer surface checkered, grooved, or left plain. The contour shown permits full forward and aft movement and looks fairly decent. The longitudinal grooving, cut with a metal checkering file, provides a nonslip surface. It can be shaped to your own desires.

A hole must be drilled from the top of the bolt sleeve to allow a snug fit of the safety shaft. Almost half of the shaft diameter must protrude inside the hole for the cocking piece. This requires that a close-fitting plug must be inserted in the bolt sleeve hole to support the drill.

Otherwise, it would wander to the unsupported side and likely break. The smaller diameter hole for the lower end support is drilled first. This one should go all the way through the bolt sleeve. The larger hole is then drilled to the required depth, and the plug is removed.

A concave cut must be made in the side of the safety shaft to clear the cocking piece when the safety is in its forward (ready to fire, or off) position. This can be accurately done by assembling the lever in position and taping it securely, using several layers of electrician's tape. The threaded end is caught in the lathe chuck, and the material to be removed is bored out, using an end mill in the tailstock chuck. A relief cut must be made at the rear end of the bolt sleeve to allow the safety to swing fully to the rear. Also, a hole must be drilled lengthwise to contain the safety detent and spring. This is drilled with an .087-inch drill and enlarged partway with a .156-inch drill. With the bolt installed in the receiver and fully closed, the location of the slot that locks the bolt closed can be marked by running the .087-inch drill in until it contacts the bolt and drilling slightly into it. This hole should then be deepened and enlarged slightly.

Three detents must be made around the circumference of the upper shaft. These are located by drilling slightly with the .087-inch drill from the front end of the bolt sleeve. One is marked with the safety completely forward, another with it positioned halfway to the rear, and the third with the lever completely to the rear. When these are enlarged slightly, the spring-loaded plunger will hold them in position.

A small hole of .065-inch diameter is drilled through the side of the bolt sleeve. This is to contain a retaining pin to hold the safety lever in place. It is best to drill this hole with the safety lever installed and hope that about half of it intersects the lever. If the drill is run through it with the safety in both the front and rear positions, each end of the retaining groove will be marked, and the remainder can be cut with a small triangular file.

The safety is assembled by installing the spring and plunger in the hole and, while pushing against the plunger with the shaft, pushing it in the hole. The retaining pin is installed, which keeps the safety in place. The firing pin spring is put in place around the firing pin, the firing pin is pushed through the bolt sleeve, and the cocking piece is screwed on. Ideally, with the bolt in the closed position and the trigger and sear installed, pulling the safety to the rear will cam the cocking piece slightly to the rear, completely out of engagement with the sear. If it doesn't do this, a small amount of metal must be removed, either from the cocking piece or the sear, until this happens. Correctly done, the trigger can be pulled with the safety engaged, and when the safety is released, the firing mechanism will remain locked in the safe position. If the firing pin moves forward after the safety is released, this is a dangerous condition and must be corrected.

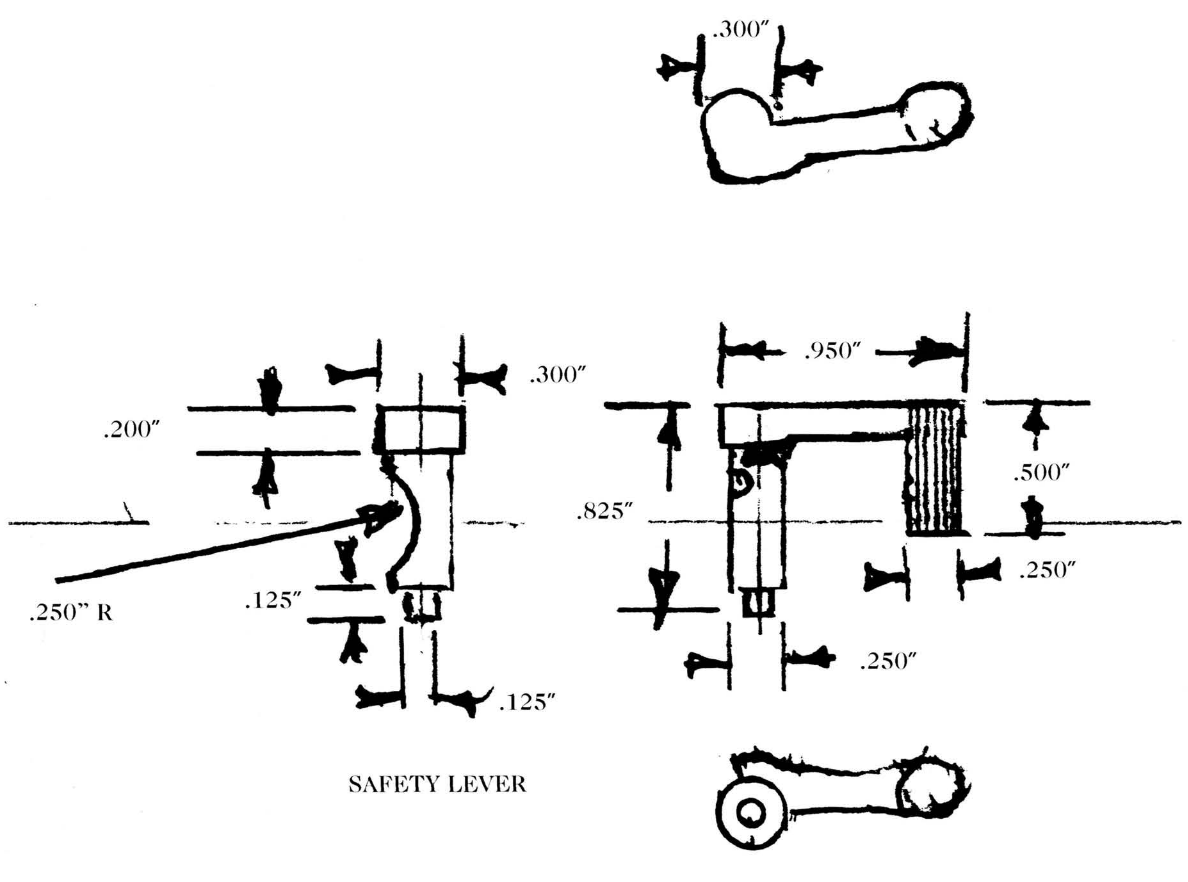
If undue effort is required to engage the safety, a small bevel should be stoned or filed on the right side of the cocking piece or the edge of the safety shaft until it will move rearward with only a small amount of resistance

The three detents that the spring plunger contacts should have a slight groove cut between each one with the forward two some .050-inch deeper than the rearmost one. This is so that when the safety is moved to its rearmost position, the spring plunger will be cammed into the slot cut in the rear of the bolt and lock it shut.

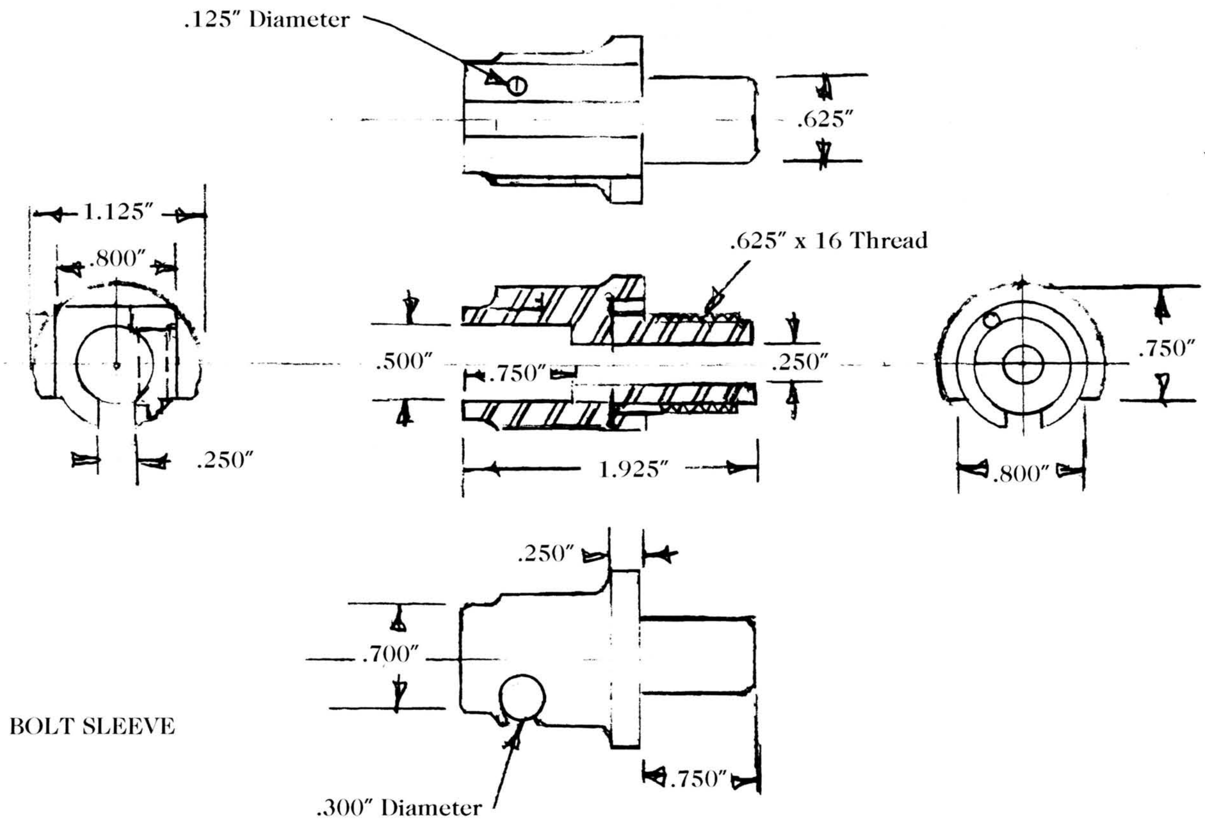
Safeties of this same type can be made up and fitted to such existing actions as the Mauser, Springfield, and Enfield, as well as others. In most cases it will be necessary to build up the bolt sleeve somewhat to provide enough room for the safety shaft. This is quite simple on the Enfield. A close-fitting collar is bored and welded in place over the bolt sleeve. After the relief cuts are made to clear the receiver tang, the hole is drilled and the safety is installed, as described for the fabricated rifle.

The Mauser and Springfield will require slightly more work since extra metal must be welded both to the right side and top. The remainder of the process is done as previously described.

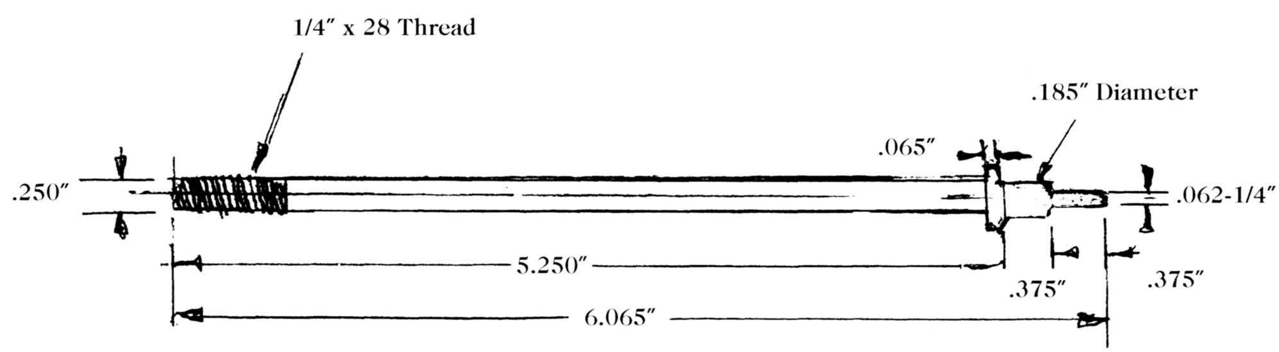
It is possible to manufacture new bolt sleeves for existing actions. In fact, several companies do just that. But, I am told, they use CNC machines, which turn out one of these parts in short order, whereas, with the single-point tools usually found in the small shop such practice takes most of a day.



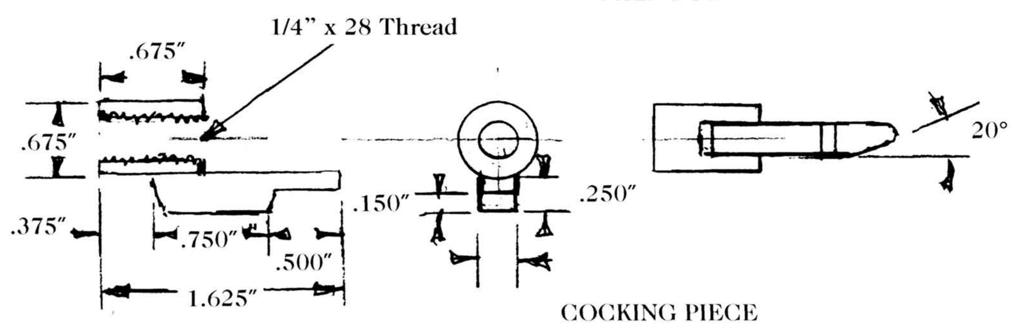
SAFETY LEVER



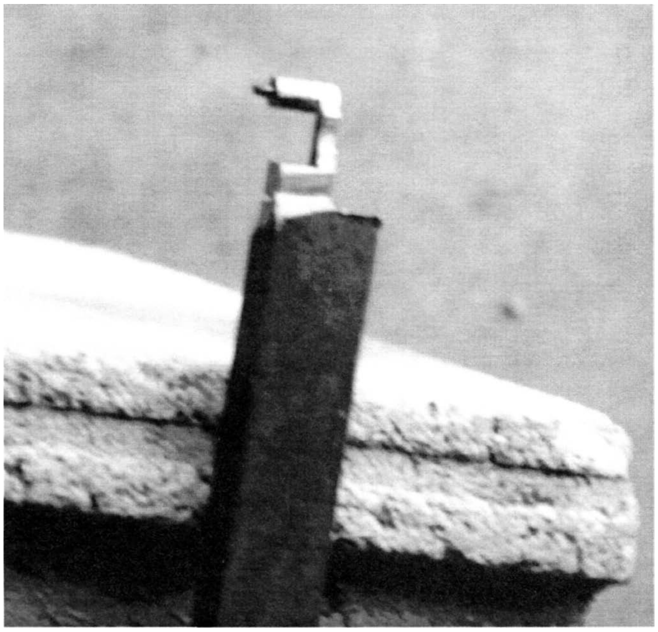
BOLT SLEEVE



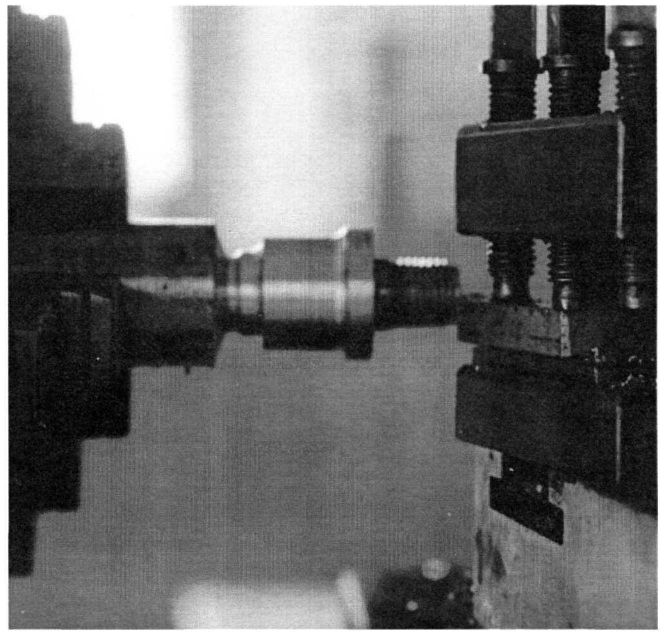
FIRING PIN



COCKING PIECE

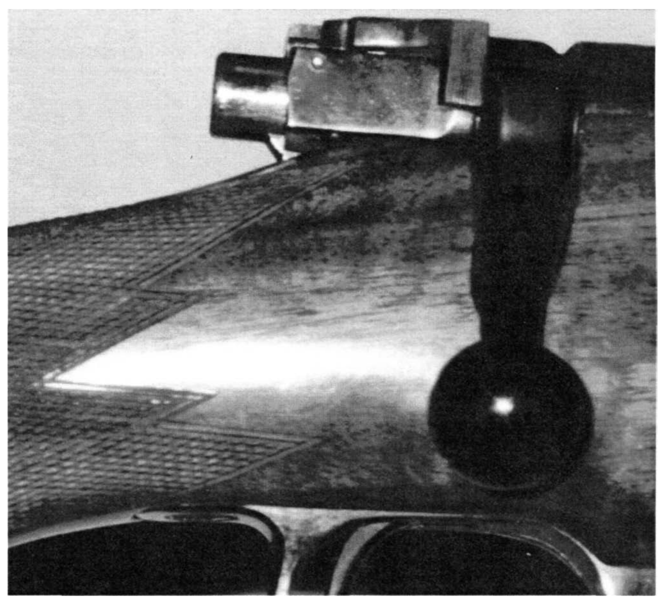


The safety lever, rough-finished, is next separated from the steel bar and finished with a sanding wheel and drum sander.

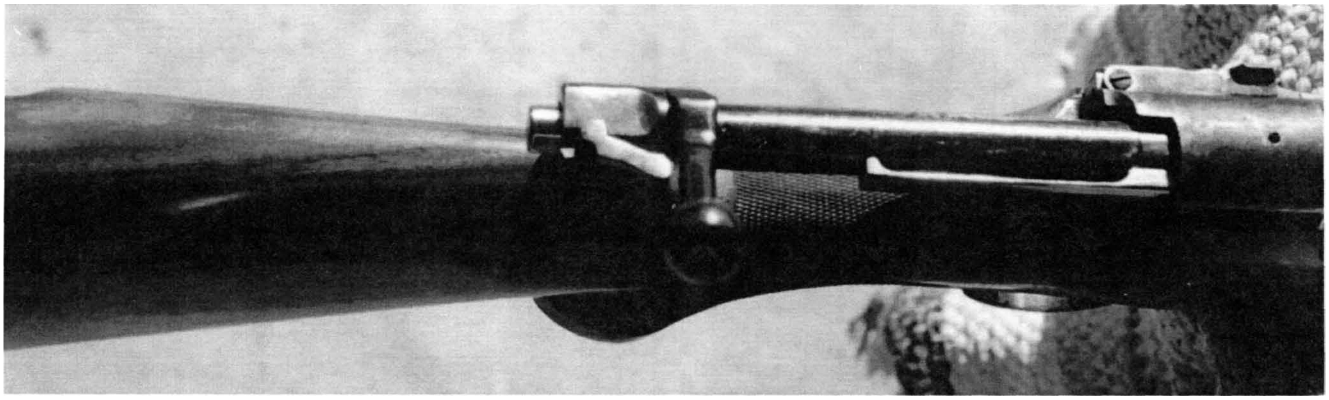


The bolt sleeve is turned from round stock.

The safety lever in place on the bolt sleeve is taped in the forward (unlocked) position, allowing the relief on the shaft to be bored in the lathe. A 1/2-inch end mill should be used for this.

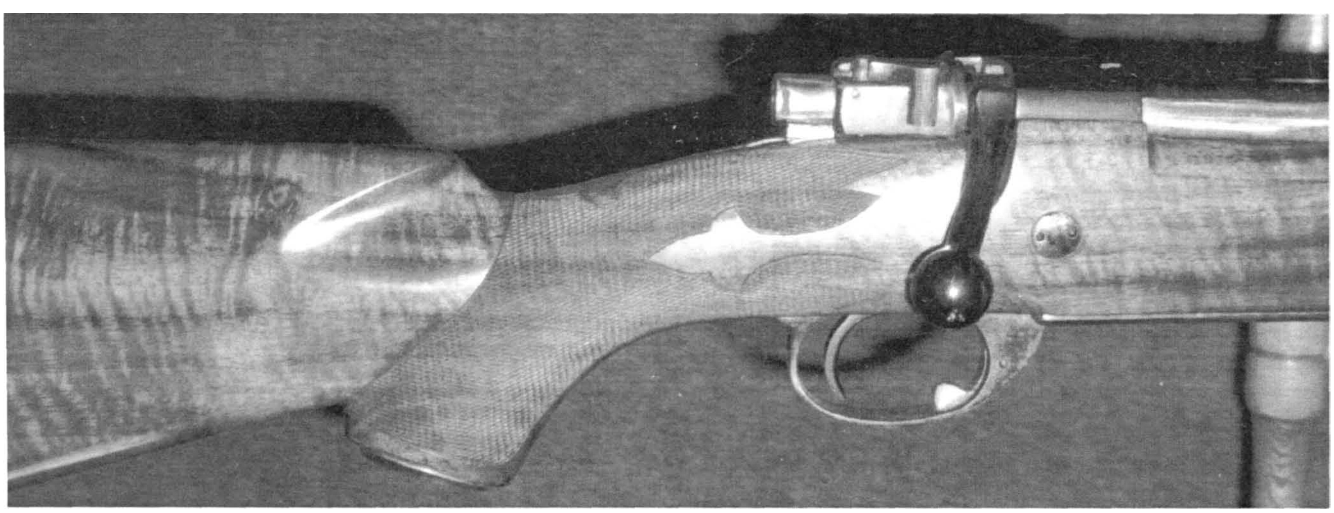


The finished safety and bolt sleeve in place on the rifle.

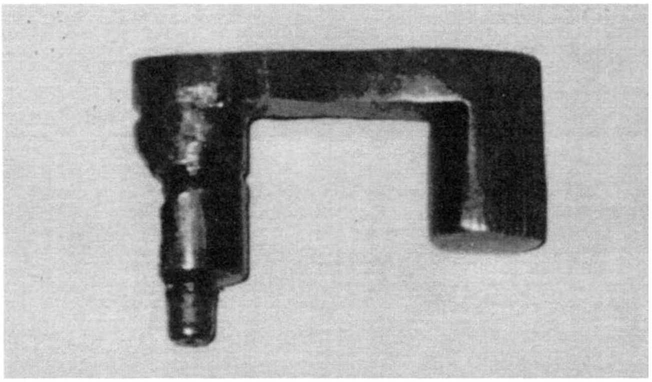


Top view of the safety in the unlocked position.

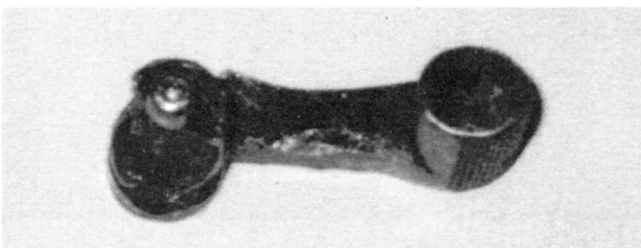
The safety in place on the prototype rifle.



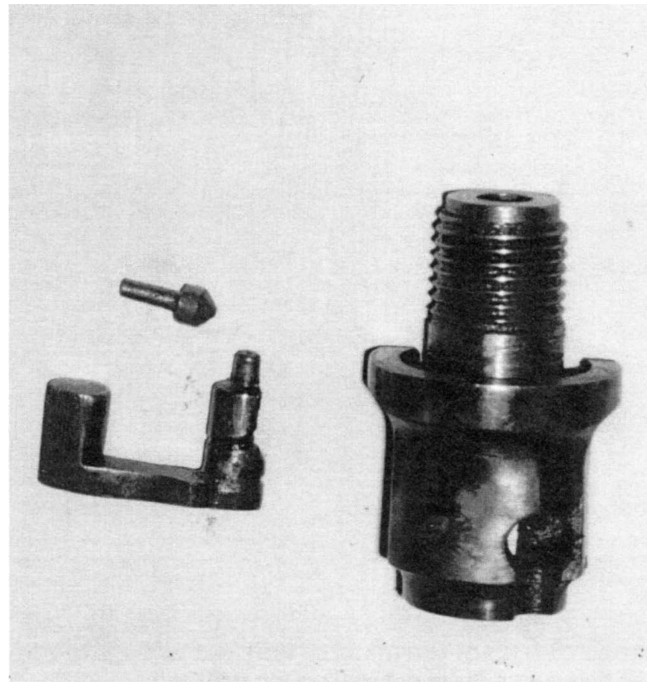
The safety and modified holt sleeve on a Mauser.



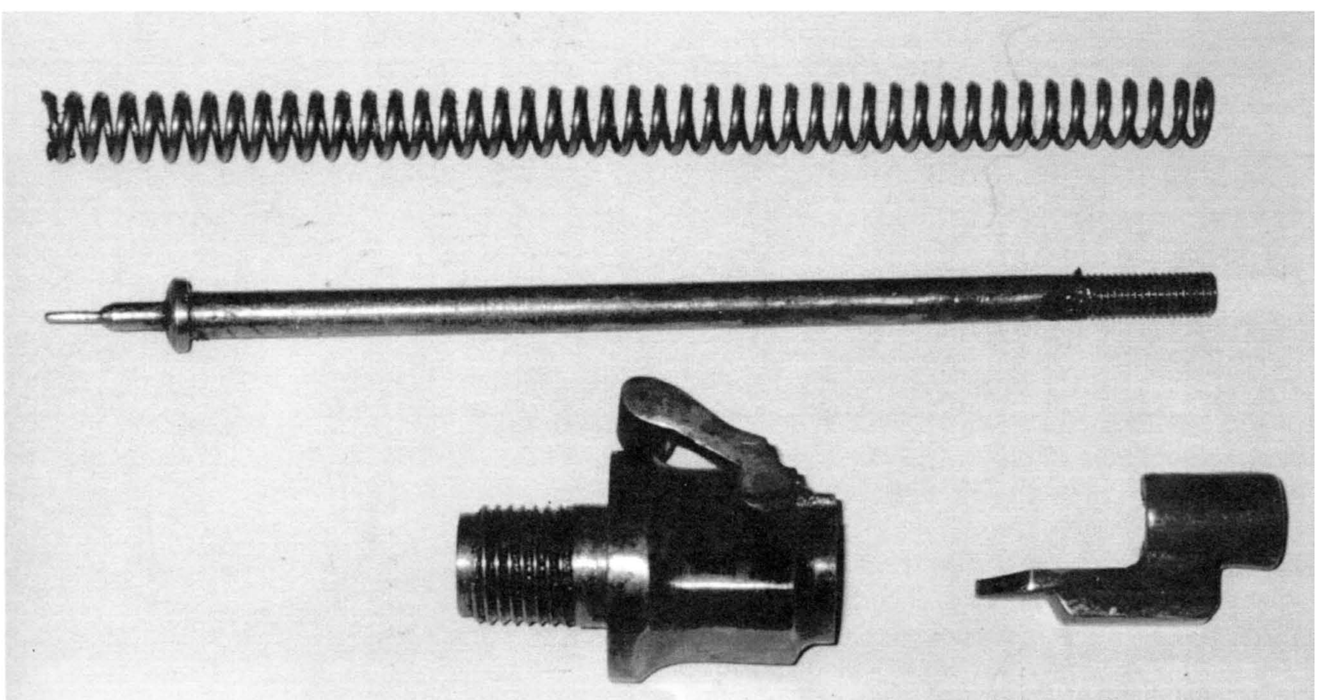
Side view of the finished safety.



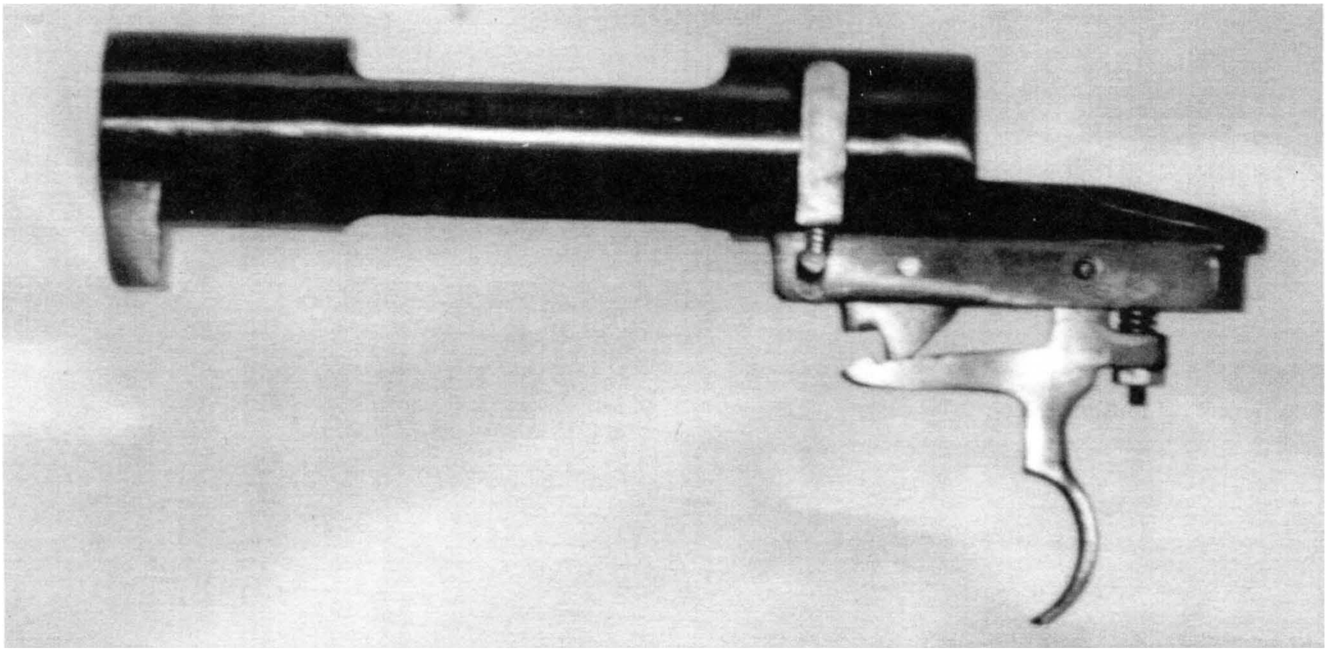
Bottom view of the finished safety.



The safety, shown with bolt sleeve.



The cocking piece, bolt sleeve, firing pin, and spring make up the striker assembly.



The bolt stop rides in dovetail on the right'side.

The bolt stop shown on the finished rifle.

CHAPTER EIGHT

Bolt Stop and Ejector

This chapter shows two ways to install the ejector. The first is a blade type, hinged at the rear and spring-loaded to cause it to pop up into the bolt face when the bolt is retracted. It contacts the cartridge head and causes the fired case to be thrown from the ejection/loading port. This style has no contact with the cartridge case until the bolt is almost completely retracted.

Since this part is exposed to wear from friction on the upper side and battering on the forward end, it should be made from better material than common sheet metal. A thin strip of some sort of tough, wear-resistant alloy should be used here. A thin strip of the material used for the action parts, such as the 4140 or the leaf-spring material, can be cut from the larger block and used for this. A hole is drilled and counterbored for the screw head at the rear end, and the forward end must be offset as shown in the drawing. This end must fit closely, without binding, in the receiver slot. The front end should protrude from the bolt face .250 inch when the bolt is completely drawn to the rear. The spring recess should be cut in line with the spring pocket in the receiver.

The bolt stop must fit the receiver dovetail closely. The projection on the inside surface that contacts and stops the bolt should be angled forward slightly at the upper front face, giving it a slight hook. If angled in the other direction, it could cam its way out of engagement if the bolt is withdrawn quickly and slammed to the rear. The spring pocket must be in line with the sear hinge pin, which holds the spring in place. The top edge of the bolt stop should be rounded slightly to enhance its appearance and the upper surface checkered, matted, or cut with lengthwise grooves to provide a nonslip surface.

Another type of ejector can be installed simply by drilling a small hole for a spring-loaded plunger just inside the rim of the bolt face. This is held in place by a cross pin. Without pressure against it, the plunger (henceforth called the ejector) should extend from the bolt face, with the front face even with the bolt body rim. When pressed inward against the spring, it should stop flush with, or just below, the surface of the bolt face. A flat slot on one side of the ejector gives clearance for the cross pin.

This type is simple to make, but it has drawbacks. First, it causes pressure between the bolt face and cartridge head as the bolt is closed and rotated shut. Second, it is trying to eject the empty case before the bolt is open, and just as soon as the case neck clears the rear of the receiver ring it is (probably) ejected. Other times it can be forced out of the bolt face and may fall back in the action. Third, if any sort of dirt or debris works its way into the spring pocket, it will keep the ejector from bottoming, and the bolt won't close on a cartridge.

I first learned of this shortly after the 700 series of Remington rifles was put on the market. A friend of mine bought one of these in 7mm Magnum caliber and was quite proud of it initially. Then, one day he called me and asked what to do with a rifle that had its head space growing.

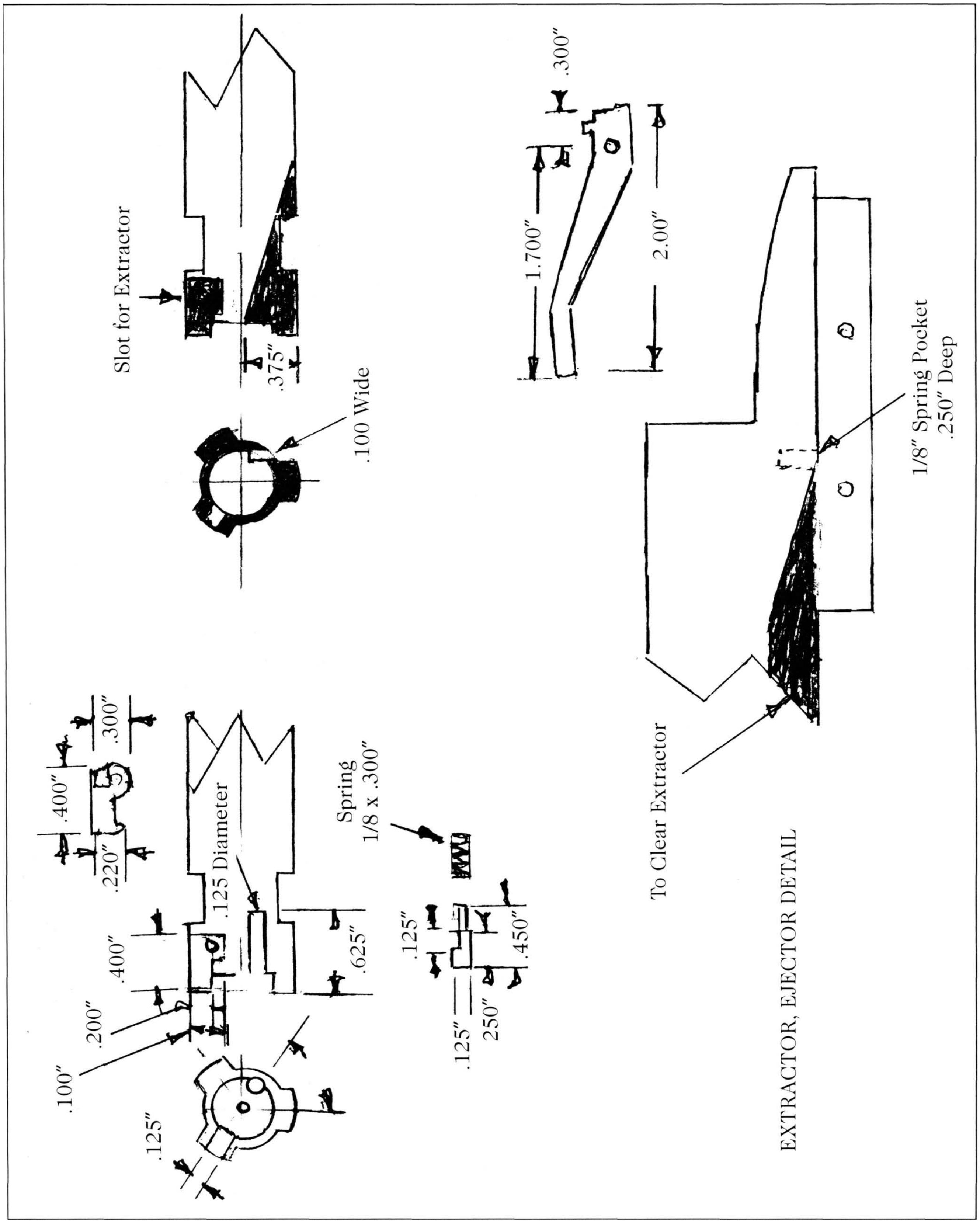
"Hell, I don't know," I replied. "Cultivate it and sell the fruit?"

I'm not kidding," he said. "The head space has grown so much I can't close the bolt on a shell."

I suggested he bring it by, and, sure enough, the bolt would no longer close on a loaded round. I tried everything I could think of (he even wanted to deepen the chamber) and finally removed the ejector. The bolt would once again close on the cartridge. Further examination revealed a minute amount of shaved brass at the bottom of the ejector hole. When this was removed and the ejector replaced, his growing head space stopped. The rifle was restored to working order.

I have heard of, and experienced, this happening on several occasions since. If it happened to your only rifle while you were on an expensive hunting trip, your hunt would be ruined. Keep this in mind when choosing.

Very little modification is needed on military bolt stops. The Mauser can have the little flange at the upper front checkered or grooved, which won't really help it any. Enfields can have the bolt stop spring cut off just behind the pivot and a thin strip silver-soldered to the rear side of the pivot to maintain spring tension. The little round button is discarded, and (usually) the excess material at the rear of the receiver bridge is cut away and reshaped. The Springfield should have the upper edge of the bolt stop cut away until the bolt can be removed without opening the bolt stop far enough to require cutting a relief cut in the stock. The only reason for this is to maintain a straight top line on the stock.

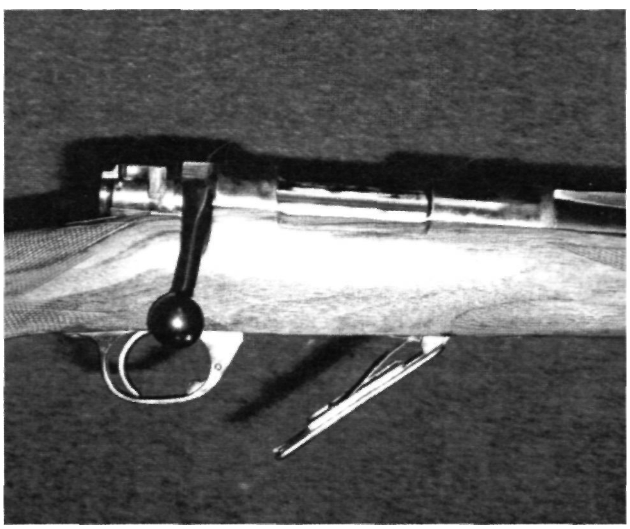


EXTRACTOR, EJECTOR DETAIL

CHAPTER NINE

Magazines, Trigger Guards, and Floorplates

Custom magazine/trigger guard assemblies that incorporate hinged floorplates have become a desirable, almost mandatory feature of today's custom rifle. The magazine box proper is tailored to accommodate the specific cartridge used, including depth, length, and width. The hinged floorplate, which may or may not be useful in loading or unloading the gun, is most desirable as an aid in clearing a jam, which could result from an overlong or otherwise nonstandard cartridge. Of course, this is unlikely to happen if a magazine box of adequate length and width for the subject cartridge is used, but it is possible.



A hinged floorplate, shown here on my number-one rifle, is a desirable feature.

Several specialized manufacturers make and market such custom magazine assemblies, but they are expensive. Most cost as much, or more than, a complete factory-made rifle. These are only made to fit certain rifles or actions, leaving others to be fabricated in the shop. Besides, if you intend to claim that you built the gun, you should actually *build* all of the component parts yourself. If you obtain parts from other makers and simply fit and assemble them, you are just another mechanic . . . not a gun maker.

Actually, there are several ways to build such an assembly in a small shop. Assuming that an existing magazine assembly with the correct internal dimensions is used—as on Mauser, Springfield, and similar actions—modification can be done simply by extending the front side of the trigger guard bow enough to accept a latch that will secure the floorplate and making a replacement floorplate.

To accomplish this, the front side of the trigger guard is slotted as shown, using a 1/4-inch inch end mill and a spacer made to fit inside this slot. Two small filler blocks, one for each side, are cut from flat stock and shaped to fit against the front trigger guard edge. These are relieved along the surfaces to be welded to ensure deep penetration of the weld seam. The filler blocks are clamped in place against both the spacer and the trigger guard and welded using the TIG process. These are then shaped to the desired contour and dressed flush with the sides of the existing guard. If done by a skilled welder, no evidence of the weld joint will remain.

A floorplate latch is made from flat stock, as shown in Illustration V. This should be made of heat-treatable material and hardened after completion. It is desirable that this part fit the slot closely, without unsightly gaps to mar the appearance of the finished product. The hinge pin hole is drilled through both sides of the guard and the latch simultaneously, with the latch secured in position. This can be done easily by temporarily cementing the part in place using superglue or similar adhesive. After drilling, the parts can be separated by heating to 350 to 400 degrees, which will cause the glue joint to release. A hinge pin is made from a drill rod, or similar item, of the same diameter as the drilled hole, preferably with one end slightly larger then the drilled hole. This will ensure that it remains securely in place after installation. A fairly stiff 1/4-inch-diameter coil spring is installed in the spring pocket as shown. This exerts pressure on the latch, holding it in the closed position. This spring should have enough stiffness to require considerable effort to release the latch. This will assist in holding the floorplate shut during firing since recoil can jar the floorplate open, causing cartridges remaining in the magazine to be dumped on the ground at the shooter's feet. This could cause a considerable amount of excitement if it happened while the shooter was facing a charging wounded animal. Although this has never happened (to my knowledge) with one of my guns, I have been told about its happening with others and was assured that it wasn't a pleasant experience.

The floorplate is made from flat stock of at least .450-inch thickness. This too should be made of heat-treatable material, such as 4140 or similar. While this part does not actually require any heat treatment, the spur that is engaged by the latch and the hinge area will resist wear better than if low carbon steel of the 1018 class is used.

The part is formed by first clamping the material in the milling machine and then cutting away the excess material from the upper surface, leaving a projection at the front end that forms the hinge block. This should be at least high and left slightly wider than the required thickness to permit final hand-fitting. A slot to accept the follower spring is machined lengthwise along the centerline, with an undercut tab on each side at the forward end to hold the spring in place. The little slitting saws, as used with the Dremel-type hand grinders, can be used to form the undercut. It is possible to achieve the same purpose by grinding a flange at the end of a four-flute milling cutter, which forms a narrow saw-type cutter. Copying the slot in an existing floorplate is advisable.

A 4-inch-wide slot is cut in the front tang to accept the floorplate hinge. If a relief, or lightening, cut is present on the upper side, a filler block should be shaped to fit and silver-soldered in place before this cut is made. This will eliminate, or at least limit, the side play that will be present if it is not done.

The front hinge block is now fitted into the slot, which has been filed square at the forward end, while at the same time fitting the "straddle" rear end of the floorplate into, and around, the trigger guard. A close fit is desirable here and is obtained by milling and carefully filing the parts until such a fit is obtained.

The hinge pin hole is now drilled. Again, this should be done with the parts clamped together and drilled through in one operation. A close-fitting pin is made from drill rod or similar material, preferably with one end a couple of thousandths of an inch oversize, which will hold it in place when assembled. Don't try to make this pin (or any other pin for that matter) from soft material, such as nails or coat hanger wire, because it will bend or wear quickly.

In the event your weld joints don't work out the way they should, or if a complete new magazine assembly is required, an entirely new trigger guard bow can be machined from solid stock and welded to the lower rear of the magazine box. This can be made from 5/8-inch flat stock in most instances. However, the original 98 Mauser trigger guards are slightly wider than this. If intended for use with a pre-inletted or existing stock, slightly thicker material should be used.

The outline of both the inside and outside shapes, or contours, should be scribed or otherwise marked so that they remain visible on the surface of the material used and the excess cut away with the milling machine. The inside should be cut first. If a 1- or 1 1/8-inch-diameter end mill is available, the inside opening can be cut to exact size, thus requiring only a small amount of finishing. Even so, the inside opening should be roughed out with a smaller cutter of 1/2- or 5/8-inch diameter and finished with the larger one. If it is necessary to form the entire opening with the smaller cutters, a certain amount of finishing with files or small-diameter grinding wheels will be required.

The outside contour can be formed by milling away the surplus material, as close to the marked outline as you are comfortable with, and finishing with a sanding wheel. The slot for the floorplate latch is machined in the same way, and to the same dimensions, as the built-up guard previously described. A slot to clear the trigger is cut from the top side, and a wider lightening cut is made to reduce weight. The screw hole is not drilled until the magazine box is finished.

A new magazine box, whether a replacement for an existing action or for an entirely new action, is made by folding a 16-gauge (.0598-inch) sheet metal blank around a form block, which forms the forward end and both sides of the box. A filler plate, cut from 12-gauge (.1046-inch) material, is welded in place between the rear ends of the sides, forming the completed box.

Although the front tang can be made from 1/4-inch flat stock, slightly thicker material (such as 5/16- [.312-] inch) should be used if available. The extra depth allows a deeper weld joint and more material around the hinge pin, making for a slightly stiffer assembly. It will look better if made the same width as the trigger guard.

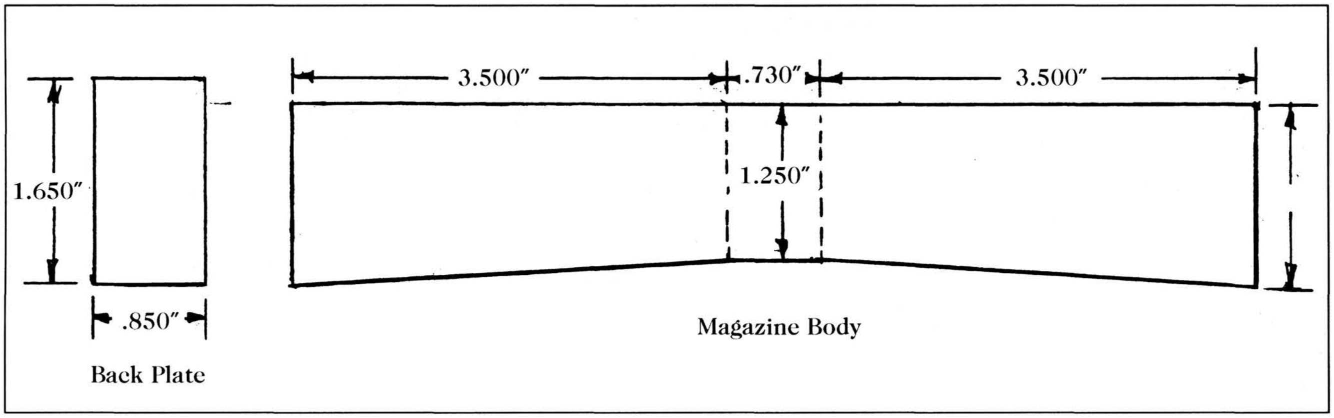
The parts can be aligned for welding by first clamping the magazine box in its exact location on the bottom of the receiver. The distance between the rear of the box and the screw hole in the receiver rear tang is measured and the dimension transferred to the trigger guard, whereupon the screw hole is drilled and counterbored for the screw head.

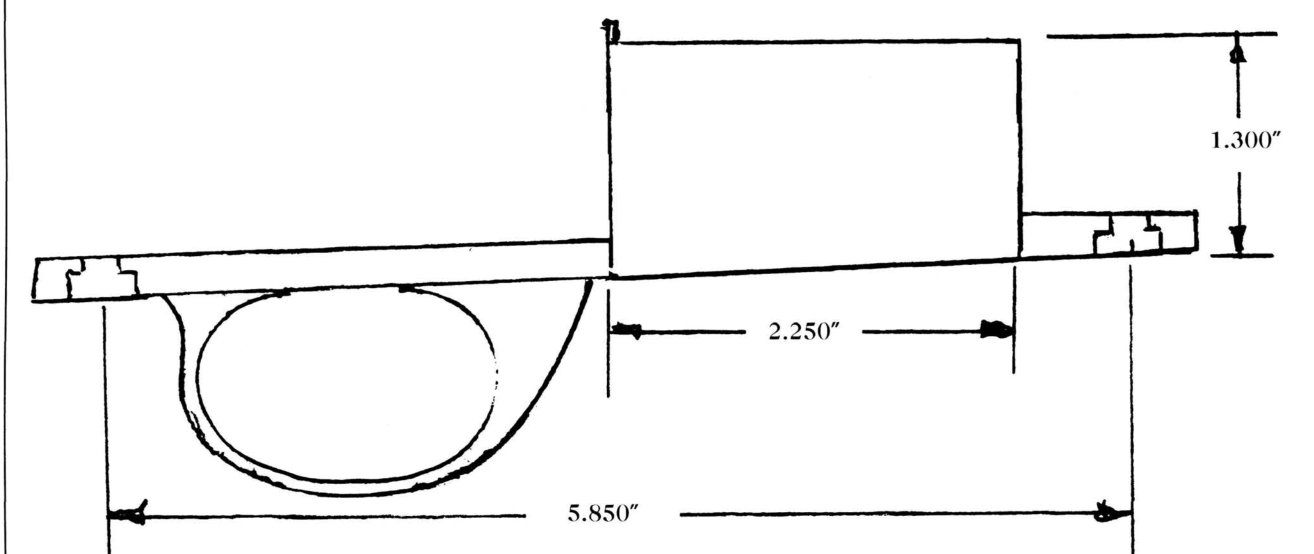
Locating and drilling the front screw hole is done in the same manner. Both the front end of the trigger guard and the rear of the front tang are cut to length and beveled to accept a fairly deep weld, extending all the way around them. Both parts are located in place by blocking them up to the desired heights and installing the guard screws. Both joints are then welded, using the TIG process. The welds must be built up enough above the surface to allow dressing them back flush with the surface, after which no trace of the welding should show.

The floorplate hinge slot is now cut in the front tang, and the floorplate is fitted in the same fashion described earlier when an existing assembly was used.

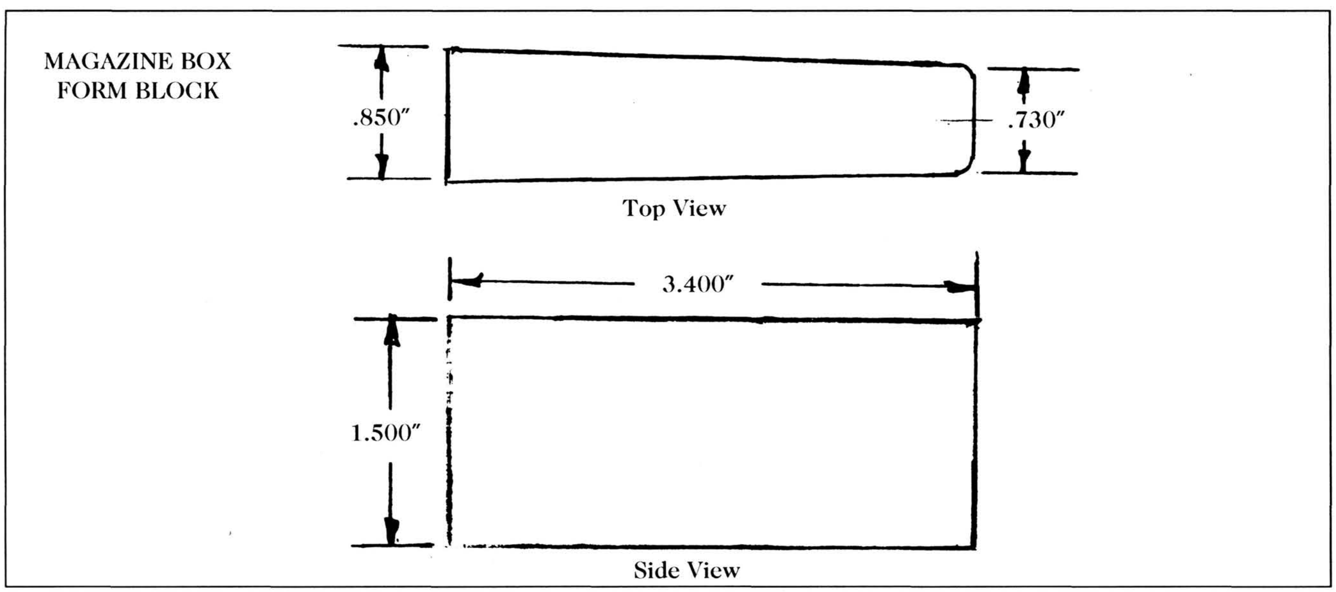
A short trigger guard, for use with blind magazines or single shots, is made in the same manner as that previously described, except that the latch slot is omitted and the front tang is lengthened and drilled for a retaining screw.

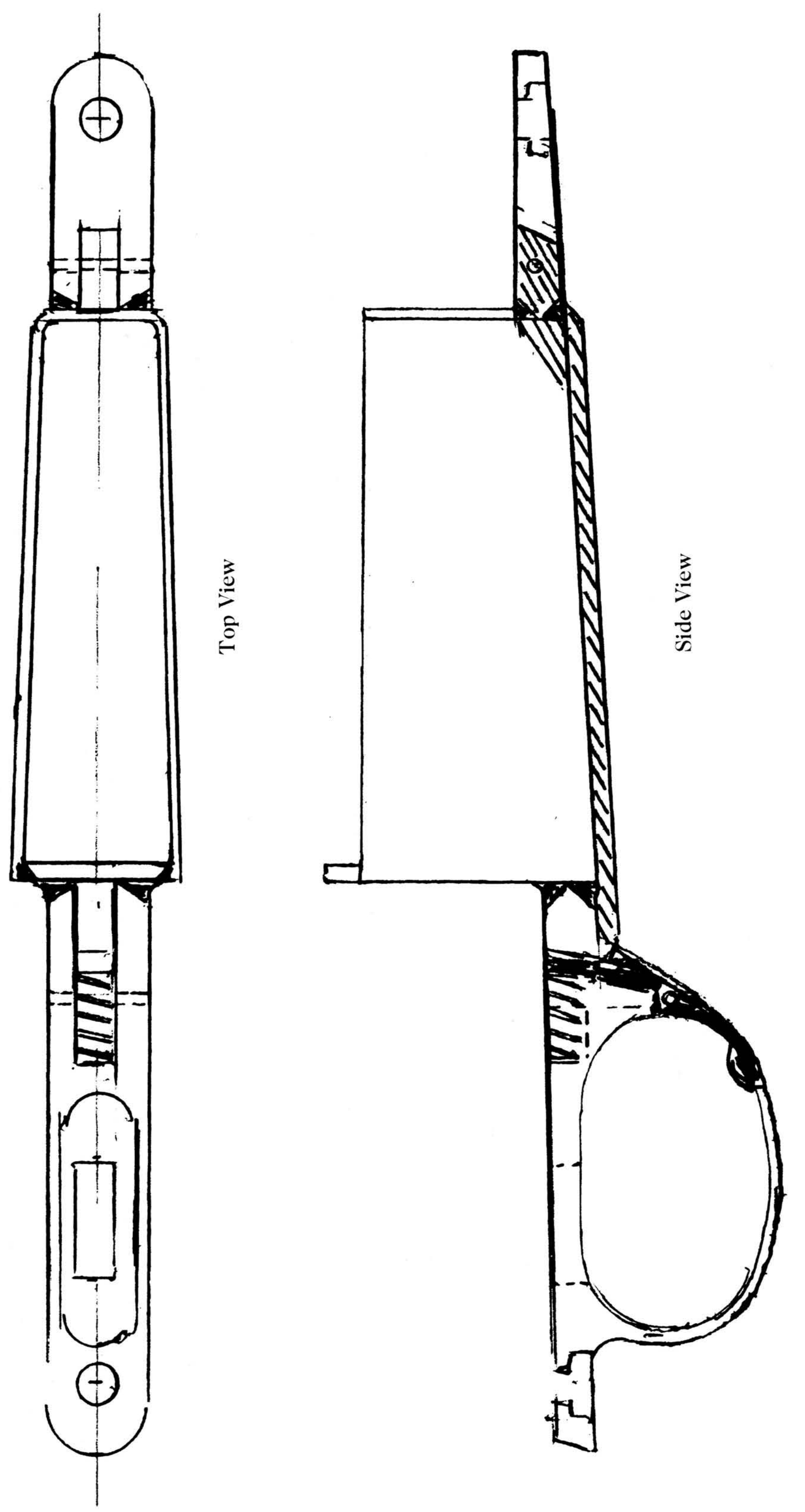
It is recommended that the outside contours of both the trigger guard and the floorplate be formed using a stiff-backed sanding wheel and hand-finished using files and progressively finer grits of abrasive cloth or paper. Properly done, this results in sharper, flatter surfaces, which enhance the finished appearance.



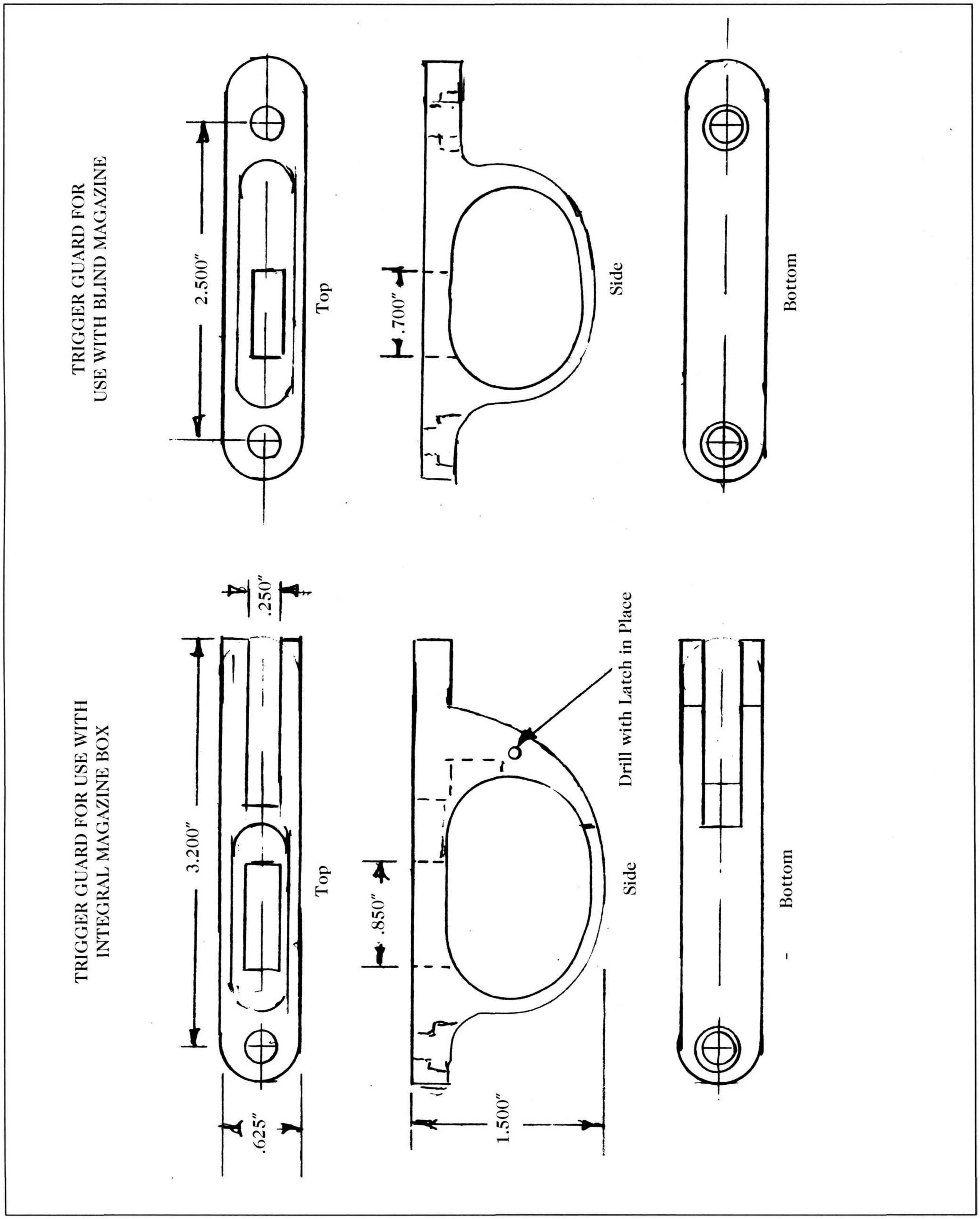


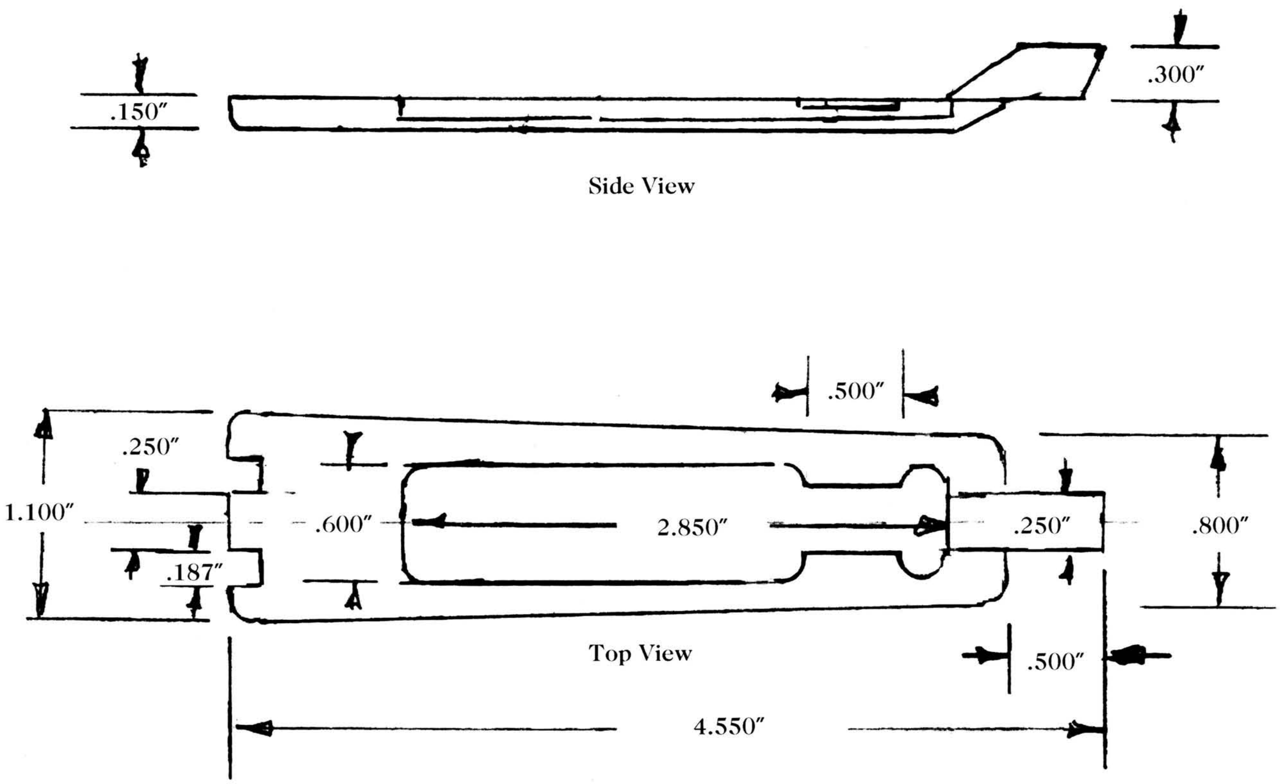
TRIGGER GUARD AND MAGAZINE FOR .250/3000 LENGTH





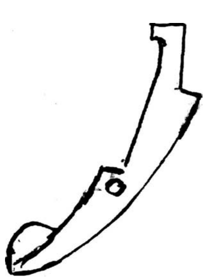
The size shown is for use with a 98 Mauser action and a drop magazine with enough length to accommodate .300–.338 Winchester-length cartridges. The size and shape can be changed for other uses.


TRIGGER GUARD FOR
USE WITH BLIND MAGAZINE
2.500"
Top
.700"
Side
Bottom
TRIGGER GUARD FOR USE WITH
INTEGRAL MAGAZINE BOX
.250"
3.200"
.625"
Top
.850"
1.500"
Drill with Latch in Place
Side
Bottom



FLOORPLATE

Shaped to match outside contour of the trigger guard.



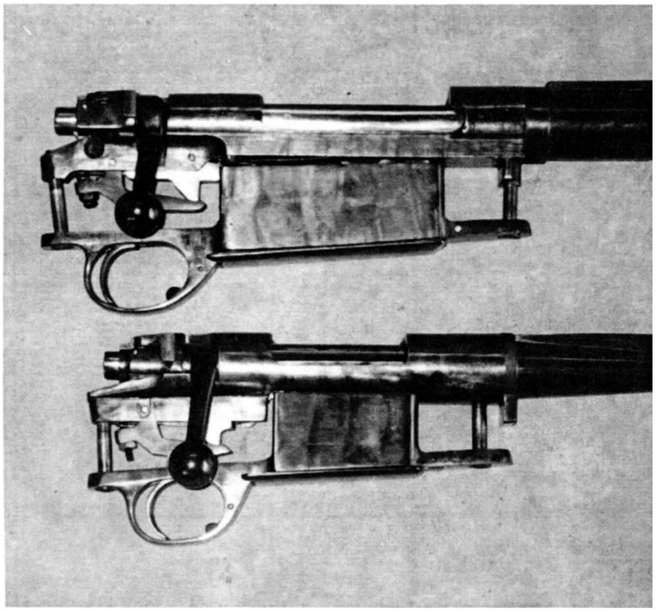
T
1.450"
U l
*l k .250"

FLOORPLATE LATCH

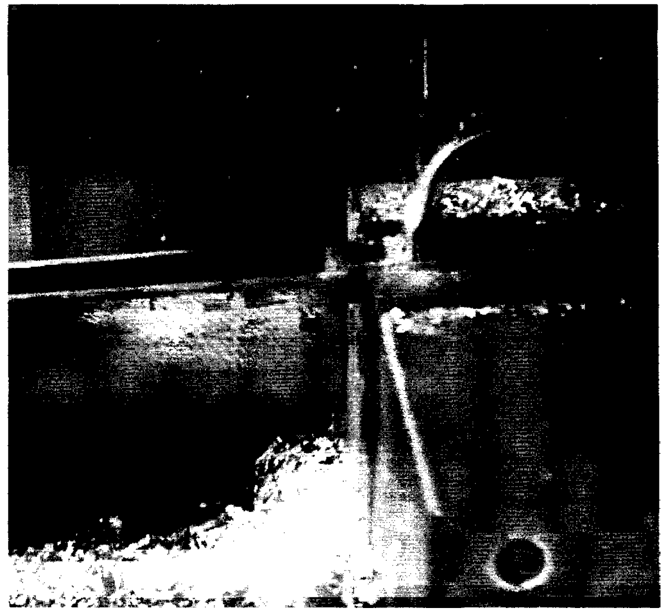
Slot is cut after welding.

1.600"———fe»j J,
oo" 1 7 ^ -200
T •
V^ -500" U
.250" .0625"
T _JL_

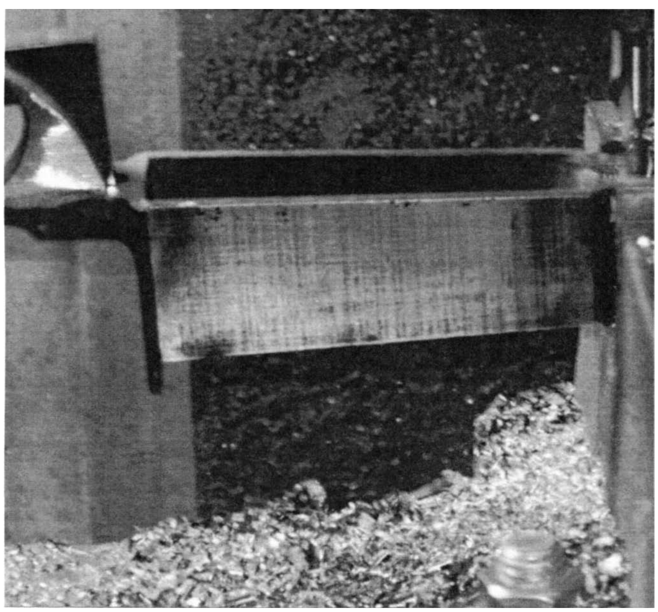
FRONT TANG



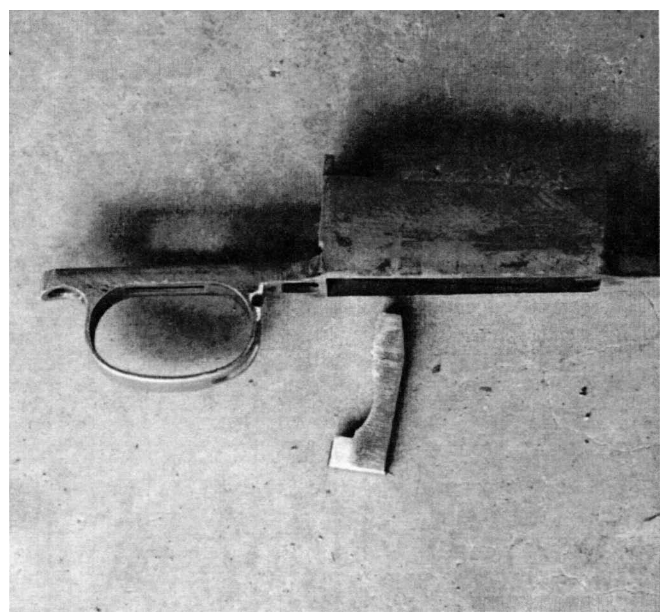
Custom trigger guard/magazine assemblies made entirely in my shop. At top is a .416 Rigby using an Enfield Action; at bottom is my number-one 7.62x39.



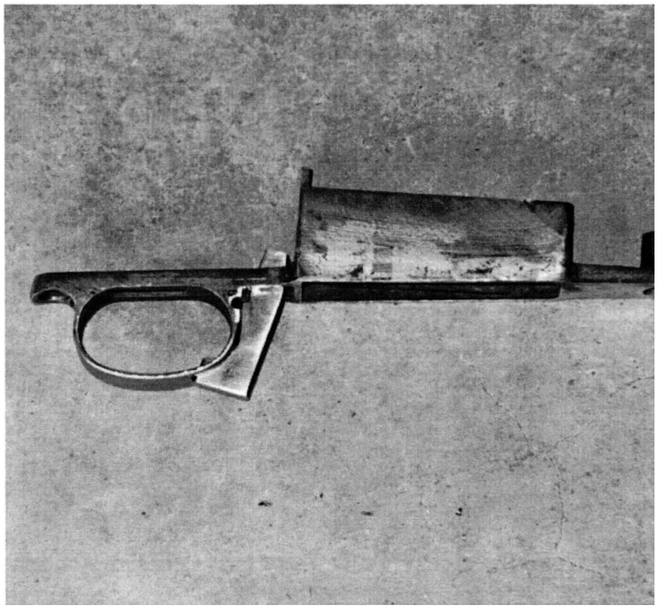
The modification of an existing assembly is begun by slotting the forward end of the guard bow to accept the latch.



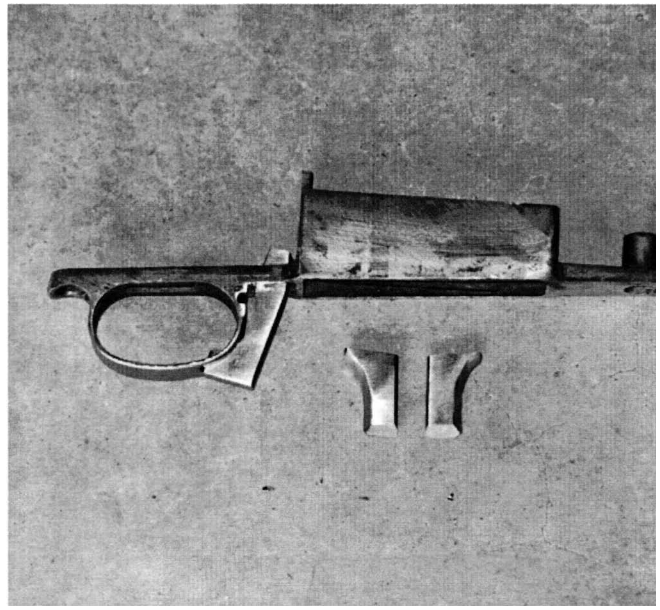
A slot is cut in the front tang for the floorplate hinge.



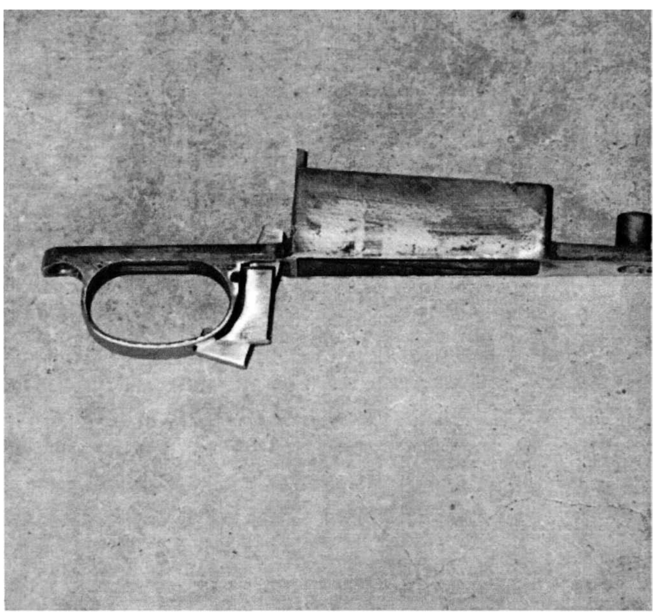
A spacer is cut to fit the trigger bow slot.



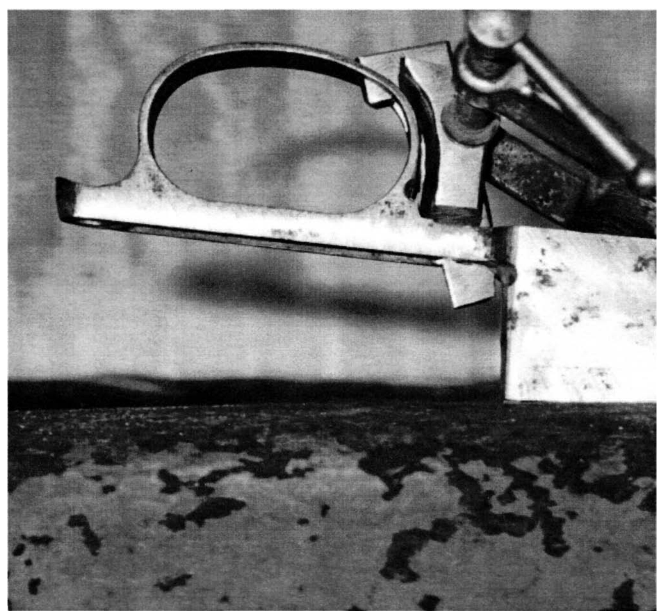
The spacer in position.



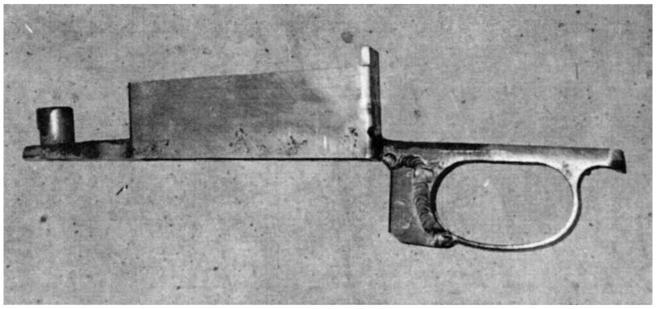
Filler blocks, or "fillets," are made to weld to the guard bow.



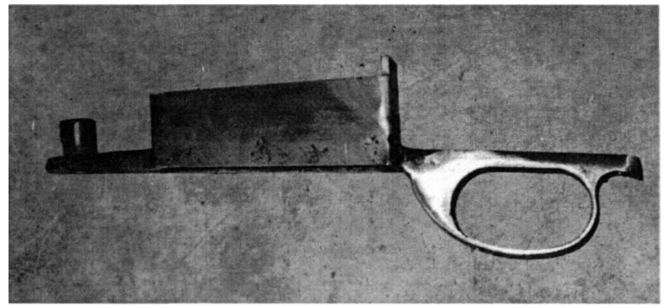
Filler block in place with a spacer in position.



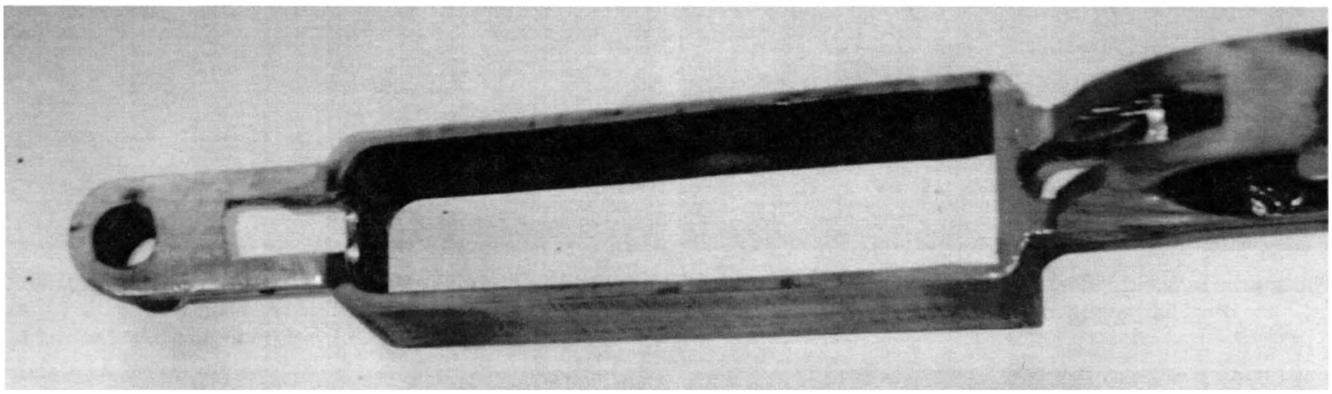
Filler blocks clamped in place ready for welding. Note the beveled edges, which permit a deeper weld.



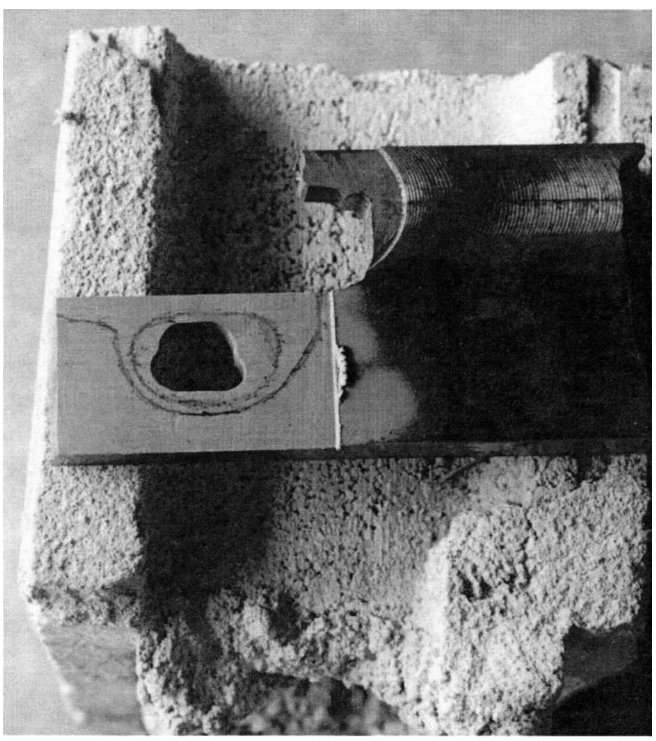
Welding completed, ready for shaping and finishing.



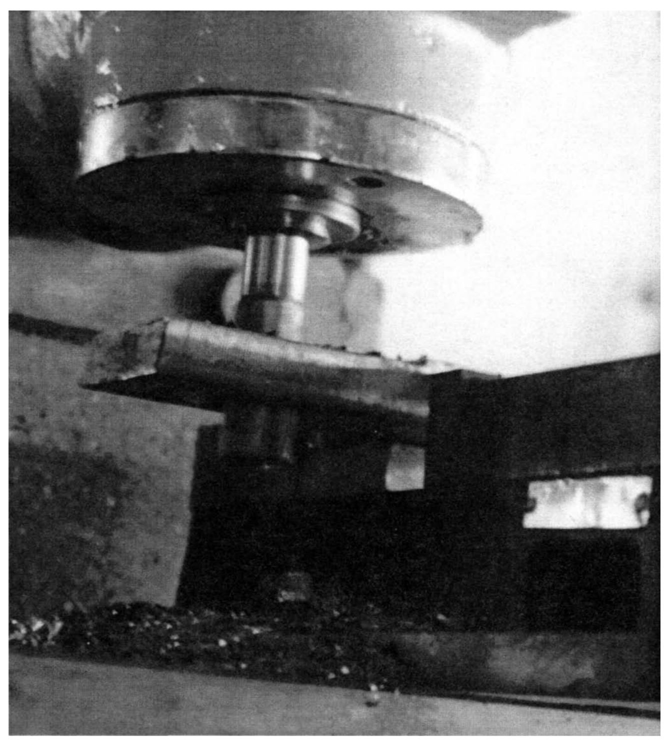
Rough shaped, ready for final polishing and finishing.



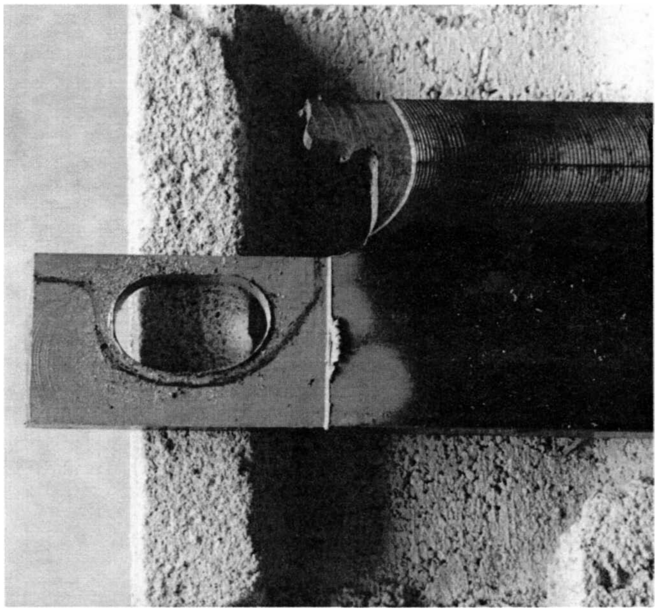
Bottom view, showing hinge and latch cuts.



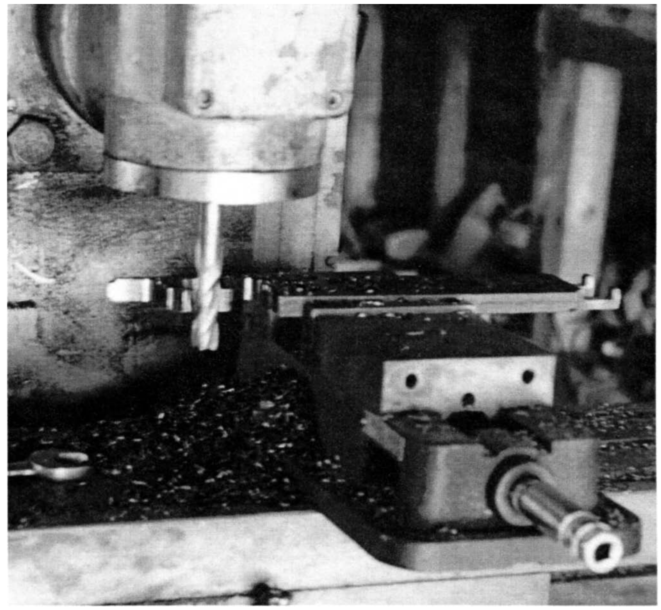
A new guard is made by marking inside and outside outlines on steel plate. Enough material has been removed with a small end mill to allow a larger mill to be used to finish.



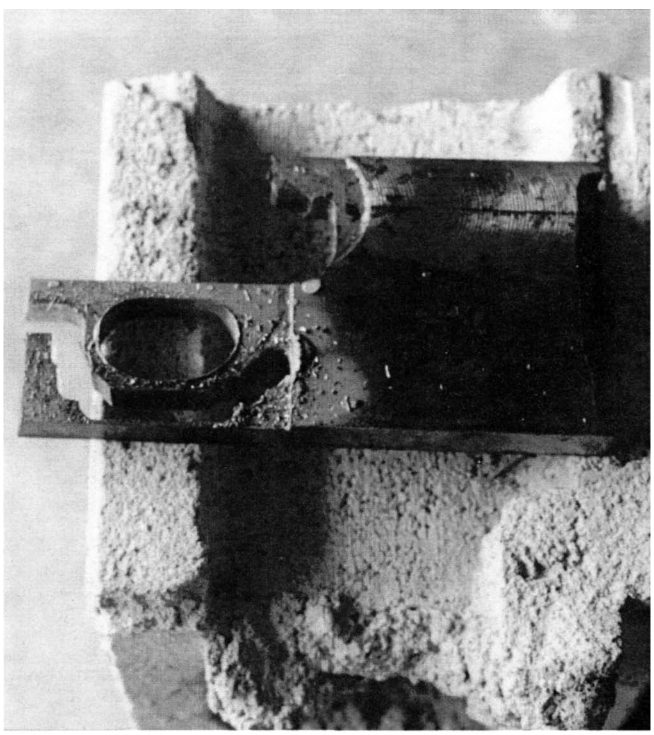
To form the inside contour, a 1 1/8-inch end mill is used.



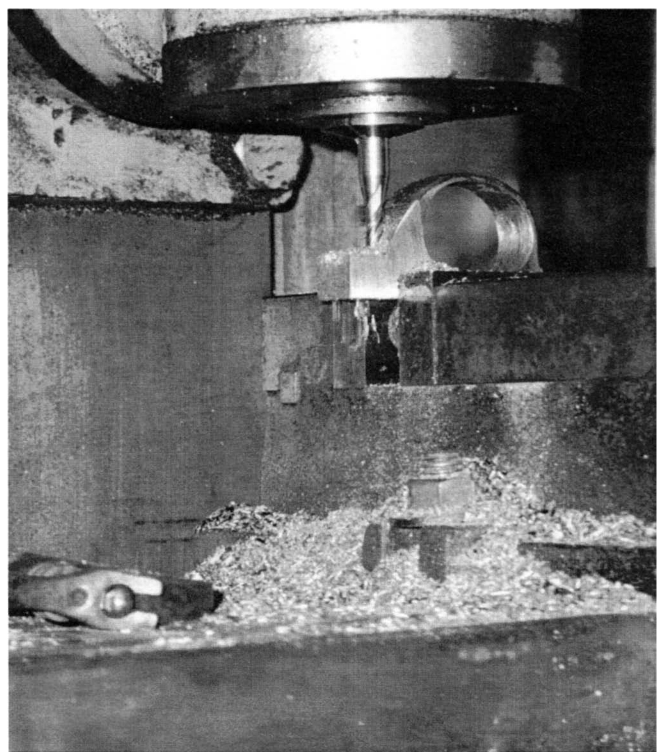
The inside eontour eut to finished size.



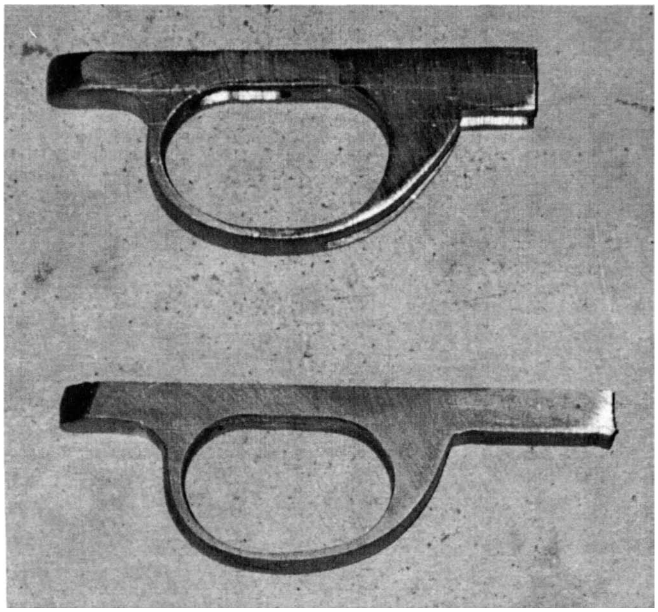
The outside is shaped using a small end mill.



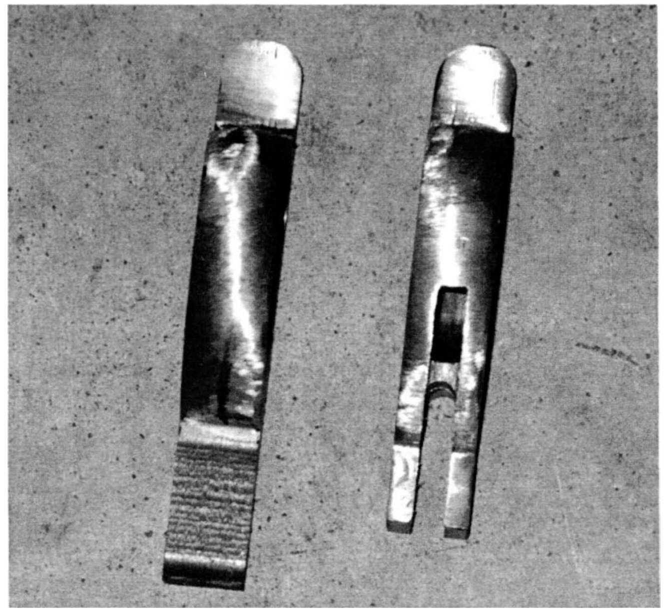
The outside contour partially cut. It will be cut the rest of the way with a saw and finish-shaped with sander.



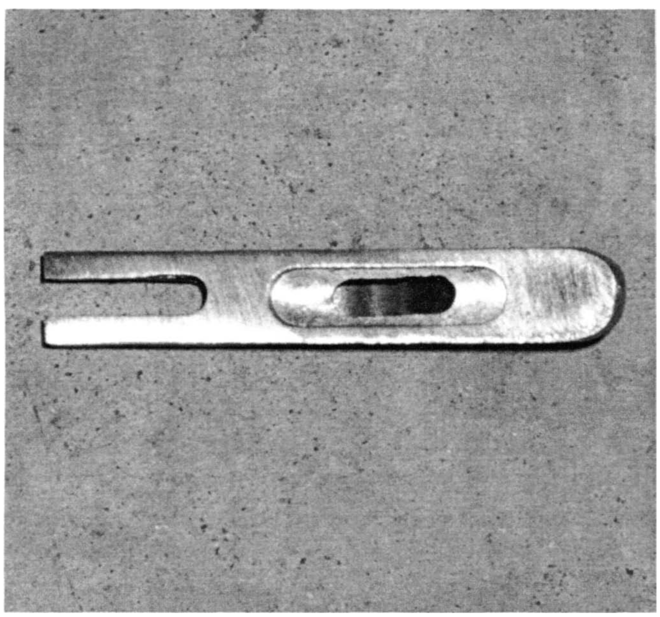
The latch slot is eut in the same manner as previously shown.



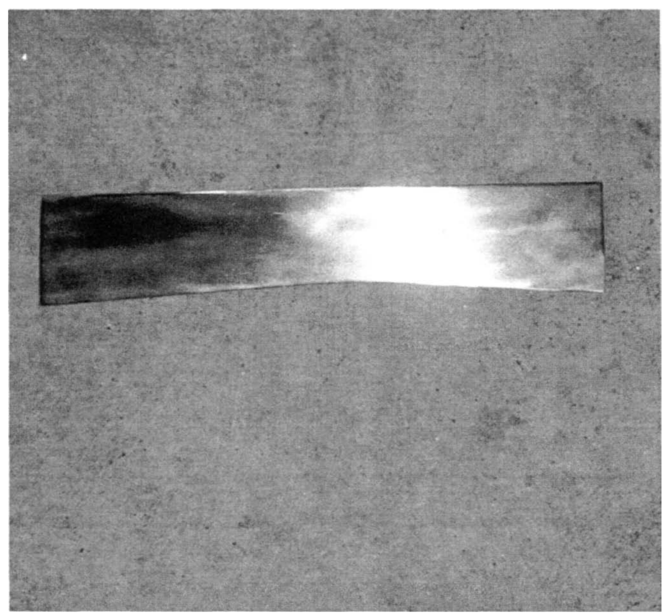
The guard cut to finished shape. The lower guard is intended for use with a concealed magazine.



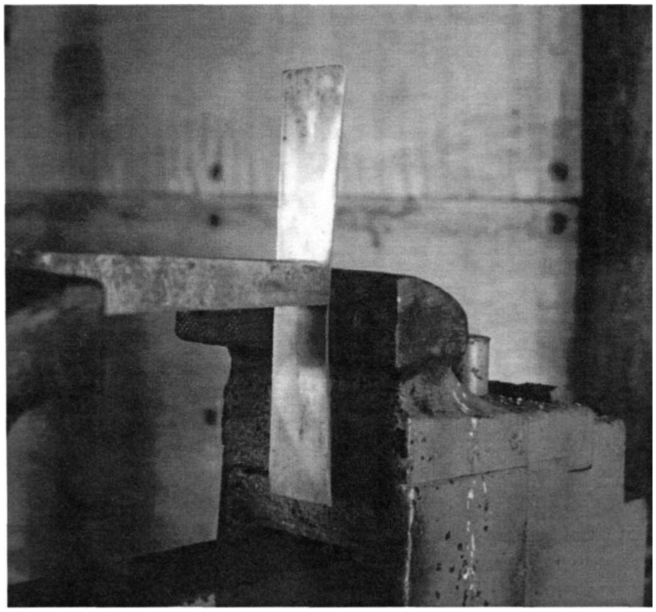
A top view showing a blind magazine guard at left. An integral guard with latch cut at right.



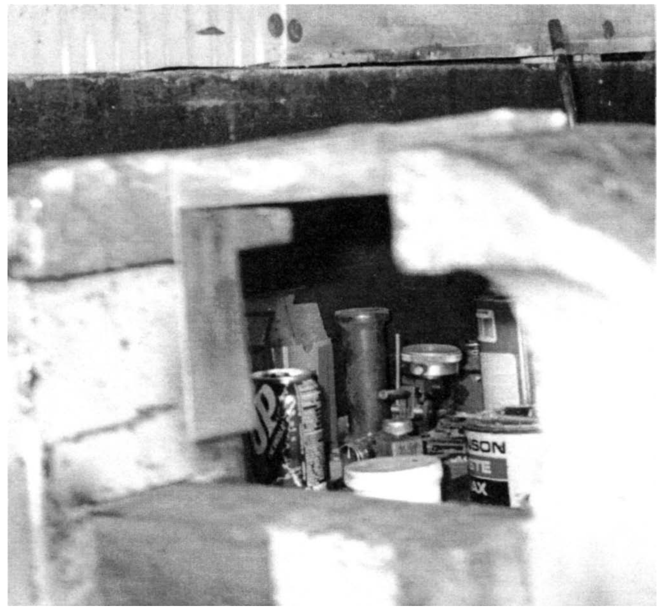
This shows trigger slot and lightening euts. The bolt hole should not be drilled until all parts are completed.



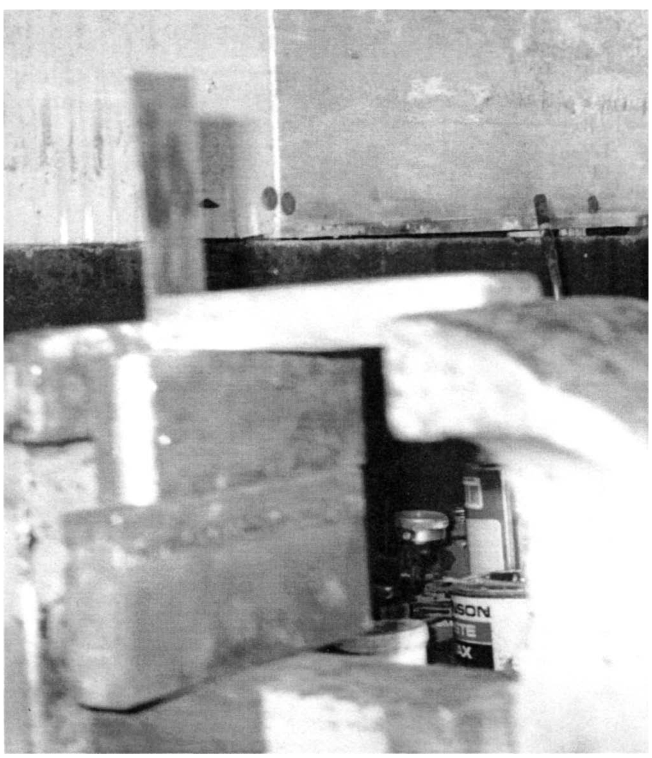
A blank to form the magazine body is cut from 16-gauge material.



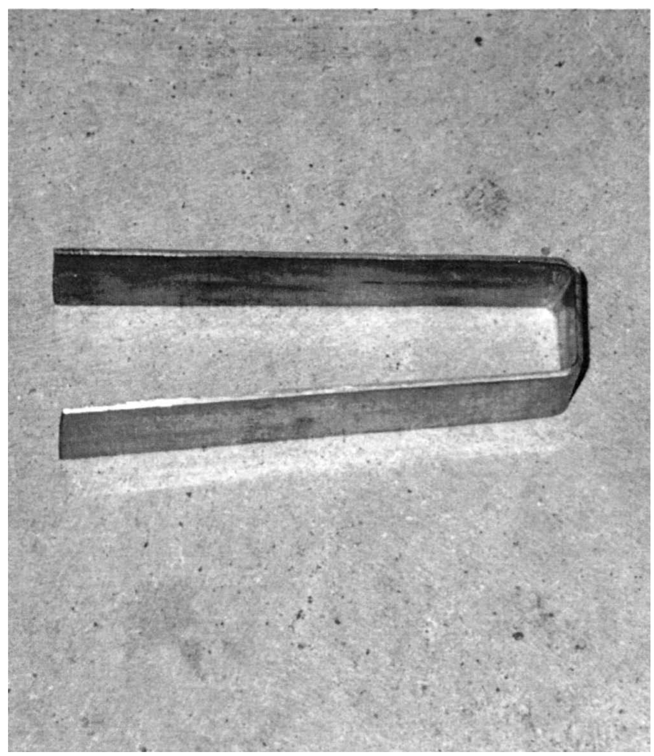
The form block, with sheet metal blank in place, is clamped in the vise.



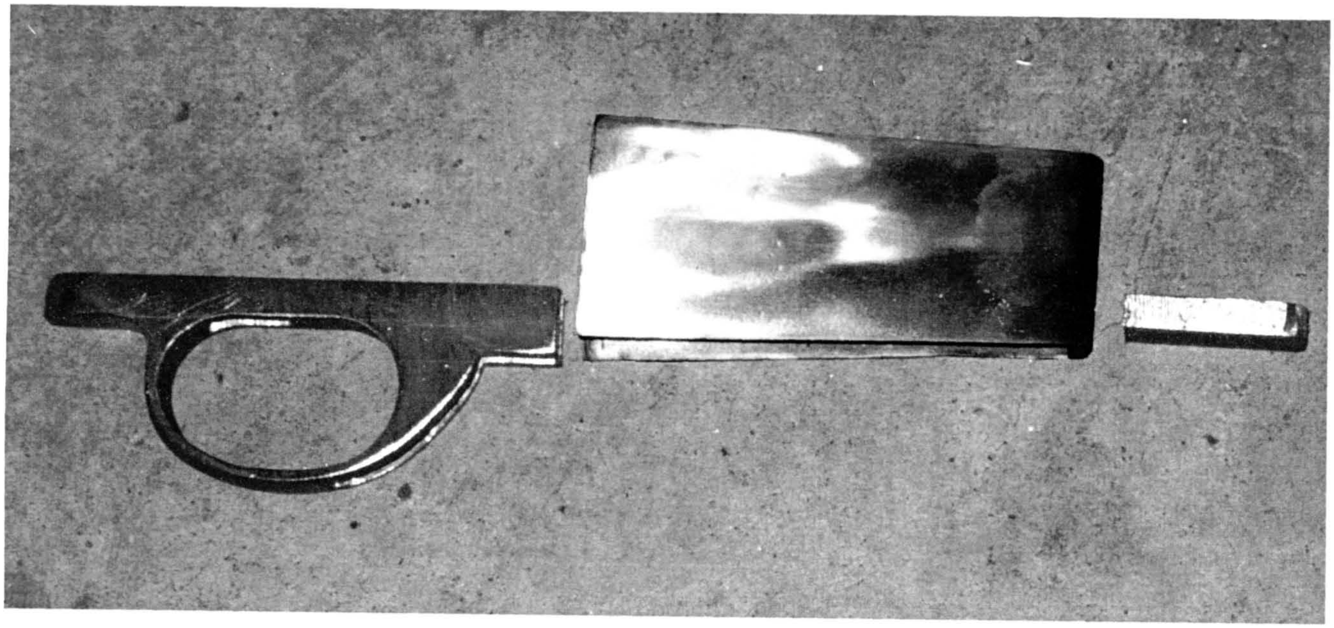
The upper side is folded flat, using block and hammer.



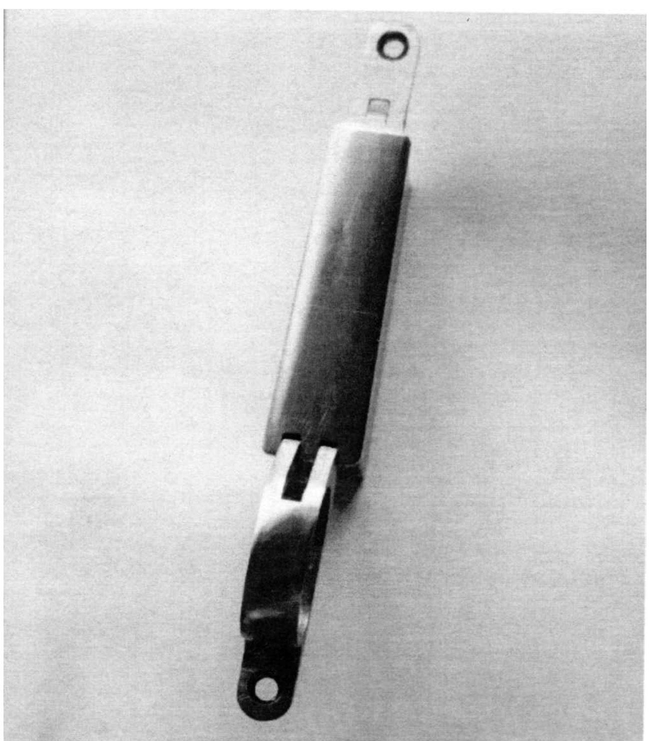
The assembly is turned over, and the operation is repeated.



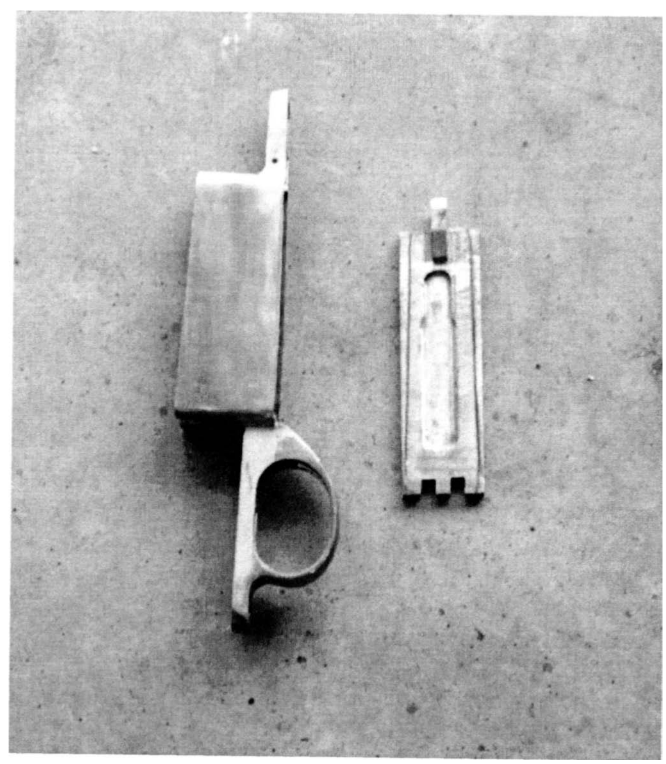
The magazine box, formed to shape. Welding a block in the open end will complete the box.



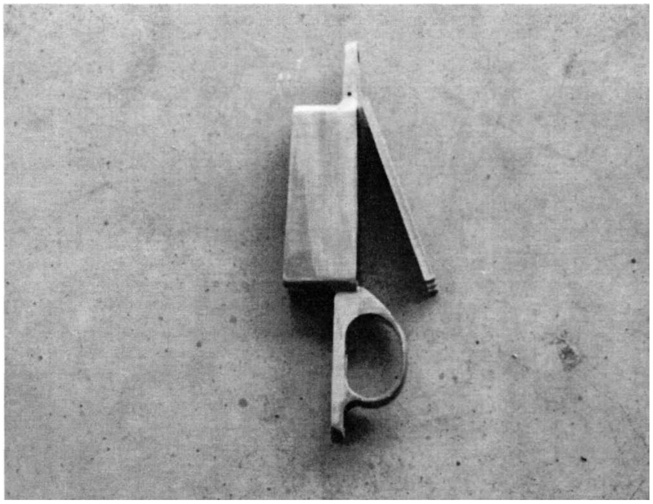
Component parts ready for welding.



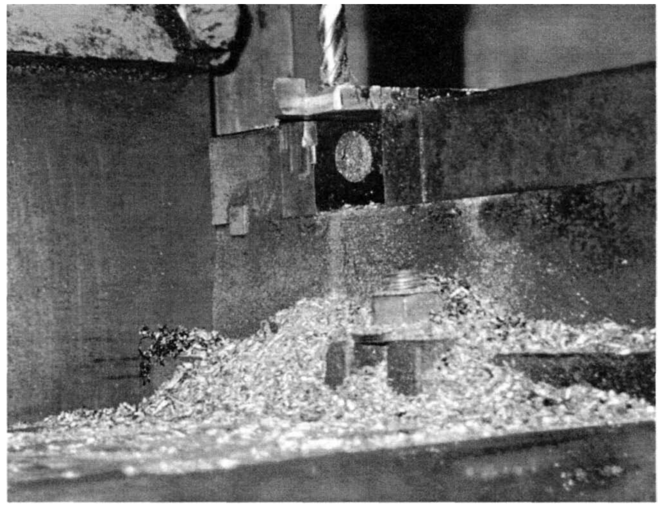
Welded and finished assembly with floorplate in place.



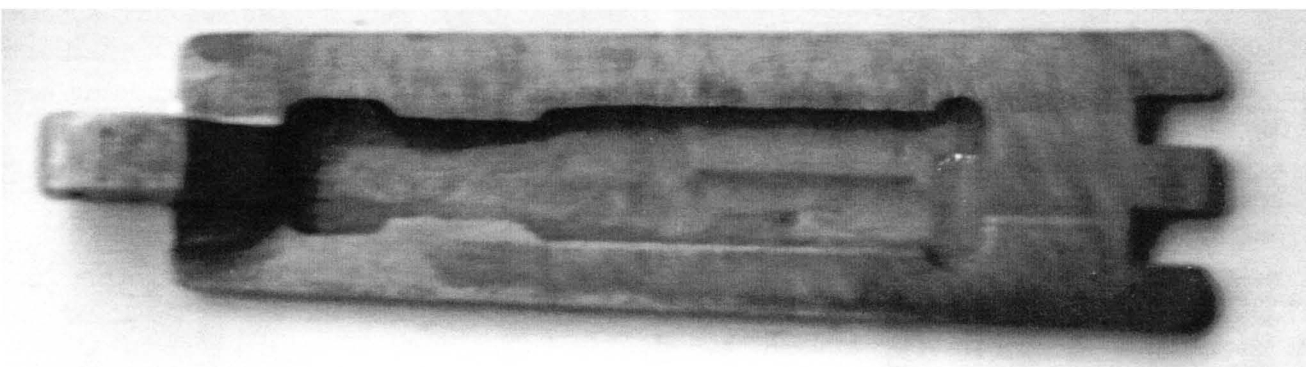
Completed assembly with floorplate (right).



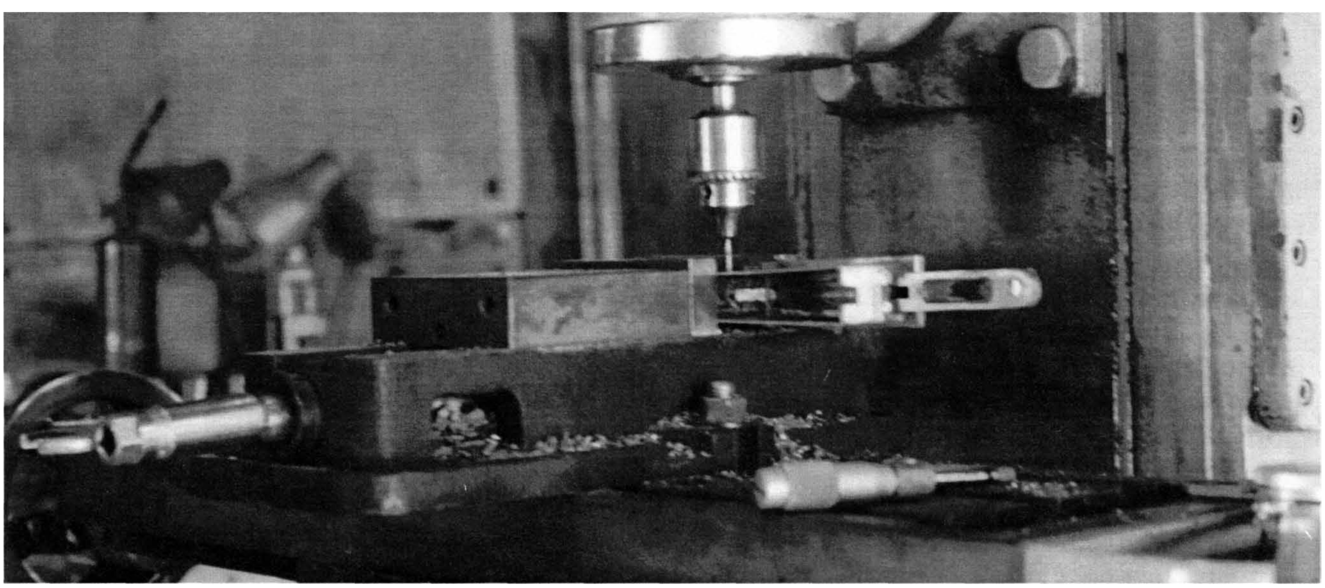
Assembly with floorplate in place.



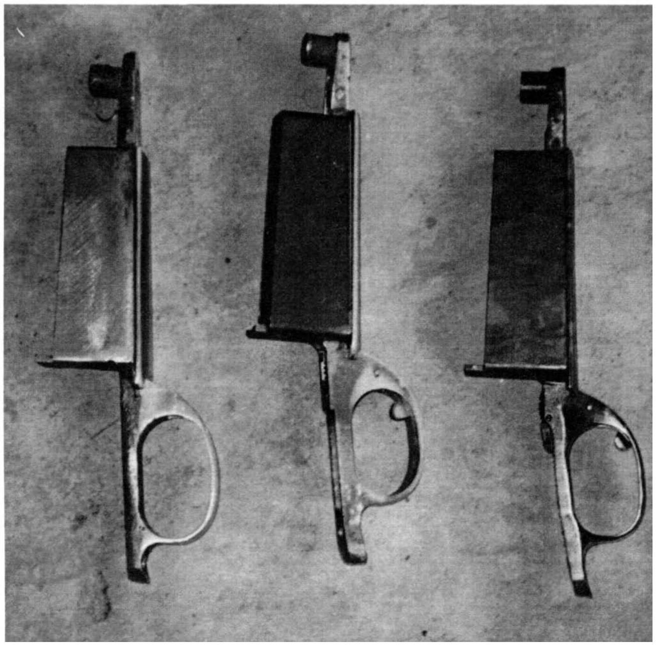
The floorplate is made by first machining away surplus material while leaving the projecting hinge block in place.



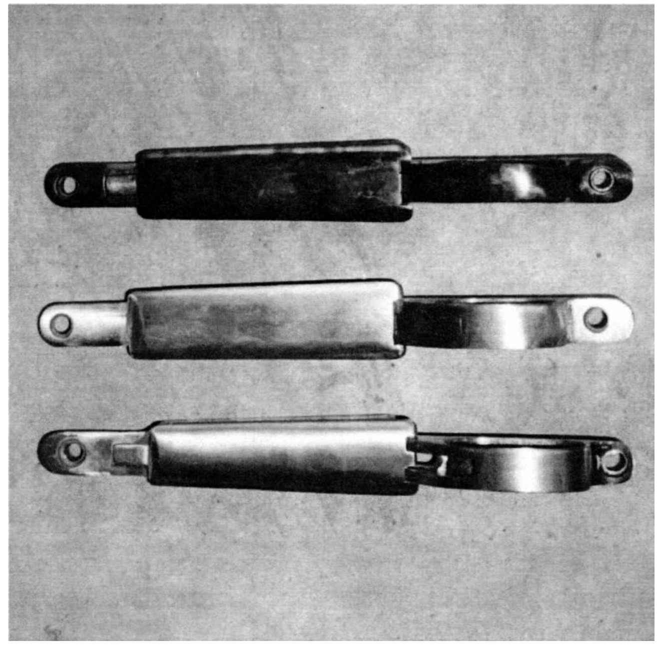
The completed floorplate showing the hinge bloek at left, the slot for spring, and cuts for latch and straddle at right.



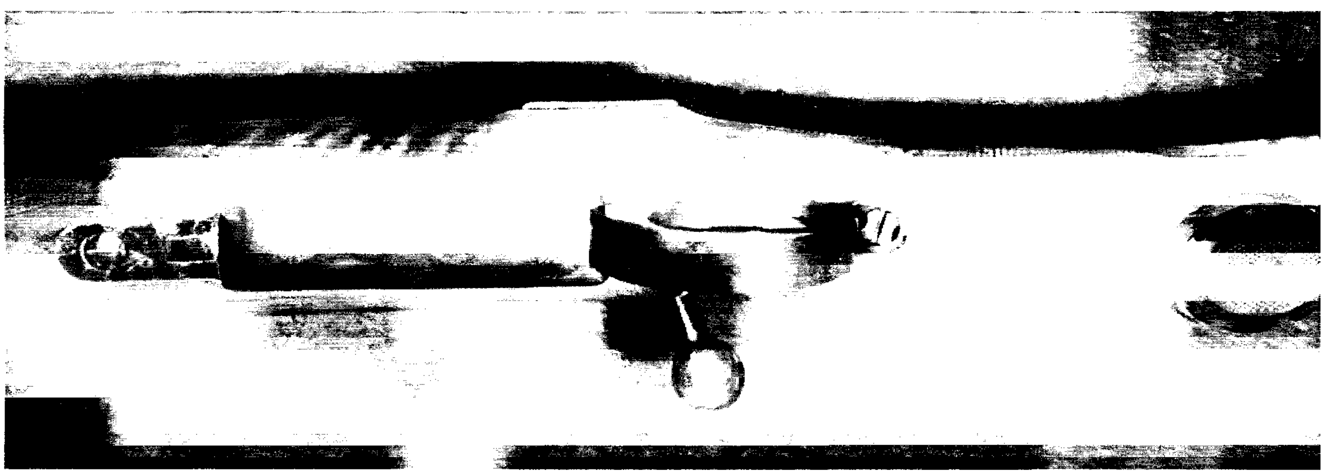
Hinge pin holes are drilled with parts clamped together, ensuring alignment.



Side view of finished assemblies. At the top is a Mauser 98; the other two are Springfields.



From left: bottom views of Mauser 98, Springfield with new trigger bow, and Springfield with modified original bow.

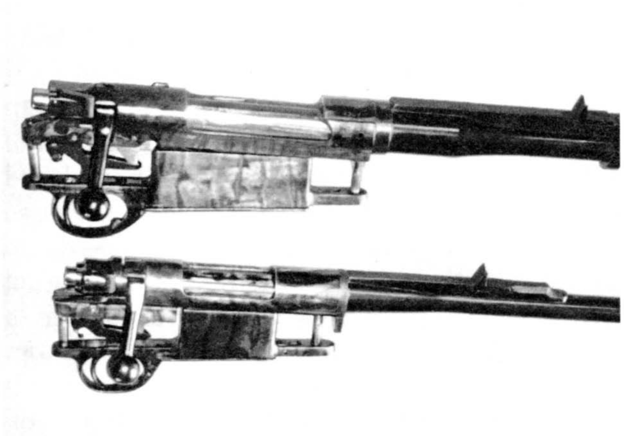


Finished magazine assembly in place, with ease-colored finish.

CHAPTER TEN

Modification of Existing Actions

Most of the modern bolt-action sporting rifles, including the ones featured in this book, are close relatives to several military rifles of pre-World War I and II vintage. In fact, most evolved in various shapes, forms, and sizes by incorporating features from these rifles into the designs of the ones manufactured now. Therefore, it should be considered that any so-called improvements built into these later guns might very well improve the older ones if added. In fact, many of the older gunsmiths have been doing this for years.



Top: A 1917 Enfield with a new magazine and hinged floorplate, new trigger, safety, and holt handle. Note the quarter rih and reeoil lug under the harrel.

I was told by a recent gunsmith school graduate that the school now condemns the use of military actions in the building of custom rifles because they are considered unsafe. Instead, the instructors advocate purchasing one of the more modern actions or barreled actions and building the rifle around it. This usually involves removing and discarding the stock and barrel, which seems quite wasteful. It also ignores the fact that these military actions have stood the tests of time and battle and that they are composed of machined steel while the more modern actions may contain mostly castings, stampings, and flimsy alloy parts, all in an attempt to cut manufacturing costs. Note that in some cases the modifications described may also be adapted to the (modern) actions.

Of all the military bolt actions three stand above the rest: the P14 and P17 Enfield, the Springfield 03, and the Mauser 98, along with its variations. Of the three, the Enfield is the first choice to build a rifle chambered for the long cartridges of the Magnum variety. It also requires the most work to turn into a thing of beauty and joy forever. If the work is well done, however, the end result is worth it.

Much has been written about which Enfields are safest, which are more desirable, and which are most apt to blow up. The P14 Enfield was designed in England to handle a .276 Magnum cartridge for military use—hence, the huge action. When it became apparent that World War I was about to begin, the designers decided that there wouldn't be time to change calibers, so the rifle was barreled for the .303 British cartridge and the magazine was modified to make the shorter cartridges feed. Several U.S. companies (New England Westinghouse, better known as the Eddystone; Winchester; and Remington) were contracted to build the modified Enfield. Then, when the United States got into the war and there were only two plants to build Springfields, Enfield production was taken over and the rifle was chambered for the .30/06 cartridge.

The firing pin was enlarged significantly, and the magazine was altered to feed. Apparently the rifle was never used in combat, but rather chiefly as a training rifle.

Drawing on my 50-some years of experience in remodeling such rifles, I found that the "Eddystones" built before the war and in P14 configuration were the smoothest and best finished, even though others condemned them as unsafe. Though I have seen pictures of the same, I never actually saw a blown-up action. The Winchesters are adequate but rougher. The Remington has a solid receiver bridge, whereas the others have an oblong cut under the rear sight, which must be filled.

The receiver, with metal removed and the remainder reshaped some, turns out to be considerably lighter in weight and features contours as pleasing to the eye as most of the others.

The first step is to remove the rear sight ears. Some receivers are soft enough that most of the material can be cut off wit a saw. Others are almost as hard as glass. These can be milled away using carbide cutters. With the rear sight removed on the Eddystone and Winchester, a large oblong cavity is visible in the top of the receiver bridge. (The Remington has a solid bridge.) It has been said that this cavity was done to save weight. With all the other extra material present on this action, I doubt that this was the reason. Whatever the reason, the unsightly gash should be filled, and it must be if scope mounting is intended. The easiest way to fill it is to make a close-fitting plug and weld it in place.

Many people think the rear-bridge contour should be a true radius, the same radius as the receiver ring. I think they still look fat when done this way and should be ground to the same shape and relationship to the receiver ring as the Mauser.

The bridge can be shortened. The clip guides should be ground away completely, and the lines are blended into the forward portion of the receiver using a fairly sharp curve. Starting at the rear of the bridge proper, cut the left side of the rear of the receiver straight down, where it will join the tang with a short radius. This will remove all the portion of the receiver ring lying behind the bolt stop pivot, down to the receiver tang. The portion of the bolt-stop spring extending behind the bolt-stop should be cut off, and a thin strip of metal is silver-soldered to the rear of the bolt-stop pivot for the spring to bear against. The safety is removed and discarded, and both sides of the tang are cut to the same shape.

The bolt handle is one of the ugliest ever put on a rifle (would you believe it was once copied by a maker of .22 rifles?). The unsightly bends in the handle were put there to clear the rear sight. Now that the sight has been removed, there is no further reason for it. The handle can be heated and the bends straightened out. This will leave it too long, so the knob should be cut off and reversed, jamming the hollow portion over the shank and welding it in place. All excess material in the handle should be ground away, giving it a more graceful shape. But since welding is required anyway, a far more graceful-appearing handle can be turned as described in Chapter 5 and welded in place.

The clumsy cock-on opening feature so beloved by the British can be best eliminated by building out the cocking cam on the bolt enough to cock the striker on the upstroke of the bolt. This was the system used by Remington when it made a sporter from the Enfield and called it a Model 30S, which later evolved into the Model 720. A first-class welding job is called for here and should be done by the heli-arc process. The cam proper can be ground to the angle and shape of a Mauser or Springfield, and the inside weld can be smoothed up in the lathe. The outside can be ground or filed back to the outside contour of the bolt. When finished, the surface of the cam must be hardened. This can usually be done by heating the immediate area around the cam to a cherry red and quenching it in oil. It is then drawn to a straw color.

When the preceding operations are finished, the entire bolt and extractor should be polished to the highest degree possible. As issued, most bolts work hard, and a good part of the trouble is caused by a rough bolt and extractor. The rest is caused by the extractor rubbing against the bolt lug race and causing friction. Peening the ends of the extractor collar pulls the extractor in toward the bolt body and eliminates much of this, making it a slick, smooth-working action.

An M70-type trigger, as shown for the prototype rifle, can be installed without the addition of a mounting block. The inside bottom rear of the lower tang must be cut out at the rear almost to the bolt hole, and the sear slot is lengthened.

The side-swing safety that is included in the prototype design can be installed by welding a slab on the right side of the bolt sleeve to contain the safety shaft. This is best done by making up a round collar, which will just slip over the bolt sleeve, and welding it in place at the front, rear, and lower edges of the cocking-piece opening. It can then be milled flat on the sides and top, and completed as described for the prototype.

A new hinged-floorplate magazine assembly, as described in Chapter 9, can be used with this action simply by changing the dimensions as required. This will add greatly to the appearance and usefulness of the rifle since the odd-shaped trigger guard and the wide frame around the magazine are eliminated.

Whatever caliber you choose, some metal removal is probably necessary to make the cartridges feed properly. This is mostly required on the feed ramp just in front of the magazine opening and at the rear sides of the receiver lips.

Well-executed and finished, this action is the equal to any in existence. Springfield actions require far less work to be presentable. These were actually the basis for the Model 54 Winchester, which later evolved into the Model 70 by using several of the modifications described here.

The actions on Springfield rifles with serial numbers below 800,000 were made using a simple case-hardening treatment and are said to be unsafe with modern ammunition. All sorts of stories exist about how the actions have simply blown apart when fired. Back before I knew about this, I fired several thousand rounds of military ammunition that had been liberated by some of my older relatives who had access to it in the army. This ammo was fired in one of the low-numbered rifles, but I found nothing unsafe about it. I have known of several cases where others have used these same "unsafe" rifles for years without any problems. A number of "blowups" were later attributed to firing 8mm cartridges in the undersized .30/06 barrels. This was also determined to be the cause of "blowups" of M1895 Winchesters in .30/06 caliber. Rifles made at Springfield with serial numbers between 800,000 and 1,275,767 were given what was known as a "double heat treatment," as were those made by Rock Island Arsenal with serial numbers between 285,507 (rifles below this number were also unsafe) and 319,921. These were considered safe and dependable.

Up until around the start of World War II the firm of R.F. Sedgley had available low-numbered Springfield actions that they claimed to have "re-heat-treated." My first "custom" rifle was built on one of these actions, for which I paid $25. I didn't have any trouble with it, but, then again, I didn't have any trouble with the original either. Rifles from Springfield with numbers above 1,275,767 and from Rock Island above 319,121 were made from nickel steel and were considered the strongest of the lot.

The later rifles, designated 03A3 and 03A4 (which were intended as sniper rifles), were made by Smith Corona and Remington. They were usually somewhat rough on the outside and had several stamped parts. Although plenty strong enough, these are not as desirable as the original actions.

The Springfield receiver is about as good as is possible to get it without alteration. The bolt stop and ejector housing can be reshaped to a bullet-like profile, which some consider desirable. The rear tang can be reshaped and narrowed to resemble that of a Mauser. This allows a slimmer, more rounded upper grip line on the stock. Except for a good polishing, this should take care of it.

If the M70-type trigger is desired, it is necessary to make up a hangar, or mounting block, and silver-solder it in place, as shown Chapter 6.

Even if no scope is to be used, a new bolt handle enhances the looks of the rifle. In certain instances 03A4 sniper rifle bolts have been substituted for the original. These were made with production in mind, and most are quite rough, with varying steps in the diameter along the bolt body. The handle is too short and poorly shaped. It is far better to modify the original bolt, which has a smooth body, and if it is stamped "N S" (which indicates nickel steel), it is one of the very best. While the original handle can be heated and forged lower to clear a scope (using a set of bolt-bending blocks to hold it in a vise and protect the lugs from the heat), the most attractive bolt handle is turned to shape and welded in place. The bolt-bending blocks are available from gunsmith houses, as are weld-on bolt handles if you don't want to make your own.

It has been written that the two-piece firing pin is unsafe because it could break at the joint and allow the gun to fire accidentally. Here again, I have only heard about this. Although I have rebuilt and remodeled several hundred of these rifles over the years, I have never seen it happen. It is possible to adapt an Enfield firing pin if you are uncomfortable with the original, but I have never found it necessary or desirable.

Although the knurled knob on the end of the cocking piece is handy to cock and uncock the striker, cutting the knob off enhances the appearance of the rifle. Because this removes most of the threads between the cocking piece and firing pin, and could allow them to separate, it should be secured by welding around the rear end of the firing pin and cocking piece, or drilling a hole through the side and cross-pinning them together.

The side-swing M70-type safety can be added by welding a slab of metal to the right side of the bolt sleeve to contain the safety shaft and the locking pin and spring. The top is ground off, removing the original safety shaft housing, and rounded off to blend in with the side you added.

The original trigger guard and magazine assembly is easily the best looking such assembly ever put on a military rifle. With the addition of a hinged floorplate it is at least equal to any seen on factory-made sporting rifles. I refer here to the original milled jobs. The stamped ones, as included on the A3 and A4, aren't worth carrying home.

Because of the quality of the original, it is only necessary to make up a new floorplate and hinge it in an opening cut in the front tang. This hinge should mate closely, without a visible gap, when closed. Two small strips are welded at the front of the guard to hold the floorplate latch. The assembly is shaped to the contour shown. (This operation is described in detail in Chapter 9.)

The Model 98-type Mauser is considered by most to be the best of the military and sporter actions ever built. Obviously, since the Mauser came along first, most of the others copied something, however minor, from its design. Ironically, while this action is considered the strongest and best, it is the only one I have ever seen actually blown up. But this was caused by an idiot who thought he was a reloading expert and knew more about the reloading subject than any reloading manual. To him, powder was powder, whatever the designation. If a maximum load was listed, some more was better. Overlength cases, due to a lack of trimming, meant nothing to him. It was too time-consuming. The end result was the upper part of the receiver ring being blown off, wrecking a perfectly good action.

About the only modification needed on the receiver is to remove the clip charger guide and grind the front of the bridge to the same contour as the rest of it. This makes it possible to use the same scope bases as on the FN and other commercial actions.

As with the Springfield, this trigger assembly must have a mounting block silver-soldered to the bottom of the tang. This is drilled for pivot pins to hinge the trigger and sear. (Such triggers are described fully in Chapter 6.)

The bolt handle sticks straight out on most of the earlier actions and is bent down on the later ones. These can be forged low enough to clear a scope, as described for the Springfield. The resulting handle will be too short to look good. The original handle should be cut off and a new handle welded in place.

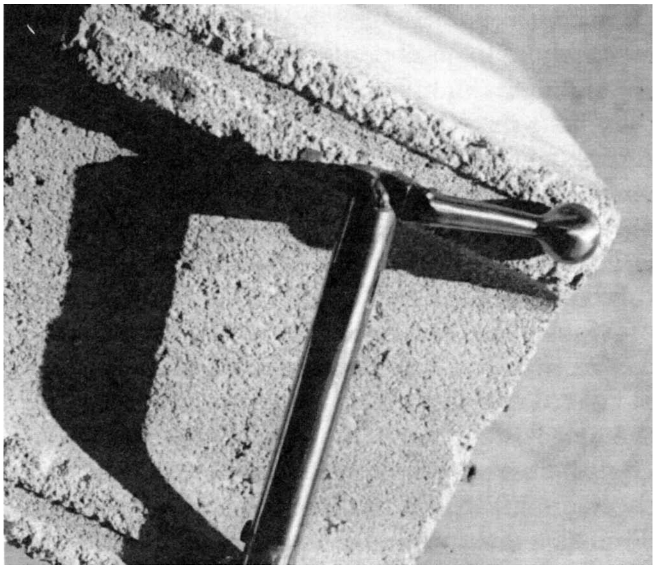
If a simple jig is made, as shown in the pictures and drawing, it is a simple matter to clamp both the bolt body and handle in place where they can be joined together by the heli-arc welding process. The welds on the front and rear sides can be cut smooth by turning in the lathe, and the outer side can be formed with a small grinding wheel and drum sander.

The side-swing safety is installed just like on the others, by building the right side out to a point where the safety shaft can be mounted in place, together with the locking pin and spring. The top safety shaft housing should be ground off and blended into the sides, leaving a smooth, rounded contour.

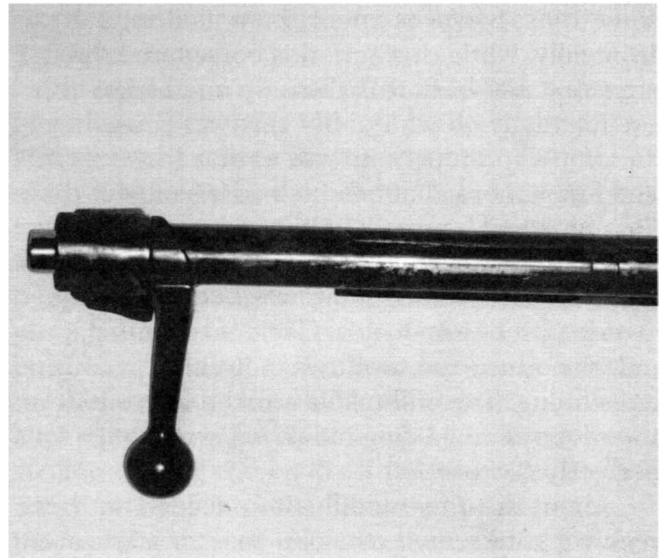
As with the Springfield, the magazine assembly, if in good condition and free from pits, should have the hinged floorplate added. Most of these also have lock screws to lock the guard screws and keep them from backing out (as if one ever did). These should be welded shut and dressed flush. The trigger guard is somewhat larger than it needs to be. If you are happy with this, the front can be built up as described previously and reshaped. A new trigger guard can be made as described before and, with the old guard cut off, welded in place at the rear of the magazine.

It takes quite a lot of time and work to make these modifications, but the end result, if well done, is an action that is equal to, if not better than, any on the market today. These actions are safe to use with factory-loaded ammunition, as well as reasonably loaded hand loads. This should make it all worthwhile.

The oval slot in the reeeiver ring should be filled by welding a close-fitting plug in plaee and dressing smooth. Remington aetions do not have this slot.

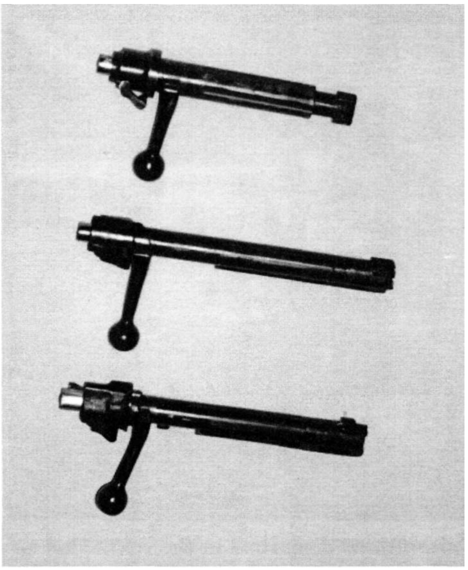


The cocking cam on the Enfield bolt must be built up by welding, as shown, ground and filed to shape, and well polished.

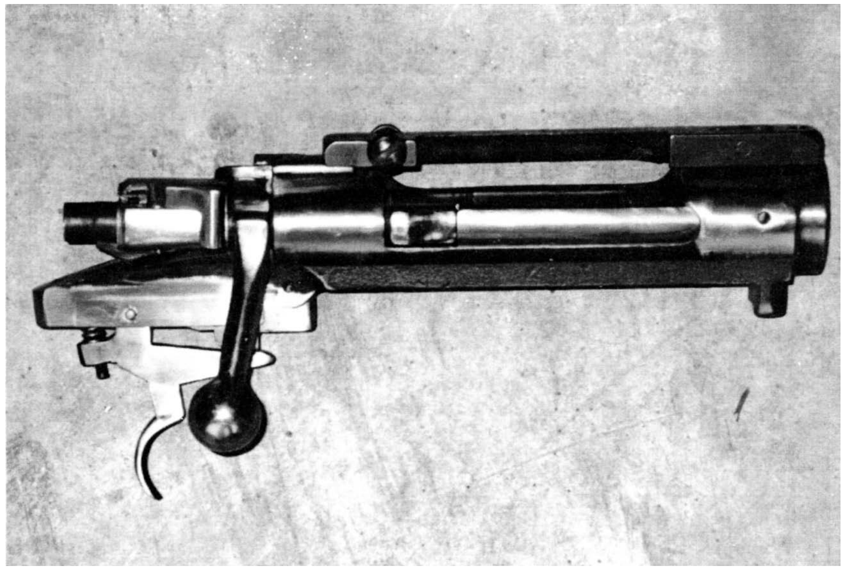


An Enfield bolt with a new handle, bolt sleeve, and safety, and altered to cock on opening.

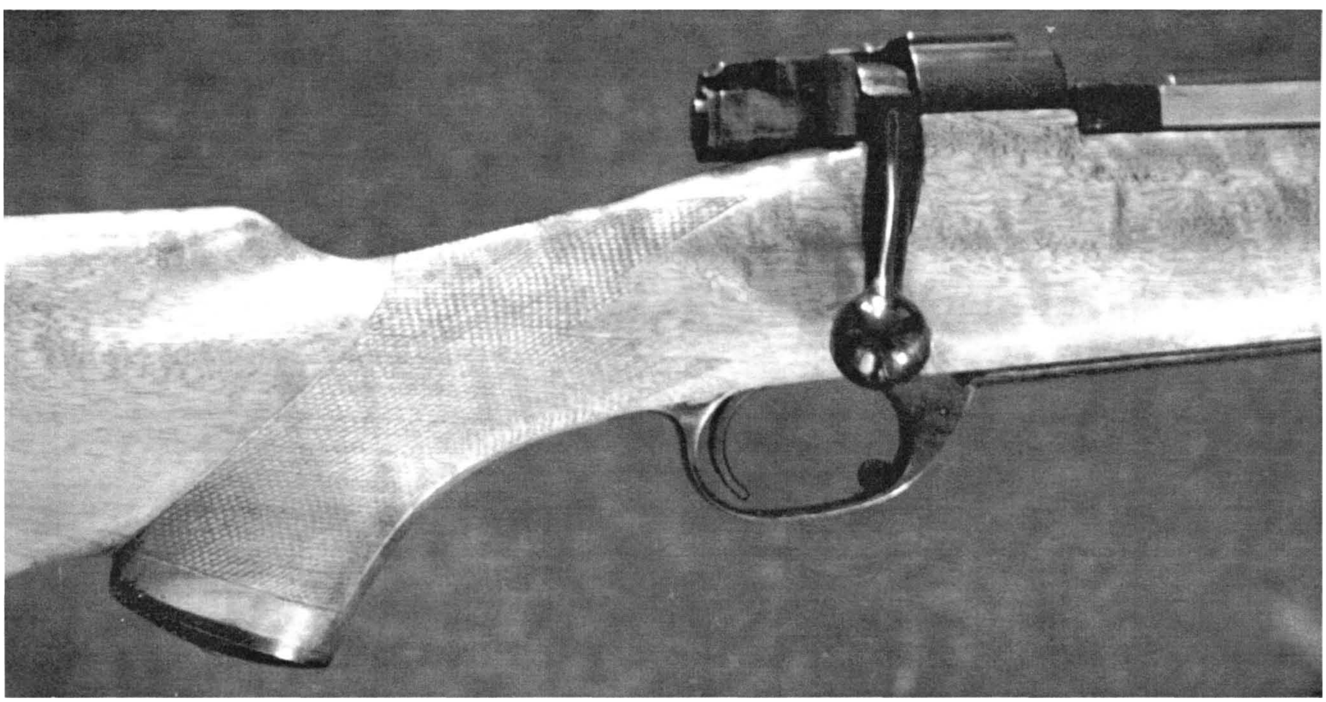
An Enfield bolt-stop and ejector housing altered as described in the text.



From top: Prototype bolt, Enfield bolt, and Mauser bolt, built as deseribed.

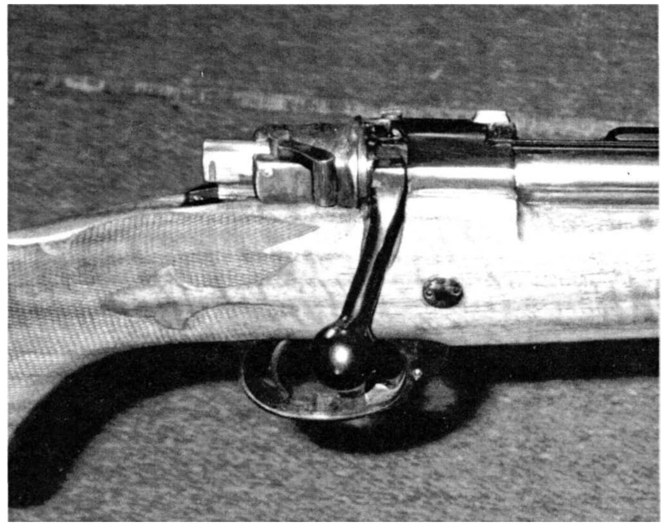


A Springfield 03 action, altered as deseribed in the text.

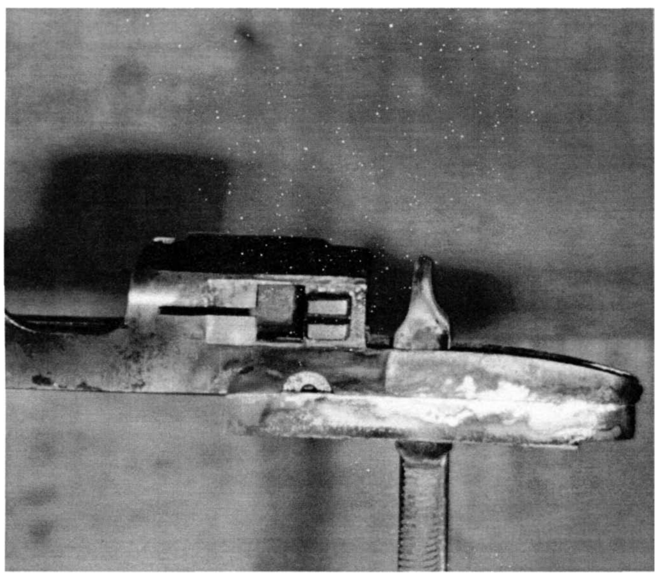


The same aetion shown above right in myrtle wood stoek. This is the last rifle I ever built. It was for a friend of mine, now deceased, who was almost 7 feet tall and weighed some 300 pounds, hence the long grip.

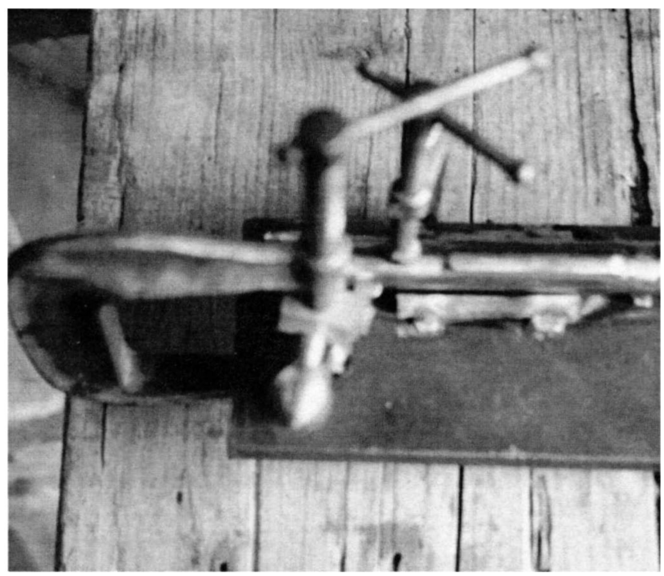
A 98 Mauser bolt, altered as described.



A Mauser with all alterations described in the text. This is a .338 Winchester Magnum with a Bastogne walnut stock. This is the hardest piece of walnut I ever worked with.



Trigger assembly mounting block silver-soldered in place on a Mauser receiver.

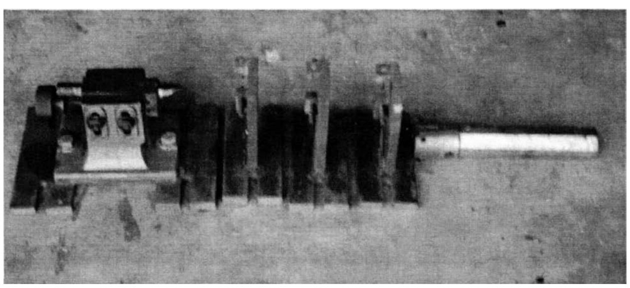


This simple jig makes locating and welding bolt handles in place easy.

CHAPTER ELEVEN

Barrel Fitting, Chambering, and Shaping

While it is possible to bore, ram, and rifle barrels from a solid-steel billet, or blank, the cost of the tooling and equipment necessary to accomplish this in the small shop makes it impractical as long as barrel blanks with finished bores remain available.



Equipment needed for octagon or fluted barrel work (from left): tailstoek, supports (clamps), and indexing bar.

At present there are a number of barrel makers practicing their trade and producing barrel blanks with finished interiors in just about any configuration desired. Though I have always liked the idea of being able to truthfully say that I built every part of my guns in their entirety, I could never justify the expense it would take to build only a small number of barrels per year. So, when people ask if I made the barrel I am forced to admit that I used a purchased pre-rifled blank.

Most applications require only a round, light sporter contour barrel. Since these are available already turned to shape, and come in several sizes and weights, it makes sense to procure them with the outside finish turned to the contour that comes closest to your requirements . . . especially since these cost only a few dollars more than an unturned blank.

There are, however, instances where it is necessary to procure barrel blanks in the straight-cylinder configuration. This is required when such features as an extra recoil lug is made on the barrel of a rifle with heavy recoil, or an integral front sling swivel machined on the barrel, or an integral front sight ramp, among other reasons. Octagon barrels require a larger diameter blank, in certain cases, than a round barrel of similar dimensions.

Whatever the outside contour is to be, the barrel installation should begin by turning the barrel shank to its required diameter and cutting threads on it. Some gunsmiths chuck the muzzle end of the barrel in the lathe and place the tailstock center in the breech end while threading and chambering it. This requires use of a steady, or center, rest to support the breech end during the chambering operation. Others shove most of the barrel length into the lathe headstock and secure it with the chuck. The tailstock is used in the same manner as above for threading and chambering. Personally, I favor the idea of inserting the barrel through the headstock spindle and securing the breech end in a four-jaw stock, or an adjustable three- or six-jaw chuck, allowing something over an inch to protrude from the chuck. Using a dial indicator, the bore is centered, and the threading and chambering can be done without having to use the steady rest.

There are gunsmiths who make a practice of cutting barrel threads somewhat undersized, allowing the action to screw on the barrel with quite a bit of slack and wobble. Their theory is that when drawn up tight, all contact will be on the front side of the threads, which results in better alignment . . . or something. I like the idea of a snug thread fit, whereby the action screws on without any looseness or wobble and some effort is required to turn it for the last couple of threads. It should also be tightened home quite firmly and forcefully.

With the threading completed, the chamber should now be cut. For the past hundred years or more it was the common and recommended practice among barrel fitters to cut a chamber almost to depth using a roughing reamer. This left the chamber slightly undersize and was followed with the finish reamer, which cut the chamber to its finished dimensions. This removed only a small amount of metal, thereby reducing wear on the finish reamer. This was followed, in many instances, with a burnishing reamer, which exerted only a scraping and polishing action and left the chamber extrasmooth.

Now, in the past few years, more and more people in the gun trade have begun to advocate using only a finish reamer to cut the entire chamber. If this method is used, the chamber should first be roughed-out with drills to remove all excess material possible. The chamber is roughed in a series of steps with a change of drill size at each step. To allow for any slight run-out of the drills, the drilling should be kept at least .050-inch undersize at all points.

Regardless of which method is used, the process is similar in either ease. With the lathe running at its slowest speed, the well-lubricated reamer is fed into the chamber end using slight pressure from the tailstock. It must be withdrawn frequently, have the accumulated chips removed, and be relubricated. Do not neglect this. Chips accumulate in the reamer flutes with amazing rapidity and, if not removed, can score the chamber or seize and break flutes off the reamer before it is realized that anything is wrong. Abundant lubrication is required.

Unless you are absolutely certain that the tailstock center is in perfect alignment with the center of the bore, the tailstock center should not be used to center the drive end of the reamer. Just a few thousandths of an inch off will cause the reamer to cut an oversize chamber. Clymer, the reamer manufacturer, makes and markets a floating reamer drive that will correct any small misalignment. Acquire one of these if possible.

Some means must be used to keep the reamer from revolving with the barrel. A tap wrench works well for this, provided the handles are short enough to clear the lathe bed in ease you didn't pay attention to what I said about chip accumulation and lubrication and the reamer seizes. If this happens and you turn loose of the handle quickly enough, the reamer can turn with the barrel until the lathe can be stopped.

The final, or finished, chamber depth (often referred to as *headspace)* can be determined by measuring the distanee from the front edge of the receiver to the bolt face using a depth mike. This measurement will be equal to the distance between the barrel shoulder and the cartridge head, which will usually extend slightly from the chamber. It is a good idea to stop slightly short of the finished depth and cut the last few thousandths by hand, measuring frequently and trying it with the action screwed in place until the bolt will just close on the "go" headspace gauge.

Although not necessary when using a new action, such as described herein, it is sometimes a good idea to square the end of the receiver, especially when using military actions and the like. This will require making up a mandrel that will extend through the receiver and mount in the lathe chuck. The forward end of this mandrel must be threaded to match the receiver thread and relieved to allow a light cut to be taken from the front face of the receiver, thereby truing and squaring it.

In many instances it is desirable to lap the bolt lugs to the receiver lugs. This is accomplished mainly by applying a thin coating of some sort of abrasive compound to the contacting surfaces of the lugs. With the bolt in its locked position in the receiver ,it is worked by opening and closing it from the locked to unlocked position while keeping a slight rearward pressure on it. This should be continued a number of times or until you get tired of doing it. All traces of the lapping compound should be removed when finished.

For the enlightenment of those who have no knowledge of barrel work, it should be noted here that barrel work in a large production shop is a different procedure than that practiced by the small shop operator. Large shops cut the chamber and form the exterior of the barrel in machines especially adapted to the work at hand, using pressure-lubricated reamers and cutting tools throughout the operation.

The exterior shape of the barrel can be of just about any configuration desired by the owner, but the most common is the tapered round barrel. These are available from most barrel makers as unthreaded, unehambered blanks with outside contours ranging from light, featherweight barrels through several increasingly larger, heavier weights to the fully unturned blank of some 1 and 1/4 inches at both ends. Quite a bit of work can be avoided if one of these standard contours can be used as it comes from the manufacturer since it can take several hours of lathe work to turn a barrel from the basic full-sized blank to the contour desired. Even if a special profile, requiring special shaping or forming, is required it is possible to avoid a good bit of work by obtaining a slightly larger blank and removing whatever material is required to meet your specifications.

The most common profile for round barrels includes a short cylindrical section, slightly smaller in diameter than the receiver ring, located just forward of the thread shank. Just ahead of this is usually a short, tapered section that extends forward a short distanee to the smaller diameter of the long-tapered barrel, which extends in a shallow straight taped to the muzzle end. This section usually has a slight concave in the taper and has been referred to by others as the *forcing cone.* Just why this is I have never understood because I can't see how it "forces" anything. But smarter men than I have decreed it. The long portion extending forward from this taper extends with a shallow straight taper to the muzzle. If such items as integral front or rear sight bases, barrel swivel base, or recoil lugs are to be incorporated, a full-diameter blank should be used with appropriate lumps, or sections, left if sufficient diameter to form the item required and excess material removed with the milling machine and files.

Octagon barrels, which many people refer to incorrectly as *hex barrels* (they have only six flats as opposed to the eight present on the real thing), require some extra equipment—most important, a milling machine with enough table travel to expose the entire length of the barrel to the milling cutter. The machine table must also be long enough to mount some sort of indexing fixture at one end of the table and a tailstock that will locate and support the barrel at the other end. The standard 42-inch table that comes standard on the average vertical mill simply isn't long enough.

When I began machining octagon barrels, I bought a new machine with a 10x54-inch table. I shelled out several thousand dollars for it. Although it worked out just the way it was supposed to, I found a better deal later on. A few weeks later I purchased another considerably older machine with the same length table. This mill was a combination vertical and horizontal mill in excellent condition. It was also extremely well equipped. I bought it for less than one-eighth of what the new machine cost. The company I got it from decided to put all new equipment in its shop and didn't have room for it. So look around; you may find a bargain too.

Some means must be provided to precisely index the barrel blank in eight different identical positions at 45-degrce intervals around the barrel. This can be with a dividing head, a rotary table in a vertical position, an indexing spacer, or a fixture made for the purpose.

After several weeks of experimentation I made up an octagon fixture that could be mounted in the mill vise with one end bored to fit over the breech end of the barrel blank. This fixture was machined to the octagon form using a heavy dividing head and tailstock. I then bolted the swivel base mill vise in place at the extreme end of the mill table and the tailstock at the other end. The tailstock requires a false base to permit off-setting it for the taper to be cut. This, together with the swivel-based vise, allows the blank to be offset at the muzzle end, which permits any desired taper to be cut.

I made up three supports, which arc bolted to the mill table and fit over three sides of the barrel, clamping it in place and dampening vibration. The barrel is quite rigid and vibration-free when clamped and held this way, more so than when mounted only between centers.

When using the vertical mill, as shown in the accompanying photographs, all cutting is done from the side. A shell mill of 3 or more inches in diameter is mounted in the mill spindle and turned at the slowest speed possible. A coolant pump should be used to pump plentiful amounts of lubricant on the work. You may find through experimentation that faster cutter speeds are more desirable. But these large-diameter shell mills, which are necessary to form the previously mentioned "forcing cone" (that in turn changes the round shank at the chamber end to the octagon shape), are expensive and last much longer when run slowly.

Remove as much excess material as possible by lathe turning, or obtain a barrel blank just large enough to finish to the octagon dimensions. The blank is then mounted on the mill table and secured as described. With the cutter revolving slowly, the barrel blank is fed into it some .040 to .050 (forty to fifty thousandths) of an inch and the power feed and coolant pump engaged, making a full-length cut. The blank is then turned 180 degrees, and an identical cut is made on the exact opposite side from the first. It is then rotated another 45 degrees and another cut made; then another 180, then 45, then 180, until the entire rotation is made and all eight sides started. This sequence is repeated with a deeper cut on each rotation until the finished dimensions are reached. There are those who will try to cut each flat to its finished depth or rotate it only 45 degrees between cuts. This invites warpage and may set up stresses that will affect the accuracy of the barrel. It takes a little bit longer to do it as described, but the end result makes it worthwhile. Too much work has gone into this project to take a chance on ruining it by taking shortcuts.

Fluted barrels can be executed by turning the round barrel to its finished dimensions and mounting it on the mill table, as described earlier. In this case a 2-inch or larger diameter convex cutter of the desired width is mounted in the mill head, and the cuts are made in the same way the octagon barrel was done.

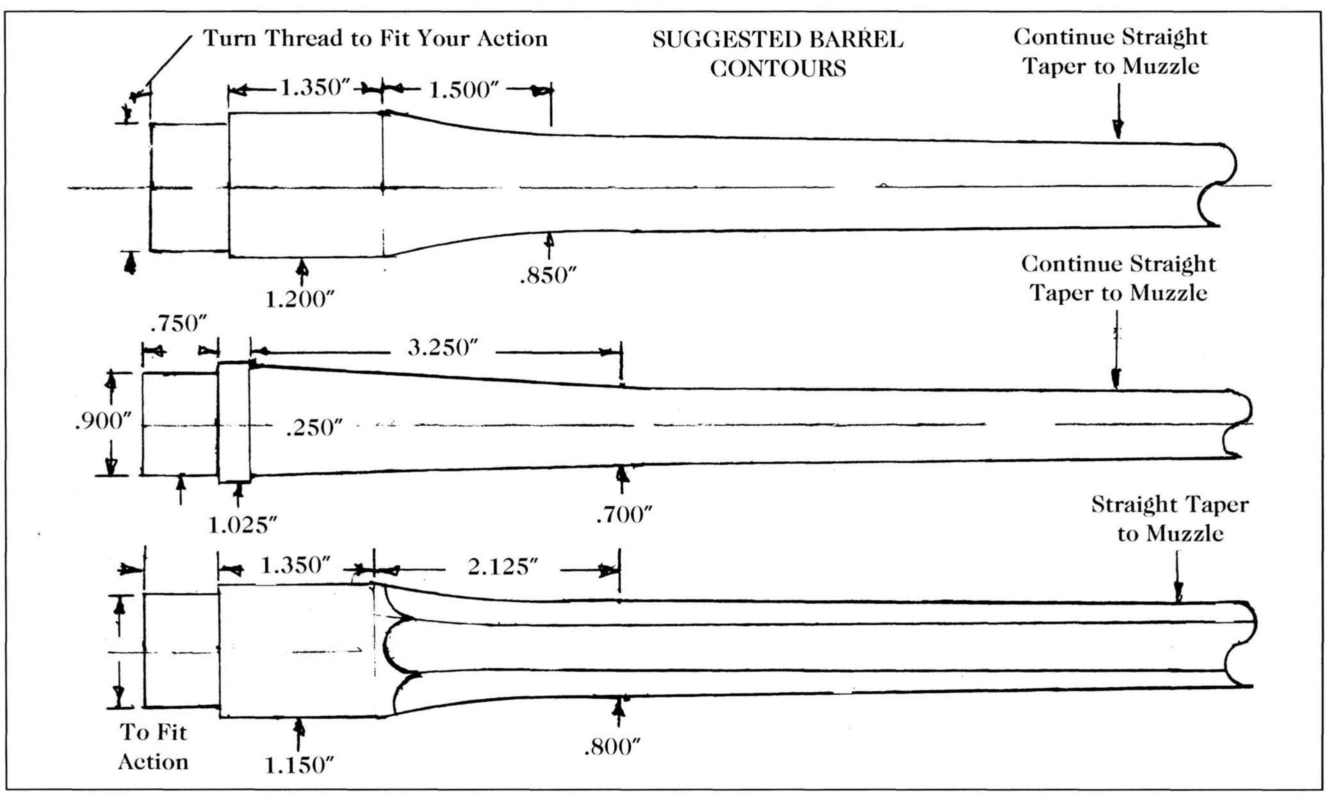
Caution should be observed when cutting flutes. I know of at least two instances where self-proclaimed experts cut such flutes too deep and the barrels split or cracked down the bottom of at least one flute. This happened to one such genius of my acquaintance, who bragged long and loud about his own intelligence and ability. He took a .50-caliber rifle of his own manufacture all the way to Turkey to demonstrate it to several foreign governments. He bragged to everyone who would listen about how rich he would be when he secured the contract he was sure he would get. After a few shots during his demonstration the barrel blew out through a flute that was cut too deep. Both gun and demonstration were ruined, and our hero came home sadder but (I hope) wiser and closed his business shortly thereafter.

The half-octagon barrel (where the barrel is octagon shaped at the breech end and remains forward until somewhere near the halfway length, where it blends smoothly into a round cross section that continues to the muzzle) makes a most attractive barrel when properly done.

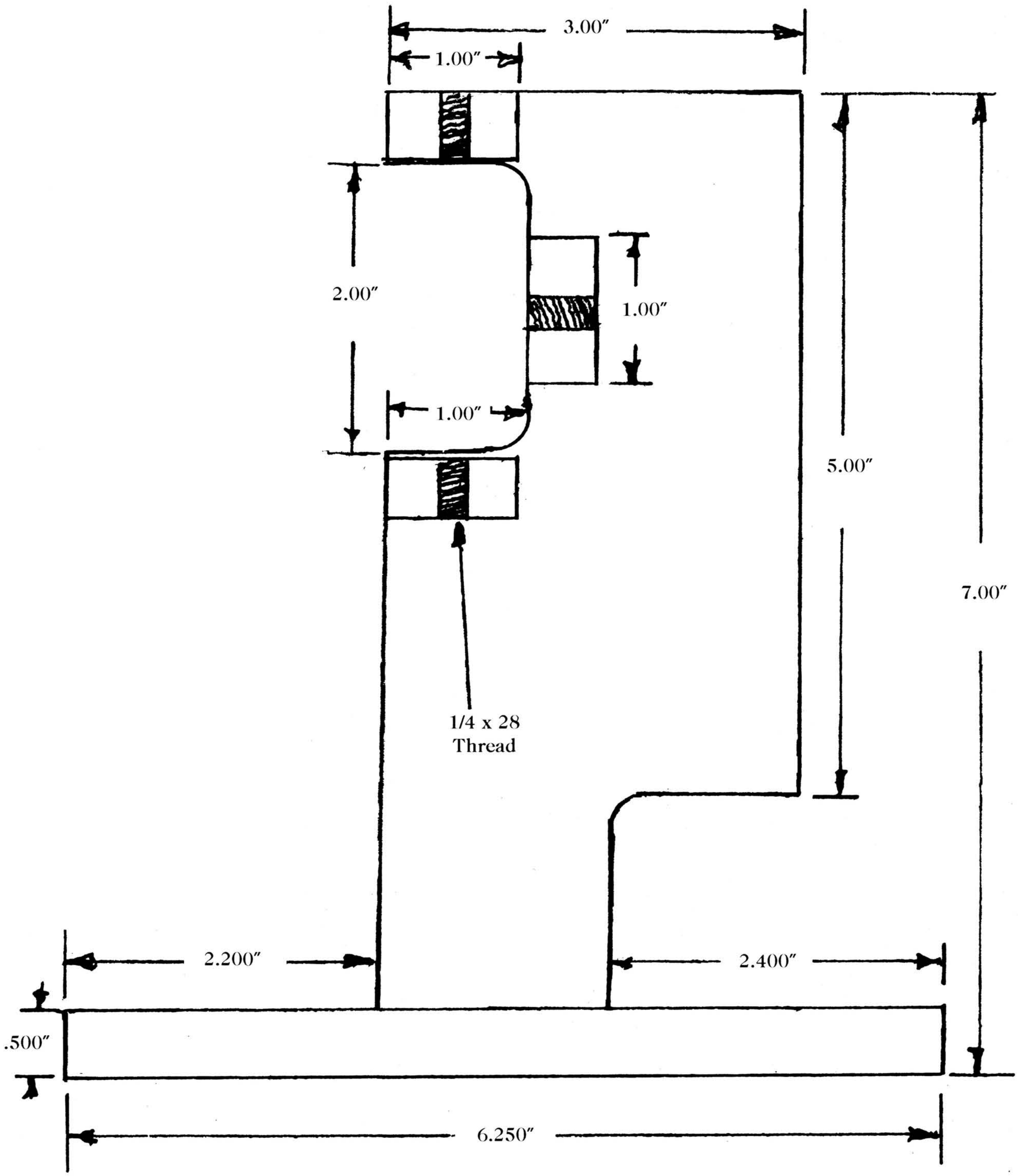
This process is begun by turning the round front section to the desired finished diameter. These barrels look best when kept fairly slim. The rear part is likewise turned using the same taper but left oversized enough to allow cutting the flats required to form the eight sides. These should blend smoothly into the round section without showing a ridge, or step, where the transition occurs.

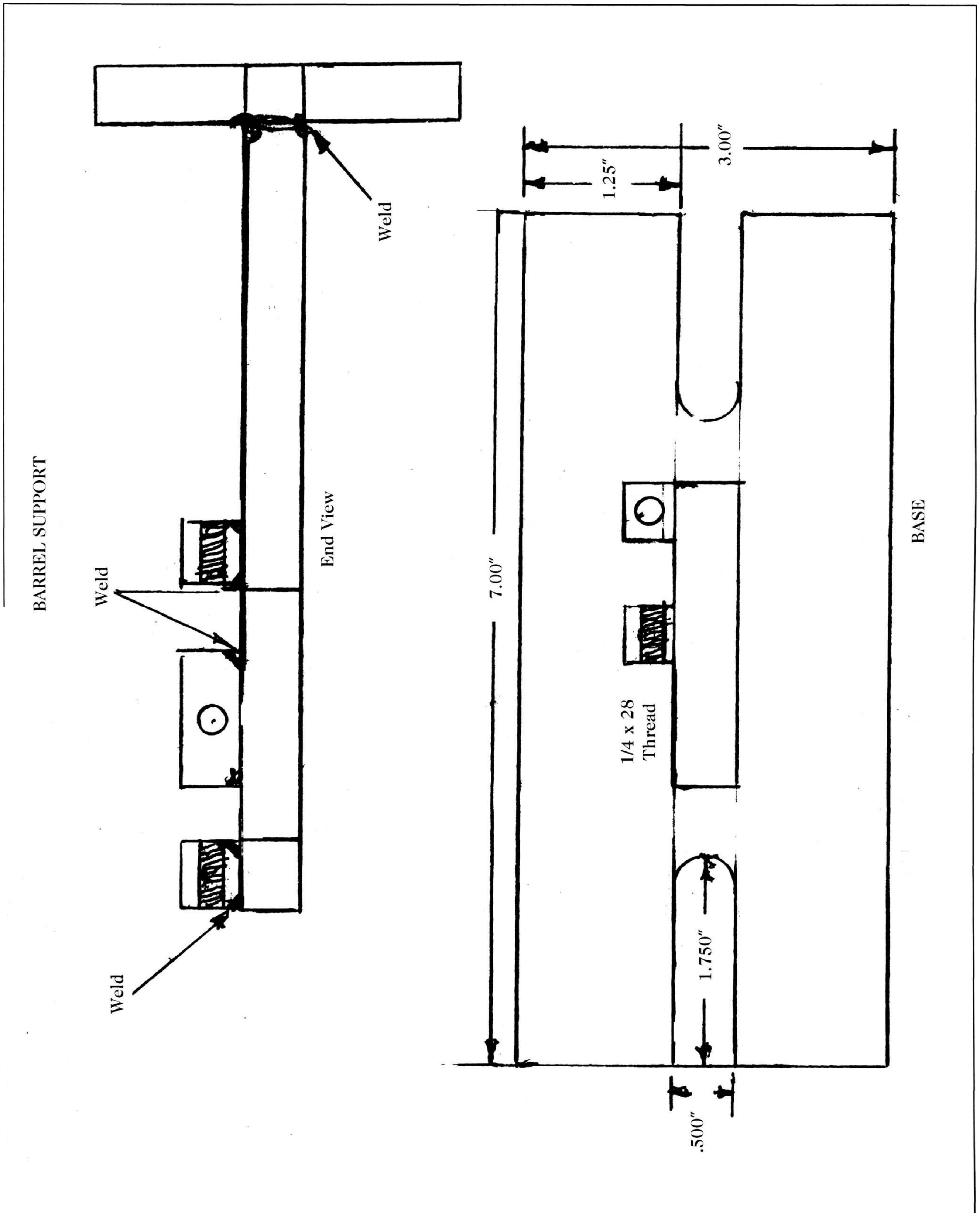
As previously stated, much labor can be avoided by obtaining barrel blanks that are already shaped to dimensions close to those desired. For instance, if a barrel is required with a muzzle diameter of .600 (six hundred thousandths) inch by 24 inches long, several barrel makers will supply one with just these dimensions. If a slightly smaller diameter is required, that size can be turned from it. If a larger barrel is wanted, blanks are available to accommodate these.

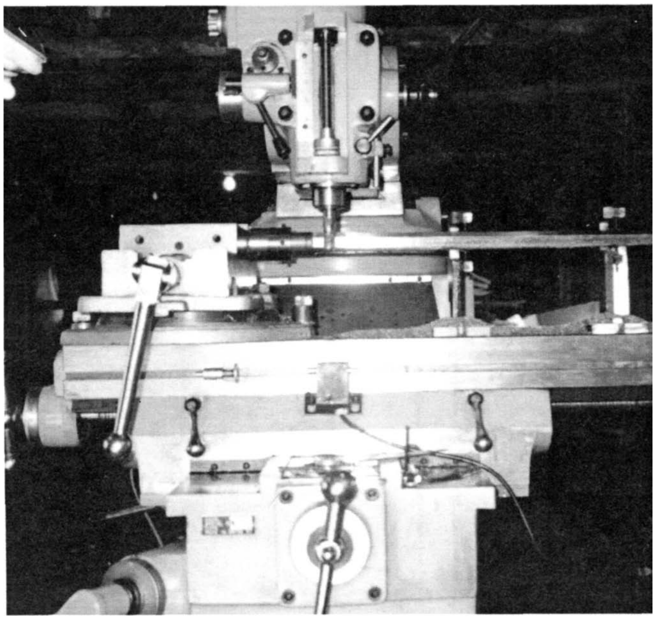
Turning barrels to size in the small shop can be done in several ways, but probably the simplest and easiest is to turn the rear cylindrical section and "forcing cone" to size. Then, with the barrel placed between centers, the tailstock is offset to produce the desired taper, which blends into the forcing cone taper. Several light cuts are usually required to reduce the diameter to the desired size.



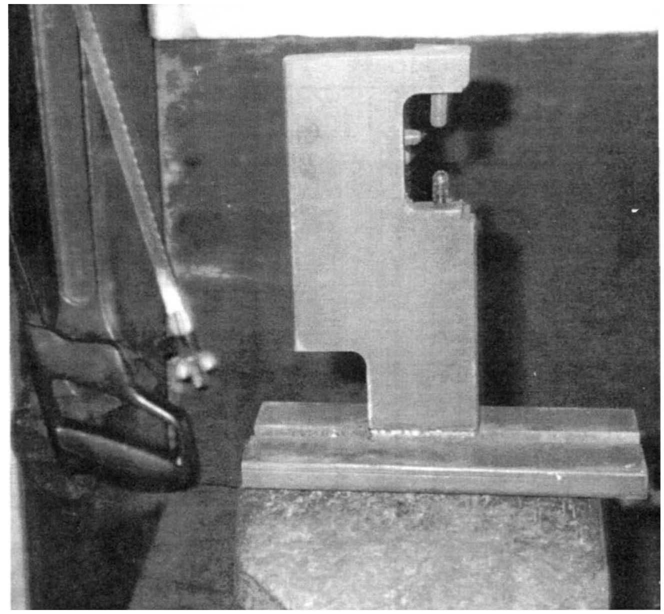
BARREL SUPPORT, FOR USE IN MACHINING FLUTED OR OCTAGON BARRELS



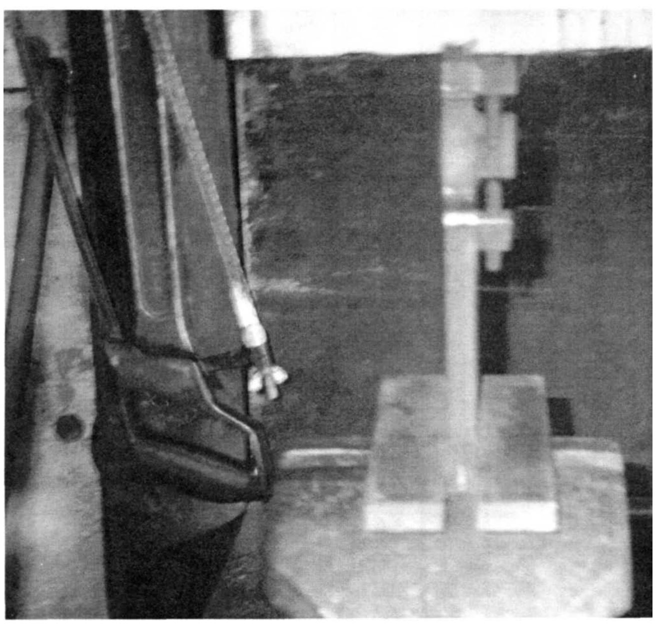

BARREL SUPPORT
Weld
Weld
Weld
End View
7.00″
1.25″
3.00″
1/4 x 28
Thread
1.750″
.500″
BASE



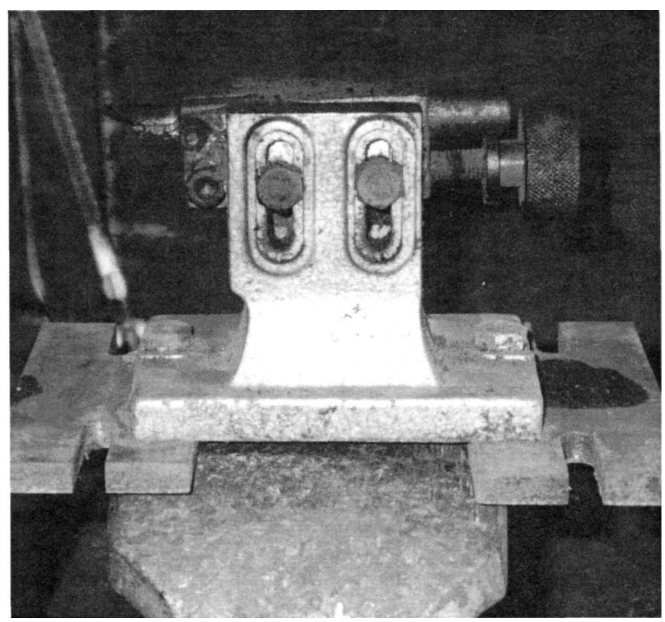
Mounted in place on mill table, with bar mounted in vise, clamps in place to dampen vibration, and tailstock supporting the muzzle end.



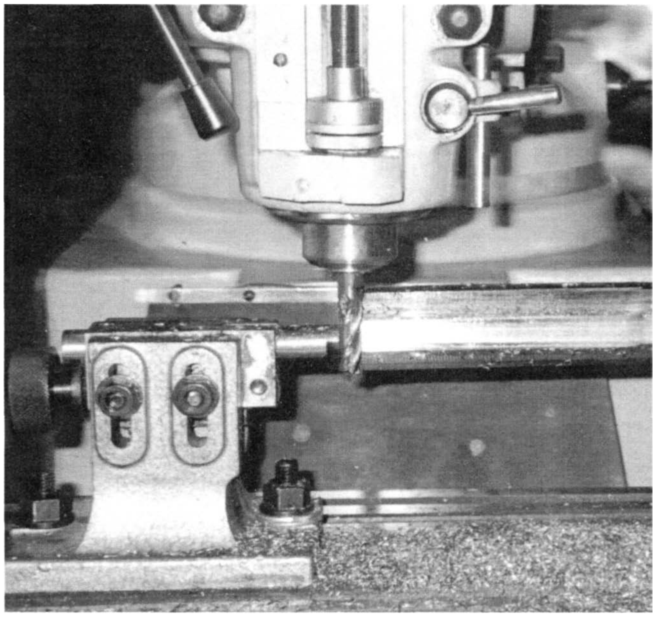
Side view of the barrel support.



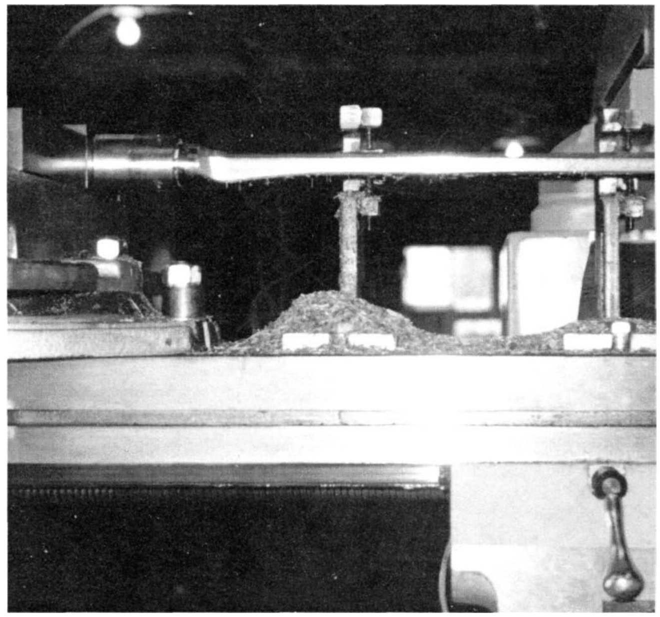
End view of the barrel support.



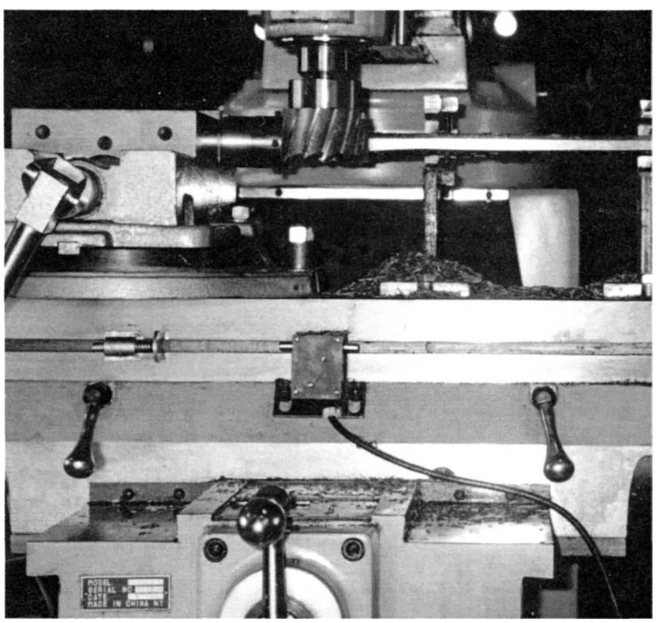
Tailstock (note the false base needed to allow offset, which will establish desired taper).



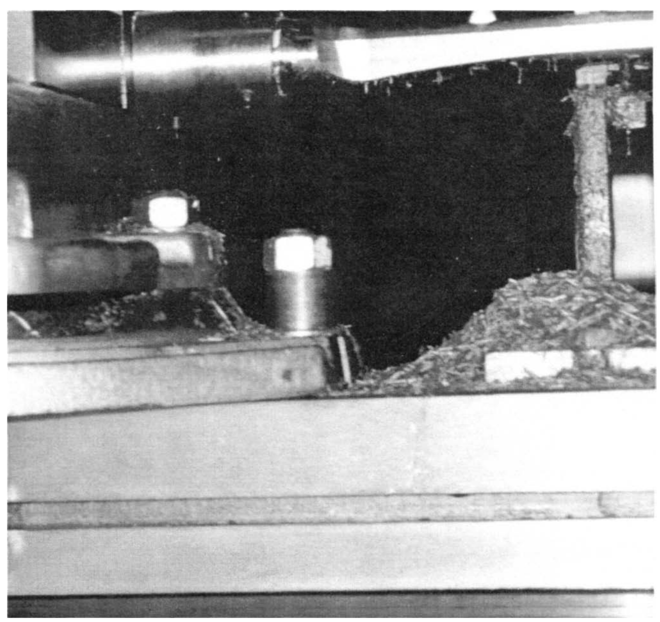
Indexing bar is formed using dividing head and tailstock.



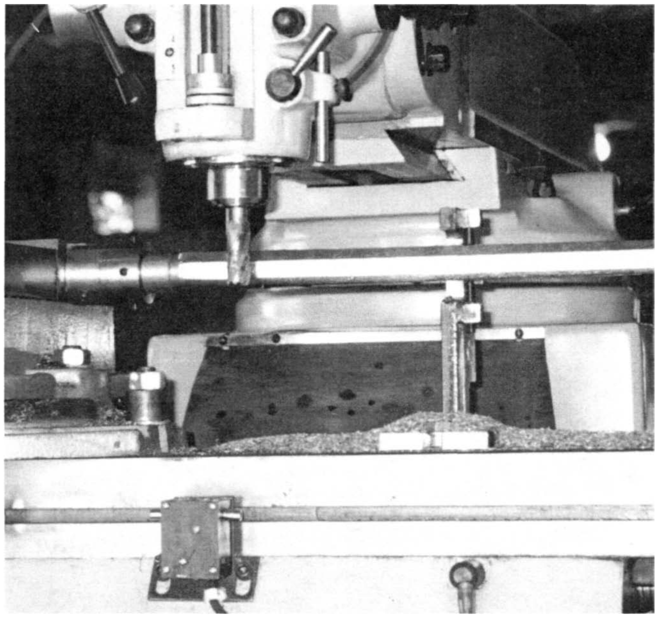
The barrel is attached to an indexing bar, the bar is elamped, and the clamps and tailstock are in place.



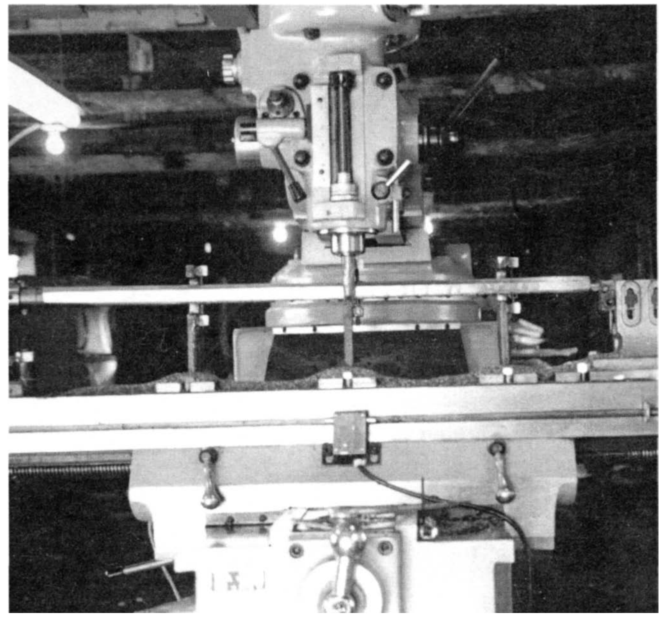
A large-diameter shell mill is used to maehine flats. Turn at the slowest speed possible for longer tool life.



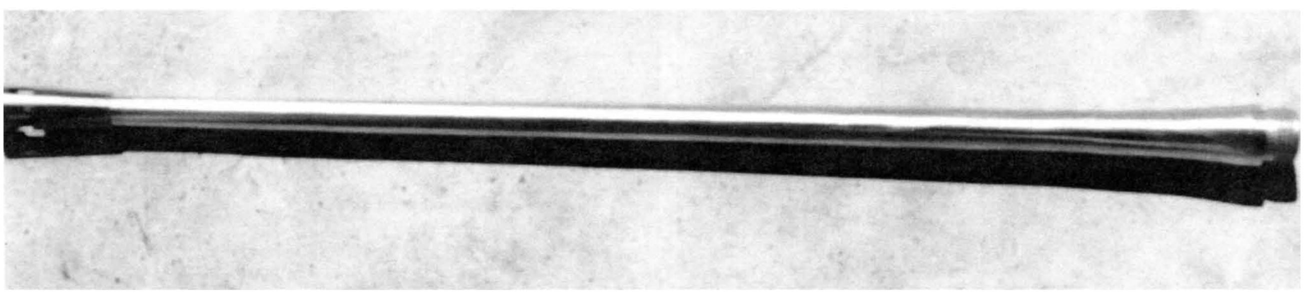
Close-up of the indexing bar clamped in mill vise. The bar must rest squarely against the vise bottom with the front flange against the vise jaw.



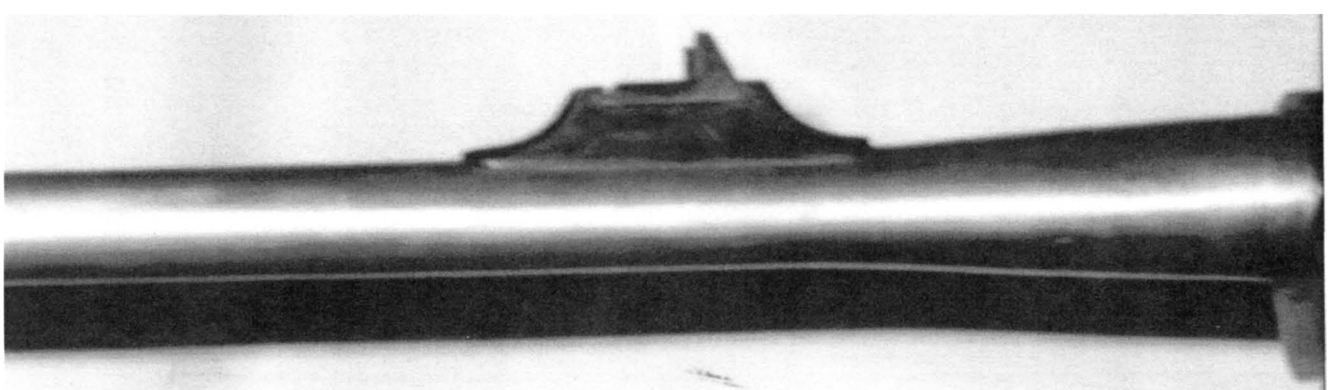
Straight-tapered barrels with a large cross section can be machined using smaller-diameter end mills running at a higher speed. Side cuts, as shown, result in a smoother finish than endmill cuts and also require less polishing.



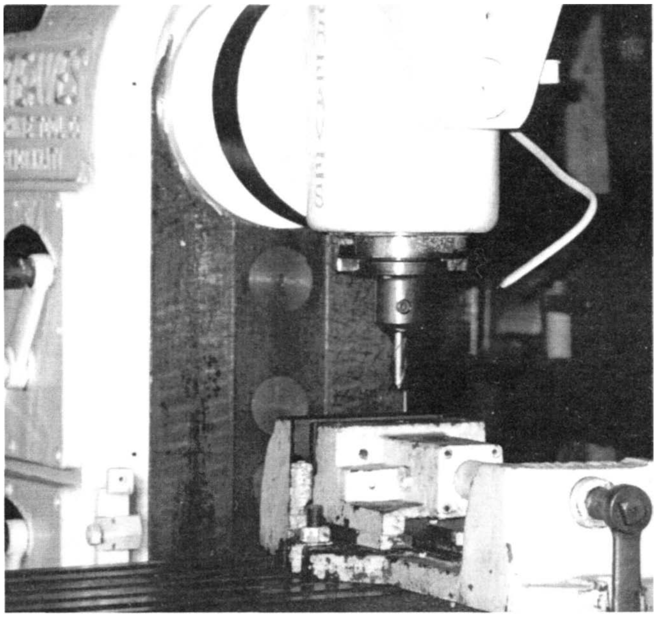
Full-length view of straight-tapered barrel during machining. This one is 30 inches long.



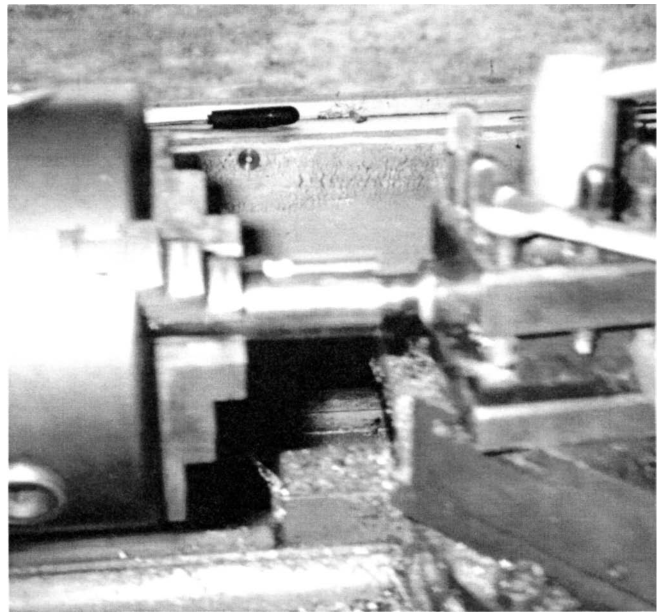
A round featherweight barrel with muzzle brake attached.



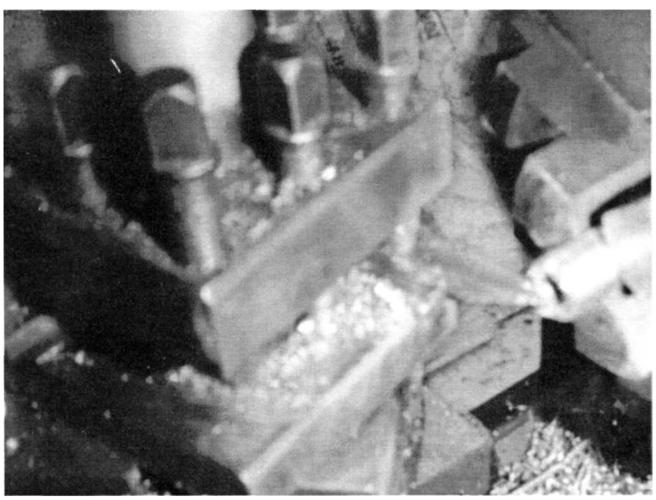
The .250/3000 barrel described in the text with rear sight in place.



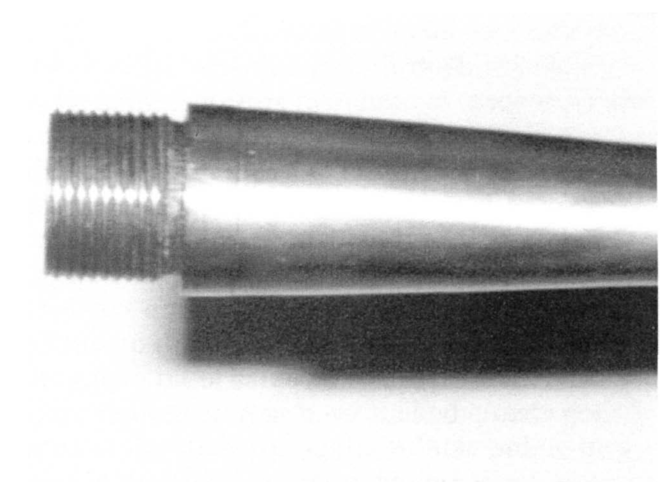
The cost of a new milling machine is prohibitive to many people, but sometimes an older machine in good condition can be found at a fraction of the cost of a new one. This one can do anything the new one can and costs far less.



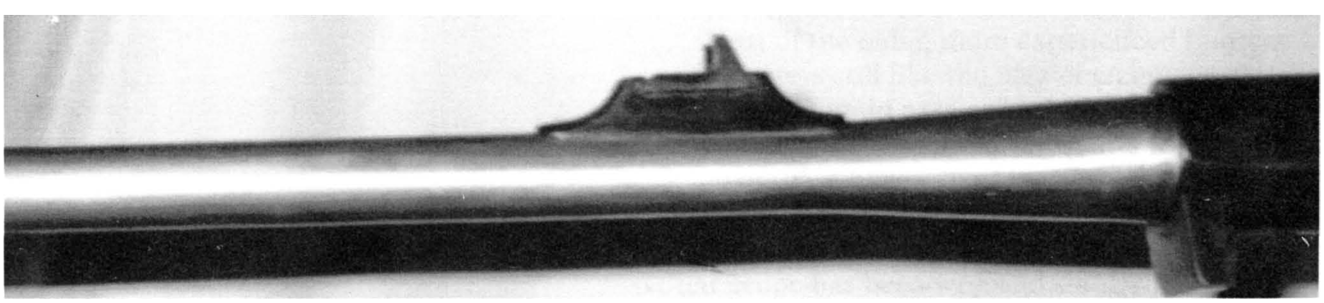
Threading the barrel shank.



Crowning the muzzle.



Barrel shank threaded for prototype rifle.



The same barrel fitted to the action.

CHAPTER TWELVE

Iron Sights and Quarter Ribs

For some reason a number of hunters and shooters will purchase a new rifle and the first thing they do with it is proceed to remove the iron sights. Some of them, if asked, will tell you that the rifle looks better with a "slick barrel." Still others tell us that the iron sights tend to snag on the inside lining of a gun case and on limbs or brush when carried through the woods. Several manufacturers take note of these facts and offer, as an option, rifles without metallic sights. Perhaps the term *metallic* is a misnomer since at least one manufacturer is at present equipping such rifles with plastic sights. These, combined with the cheap plastic stocks, magazine floorplates, and trigger guards also present, lend credence to the term "Mattel toy," which is used with quite a bit of sarcasm to describe such rifles. Certain manufacturers have sucked greedy gun writers into brainwashing the gullible public into believing that such questionable practices are actual improvements, whereas the only "improvement" is in the manufacturers' profits.

Quarter rib with a single standing leaf on a .338 Mauser.

Most of the older, more experienced hunters and shooters still like the idea of an auxiliary sighting system in case something happens to the scope they must depend on with a "slick barrel." Some of these have experienced the thrill of shelling out large sums of money and traveling several miles for a hunting trip, only to discover their scope has been wrecked somewhere along the line. Without auxiliary sights to fall back on, their trip is ruined.

A further advantage to having a front sight in place, even though it may snag when withdrawing it from the gun case, is that if you lean the gun against a tree or wall the sight will likely keep it from slipping and falling over. This alone makes the sight worthwhile, even if you never use it. There are those of us who actually believe that the lines of a custom rifle are improved with the addition of a machined-steel front sight and quarter rib, even though it is a time-consuming process to make and mount them.

It is possible to make a solid front sight ramp that is integral with the barrel. This requires quite a bit of extra work since it is necessary to start with a full-diameter "basic" barrel blank and turn it to the profile desired. A section at the muzzle end is left unturned, or it can be turned to the side profile desired for the sight ramp. With the barrel in place on the action, a top centerline is established and marked, and all the surplus material on each side of the top strip, which will form the ramp, is milled away. The barrel is mounted on the milling table with the breech end held in an indexing fixture or a dividing head. The muzzle end is held by the tailstock center. It is rotated, a little at a time, and repeated cuts are made until the barrel taper is formed forward to the muzzle. Several little flats will be left around the circumference after the milling cuts are made, which requires a good bit of careful filing to make it match the round contour of the rest of the barrel.

A dovetail slot must be cut, either crosswise to accept the readily available dovetailed sight blades or lengthwise to accept the type that push in from the front. If you arc not familiar with cutting dovetails, a bit of advice is offered: the cutter used should be slightly undersize, as sold by gunsmith suppliers. This requires two passes with the mill but allows a tight fit if the sight dovetail is undersized. A primary cut should be made to the bottom of the finished cut with a straight end mill, which will remove the bulk of the material. The dovetail cutter is then used to finish the slot. Take particular care to make sure that everything (i.e., milling machine quill, cutter, and mill vise) are tight and secure before this cut is made. Dovetail cutters have a tendency to eat deeper into the bottom of the slot if not completely secure. I have seen autoloading pistol slides ruined because of this.

Another, considerably easier, method is to make up a separate sight ramp that can be silver-soldered to the barrel. This will be cut from 3/8- (.3750-) inch material with the profile formed to the desired shape. The bottom side must have a concave, or radiused, cut to match the barrel diameter. This is formed using a ball cutter of appropriate radius or diameter. These ball mills, especially when they become slightly dull, tend to leave a small raised strip down the center of the cut. This can be removed with a light pass with a 1/8-inch-diameter end mill or a round file.

The ramp, with finished side profile, can now be clamped on the exact top center of the barrel and silver-soldered in place. A neater, better-looking job results if a cut is made down each side of the ramp using the side of the ball cutter. This reduce the top width to .250-inch while forming a radiused flare with a slight ledge around the bottom. A sturdy sight blade can be formed by reducing the top width to .100-inch to a depth of .250 inch. This is done instead of cutting the dovetail and installing a sight blade as described above.

Still another type that appeals to many is the band ramp. This one uses the same approximate size and shape as the others but has a band at the front that encircles the barrel and adds "a touch of class," as some put it, to the rifle. The very best, and most time-consuming, method of doing this is to drill and ream a hole just slightly smaller than the barrel diameter down the length of a chunk of mild steel of sufficient depth and width to accept it and have enough material on the top side to form the ramp. The sides are milled off, leaving a narrow strip along the center to form the ramp. Material surrounding the hole is cut away, leaving a band .750 inch long at the forward end. The outside of the band must be cut to a constant thickness surrounding the barrel hole, either by mounting it on a mandrel and rotating it to repeated short cuts in the milling machine or shaping it with a grinder and disc sander. Either method requires some file work to finish.

Another slightly less complicated method consists of making a ramp as first described. It is clamped vertically in the mill vise. Using a 9/16-inch end mill, the bottom, or concave, side is cut deeper by .065 inch and lengthwise by .750 inch, ending in a square shoulder, at the forward end of the ramp. If round tubing is available in 9/16- (.6875-) inch outside diameter and .065-inch wall thickness, you need a piece .750 inch long, which is placed on a close-fitting arbor and the ramp clamped to it. It is welded down the sides and around the front. When the welds are dressed flush and smooth, it should closely resemble the one-piece solid one.

The internal diameter of the band must be varied to suit the barrel diameter. The band thickness should be a constant .065 inch in thickness. The internal diameter must be a tight fit on the barrel. It can be enlarged slightly by driving it back on a slightly tapered mandrel. Peening the band with a smooth-faced hammer expands it somewhat.

A dovetail is cut crosswise in either of these, and a hole drilled and tapped for a 1/8-inch set screw down through the center of the dovetail. This screw will lock the ramp in place.

The upper surfaces of these ramps can be matted, checkered, or grooved with close parallel lines by using metal checkering files.

Barrel band sling swivels can be made using either of these same methods.

A base to accept varying sizes of open sights is made from 11-inch-wide by 3/8-inch-thick flat stock, with its length some 3/4-inch longer than the sight to be used. The bottom side is machined to closely fit the barrel using an appropriate ball cutter. The ends are rounded slightly for appearance's sake, and the dovetail is cut to the width of whatever sight you choose. It is clamped in the desired position atop the barrel and silver-soldered in place.

A well-made, close-fitting quarter rib is the epitome of rear sight bases. If poorly executed or fitted they look like the junk they are and degrade the rest of the gun. It is better to leave it off altogether if this is the ease. A design that looks as if it belongs on the rifle butts up against the front edge of the receiver and comes up just above the top of the forward 6 inches, or more, in a flat-level plane on top, which is parallel to the bore. The bottom side fits the contour of the barrel closely for its entire length.

Ideal for use here is 1/2-inch square key stock. A template to match the contour of the barrel is cut from stiff cardboard and trimmed until it matches the barrel profile closely. This profile is marked on one side of the key stock and machined flat to this contour. Ball cutters in varying diameters are used to machine the concave surface required for a close fit to the barrel. The rear end, which mates with the cylindrical rear portion of the barrel, can be cut fairly close with a 1 1/8-inch cutter. The curved taper part can be cut with one of 7/8-inch diameter, and the straight tapered portion can be cut with a 3/4-inch cutter. The rib must be repositioned in the vise several times to make the cuts parallel to the outer edges. When the entire length is cut out to match the barrel diameter fairly close, it should be cheeked for fit and high spots removed until it lies flush on the barrel. Spotting compound applied to the barrel will reveal such high spots when the rib is put in place and slight pressure is applied using G clamps.

When satisfied that the fit won't get any better, the front end is shaped to the contour shown or whatever else suits you. A hole is drilled an inch from the rear end and another 2 inches back from the front, using a number 28 drill. These should be on the centerline of the ramp. It is clamped in position, and the holes drilled into the barrel just enough to mark their location. The holes are drilled some .200 inch deeper with a number 31 drill, and tapped for 6 x 48 screws. Take care not to drill into the bore. A company with a reputation for building high-quality rifles sent one to a gun magazine several years ago for testing and evaluation. After a few shots were fired the rib flew off, and it was revealed that the hole for the single screw holding the quarter rib in place was drilled through into the bore. Of course, the magazine reported the incident, complete with pictures, which didn't help the company's reputation any.

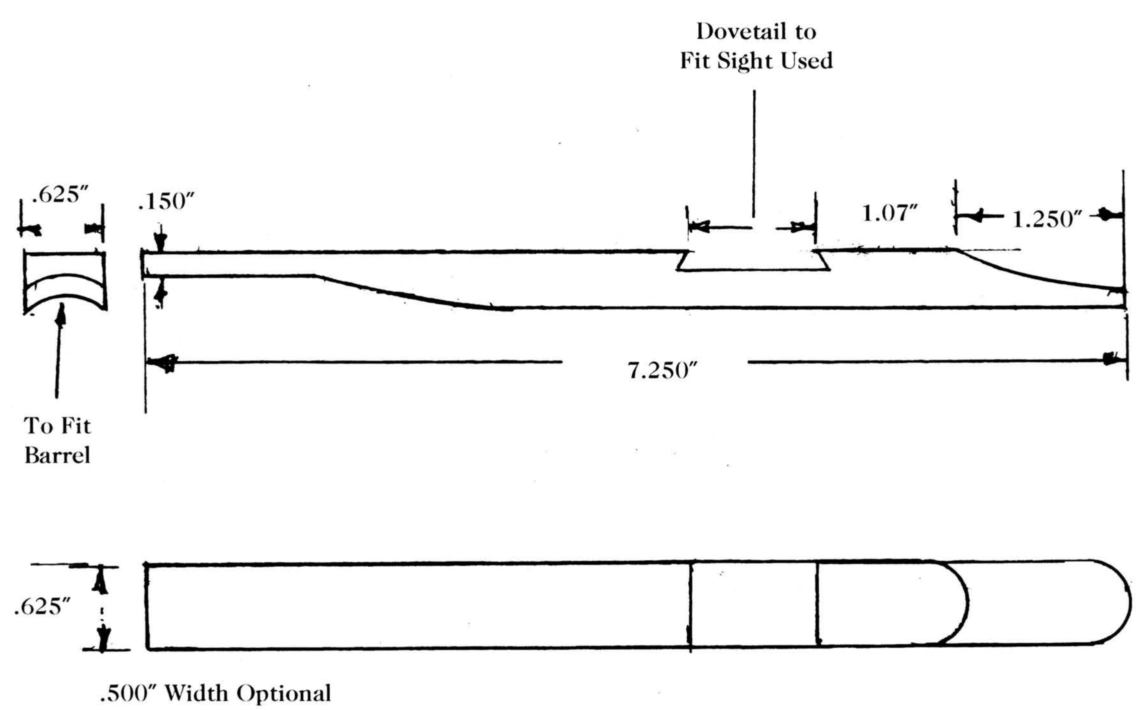
The top side of the quarter rib is now machined to the desired height, and the dovetail is cut. The two screw holes must be counterbored for the fillister-head screws. The front screw hole should be counterbored deep enough for the screw head to go slightly deeper than the surface. It is underneath the rear sight and doesn't show. But the rear screw head should protrude enough above the surface to allow the screwdriver slot to be removed.

The bottom side of the rib and the corresponding surface of the barrel are tinned with a lead-free solder, such as Force 44, that has a fairly high tensile strength and is not affected by caustic bluing. When cool, the rib is put in place on the barrel, and the screws are run up snug. Heat is again applied until the solder melts, at which point the screws are tightened as much as possible, drawing both surfaces together.

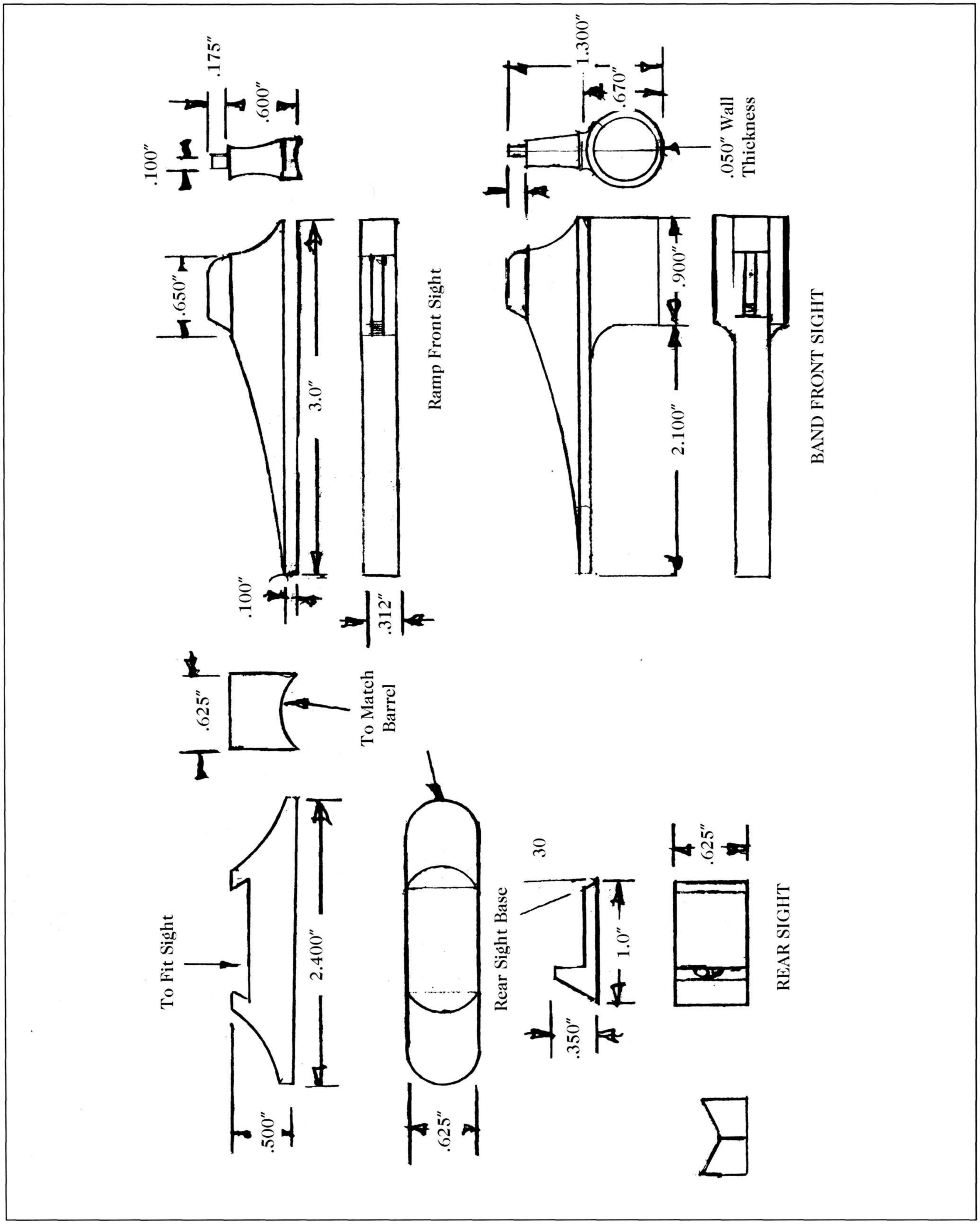
There should be no visible crack, or open seam, along the joint when the solder that flowed out of the heated joint is cleaned up. If there is, you have three choices: live with it, remove the rib and forget it, or do it over.

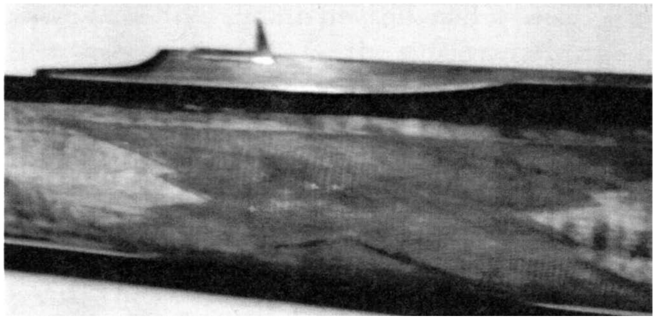
If it does suit you, the rear screw head is peened slightly to expand the head enough to completely fill the counterbore, and the screw head is dressed flat with the surface. Properly done, the screw head should be invisible when matted or checkered over. With two screws and the sweated joint, this should result in a strong installation that will remain in place.

Needless to say I'm sure, the flat sides of these parts should be draw-filed and polished by hand to keep the sides flat and the corners sharp. The top surfaces should be dulled to prevent light reflection by matting or checkering.



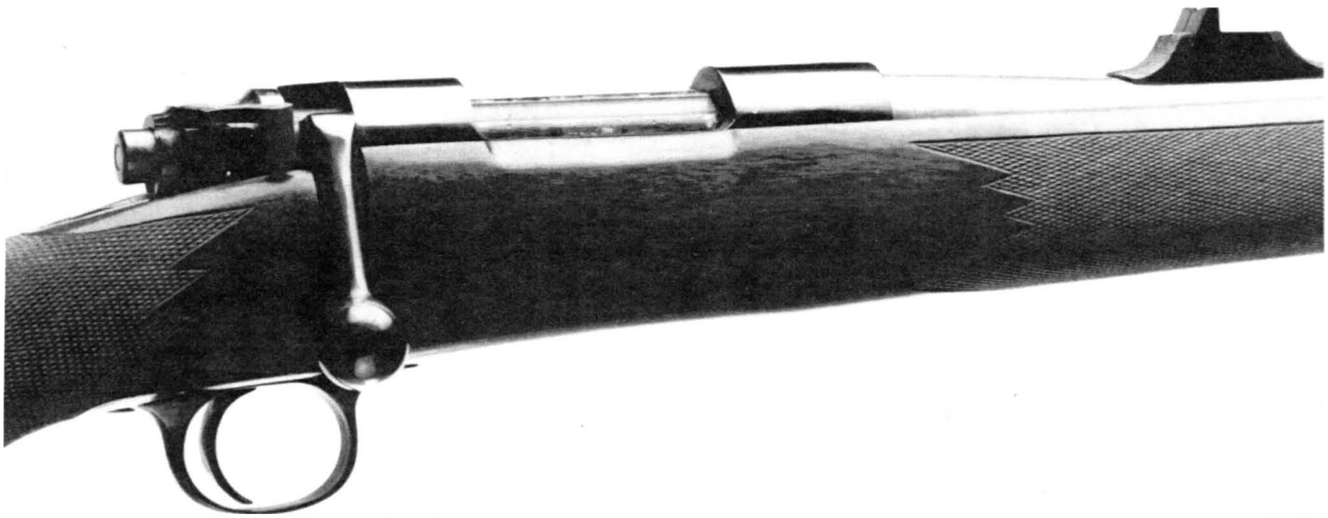
QUARTER RIB


.100″
.175″
.600″
.650″
3.0″
.100″
.312″
Ramp Front Sight
1.300″
.670″
.050″ Wall
Thickness
.900″
2.100″
BAND FRONT SIGHT
.625″
To Match
Barrel
To Fit Sight
2.400″
.500″
.625″
Rear Sight Base
30
1.0″
.350″
.625″
REAR SIGHT

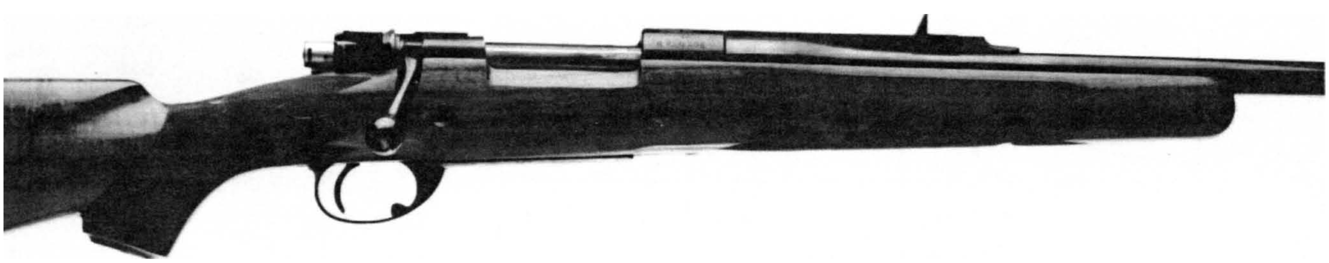


Quarter rib on .416 Rigby. This one is both serewed and soldered in place, so it will not come off as a result of recoil.

Quarter rib on prototype rifle.



Rear sight mounted in the ramp on the other prototype rifle.



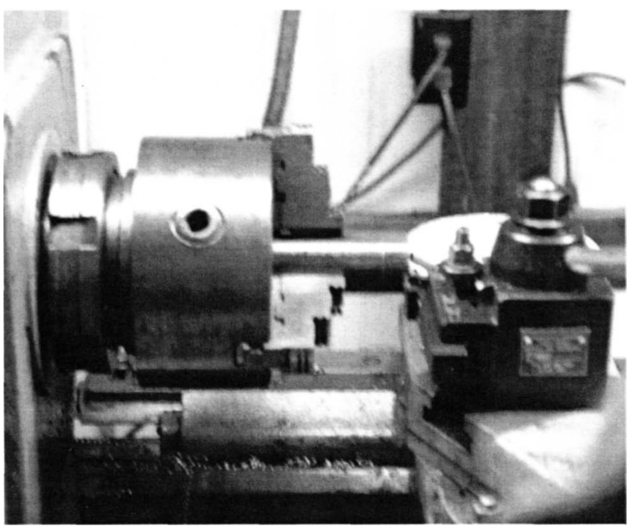
This quarter rib is not for everyone. Found on most high-grade British rifles, it adds class to most custom rifles.

The prototype rifle shown with ramp front sight and matching open rear sight contained in ramp.

CHAPTER THIRTEEN

Muzzle Brakes

I first became acquainted with muzzle brakes just after World War II. Even though they were touted as a new discovery at the time, I later found that some had been around for years, even then. As I remember, one of the first I ever saw was called a "Pendleton De Kicker." There were also a "Rex" and a "Saturn." And George Leonard Herter sold one that, according to his advertising, would do everything except answer back when you talked to it. I don't remember the exact date or even the year, but I do know that just shortly after the DGM began delivery of 03A3 rifles to members of the National Rifle Association for the sum of $14.50 I started building muzzle brakes.



The brake body is turned to size.

As with most items made or marketed by more than one person, muzzle brakes are referred to by more than one name. Some refer to them as a *muzzle break,* as opposed to *muzzle brake.* Since a brake is intended to stop or slow something down, and break means to tear apart or wreck something, it would seem apparent that the term *muzzle brake* should be favored. We certainly hope nothing "brakes" in the process.

For almost two years I made my living mostly by remodeling these 03A3 "Springfields," as they were still called. The .308 Norma Magnum cartridge came along about this time, followed shortly thereafter by the .300 Winchester Magnum. At least two-thirds of the rifles I worked on were rechambered to one of these calibers. In the process I drilled and tapped the rifles for scope mounting, made and installed new bolt handles, installed new safeties to clear a scope, added a muzzle brake, and polished and blued the finished product. Restocking was left to others because I didn't have time to do it.

But later when the supply of these rifles dwindled away, so did the demand for muzzle brakes. They were largely forgotten, and I went on to other things.

Then, like a bad penny, a few years ago muzzle brakes were back, rediscovered as something new and wonderful. Gunsmiths from all over the country suddenly discovered or invented their own versions, and muzzle brakes were in demand once more.

There is one big difference in the market though. Back in earlier times muzzle brakes were usually installed only on rifles with heavy recoil. Today such are even seen on .22 rimfire rifles. I have heard of instances where they were installed on air rifles—and even on paint guns. Personally, I don't see any purpose for one except for the Magnum calibers with uncomfortable recoil: .50 BMG rifles; combat-, or riot, type shotguns; and large calibers shooting heavy bullets.

My own design is no better than some, probably no worse than others. It differs from some in that it incorporates an enlarged expansion chamber with a flat wall at the forward end for the gasses to push against. The gas exit holes are drilled at right angles to the bore and in parallel rows spaced equal distances around the body of the brake.

Some makers do not understand that the 1/2-inch-diametcr, or larger, expansion chamber, which ends in a flat surface with an exit hole just larger than the bullet diameter, has anything to do with recoil reduction. Bore the inside diameter just larger than the bullet for the entire length of the brake. Then drill intersecting gas ports that angle slightly forward, which supposedly deflects the loud muzzle blast away from the shooter and adds to the push against the shooter's shoulder.

Brake construction is begun by cutting a short section of quality round stock to the length desired and boring a hole slightly smaller than the bullet diameter through it lengthwise. This hole is enlarged to the desired diameter to a short distance behind the forward end, ending with a square shoulder at the end. A 1/2-inch end mill chucked in the lathe tailstock is ideal for this.

The inside is bored at the extreme rear to a diameter that is compatible with the barrel and threaded with a pitch of 24 or 28 tpi. The outer end should be bored smooth to the bottom of the threads for a distance of 1/4 inch. This will mate with a close-fitting shoulder just behind the barrel thread and assist in keeping it in line and parallel to the bore.

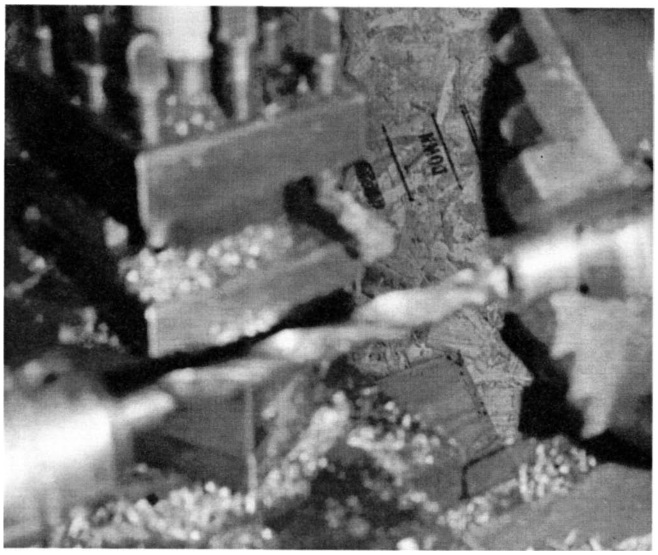
The barrel is mounted in the lathe if it will fit through the headstock spindle and the bore can be centered fine. Otherwise it must be removed from the action and placed between centers. The muzzle end is turned to the correct diameter and threaded to accept the brake. Note the smooth shoulder just at the rear of the thread, which mates with the brake interior. A close fit is important here.

With the brake threaded in place as tight as possible, the outside is turned to the desired diameter, and the muzzle end is finished to the contour wanted. The exit hole for the bullet should be bored to just slightly above (.005 to .010 inch) the bullet diameter and polished smooth.

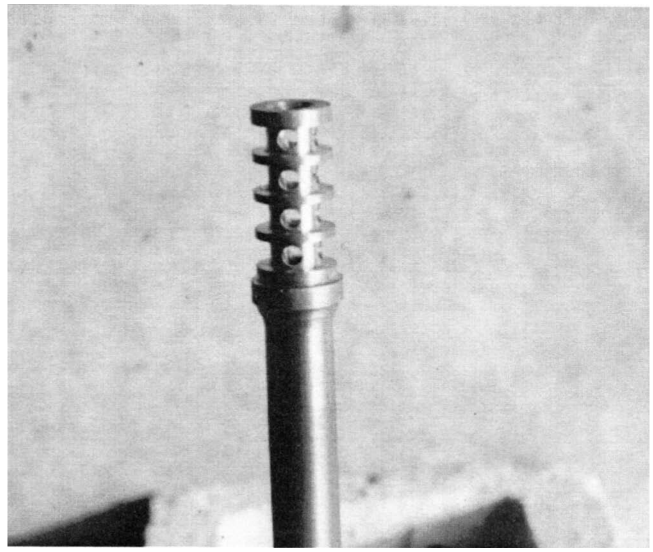
Beginning just forward of the threaded joint a series of holes are drilled in six straight rows, spaced at equal distances around the circumference of the barrel. Each line should consist of at least four holes of .187 to .250 inch in diameter. If possible, these should be drilled using the milling machine. This will assist in keeping them on center and equally spaced.

Test-firing should show a notable reduction in recoil.

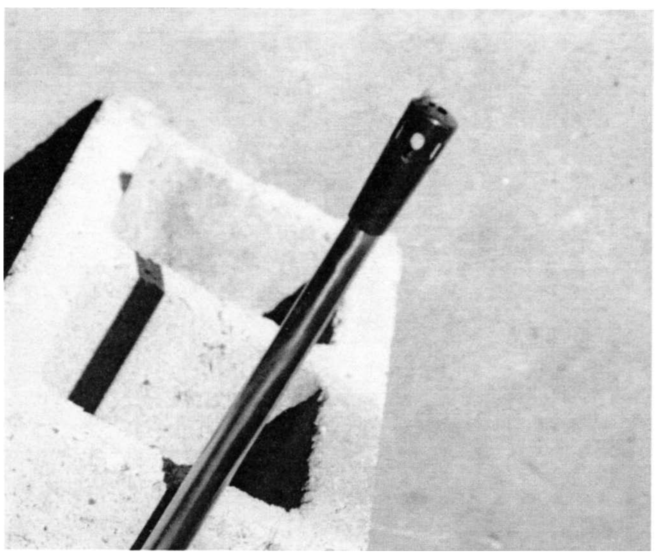
Some makers think that the exterior of the brake should be a continuation of the barrel diameter. Others, including me, opt for a diameter slightly larger than the barrel at the thread joint with a rounded corner at the edge. It is a matter of taste. When finished, the brake should be colored to match the barrel and action.



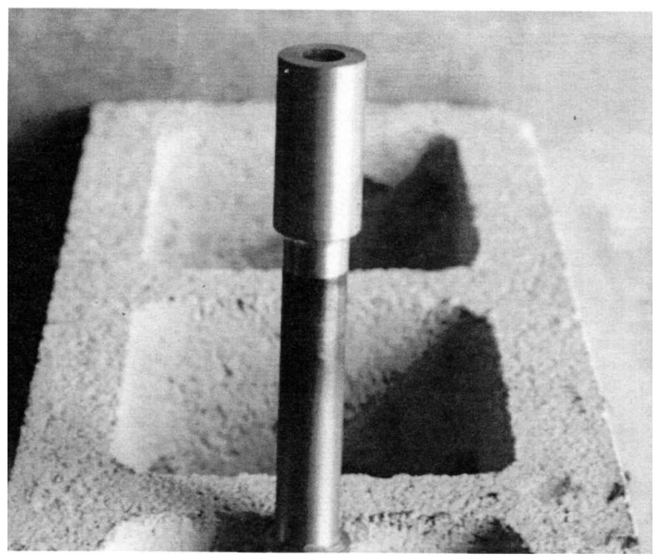
The inside is bored to size, reamed, and threaded.



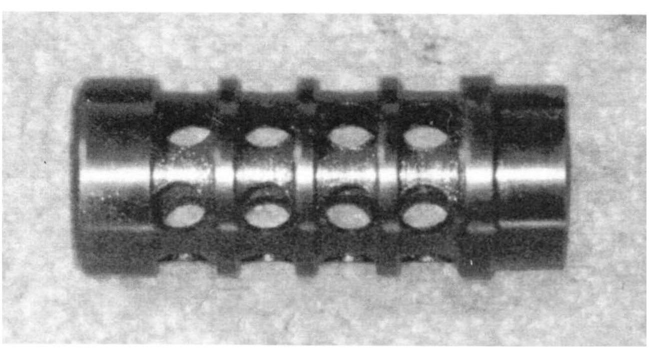
A muzzle brake used on sniper rifle is efficient and quiet.



This experimental brake was installed on a featherweight .30/06. It is quieter than most and very efficient.



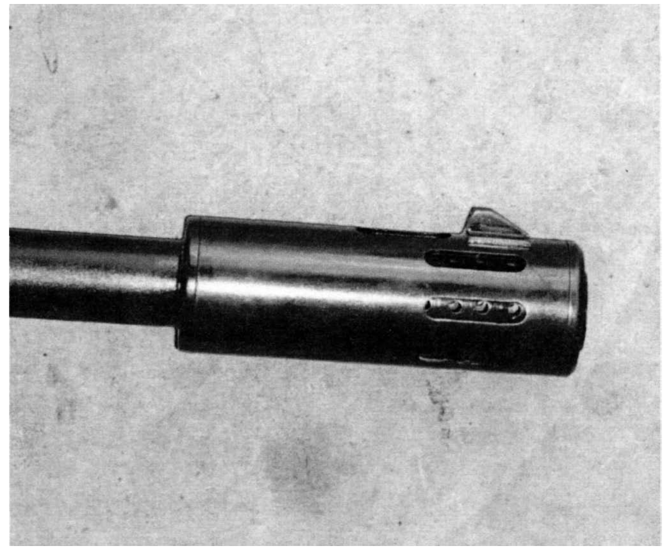
The muzzle brake installed and ready for porting.



Finished muzzle brake as used on a .416 Rigby.

Muzzle brake installed on a .338.

This .50 Browning Machine Gun muzzle brake was efficient—but very loud.



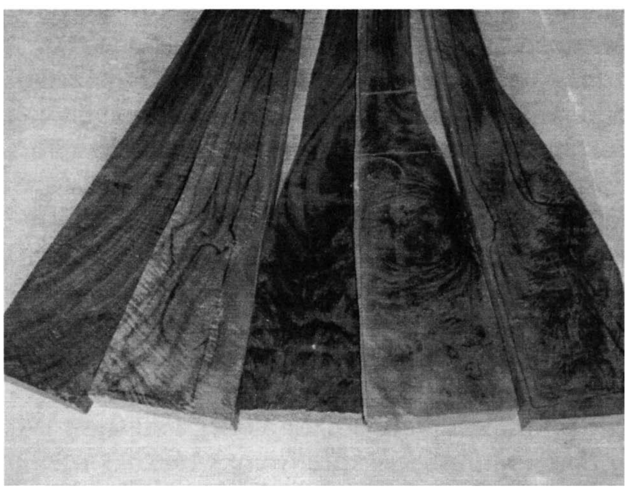
Using a muzzle brake on this 12-gauge shotgun did not increase the noise level.

This .870 Remington 12-gauge with brake installed is no louder than before, and the lack of recoil makes it pleasant to shoot.

CHAPTER FOURTEEN

Stocks

Now that the metal work is finished and the parts ready for final polishing before bluing, it is time to make the stock. To far too many "stockmakers" making the stock consists of fitting a semifinished blank to the metal parts, finish sanding the exterior, and giving it a finish. In this case, since you have built all the metal parts to an original design for which no semifinished stock exists, you must actually "make" the stock, starting with a rough sawn to profile blank and progressing from there.



Fancy-figured wood of good quality will add to the value of the finished rifle, if the work is well executed.

When I first started making stocks World War II had just begun. No semifinished stocks were available for the duration of the war, so said E.G. Bishop and Stoeger Arms Company, both principal suppliers of such items before the war. In fact, it wasn't easy to even find a walnut plank or the like suitable for making a stock. I found a supply though and made stocks from the block all through the war and beyond. By the time the semifinished jobs were available again, I was so set in the way of making stocks completely that I simply kept on. Very few stocks that I ever had anything to do with came from the semifinished blanks. Now, though, there are several sources of the semifinished ones available that will make up into a finished stock, which will equal many block-stocking efforts. However, you must stick fairly close to the producer's design because little extra wood is left for redesigning.

Whatever the drawbacks of either method, in this case the stock is going to require complete inletting and shaping from the block, which is appropriately called *block stocking.*

For those with little or no experience in stock making there is an alternative. The inletting can be roughed out slightly oversize in a cheap piece of wood and the barrel and action glass bedded into it. The outside is then shaped to the best of your ability and finish-sanded. This will be used as a pattern that can be sent to one of several companies that machine such blanks to order. Included should be the best piece of wood you can afford. The company will return to you a semifinished blank that will require little work to complete the stock. In fact, a large percentage of the custom stock makers working today use this same method, strictly as a labor-saving device.

Whatever method you choose, if you feel capable of finishing the stock as it should be, use the best piece of wood available and affordable. Too much labor is expended in making the stock to be wasted on a cheap, plain piece of wood.

Several kinds of wood are suitable for gun stocks, including maple, myrtle cherry, mesquite, and several types of walnut. Walnut comes in American (black), claro, and several different names for the wood from the thin-shelled trees that grow mostly in California. English, French, Bastogne, and Circassian are some of the names applied to these blanks, even though it not unknown for more than one type to be cut from the same tree. Of all the kinds available, I prefer the thin-shelled walnut—regardless of the name attached. This wood is usually harder and denser than the other types, and holds finer checkering and requires less finish than the softer woods. Assuming your stock blank includes enough wood to allow some leeway in positioning the stock in relation to the grain, the stock should be laid out so that the grain through the grip runs parallel to the action upper tang, and follows an angle that allows the grain through the buttstock to run parallel to the lower line of the buttstock all the way to the action mortise. No cross-grain or any grain that slopes out in the grip area should be allowed. If present, it is quite likely to break. Likewise, no burl figure should be present in this area.

It is desirable that the grain in the fore-end run slightly uphill because the fore-end will have little or no tendency to warp away from the barrel. If the wood is properly dried, it will have less tendency to warp than a wet one, but, even so, it may warp some. Except for burl walnut, which can warp in several directions at the same time, it should be a fairly simple matter to determine the direction the stock should most likely take in its warping process, since the wood will almost always warp toward the bark.

Burl walnut, with its tendency to check and erratic warpage patterns, should be confined to the buttstock with the grain at the toe of the stock running parallel to the bottom stock line as closely as possible. This is desirable to prevent the toe of the stock from cracking or breaking off, as may happen if the grain slopes downward toward the front at this point.

It is helpful to draw and cut out a full-sized cardboard pattern of the stock profile that is pleasing to you. The most attractive stock will have the bottom line of the fore-end run in a straight line from the fore-end tip back to the rear end of the magazine, where it will begin a parabolic curve that increases toward the bottom of the curve, running from the end of the trigger guard to the forward edge of the grip. The grip cap should sit at slightly more than a right angle (approximately 100 degrees), and the front edge should measure from 3 1/4 to 3 1/2 inches from the center of the trigger to the front edge of the grip cap.

The top and bottom lines of the buttstock should be straight with a nearly level comb line running forward from the buttplate to the comb nose, which should drop in a fairly sharp curve to form the point of the comb. The stock will usually look best if the center of the grip is in a direct vertical line to the point of the comb. The bottom line of the buttstock should extend in a straight line from the lower edge, or toe, of the buttplate to just above the rear edge of the grip cap. If projected forward this line should intersect the bottom side of the stock just at the rear of the grip.

One side of the blank should be dressed flat, as well as the top line of the stock. 1 usually do this with a large-diameter shell mill mounted in the milling machine. It is a simple matter to obtain absolutely flat and square surfaces using this method. It is also a common practice to saw the stock to profile using a band saw. However, straighter lines are probable if a skill-type power saw is used. The grip and comb curves can't be cut using such a saw but are easily formed using the milling machine, a power sanding drum, or even a wood rasp. For the inexperienced gunsmith, it is a good idea to leave an extra quarter inch of wood on the bottom of the fore-end back to the grip. This will provide extra wood so that if mistakes or slips are made in the barrel and receiver inletting, the top can be dressed off and the inletting deepened and refitted to (one hopes) allow any slips or oversized cuts to be obliterated.

A centerline should be scribed along both the top and bottom of the stock parallel to the flat side of the blank. All inletting and shaping cuts will be laid out centered on these lines.

Actual inletting is begun by laying out the outline of the magazine box on the bottom of the stock. Most of the wood to be removed can be cut out with a small end mill in the milling maehine or by drilling intersecting holes around the perimeter of the outline drawn on the stock. The cavity thus formed is finished by removing just enough material (using files, rasps, and chisels) to allow the box to slip in place. The front and rear of the opening should fit snug against the box, especially on calibers with heavy recoil, but the sides should have just a small amount of clearance. If such clearance is not provided and the stock wood shrinks, the stock may very well split.

With the magazine bottoming on the upper side of the front tang and trigger guard, the outline of these are scribed or drawn around. Wood is removed to allow the entire assembly to fit into the stock. The action screw holes are drilled through the tang holes. Note that, at this point, the magazine assembly still is not in deeply enough by about 1/4 inch. After the barrel and receiver and barrel are inlet satisfactorily, it will be let in to the proper depth.

You are now ready to inlet the barrel and receiver. Before beginning, however, you should make up a pair of guide pins. These will screw into the action screw holes and serve to keep the assembly in a straight line as it is inletted down into the wood. These are simply a couple of steel rods some 3 inches long and 1/4 inch in diameter, threaded on one end with 28 tpi. The easiest way to obtain these is to buy a couple of bolts of this size and saw the heads off.

With the magazine assembly in place and the guide screws installed, the assembly is pushed in place on top of the stock. The recoil lug can be located and marked simply by scribing around it. With the metal removed, it is a simple matter to cut the mortise to depth in the milling machine and squaring the ends with a small chisel. It must fit closely. This cut will allow the receiver to almost hit the wood, as well as allowing undersized cutting of both the barrel and action to be marked on the stock. Wood inside these lines is most easily and quickly removed using a ball cutter in the milling machine. Of course, it can be done with chisels, but this is much slower. The assembly is again put in place and now should go considerably deeper into the wood. The outline is again marked and wood removed just to the inside perimeter of the outline. It will require a bit of chisel work to cut the square corners at the front of the receiver.

This process is repeated until the assembly fits in place almost to half depth. The inletting can be cut to full depth using various sizes of milling cutters, but the sides should be finished using sharp chisels and perhaps a barrel rasp.

All surfaces that contact the wood should be coated with some sort of spotting compound (lipstick works well for this) and the assembly pressed into the stock. High spots, which prevent the assembly from going in to full depth, are indicated by marks from the spotting compound. Shave off all the colored spots, spread the lipstick over the surface, and install it again. Continue to shave, spot, and shave until the assembly makes eontaet with the bottom of the inletting. The assembly should now fit closely into the wood without any unsightly gaps or chipped places.

It is a good idea to induce a little bit of upward pressure from the fore-end front end against the barrel. This is done by relieving the barrel channel from a point just forward of the receiver to within an inch of the fore-end tip. The top edge of the barrel channel should be left alone for appearance's sake. It is possible to obtain the same result by gluing a short, thin strip of wood in place just behind the fore-end tip. Either method will result in a single-point bearing of the forearm against the barrel, which should dampen vibration and sometimes increase accuracy.

A slot to accommodate the trigger must be cut, as well as clearance for the bolt stop and ejector. It is a simple matter to measure the location of these relative to the action and transfer them to the stock.

The guide screws are removed from the action, and the proper action screws are installed. With the screws tight the receiver and magazine should almost, but not quite, touch. A gap of approximately .050 inch should remain.

In the event that your inletting job has gaps, gashes, or cracks that make it look shoddy, black dye can be added to glass bedding material and be used to fill the gaps or, preferably, bed the entire barrel/action assembly since it is likely that if flaws exist on the surface they are also present underneath. The result won't be noticeable and is a means of camouflaging flaws. The black-dyed material should only be used where it contacts metal.

The bottom line of the forearm back through the magazine should be cut in a straight line to the rear of the magazine, preferably machined off with the milling machine. The grip cap and buttplate are secured in place. These can be of any material you choose. I am somewhat conservative and favor the Neidner-type steel grip caps and buttplates over those made of plastic or other materials. I detest colored spacers between them. However, this is your project, so use whatever suits you.

The actual shaping can now begin. Quite a bit of the surplus wood can be removed with the milling machine. The fore-end should have straight sides, at both top and bottom and on the sides. The thickest part will be some 1/2 inch forward of the rear end of the magazine and taper forward to the fore-end tip.

It should be slightly pear-shaped in cross section and almost flat on the bottom. An almost flat scalloped cut at both ends of the magazine and on both sides will cause the stock to appear slimmer without sacrificing strength.

The grip should be just slightly wider at the grip cap than at the small of the grip, with straight sides blending into the stock lines. Much has been written about the advantages of a "Wundhammer swell," where a slight swell, or bulge, is left on the palm side of the grip. This was named after its originator, a stock and furniture maker named Louis Wundhammer, and touted early on by writers who mostly never saw one. I have never found any advantage to this swell.

If a cheekpiece is used, it should be no wider at the top than the comb thickness. The bottom rear edge should be of ample thickness to actually support the cheek and taper forward to blend into the grip. It should also be nearly flat. A dished, or concave, cheekpiece may feel comfortable, but when the gun is fired and this form-fitting cheekpiece recoils back into the shooter's face, it loses its comfort. The cheekpiece needs to be no bigger than the area that contacts the cheek. The little flat line cut around the outside perimeter and called by several names (e.g., sculptured, ghosted) can be started with a single-line checkering tool and finished to depth with the stoned smooth corner of a flat file.

With the stock shaped to suit you, sanding is now in order. Ordinary sandpaper is a waste of time and money. Garnet paper of preferably 50 grit is used first, followed by progressively finer grits until you reach 150 grit. From then on the black paper known as "wet or dry" should be used, finishing with a final sanding with 400 grit.

Do not try to simply wrap the sandpaper around your fingers. Use flat and curved blocks with the paper wrapped around them. Sharp edges such as the cheekpiece perimeter should be kept sharp and flat. All sanding must be done with the grain; sanding across the grain results in scratches, which are hard to remove.

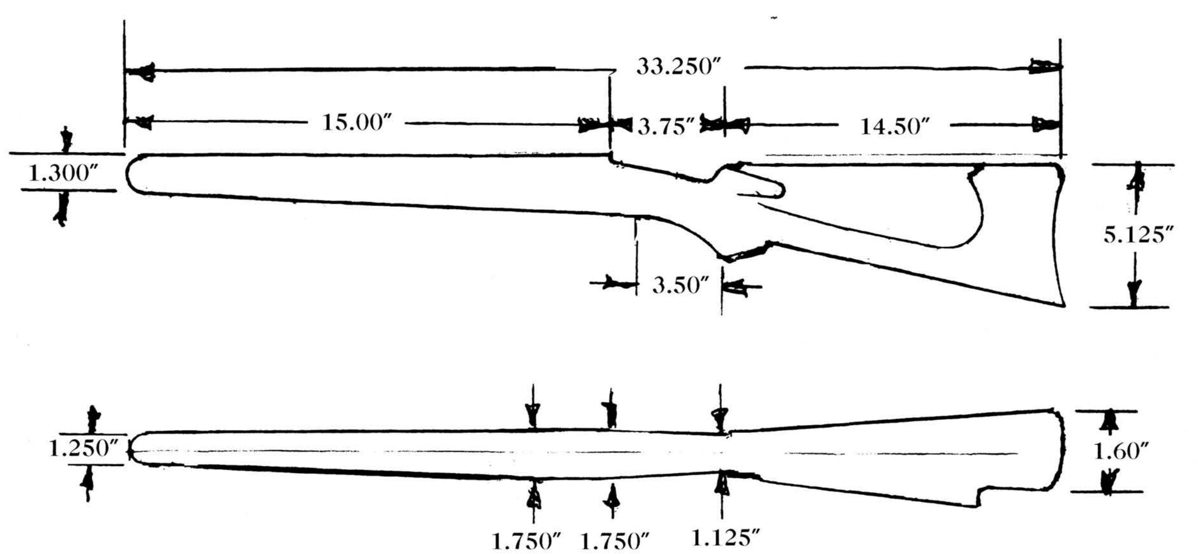
When you decide the wood is as smooth as you can get it, it should be dampened all over with water and dried over a hot surface. This will raise the grain, causing the stock to look like it has grown whiskers. Then, using the 400-grit paper, sand the wood smooth again. This process is repeated until the surface remains smooth after drying. If this is not done, these same whiskers may show up again after the finish is applied.

A number of stock finishes are available, any of which are satisfactory. One called Tru-Oil is available more or less universally and will do a beautiful job if applied properly.

It has been said that three coats are sufficient. Actually the first three coats should be applied and then sanded back to the wood. This will only partially fill the pores, and the process must be repeated until the grain is filled, leaving the surface smooth and level. Another six or more coats are applied without sanding between coats. These are allowed to dry thoroughly. The finish is then rubbed down with rubbing compound, and a coat of hard automobile wax is applied, allowed to dry, and polished with a soft cloth. This will result in a hard, tough, high-gloss finish, which will show off fancy grain far better than a dull finish would.

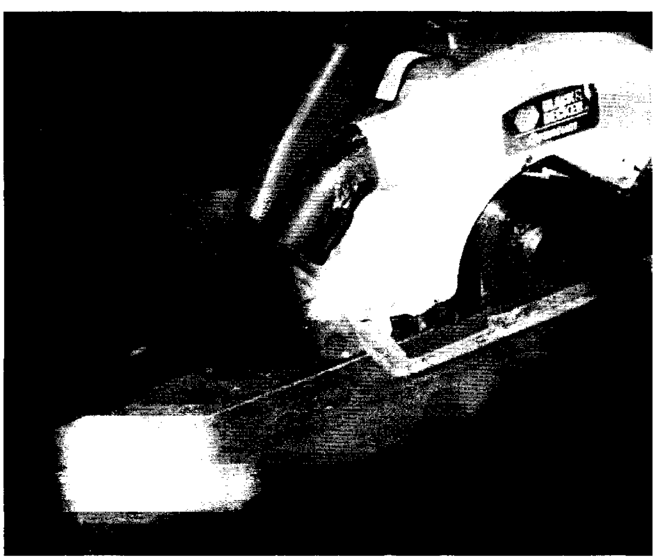
If checkering is intended the checkering pattern should be laid out, on the stock, after the first filler coats, and no more finish applied inside the perimeter of the pattern. The checkering can be cut with less effort, and the cutters will last longer if this procedure is followed.

Such magazines as *Guns* and the custom-rifle section of the *Gun Digest* usually contain pictures of some of the finest custom rifles in the world and can give valuable insight into what a stock should look like.

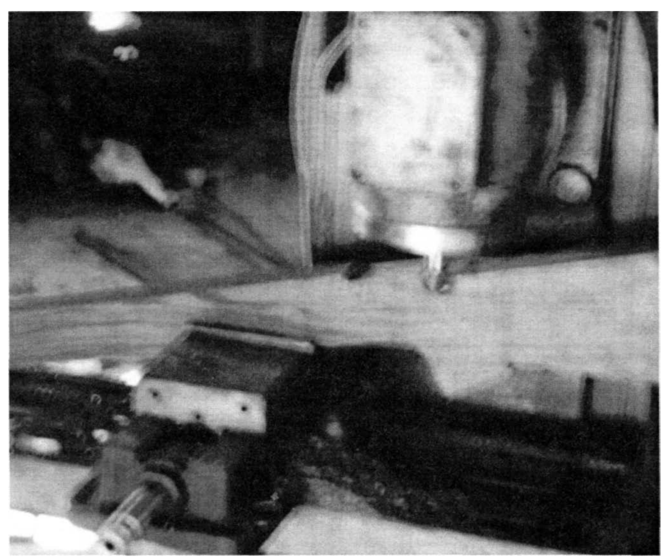


SAMPLE STOCK DESIGN

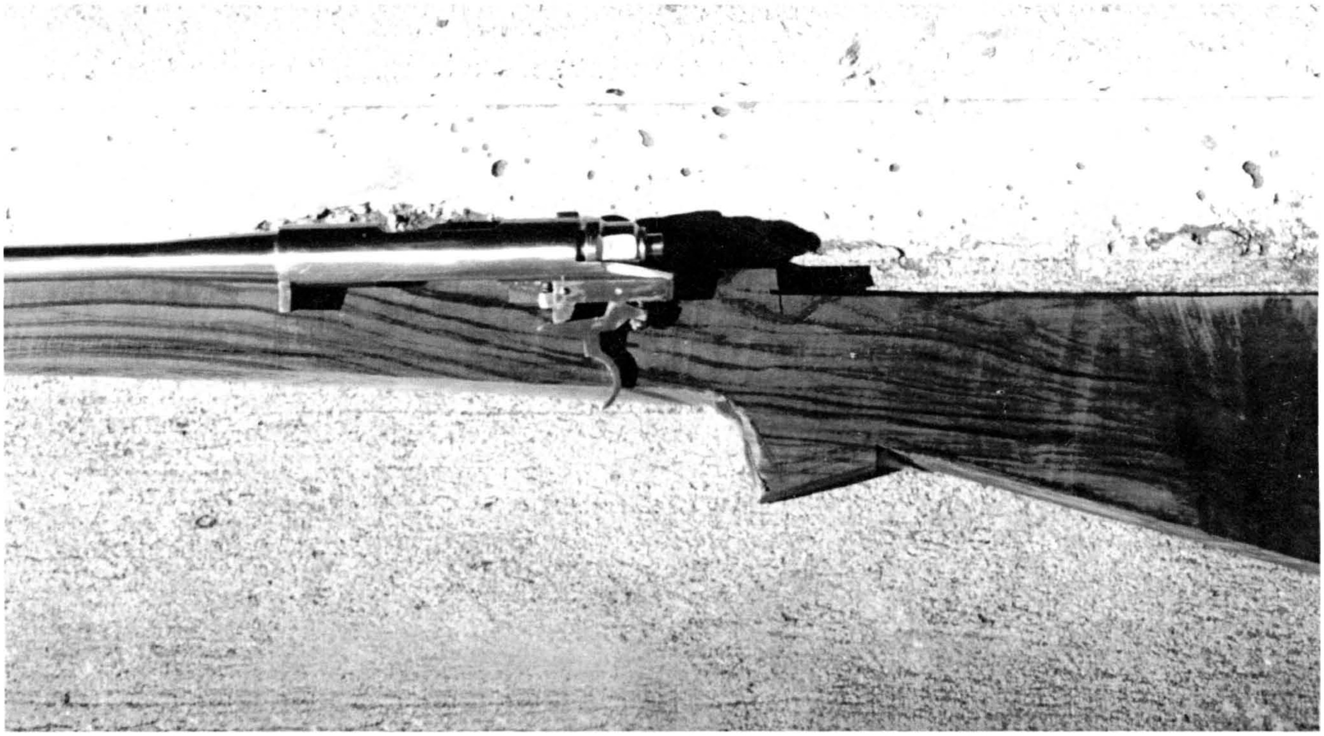
Grain layout is important. The top stock has excellent layout; the lower would have been better if the grain was parallel to the bottom stock line.



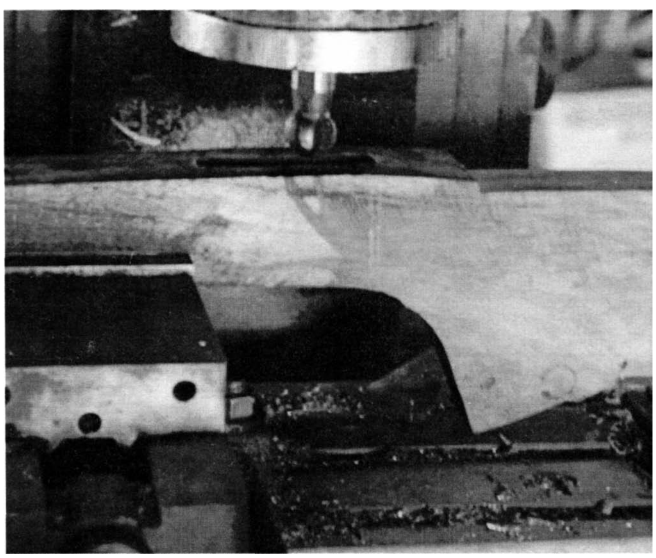
Straight lines are easier to cut by using a power saw, as shown.



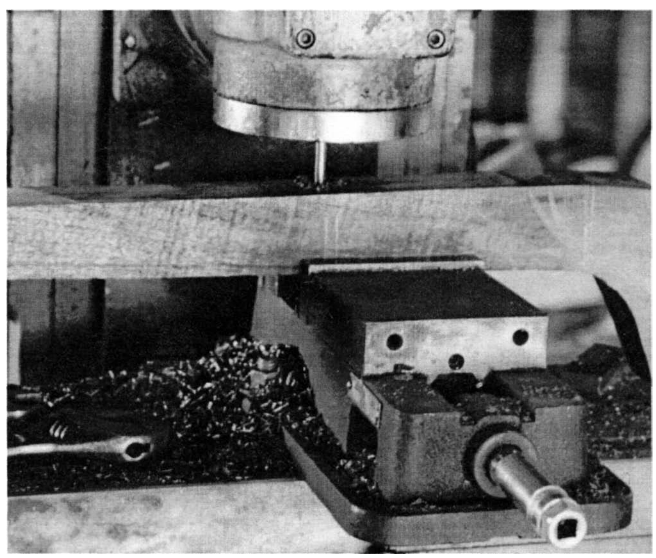
The comb nose curve is formed with a ball cutter.



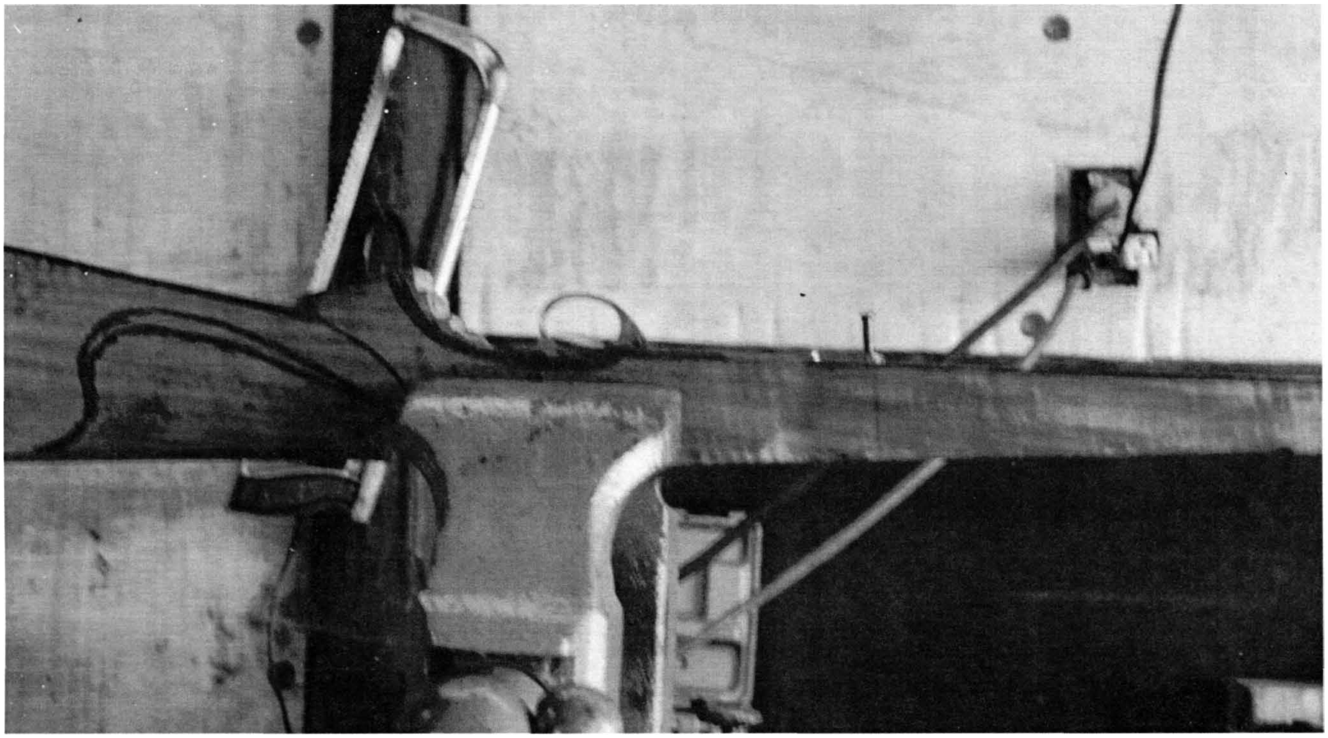
The barreled action in position on stock blank. Screw hole positions are located and marked.



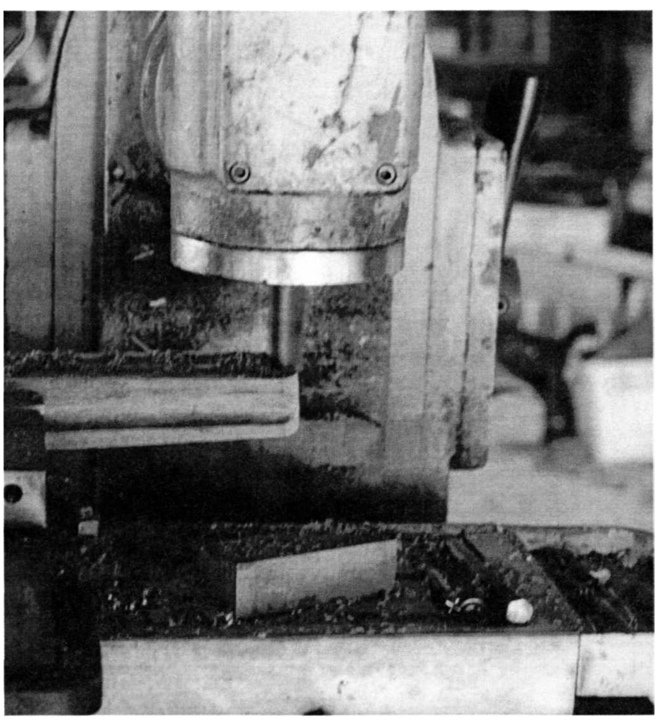
Most of the action inletting can be done with a ball cutter.



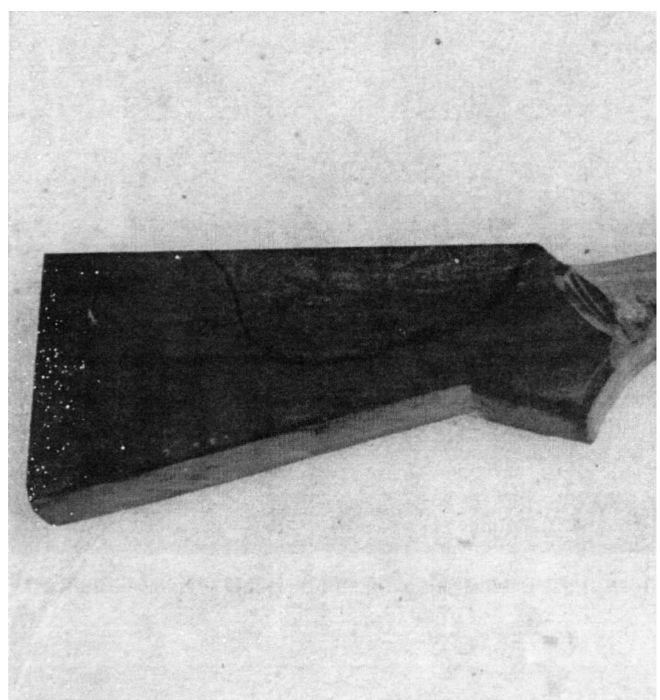
Barrel channel can be inletted just slightly undersize by using a smaller ball cutter.



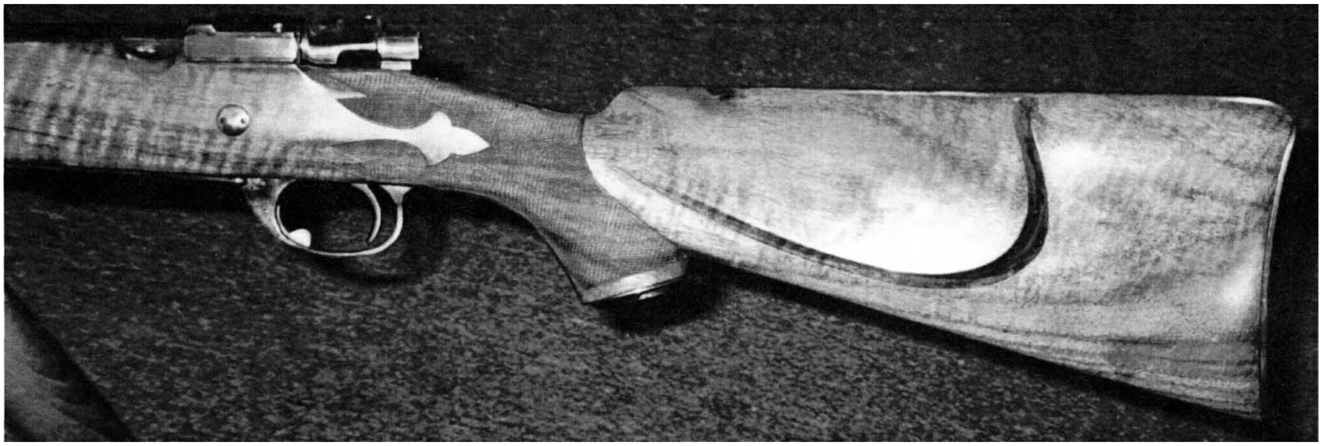
Magazine and trigger guard are inlet with mill and finished with files and chisels. Screw holes are marked through openings in tangs.



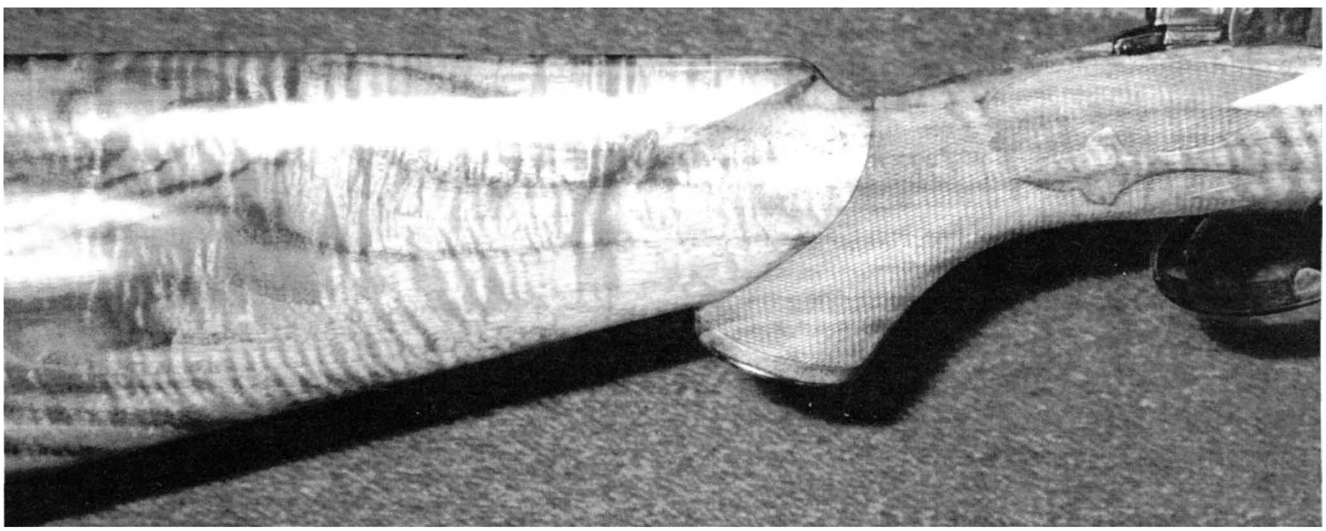
Quite a bit of the outside shaping ean be done with a milling machine using various cutters.



The stock inletting is finished. After buttplate and grip installation, it will be ready for shaping and sanding.

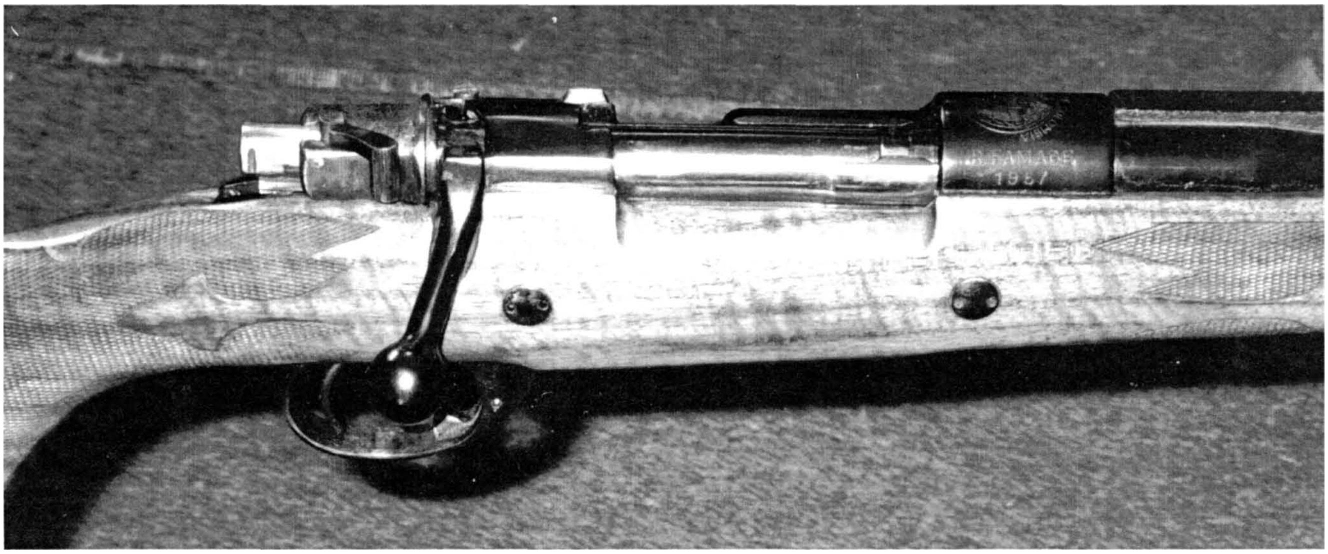


The cheekpiece should be no longer than required to support the cheek with full contact.

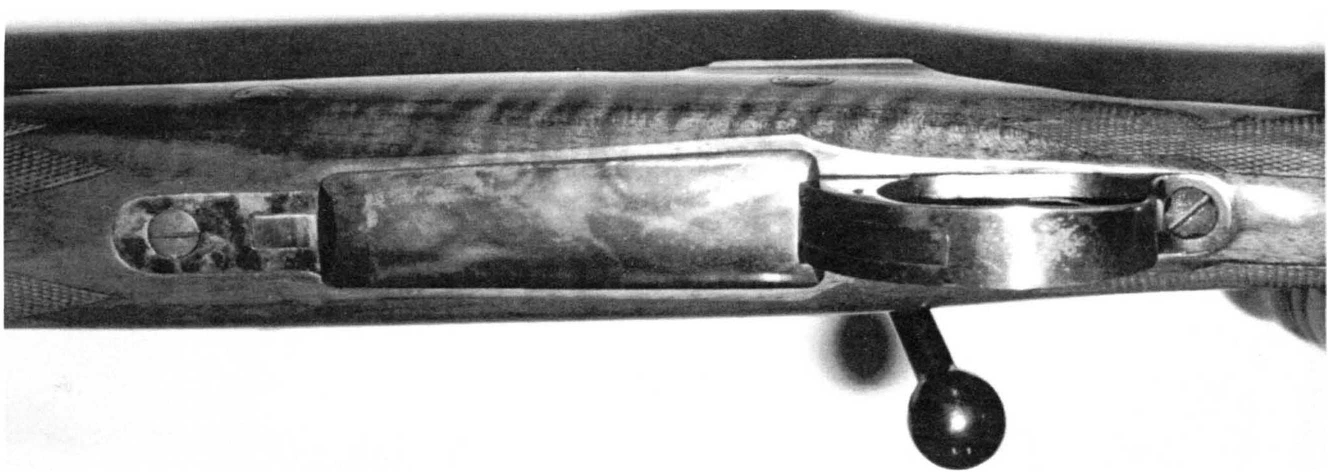


Stock lines should be kept as straight as possible.

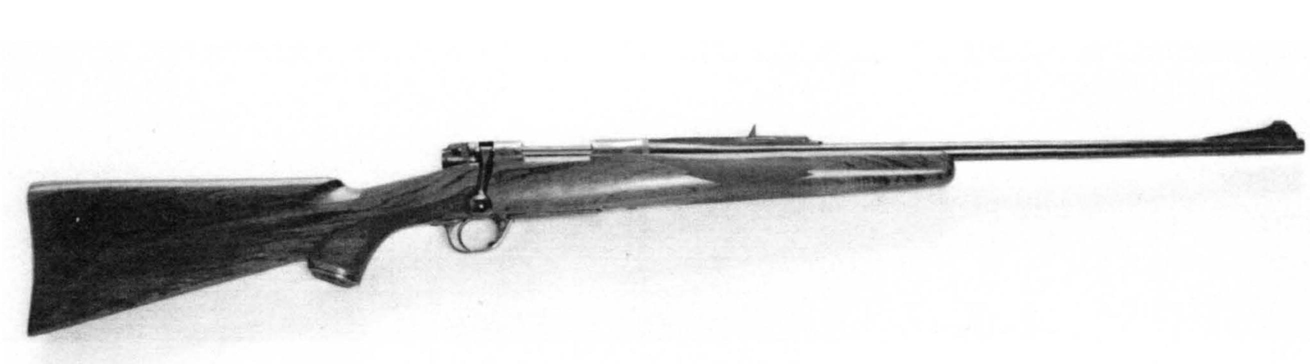
Finished stock: note that all straight lines are actually straight and the grip meets the stock line in a graceful curve.



Finished stock: note that all straight lines are actually straight and the grip meets the stock line in a graceful curve.



Bottom view of stock showing the scallop, or fillet, just above the trigger guard, which allows a trimmer stock.

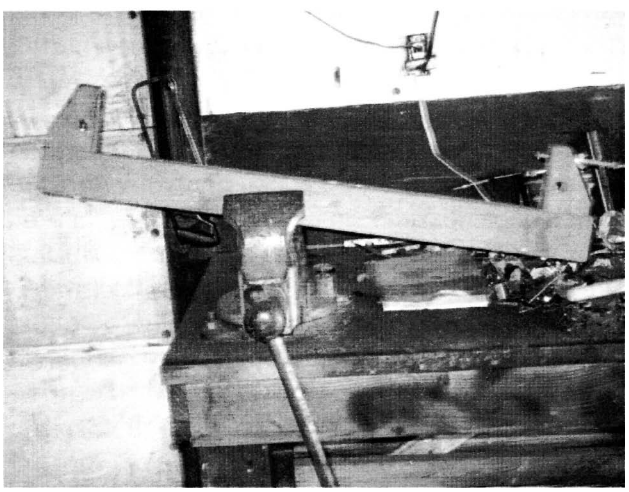


The finished rifle, as described in the text and shown in the drawings.

G HAPTER FIFTEEN

Checkering

Years ago, the practice of cutting two sets of parallel lines closely spaced and crossing each other at an angle was usually called *checking.* In recent years common usage has evolved the term into *checkering.* Since this is a modern book, written some 50 years later, the term *checkering* will be the standard.



A checkering cradle of sorts. These cradles are available cheap. Start with one of these and then, after deciding what you need, build one to suit you.

Good checkering can add to both the looks and the value of a custom- or shop-made stock. (It should—it usually took me at least 40 hours to do a checkering pattern.) By the same token, a poorly executed job can make an otherwise good stock look like a piece of junk. As I have related in the past, when I was young I once reluctantly showed one of my own early efforts to one of this country's premier stock makers, whose first comment was, "That would be a pretty good stock, kid, if you hadn't fucked up the checkering." But he took pity on me; he gave me some good tools and showed me how to use them and how to lay out a pattern. It wasn't long before my checkering had improved quite a bit.

In my area there is a local gunsmith who does an excellent job of finishing and fitting a stock, but he puts on checkering as an afterthought. He tries to hold the stock in one hand and cut the checkering with an electric checkering tool. Frankly, this makes an otherwise attractive stock look terrible. But he works cheap, and most of his customers don't know the difference, so he gets away with it.

What I have been building up to and trying to say is, if you don't have the expertise to do a good job, it is better to leave the checkering off, at least until you gain some experience.

For those who would like to learn, I suggest you practice first on an old factory stock that only had the eheckering started and the lines barely spaced when it came from the factory. Try going over one of these with a single-line "V" tool several times in both directions. Deepen them until the diamonds are pointed up; then deepen and recut the border. This practice gives you valuable experience, and you won't ruin a good stock if you mess it up. It's possible that you may do a good job on your first attempt, and the factory stock will look better than ever.

Next, you should obtain a cheap stock that has no checkering and try to lay out and execute a checkering job on it. A discarded military stock will do for this. If possible you should examine the checkering on a first-class custom stock—the entire stock for that matter—just to see what you should strive for. Don't use factory stocks as examples. Very few of these have eheckering that is better than mediocre.

If you decide to take up checkering seriously, you will need several tools. One of the most important is a cradle for holding the stock. Some people can do a fair job while holding the stock on their knees. I've done it myself. But the stock should be rotated as the cutter goes around curves to enable the cutter to be held perpendicular to the work at all times. A more elaborate cradle can be built in time, but for the first few jobs a simple cradle as sold by gunsmith supply houses will suffice It consists simply of a 2 x 4 board with a bracket at each end to support the stock and is intended to be bolted to a bench or held in a vise.

Also required are a few checkering tools. You can get by, barely, with just two: a single-line "V" cutter and a two- or three-line cutter. The "V" cutter is used to lay out the checkering pattern and to deepen and point up the spaced lines that are cut with the two- or three-line cutter. These two are the bare minimum; I suggest that you also obtain a bordering tool that will cut a two-line border around the pattern, which will hide the slips and run-overs that are bound to occur while you are learning. A small 60-degree "V" chisel is nice to have to form sharp curves and finish the very short lines formed at the very end of some point patterns, which are hard to cut with the regular cutters. Little, short single-line tools that are intended to serve the same purpose are also available.

Several brands of ready-made tools have been on the market for the last several years, so you don't have to make your own. Of these, I prefer the Dem Bart brand, which is available with single-, two-, and three-line cutters, as well as border-cutting tools, and features interchangeable cutters that are replaceable in the same tool handle. Any practical line spacing is available from 16 to 32 lines per inch, as well as skip-line cutters for French checkering. These are also useful in laying out ribbons through fancy checkering jobs.

Such ready-made tools are satisfactory enough that I quit trying to make my own immediately after using some. When I first tried checkering, I tried to make spacers from umbrella ribs, as recommended by Clyde Baker in a gunsmithing book, and to use a small three-cornered file to deepen the lines. It looked about like it would have if it had been cut with a pocket knife. How I wish ready-made tools had been available then.

One more item should be made up before you start: a pattern made from plastic or cardboard for laying out the diamonds. Most people feel that the most attractive proportion for the diamonds is 3 to 1, which means it is three times as long as it is wide. Diamonds shorter than this look crude and should be avoided. Longer diamonds may look good to some people but are hard to cut and are likely to chip out on softer wood.

While you are at it, make another half-diamond long enough for the flat end to reach across both the receiver and trigger guard. This one can be helpful in locating both sides of the pattern in identical positions on both sides of the stock.

Several straight-edged, thin plastic strips in various widths are handy to have when projecting straight lines around long, curved surfaces. And a couple that will just fit inside the trigger guard and magazine tang openings are helpful when centering the pattern on both the forearm and grip. A few templates for curved patterns, such as a fleur de lis, are also useful.

Choosing a checkering pattern is purely a matter of personal taste. There are almost as many patterns in existence as there are people doing checkering. While many patterns are similar, few are identical. Mostly patterns run in curved and scroll outline and straight-line patterns. While the straight-line pattern, or point pattern as it is commonly known, may appear the simplest to apply, with its lines forming its outline into the same diamond shape as the small single diamonds that make up the pattern, in reality it can easily become the most difficult to execute. The tiny individual diamonds must be cut and deepened without run-overs clear up to the very tips of the pattern points. The straight lines that make up the outline can easily be checked for straightness, while a curved or irregular-shaped edge pattern can only be cheeked by observation. So, regardless of which type you prefer, you should begin your first effort with an irregular-shaped border design. If you absolutely must have a point pattern, at least use a design where a larger diamond forms the outline at the top and bottom of the pattern. This will avoid the sharp points that require the extremely short lines mentioned before.

It has been stated elsewhere that if slips, nicks, and run-overs are present, a two- or three-line border can be cut around the outer edge, effectively camouflaging the errors. It certainly won't add to the appearance of the stock to cut borders such as this around curved patterns. And it will be obvious to anyone with any knowledge of checkering just what the reason for such a border is. On the other hand, if such nicks or run-overs occur in a straight-line pattern, another line or two can be cut and the checkering extended to the edge, effectively removing the mistakes that, if not repeated in this operation, will be undetectable. If this is required on one edge or side of the patterns, it should be duplicated on the other side in order for both to match.

Next to be arrived at is the spacing of the lines that make up the pattern. Beginners will do well to start with 16- or 18-line spacing. You should wait to tackle narrower spacing until you become more experienced. Cheap soft wood, such as that found in military stocks and the lower-priced grades of the semifinished stocks, usually won't break off if spaced too closely. Actually, the 16-line checkering gives a maximum high-friction grip and is recommended for use on target stocks and the like even though it is somewhat crude in appearance, regardless of the quality of wood used. On the other hand, about 50 percent of the expensive high-grade look of the stock is due to the presence of fine checkering. If you are using a highly figured, dense chunk of wood and feel comfortable doing it, 24-to-32-line checkering, when well done, certainly adds to the appearance of the gun. Take comfort in the fact that if you mess it up, you can always sand it off and start over. I assume that you are aware that the term *line* as used in 16-line or 20-line means that the finished checkering will have that many lines in an inch of the finished work.

The first and high important step is to lay out the design to be applied. The stock should be mounted in the checkering cradle and the pattern laid out using a soft pencil. Hard pencils leave marks in the wood that are hard to remove later.

Pick a pattern that blends in with the contours of your particular stock. Try for one that is not too complicated for your early efforts. The well-experienced artist can run patterns completely over the top of the grip and across and around the forearm and have them match on both sides of the stock, but for the beginner such work is almost impossible. Straight lines tend to wander off on the curves and spread out as they go around. Then, when they approach the edge, they tend to crowd together. This is caused by not keeping the spacing tool perpendicular to the surface of the stock as it goes around. When the beginner attempts such, the faults get worse with every line cut, and the continuous pattern that was supposed to wrap around the stock in straight lines wanders off to who knows where and looks far worse than it would if never started. Get plenty of practice before attempting this.

For the beginner the pattern should consist of two grip panels, one on each side, with an open, smooth area along the top center of the grip and the forearm. It should be a two-piece pattern with an open area along the bottom and the end contours matching those of the grip.

Both sides of the pattern should match. Gut a paper pattern and lay it on the stock, trimming it until it looks right. You can then draw around the pattern lightly with a pencil. This will fairly well establish the locations of the front, bottom, and upper and rear lines of the grip pattern. Lay the half-diamond on the pattern and mark on the template the points where it intersects the upper and lower tangs. Mark on the stock the point where the template intersects the rear line. Turn the stock over and again draw the outline around the pattern. Measure up from the bottom line along the rear to the mark on the first side and mark this side at the same point. Place the point of the half diamond even with this mark and adjust this up and down at the front until the tang marks line up with the tangs. This should locate the master lines in the same place on both sides. Mark along these lines lightly. Then, using a flexible straight edge, mark them in firmly and cut them lightly, as well as around the border, with the single-line tool.

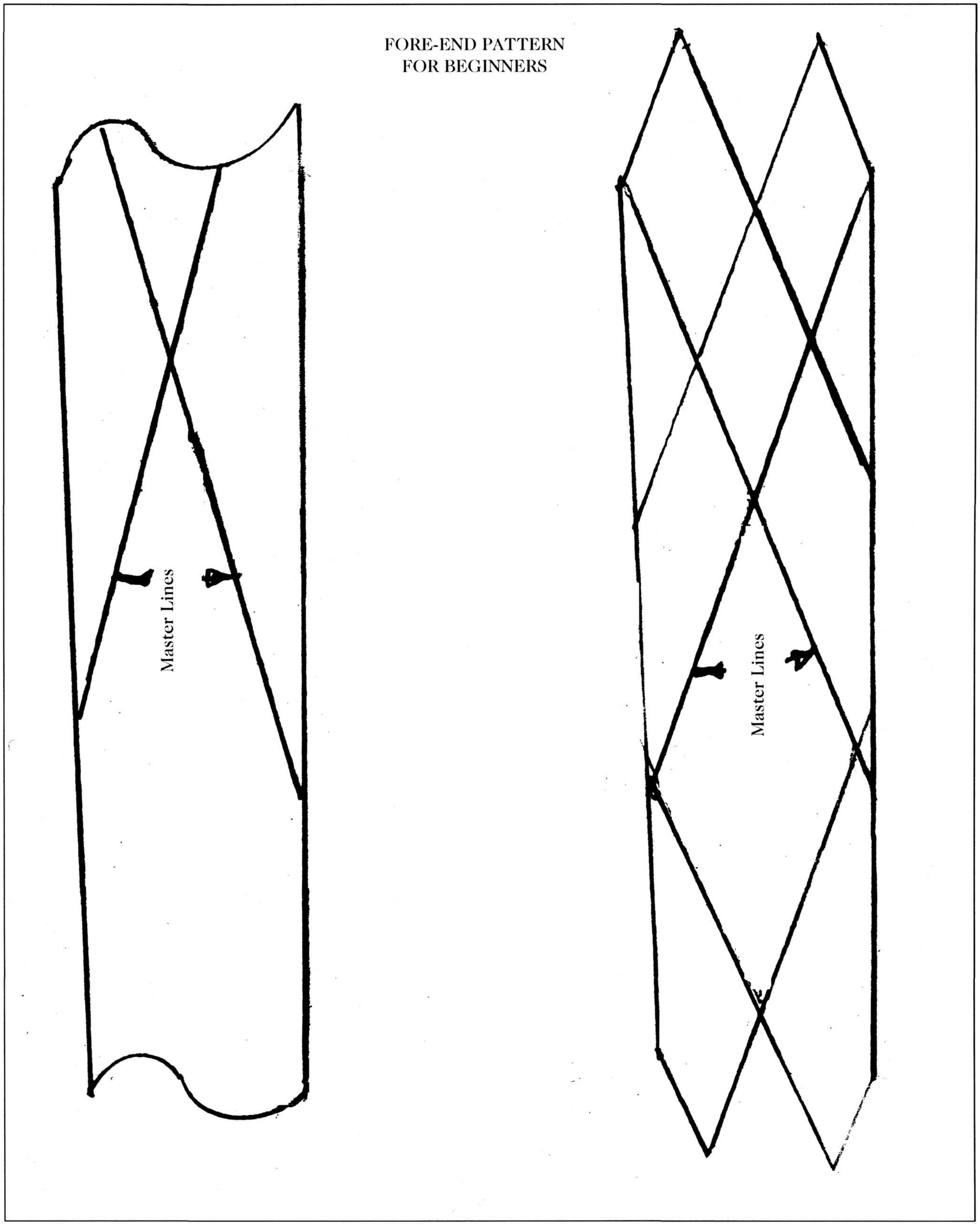
The fore-end pattern is done the same way. Draw two lines of the same length on the bottom of the fore-end 1/2 inch away from and parallel to the centerline. Another straight line is drawn on each side about 1/4 inch below the top line of the stock. The half-diamond is again put in place, and the master lines are drawn.

Now you can start the actual checkering. Place one of teeth of the spacing tool in one of the master lines and work it back and forth until the line is cut the entire distance between the border lines. Don't try to cut the lines to full depth on this first pass; you are simply spacing the lines inside the pattern. Gut each line to its full length right up to the lightly cut border and stop. If the tool jumps the track, due mainly to hard or soft spots in the wood, stop and straighten it up with the "V" tool before proceeding. If you don't, it will be copied and likely get worse with each succeeding line.

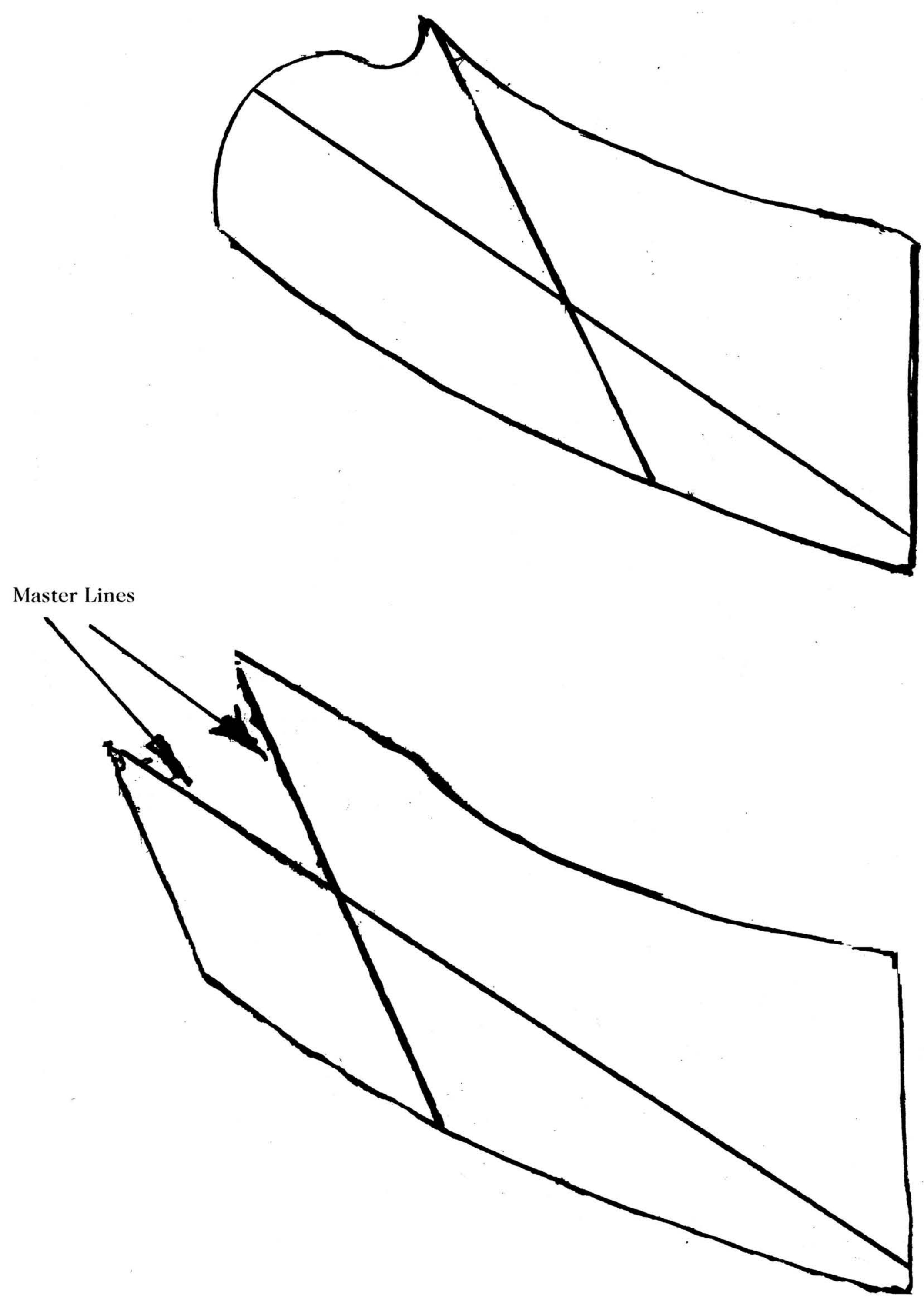
When both master lines have been paralleled on each side with spacing lines to the outside edges of the pattern, you can start using the "V" tool to deepen the lines and point up the diamonds. Go over each line carefully several times in both directions until the diamonds are all brought to sharp points. When using cutters such as the Dem Bart, the spacing tools can be used to partly deepen the lines, especially by using the three-line cutter, and will aid in keeping the diamonds uniform.

The outline, or border, should be cut to the same depth as the checkering and should do away with most shallow nicks in the outline. If deeper nicks or run-overs are still present, the bordering tool should be used to cut a two-line border.

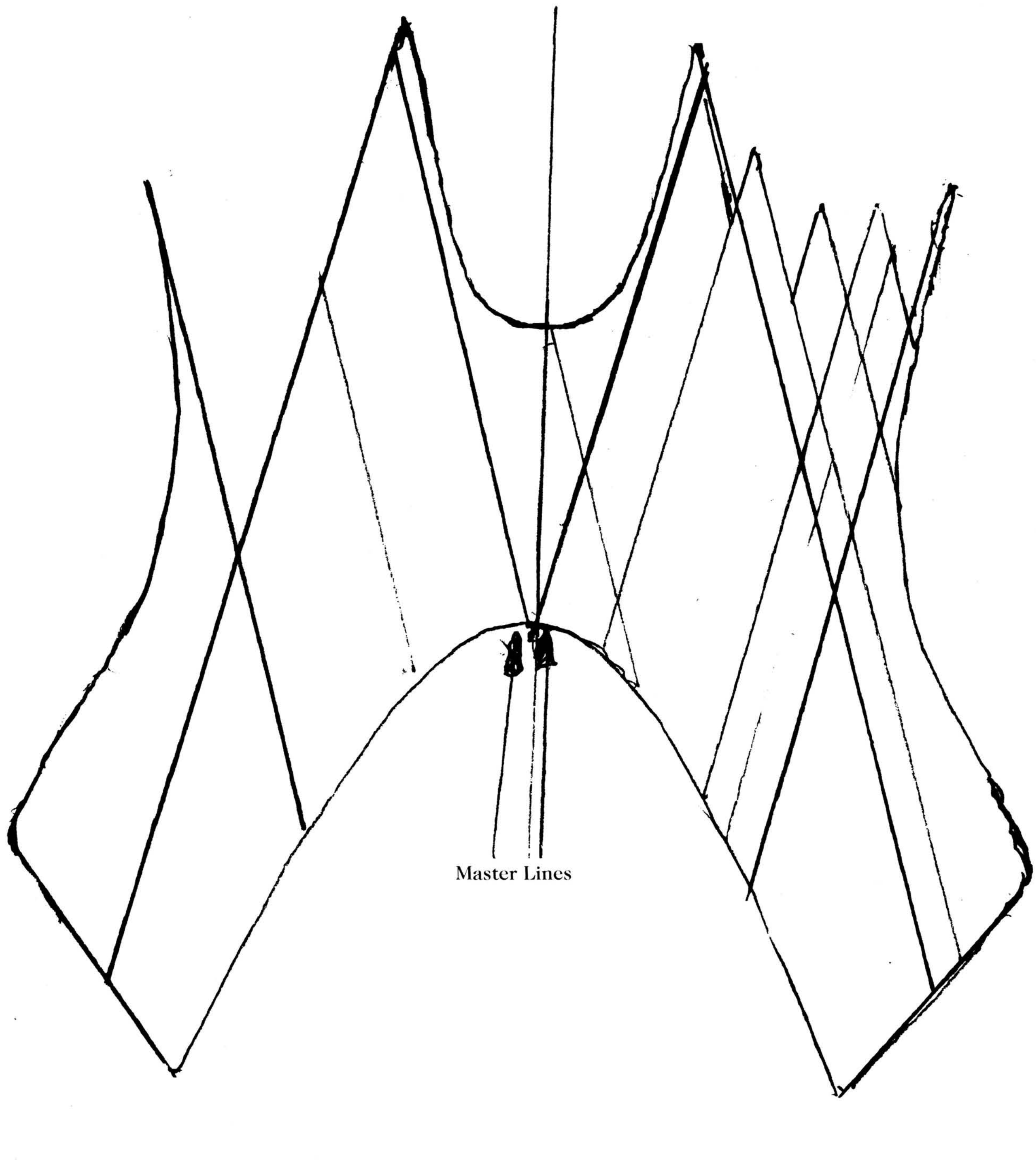
When satisfied that you can't improve on it, the checkering should be brushed out thoroughly with a toothbrush to remove any dust present and given a single thin coat of Tru-Oil.


FORE-END PATTERN
FOR BEGINNERS
Master Lines
Master Lines

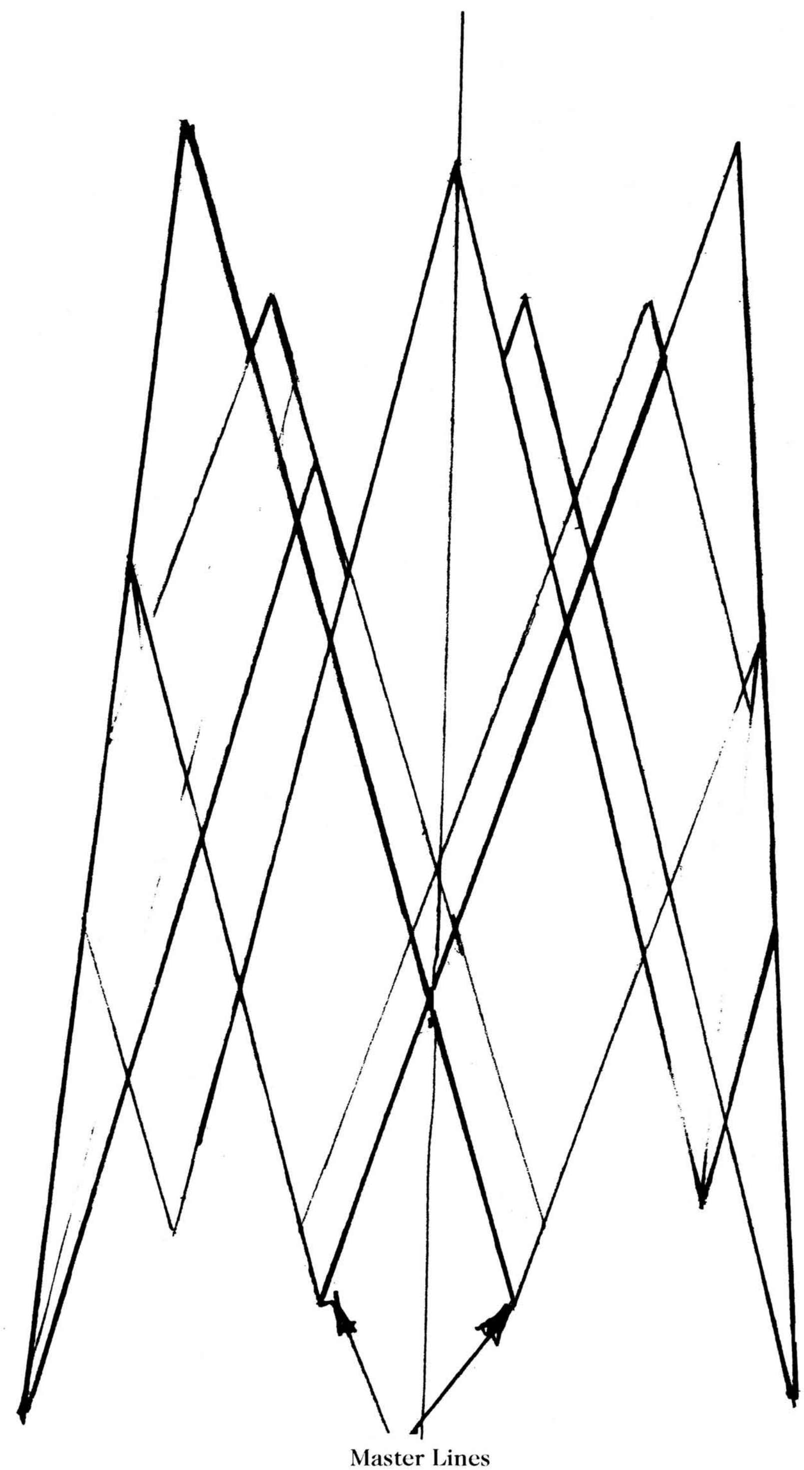
GRIP PATTERNS FOR BEGINNERS

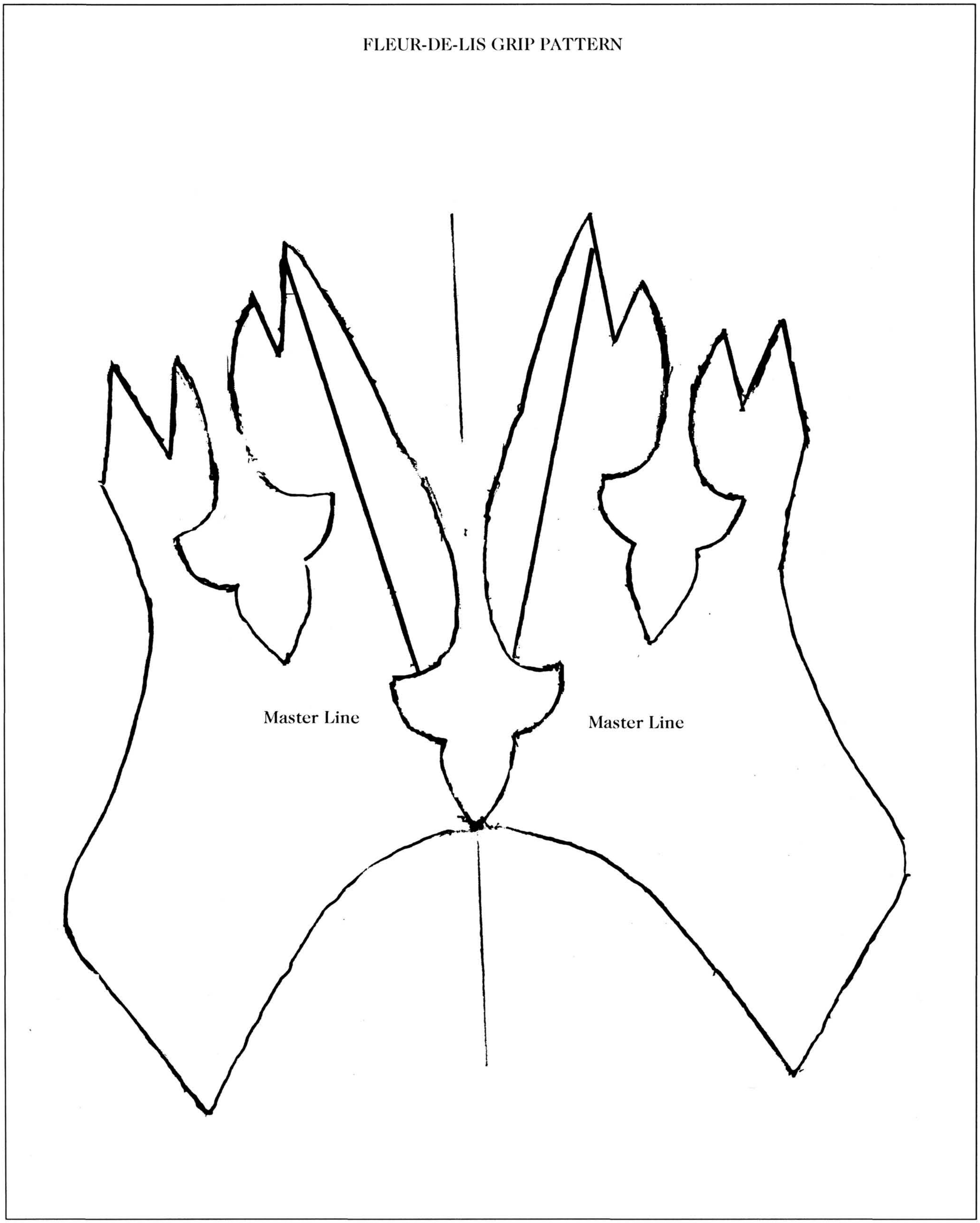


MULTIPOINT CONTINUOUS-GRIP PATTERN

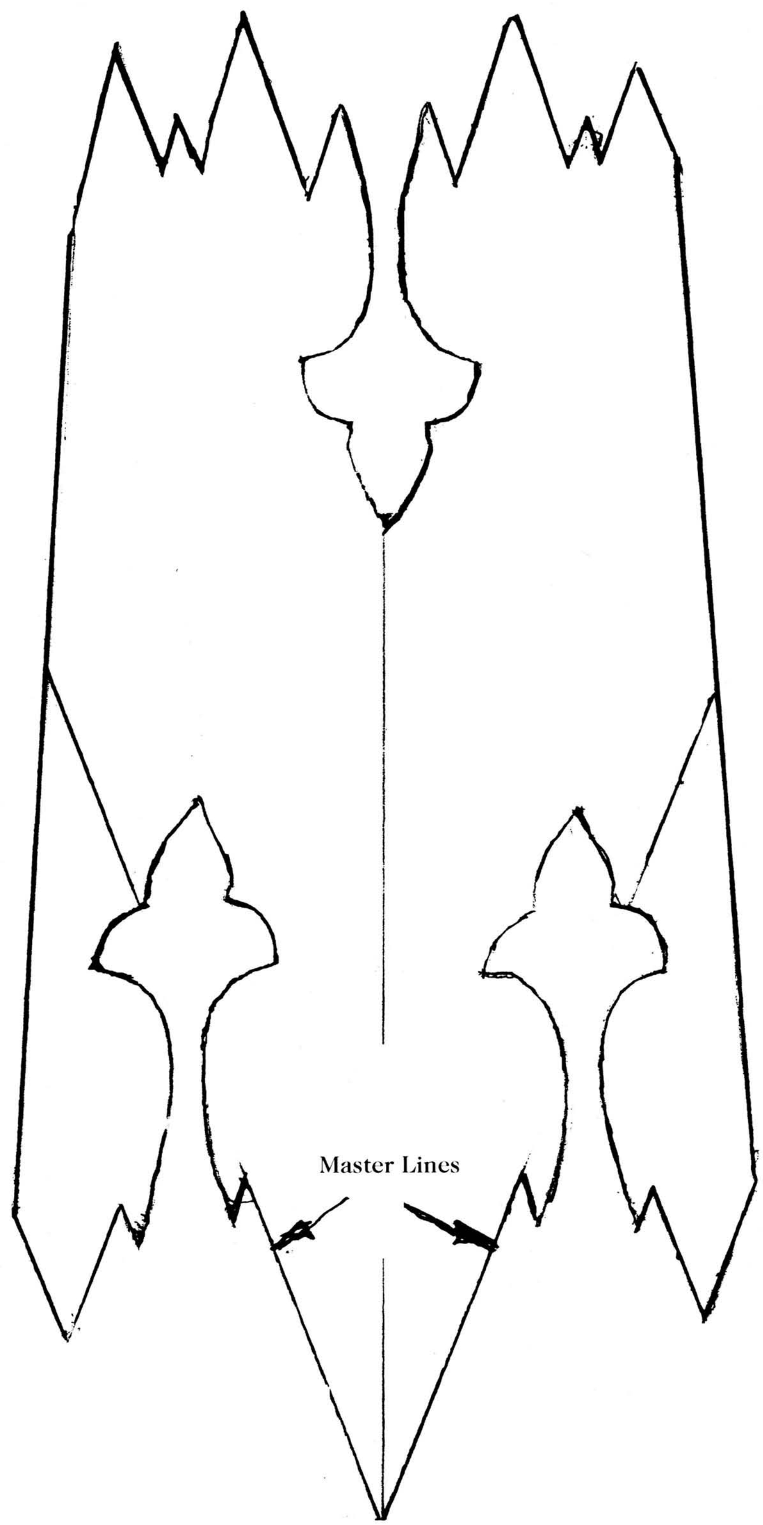


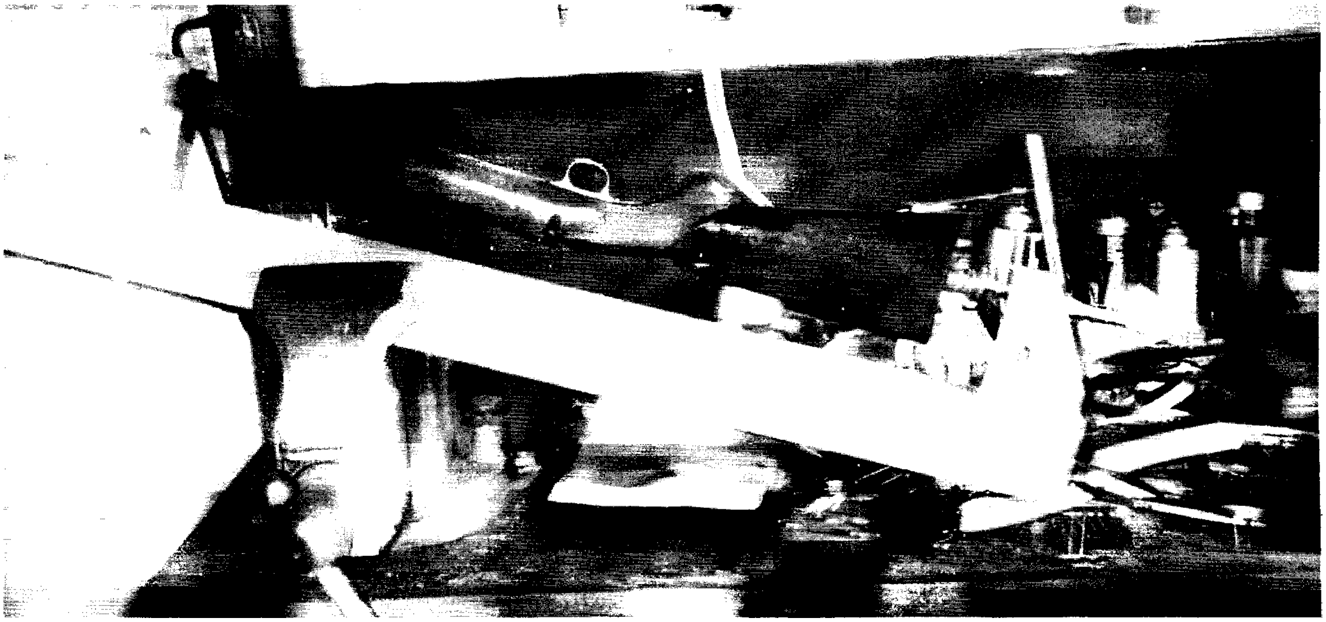
MULTIPOINT FOREARM PATTERN MODIFICAITON REQUIRED TO FIT YOUR STOCK



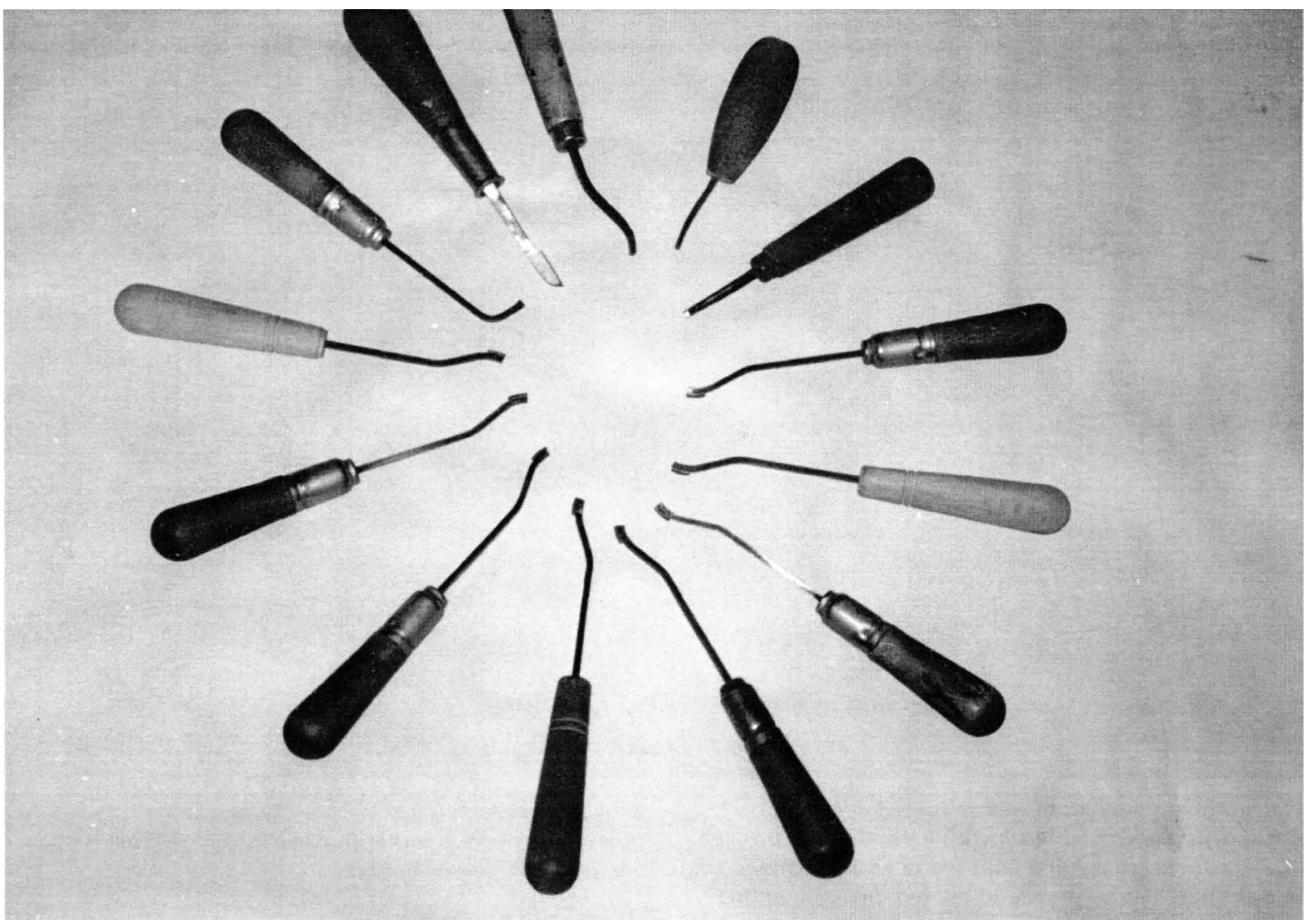

FLEUR-DE-LIS GRIP PATTERN
Master Line
Master Line

FLEUR-DE-LIS FORE-END PATTERN

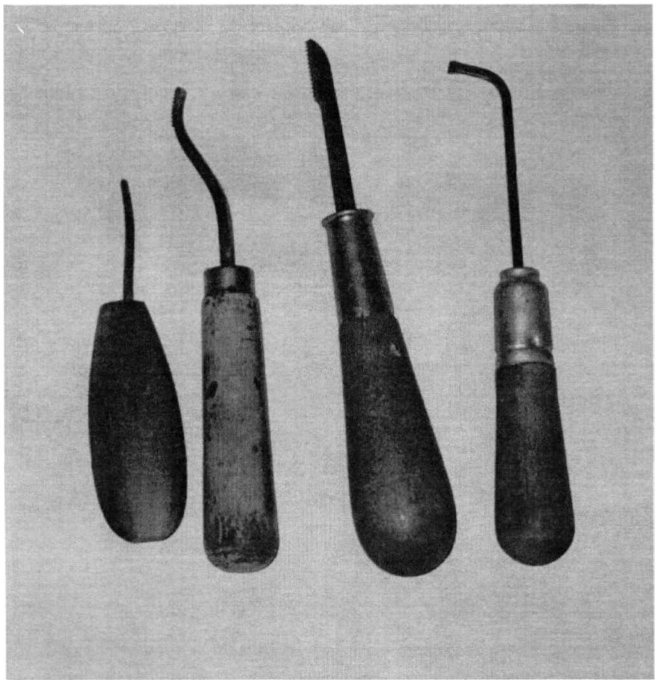




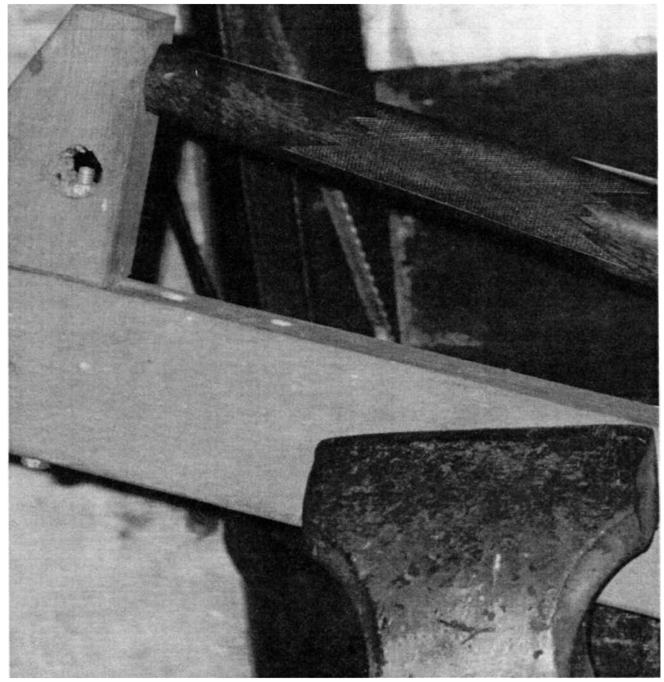
The stock is in place and ready to checker.



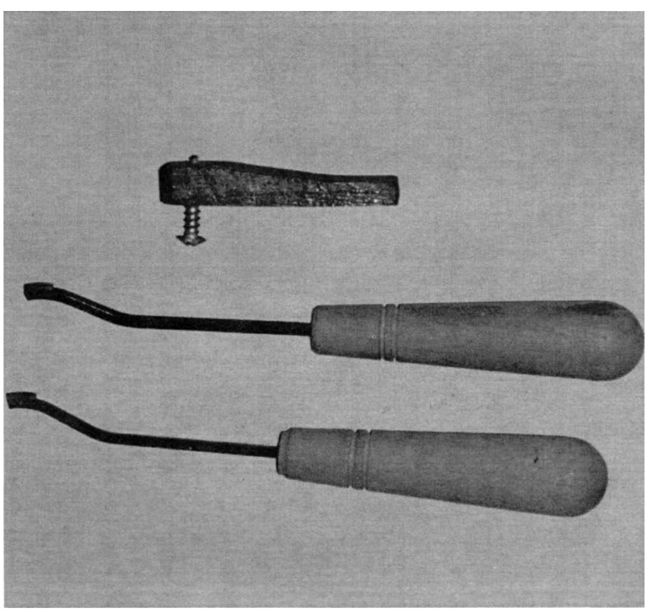
There is no such thing as too many tools. These are only a few of the ones I have collected over the years.



From left: a veining or "V" tool, useful for cutting short curves; a skip line tool, used to lay out narrow ribbons and in Freneh checkering; three-line spacer, purchased from Stoeger more than 50 years ago; and a short cutter, handy to cut the short lines at the ends and corners of patterns.

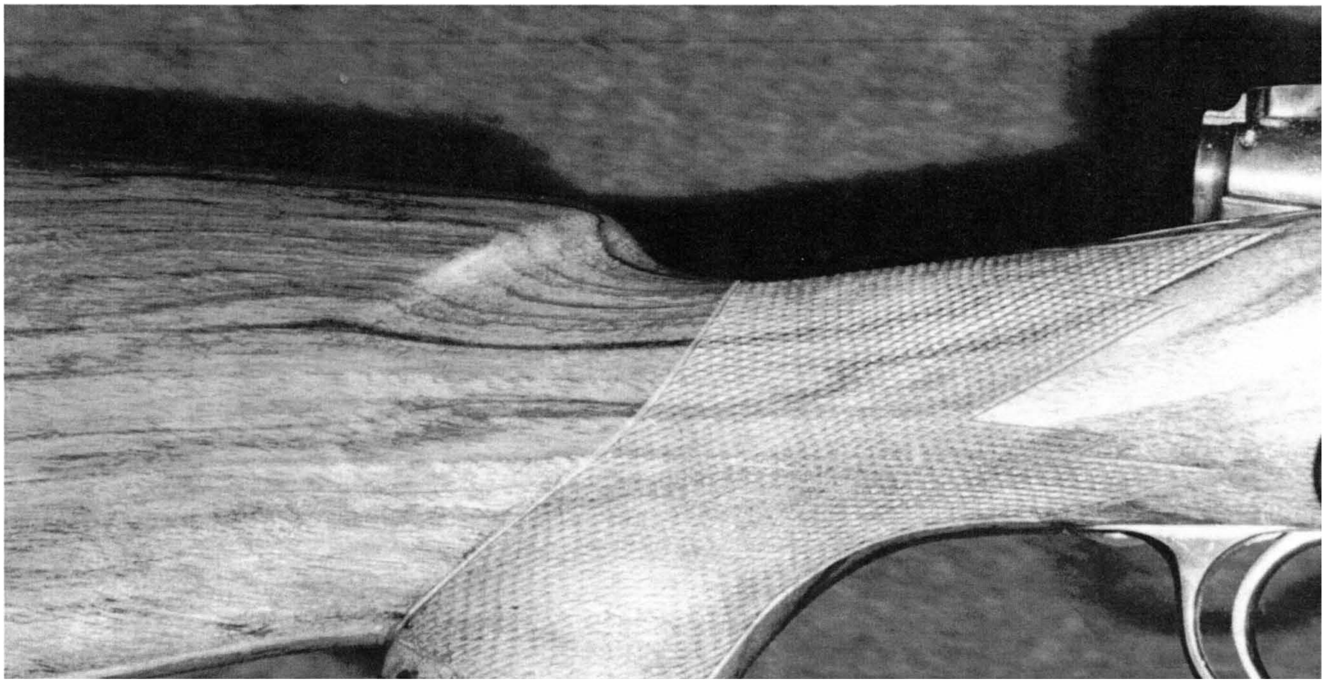


Cradle and stock in position to allow easy access to the forearm. One hand rotates the stock while the other operates the checkering tool.

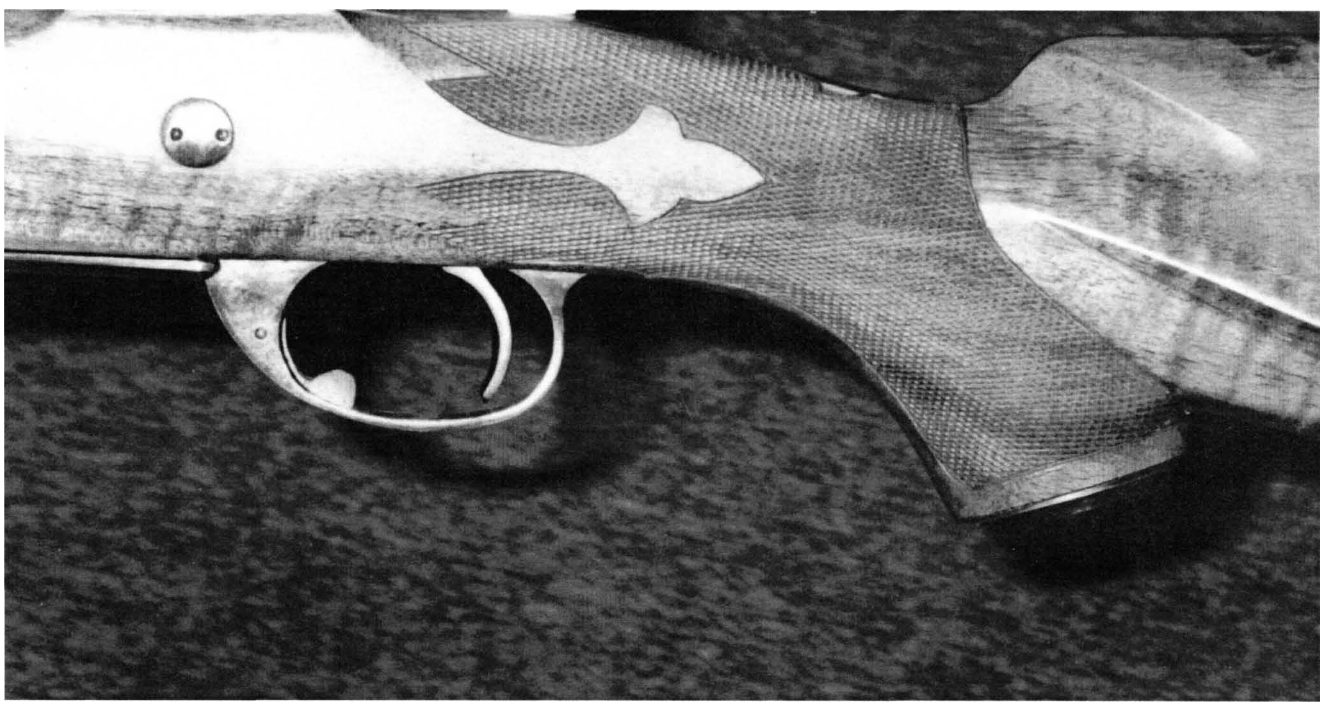


The minimum number of tools required to checker a stock. At top is a wood block with a wood screw through it. The edge is ground and polished to a sharp surface. Straight lines can be drawn on the top fore-end outline using this.

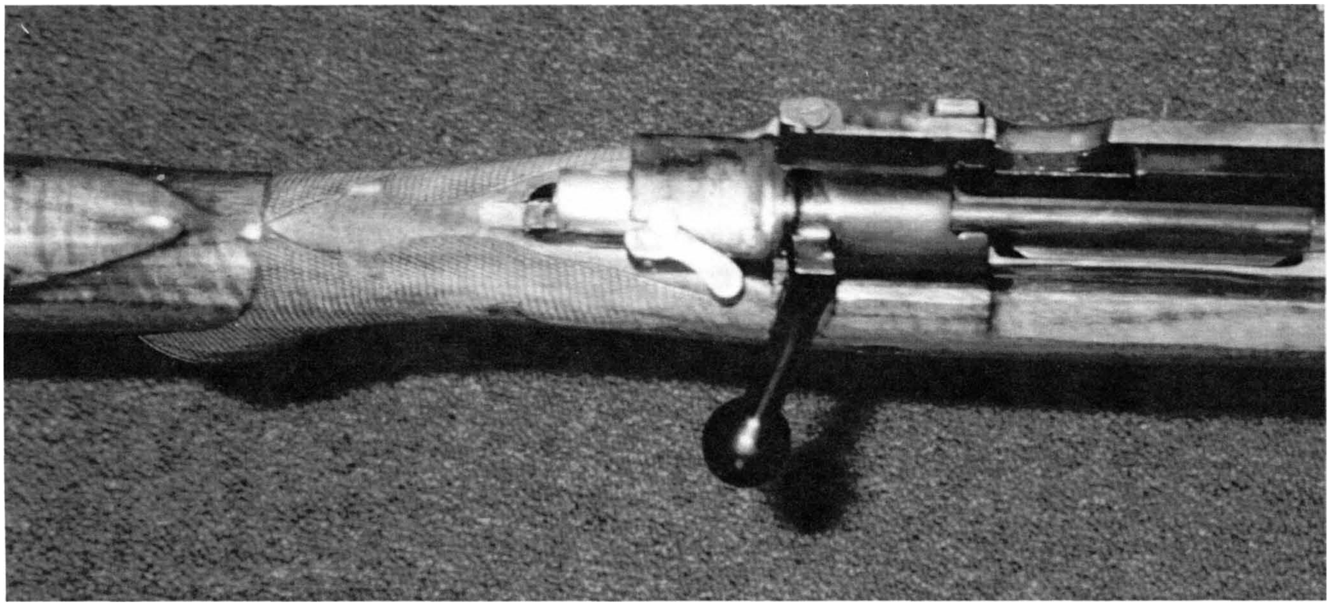
A 24-line per inch point pattern can be most attractive. In ease of run-overs, another line can be added. This is not possible with curved borders.



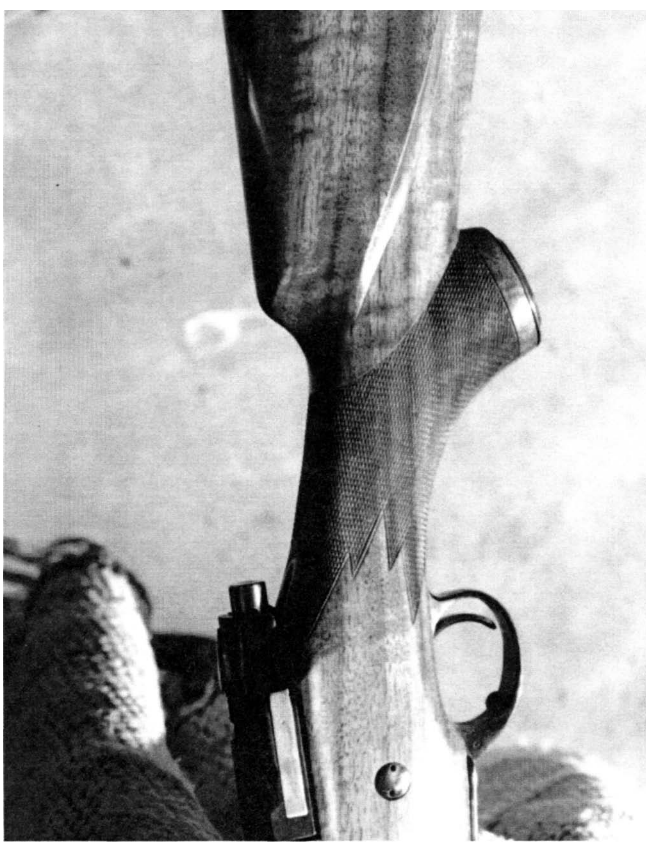
Lines must be straight and parallel throughout the pattern. Diamonds must also be the same size throughout.



The fleur-de-lis pattern looks good, but it should not be attempted until simpler patterns have been mastered. Lines should maintain the same direction after passing around the fleur.

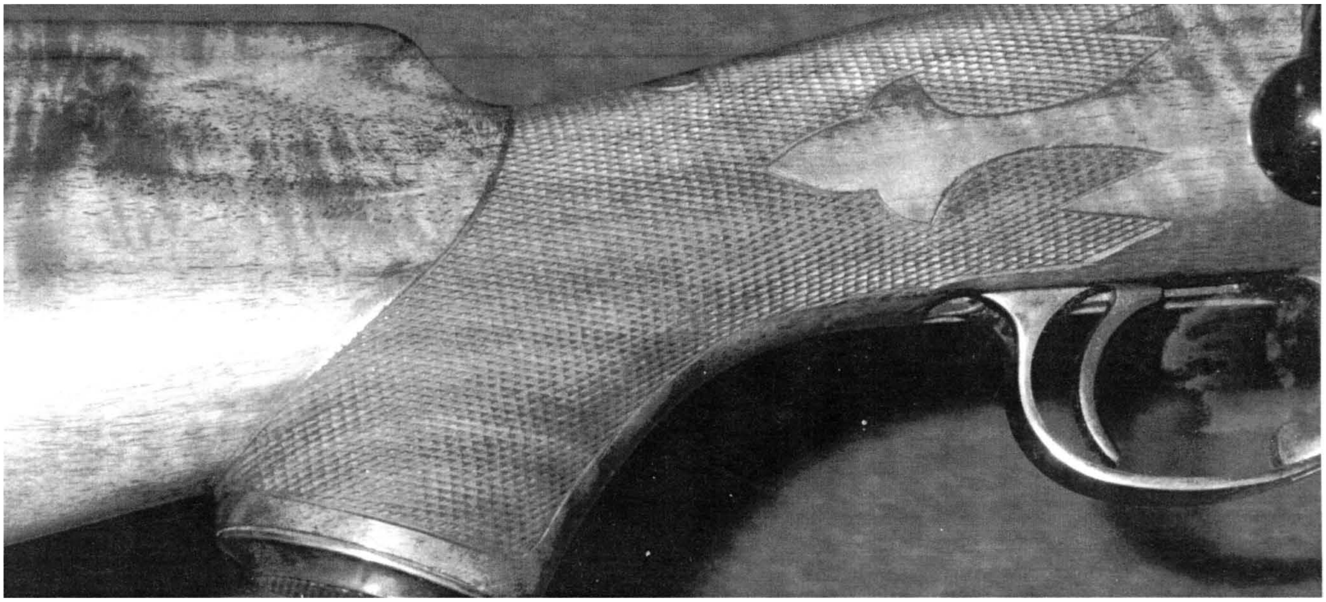


An additional fleur, down the center of the grip, allows a break in the "over the top" pattern, making it easier to maintain straight lines.



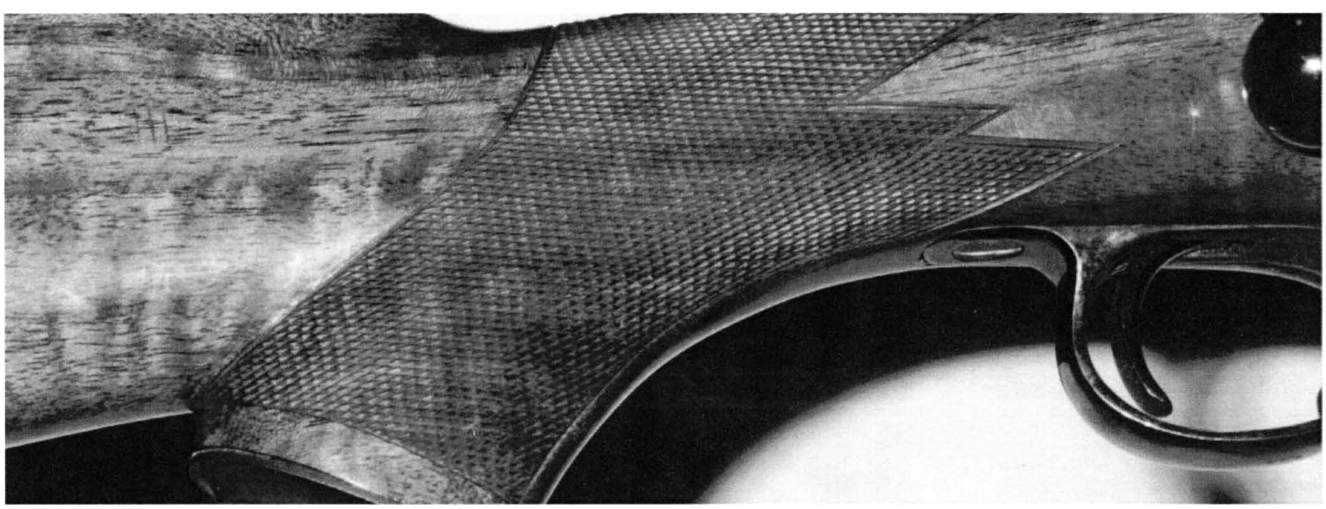
A 24-line per inch point pattern on a big .416 Rigby. This pattern runs over the grip in one continuous pattern.

Top view, showing continuous pattern. Master lines are laid out using the centerline of the grip. Care must be taken to hold the tool perpendicular to the work to keep lines from spreading.



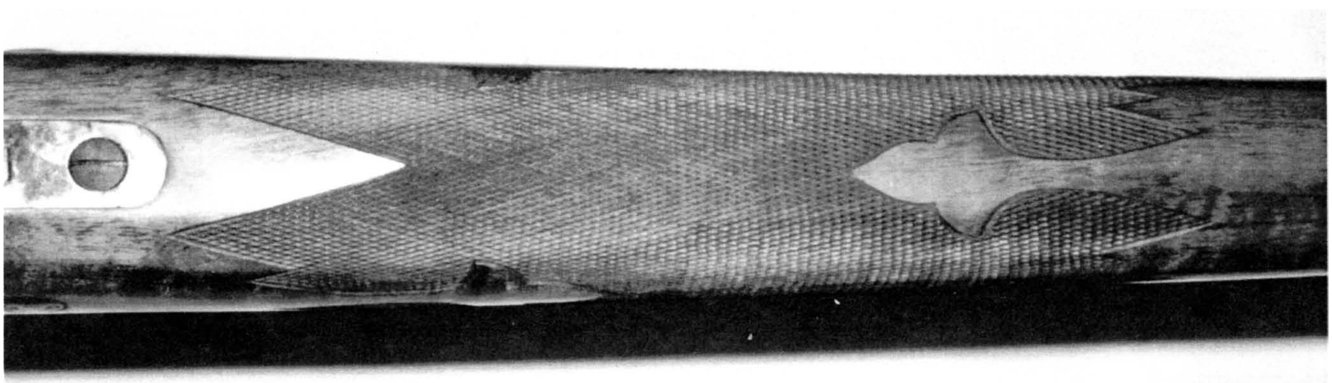
Right side of fleur pattern. Note that lines are still parallel after interruption. Lines must not be allowed to spread, whieh eontributes to this.

Full-length view of stock showing both grip and forearm checkering. Note that both match closely.



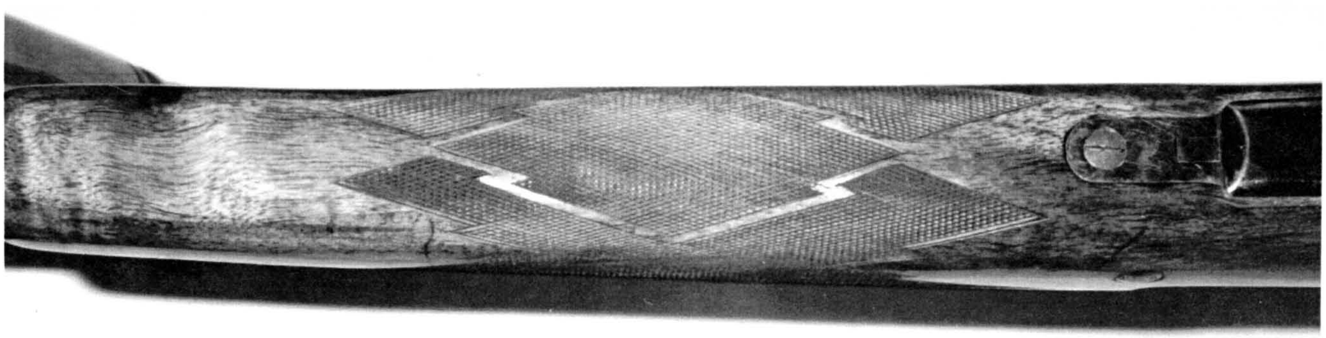
Right side of .416 Rigby stock. This one has a narrow border around the pointed portion of the checkering. It was not put there to hide run-overs.

Another "over the top" pattern. This is the .250-3000 rifle described in the text. Note the M70-type safety.

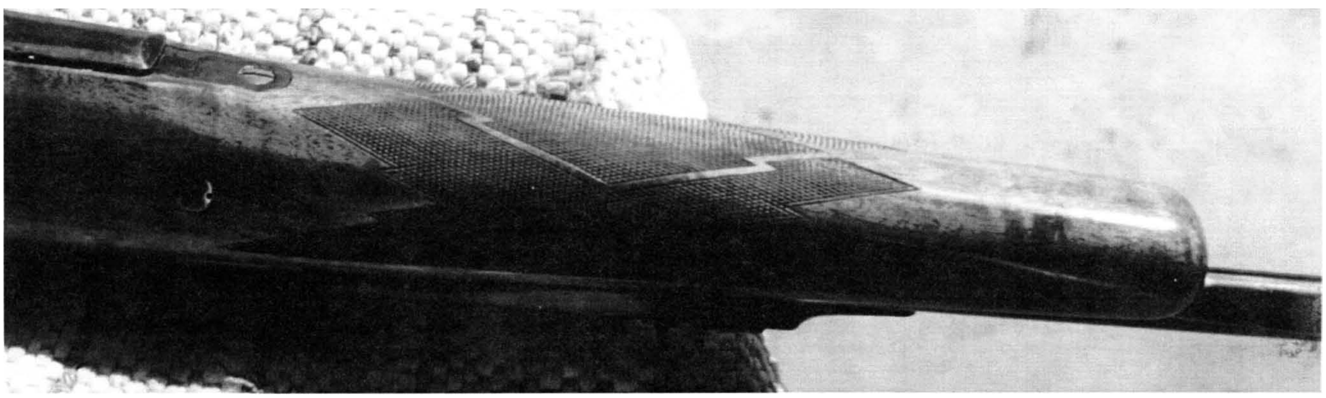


Bottom view of fleur-de-lis pattern. Angled lines at the rear eenter form the master lines, which wrap completely around the bottom of forearm.

Side view of same pattern. Note the crossbolts, which help prevent splitting on rifles of heavy recoil.

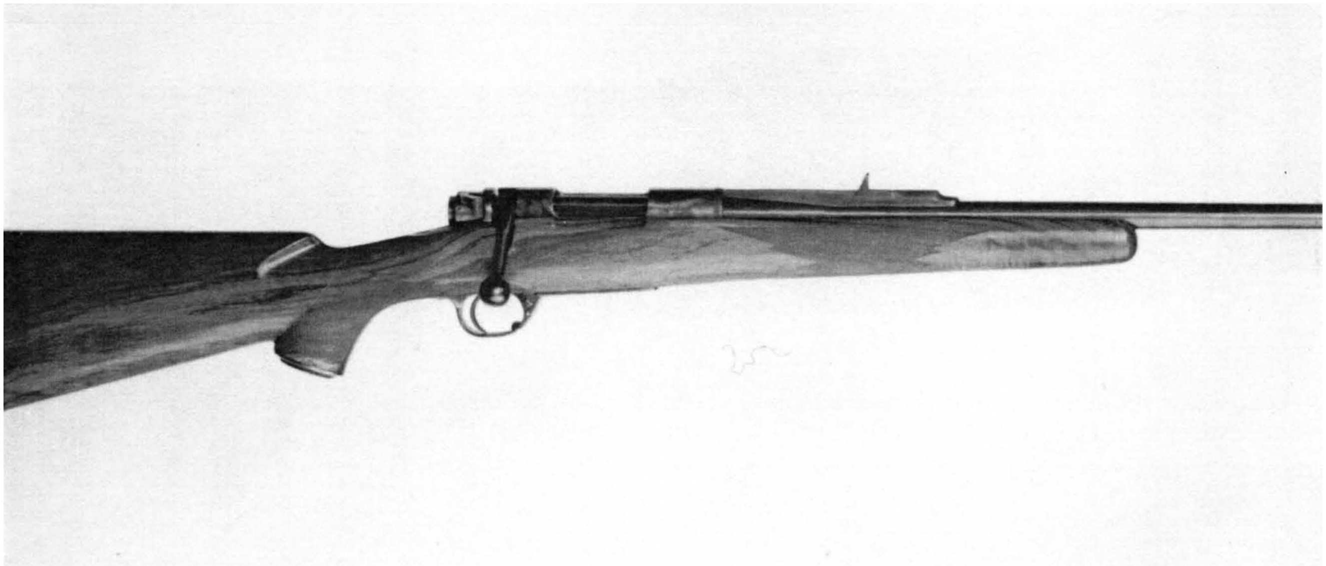


A .416 forearm showing a diamond ribbon included inside the pattern. This breaks up the long lines that would be required otherwise. The center diamond is formed first, with side panels added.

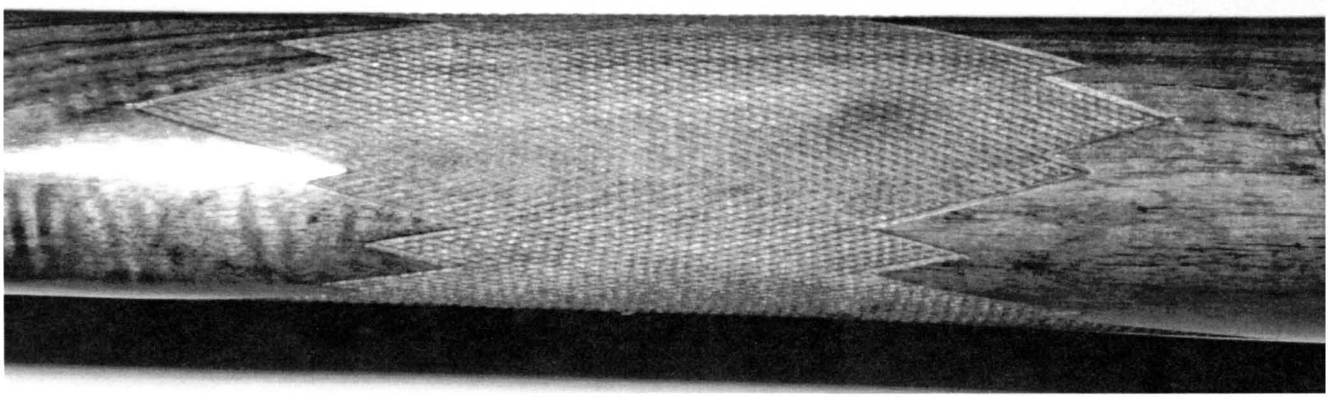


Another view shows how the large diamond wraps around the forearm. Lines must meet at ribbon edges and continue in the same directions as though no break existed.

Point pattern as applied to the prototype rifle in this book.



Full-length view of the same stoek. Pattern wraps eompletely around the bottom of the forearm.



Bottom view of a point pattern. Master lines start on rear of the eenterline. This pattern is not for a beginner.

Full-length view of forearm pattern shown above.

CHAPTER SIXTEEN

Buttplates

Several years ago, even cheap guns came with metal buttplates. Although these were usually made of steel, eventually they evolved into aluminum, which was lighter in weight, they said. Buttplates also became lighter in color when the anodizing or paint wore off. Gradually most buttplates were replaced with plastic. Much has been said about the advantages of using plastic, but the biggest advantage is in the cost of manufacture. Rubber buttplates and recoil pads now come as standard equipment on some of the higher-priced rifles.

Whether you buy it or make it, a top-quality, one-of-a-kind rifle—such as we are building here—should have a slightly curved steel buttplate for the stock to look and feel right. On rifles with severe recoil, a rubber recoil pad can be used, but if so, it should be one with solid walls and should not have any off-colored stripes or spacers running through it. The color should match that of the grip cap, which should match that of the fore-end tip, if one is used.

Up until a few years ago there was a well-finished and -shaped checkered steel buttplate (known as a Neidner steel buttplate) available from several sources. A matching grip cap was also available. These appeared to be stampings and were lightweight and nicely finished and sold at a very reasonable price. Herter's Inc. sold a similar steel buttplate and grip cap that were fairly attractive and finished, but they were ruined (for a real conservative like me) by having a cheap-looking little shield stamped in the middle with checkering around it. The shield ruined it for many of us. There was a way to salvage it, however. We milled the inside away, leaving a steel ribbon some 5/16-inch-wide around the outside plus room for four screw holes. This made what is known as a skeleton buttplate, which was mostly standard on high-grade double shotguns (e.g., Parker) and on many deluxe sporting rifles.

Suddenly these were no longer available. Herter's went out of business, and the Neidner was apparently discontinued. When the existing supply was exhausted, there were no more. A few custom gunsmiths offered versions of these at a considerably higher (but well worth it) price. It was either buy these or make your own. I chose the latter course.

It should be noted that the Neidner caps and plates again became available a few years later. However, instead of the lightweight stamped items as made in the past, they were now investment castings that are thicker, heavier, and nowhere near as well finished. I continued to make my own.

For large-production runs of these, it would be wise to make up a set of dies that could be stamped and formed quickly. But for the home shop, which would require only a dozen or so per year, this would be impractical. The method I used was time-consuming, but the end result was the same. I say "was" because, as I have stated before, I am no longer able to do any gun work.

A form block is made up in the same shape and contour as the butt end of your proposed stock. This should be made from extrahard wood, such as cherry, oak, and ash. Black walnut can be used, but it won't last as long. It should be long enough to allow mounting solidly in the vise.

A sheet-metal blank of the size and shape required is cut from 14-gauge material, and the screw holes are drilled and countersunk. The blank is put in place on the form block, and the upper screw is installed. A light ball-peen hammer with the flat (peen) end ground and polished to a slight convex shape is used, with light blows, to form the rounded heel contour and the slight curve between the screw holes. The lower screw is installed, and the exact contour is formed using light hammer blows. If care is used, very little deformation or very few dings from the hammer will be present. A brass hammer would be useful here. The outer surface and edges are finished smooth with a drum or disc sander and polished as described for the other metal parts. It can be colored by bluing or case-hardening, or left bright.

Skeleton buttplates and grip caps are made in the same fashion, with the inside machined out similar to the patterns shown here. A slight amount of draft around the inside edges makes fitting easier. These are installed by removing wood around the outer edges until the plate or cap fits over the inner wood portion closely with the surface flush with the wood. The exposed wood portion can be finished smooth or checkered.

Grip caps can be made by forming a slight dish to the interior and mounted with a center screw. If a skeleton type is required, a screw is used at the front and rear. These can also be made from hardwood, preferably ebony if used with a black steel buttplate. Other wood can be dyed or stained black if desired.

Both buttplates and grip caps similar to these, and of several other designs, are available from gunsmith supply houses.

Leather-covered recoil pads are sometimes desirable. These are often found on the very best British guns, among others. Well done, without wrinkles or seams, they will add class to the gun. Sloppily done, they look horrible.

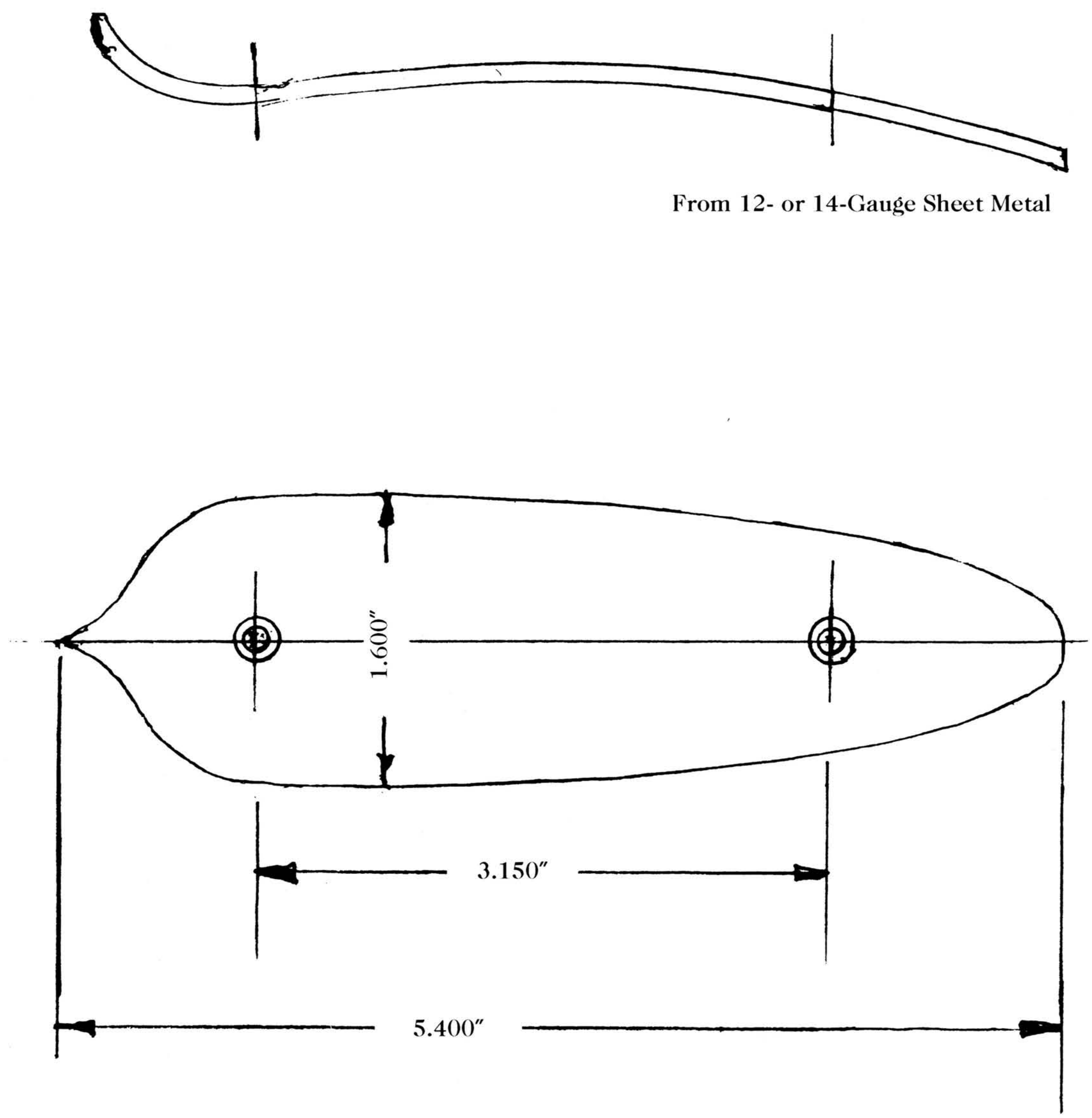
In practice, the pad is shaped to fit flush with the buttstock. Just slightly (the thickness of the leather) smaller if possible. The screw holes are drilled to fit over 1/4-inch locating pins made from dowel rod, which is installed in corresponding holes in the end of the stock.

A wood block of an inch or more in thickness is shaped to the same size and contour as the recoil pad and located against it with the same size pins.

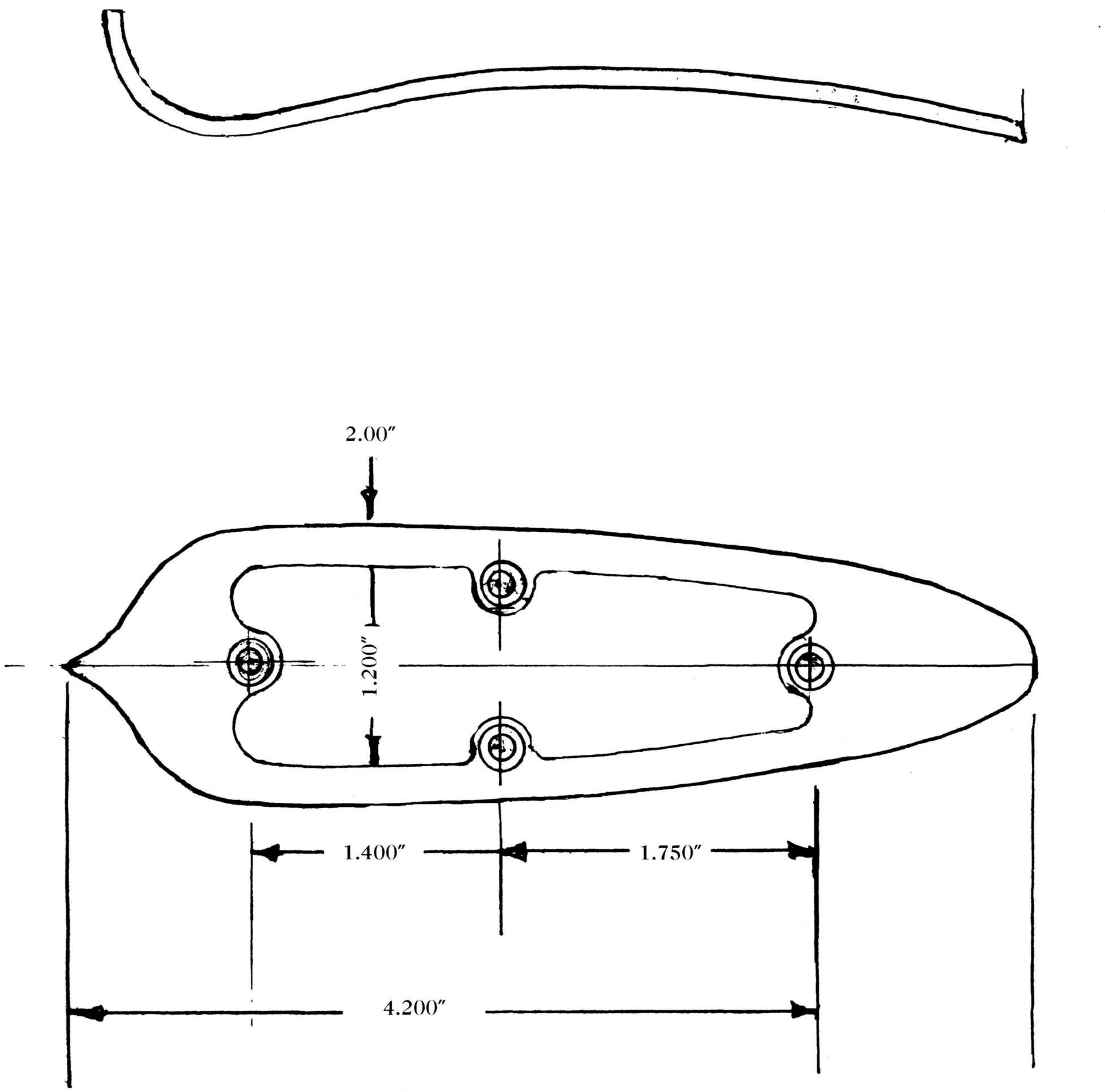
Extrathin leather (goatskin works well for this) is soaked in water until pliable and stretched over both the pad and block. When stretched and molded to fit over the pad without wrinkles, the area overlapping the wood block is fastened to it using small nails or tacks.

When thoroughly dry, the nails and wood block are removed, and the leather cover is cemented to the edges of the pad base. When the cement has dried, the leather is carefully trimmed flush with the pad face. An X-acto knife works well for this. The pad is secured to the stock, with the locating dowels in place, using a thin coat of epoxy cement, which must not be allowed to bleed out around the edges.

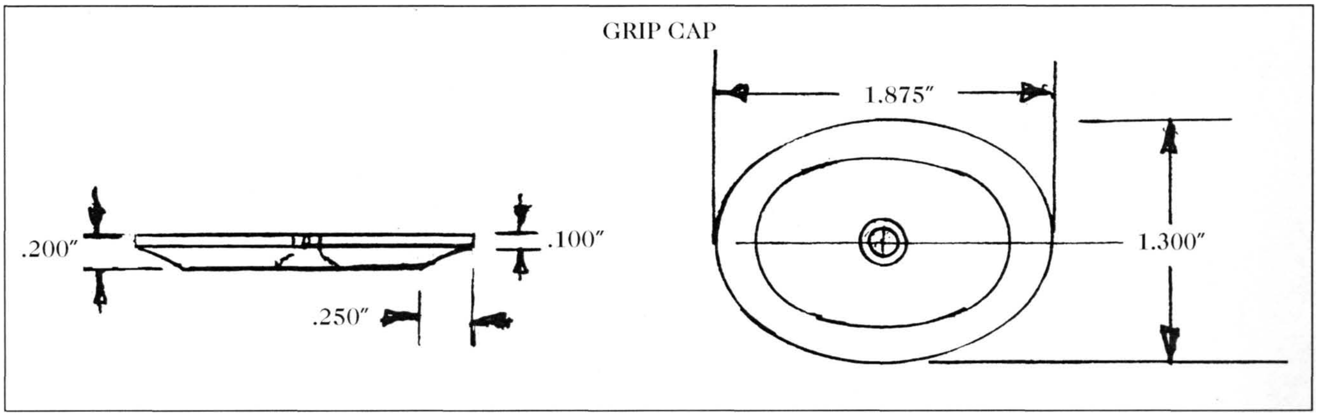
Please consider that my own conservative tastes were acquired through many years of observation of what others considered the very best. If such does not appeal to you, then by all means, change whatever part you don't like to suit yourself.

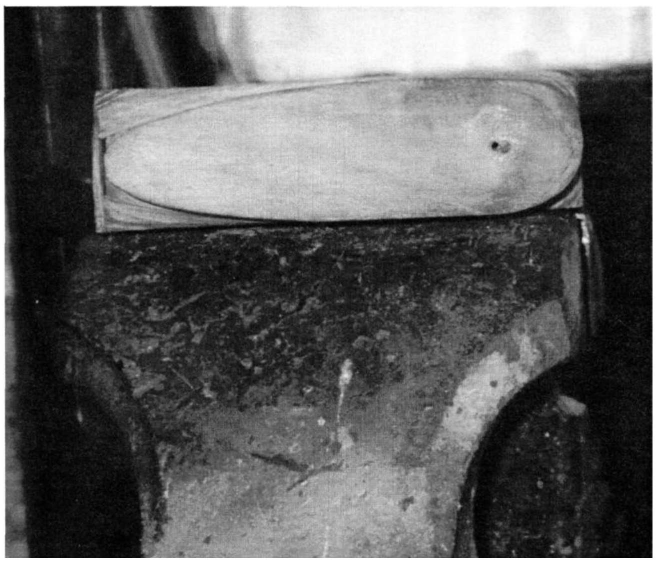


BUTTPLATE

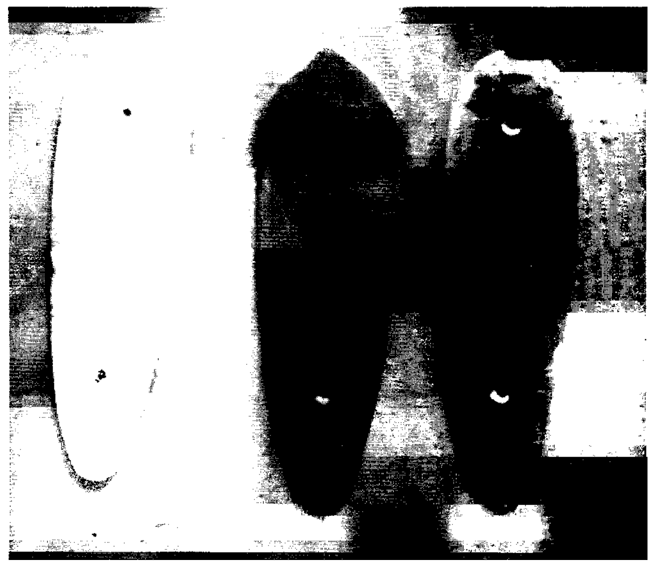


SKELETON BUTTPLATE

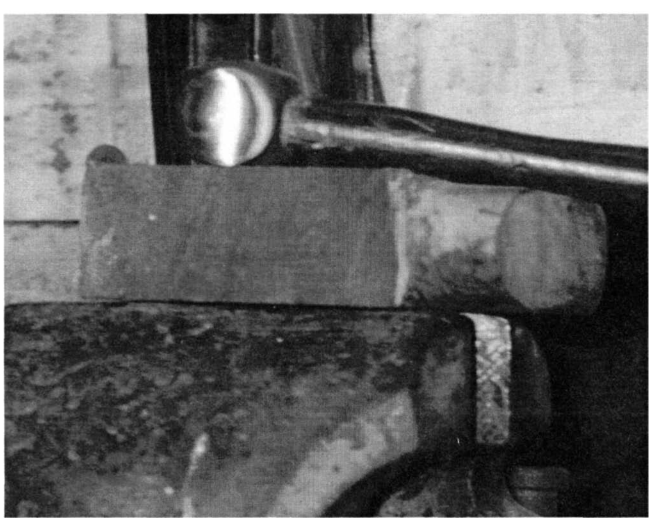




End view of form block.

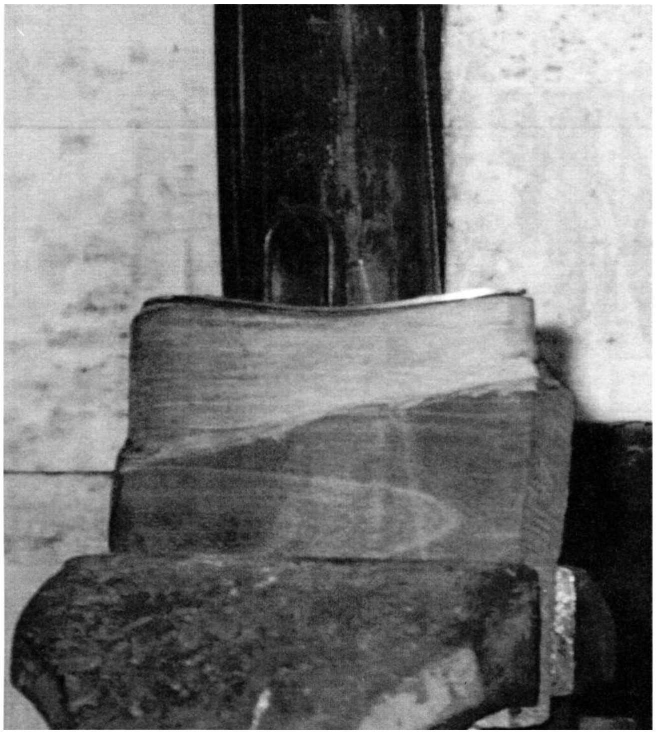


Buttplate blank is cut from sheet metal. Shown is cardboard pattern, flat blank and formed blank, ready for polishing.



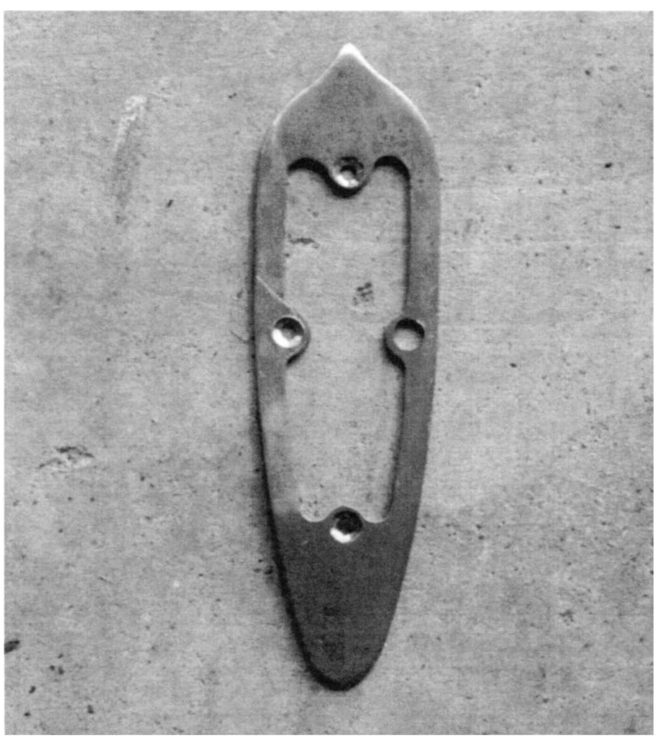
The face of the hammer should be slightly rounded and polished smooth.

The form block is shaped to the desired contour using dense hard wood. Walnut was used here.

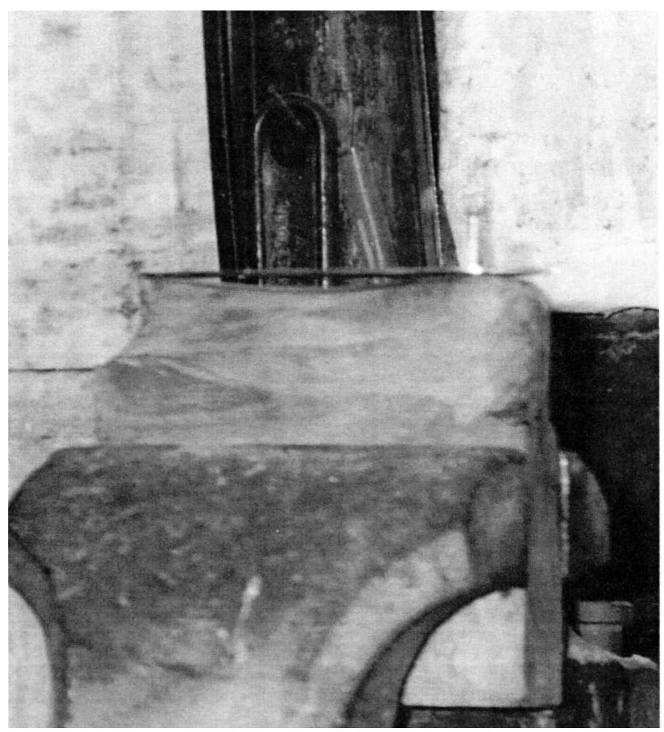


The final forming is done using light hammer blows.

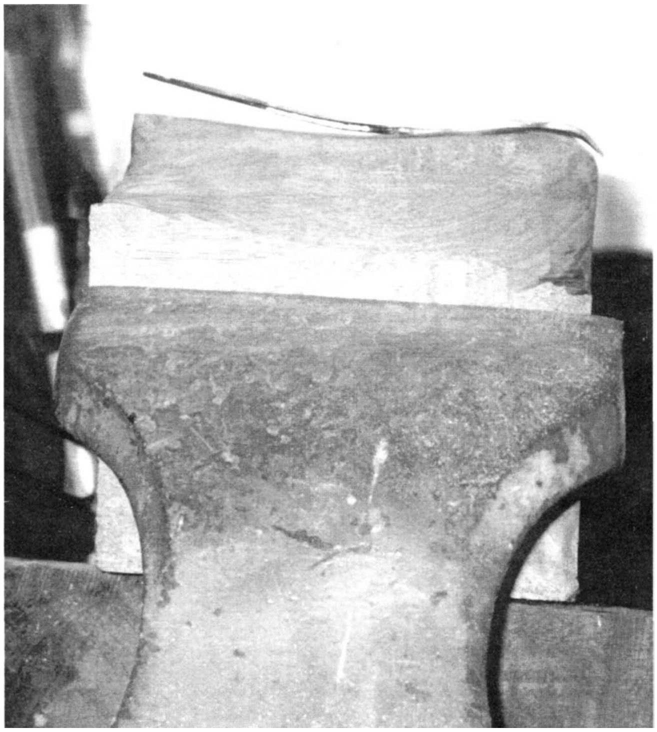
Shown here is a finished skeleton buttplate (left) with a finished solid plate, whieh has a case-hardened finish.



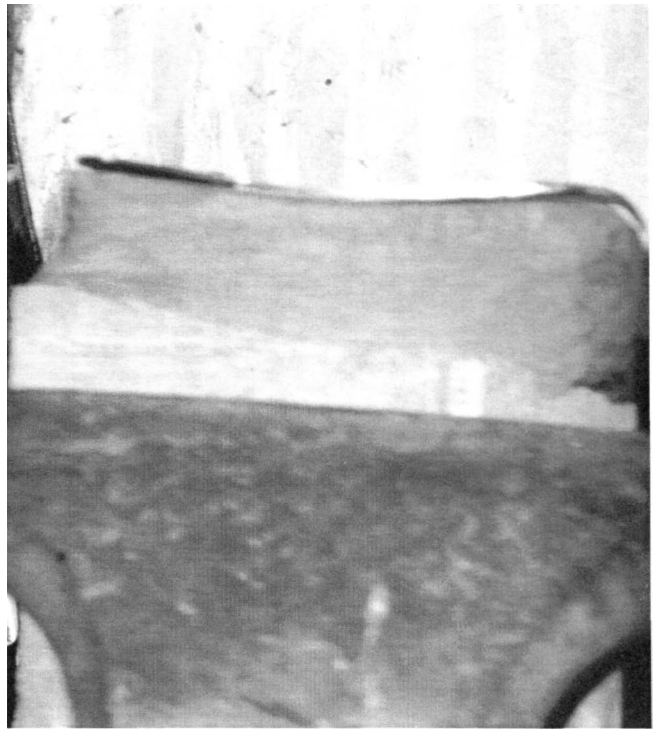
A blank for a skeleton buttplate is made by removing inside material.



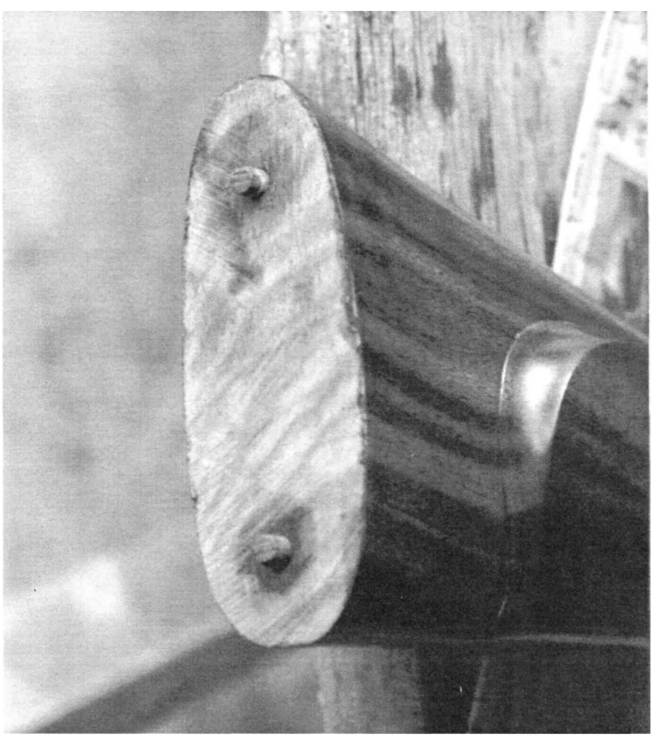
The blank is held in place against the form block by an upper screw.



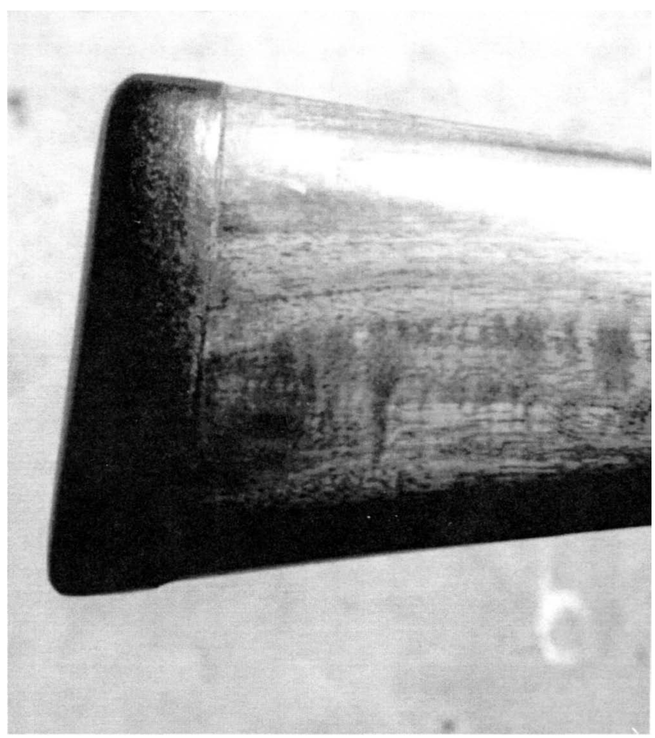
The heel (upper end) of the plate is formed with only the upper serew in place. It is shown here partially formed.



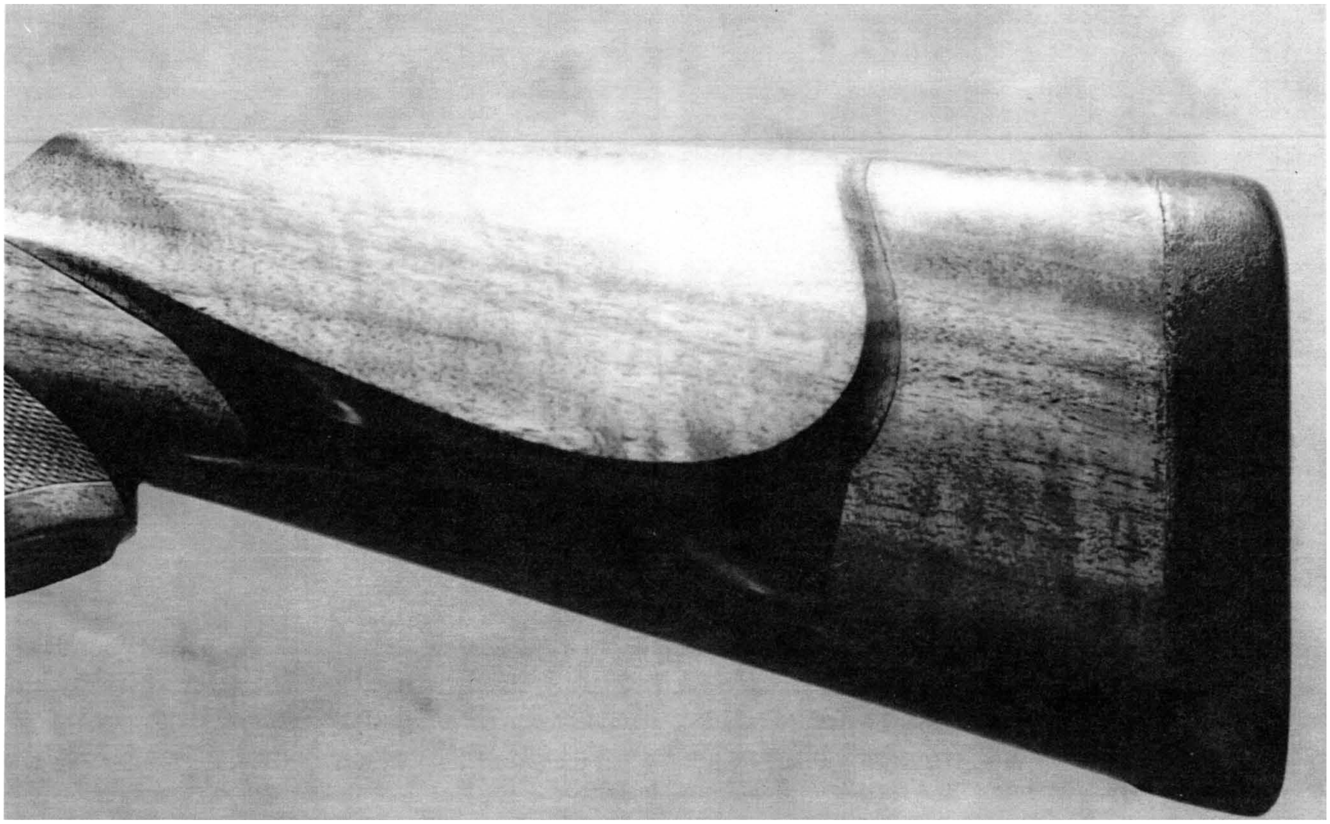
When the forming is almost completed, the lower screw is installed.



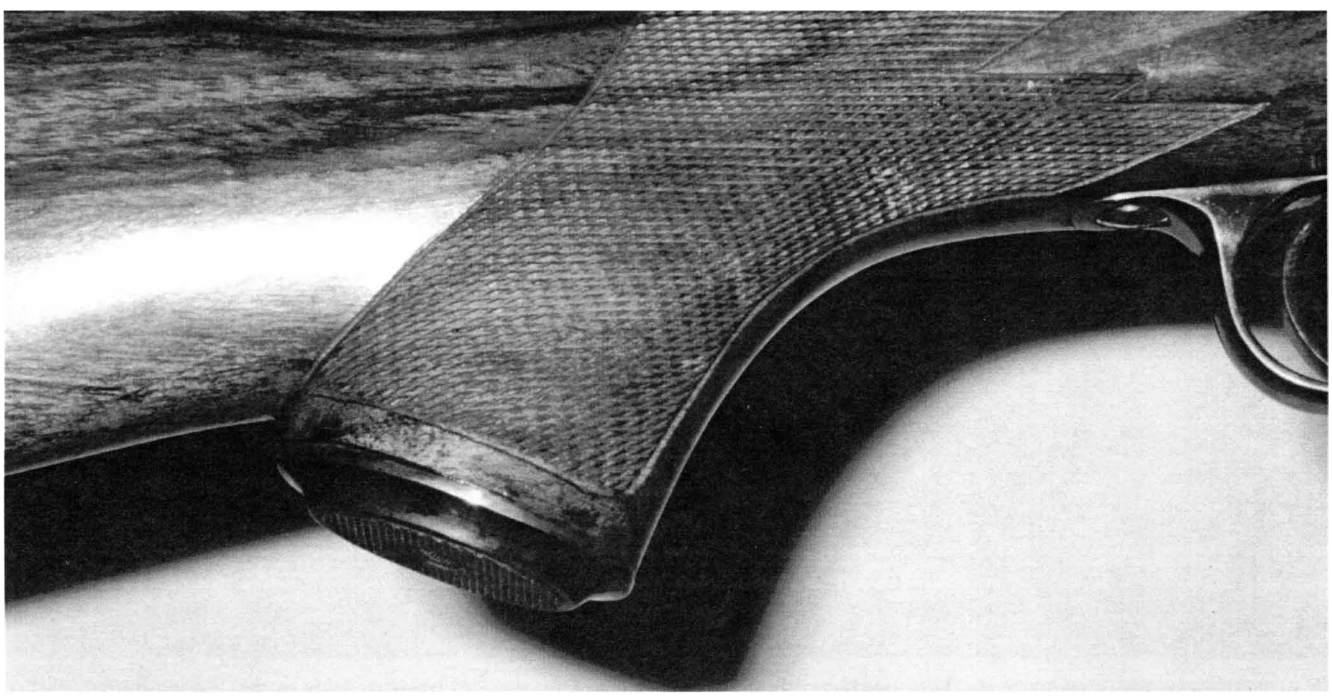
Dowels must be used to locate the leather-covered pad, which must be cemented in place.



The pad in place on the stock. It must be wrinkle free to be acceptable.



The left side of the stock with leather-covered pad.



Ebony grip cap in place on the stock.

CHAPTER SEVENTEEN

Heat Treatment

Regardless of the material used, some of the component parts described here will require heat treatment. In part, this is to reduce any tendency to bulge, stretch, or otherwise distort, but also to inhibit any tendency to batter, upset, or wear excessively.

All parts of the action should be installed and fitted until the desired functioning is achieved. The parts should be polished almost to the desired final finish. They will need a final polishing with the finer grades of paper or buffing compound before bluing.

The bolt and receiver, if made from 4140 or 4340 as recommended, should first be normalized by heating to 1,700°F and allowed to air-cool. They are then heated to between 1,550° and 1,600°F and quenched in oil, at which point they will be almost as hard as glass and also brittle.

After cooling, all traces of oil are removed, and the part is again heated, this time to a temperature of 800°F if made from 4140. This draws the temper to a hardness of 38 on the Rockwell G scale. It now has a tensile strength of 180,000 pounds per square inch (psi) and a shear strength of 135,000 psi. If 4340 material is used, the same normalizing temperature of 1,700°F is used. However, this time the hardening temperature is slightly lower at 1,500° to 1,550°, and the draw temperature should be 1,000°. This results in the same RG38 hardness with a tensile strength of 178,000 and a shear strength of 156,000 psi. This is far more than required for a rifle action.

The bolt sleeve, cocking piece, and safety should receive the same treatment since they are made from the same material. Because these parts are small enough to be heated evenly with the torch, they can be processed in the same way as the other small parts.

The bolt and receiver especially must be processed by a professional shop, with the equipment and knowledge to do it right. I have seen, and had experience with, a number of small shops that obtained a small furnace and became instant experts on all phases of heat treatment. Many of these can probably do all right on other things but can easily ruin gun parts.

One such individual, who talks a better game than he practices, enticed me into letting him do my heat treating. I took several shotgun bolts to him with written instructions on how it was to be done. He assured me that he knew exactly what I wanted and how to do it.

When I returned to pick up the parts he went into a lengthy description of how he had packed the insides and pin holes with steel wool to prevent scale and how he had used a case-hardening method that I had never heard of. This, he said, was far superior to the procedure I had asked for. He then proceeded to charge me almost twice as much as the heat-treating company I had been using.

After a final polishing of the parts, the guns were assembled and test-fired. The first one lasted for three shots before one of the bolt lugs broke off. The second let go on the first round. I quit shooting at this and took them back to the shop. After disassembling them I laid one of the broken bolts on my anvil and hit it with a hammer. It shattered like glass. When I confronted the "expert" with this, he admitted that he has used a process for low-carbon steel and was unaware that it would overharden the alloy steel to such brittleness.

Another self-proclaimed expert, this time a knife maker in a nearby town, obtained a kiln intended for baking ceramics. He insisted that he had a state-of-the-art operation and could take care of any heat treatment I needed done. On this one particular day I had two .50-caliber sniper-type rifles completed and needed the bolts and barrel extensions heat-treated rather quickly. I went to his shop and told him what I needed. As it turned out he could do it immediately, and he quickly fired up his furnace. It didn't take long to reach the required temperature, and I asked him to let the parts soak for a little while to ensure an even temperature throughout. He complied with this. However, he removed a basket containing all four parts and placed them on the side of his furnace. He picked one and quenched it in a litde container of oil, which immediately began boiling. When he removed it from the oil it was still glowing a dull red. This one was followed, one at a time, by the other three, which had cooled to a point where the process was valueless. I waited until they had cooled some more and dunked them in water. They were softer than when I had taken them in.

After this I went back to the real experts that I had been using before.

The moral of this is to teach you that a loud mouth doesn't necessarily guarantee knowledge. Be sure your people know what they are doing before you turn them loose on something as important as gun parts. You may have your parts ruined.

Remember one thing, though: it is always better to err on the soft side when heat-treating parts. The parts worked over by the knife maker were simply redone with no harmful effect. The bolts done by the first genius were ruined. At least, the first two were; I had the rest annealed and redone, which made them serviceable again. But think what might have happened if the first two had lasted a little longer (I usually fired five test rounds through each gun) and I had shipped these guns to customers.

If made from leaf-spring stock, the trigger, sear, and bolt stop can be heat-treated with an oxy-acetylene torch. Each part is fastened to heavy wire as a means of handling it; heated individually to a bright cherry red, which indicates a temperature of 1,450° to 1500°F; and quenched. When the part is cool, all traces of the oil are removed, and it is polished bright. This is done so that the color can be observed and the part heated until a pale-blue color is seen. This will draw the temper to a hardness of near RG50, which will resist wear and is ductile enough to resist breakage.

If none better is available, low-carbon steel can be used for these parts and case-hardened through the use of a compound such as Kasenit. This is not recommended, however. Think back on the amount of work that was required to make these parts. It would be a waste to lose the parts through carelessness or shortcuts.

CHAPTER EIGHTEEN

Finishing and Coloring

In each of my previous books I have described at least one different method of bluing, as well as other finishes. There is no need for a lot of repetition here, except for the fact that I need some extra words to fatten out this chapter!

Just kidding. The prototype rifle featured in this book is special and deserves the very best finish you are capable of. So a few words to help you achieve this are not out of place.

Every part of this rifle should be finished by hand. Curved surfaces should be round, true arcs of circles, with no low places or flat spots. The flat surfaces likewise should remain flat and straight. All edges should be sharp and square with no rounding off of corners. Screw holes should have flat, square edges with no dishing or low spots surrounding them.

The barrel should be examined carefully. Sight down it lengthwise: if it has high and low spots, they will be readily discernible to the eye. If they are present, the barrel must be draw-filed.

The correct way to do this is to support the barrel at each end, holding it between centers in the lathe, or with one end held in a vise and the other end blocked. Any way that holds it fairly solid will work. A fine-cut flat file, commonly known as a "mill bastard," is grasped by each end and advanced sideways along the barrel with steady pressure. This removes steel in fine ribbons, much like steel wool, and leaves a smooth finish. It also leaves the barrel covered with very small, lengthwise flats, which tempt one to remove them with buffing wheels. This would likely return it to the same condition it was in to start with. Remove these with abrasive cloth strips, in progressively finer grades, used in shoe-shine fashion, around the barrel, until roundness is restored. It is then polished both lengthwise and crosswise, finishing with 500-grit paper.

The top surfaces of both the front sight and quarter rib should be given a non-glare finish of some sort. The barrel and sides of the sights should be covered with masking tape before the exposed surfaces are sand- or bead-blasted. They can be matted through the use of a Dremel electric engraving tool. This little rig operates at 7,000 strokes per minute and, with a little practice, will impart a fine, even, frosted surface. The top surfaces could be checkered with a fine metal checkering file, but this is extremely time-consuming and won't look any better than the matted surface.

The sides should be polished lengthwise with abrasive cloth or paper-wrapped around a flat backing block. They should be draw-filed first if necessary.

The receiver is also draw-filed if required and polished in the same fashion as the barrel. Flat surfaces and edges, such as those surrounding the ejection port, must remain sharp and flat, and the front and rear ends of the receiver should remain flat and square. All sharp corners should remain that way.

The bolt is finished using the same methods. The stub where the handle joins the bolt should have square edges and corners, which blend into the round shaft and knob. The little concave flat on the outer side should also have square, sharp edges.

Such small parts as the trigger, safety, bolt sleeve, cocking piece, and bolt stop can be finished flat and square by placing fine "wet or dry" abrasive paper on a thick piece of glass and rubbing it back and forth (in the same direction) until the desired degree of finish is reached. The trigger curve and inside of the trigger guard can be rough-polished with an appropriate-sized drum sander and finished by hand.

The trigger guard and magazine bottom edge, including the front tang, are hand-polished lengthwise with the abrasive wrapped around a flat block to avoid dishing the screw holes. This is done with the floorplate and floorplate latch in place, which results in matching flat surfaces at the hinge. The remainder, or floorplate proper, should have a rounded, slightly convex cross section with sharp corners and straight lines along the edges.

Action screws should fill the screw holes, flush with the surface of the tangs, with thin, narrow screwdriver slots, which are likewise straight and sharp. The screw heads should be rounded slightly. An otherwise plain surface can be made more attractive by checkering the screw heads with a fine metal checkering file.

The only power polishing or use of buffing wheels that should be permitted here is when using the white 555 polishing compound. This should be used first on a hard felt wheel, followed by the same on a loose muslin wheel. If all scratches and imperfections have been removed, this yields a mirror finish you can see to shave in. If even slight scratches remain, however, they stand out like a sore thumb after the bluing is completed and will ruin an otherwise near perfect job.

With the super-deluxe metal-finishing job we have here, only two methods of coloring them should be considered: the caustic blue used by most manufacturers and gun shops today, which would really compliment the mirror finish we have imparted on the metal; and a rust blue, which may result in a slightly duller luster in the final finish because it sometimes requires etching before the solution will take. This latter method takes considerably longer to apply.

As I stated at the beginning of this chapter, both of these methods have been described in detail in my previous books, along with formulas for mixing the solutions.

There was a time when this was practical, but government agencies have restricted the sale of various components and caused others to be diluted to a point where they no longer work the way they once did. If these components are even available, the price of most has escalated to a point where it is no longer practical to mix your own. Ready-mixed salts and solutions that work well and eliminate the hassle of trying to make your own are available from several sources. Buy these and follow the instructions that accompany them.

CHAPTER NINETEEN

Adjusting and Test-Firing

At last, the goal is reached—the rifle is finished. One last time, you will assemble it and finally, for the first time, shoot it.

It is wise to check for proper fit and function as the rifle is being assembled. Mere bluing or heat-treating of parts has been known to cause dimensional changes.

The iron sights should be installed and bore-sighted. This is done by clamping the barrel and receiver in the vise and lining the bore up on some distant object. I have a black cross painted on a white board that is attached to a board fence some 50 yards distant for this purpose. I center the bore on this cross. The sights are adjusted, by filing or moving, until they too line up centered on the cross. The same is done when mounting a scope. This, of course, is not exact, but it should be close enough to zero the rifle by firing.

The bolt stop, trigger, and sear are put in place in the receiver. Test the pivot pins for binding in the holes in the trigger and sear before installation. Heat treatment sometimes causes these to grow. If binding is present, which can also be caused by scale, run a drill or reamer through the holes to relieve them.

Reassemble the bolt and check the firing pin protrusion. It must be between .055 and .060 inch. Adjust this, if necessary, before proceeding.

With the bolt in place in the rifle, pull it smartly to the rear. If the bolt stop doesn't stop it and allows it to be pulled out of the receiver, a stronger spring is needed or the bolt should be given a slight hook where it contacts the bolt. If any negative rake is present, it may cam its way open when pulled against, thus releasing the bolt.

With the safety engaged, pull the trigger. If you hear a slight click and the firing pin snaps forward when the safety is released, something must be done. A small amount of metal must be removed from either the sear face or the front lower edge of the cocking piece. This will cause the safety to hold the cocking piece back slightly, with no pressure on the sear, and let the trigger snap back into engagement with the sear. This is what holds the firing pin in the cocked position. Be sure to check this carefully. If such a condition is present, the rifle may fire when the safety is released.

Check the trigger pull. It may very well have changed since its last installation. Readjust if needed.

With the extractor and ejector in place, the rifle is checked for feeding and ejection. If dummy rounds are available, they should be used for this. Otherwise, the firing pin assembly should be removed while working several rounds. This is done both with single rounds and from a full magazine. No accidental discharge is possible when done this way.

I make no recommendations about the method of test-firing this rifle. If the specified material was used, the heat treatment was competently done, and the firing pin protrusion is within limits, the rifle should be safe enough. I simply held the ones I built out in one hand and fired them, as with all the other firearms I have built. But I have confidence in my materials and workmanship.

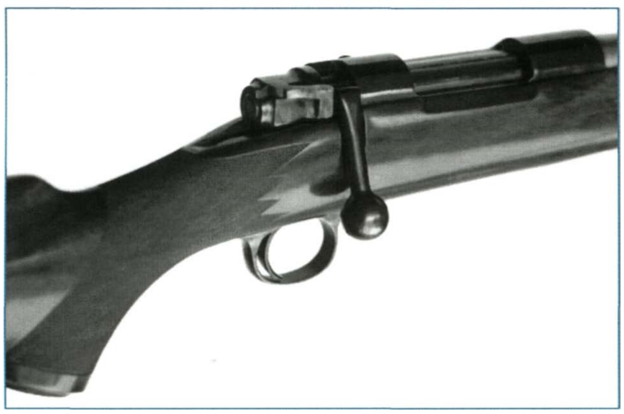
If you have doubts—probably even if you don't—you should remove the stock to prevent marring it, tie the barreled action down, and fire it from a distance using heavy string to pull the trigger. Use your own judgment here and don't take anything I say as a recommendation.

Make certain that there is no live round left in the chamber. Not long ago I test-fired the .308 sniper rifle pictured near the front of this book quite by accident. I had just assembled the receiver to the barrel, which was held between blocks in my vise. I had not yet installed the extractor in the bolt. Although I had cut the chamber to a minimum length using a headspace gauge, I decided to see if the bolt could be felt closing on a cartridge. For some reason, I became distracted and didn't remove the live round used for the trial from the chamber. Some time later I installed the extractor and firing mechanism in the bolt and slipped it in place. Then, like the damn fool that I am, I pulled the trigger. Since I was standing almost over the muzzle brake and was not wearing ear protection, it sounded like a stick of dynamite . . . make that two sticks of dynamite. Not only did the rifle fire, the bullet took one corner off my milling machine vise. Then parts of the bullet went through a nearly new bench grinder, wrecking it, and some sort of shrapnel from it went through my drill press motor. However, the rifle suffered no ill effects from the "test-firing."

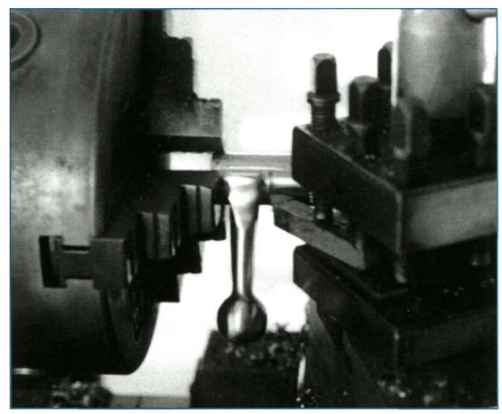
The above should demonstrate that you should *not* take advice from me regarding gun safety.

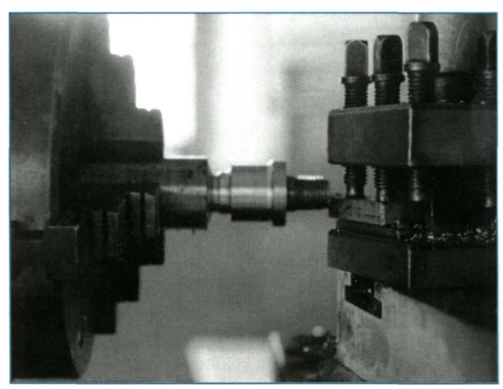
After test-firing the rifle the headspace should be checked, and the bolt and receiver should be inspected for cracks or deformation. If everything checks out, fire several more rounds and check it again. If everything is as before, you now have a rifle you can be proud of. After all, you built it completely from raw materials. Very few rifle builders can truthfully say that.

Remember one thing above all else: as I have made clear in previous volumes, neither the publisher nor I can accept any responsibility whatsoever for any problems experienced with your rifle since we have no control over the materials or the workmanship.



MANY PEOPLE TODAY call themselves gunmakers, but very few have actually *made* a gun. Most buy parts wherever available and simply assemble them. During the past 50 years Bill Holmes has built from scratch countless rifles, shotguns, and pistols of amazing artistry, ranging in caliber from .17 to .50 and just about everything in between. In the process he mastered the art of custom-making all the component parts himself and earned the right to call himself a *gunmaker.*





The bad news is that Bill Holmes no longer makes firearms, so you can't have him turn out one of his precision-crafted specimens for you. The good news is that you can learn to make your own from this esteemed gunmaker.

This book shows you how to make (or modify) a custom bolt-action rifle in a small shop, using single-point tools. By following the simple instructions and mechanic's drawings, you will discover how to select the design, materials, and tools; manufacture the bolt, trigger, safety, and sights; fit, chamber, shape, and finish the barrel; ensure that your heat-treating is done properly; design, checker, and finish the stock; and everything else you need to know to be able to call yourself a *gunmaker*.

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