The Study of Gunsmithing



Sonoran Desert Institute
1921

MODULE NUMBER 1

Introduction to Gunsmithing



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MODULE NUMBER 1
Introduction to Gunsmithing

2163 Introduction to Gunsmithing

2164 Types of Firearms

2165 Firearm Fundamentals

2166 Setting Up Your Shop

2167 Gunsmithing Tools and Their Uses

2168 Firearms Identification (#)

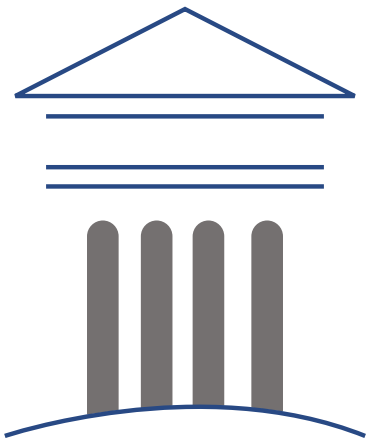
(#) Indicates point in your program at which additional lesson materials will be sent as you complete and return the lesson exams for grading.

Sonoran Desert Institute

1921

Introduction to Gunsmithing Lesson: 2163

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Objectives

When you have completed this lesson, you should

1. Have a study schedule for completing this course.
2. Have an understanding of the need for trained gunsmiths.
3. Be familiar with the rules for safe firearms handling.

Introduction

Welcome to the world of gunsmithing. It is a fascinating world with many opportunities for individuals who want to make a good future for themselves. Gunsmithing is also suited to those firearm enthusiasts who want to keep their own firearms in perfect operating condition and have features on their guns that are unobtainable from the manufacturers. In either case, you have taken an important first step by deciding to take this course in gunsmithing.

Consider us at the Sonoran Desert Institute your partners in your climb up the ladder to the future you want. We want to help you achieve success as you learn about firearms—everything about firearms—from troubleshooting and repairs to building one-of-a-kind custom rifles. We will be at your side every step of the way, helping you learn and helping you start your new career as a gunsmith.

But even if you do not want to go into gunsmithing on a full-time basis, the course will still do many good things for you. What you learn from the course will enable you to troubleshoot and repair almost any firearm. No more waiting several months to get your own firearms repaired by a professional. With Sonoran Desert Institute training and the accompanying tools, you will be able to do most jobs yourself. Once you get your Federal Firearms License ($200 for the first 3 years, $90 on renewal, but check with the BATF, as these fees may change), you will also be able to buy guns and ammunition at wholesale prices, which can mean a significant savings to you.

Whether you are going into the gunsmithing business full-time, or just want to make sure that your own firearms give you the kind of service and accuracy you want, you are ahead with the Sonoran Desert Institute course on gunsmithing.

Over 20 million hunting licenses are issued each year in the United States, with over 300 million firearms in use. There are also thousands more being manufactured or imported each year. All of these firearms will eventually need repairs. This is where you come in. With the knowledge that you gain from this course, and the practical shop experience we recommend for you, you should be able to cure many of these "sick" guns and put them back into service—all the while getting paid for your time.

Furthermore, you can learn the ins and outs of all types of firearm actions—single-shots, bolt-actions, lever-actions, slide-actions, and even semi-automatic weapons. This knowledge will broaden your opportunities for profitable employment with existing gunshops or firearm manufacturers. Really good gunsmiths are in short supply in the United States.

The beauty of the Sonoran Desert Institute gunsmithing program is that you can start out by handling minor gun repairs, mounting telescope sights, boresighting rifles, installing rifle slings, and such at nights or on weekends while still keeping your regular job. Then later, as business builds, you can go to work in a regular gunshop or open your own business. Either way, the training that we provide for you will help you every step of the way.

Your Sonoran Desert Institute training is designed to make you a "top-notch" service technician. You will learn not only how firearms work and how they are constructed and operate, but also how to fix the trouble when something goes wrong. You will also learn how to turn a rusted and badly abused firearm back into a thing of beauty in the lessons and training exercises on bluing metal and stock refinishing. And that is what being an expert is all about. The expertise we offer you in the gunsmithing course will equip you to handle just about any gunsmithing job that comes your way.

How to Study

Naturally, you want to become an expert gunsmith as quickly as possible. Your lessons have been carefully planned to help you receive the most from your investment of time and money. However, even the best assignment is only as good as your own use of it. We want you to do well, right from the beginning. To help you, here are a few suggestions on how to get the most out of the lessons we send you. Read them carefully. Over the years, these suggestions have been successfully followed by tens of thousands of distance education students. The closer you stick to these suggestions, the more rapid your progress through the course and the better your understanding of the material will be.

Reading the lessons and learning what is in them is not as easy as reading the evening paper. This is because you read the lessons to learn facts and to remember them. We have done all we can do to make the lesson easy for you to read. The lessons have been analyzed by experts for readability and for ease of understanding. Even so, some of the facts may be a little hard to understand. Following these rules will make comprehension easier for you:

- When you start on a lesson, turn the pages one by one. Look at the illustrations. Read the section headings carefully. This will give you an idea of what the lesson is about.
- Read the first section of the lesson. The first section is the introduction, and it tells you what you are going to find in the lesson.
- Read through the lesson section by section. If you come to anything that is not clear, reread that part of the section again. Sometimes it helps to read the sentences aloud. If this does not help, write the sentences down on a piece of paper. This often makes the meaning jump out at you.
- Do not hesitate to admit that something puzzles you. Everyone gets stuck once in a while. That is where the Sonoran Desert Institute Consultation Service comes

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1 Study 8:30 - 10:30
2	3 Study 7:30 - 9:00	4	5 Study 9:00 - 10:30	6	7 Study 8:30 - noon	8 Study 8:30 - 10:30
9	10 Study 7:30 - 9:00	11	12 Study 9:00 - 10:30	13	14 Study 8:30 - noon	15 Study 8:30 - 10:30
16	17 Study 7:30 - 9:00	18	19 Study 9:00 - 10:30	20	21 Study 8:30 - noon	22 Study 8:30 - 10:30
23	24 Study 7:30 - 9:00	25	26 Study 9:00 - 10:30	27	28 Study 8:30 - noon	29 Study 8:30 - 10:30
30	31 Study 7:30 - 9:00					

Figure 1: *A typical student's learning schedule. Student has built schedule around favorite tv programs.*

in. You just use one of the consultation form we supply and write us about your problem. We will send you a reply that should clear up the difficulty. Your instructor will give you all the help possible so your training goes smoothly.

- Do not worry if you do not understand everything the first time you read it. Most good students read and reread their lessons several times. That's the way to make it stick! Now, let's get down to the facts of how and where to work on your lessons—that is, let's set up a learning schedule for you.

YOUR LEARNING SCHEDULE

Let's plan your learning schedule. That is, let's see what time of day you should work on your lessons, how many days a week you should set aside for the lessons, and what hours you should use for study. But let's not call them "study hours" or "learning hours," let's call them "success hours." Every minute that you spend on the lessons brings you that much closer to success.

As we said, you should decide which days are best for you to work on your lessons. Then you should decide on the time of day that would be best for you. Now, make up your own personal learning schedule, like the one in Figure 1. On your calendar for each month, write in the days and times you will study. Space your learning sessions—your success hours—close together. The ideal arrangement is to devote some time to your course each day. If you cannot spare one or two hours, work on the lessons for 45 minutes or even for half an hour, whatever time you can spare.

Keeping regular success hours is the key to effective learning. You can learn and remember much more from studying 30 minutes daily than from longer sessions spaced several days apart. Studying regularly keeps the instruction fresh in your mind. If three or four days pass between study periods, you may forget most of what you learned from your last session. Once you have planned your study schedule, stick to it. Skipping one success hour in an emergency is not going to set back your progress a great deal. However, skipping a session for no real reason can lead to skipping another session and then another one, until eventually you are making little or no progress in your lessons. Do not let this happen to you!

TAKE A BREAK

Unless you are accustomed to studying regularly, you may find that you tire easily. This is not unusual. It will take time for you to get into the study habit.

In the beginning, make your success hours short and break them up with periods of rest. After you have completed several lessons, you will be able to study for an hour or more in one session without getting tired.

It is important that you do not make your schedule too ambitious in the beginning. Until you get used to studying again, two short periods of study with a break in between are better than a single long study period.

BE FAIR TO YOURSELF

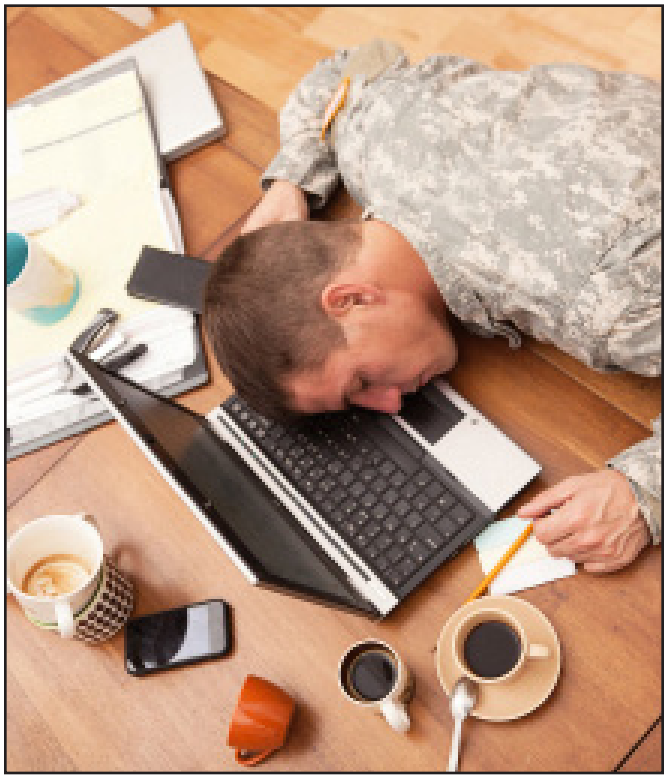
Be sure your study schedule is reasonable and is one that you will be able to follow. This schedule should not deprive you of time for other activities. Each activity gets its fair share of attention with a carefully planned schedule. Although you will have to work to get ahead, be sure you leave time for relaxing activities. You will make better progress in the long run.

WHERE TO STUDY

If possible, you should have a regular place to study. Naturally, this place should be relatively free of distracting noises. You cannot successfully study your lessons and watch television or listen to the radio at the same time. You have to devote your full attention to your lessons. If you do not have a quiet place where you can study, consider going to a public library. Most libraries are quiet and have an ideal study atmosphere. Before you sit down to study, be sure that you have everything you need. Then you will not have to stop in the middle of a lesson to get a pencil or a piece of paper. Keep these materials near your place of study at all times so that you can go right to work once you sit down. There is nothing more distracting than continually jumping up and down. Running to the kitchen to get a pencil or running somewhere else to get some paper or a glass of water leads to bad study habits. Be sure you are ready to study before you sit down.

READING YOUR LESSONS

Do not try to read the lesson as you would read a newspaper. You should read each sentence carefully and then reread it if you do not understand it. If you run into a difficult paragraph where you have to reread several sentences, go back and read the entire paragraph again. This is particularly important in the introductory lessons in which you are studying fundamentals.



REMEMBER IMPORTANT POINTS

Perhaps you have tried to remember someone's name only to continually forget it, but once you have seen the name in writing, you have found it much easier to remember. The same is true of studying. Making notes helps you to remember the material. You do not have to make elaborate notes; a few brief notes, or perhaps only a word or two in the margin of your lesson, will be of great help to you. Remember, the lesson books are yours. We encourage you to write and work in them.

Another technique students often use to help them remember important points is to highlight phrases or key words in their lessons. You may wish to devise your own method to help you remember material you think is important. For example, some students trace and color the line drawings using color pencils or highlighters. This helps them visualize the construction and operation of a part or assembly.

ANSWERING THE SELF-TEST QUESTIONS

At the end of the main sections of most lessons, you will find a group of questions headed "Self-Test Questions." These questions are prepared to help you test yourself, so that you can see how well you have mastered the material in that particular section of the lesson.

When you have studied a section of the lesson and feel that you understand it, stop and answer the Self-Test Questions before going on to the next section. If you come to a question you cannot answer, go on and do the next question until you have tried all the questions at the end of that section. Then, if you have missed one or more questions, you should go back and carefully reread that section of the lesson until you can answer the questions you were unable to answer.

ANSWERING THE LESSON QUESTIONS

At the end of each lesson are 10 questions covering the subjects discussed in the lesson. You will probably find many of the questions easy to answer, while some questions may require a good deal of thought. In some cases, the answer may be a simple yes or no. If you come to a question you cannot answer, do not try to guess. Find that part of the lesson where the subject is covered and reread that portion carefully to find the answer. Looking in the lesson to find the answer to a question is not cheating; it is learning. We are not interested in having you give a wrong answer to a question, we are interested in your learning the correct answer.

To mark your answers to the questions, use the lesson answer card we have provided. Use a soft (No. 1 or No. 2) pencil, not a pen, to mark your answers. Fill in the whole box that you wish to mark. Do not erase; if you make a mistake, code a new card. Mark only one box for each question. Be sure to code your card with the lesson number shown at the beginning of your Lesson Questions.

Use your lesson answer cards for Lesson Question answers only. If you have questions for your instructor, write them on a separate sheet of paper or on the Consultation form. Be sure to write your name and student number on everything you send in. For prompt grading of your Lesson Questions, return your



lesson answer cards only in the Business Reply Envelopes provided. We will periodically send you additional answer cards and envelopes throughout your training. You may also complete your exams and submit them online via the SDI Student Services page at www.sonoranlearning.com.

When you send your answers to us, we will grade them promptly and send the results back to you. You will receive a letter that will show you where you went wrong on an incorrect answer and use your correct answers to emphasize important points. If you should run into a subject in one of the lessons that you do not understand, do not leave out that section. Instead, take advantage of our Consultation Service. Use one of the consultation forms provided to write and tell us what your problem is. If a particular section of a lesson is giving you trouble, refer to the page and paragraphs, and give as much information as you can on exactly what your difficulty is. Your instructor will either expand on the section that is giving you difficulty or explain it in a different way. Do not hesitate to use the Consultation Service as often as necessary. We take pride in the fact that we are always here to help you.



Figure 2: *This custom rifle, built by master gunsmith Don Bartlett, is designed around pre-1964 Winchester Model 70 action. The flawless checkering shown here enhances the high-grade French walnut stock. Such rifles start out at $1,000 and work up to over $10,000 each. Building custom rifles is but one opportunity that awaits the skilled gunsmith.*

Opportunities for the Gunsmith/Firearms Expert

Have you ever stopped to consider the number of sporting firearms currently in use in North America? In the world? Add to these millions the obsolete firearms in museums and collections and the total figure will be astonishing! But wait a minute. How about the military and law enforcement agencies? These bring the total amount of firearms to an even higher figure!

Many people throughout the world depend upon firearms for their livelihood. Guards and police officers depend upon their firearms to help protect life and property, to assist in an arrest, or to prevent a crime. Farmers and ranchers use their firearms to protect livestock and crops against predators and crop-damaging animals and birds. Of course, the use of firearms by the armed forces needs no explanation. Many private citizens also keep a firearm in the house. But the sports enthusiast or collector purchases the majority of firearms.

Anything that goes wrong with a firearm is disappointing to the owner, but in some cases, a malfunction could even be fatal. Therefore, someone has to keep all of these firearms operating. This someone is not necessarily the owner of the gun, who may not have the time, the knowledge, or the proper tools to service firearms. In a busy office, for example, a good computer operator is a specialist, and although the operator can run the computer at its peak performance, he or she normally will not have the knowledge or tools needed to make repairs or adjustments. Some offices often subscribe to a preventive maintenance service that provides regular cleanup and examination of the machine, replacing any parts that are worn or that show signs of giving trouble. Having this preventive maintenance can save any office or factory money that would be lost if the machine failed and production was delayed.

The same is true for many firearm owners. Preventive maintenance is a good policy for any firearm owner. Periodic cleaning of a firearm will keep rusting and other deterioration to a minimum. It will prevent the gun from malfunctioning due to debris and other foreign matter in the action and will extend the accuracy and life of the bore, and other gun parts.

There are many museums, dealers, law enforcement agencies, gun collectors, and others that cannot afford a full-time gunsmith to keep all of their firearms clean and preserved. Nor do they have any other qualified personnel to do this type of work. Such places are good prospects for a reliable gunsmith trained in the repair and maintenance of firearms to offer a periodic firearm inspection and cleaning service. The hunters and collectors and their growing accumulation of firearms offer a tremendous market for gunsmithing services. The average gun owner will not have the proper tools readily available, or the knowledge to use them. Even owners who have both the knowledge and tools will still often seek outside help—they would rather spend their time in other pursuits.

There are also those who have only the back half of an old Model 97 takedown shotgun and want it restored to its original condition. Or, perhaps the restoration work will involve an old Winchester Model 86 that was found buried in the backyard. Restoration work is a rapidly growing field. On the other end of the spectrum is the custom rifle — a one-of-a-kind rifle built exactly to the owner's specifications. There are dozens of custom gunsmiths throughout the United States who can take

a factory-built receiver, a barrel blank, and a hunk of wood, and come up with the smoothest operating rifle you have ever laid your hand on—not to mention the satin rust-blue finish on the metal; perhaps a colored case-hardened trigger guard and buttplate, and an elegant hand-checkered stock carved from burl French walnut. Such a rifle may cost in the neighborhood of $10,000.

Gunsmiths are in short supply. Therefore, the opportunities for employment as a gunsmith are excellent. Sales of new firearms run into the hundreds of thousands each year. Firearm manufacturers continually seek new gunsmiths to help assemble their firearms. Furthermore, manufacturers need hundreds of gunsmiths throughout the country to carry spare parts and to repair the firearms that fall under factory warranty. Nearly every community in the United States could use another qualified gunsmith. Those few full-time gunsmiths who are now in business are usually so swamped with work that most have a 9 to 14 month backlog. There are also hundreds of sporting goods stores throughout the country that could use a gunsmith - especially in the fall when hunting seasons begin in most parts of the United States. There is always a mad rush the week before hunting season to have rifles sighted in, minor repairs made, gun slings installed, and a host of other necessities — including the purchase of ammo and gun cleaning kits. All of these things mean extra money for the trained gunsmith —one who knows the correct answers when they are needed. You can work for yourself or someone else; the pay is good either way.

A BUSINESS OF YOUR OWN

At one time or another, almost everyone has wanted to be his or her own boss—to have a business of one's own. Running a business of your own brings a sense of independence and an opportunity to use your own ideas. You will be the top person and you cannot be fired. It will mean a chance for higher income because you can collect a salary plus a return on your investment.

Your Sonoran Desert Institute training in gunsmithing provides the opportunity for you to become self-employed in a number of ways. If your goal is to have your own business, here are some of the possibilities. Some of these possibilities could be started before you finish your course in gunsmithing.

Many beginning gunsmiths start out on a part-time basis. That is, as they learn about firearm operation, disassembly, troubleshooting, and similar techniques, they get started in the business by servicing firearms of neighbors and friends. If they are good at it, a night and weekend business can grow until it becomes their main business. Here are a few important precautions about working in your home or garage.

First of all, you must have a Federal Firearms License to work on any firearm other than your own. The next lesson will show you how to apply for a Federal Firearms License. Also, check



state and local laws regulating the sale and service of firearms, as well as insurance regulations.

The second precaution is to never load a gun for testing inside of your home or garage. A malfunctioning firearm can discharge at unexpected times, and some can start firing automatically. Many high-powered rifle cartridges can shoot completely through a frame house, so do not take any chances. Always use dummy rounds (cartridges that will not fire) when testing a firearm for feeding or functioning.

The third precaution is that you must observe local residential zoning ordinances and laws about running a business in your home. Some cities or localities have ordinances that forbid operating certain businesses in residential areas. Be sure you do not break the law. A telephone call to local authorities will usually provide the answers quickly.

Doing service work in your free time is a good place to start. This type of business requires the least investment and gives you the security of retaining your regular job while you gain experience. There are many gunsmithing jobs you can do at your own home. As we mentioned earlier, you need a Federal Firearms License, and you must be sure to check the zoning regulations for your neighborhood. Once your business is started, you can use your technical skill to increase the services you provide and increase your profits.

Another possibility is to make an arrangement with a local sporting goods store, or another related business, to use a portion of their store for your shop. A workbench, a bench vise, and the tools you get with your Sonoran Desert Institute course are about all you need to get started. You might have to pay some rent or give the owner a percentage of your fees, but the additional customers the store should get from having a gunsmith on the premises should more than offset any costs.

SAFETY

There are certain safety rules that apply to everyone who handles firearms. The chief rule is never point a firearm at anyone or anything unless you intend to shoot it. This applies to loaded and unloaded guns. Get in the habit of always checking the chamber and magazine of every gun you handle before doing anything else. Even after you have assured yourself that the gun is unloaded, always keep the muzzle pointed in a safe direction.

Make certain the firearm you intend to shoot is in good operating condition with the proper ammunition being used, and that no obstructions—such as a cleaning brush or patch—are in the chamber or bore.

Beyond these precautions, anyone who performs work on firearms should observe the following:

- When inspecting any gun, make certain it is unloaded, but always treat it as if it were loaded.
- Never apply heat to any part of a firearm unless you know exactly what you are doing; even then, proceed with caution.
- Never remove excessive amounts of metal from a rifle or shotgun action at points of stress, such as, receiver rings, locking lugs, and the like.
- When installing replacement parts, make certain that these parts are functioning properly before firing the gun.
- Be careful with trigger pull; avoid "hair" triggers.
- Wear safety goggles when grinding, chipping, sanding, or working with caustic solutions.
- Always make certain that you are competent and understand the principles of a gunsmithing job before attempting it.



Figure 3: When you need some specific information on a gun, look it up in the manufacturer's service manual.

SERVICE MANUALS

Manufacturers of most American-made firearms provide parts lists and takedown instructions for each (Figure 3). This information is very useful to the gunsmith, especially if a certain model has never been encountered before. Many of these same manufacturers also have service manuals for their various models which give specifications, principles of operation, assembly/disassembly instructions, and most important, troubleshooting and repair techniques. A sample page is shown in Figure 4.

You should start accumulating all of the literature that is currently available. Furthermore, you should keep it arranged so it is readily available when the need arises. Filing cabinets are ideal, but cardboard boxes will suffice for the present time. Just make sure you file the literature so you can find what you need without going through the whole pile, arrange the material in alphanumerical order: first by manufacturer, then by model number.

Manufacturers' service manuals can range in price from $1 to perhaps as high as $75. However, some literature is free. Now would be a good time to inquire as to the availability and price of service manuals and parts catalogs that manufacturers offer.

The following is a list of the major firearm manufacturers and importers in the United States including websites and where to write to obtain information. Manuals for some firearms are out of print and no longer available.

Charter Arms
273 Canal St., Shelton, CT 06484
(203) 922-1652
www.charterfirearms.com

Colt Firearms Co.
P.O. Box 1868, Hartford, CT 06144-1868
(800) 962-COLT
www.coltsmfg.com

Daisy Manufacturing Co., Inc.
P.O. Box 220, Rogers, AR 72757-0220
(800) 643-3458
daisy.com

Ithaca Gun Company, LLC
420 N. Warpole Street, Upper Sandusky, OH 43351
(877) 648-4222
www.ithacagun.com

Marlin Firearms Co.
P.O. Box 1871, Madison, NC 27025
(800) 544-8892
www.marlinfirearms.com

O.F. Mossberg & Sons, Inc.
7 Grasso St., North Haven, CT 06473
(203) 230-5300
www.mossberg.com

H&R 1871 LLC
PO Box 1871, Madison, NC 27025
(866) 776-9292
www.hr1871.com

Remington Arms Co., LLC
870 Remington Drive
P.O. Box 700, Madison, NC 27025
(800) 243-9700
www.remington.com

Savage Arms, Inc.
100 Springdale Rd., Westfield, MA 01085
(413) 568-7001
www.savagearms.com

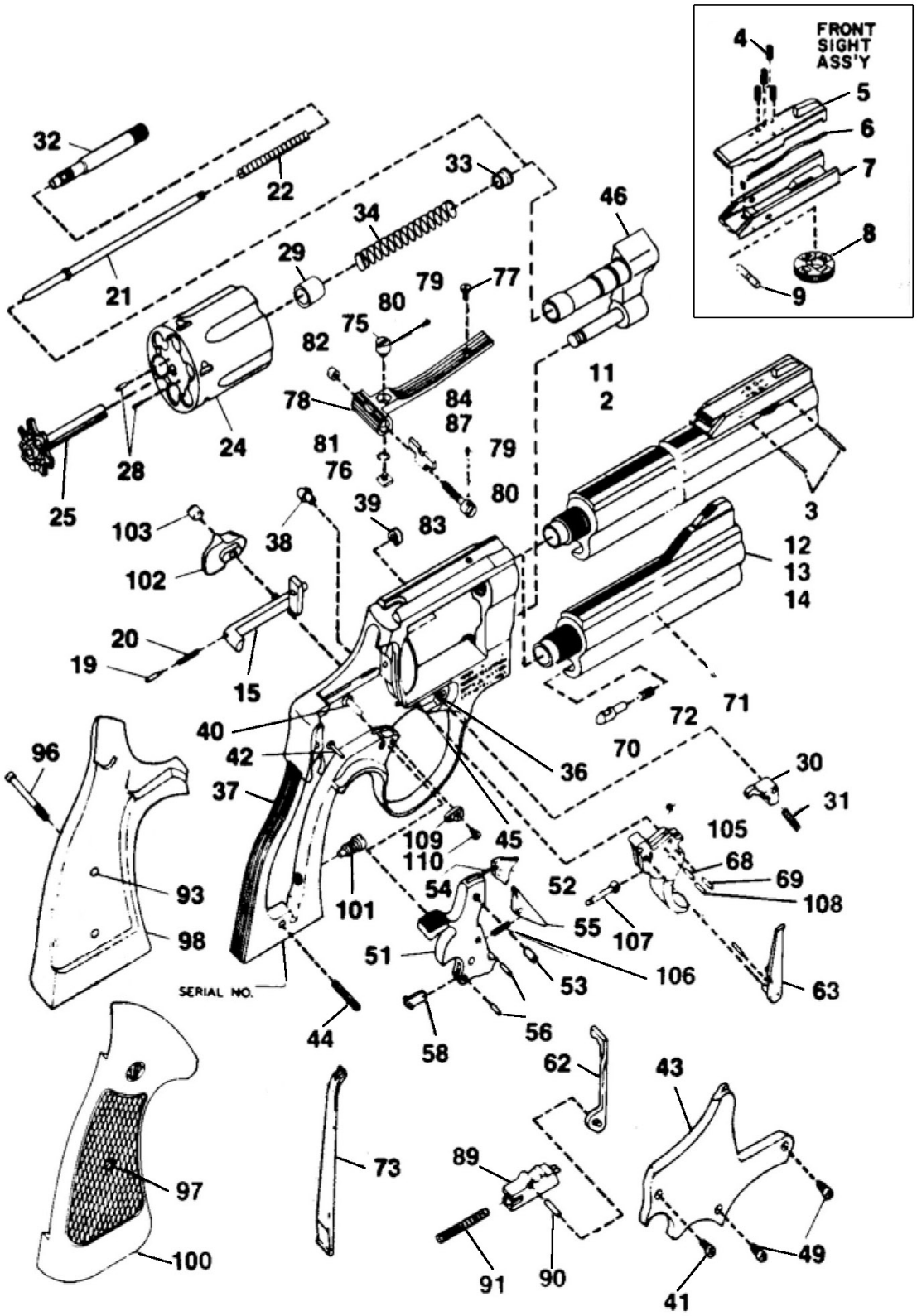
Smith & Wesson, Inc.
2100 Roosevelt Avenue, Springfield, MA 01104
(800) 331-0852
www.smith-wesson.com

Strum, Ruger & Co., Inc.
1 Lacey Place, Southport, CT 06890
(203) 259-7843
www.ruger.com

Thompson Center Arms
2100 Roosevelt Avenue, Springfield, MA 01104
(866) 730-1614
www.tcarms.com

Weatherby Inc.
1605 Commerce Way, Paso Robles, CA 93446
(805) 227-2600
www.weatherby.com





This schematic diagram and parts list conform to the current specifications provided by our Engineering Department. From time to time, improvements are made in all our models. For this reason, the gun which you own may not correspond exactly to the information provided on this sheet. When requesting information or ordering parts for your gun, please provide the serial number and approximate date of purchase.

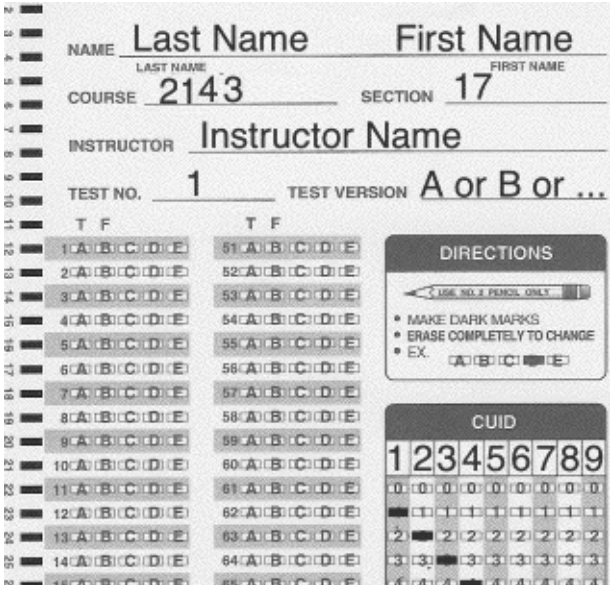
***Figure 4**: Sample page from a Smith & Wesson service manual. Such manuals usually give complete specifications of the firearm, the principles of operation, an exploded view, the parts lists, and sometimes a troubleshooting chart.*

COMPLETING YOUR FIRST LESSON

You have already completed your first lesson! Continue on to answer the Lesson Questions while the material you read is fresh in your mind.

Once your answers are completed, submit your grades online via our website at www.sonoranlearning.com. Welcome to the Sonoran Desert Institute and to the fascinating world of gunsmithing!

THIS IS LESSON NUMBER 2163.



Make sure you print your name, student number, and lesson number in the space provided on the Lesson Answer Form. Be sure to fill in the circles beneath your student number and lesson number.

REMINDER: A properly completed Lesson Answer Form allows us to evaluate your answers and send the results and additional study material to you as soon as possible. Do not hold your Lesson Answer Forms to send several at one time. You may run out of study material if you do not send your answers for evaluation promptly.

Lesson Questions

1. **It is estimated that the number of firearms in the United States exceeds**
   a. 10 million.
   b. 100 million.
   c. 200 million.
   d. 300 million.

2. **To keep from getting bored while you study, you should turn on the TV or radio.**
   a. True.
   b. False.

3. **Before a gunsmith can work on firearms for others — in any capacity — he or she must first have a**
   a. Hunting license.
   b. Labor Union card.
   c. Federal Firearms License.
   d. Driver's License.

4. **Studying for a three- or four-hour period once a week is better than studying for a shorter time every day.**
   a. True.
   b. False.

5. **City zoning ordinances may make it unlawful to operate a gunsmithing service in your own home, even if it is only part-time.**
   a. True.
   b. False.

6. **If you find a section of a lesson that you do not understand after you have read it several times, you should**
   a. Ask a friend to help you.
   b. Forget about it.
   c. Go on to the next section.
   d. Use a consultation form to ask your instructor for help.

7. **The chief rule of firearms safety is never point a gun at anything unless you intend to shoot it.**
   a. True.
   b. False.

8. **Most full-time gunsmiths in the United States today**
   a. Have the time to repair all firearms quickly.
   b. Are usually backlogged for several months.
   c. Find business very slow.
   d. Have another business as well.

9. **One source of information for assembly/disassembly of firearms is**
   a. Exploded views and parts lists.
   b. The local police department.
   c. Local sporting goods stores.
   d. Steel manufacturers.

10. **Training in gunsmithing may provide you with the opportunity to become self-employed.**
   a. True.
   b. False.

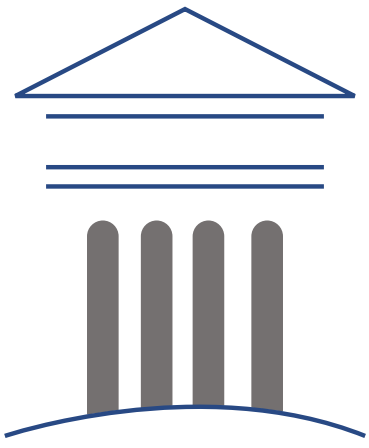
Types of Firearms
Lesson: 2164

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Objectives

After completing this lesson, you should

1. Understand the different types of firearm actions.
2. Be able to determine the difference between a rifle and a shotgun.
3. Be familiar with the procedure for obtaining your Federal Firearms License.

Introduction

Gunsmithing is the art of repairing, refinishing, modifying, customizing, or building a firearm of any type. A gunsmithing job may consist of the simple cleaning of a firearm, up through the various stages, to building a complete rifle or shotgun from raw materials and other pre-manufactured components. However, in most cases, the professional gunsmith's work will consist of repairing malfunctioning firearms; that is, replacing or adjusting broken or worn parts. Another common task is refinishing rifles, shotguns, and handguns, which consists of rebluing or browning the metal and refinishing the wood.

It is estimated that in the United States repairing and refinishing firearms make up about 75% of the gunsmith's work. The remaining 25% of gunsmithing jobs consist of customizing existing firearms. Many serious shooters wish to have their firearms customized; standard products of the large manufacturers seldom conform in every respect to the ideas some people have about how a firearm should be made. Perhaps a factory stock does not fit perfectly, or the trigger pull needs adjusting. Maybe the owner wants an extremely fancy firearm with elaborate metal engraving, stock carvings, and inlays.

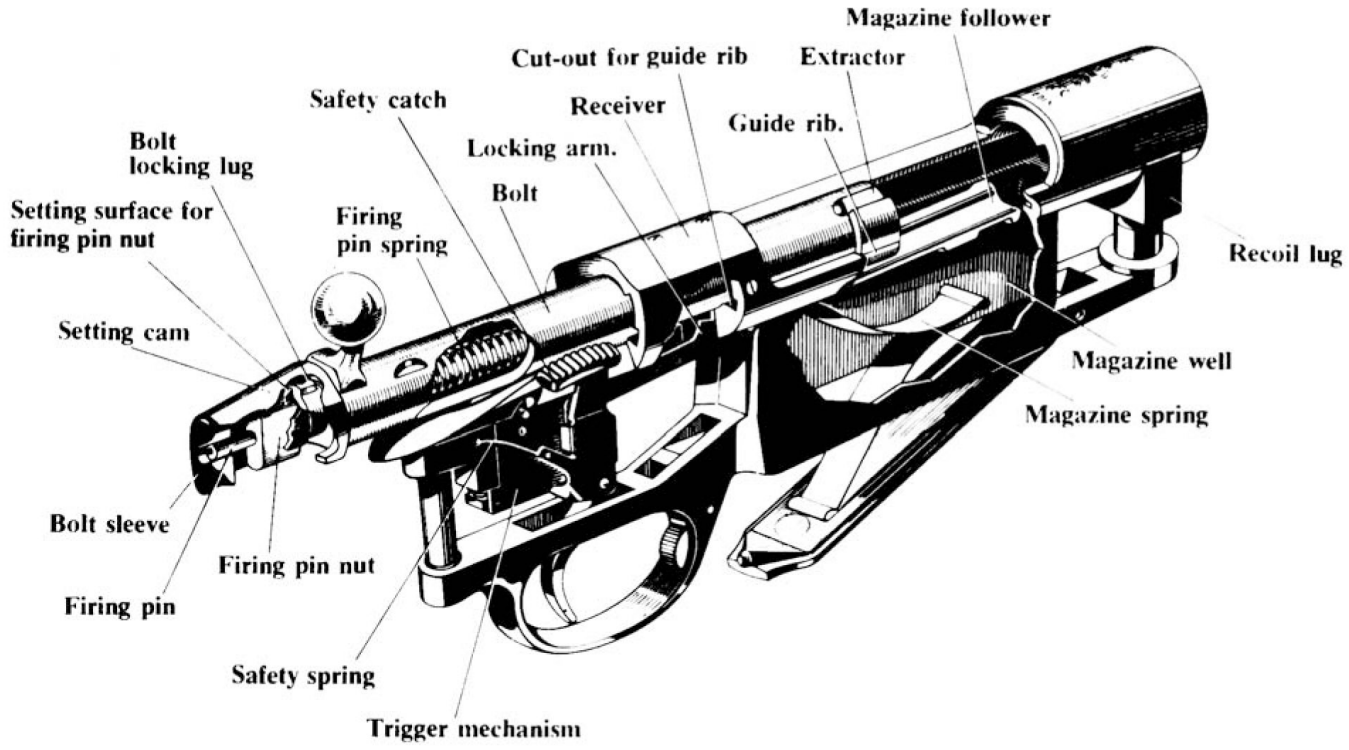


Figure 1: Cutaway view of the bolt assembly for a bolt-action rifle

Although there is a wide variety of calibers and gauges available from the manufacturers for almost any conceivable type of hunting or shooting imaginable, some people still want something different, like a "wildcat" cartridge for which no factory ammo is available. These cartridges are usually modifications of existing factory ammunition, designed to perform better than their factory counterparts. The gunsmith must be consulted for chambering and rebarreling a rifle/receiver for a wildcat cartridge and should also be able to make the entire conversion for the customer.

While most professional gunsmiths do what may be classified as general gun repair, some experts specialize. For example, dozens of gunsmiths throughout the country do nothing but make custom stocks. Another specialist may do only metal engraving on firearms - getting anywhere from $1,000 and up per gun. Still another may be concerned only with accurizing target rifles for the serious competitive shooters. At the start, you should become involved in all phases of gunsmithing—from general repairs, to refinishing, to checkering gunstocks. Then, later on, you might find that you excel in one particular field, making your work in this area very much in demand. Because of this, you can charge (and often get) top dollar for your work. Should such a situation exist, take a good look at the possibility of specializing in this phase of gunsmithing work.

How to Get the Most From Your Lessons

The lessons you receive in the Sonoran Desert Institute Gunsmithing Course are designed to give you the complete background information you need to become a professional gunsmith. Here are several things you can do to help you understand and remember the lesson material.

GETTING PRACTICAL EXPERIENCE

Reading the lessons alone will not make you an expert gunsmith, just as dental books alone cannot make a student into a dentist. You need practice in handling guns. You must also become familiar with the various tools used in gunsmithing. We will help you get this practice. Apply the knowledge you gain through studying a lesson as quickly and as often as possible. Study and work with the tools and instruments provided with the course. You may be able to get practical experience by working part-time in a local gunsmithing shop. If you are already performing gun repairs, then this course will broaden your knowledge. It will prepare you for greater responsibilities, such as starting your own gunsmithing business.

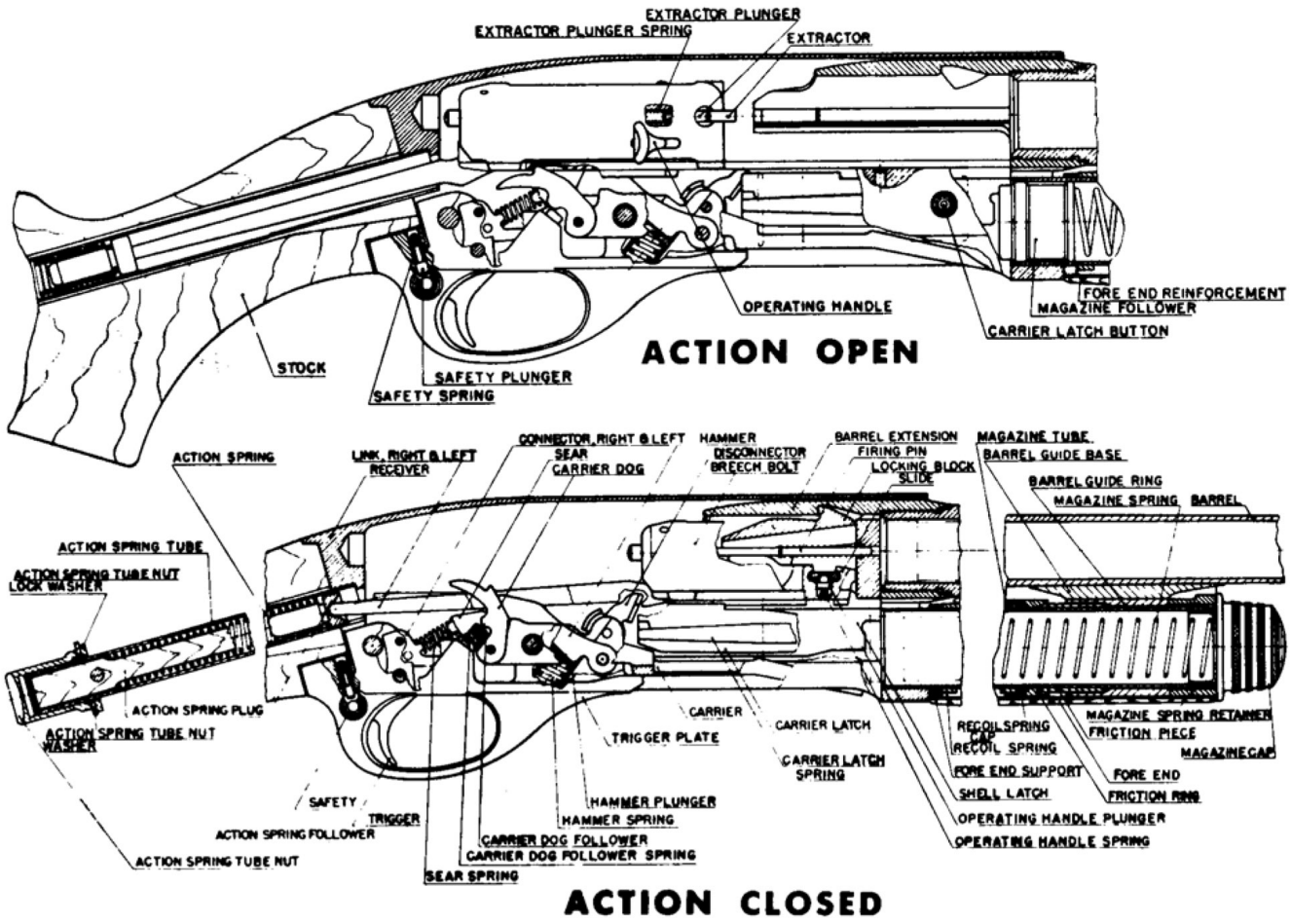


Figure 2: Section views of a semi-automatic shotgun.

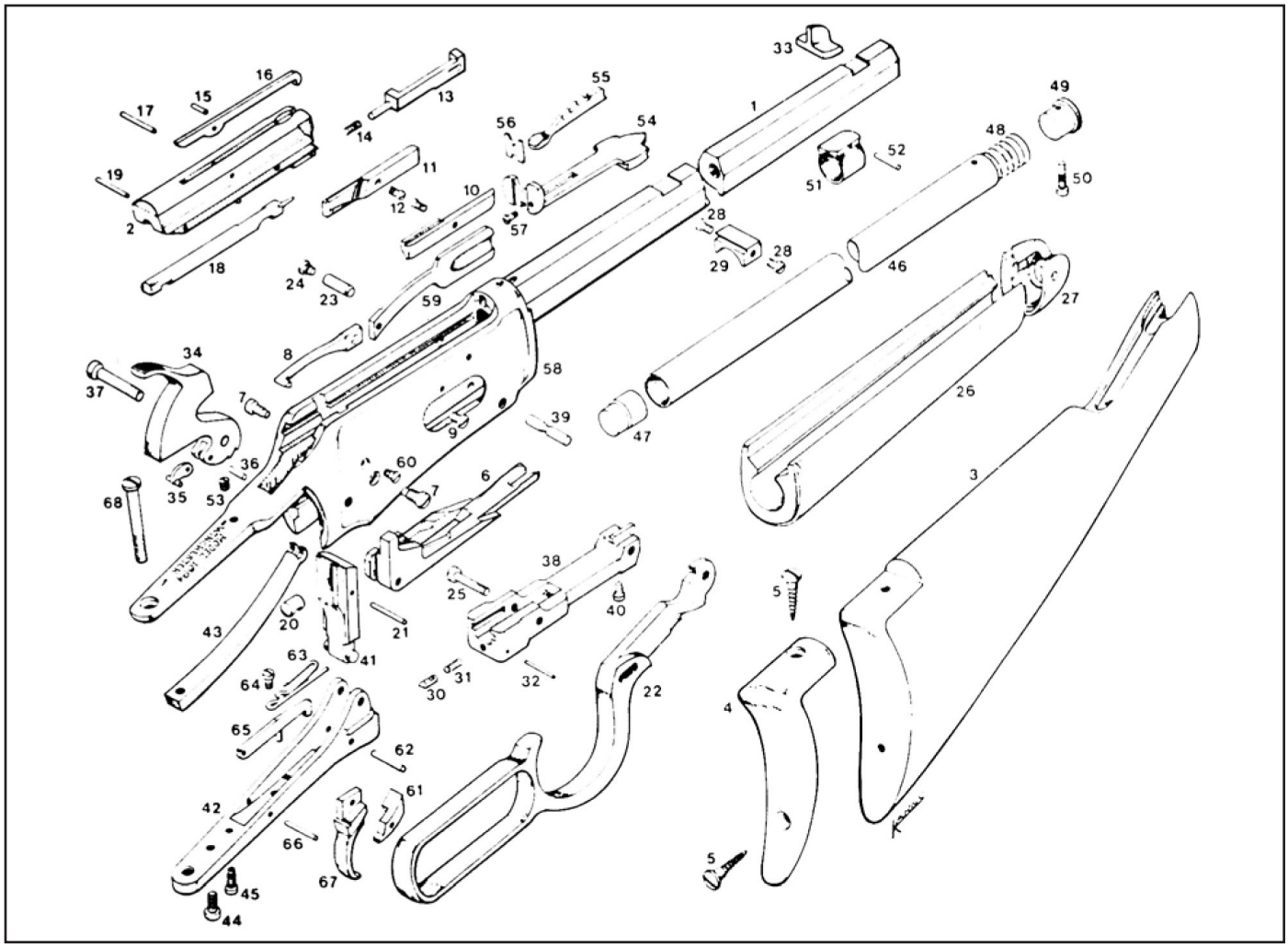


***Figure 3**: Exploded view of a Winchester Model 94 lever-action rifle*

DISASSEMBLY INSTRUCTIONS

In the previous lesson, we discussed the importance of factory service manuals. These manuals usually have an exploded view of each currently manufactured firearm, a list of parts, disassembly instructions, special tools for each model, and sometimes a troubleshooting chart. These publications are designed to help gunsmiths with factory warranty jobs. Studying these publications will be very helpful. Someday you might get stuck while doing a job, and the service manuals will probably contain the information you need to perform the proper disassembly/assembly and troubleshooting techniques to repair the firearm. Be sure you know where and how to locate these publications.

KEEPING A NOTEBOOK

Keeping a notebook will be of great value to you. Get a loose-leaf notebook so you can insert or remove pages. Write down any interesting procedures you run across in your shop work, or in reading the various shooting publications. Monthly periodicals such as *American Rifleman, American Gunsmith, Guns & Ammo, Rifle, Shooting Times, Guns*, and others often have helpful gunsmithing articles. Save these articles and place them in your notebook. As you do this, you will find that your notebook will become an increasingly valuable source of information you can refer to. Some students keep a page for each model of gun that they service. They list the complaint, cause, and correction for each problem. Then they list the parts used to repair the gun. When the time comes to begin stocking fast-moving parts, these pages tell you what parts you will need, and how often they will be needed.

DOING THE JOB

Keep your eyes open. There are many important things to look for in troubleshooting and repairing firearms. We try to cover the important features and conditions that you can see. Write down the important facts in your notebook. Learn to do the various servicing jobs properly. This is very important. In addition, be pleasant and cooperative with people who bring their gun to you for repair. After all, you want them to bring the gun back to you the next time it needs service. To really get ahead in the world of gunsmithing, you must not only do your

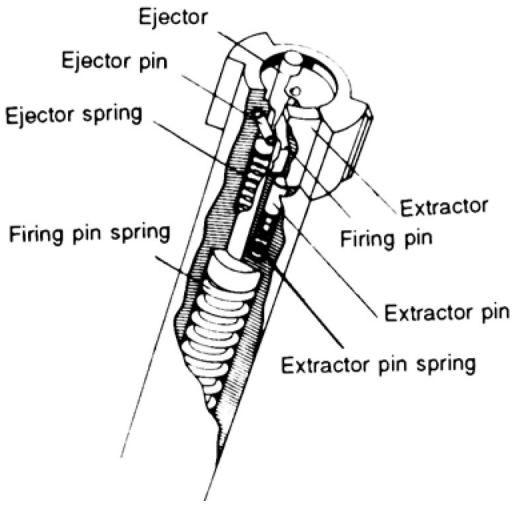


Figure 4: Phantom view of a rifle action bolt.

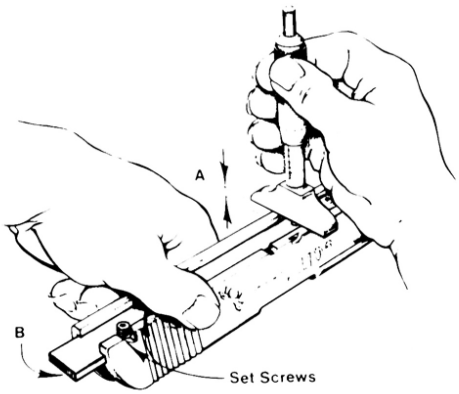


Figure 5. Line drawing showing how to measure the slide-rail height on a Colt .45 semiautomatic pistol.

Figure 5: Line drawing showing how to measure the slide-rail height on a Colt .45 semi-automatic pistol.

job well, but also know how to get along with and satisfy your customers. When dealing with a customer, never forget how you like to be treated when you are the customer.

ILLUSTRATIONS

Before you begin your studies of firearm construction, operation, and servicing, we would like to explain the various kinds of illustrations you will find in your Sonoran Desert Institute Gunsmithing course.

Many of the illustrations have been specially prepared to make the explanation in your lessons easier to understand. For example, Figure 1 is a cutaway view of a rifle bolt. The picture was made to show you what the inside of a bolt would look like if part of it were cut away. Study this illustration and see how many of the interior parts you can identify. Do not be discouraged if most of them are strange to you now. As you progress through the course they will become very familiar.

Another way to show the inside of a mechanism is with a sectional view. This is also a cutaway view, but the cut is made straight through. Figure 2 is a sectional view of a Remington Model 11-48 semi-automatic shotgun. Note that in the sectional view some of the parts are cut so that you can see what is inside of them. Another way to show how the parts are related to each other is with an exploded view. Look at Figure 3, which is an exploded view of the famous Winchester Model 94 lever-action carbine. Notice that the parts are arranged in the order in which they go into the assembly. It is called an exploded view because everything has been "blown" out of the gun in a well-arranged "explosion."

Exploded views are very helpful to the gunsmith because they show how the various gun parts are related to each other and how they fit together. Such illustrations are extremely useful when trying to assemble or disassemble an unfamiliar firearm. You will be seeing many of these pictures as you continue through your course. Firearm manufacturers use many such illustrations in their service and parts manuals.

There is another type of illustration you should understand — the phantom view. Figure 4 is a phantom view of a rifle action bolt. In this illustration, various parts are drawn as though they were transparent. That is, they are drawn as though you could see through them.

You will also find line drawings and photographs used throughout the course. Figure 5 is a line drawing showing how to measure the slide-rail height for a Colt .45 semi-automatic pistol. While line drawings are simple in appearance, they are very important. Many are drawn by expert illustrators especially for use in the lessons of your Sonoran Desert Institute Gunsmithing course. Figure 6 on the next page is a photograph of a Ruger single-action revolver showing the components necessary to change to a safer hammer. Remember, every illustration in this gunsmithing course has a purpose. That purpose is to help you understand the material you are studying. The pictures will show you what is inside the various components, how they are assembled, and the different troubleshooting and repair techniques required. The illustrations have been included to make things easier for you. Do not overlook them or their descriptive captions.



Figure 6: Photograph of a Ruger revolver showing components necessary to change to a safer hammer.

SELF-TEST QUESTIONS

Please check your answers on page 16.

1. *True or False.* **All you need to do to become an expert gunsmith is to read the lessons in this course and pass the examinations.**
2. **Where is the best place to find assembly/disassembly information for a specific firearm?**
3. **An illustration that is drawn so it appears that you can see through the parts of a gun is called a(n) _____ _____.**
4. **An illustration of a gun that is drawn with the gun disassembled and the parts laid out in the proper relation and order they would be reassembled is called a(n)_____.**

Types of Firearms

FIREARM BASICS

What's the difference between a shotgun and a rifle? It's actually fairly easy to tell these two types apart. Looking at Figure 7, you will see that the shotgun has a barrel with a relatively thin wall, a large bore diameter, no grooves inside, and a small bead for a front sight. On the other hand, the rifle barrel will have relatively thick walls, a smaller bore diameter, inside grooves, and a more prominent front sight.

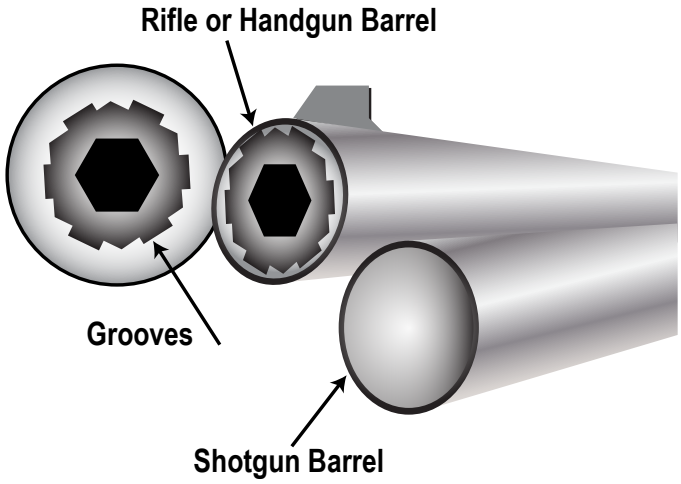
Both guns are called "shoulder guns" because they are held in two hands with the stock braced against the shooter's shoulder.

The grooves inside the rifle barrel make the bullet spin as it travels through the barrel when the rifle is fired. The bullet continues to spin on its flight to the target. The spinning helps the bullet to travel more accurately.

Shotgun barrels have no grooves because the shotgun does not shoot bullets; it shoots a column of small lead pellets called shot. Shotgun shells are also loaded with rifled slugs for use on deer-size game. Slugs are solid projectiles that resemble a large rifle bullet.

Shotgun shell bodies are usually plastic or paper, but some are brass. The plastic or paper shells are made in a variety of colors —depending upon manufacturer and load—mainly in green, red, blue, and yellow. Cases and projectiles used in shot shells and rifle cartridges are. The body (case) of a rifle cartridge is made of brass (Figure 9.) The bullet is made of lead-alloy. Some bullets have a copper-alloy jacket.

When a shotgun is fired, the pellets are shot out of the barrel. The farther they travel, the more they scatter. To control this scattering, the mouth of the shogun barrel is choked or slightly constricted. You will learn more about chokes in later lessons.



7: Shotgun barrels have smoothbores whereas rifle barrels have grooves or rifling.

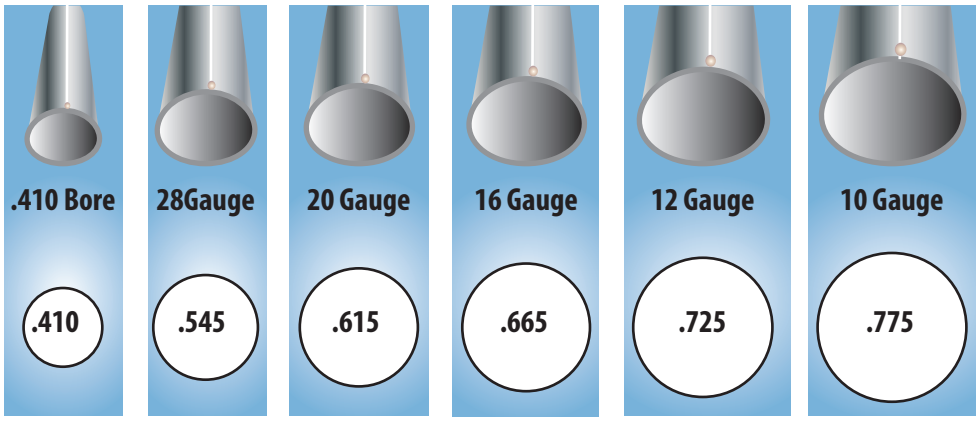


Figure 8: Size comparison of various shotgun bores. The approximate bore diameter of each shotgun gauge shown above is the result of the original method of determining gauge by counting the number of lead balls per pound for each gauge gun, except the .410 which is a caliber, not a gauge.

Shotgun shells and shotguns are manufactured in several gauges, including 12-gauge, 16-gauge, 20-gauge, and 28-gauge. Gauge numbers relate to the size of the inside diameter of the shotgun barrel. The inside diameter of a 12-gauge shotgun barrel is just less than $^{3}/_{4}$, or .729 inches (that is seven hundred and twenty-nine thousandths of an inch). Then we have the .410 bore, which measures exactly .410" inside the diameter of the barrel. An actual-size comparison of several gauges of shotgun barrels is shown in Figure 8.

Each gauge or bore of shotgun shoots only shells of the same gauge or bore. For example, 12-gauge shells are used in 12-gauge shotguns. The gauge of a shotgun is usually marked on the rear of the barrel, and the gauge of a shell is always marked on the shell (Figure 9). Warning! If 20-gauge shells are mistakenly fed into a 12-gauge gun, they will slip past the chamber and lodge in the barrel, causing gun damage or injury should a 12-gauge shell then be fired in the gun. To help prevent this mistake, shells are color-coded. Most 20-gauge shells are colored yellow, and most 16-gauge shells are coded purple. Some 12-gauge shells are colored green, blue, dark red, red, etc. Never put any shell in a gun for which it is not chambered.

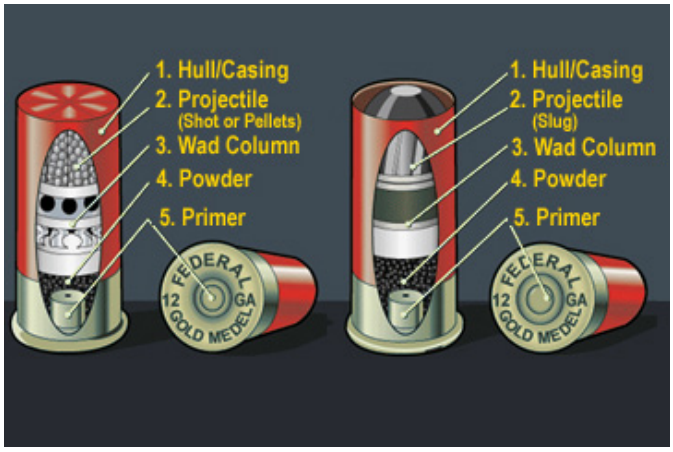


Figure 9: Parts of shotshells and rifle cartridges.

Shotguns, owned by about 20 million shooters, are used for hunting upland game birds and animals, and also for shooting clay targets. Buckshot shells, loaded with very large pellets, and also shells loaded with a single-rifled slug, are used on big game (mostly deer) at ranges under 100 yards. The various size shotgun pellets are shown in Figure 10, while several sizes of shotgun slugs are shown in Figure 11.

Rifles, like shotguns, are also manufactured in several sizes or caliber. The caliber is related to the inside diameter of the barrel which is usually expressed in decimal fractions of an inch or in millimeters. For example, there is a .35 caliber rifle, with the inside diameter of the barrel measuring about $^{35}/_{100}$ of an inch, and a 6mm caliber rifle, with the inside diameter of its barrel measuring approximately 6 millimeters. The bullet diameter must fit the barrel.

Lead shot sizes:	12	9	8.5	8	7.5	6	5	4	2	00
Pellet diameter:	•	•	•	•	•	•	•	•	•	•
(inches)	.05	.080	.085	.090	.095	.110	.120	.130	.150	.180
(mm)	1.27	2.30	2.16	2.29	2.41	2.79	3.05	3.30	3.81	4.57

Buckshot sizes:	No.4	No.3	No.2	No.1	No.0	No.00	No.000
Pellet diameter:	•	•	•	•	•	•	•
(inches)	.24	.25	.27	.30	.32	.33	.36
(mm)	6.10	6.35	6.86	7.62	8.13	8.38	9.14

Steel shot sizes:	6	5	4	3	2	1	Air Rifle	BB	BBB	T	F
Pellet diameter:	•	•	•	•	•	•	•	•	•	•	•
(inches)	.11	.12	.13	.14	.15	.16	.177	.18	.19	.20	.22
(mm)	2.79	3.05	3.30	3.56	3.81	4.06	4.49	4.57	4.83	5.08	5.59

Note: the size of the shot, whether lead or steel, is based on American Standard shot sizes. Thus: a steel No. 4 pellet and a lead No. 4 pellet are both .13 inches (3.3 mm) in diameter.

Figure 10: Shot pellets are made in several sizes, ranging from No. 12 to No. 00 buckshot

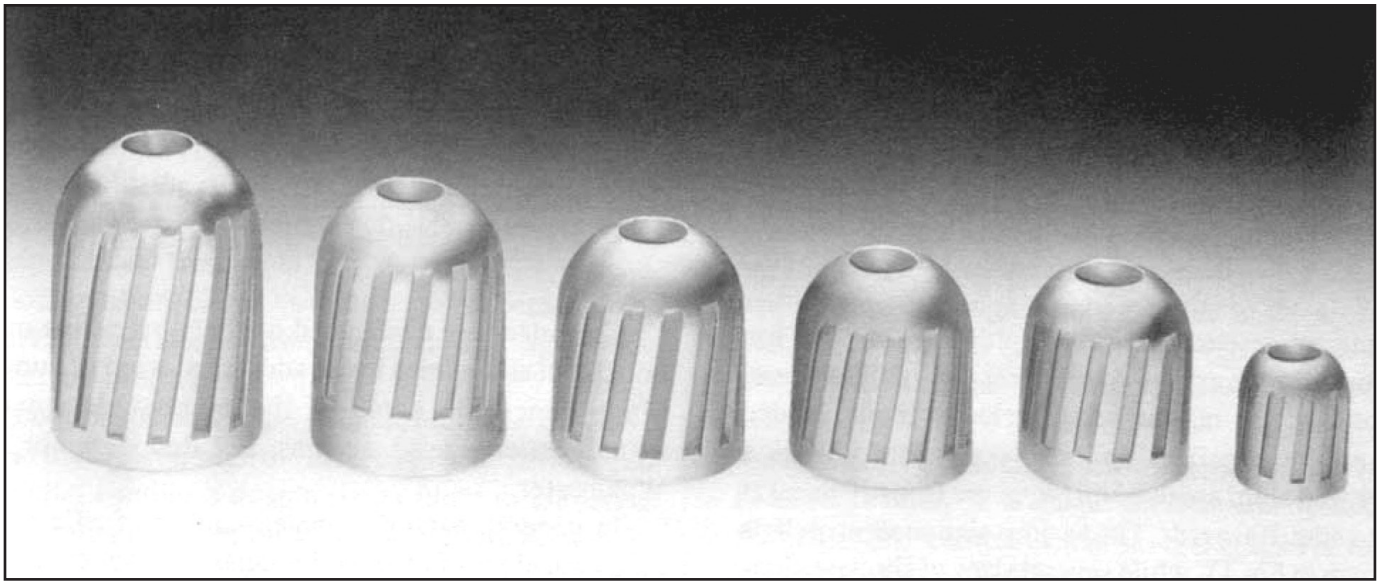


Figure 11: *Shotgun slugs are currently available from 10-gauge bore to .410 bore.*

One of the smaller centerfire caliber rifles is the .17 Remington cartridge, while one of the larger is a rifle chambered for the .458 Winchester Magnum caliber. Figure 12 shows a comparison of the cartridges used in these two rifles.

Cartridges are designated not only by caliber of the bullet, but also sometimes by an additional word or number. Many times the name of the original designer or manufacturer is used, such as .222 Remington or .270 Winchester.

In general, each designated caliber of rifle shoots only cartridges of exactly the same designation. For example, a .270 Winchester caliber rifle shoots only .270 Winchester caliber ammunition. This is a good time to point out the difference between the two general classes of ammunition:

- Centerfire
- Rimfire

You will note a small metal spot in the center of each of the cartridges shown in Figure 13. This "spot" is actually the bottom of a small metal cup called a "primer," containing a small amount of highly explosive priming mixture. When the firing pin of a centerfire rifle or shotgun strikes this primer, the priming mixture is ignited by friction and it explodes, igniting the powder in the shell or cartridge.

The rimfire cartridges are a little different. They have no center spot, but they do have a rim. The priming mixture is contained inside the walls of this rim. The firing pin of a rimfire rifle is designed to strike the rim of the cartridge (where the priming mixture is located) and the cartridge is fired in this manner. Figure 13 shows the location of the primer in different types of shells.

"Twenty-twos" are the most popular cartridges ever made, and are manufactured in three versions known as Shorts, Longs, and Long Rifle, as shown in Figure 16. There is also a .22 Winchester Rimfire Magnum, which is a little more powerful than the other three .22 rimfire cartridges.

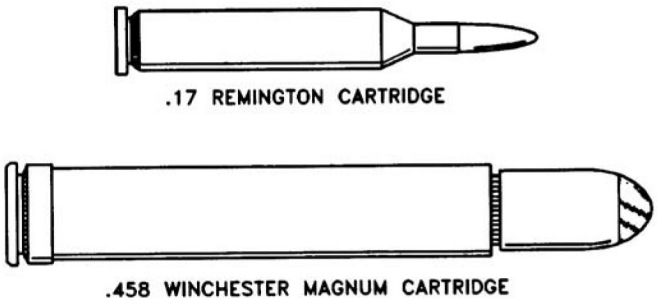


Figure 12: *Actual-size comparison of a .17 Remington cartridge and a .458 Winchester cartridge.*

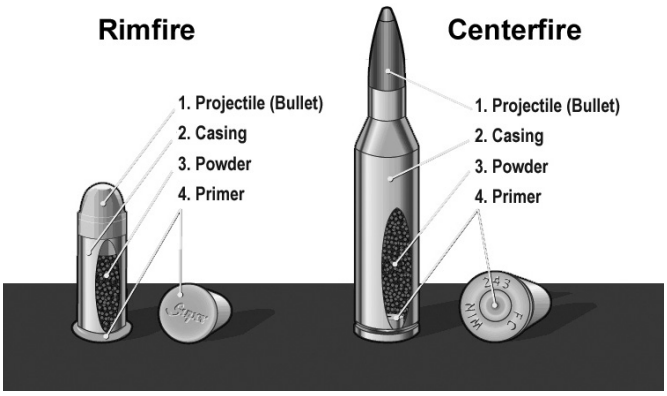


Figure 13: *Details of Rimfire and Centerfire ammunition*

RIFLE AND SHOTGUN ACTIONS

There are several types of actions common to shotguns and rifles. Rifle actions are similar to shotgun actions, so the description of one applies to both. Figure 17–Figure 22, on this page and the next, show the most common types of firearm actions.

VENTILATED RIBS

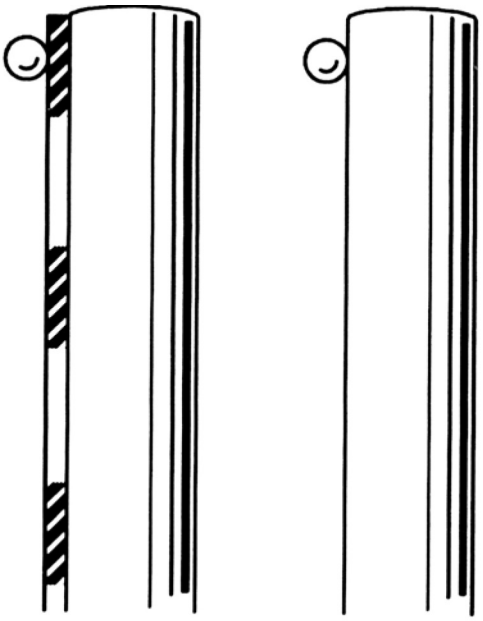


Figure 14: *Vent rib (left) and plain (right) shotgun barrels.*

Ventilated rib, or vent rib, is a term used to describe a shotgun barrel with a narrow, bridged platform on top. It dissipates heat waves from hot barrels, aids in pointing the gun, improves accuracy, and gives a shotgun a handsome, well-finished appearance (Figure 14).

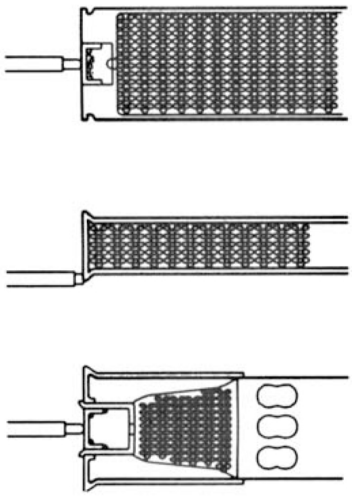


Figure 15: *Cartridge heads of centerfire cartridge (top) , rimfire cartridge (middle, and shotshell (bottom)*

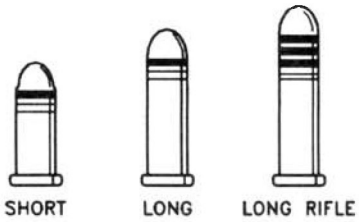


Figure 16: *Rimfire cartridges from left to right: .22 Short, .22 Long, and .22 Long Rifle*



Figure 17: *Slide-action repeating shotgun. In this type of action, shells or cartridges are fed from a magazine into the chamber, and are extracted or ejected by back-and-forth pumping or sliding of the fore-end by the hand and arm of the shooter.*

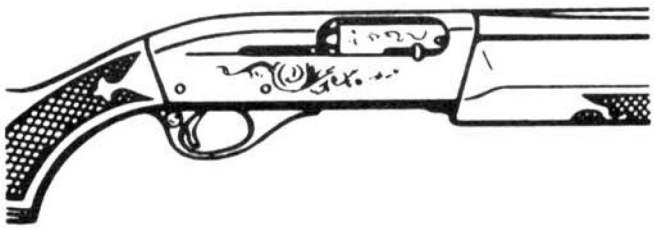


Figure 18: *Semi-automatic shotgun action. In this type of action, the first shell or cartridge is fed from the magazine by manual pressure on the action release; the automatic mechanism then extracts and ejects the first shell after it has been fired, and continues to feed fresh shells into the chamber and fire them, with successive pulls of the trigger.*

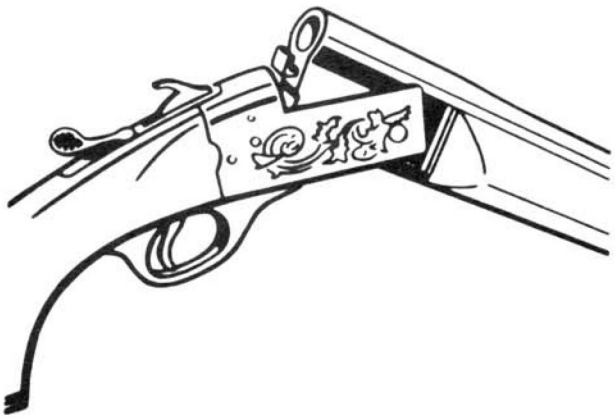


Figure 19 : *Single-shot, break-open action. In break-action guns, shells or cartridges are inserted by hand into the chamber, and extracted and ejected either manually or automatically as the action is opened.*

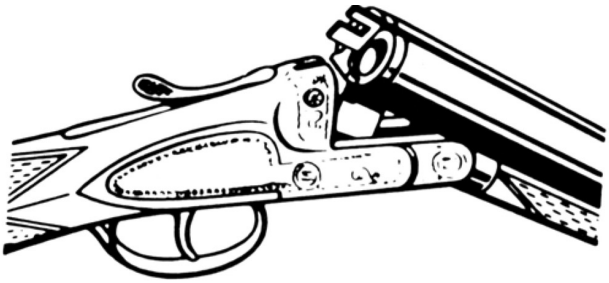


Figure 20: Side-by-side double-barrel shotgun action. This is also a break-open type action.

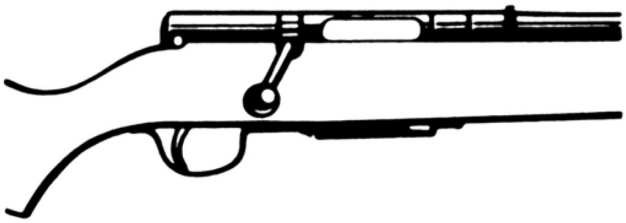


Figure 21: Bolt-action shotgun. In this type of action, shells or cartridges are fed from a magazine by closing of the bolt, and extracted and ejected by the opening of the bolt.



Figure 22: Lever-action rifle action. This action operates similarly to a slide-action except the finger level is used to operate the action rather than a sliding fore-end.

SHOTGUN CHAMBER LENGTHS

The chamber is the opening at the rear end of the barrel where the shell is placed for firing. A standard length chamber is for 2¾" shells and a magnum length chamber is for 3" shells. Both measurements are made of the shells after they have been fired, as shown in Figure 23. An unfired shell is somewhat shorter than its designated length. Obviously, 3" shells should not be used in 2¾" chambers. You may be able to place a 3" magnum shell in a standard 2¾" chamber and fire it, but besides getting erratic shot patterns, the chamber pressure will increase to a point where the gun may explode. Remember, just because you may be able to get a shell or cartridge into the chamber of a gun does not mean it is safe. Use only the shells or cartridges designed for the gun in which they will be shot. Using the wrong ammunition could prove fatal to the shooter or bystanders.

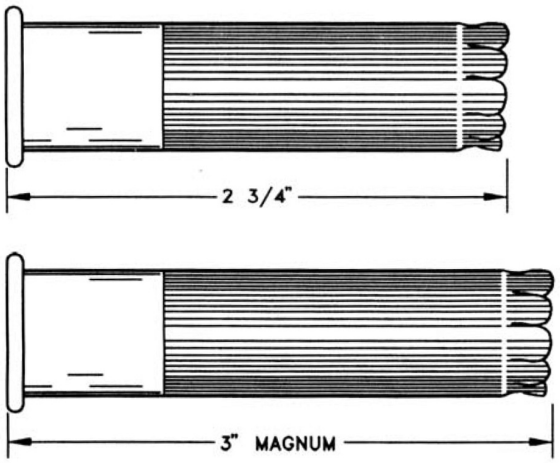


Figure 23: Shotshells are measured for their chamber length after firing.

A 2¾" shot shell may be safely used in a 3" shotgun chamber, but in general, 2¾" shells tend to deliver better shot patterns and more even pellet distribution when fired in guns with 2¾ chambers than they do when fired in guns with 3" chambers.

SHOTGUN BARREL LENGTHS

Shotgun barrel lengths are generally 26", 28", and 30", although shorter and longer barrels have been made.

Contrary to what some people may think, longer barrels do not shoot harder and farther than shorter barrels. Longer barrels do aid in aiming the gun and are used mainly for duck and goose shooting.

SHOTGUN SIGHTS

When firing shotgun shells loaded with pellets, the sights on a shotgun are not as important to good shooting as sights on a rifle. The shooter swings and points the shotgun as if it were an extension of his or her arm. On the other hand, a shooter carefully aims the rifle, which requires better sights. One exception is for shotguns using rifled slugs. When shotguns are equipped with rifle sights, and rifled slugs are used, they make very effective weapons for hunting deer and black bear at ranges under 100 yards.

SHOTGUN CHOKES

When talking about shotguns, you will hear the term choke mentioned quite a bit, so let us learn more about it. The choke controls the spread of the shot after it leaves the barrel. It does this by a constriction at a point about 1½" from the end of the barrel. One way to visualize a choke is to think of it in terms of a waterhose nozzle. That is, a shotgun full choke is like when water comes out of a hose in a narrow stream; a shotgun cylinder choke is like when the water comes out in a wide spray. Basic shotgun chokes are full, modified, and cylinder. There are also variations of these three; that is, improved cylinder, improved modified, extra-full, etc.

SELF-TEST QUESTIONS

Please check your answers on page 16.

5. ***True or False*. It is safe to fire a 3" magnum shot gun shell in a standard $2^{3}/_{4}$" chamber.**
6. **A narrow, bridged platform on top of a shotgun barrel is called a(n)_____.**
7. **Of the three basic shotgun chokes, which one gives the widest spread of shot pellets?**
8. **A type of shotgun action that is operated with the fore-end is called a(n)_____.**

Applying for your Federal Firearms License

There are certain firearm regulations that you should be aware of before getting involved with gunsmithing. In some cases, this grief has come in the form of ten years or more in prison for some otherwise innocent citizens who were unfortunate enough to get caught in a firearms violation. Do not let this happen to you. Abide by all firearm regulations. However, antique firearms and modern black powder muzzleloading firearms do not fall under the current federal firearms laws.

In general, the law allows you to work on your own firearms any time you wish. But if you work on another person's guns, even just cleaning them, you must have a Federal Firearms License (FFL) or else work for someone who has one. To qualify for the license, you must:

- Be 21 years of age or older
- Not be under indictment for, or have been convicted of, a crime punishable by imprisonment for a term exceeding one year (except for business offenses or misdemeanors that do not involve a firearm or explosive and are punishable by a term of imprisonment of less than two years)

U.S. Department of Justice
Bureau of Alcohol, Tobacco, Firearms and Explosives

OMB No. 1140-0018

Application for Federal Firearms License

For ATF Use Only

1. Name of Owner or Corporation *(If partnership, include name of each partner)*

2. Trade or Business Name, *if any*

3. Employer Identification Number (*EIN#)* or Social Security Number *(SSN is Voluntary)*

4. Name of County in Which Business is Located

5. Business Address *(RFD or street number, city, State, and ZIP code) (NOTE: The business address CANNOT be a P.O. Box.)*

6. Mailing Address *(If different from address in item #5)*

7. Contact Numbers *(Include Area Code)*

Business Phone _____ Fax Number _____

Cell Phone _____ 24 Hour Emergency # *(If different)* _____

8. Applicant's Business is *(Select one)*

☐ Individually Owned ☐ A Partnership ☐ A Corporation ☐ Other *(Specify)* _____

9. Describe Specific Activity Applicant is Engaged in, or Intends to Engage in, Which Requires a Federal Firearms License. *(Sale of ammunition alone does not require a license.)*

10. Do You Intend to Engage in Business as a Pawnbroker?

☐ Yes ☐ No

11. Application is Made For a License Under 18 U.S.C. Chapter 44 as a: *(Place an "X" in the appropriate box. Submit the fee noted next to the box with the application. Licenses are issued for a 3-year period. See instruction #13 for payment information.)*

Type	Description of License Type	Fee	
01/02	Dealer (01), Including Pawnbroker (02), in Firearms Other Than Destructive Devices (Includes: *Rifles, Shotguns, Pistols, Revolvers, Gunsmith activities and National Firearms Act (NFA) Weapons)*	$200	☐
06	Manufacturer of Ammunition for Firearms Other Than Ammunition for Destructive Devices or Armor Piercing Ammunition	$30	☐
07	Manufacturer of Firearms Other Than Destructive Devices	$150	☐
08	Importer of Firearms Other Than Destructive Devices or Ammunition for Firearms Other Than Destructive Devices, or Ammunition Other Than Armor Piercing Ammunition (NOTE: *Importer of handguns and rifles, see instruction #8.)*	$150	☐
09	Dealer in Destructive Devices	$3000	☐
10	Manufacturer of Destructive Devices, Ammunition for Destructive Devices or Armor Piercing Ammunition	$3000	☐
11	Importer of Destructive Devices, Ammunition for Destructive Devices or Armor Piercing Ammunition *(See instruction #8)*	$3000	☐
		Total Fees $	

12. **Method of Payment** *(Check one)*

☐ Check *(Enclosed)* ☐ Cashier's Check or Money Order *(Enclosed)* ☐ Visa ☐ Mastercard ☐ American Express ☐ Discover ☐ Diners Club

Credit/Debit Card Number *(No dashes)* | Name as Printed on Your Credit/Debit Card | Expiration Date *(Month & year)*

Address:

Credit/Debit Card

Figure 24. Refer to the BATF website at www.atf.gov to request the most recent edition of this application.

- Not be a fugitive from justice
- Not be an unlawful user of or addicted to marijuana or any depressant, stimulant, or narcotic drug
- Not have been adjudicated as a mental defective or have been committed to a mental institution
- Not be an alien.
- Not have renounced United States citizenship
- Not have willfully failed to disclose any material information or made any false statement as to any material fact in connection with an application for a federal dealer's license
- Have premises from which you conduct business or from which you intend to conduct a dealer's business within a reasonable period of time

Besides permitting you to work on firearms for others, this license also allows you to buy and sell firearms and ammunition at wholesale or retail to residents of your state. Depending on state laws, sales to residents of adjoining states may be permitted. The business may be located in a garage, an outbuilding, or a regular place of business, but must be open to the public during the hours you specify on your application.

To apply for a firearms license, you may visit the website at www.atf.gov to download the application or you may call the Bureau of Alcohol, Tobacco, Firearms and Explosives (BATF) Licensing Center in West Virginia at (866) 662-2750. In most instances, you will receive a voicemail message requesting your name and mailing address. Please make sure that you request an application for Federal Firearms License (FFL) under U.S.C. Chapter 44, Firearms.

The following types of Federal Firearms Licenses are available:

Type 01 - DEALER IN FIREARMS/GUNSMITHING
(buy, sell, & repair) Application fee and the first three (3) years is $200. Renewal every three (3) years is $90.

Type 02 – PAWNBROKER
Application fee and the first three (3) years is $200. Renewal every three (3) years is $90.

Type 03 - COLLECTOR OF CURIOS AND RELICS
Application fee and the first three (3) years is $30.00. Renewal every three (3) years is $30.

Type 06 - MANUFACTURER OF AMMUNITION FOR FIREARMS
Application fee: $30.00 for three (3) years.

Type 07 - MANUFACTURER OF FIREARMS / AMMUNITION
(buy, sell, repair, assemble, & manufacture) Application fee and the first three (3) years for Type 07 is $150. Renewal every three (3) years is $150.

Type 08 - IMPORTER OF FIREARMS / AMMUNITION
Fee: $ 150.00 for three (3) years.

Type 09 - DEALER IN DESTRUCTIVE DEVICES Fee: $ 3,000.00 for three (3) years.

Type 10 - MANUFACTURER OF DESTRUCTIVE DEVICES
Fee: $ 3,000.00 for three (3) years.

Type 11 - IMPORTER OF DESTRUCTIVE DEVICES
Fee: $ 3,000.00 for three (3) years.



If you qualify, you will receive your license in approximately three months after mailing the completed application and fee. The original license should be displayed, unsigned, in your place of business. Have several copies of this license made and send a copy with an original signature to each supplier when placing an order. When requesting catalogs, also send a signed copy of this license, since most suppliers require proof that you are entitled to a trade discount. Do not photocopy your signature, sign each copy individually.

Your license covers operations only at the location shown on the license. The BATF will send a renewal application about sixty days before the expiration date shown on your license. If you do not receive a renewal application thirty days or so before the expiration date and you want to remain in business, notify the BATF regional office immediately.

To renew your license, complete and send the application and fee to the BATF before the expiration date. You may operate until your new license is received, even though the expiration date has passed.

Gunsmiths, like firearms dealers, must maintain a separate permanent record of all firearms received and disposed of, including firearms received for repair. They must be logged in and out using a firearms acquisition and disposition record. A comprehensive book explaining what is required of a dealer, which records are necessary, and how to prepare them will accompany your license. Refer to Figure 24 for a sample FFL application.

SELF-TEST QUESTIONS

Please check your answers on page 16.

9. **Where can you request an application for a Federal Firearms License?**
10. **What is the minimum-age requirement to obtain your Federal Firearms License?**
11. **Do you qualify for a Federal Firearms License if you are an unlawful user of marijuana or other narcotic drug?**
12. **If qualified, how long after you apply can you expect to receive your Federal Firearms License?**

ANSWERS TO SELF-TEST QUESTIONS

1. False
2. From the manufacturer of the particular firearm
3. Phantom view
4. Exploded view
5. False
6. Vent rib or ventilated rib
7. Cylinder bore
8. Slide-action or pump-action
9 Department of the Treasury: Bureau of Alcohol, Tobacco, Firearms and Explosives
10. 21 years old
11. No
12. Three months

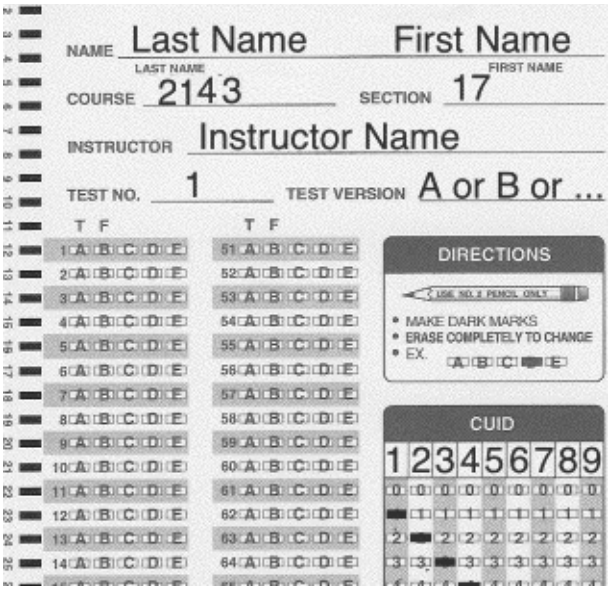
Lesson Questions

THIS IS LESSON NUMBER 2164.

Make sure you print your name, student number, and lesson number in the space provided on the Lesson Answer Form. Be sure to fill in the circles beneath your student number and lesson number.

REMINDER: A properly completed Lesson Answer Form allows us to evaluate your answers and send the results and additional study material to you as soon as possible. Do not hold your Lesson Answer Forms to send several at one time. You may run out of study material if you do not send your answers for evaluation promptly.

You may also complete your exams and submit them online via the SDI Student Services page at www.sonoranlearning.com.



1. **What estimated percent of gunsmithing jobs consists of repairing and refinishing?**
   a. 10%.
   b. 25 %.
   c. 50%.
   d. 75%.

2. **One way to get practical experience in gunsmithing work prior to opening your own business is to**
   a. Work part-time for another gunsmith.
   b. Read all of your lessons over more than once.
   c. Start working on firearms before getting your FFL.
   d. Work on a friend's gun.

3. **A shotgun usually has a bead type front sight.**
   a. True.
   b. False.

4. **The main purpose of a shotgun is to fire:**
   a. A solid projectile.
   b. More than one bullet at the same time.
   c. A charge of small pellets.
   d. Buckshot only.

5. **What causes a bullet to spin as it travels through a rifle barrel?**
   a. The smoothness of the bore.
   b. The small bore diameter.
   c. The thick wall of the rifle barrel.
   d. Grooves cut into the rifle bore.

6. **Most bullets have a core consisting of lead-alloy. What does a bullet jacket consist of?**
   a. Copper-alloy.
   b. Lead-alloy
   c. A very smooth plastic to cut down on friction.
   d. Paper.

7. **The two basic types of cartridge ignition are**
   a. Pinfire and centerfire.
   b. Rimfire and pinfire.
   c. Centerfire and rimfire.
   d. Pinfire and flint.

8. **One benefit of a ventilated rib on a shotgun barrel is that it dissipates heat waves from hot barrels.**
   a. True.
   b. False.

9. **A solid projectile used in smoothbore shotguns for deer and black bear hunting is called a**
   a. Shot string.
   b. Rifled slug.
   c. Buckshot.
   d. Bullet.

10. **To apply for a Federal Firearms License, write to the Department of the Treasury: Bureau of Alcohol, Tobacco, and Firearms, addressed to**

    a. Your local Social Security office.

    b. Your State Tax bureau.

    c. The federal BATF office

    d. Your City or Town offices.

Firearm Fundamentals
Lesson: 2165

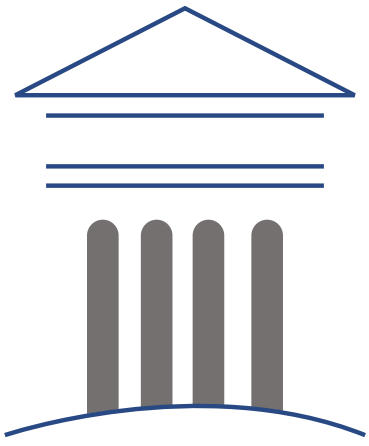
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Objectives

After completing this lesson, you should

1. Have an understanding of the operation of revolvers, semi-automatic pistols, and pump, lever, and semi-automatic rifles and shotguns.
2. Be familiar with the operation and history of percussion firearms.
3. Be familiar with the parts and operation of two basic types of revolvers.

Introduction

Knowing how firearms function is necessary for successful troubleshooting. If the gunsmith knows how a firearm should function, it is easier to find the problem when the gun does not operate properly.

Although there are numerous brands and models of firearms, all of them have some similar characteristics; that is, a shell or cartridge is placed in line with the bore of the barrel either in a chamber or cylinder, and a trigger mechanism releases the firing pin to ignite the shell or cartridge, and the shell or cartridge is expelled from the chamber allowing room for a new unfired cartridge. These operations take place in all firearms, regardless of whether they are single-shot, slide-action, lever-action, semi-automatic, or fully automatic. The differences are in how these operations are performed.

The common single-shot shotgun has a lever or button that is depressed to unlock the barrel from the standing breech. The barrel then pivots upward, allowing access to the chamber. A shot shell is then manually inserted into the chamber and the barrel is closed. Most guns of this type require that the hammer also be cocked manually, although a few perform this automatically when the barrel is opened. Once cocked, all that is required for firing is to pull the trigger. The force of the mainspring slams the hammer onto the firing pin which hits the shell's primer and discharges the shell.



Since we are referring to a single-shot shotgun, the gun can be fired only once for each loading. Therefore, the lever is again depressed to pivot the barrel downward. At this point, an extractor, built into the barrel assembly, pulls the fired shell out of the chamber. Most single-shot shotguns guns have automatic ejectors to automatically "kick" a fired shell out of the chamber. However, if the gun was not fired, the shell will not be ejected and would have to be removed by hand.

The gunsmith has to know exactly how each of these operations take place, and how the gun parts are related to each other. Furthermore, he or she must know how to correctly disassemble and reassemble the gun for cleaning and repairs. However, first, let us see how the modern firearm evolved and how some of the more popular firearms operate.

Evolution of the Modern Firearm

The majority of modern rifles and shotguns are breechloaders, utilizing a cartridge or shotshell that is loaded from the stock, or breech, end of the gun. Until about 150 years ago, most firearms were muzzleloaders, which utilized black powder and a ball or bullet loaded from the muzzle, or barrel, end of the gun. Breechloading had been tried prior to this time, but all such arms leaked powder gas at the breech, weakening the charge, and often burning the hand or face of the shooter. Breechloading first became practical around 1860 with the advent of fixed ammunition with metallic cartridge cases to act as gas seals.

SMOOTHBORES. Most early firearms used smoothbores, using a round lead ball, lead shot, or cut-up lead scraps. Among them were arquebuses, blunderbusses, and later muskets and fowling pieces.

The earliest muzzleloaders were fired by a slow match applied to a touch-hole at the breech. Later the charge was set off by a shower of sparks from steel and flint, first by a (shown in Figure 1), which was wound up by a special key, and then by a more practical device called a flintlock, shown in Figure 2. Thus, a gun was made up of "lock, stock, and barrel," an expression for completeness that is frequently used today.

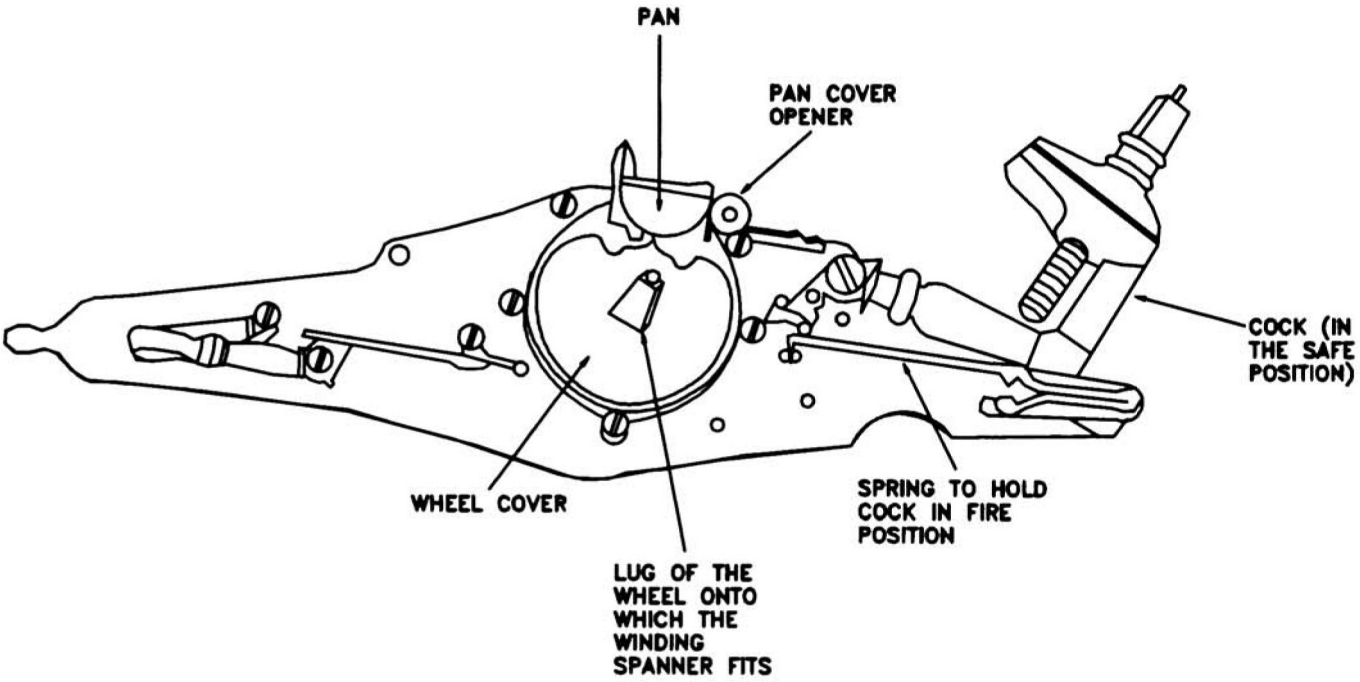


Figure 1: Wheel lock mechanism

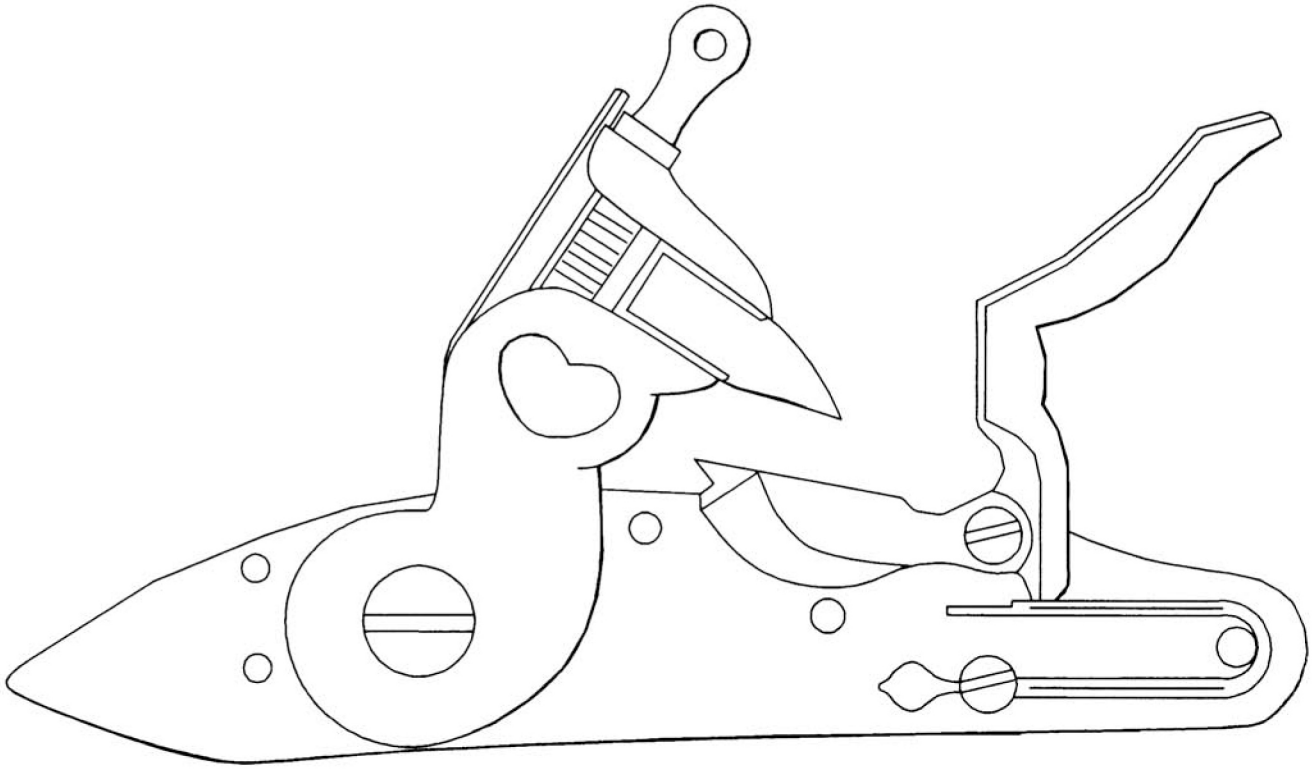


Figure 2: *Flintlock mechanism, circa 1775. This type of robust mechanism was in use until the invention of the percussion system.*

Flintlocks were primed by fine black powder carried in a pan into which the sparks from the contact of flint and steel were showered. But sometimes the priming powder jarred away from the touchhole and gave off a flash which failed to set off the powder charge in the barrel. This was called a "flash in the pan."

Smooth bore muskets were far from accurate. "Don't fire until you see the whites of their eyes" was shouted for a good reason. Accuracy beyond 50 yards was very unlikely.

KENTUCKY RIFLES. Before the advent of the Kentucky rifle, someone in Europe had discovered that grooves in a barrel enabled tighter fitting bullets to be rammed down easily. But in Kentucky it was discovered that if the grooves were spiraled so the bullet spun as the gun was fired, accuracy was immensely improved. This process of grooving the barrels was called rifling—hence the name *rifle*.

Around 1725, German gunsmiths in Pennsylvania were making the famous Kentucky pattern flintlock rifles. These were lighter, very accurate, and more economical than other rifles because they used a smaller bore. Lead and powder were scarce items along the Kentucky frontier to the unknown West.

PERCUSSION CAP. The next great improvement in firearms was the invention of the percussion cap in the early 1800s. The Civil War was fought mainly with percussion-cap, muzzleloading rifles using conical lead "Minié" balls, as shown in Figure 3. Today's primer is simply a refinement of the "cap," which fitted over a nipple that extended into the breech. On hitting the cap, the hollow-faced hammer exploded the fulminate compound in the cap, which shot a stream of flame through the hollow nipple into the powder charge. Bullets began to assume the conical shape they have today, except that most were of large caliber, as well as being flat and short as compared to the slimmer, more elongated modern bullets.

BREECHLOADERS. Practical breechloaders began to appear at the end of the Civil War and some, shown in Figure 4, were used by Union troops in the Civil War. The most notable were the Spencer and Henry carbines. Both were practical repeating rifles using the then recently invented metallic cartridge, in which the powder, bullet, and primer were all contained in a metallic case. These rifles used rimfire, brass-cased cartridges of relatively low power.

With sturdier, stronger brass cases and centerfire primers, heavier loads were used, and the development of rifles to handle them went hand in hand. Knockdown power was obtained by large caliber, heavy bullets propelled to the limit of black powder velocities, which was the only type of powder known at the time. Still, their velocities were very low by present-day standards and the path of the bullet's flight was highly curved—limiting their range to about 150 yards. There are stories of old buffalo hunters downing their game at ranges of 500 or even 1000 yards, but these were professional hunters who had fired thousands of rounds through their Sharps giving them the practice to shoot this accurately.



Figure 3: A United States was one type of percussion-cap rifle that was used in the Civil War.

SMOKELESS POWDER. Next came the advent of smokeless powder. This advancement brought many changes, one of which was a great increase in velocity. By reducing bullet diameter and weight, the striking energy was amplified to nearly double that of black powder. This, in turn, meant a much flatter shooting rifle, because the force of gravity had less time to blow the bullet off its course. Inaccurate firings due to errors in estimating the range and windage were cut dramatically, and the target was not obscured by smoke.

Over the next 90 years, smokeless powder stimulated a steady improvement of gun steels, heat treatments, and special alloys designed to withstand the higher pressures of the most modern cartridges. Powders were improved to burn cooler and be less erosive to barrels. Noncorrosive primers practically did away with pitted barrels, and improved bullet jackets all but eliminated metal fouling.

RIFLES

The variety of rifles made today is truly overwhelming to the common person. If you were to familiarize yourself with the dozens of models that have become obsolete in the past 100 years, you would be doubly amazed.

Every basic form of rifle in use today is the result of work by mechanics and inventors now long gone. Most were conceived before the turn of the century, and several date back to Civil War times. So before dealing with rifles of today, we ought to mention some of the famous old single-shot breechloaders such as the Sharp's, Ballard, and the famous Winchester.

SINGLE-SHOT RIFLES. The early repeaters like the Henry, Spencer, and the original Winchester Model 1866 used low-power cartridges. It took quite a few years to develop a repeater strong enough to handle the more powerful cartridges used, for example, by the buffalo hunters of the Western plains. For a while, the simple, strong, and sturdy single-shot rifles were the only rifles that could safely handle the long cartridges loaded with heavy charges of black powder and heavy bullets of .40, .45, and .50 caliber.

These rifles were dropping-block actions like the Sharp's and later falling-block Martini action. All were actuated by a finger lever located under the grip, which also served as a trigger guard. The Remington rolling-block single shot was manually thumbed back for loading, and supported when fired by engagement of the hammer against the underside of the block.

These famous single shots were later challenged by improved repeating rifles chambered for considerably more powerful cartridges approximating the heavy single-shot loads. They included some famous Winchesters, among them Models 1876 and 1886, and a bolt-action rifle called the Hotchkiss. All were "black powder" rifles, although the '86 was later adapted to a smokeless cartridge as the 33 Winchester. All are gone since the advent of the smokeless powder and subsequent flatter-shooting, higher-velocity repeating rifles that were created from better and stronger metal.

SHOTGUNS

The descent of shotguns can be traced from the ancient bell-mouth blunderbuss. The later fowling piece was simply a shorter, lighter version of the smooth bore musket.

The slow ignition of the flintlock limited the success of hitting birds on the wing, and fowling pieces were not used too much until the introduction of the percussion cap. With its more rapid ignition, wing shooting became more practical.

The average individual found that the .69-caliber smooth bore musket, loaded with a charge of shot pellets, worked well enough at shooting nonmoving objects, but rifled barrels were unsuited for shot loads. As the rifle replaced the smooth-bore



Figure 4: A breechloader that saw use in the Civil War was the Spencer Repeating Carbine.

musket, the fowling piece — or shotgun, as it was beginning to be called — was made with both single and double barrels, and rapidly acquired the characteristics that it has today.

Breechloading shotguns appeared earlier, but did not come into common use until around 1880 when the modern shotshell evolved from earlier types of ammunition. Shortly after breechloading shotguns appeared, *choke boring* was discovered. By constricting the bore at the muzzle, it was found that a gun would throw a narrower, denser pattern of shot, thus extending its effective range. Today most shotgun barrels are choked to some degree.

Repeating shotguns were first introduced a little over a hundred years ago. The first was a lever-action Winchester. A later development was the slide-action or "pump" gun in the form of the Winchester Model 93, Model 97, and the later Model 12.

Self-loading, auto-loading, and automatic shotguns (all three terms are synonymous) followed in the early 1900s. Minor refinements in design, metallurgy, and new operating concepts have occurred since their introduction, but no major changes have been made in their design.

HANDGUNS

The handgun has traditionally been a weapon of self-defense, but in recent years it has been used quite extensively for big game hunting, target shooting, and more recently, silhouette competition. Modern cartridge handguns are made in single-shot, revolver, and semi-automatic types; the revolver is either single- or double-action in design.

From the early hand cannons (which were fired with a slow match) to the flintlock and caplock guns, to the modern semi-automatics, the handgun has enjoyed great popularity.

Samuel Colt is normally credited with developing the first successful repeating handgun. Early Colt cap-and-ball revolvers were used extensively by both the military and civilians alike.

The first cartridge revolver brought out by the Colt Company was the .45-caliber single-action Army revolver. The U.S. Ordinance Officers performed experiments with this revolver from 1870 to 1873, resulting in a large order being placed by the Government. Consequently, the Colt single-action Army revolver, shown in Figure 5, was adopted as the official arm of the Army and Navy, and was regularly manufactured for these departments until 1894.



***Figure 5:** The popular Colt single-action Army revolver has seen service for over 100 years.*

This same model was made for commercial sale, and won great fame in the wild Western country, being almost exclusively adopted by the pioneers, cattlemen, miners, prospectors, and law officers. This civilian model was dubbed "Peacemaker" when chambered for the .45 Colt cartridge; those chambered for the .44-.40 were known as the "Frontier" revolver. Those on the wrong end of this revolver had other names for it.

Many tales have been told of the remarkable marksmanship of the early frontiersmen and law enforcement officers equipped with this arm. It is also interesting to note that this handgun was made, in slightly different variations, for over 100 years, except for a lapse of about 15 years during and after World War II.

A double-action revolver followed the single-action revolver. It was made in practically the same calibers and used for the same purposes by the Government and the public where a double-action or self-cocking weapon had been preferred. The double-action revolver became the United States Government's chief side arm until it adopted the Colt Model 1911 semi-automatic pistol in 1911. The double-action revolver also became the standard side arm for nearly all law enforcement officers, but today it has been replaced by various semi-automatic pistols.

SELF-TEST QUESTIONS

Please check your answers on page 22.

1. ***True or False.*** **The percussion ignition system came before the flintlock system.**
2. **Name two brands of breechloading carbines that were used during the Civil War.**
3. **What caliber was Colt's first single-action cartridge revolver chambered for?**
4. **In what year did the U.S. Government adopt the Colt semi-automatic pistol as its official side arm?**

Handgun Operation

Although several new models of firearms appear on the market each year, the basic operating principles were developed almost 100 years ago. Minor improvements have been made over the years, but the basic designs are still the same. Therefore, by studying the general characteristics of only a few different models, you will understand how the majority of firearms function.

MODEL 1917 COLT REVOLVER

The Model 1917 Colt revolver is provided with a swing-out cylinder having six chambers arranged around a central axis so that six shots may be fired before reloading is necessary. When the cylinder is closed, the revolver is ready to fire. It may be fired either single-action—cocking the hammer with the thumb—or double-action—cocking the hammer with the trigger.

The action of cocking the hammer, either in single- or double-action firing, causes the cylinder to rotate and align the next chamber with the barrel. The rate of fire is limited only by the dexterity of the operator in reloading the cylinder and his or her ability to aim and squeeze.

A cross-sectional view of the Model 1917 Colt revolver with the names of the various parts labeled is shown in Figure 6. Look at this figure as you read about the Colt revolver.

Pulling backward on the latch (located on the opposite side of the frame) with the thumb disengages the latch pin from the ejector and permits the cylinder to pivot on the crane and swing outward to the left. The cylinder can then be loaded with up to six cartridges.

The latch pin is under pressure of the latch spring, which is located in a hole in the sideplate to the rear of the latch slot. Under this pressure, the latch pin is forced into the recess in the ejector when the cylinder is swung back into the frame. The cylinder is then locked and ready for firing, as shown in Figure 7.

In double-action firing, pressure by the finger on the trigger causes the upper edge of the trigger to engage the hammer strut and raise the hammer to near full-cock position. When the strut escapes from the trigger the hammer is allowed to fall. Also, when the trigger is pulled back, the safety lever attached to it pulls the safety out of the path of the hammer so that when the hammer falls it will strike the cartridge.

When firing single-action, the hammer is first pulled back with the thumb until the upper edge of the trigger engages in the full-cock notch at the lower front end of the hammer. The backward movement of the trigger also disengages the safety just as when firing double-action, as shown in Figure 8.

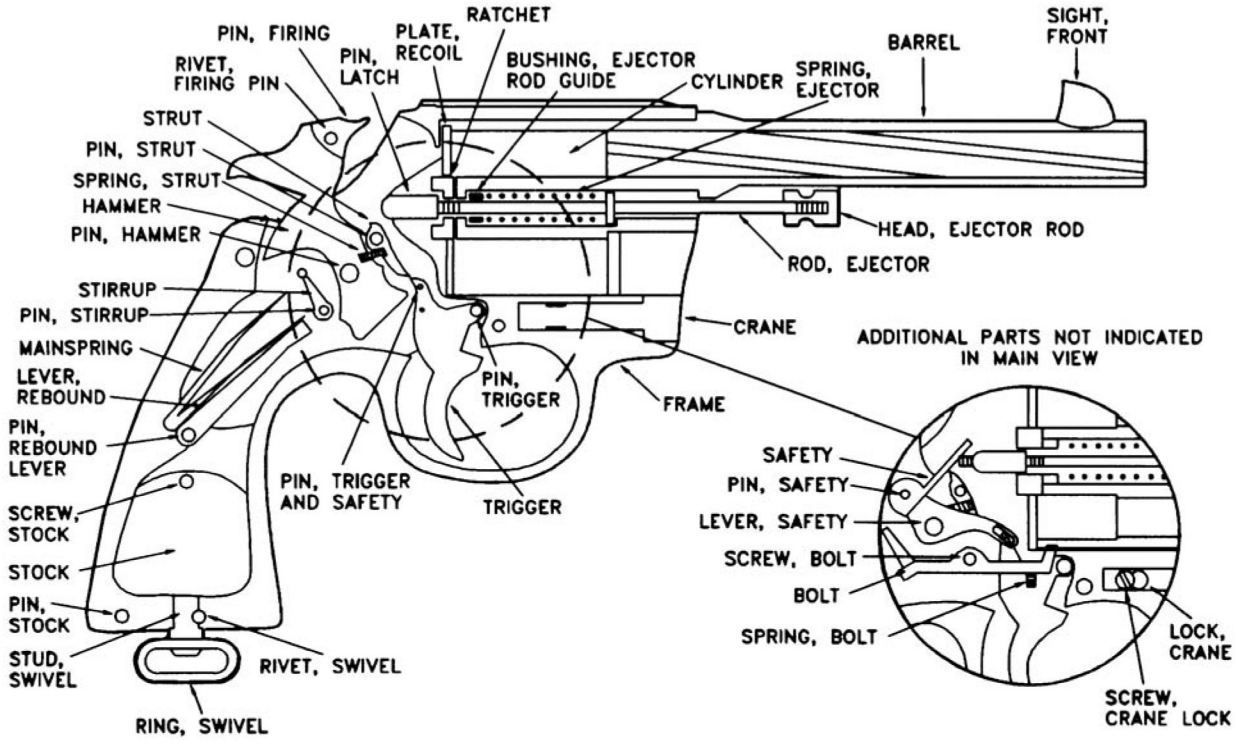


Figure 6: A cross-sectional view of the Colt Model 1917 revolver. This revolver was originally chambered for the .45 Colt, but was used mainly with .45 ACP cartridges when used in conjunction with 3-shot clips.

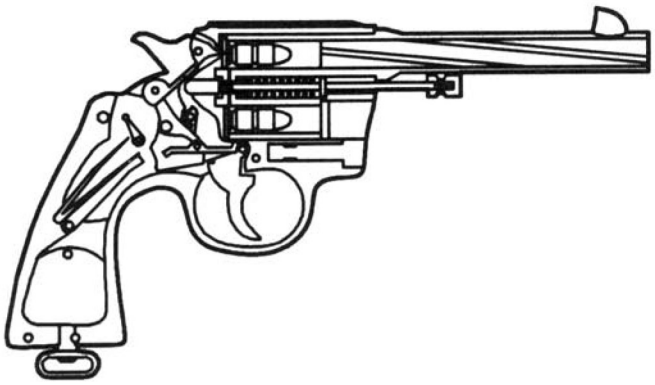


Figure 7: *Sectional view of a Colt Model 1917 revolver with hammer down and cylinder loaded.*

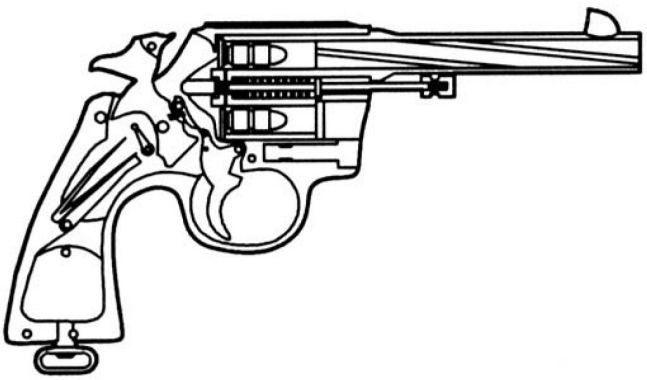


Figure 8: *Colt Model 1917 revolver with hammer and trigger back.*

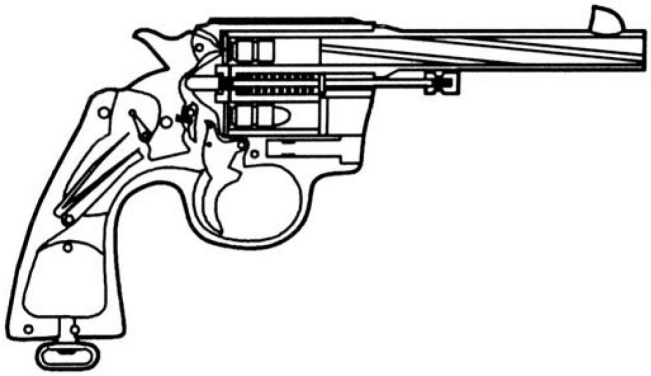


Figure 9: *Colt Model 1917 revolver with hammer striking cartridge. Trigger must be held back until hammer strikes.*

The movement of the trigger in cocking the hammer is simultaneous with the nose of the bolt withdrawing from the cylinder. This is caused by the rear end of the bolt coming into contact with the lug on the rebound lever. The hand can then rotate the cylinder. The hand which is pivoted to the trigger swings on its pin and is raised. Its upper nose engages the ratchet on the cylinder causing it to revolve.

As the trigger continues its backward movement, the lug on the rebound lever slips off the rear end of the bolt. This permits the nose of the bolt to drop into the proper recess in the cylinder the instant the hand has rotated it. In this manner, the next chamber is brought into alignment with the barrel. When the hammer falls at the time of firing, both the hand and the bolt lock the cylinder in such a position that the chamber of the cylinder coincides with the axis of the barrel, as seen in Figure 9. The pressure of the rebound lever on the hand lug insures its engagement with the ratchet until the trigger is released. The bolt also prevents the cylinder from making more than one-sixth of a revolution each time the revolver is cocked.

When the trigger is released after firing a shot, the rebound lever, under the pressure of the mainspring, forces the hammer back to its safety position. The trigger is also forced forward. The safety lever moves the safety upward in front of the hammer by the same motion. Thus, the hammer can strike the cartridge only when the trigger is pulled.

After firing, the cylinder is again swung open and cartridges or cartridge cases are ejected from the cylinder by pressing on the front end of the ejector rod. This action counteracts the pressure of the ejector spring inside the center arbor of the crane, and pushes the ejector out of its recess in the rear end of the cylinder. The spring also forces the ejector to return to its position inside the cylinder where pressure is released from the forward end of the rod.

SMITH & WESSON MODEL 1917

Figure 10 shows a cross-sectional view of a Smith & Wesson (S & W) Model 1917 revolver. This basic design is still used, with some refinements, in present day S & W revolvers. Refer to this figure as you read about the S & W Model.

Pushing on the thumbpiece forces forward the latch to which it is attached by the thumbpiece nut. The nose of the latch presses against the end of center rod within the ejector plunger and, in turn, pushes it into the main shaft of the crane. This releases the cylinder so that it can pivot on its crane and swing outward to the left. The cylinder can then be loaded with two clips of three cartridges each. Never snap or jerk the cylinder out because it might damage the crane.

While the cylinder is open the hammer cannot be raised, because the pressure of the latch plunger spring holds the latch forward. In this position, a lug on the rear of the latch is under the rear edge of the hammer.

When the cylinder is swung back into the frame, as shown in Figure 11, the center rod spring, which has a greater pressure than that of the latch plunger spring, forces the end of the center rod into engagement in the frame by pushing the latch backward, thus locking the cylinder in place. At the same time, it disengages the interlocking lug of the latch from under the hammer. The cylinder is thus locked into position for firing and the hammer can be raised. In the closed position of the cylinder, the pressure of the center rod spring is assisted by the pressure of the locking bolt spring, which is mounted with the locking bolt on the underside of the barrel. This bolt also assists in maintaining the alignment of the ejector plunger and cylinder when the cylinder rotates.

In double-action firing, pressure of the finger on the trigger causes the upper edge of the trigger to engage the hammer strut and raise the hammer until the nose of the trigger comes into contact with the hammer. The trigger continues to raise the hammer until the latter is nearly in its full-cock position, as shown in Figure 12, when it will escape from the trigger nose and fall due to the pressure of the mainspring. When the trigger is pulled back, the rebound slide is also pushed back to a point where a projection on the slide is far enough back to prevent the lug on the hammer from coming in contact with it. This permits the hammer to fall the full distance and strike the cartridge.

In single-action firing, the hammer is first pulled back with the thumb until it is in the full-cock position, as in Figure 13. In this position, a notch in the lower front end of the hammer is engaged with the nose of the trigger. Pressure on the trigger disengages it from the notch in the hammer, thereby releasing the hammer and permitting it to fall. The hammer will fall the full distance due to the position of the rebound slide. If the

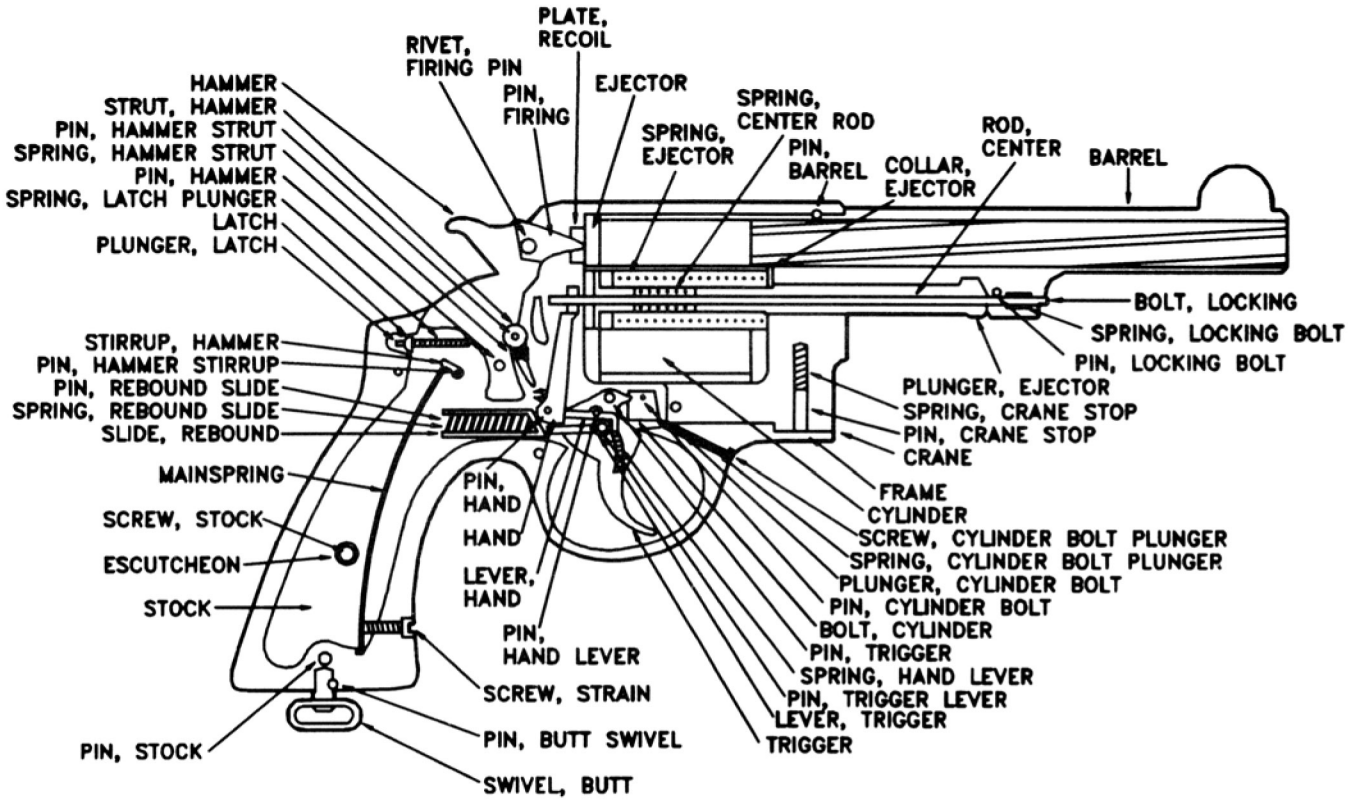


Figure 10: A cross-sectional view of the Smith & Wesson Model 1917 revolver. Many refinements have been made to this revolver but the basic principles of operation remain.

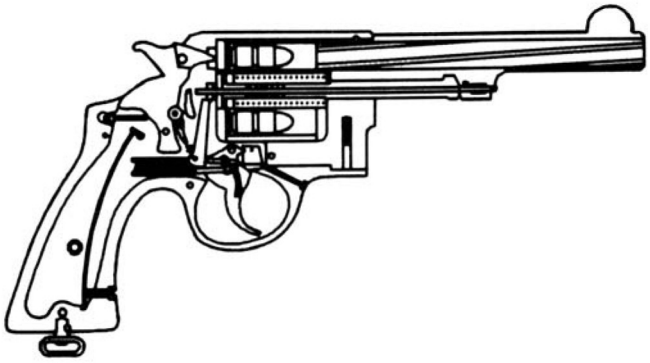


Figure 11: *A Smith & Wesson Model 1917 revolver with hammer down and cylinder loaded*

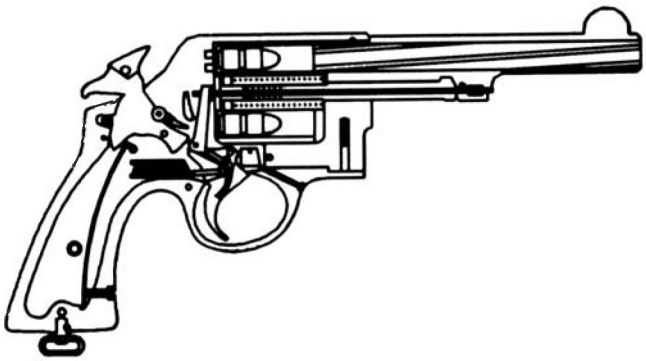


Figure 12: *A Smith & Wesson Model 1917 revolver with hammer and trigger back.*

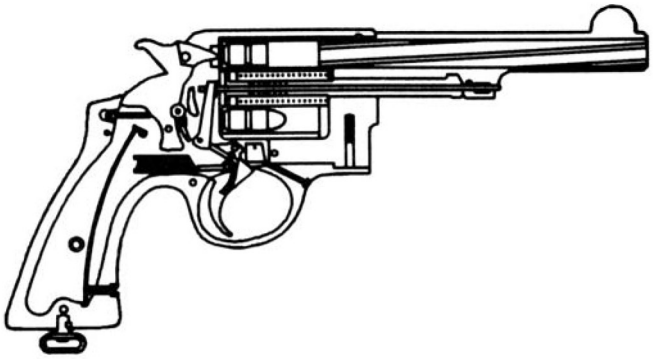


Figure 13: *A Smith & Wesson Model 1917 revolver with hammer striking cartridge. Trigger must be held back until hammer strikes primer.*

trigger is allowed to return to its normal position before the hammer completes its cycle, the rebound slide will block the hammer force, causing a misfire.

In either single- or double-action firing, the trigger must remain back while the hammer falls so that the lug on the lower edge of the hammer will not come in contact with the projection on the rebound slide. If the trigger is allowed to return to its normal position between the time the hammer falls and comes close to the cartridge, the projection on the slide will prevent the hammer from falling the full distance and in turn prevent it from striking the cartridge.

The cylinder cannot be opened while the hammer is cocked since the lug on the rear of the latch is held by the hammer against forward movement. As the hammer is cocked, a lug on the upper front edge of the trigger engages in the slot in the cylinder bolt and forces it downward against the pressure of the cylinder bolt plunger and spring. This withdraws the nose of the bolt from the cylinder and permits the cylinder to rotate under the action of the hand. The hand, which is pivoted to the trigger, swings on its pin and is raised to engage with the ratchet on the ejector and to revolve the cylinder.

As the trigger continues its backward movement, the bolt is released from the trigger, permitting its nose to drop into the proper recess in the cylinder as soon as the hand has rotated it enough to bring the next chamber into alignment with the barrel. When the hammer falls, both the hand and the bolt lock the cylinder in such a position that the chamber of the cylinder aligns with the axis of the barrel. Pressure caused by the contact of the hand and the ratchet is maintained by the hand lever and hand lever spring which are mounted within the trigger.

The cylinder bolt also prevents the cylinder from making more than one-sixth of a revolution each time the revolver is cocked.

When the trigger is released, the rebound slide, under pressure of the rebound slide spring, forces the trigger forward. The lug on the top edge of the slide also comes into contact with the mating lug on the lower edge of the hammer forcing the hammer backward until the firing pin is withdrawn into the frame of the revolver. As long as the trigger remains in normal position, a blow on the hammer cannot cause it to strike the cartridge, since the lug on the slide will prevent forward movement of the hammer. The hammer can strike the cartridge only when the trigger is pulled back completely.

After firing, the cylinder swings open and the cartridges or empty cartridge cases (including clips) are ejected from the cylinder by pressure of the finger on the head of the ejector plunger. When the plunger is depressed, backward movement of the cylinder is prevented by a lug riveted into the left side of the frame.

COLT MODEL 1911(A1) PISTOL

The United States Government began showing an interest in a .45-caliber semi-automatic pistol as early as 1905. John M. Browning began working on a number of prototypes that eventually led to the design of the Colt Model 1911 which was ultimately accepted by the Army, Navy, and Marine Corps. When adopted, this model, and later refinements, became the official U.S. military side arm for over 70 years.

This basic semi-automatic design was used by numerous manufacturers including those manufacturing the Browning automatic pistols that became the official side arm of many countries throughout the world.

A cross-sectional view of the Colt Model 1911(A1) is shown in Figure 14. Study this view as you read about the semi-automatic pistol.

In loading, the charged magazine is inserted in the receiver, as shown in Figure 15, and the slide is drawn to the rear. Figure 16 shows how this movement cocks the hammer and compresses the recoil spring. The magazine follower then raises the upper cartridge into the path of the slide, as shown in Figure 17. When the slide is released, it is forced forward by the recoil spring and carries the first cartridge into the chamber of the barrel. As the slide approaches its forward position, it encounters the rear extension of the barrel and forces the barrel forward. The rear end of the barrel then swings upward on the barrel link as on a pivot. When the slide and barrel reach their forward position, they are locked together by the locking ribs on the barrel and slide. Their forward movement is stopped by the barrel lug coming in contact with the pin on the slide stop. The pistol is then ready for firing (Figure 18.)

If more than seven cartridges are to be fired, an additional cartridge is inserted by hand into the chamber of the barrel prior to inserting a loaded magazine. This is accomplished by drawing back the slide, inserting the cartridge, allowing the slide to close, and then locking the slide and the cocked hammer by pressing the safety lock upward. The slide and hammer are then locked, and the pistol may be carried safely at full cock. It is only necessary to press down the safety lock to make the pistol ready to fire.

When the hammer is cocked, the hammer strut moves downward to compress the mainspring. The sear, under the action of the long leaf of the sear spring, engages its nose or tip in the notch on the hammer to hold it in the cocked position.

For the pistol to be fired, the following conditions must exist:

- The grip safety must be pressed in, permitting the trigger to move.
- The slide must be in its forward position, properly interlocked with the barrel so that the disconnector is in the

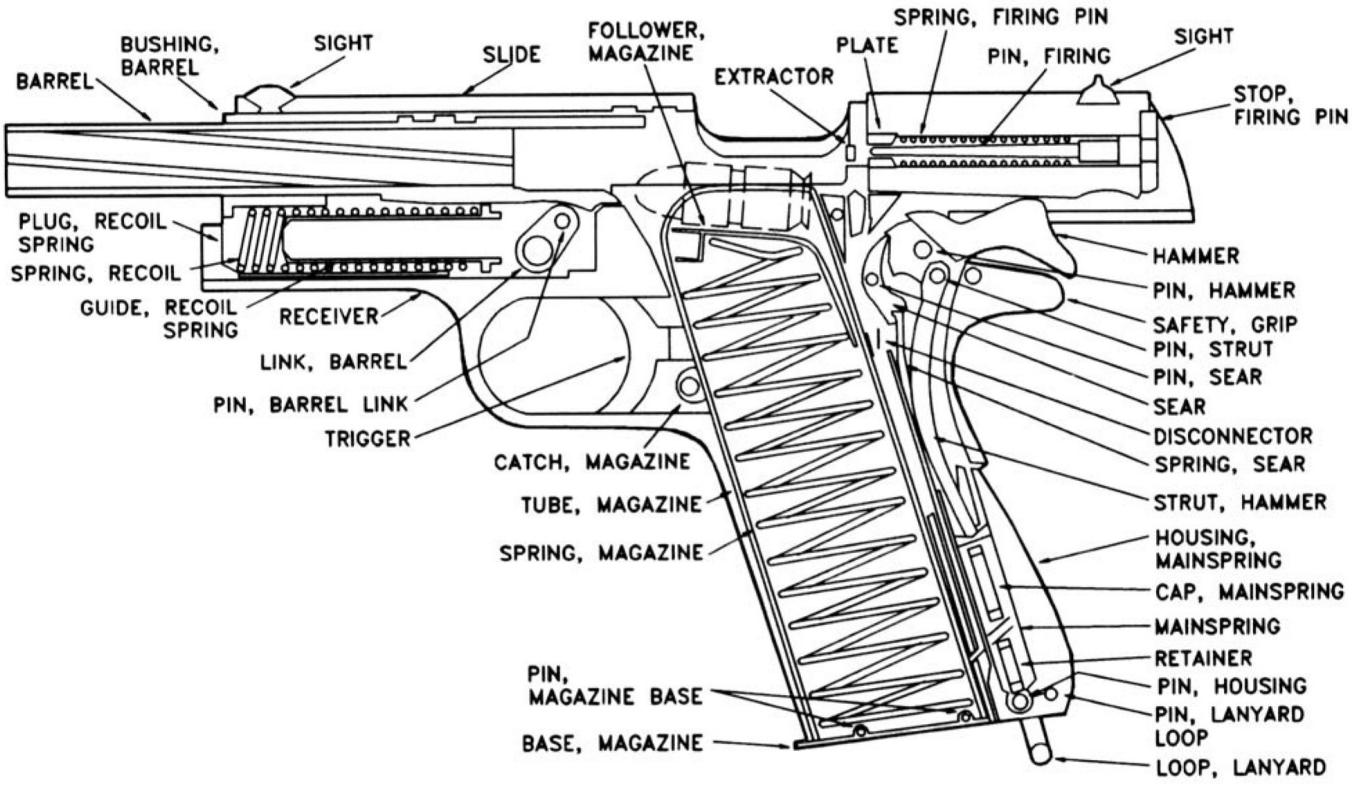


Figure 14: A cross-sectional view of the Colt Model 1911 (A1) semi-automatic pistol.

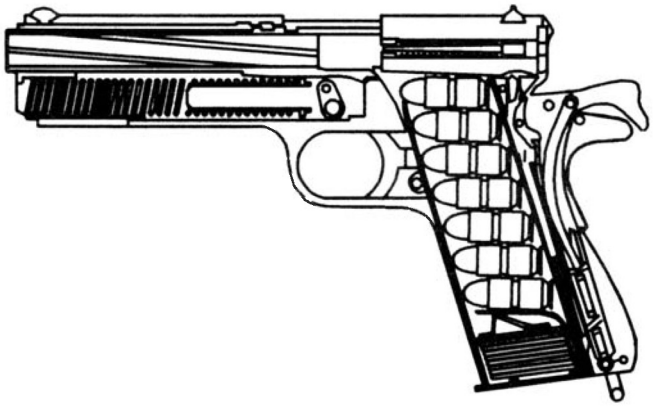


Figure 15: *A Colt Model 1911 (A1) with the slide forward, magazine loaded, chamber empty, and the hammer down. This is the normal 'carry' position.*



Figure 17: *The slide moves forward to pick up cartridge from magazine.*

recess on the underside of the slide. In this position, it transmits any motion of the trigger to the disconnector and sear.

- The safety lock must be down and in the unlocked position, so that the sear will be unblocked and free to release the hammer. The slide will then be free to move back.

Squeezing the trigger disengages the sear from the sear notch, releasing the hammer and letting it strike the firing pin. The blow overcomes the inertia of the firing pin spring and causes the firing pin to move forward. The forward end of the pin then strikes the primer of the cartridge, causing it to fire, as shown in Figure 19.

The primer of the cartridge is the cap inserted in the center of the cartridge case head. It contains the detonating charge, which is ignited by the impact of the firing pin. Detonation of this charge then ignites the propelling powder charge contained in the cartridge case.

The pressure of the gases generated in the barrel by the explosion of the powder in the cartridge is exerted in a forward direction against the bullet, driving it through the bore. Pressure is also exerted in a backward direction against the face of the slide, driving it and the barrel backward together. The slide travels the full distance while the barrel moves about 1/8 inch. The downward swing movement of the barrel disengages it from the corresponding grooves in the slide. The barrel is then stopped in its lowest position. The slide continues to move to the rear, opening the breech, cocking the hammer, extracting and ejecting the empty shell, and compressing the recoil spring until the slide reaches its rearmost position (Figure 20). The return movement of the slide under the pressure of the recoil spring catches the next cartridge and forces it forward. The lips on the magazine, as well as the loading ramp on the rear end of the barrel, guide the cartridge into the chamber.

The weight, and consequently the inertia of the slide and the barrel, is so much greater than the weight and inertia of the bullet that the latter is driven from the muzzle before the slide



Figure 16: *A Colt Model 1911 (A1) with the slide back, hammer back and magazine loaded.*

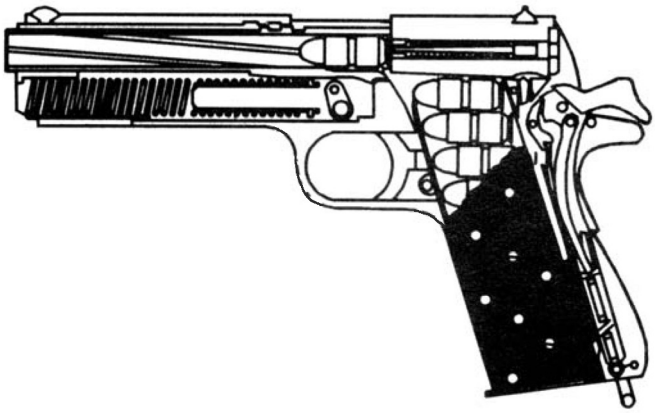


Figure 18: *The slide is fully closed and ready to fire. Note that the cartridge is in the chamber and the hammer is fully cocked.*

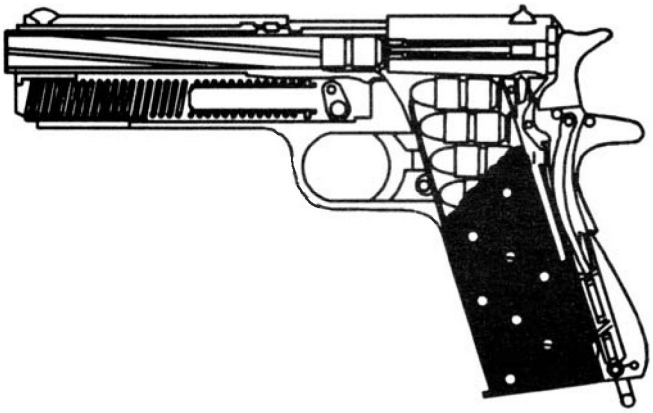


Figure 19: *A view of the pistol just after being fired. The hammer is down and the firing pin is striking the cartridge.*



Figure 20: *After firing, the slide moves back, ejecting the fired cartridge. If the magazine is empty, the slide will remain open; if the magazine is not empty, the slide will move forward to pick up another cartridge and chamber it.*

and barrel have recoiled to the point where the barrel commences its unlocking movement. Thus, the opening of the breech of the barrel is delayed until after the bullet has left the muzzle and the escape of any of the powder gases to the rear is practically prevented. This factor of safety is further increased by the tension of the recoil spring and mainspring, both of which oppose the backward movement of the slide.

The comparatively great weight of the slide of the pistol not only prevents premature opening of the breech, but also assures operation of the pistol. This is because the heavy slide attains a sufficient momentum to enable it to complete the rearward movement, allowing the cartridge to be forced into position by the magazine follower.

When the magazine has been emptied, the pawl-shaped slide stop is raised into the front recess on the lower left side of the slide by the magazine follower. This locks the slide in the opened position and serves as an indicator to remind the operator that the empty magazine must be replaced by a loaded one. Pressure upon the magazine catch quickly releases the empty magazine from the receiver and permits the insertion of a loaded magazine.

To release the slide from the open position, it is only necessary to press upon the thumbpiece of the slide stop. The slide will then go forward to its closed position carrying a cartridge from the magazine into the barrel and the pistol is ready to fire again.

The three models of handguns just described will suffice for most of the gunsmith's handgun work. However, detailed descriptions of other models are covered in later lessons. You will also want to start collecting manufacturer's data on all their models for exact details on firearm operation. Although most handguns operate in a similar way, every model is designed slightly different.

SELF-TEST QUESTIONS

Please check your answers on page 22.

5. **What is the maximum number of cartridges the cylinder of the Colt Model 1917 revolver is designed to hold?**
6. **What is the maximum number of cartridges the cylinder of the S & W Model 1917 designed to hold?**
7. **What is the maximum number of cartridges the magazine of the Colt Model 1911 or Model 1911(A1) is designed to hold?**
8. **If an additional cartridge is desired in the Colt Model 1911 or Model 1911(A1) pistol, what must you do?**

Shotgun Operation

As the name implies, shotguns are made to shoot shot. They are the only practical arms for bird and waterfowl shooting, but they are predominately used on small game, such as rabbits, and for trap and skeet shooting.

Like its muzzleloading predecessor (the fowling piece), the shotgun has a smooth bore. Because its charge is a load of shot pellets, the shotgun bore is large in diameter. The size of the bore is designed by its gauge. While 4- and 8-gauge guns were fairly common years ago, 10, 12, 16, 20 and 28 gauges and .410 bores are the only sizes still manufactured in the United States today. The 16-gauge is another gauge that is seldom made in this country.

SINGLE-SHOT SHOTGUNS

Single-shot shotguns are the least expensive type of shotgun. They are the break-open type with the barrel hinged on the frame. The low cost has made them popular with youngsters just beginning their shooting experience. Many are exported. Most come with full choke barrels, are rather light-weight, and consequently, "kick" more than heavier types. Most are "hammer" guns, with the hammer outside and cocked by hand. Some are hammerless — that is, having a concealed hammer which is cocked when the gun is opened for loading. On the other hand, single-barrel trap guns are quite heavy, expensive, and of superior quality. Most are imported, with only one type being made in the United States. All are hammerless, have ventilated ribs on the barrels, and have automatic ejectors. However, their use has steadily declined in favor of pump guns.

DOUBLE-BARREL SHOTGUNS

The double-barrel, or side-by-side shotgun, is regarded by many as the classic shotgun, especially for upland shooting; a well-balanced double is considered by most experts as the finest handling of all guns. A good double-barrel shotgun is very expensive and involves a lot of hand work, which increases costs. Double guns offer the advantage of two quick shots from side-by-side separately choked barrels. Better grade doubles have single triggers that can be quickly set to fire either barrel first, plus automatic ejectors that kick out one or both fired shell cases when the gun is opened for reloading.

Quite a number of medium-priced double guns are imported from Europe, where labor costs are much lower than in the United States. Other fine doubles are made in Japan and are imported under American manufacturers' names. In the United States, only a few double gunmakers remain today, one of which is the Savage Arms Company.

OVER/UNDER SHOTGUNS

Over/under shotguns, in which the barrels are stacked on top of each other, have a narrower sighting plane than the side-by-side double. This appeals to many people. However, the barrels must swing through a much greater arc when the gun is opened for reloading. Like the double, a fine over/under is an expensive gun to make.

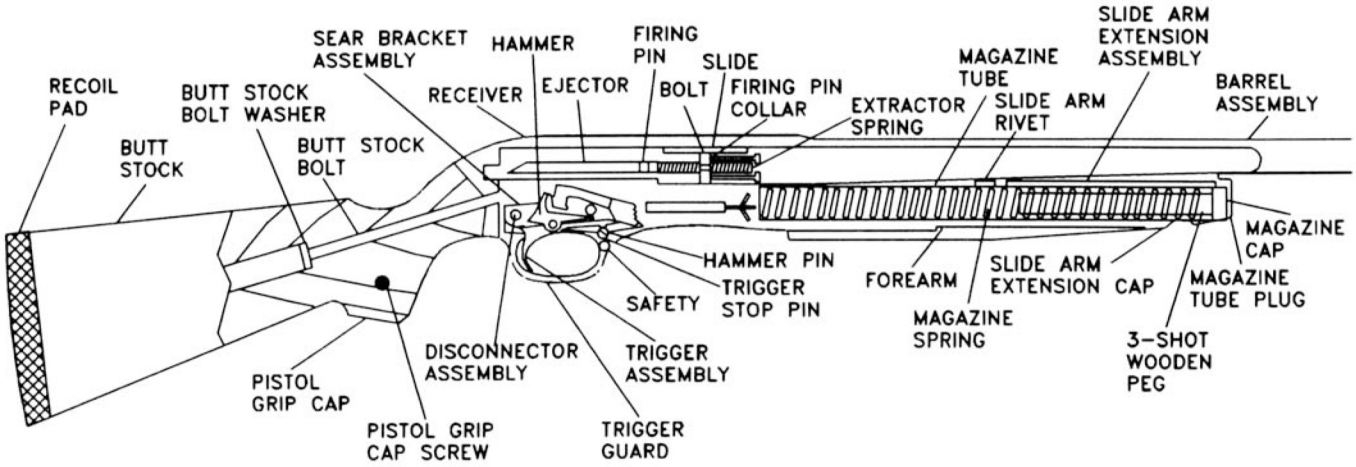


Figure 21: A cross-sectional view of a Winchester Model 1200 slide-action shotgun

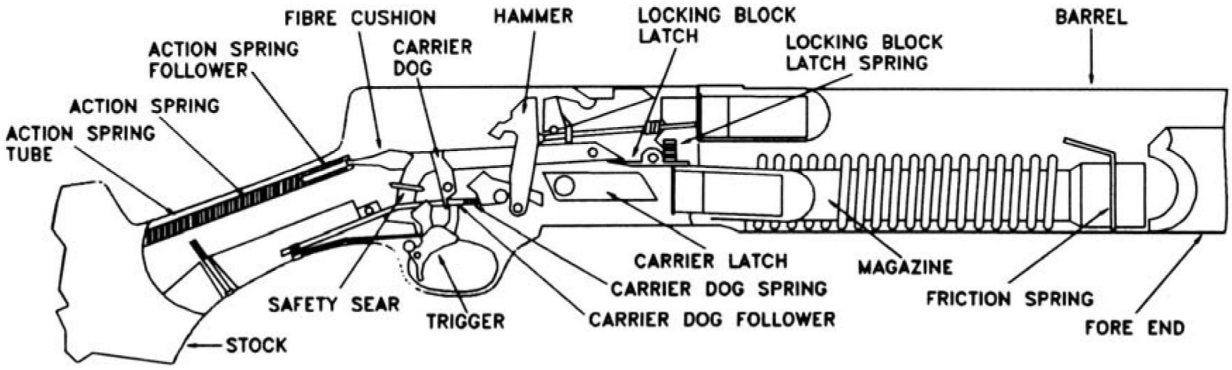


Figure 22: John M. Browning's long recoil system is the basic system for nearly all semi-automatic shotguns.

SLIDE-ACTION SHOTGUNS

Slide-action or pump guns are immensely popular and there are several models available on the market; the Winchester Model 12 is one of the most noted. However, this model is no longer manufactured and has become a very coveted collector's item. The Remington Model 870 is probably the most popular pump shotgun manufactured today.

The slide-action or pump gun derives its name from the way in which it operates. For example, when the Winchester Model 1200 is fired, as shown in Figure 21 the action unlocks. A backward pull on the slide handle (that is connected to the breechblock) causes the breechblock to unlock its 4-lug rotary bolthead and then move back in the receiver, pulling the fired shell with it and flipping it out through the ejection port. At the same time, the springloaded magazine is pushing out a fresh shell onto a hinged carrier. With the empty shell ejected and out of the way, the forward stroke of the slide handle causes the breechblock to push the fresh shell along the carrier, which is now hinged upward, and into the chamber. At this point, the bolthead rotates to engage its locking lugs directly behind corresponding lugs in the barrel breech, and the action locks for firing.

A safety located in the trigger guard locks the sear in the sear notch of the hammer. An interruptor prevents discharge if the trigger is held back during manipulation. This means that the trigger must be allowed to "recover" before it can be pulled. Slide action shotguns are made in 12, 16, and 20 gauges, .410 bore, and in field, trap, and skeet styles. Some 12- and 20-gauge slide-action shotguns are made as duck hunting guns with 3" chambers.

SEMI-AUTOMATIC SHOTGUNS

Semi-automatic or self-loading shotguns are another American development, but are currently made in the United States, Europe, and Japan. The automatic shotgun enjoys great popularity in North America and has lately found favor in Europe—probably due to the rising cost of double guns. There are basically two types of semi-automatic shotguns in use: recoil- and gas-operated. The recoil-operated mechanism may be further categorized into two separate groups: long recoil and short recoil. As seen in Figure 22, the original Browning A-5 automatic (almost identical to the Remington Model 11) used a long recoil system, while the Browning double automatic and the Winchester Model 50—to name only a couple—use the short recoil action.

With the long recoil type, the barrel and breech are pushed back while still in contact with one another until they reach the rear of the shotgun receiver. This action compresses the action spring. The barrel and breech separate when they reach this position, with the barrel pulling itself forward. As the barrel moves forward it pulls away from the expended shell case which is held in contact with the breechblock by a set of double extractors. As the barrel reaches its original position, the shell is ejected by a special spring that is 17 attached to the barrel. When the barrel is moving forward, it trips the compressed spring in the stock that releases the action spring to move the breechblock forward. The breech also picks up a new shell and pushes it into the chamber. The gun is then ready to fire.

Since the long-recoil shotgun has a two-part recoil, many shooters complain of the double-kick effect. When the shell is fired, the shooter feels the kick, but there is a second kick when the barrel and breech recoil. Since all of the movements are controlled by the adjustments on the various springs that are involved, misadjustment can cause some rather jolting recoils.

To lessen the effects of the double-recoil, some shotgun manufacturers started using a short recoil system, as shown in Figure 23. With the Browning double-automatic, for example, the barrel only recoils about $^{5}/_{8}$", just enough to start the action moving. Winchester, on the other hand, has a fixed barrel and a floating chamber in its Model 50. It also has an inertia rod that runs into the shoulder stock. When a shell is fired, the chamber moves back approximately $^{1}/_{10}$", causing a special pin in the bolt to kick the inertia rod back against a spring in the buttstock. The hammer is cocked as the inertia rod moves backward. At the extreme rear position of the inertia rod, the

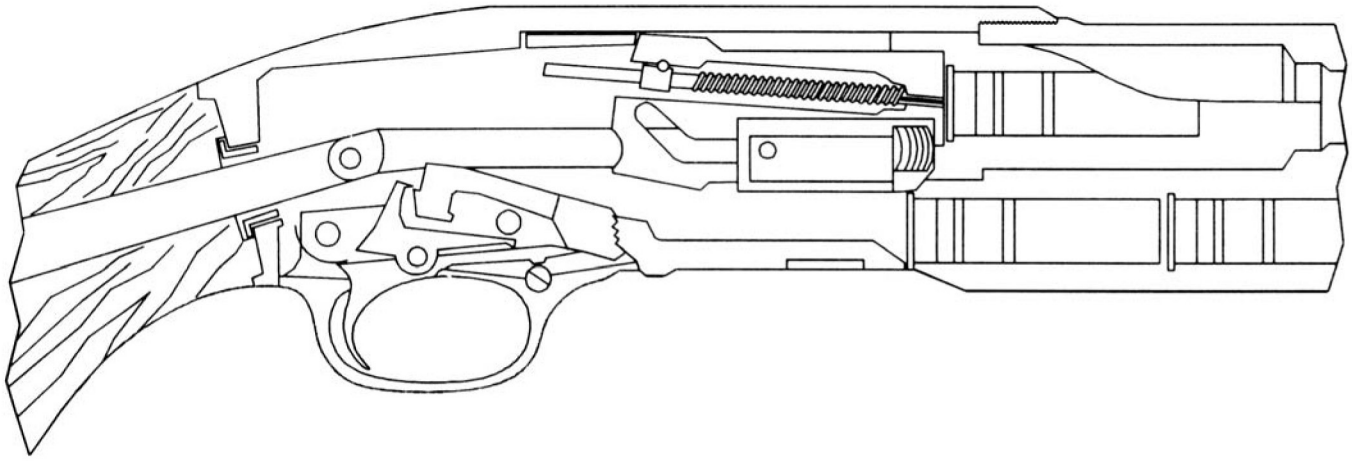


Figure 23: *The short-recoil semi-automatic shotgun is merely a modification of Browning's original design. The short-recoil action eliminates the "double kid" effect associated with the long-recoil action*

bolt is opened and the shell is ejected. When the spent shell ejects, a new shell is allowed to enter the carrier. While the spring pushes the inertia rod forward the bolt moves forward, picking up the shell on the carrier and pushes it into the chamber. This ends the cycle and the shotgun is ready to fire.

In recent years, another method for powering semi-automatic shotguns is being used. Just like semi-automatic rifles, gas-operated semi-automatic shotguns are using the gas power from the expended shell to operate the action. The gas is taken from a port in the barrel. This action minimizes the amount of recoil the shooter has to withstand—making the gas-operated semi-automatic shotgun a very smooth operating gun and a pleasure to shoot.

BOLT-ACTION SHOTGUNS

Bolt-action shotguns may be single-shot, or repeaters holding two or three shells. They are manipulated by a turnbolt; that is, when shells are loaded in the magazine, opening the bolt will cock the firing-pin spring. On closing, the bolt picks up one shell and chambers it. After firing, and again upon opening the bolt, the fired shell is ejected out of the gun while the firing pin spring is once again cocked. Closing the bolt picks up another shell and chambers it. They are good, rugged, simple, low-cost arms, but since they are relatively slow in operation, they are not as popular as pumps and automatics.

Operating characteristics for various shotguns will be discussed throughout this course. Manufacturers' service manuals also contain useful operating instructions for models currently manufactured. Any information you can obtain will be invaluable to you when you start to troubleshoot and repair the various models of firearms.

SELF-TEST QUESTIONS

Please check your answers on page 22.

9. **Name the two basic types of recoil-operated semi automatic shotguns.**
10. **Where does a gas-operated semi-automatic shot gun obtain its power to operate the action?**
11. **Where does a slide-action shotgun get its power to operate?**
12. **What part of a bolt-action shotgun is used to cock the striker, depress the mainspring (or firing-pin spring) eject the spent shell, and pick up a new shell for chambering?**

Rifle Operation

BOLT-ACTION RIFLES

Figure 24 shows a bolt-action rifle, which has a turn bolt with a knobbed handle. The bolt slides in races, or grooves, machined in the receiver. When ready for firing, the bolt is in the forward position — handle down, locking the action and supporting the cartridge head. The locking arrangement in high-powered rifles is accomplished by two or more lugs on the front end of the bolt rotating into slots at the front of the receiver. On rimfire rifles, it is generally done by rotating the lug of the bolt handle into a slot cut in the side of the receiver. Seldom does a rimfire rifle have locking lugs in the chamber area.

After firing, when the bolt handle is lifted, the upward motion frees the fired shell from the chamber wall by the reverse rotation of the bolt handle, and cocks the action. The backward pull extracts and ejects the shell. The bolt in its rearward motion uncovers the magazine, allowing the spring-loaded magazine follower to push a fresh cartridge high enough for the bolt to engage it on the forward stroke, and push the fresh cartridge into the chamber.

The operation is completed when the bolt turns down, engaging the hook of the extractor in the extractor groove which encircles the base of the cartridge, and rotating the locking lugs home, thus fully locking the bolt and bringing the shooter's hand, which is on the bolt knob near the trigger, ready to fire. The firing pin of bolt-action rifles is actuated by the compression of a heavy spiral spring. On most other types of actions, the firing pin is actuated by a blow from a hammer. The safety on a bolt action prevents movement of the firing pin. On some rimfire rifles the opening or closing of the bolt sets an automatic safety, which must be released before firing. Bolt actions, and for that matter all types of actions, have built-in safety devices that prevent firing unless the action is fully locked. Thus, a rifle may be loaded or unloaded by manipulating the bolt with the firing pin locked.

Except for a few higher priced target rifles, like the super-accurate Anschutz Target 1813, the only commercially made, single-shot, bolt-action rifles today are low priced .22-caliber rifles. Most of these are single-shot rifles that employ an action which is basically the same as the turn-bolt. Well known military bolt-action rifles include the famous Springfield of World War I, the British Enfield, and the German Mauser in many variations. Bolt-action rifles for military use were made all over the world by national arsenals, but are gradually being replaced by semi-automatic or fully-automatic rifles. However, bolt-action sporting rifles have long been popular in Europe, and quite a number are exported, most of them from Belgium, England, Finland, and Sweden.

The diversity of calibers offered in bolt-action rifles exceeds that of any other type of action. Some are chambered for the .22 rimfire cartridge, others for .22-caliber centerfire cartridges. At the other extreme are heavy, very powerful calibers, such as the .458 Winchester Magnum intended for big safari game hunting. In between are cartridges ideally suited for all types of sport hunting.

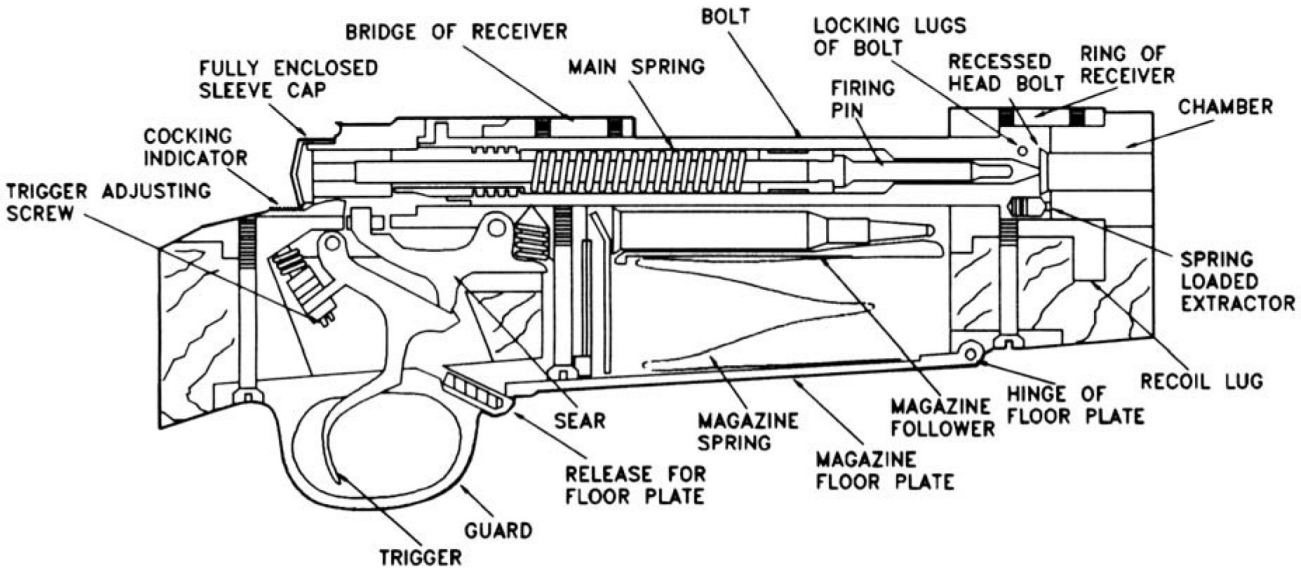


Figure 24: A cross-sectional view a bolt-action rifle

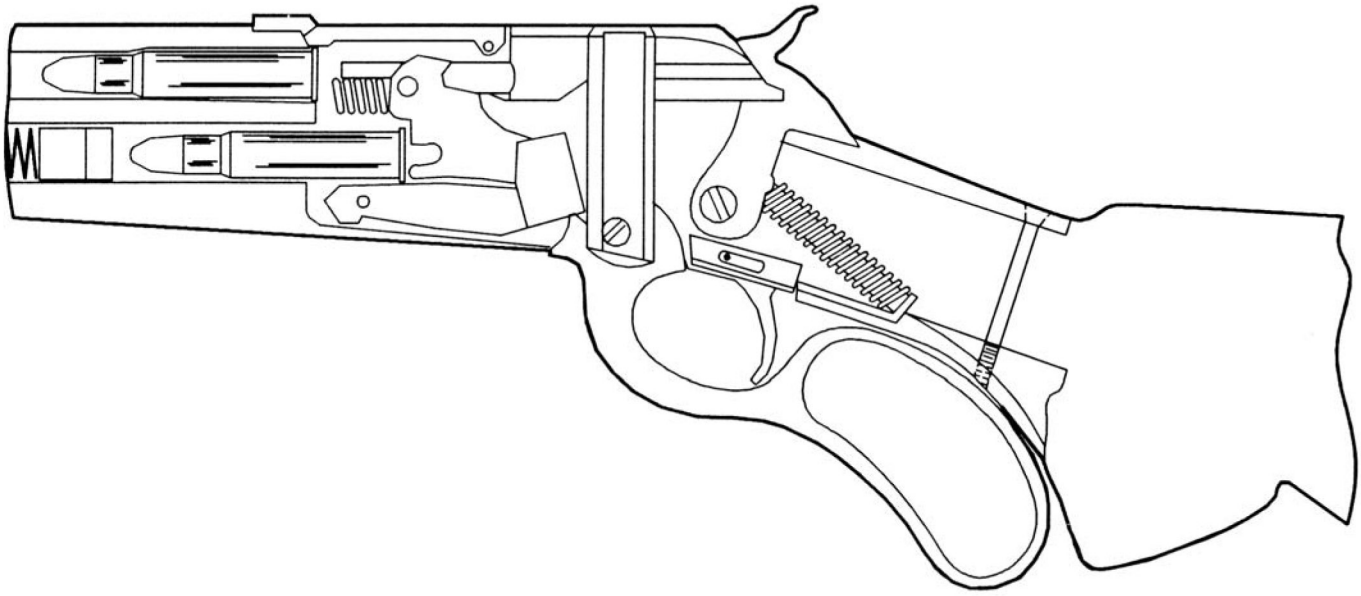


Figure 25: *The Winchester Model 71 lever-action rifle. A cartridge has been chambered, while another cartridge is in the tubular magazine below the barrel. To fire the rifle, simply cock the hammer and pull the trigger.*

LEVER-ACTION RIFLES

Lever-action rifles, shown in Figure 25 and Figure 26, are an American concept, and until recently were not made anywhere else. As their name implies, lever-action rifles are manipulated by a finger lever located under the grip and hinged at its forward end.

Lever-actions are made today in .22 rimfire for small-game sport shooting, as well as for target practice. The Marlin Model 39 and Winchester 9422 are two examples of lever-actions chambered for the .22 rimfire. The Model 9422 is also chambered for the .22 Winchester Magnum cartridge — the most powerful rimfire cartridge currently available.

Centerfire cartridges traditionally chambered for lever-action rifles in recent years have been in the deer-hunting class. The popular .30-30 Winchester, the .35 Remington, the .32 Special, and .25-35 are a few examples, although the latter two are no longer offered in modern rifles.

Winchester then came out with their Model 88 chambered for the .308 Winchester and .284 — making the lever-action suitable for all game hunting. Browning Arms followed suit and introduced a lever-action in modern high-velocity cartridges also suited for all game.

The most recent additions to the lever-action family of rifles are the introduction of the Winchester Angle-Eject models chambered for the new .307, .356, and .375 Winchester cartridges, all powerful enough for hunting most North American game.

SLIDE-ACTION RIFLES

Often referred to as pump-action rifles, the slide-action rifle is faster in manipulation than the lever type. This fact has made the slide action very popular in both low-powered arms (.22 rimfire) and centerfire cartridge arms.

One of the faults with most slide-action rifles when firing the more powerful centerfire cartridges is the ability of the action to extract fired cartridges. Consequently, centerfire rifles of this type normally have oversized chambers to compensate for this difficulty in extraction. However, this is considered detrimental to good accuracy.

Slide-action rimfire rifles are becoming scarce, giving way to the more popular semi-automatics. Most slide actions of the past had tubular magazines, and the actions handled .22 shorts, longs, and long-rifle cartridges. In the past, some were hammer types, such as the Winchester Models 90 and 62, and some were hammerless like the Winchester Model 61. Both have been discontinued.

Slide-action rifles are operated by the back and forth motion of the slide handle, which is connected to the breechblock by an "action bar." Other than that, the operation is similar in principle to that of a lever action, if we substitute the back stroke of the slide handle for the down stroke of the lever, and the forward motion of the slide handle to the return stroke of the finger lever.

SEMI-AUTOMATIC RIFLES

Semi-automatic rifles are, in reality, self-loading arms, requiring the trigger to be pulled for each shot. Fully automatic guns are really machine guns like the famous Thompson.

Most rimfire semi-automatics are equipped with tubular magazines while some utilize a clip-type magazine. Rimfire cartridges are inexpensive to shoot, and are therefore sold in large numbers. Their popularity has created greater competition in the .22 rifle market than in other categories. This has brought about frequent changes and obsolescence in favor of newer models. This is particularly true of semi-automatic rim 22 fire rifles, which can be designed and made at a cost considerably less than that of a new centerfire rifle.

Centerfire semi-automatic rifles have gained ground in the last few decades, probably due to the use of automatic rifles in the military. The sport versions available utilize gas-operated actions and are chambered for cartridges and suitable for all North American big game. However, previous semi-automatics were available only in cartridges suitable for deersize game, since they operated on the principle of the "blow-back" action or the long recoil principle. None of these attained very much popularity because of the relatively low-powered cartridges, and all weighed on the heavy side in relation to their power. But today's centerfire semi-automatics are powerful, well-designed, moderate weight sporting rifles.

What the lever- or slide-action accomplishes manually, the semi-automatic does by utilizing either the force of the recoil, or burning powder gases tapped off in the barrel to push a piston which is connected by an operating rod to the breechblock. Those using the direct force of the recoil are called blow-backs, in which the weight of the moving parts has sufficient inertia to limit movement until the bullet has left the muzzle. After this, residual energy in the recoiling parts is sufficient to push the action fully back against the compression of a spring which causes its return.

Rimfire semi-automatics usually have a blow-back type action or a combination of blow-back for longs, and long rifles and gas operation for .22 shorts. The long and long-rifle cartridges are long enough to cover the gas port in the chamber, so when shorts are used, it becomes operational only as an assist. This last is fine in theory, but gas ports in the chamber tend to plug quickly.

High-powered centerfire semi-automatics are gas-operated, with a cylinder and piston located under the barrel like a magazine tube. Except for the source of power, lever, slide, and self-loading actions work on the same principles in extraction, ejection, loading, etc. But the semi-automatic action is faster and more violent in each of these functions. For this reason, semi-automatics are more susceptible to malfunctions than any other type of rifle. Some extractors tend to tear through the thinner rims of cartridges expressly designed for semi-automatics. Dirt or other foreign debris in the action of semi-automatics will quickly cause them to malfunction. Therefore, all semi-automatic rifles should be cleaned frequently.

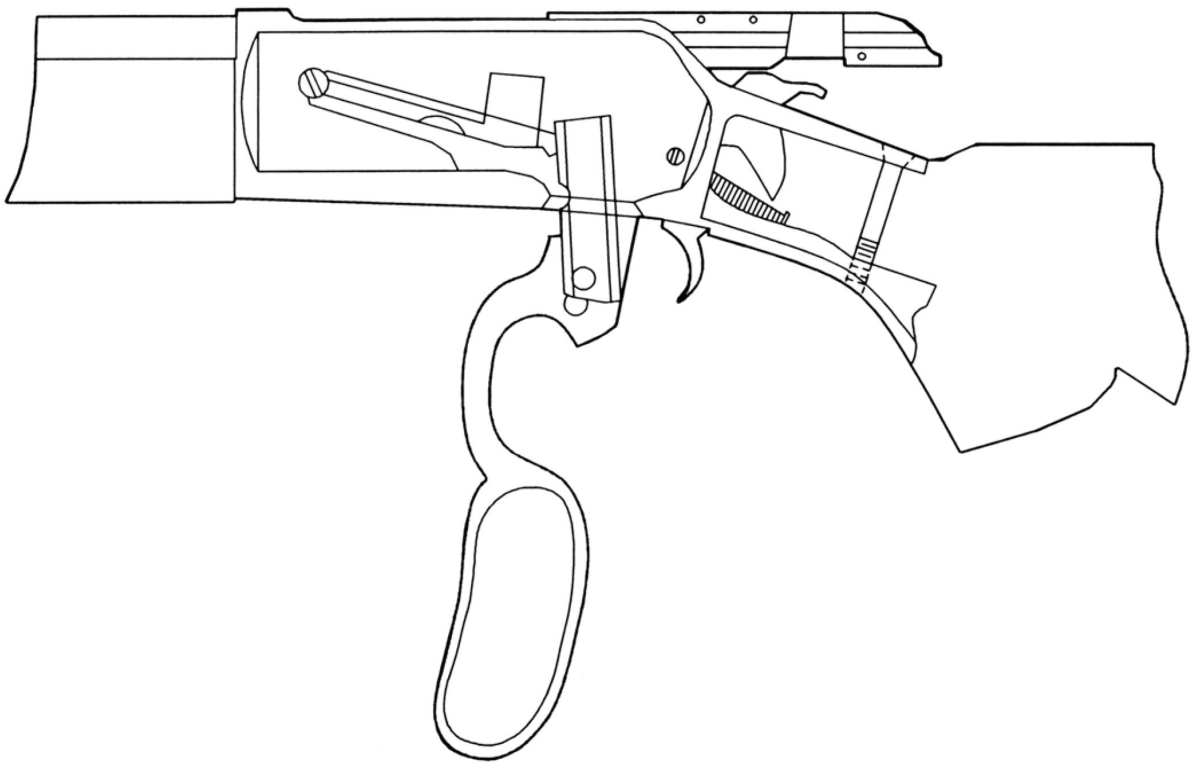


Figure 26: Manipulating the finger lever causes the breechbolt to move to the rear, extract and eject the fired cartridge, and then chamber another cartridge on its return. Once the breechbolt is in place, the hammer is cocked and the rifle is ready to be fired again.

SELF-TEST QUESTIONS

Please check your answers on page 22.

13. **What type of action do most rimfire semi-automatic rifles utilize?**
14. **What type of action do most centerfire semi-automatic rifles utilize?**
15. **What part of a lever-action rifle is activated to operate the breechbolt and other loading and ejection functions?**
16. **What part of a slide-action rifle causes the action to operate?**

Answers to Self-Test Questions

1. False. The flintlock system came before the percussion system
2. Spencer and Sharps
3. 45 caliber
4. 1911
5. Six
6. Six
7. Seven
8. Place a cartridge in the chamber and close the slide before inserting the magazine into the handle
9. Short and long recoil
10. From the gas resulting in firing a shell
11. From the slide handle which is manipulated by the hand
12. The turn bolt
13. Blow-back action
14. Gas-operated action
15. The finger lever
16. The sliding fore-end

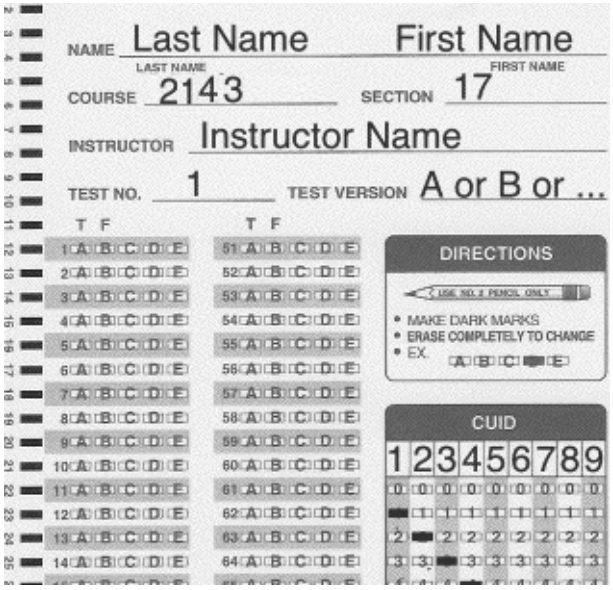
Lesson Questions

THIS IS LESSON NUMBER 2165.

Make sure you print your name, student number, and lesson number in the space provided on the Lesson Answer Form. Be sure to fill in the circles beneath your student number and lesson number.

REMINDER: A properly completed Lesson Answer Form allows us to evaluate your answers and send the results and additional study material to you as soon as possible. Do not hold your Lesson Answer Forms to send several at one time. You may run out of study material if you do not send your answers for evaluation promptly.

You may also complete your exams and submit them online via the SDI Student Services page at www.sonoranlearning.com.



1. **Early flintlocks carried the primer in a compartment called a**
   a. Kettle.
   b. Pan.
   c. Dish.
   d. Pouch.

2. **Where is the primer or cap on a percussion rifle placed?**
   a. On the nipple.
   b. On the barrel plug.
   c. On the ramrod.
   d. On the patch compartment.

3. **When breechloading rifles became practical, what type of metal where the cartridge cases made of?**
   a. Aluminum.
   b. Steel.
   c. Brass.
   d. Cast-iron.

4. **What firearm did shotguns descend from?**
   a. The double-barrel muzzleloading shotgun.
   b. The punt gun.
   c. The Kentucky rifle.
   d. The bell-mouth muzzleloader called "blunder buss."

5. **The name given to Colt's first breechloading hand gun, when chambered for the .45 Colt cartridge was the**
   a. Frontier revolver.
   b. Peacemaker.
   c. Eliminator.
   d. Dud.

6. **The name given to Colt's first breechloading revolver when chambered for the .44-40 cartridge was the**
   a. Frontier revolver.
   b. Peacemaker.
   c. Eliminator.
   d. Sidearm.

7. **On the Colt Model 1917 revolver, what is the name of the part on which the cylinder pivots?**
   a. The crane.
   b. The latch pin.
   c. The ramrod.
   d. The sideplate.

8. **What prevents the S & W Model 1917 revolver from being cocked while the cylinder is open?**
   a. The latch-plunger spring holds the latch forward.
   b. The crane jambs the cocking action.
   c. The ejector blocks the hammer.
   d. The floating firing pin protrudes to block the falling of the hammer.

9. **Which one of the following must be inacted before the Colt Model 1911 pistol may be fired?**

   a. The slide must be in its rear position.

   b. The magazine must be empty.

   c. The grip safety must be pressed.

   d. The magazine latch must be tight.

10. **How are most modern semi-automatic shotguns operated?**

   a. Slide-operated.

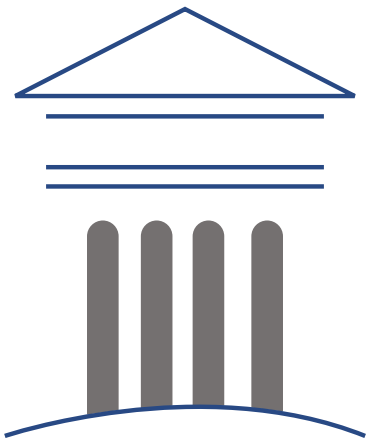
   b. Lever-operated.

   c. Recoil-operated.

   d. Gas-operated.

Setting Up Your Shop
Lesson: 2166

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Objectives

After completing this lesson, you should

1. Be able to determine the best location for your shop.
2. Have an idea of the safety requirements of your shop.
3. Know where vented hoods are necessary in a gunsmithing shop.



Introduction

Every gunsmith, either professional or hobbyist, needs a place to work and tinker. Professionals, of course, need the shop for their livelihood, and while hobbyists may save a little money on their own gun repairs, their home shop is noted more for the pleasure it offers. When planning a location for a gunshop, you must first decide what type of work you will be performing. For example, if you plan to get your Federal Firearms License (FFL) and work on guns for others, one room or area in the home must be set aside exclusively for the gun business. If it's in the basement, the room cannot also be used for a recreation room. The space must be devoted entirely to gunsmithing business.

On the other hand, if you plan to work on firearms only for yourself, you can locate the "shop" any place you like—even in your own living room.

The average gunsmith will perform a variety of work on firearms, covering the entire field involving troubleshooting, stock finishing, rebluing, stock checkering, firearm cleaning, rebarreling, chambering, soldering and welding . . . just to name a few. The ideal shop should be equipped to take care of all these jobs conveniently and efficiently.

This lesson is designed to show you how to equip a gunshop, even if your space is limited. We will begin with the very smallest home shops and progress to shops that are suitable for factory-warranty stations and that will accommodate several employees.

Shop Location

For the aspiring gunsmith who lives in a small town house or apartment where space is at a premium, finding a place to set up a suitable workbench is somewhat of a problem. However, many guns have been repaired on footlockers or large toolboxes. One gunsmithing student, living in an efficiency apartment, turned his coffee table into a very functional work center. When the piece of furniture was closed, it was a handsome coffee table that fit in with the room's decor. However, when the top was opened, it revealed an assortment of gunsmithing tools, and the folding wings gave the student a workbench that even boasted a small bench vise.

BASEMENT SHOPS

Most home gunshops are located in the basement. This location has several advantages over other locations, and the few drawbacks usually can be overcome. The chief advantages include these aspects:

- It is cool in the summer.
- It's out of the way of most family activities.
- It's quiet and can be made relatively soundproof from the living area.
- If you have to, you can leave it untidy overnight without worrying about guests seeing it.

The basement area also has several disadvantages, but most of these can be corrected. Most basement areas (as finished by the builder) are poorly illuminated. This gives a dark, dingy appearance. So, if the basement is the area chosen for the shop location, one of your first projects should be the installation of adequate lighting. Fluorescent fixtures are ideal. However, if the basement has an acoustical T-bar ceiling, you may want to go with recessed fixtures—either incandescent or fluorescent.

One of the major disadvantages of a basement is dampness, which, of course, creates rust problems. To overcome this problem, you can apply epoxy waterproofing to basement walls from the inside and then use foam insulating boards to insulate basement walls and check dampness. A good dehumidifier is added insurance.

Flooding is another problem that can be a disaster with some basements. However, if all slopes are graded away from basement walls, all gutters and downspouts are kept in good repair, and an adequate sump pump is installed, the chance of basement flooding is greatly reduced.

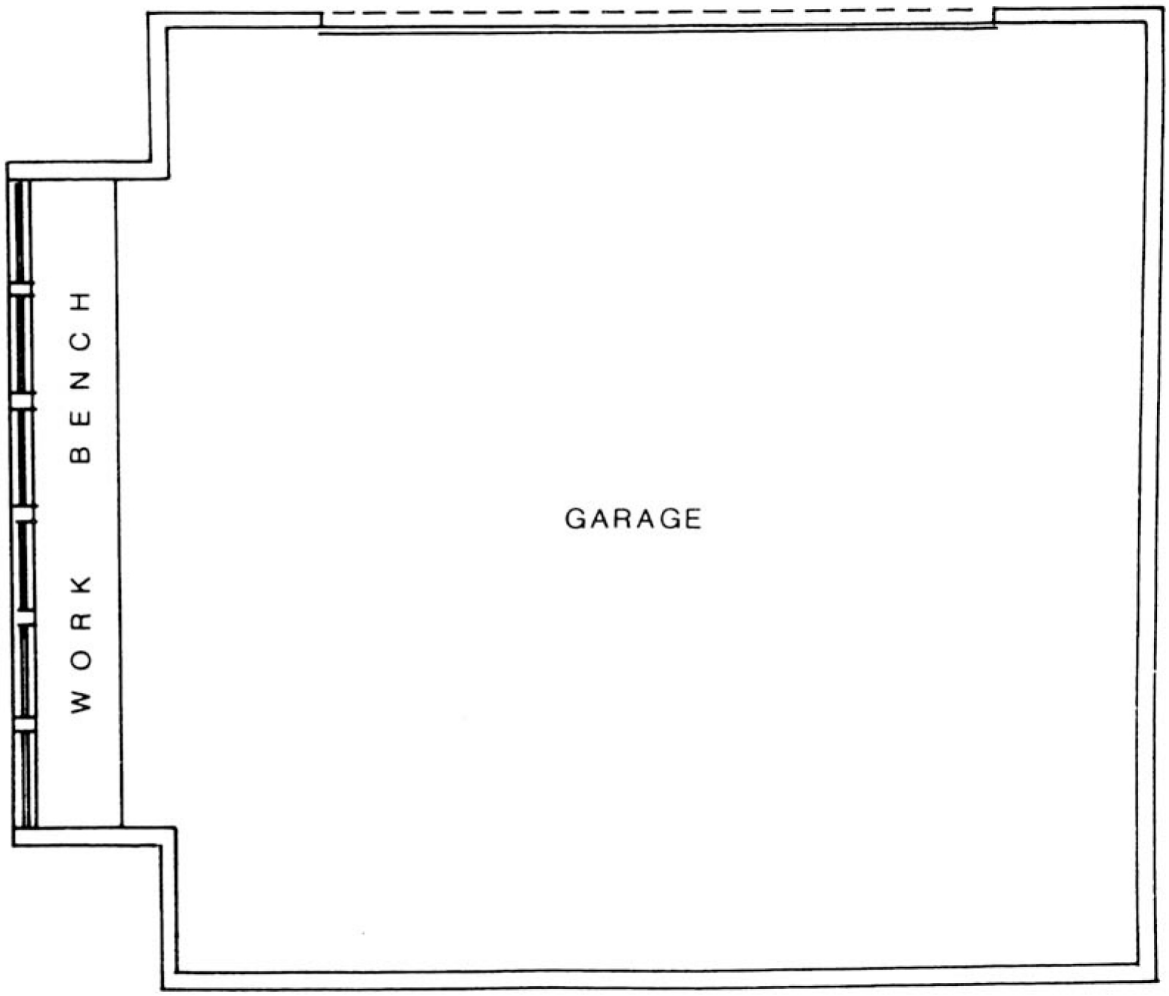


Figure 1: *This floor plan of a two-car garage has a large workbench installed in a nook on the side of the garage.*

ATTIC SHOPS

Attics are probably the worst place to put a gun shop in the home. They are often hot in summer, cold in winter and short on head room. Add to this the difficulty of transporting materials to and from the attic, plus the noise and vibration that carries down into the living area, and the disadvantages are quickly realized.

Of course, if there is no other place available, these disadvantages can be somewhat remedied. First of all, insulation in the walls, roof, and floor will help to keep a more controlled, comfortable temperature and to muffle noises. An attic-ventilating fan will reduce attic temperatures considerably, as will the installation of several windows, if they are currently absent.

Noise and vibration produced by power tools can be overcome by mounting them on rubber mats and/or rubber washers. Tightly sealed attic doors will also help retain the shop noises in the attic and cut down on dust escaping into the living area. Outside stairs to the attic also have their advantage.

GARAGE SHOPS

A garage is one of the best places to locate a gunshop. Although garages are often drafty and hard to heat in winter, they can be made into excellent shops having advantages that other areas in the home cannot offer. First of all, a garage shop allows you to work into the early hours of the morning, usually without disturbing anyone in the home. If it is located far enough away from the house and other neighbors, even power tools can be operated without bothering anyone. You do not have to worry about fumes from hot bluing and other operations smelling up the home, and you also do not have to worry if you are faced with leaving a temporary mess.



Figure 2: *Closets can create shop space easily with a little creative storage*

Even if you still plan to use the garage to park your car(s), there are ways to also use the garage as a shop. For example, the floor plan in Figure 1 shows a two-car garage with a large workbench installed in a nook on the side of the garage. A hinged, fold-down bench may also be used, but this requires that the bench be cleared before it can be folded out of the way.

The ideal setup is to use one half of a two-car garage as a shop and the other half for parking a car. If you still want shelter for a second car, build a carport — it's much cheaper than building an enclosed shop.

Even if you do not have a garage on your property or you're an apartment dweller with no other possibilities for locating a shop where you live, look around town for the possibility of renting a garage. Then set up your shop in this rented structure and work in your spare time.

OUTBUILDINGS

If your house is small, without a basement, and there is no room in the garage, a separate building may be the answer, you can work late at night or early in the morning without disturbing anyone. A precut garage may be an inexpensive way to get such a shop. Or how about a trailer?

Existing barns and outbuildings may afford prime shop space for those living in rural areas. You may need to install insulation and heating and possibly run an electric service from the house out to the building, but these are only remodeling jobs. Most people would rather remodel than attempt to build from scratch. In some areas, zoning codes may stop you from adding a structure to your property, but an existing structure usually does not pose any problem. However, check with the local building inspector's office just to be sure.

CLOSET SHOPS

With a little ingenuity, an amazing amount of tool storage and workspace can be fitted into a closet. Highly productive shops have been hung on the back of a closet door, with work tables that fold down to reveal an array of hand tools neatly stored on a panel of perforated hardboard. It's not the best solution, but it's a beginning. There may be space under a stairway or at the end of a hall that can provide comparable accommodations.

PORCHES

Does your home have a porch that is seldom used? If so, you can probably convert it to a very good shop with comparatively little expense. In most cases, the roof, floor, and at least one wall are already there, so all you have to do is fill in the other two or three walls and add a workbench, and you are ready to start working.

Since the walls that are added usually will be exposed to the weather, be sure to insulate well. The floors and ceiling should be considered too. If you cannot get to existing void spaces to install insulation, consider having insulation blown in after boring holes to reach the void spaces between studs.

Conventional framing can be used to enclose the open walls of a porch, but perhaps jalousie windows would provide a better arrangement. A jalousie window consists of a series of operable overlapping glass louvers that pivot in unison—usually by a crank-and-gear system. Such windows are best used in southern climates where maximum ventilation is necessary and in places where a flush exterior and interior appearance are desired.

SELF-TEST QUESTIONS

Please check your answers on page 19.

1. *True or False.* **The attic is the best place in the home for a work center.**
2. **What type of appliance may be used to check dampness in a basement shop?**
3. **What type of insulation is best for damp concrete block basement walls?**
4. **Disregarding finances and available space, what may prevent you from opening a gunsmithing business in your home?**

Workbenches

When beginning gunsmiths start to think of graduating from the toolbox/repair-kit stage to a full-fledged workshop, their first thoughts should turn to a suitable workbench. Unfortunately, there are not very many commercial workbenches to choose from and those that are available are usually expensive. Therefore, most gunsmiths like to build their own.

In general, a workbench should be 30" wide and from 5' to 12' long. However, do not skimp on the length, because you will soon find that there is really no such thing as too much bench space.

The height of the workbench will vary depending on your height. An average-built man might prefer a workbench about 33½" high. However, you might want yours anywhere from 30" to 35". Above all, the bench must be sturdy and firm. You cannot do your best work if the bench moves every time you take a file stroke or tap a drift pin out of its hole. Therefore, the ideal workbench should be amply reinforced, and the legs and top should be made of heavy timber.

In addition, to the main workbench, it is nice to have an auxiliary bench for special projects. One such bench is shown in Figure 2. In small shops, this bench will also suffice as a main

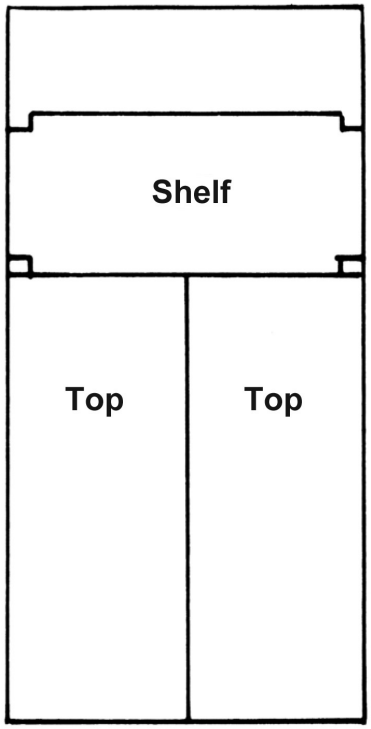


Figure 3: *Layout for the 3/4" plywood for the basic workbench.*

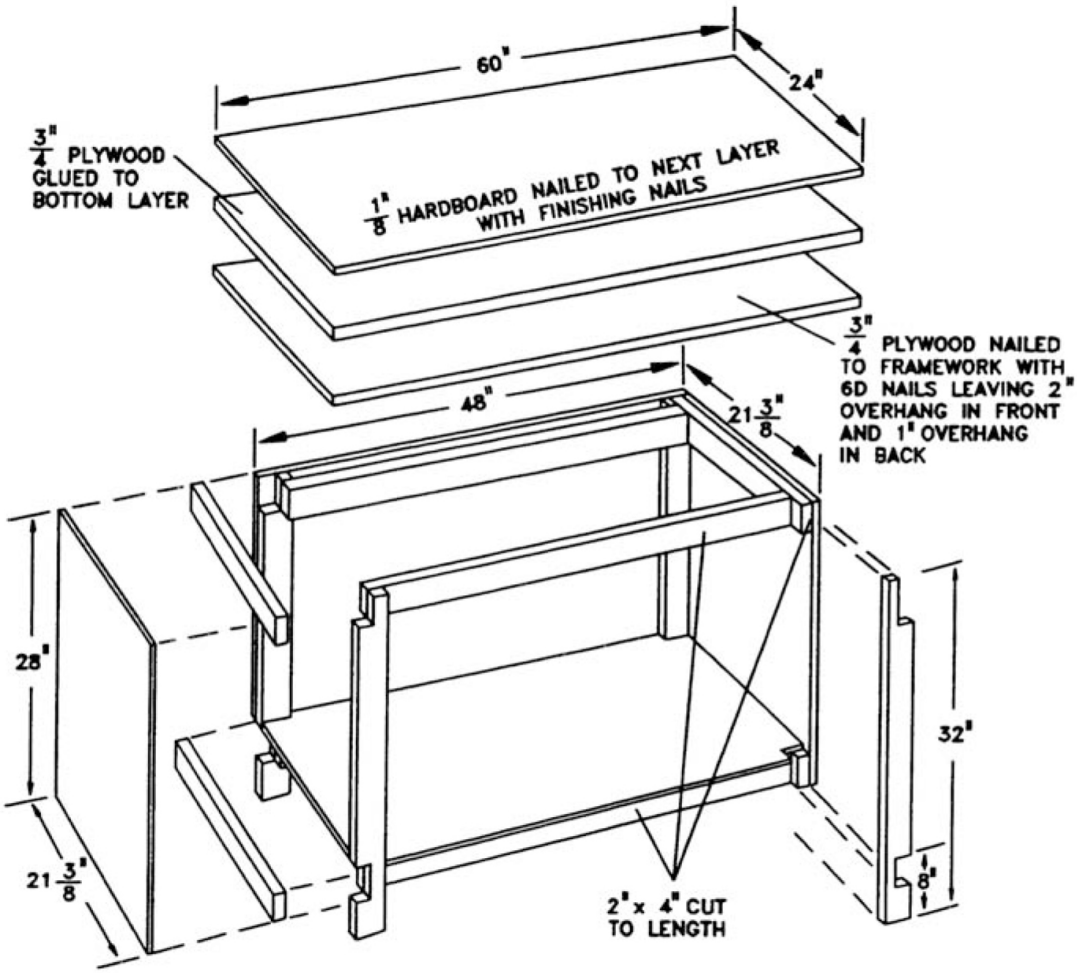


Figure 2: *A good basic bench for the beginning gunsmith. As the business expands, and the need for a larger bench increases, the smaller bench can be used as an auxiliary bench.*

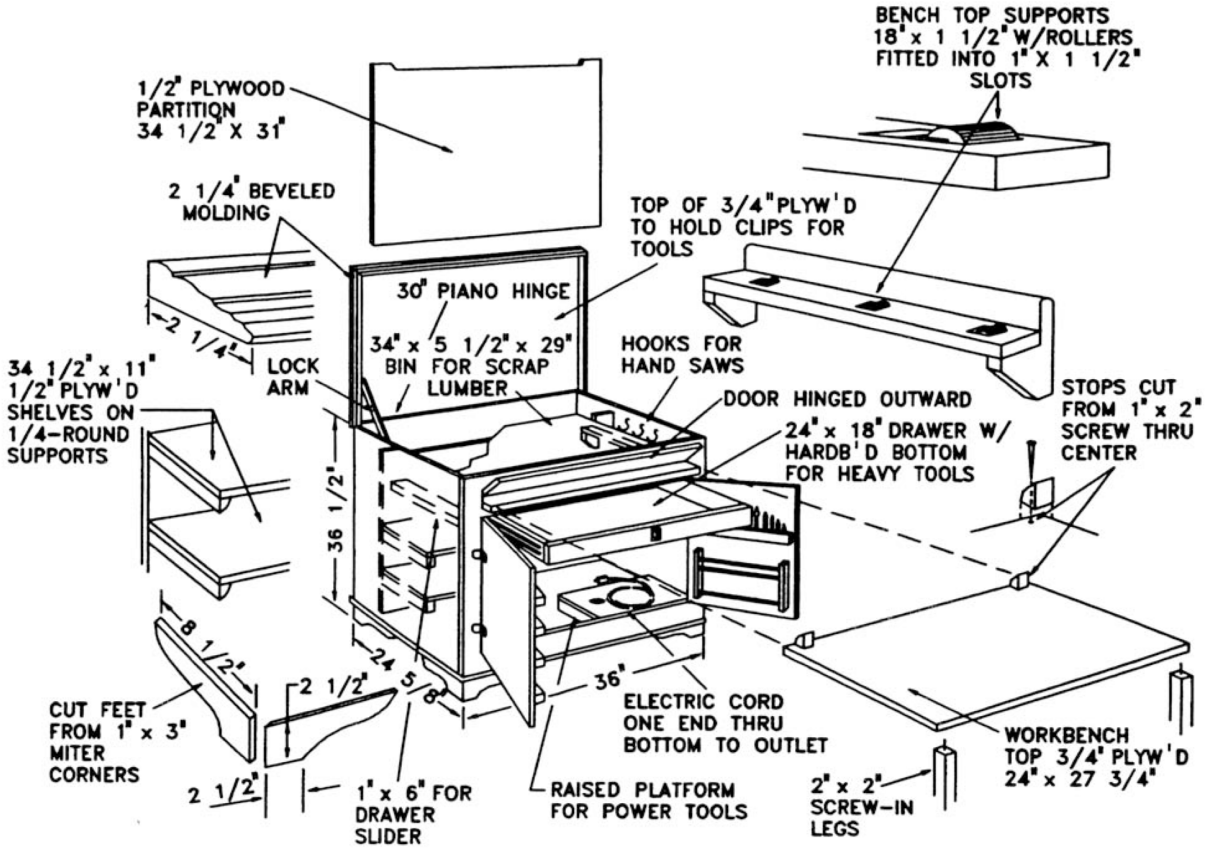


Figure 4: Plans for an apartment workbench.

bench, and although the legs are constructed of two-by-fours, the plywood bracing makes it very sturdy.

Note that the frame of the bench in Figure 2 is made entirely of two-by-fours, reinforced with 3/8" plywood. The top is constructed from two layers of 3/4" plywood glued together. A piece of hardboard nailed with finishing nails to the top protects the bench top and can be changed as often as needed.

You should design your bench or benches to fit into the available space and to serve your own needs. If you are handy with woodworking tools, you might want to build a few drawers for certain tools. If not, you can buy the prefabricated drawers of steel or plastic and install them by screwing the brackets to the underside of the bench top.

To begin constructing the workbench in Figure 2, lay out the top pieces and shelf on a single piece of 4' x 8'x 3/4" plywood as shown in Figure 3. Use a straightedge and square for the lines, and then cut out the various pieces with a hand or power saw.

Next cut all two-by-fours, notching the legs as shown in the exploded drawing in Figure 2. Mark and drill screw holes and then assemble the two end frames with glue and wood screws. You may want to countersink the screw holes for a neat appearance. Join the two end frames with the four long two-by-fours, again using glue and wood screws.

Insert the lower shelf as indicated after notching all four corners to fit the bench legs. Nail and glue the shelf in place. At this point, the work should be taking the form of a workbench.

Continue by marking the cutting diagram on the 3/8" plywood for the sides and back — again using a straightedge and square. When they are cut out, nail and glue these panels to the sides and back as shown.

Now nail and glue the lower 3/4" top panel to the top rails of the frame, followed by the next panel and the sheet of 1/8" hardboard (nailed only). Keep all of these panels under pressure (using C-clamps) until the glue dries.

If you prefer shelves over your bench, a shelving unit may be hung on a wall directly in back of the bench or mounted to the bench top. The top, sides, and shelves may be made from 3/4" plywood or 1" shelving boards of a width to suit your needs. A pegboard area is also handy for tool hanging. The overall size of the unit, spacing of shelves, etc. can be varied to suit your needs.

APARTMENT WORKBENCH

Apartment-dwellers in cities are usually handicapped by not having sufficient space in which to do gun repairs. However, it is possible to have a complete workshop in a handsome cabinet that looks like a respectable piece of furniture.

The hinged top opens to display an ample assortment of gunsmithing tools, which are held securely in place by hold clips fastened to the bottom of the 3/4" plywood top. The narrow panel on the front of the cabinet hinges out and up to provide access to the 24" x 27 3/4" workbench top, which is supported by

rollers fitted into slots as shown in the drawing. Stops cut from 1" x 2" wood blocks keep the workbench top from coming all the way out from the cabinet, while 2" x 2" screw-in legs are used to support the work surface (Figure 4).

A raised platform on the bottom shelf of the cabinet can be used to house power tools such as a Dremel Moto-Tool or even a small metal-turning lathe. Note also that an electric power cord runs through a hole cut through the bottom to a power outlet. A 24" x 18" drawer may be used for other heavy tools while the inner sides of the cabinet doors hold bits, blades, sandpaper, and other gunsmithing supplies.

SELF-TEST QUESTIONS

Please check your answers on page 19.

5. **True or False. Sturdiness is one of the most important features of a good workbench.**
6. **What is the recommended width of the average workbench?**
7. **Should workbenches be made as heavy as possible or as light as possible?**
8. **What is the reason for your answer to question 7 above?**

Planning Ahead

The beginning gunsmithing student or hobbyist will probably start out with the very minimum of tools, but you should remember to start out first with a solid workbench and bench vise; more tools can be added as the need arises. For example, the workshop shown in Figure 5 is a good shop for the beginning gunsmith or hobbyist, and is about the minimum that one can get by with to perform even basic work on guns. Still, you are looking at about a $5,000 or more investment. But if you concentrate only on the bench tops themselves (without drawers), or just one "wing" of the bench, and add the bench vise along with your basic hand tools and toolbox, you could probably get by for around $500, especially if you are handy with woodworking tools and you can get a hold of some scrap lumber.

At the first opportunity, you would probably want to purchase a drill press and a bench or pedestal grinder that can also be used as a buffer. Sure, your shop is relatively bare at the moment, but you have high hopes of expanding it into the shop shown in Figure 5. Later on, a metal-turning lathe could be placed in back of the operator, opposite the bench containing the drill press, bench vise, etc. Eventually you will have an excellent setup for performing nearly all phases of gunsmithing on a small scale.

If you are planning to expand into a part-time or full-time business, your planning should extend even further. Again, let's deal with the one-person shop layout shown in Figure 5 and see how it can be expanded. This shop could be one room in the basement of your home or in a two-car garage. While designing your shop layout, assuming that you do have plans for expansion, you should give careful consideration to the first room's location so it may be logically tied in with future expansion, as in the layout shown in Figure 6. This shop layout illustrates machine placement and organization of various shop functions. Close proximity of associated operations enhances productivity in a shop of this type. However, special consideration must be given to separate those activities that require an isolated work area. While it is desirable to separate many incompatible work functions, it is still essential to be able to monitor and control the entire operation at all times.

Note that all operations producing high volumes of air contaminants such as dust, harmful vapors, and excessive heat have been isolated and then further divided into subgroups to aid in containment. To control the dust residue properly in these areas, a high-volume portable vacuum has been centrally located near those machines involved. This unit may be connected directly to the machine in operation or to the vented hoods located above these work areas. To supplement this system, filtered exhaust fans have been installed to maintain a sufficient air exchange rate to ensure proper air filtration. These systems maintain a clean, safe work environment and further

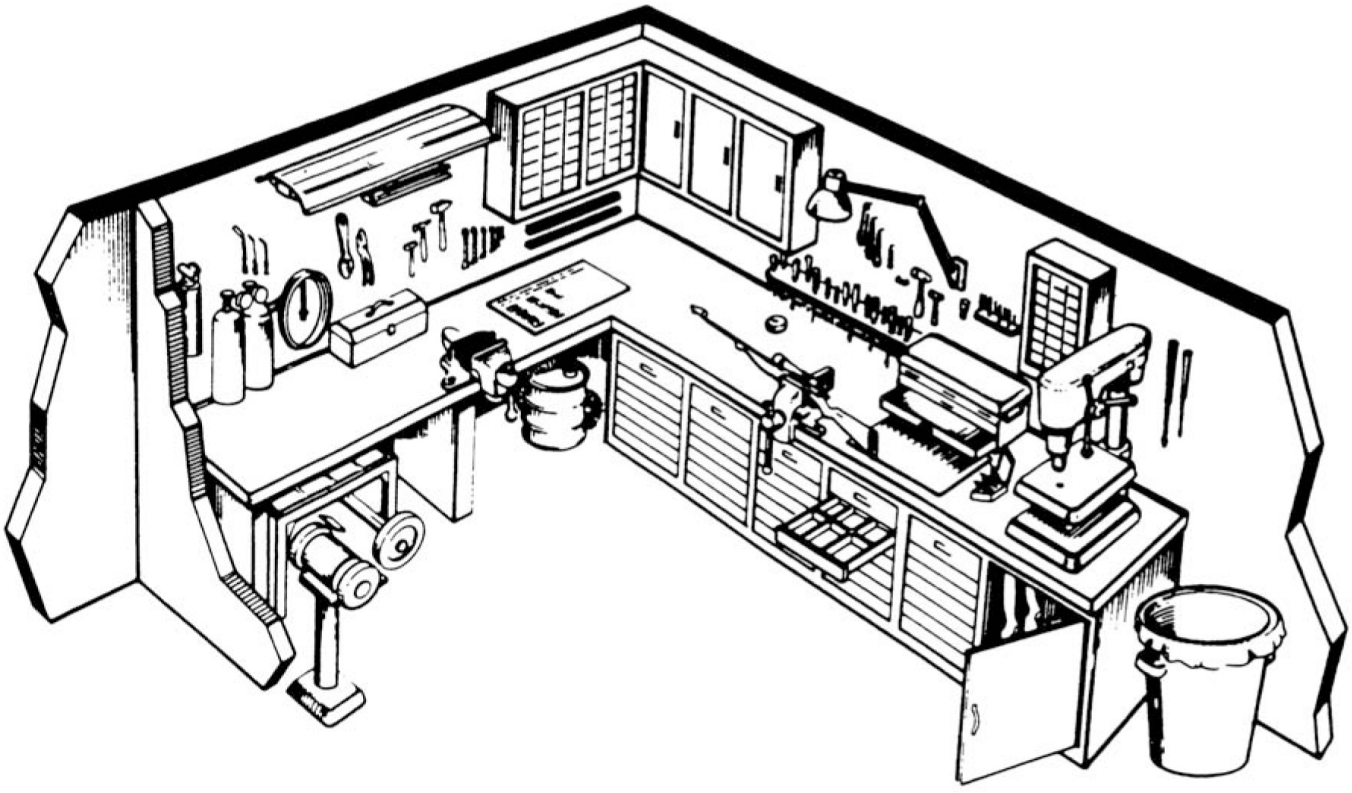


Figure 5: *Excellent shop layout for the beginning professional. A metal-turning lathe and milling machine can be added later.*

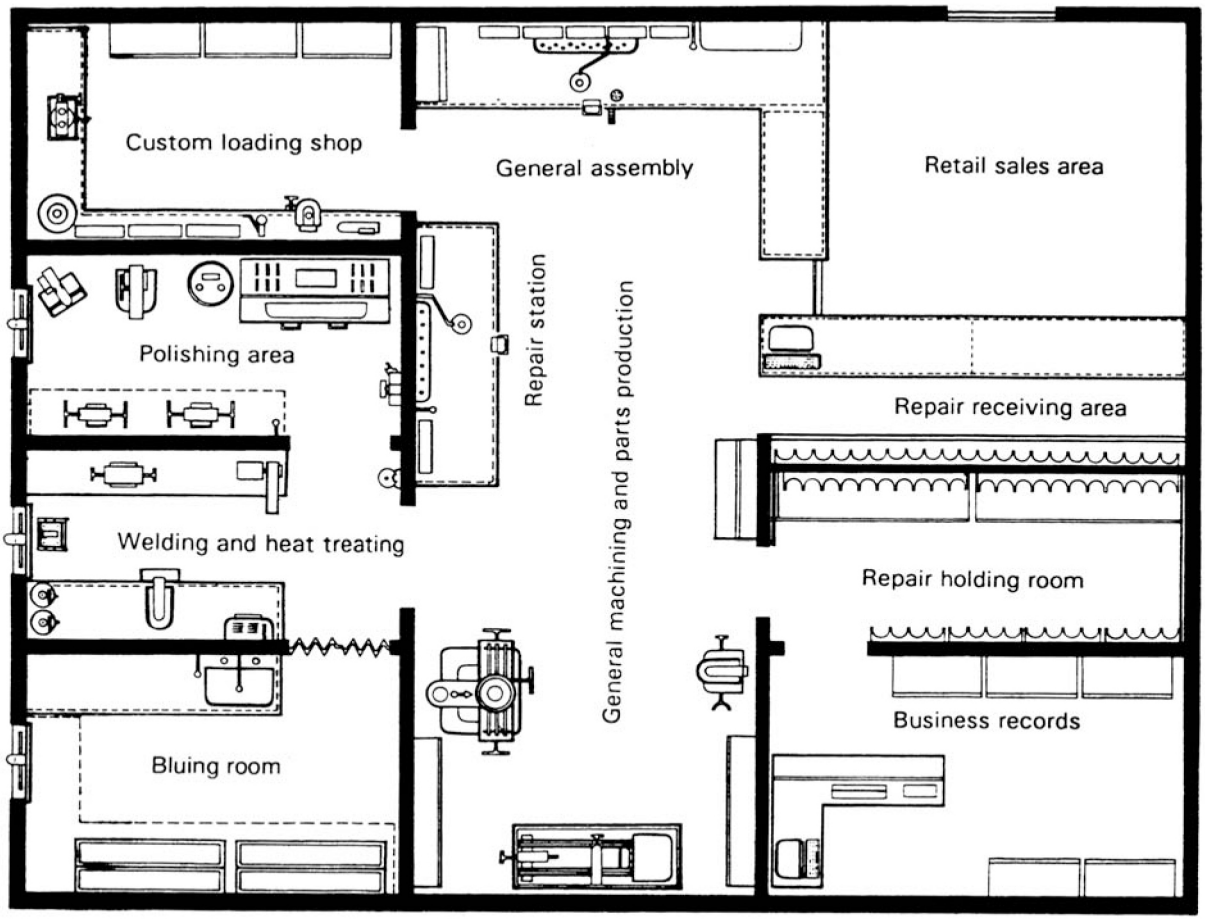


Figure 6: *Floor plan layout of an excellent gunshop arrangement for the professional. It is designed to satisfy the means of even the most demanding gunsmith. Three or four workers can easily work in these areas.*

serve to reduce cleanup time, which frees the gunsmith to be more productive.

Some gunsmiths feel that a retail sales area is necessary for business; others do not. If a retail sales area is incorporated into the gunsmith's shop, all shop operations that require isolation in a controlled area must be performed when the retail sales area is not accessible to the general public. It is also advisable to install a sensor that is never disarmed during regular business hours—alerting you when anyone entered the premises. This system would permit you to concentrate completely on work operations even when in isolated areas, yet still monitor the retail sales area effectively. In most cases, the retail sales concept is a highly recommended business function that will bring you more customers and generate sales. The benefits of additional sales and higher revenues realized from a retail sales area are apparent. But maintaining and operating this supplemental facility requires additional time, and in a one-person operation, there is no such commodity. Therefore, the time spent maintaining retail sales must provide an adequate return for the time invested to justify the time lost in service and repair.

Please note the selective use of the terms *spent* and *invested*, because you must understand them in order to achieve and maintain both repair service and retail sales. Consequently, you must be qualified to make the distinction between *spending time*, such as discussing what size shot was used to kill that big gobbler last year, and *investing time*, such as recommending the most appropriate scope to mount on that rifle that you just sold.

In other words, spending time usually involves discussions that are unrelated to business. However, investing time involves your offering professional advice and recommendations to the customer, and might be directed toward adding equipment to improve the customer's rifle. Consequently the gunsmith operating in a one-person shop situation must recognize that "time is money." Time, being a fixed commodity, can neither be replaced nor regained; invest it wisely and it will produce additional revenues.

The only remaining difficulty yet to face will be that time when it becomes apparent that you have applied this principle so well that there is insufficient time to maintain expanded retail sales and complete the contracted repairs. The solution is expansion, a sign of success.

In a one-person shop with consumer access to the display area, you should consider having a controlled shop entrance to separate the shop from the retail sales area. This facility should

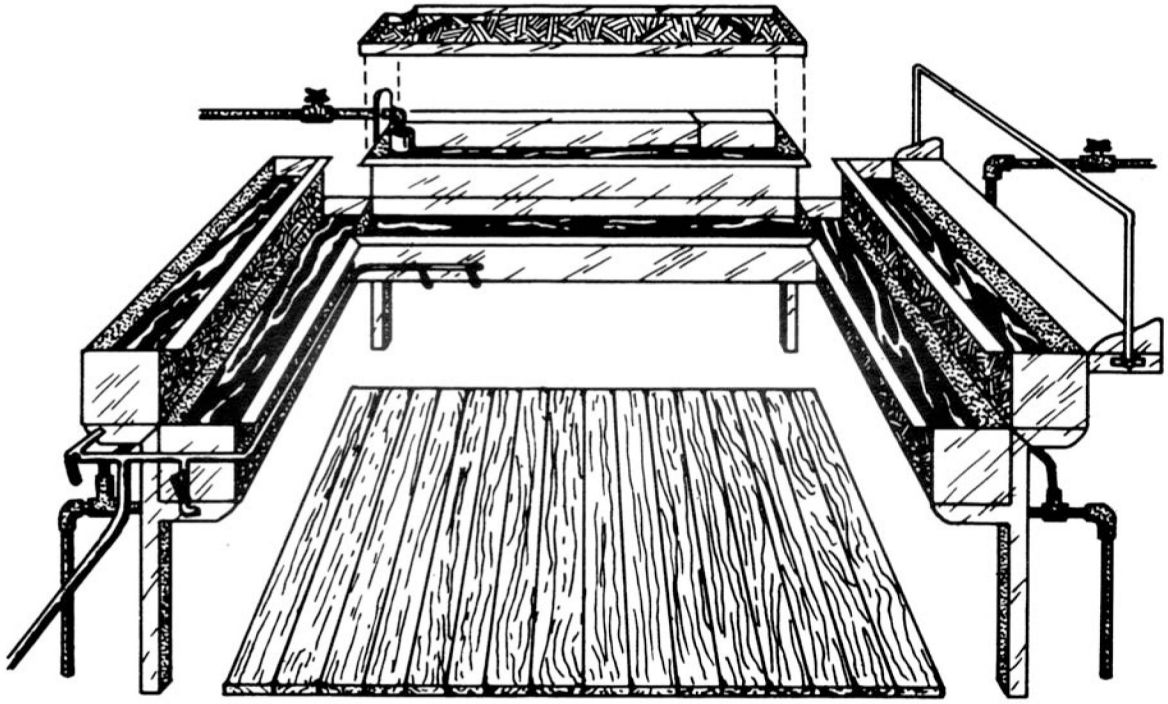


Figure 7: The multi-tank bluing setup is the most professional way to go about any hot-bath operation. In this setup, each tank has its own water and heat source.

be designed and constructed to restrict customer access and discourage unsolicited observers. In addition, the gunsmith will need to develop an effective, but diplomatic, means of retreating to this area to resume his or her work but still leave the retail customer with a sense of a successfully completed transaction.

SHOP LAYOUT

Bluing Room. This room is one of three rooms separated from the general repair area by one common access to help contain air-borne contaminants. The bluing room, shown in detail in Figure 7, is further isolated from other work areas by a vented barrier, which prevents harmful oxidizing vapors from circulating through the shop. Heated bluing tanks are situated below a vented hood, which further aids in trapping both heat and fumes, and a filtered exhaust fan provides sufficient air exchange to clear the bluing booth. An adjacent work counter provides an adequate holding area for both polished and blued parts and contains a water supply and drain for convenience. A central air jack is provided to aid in clearing residue from parts in various stages of the bluing process. See Figure 8 for a cutaway view of the bluing area, as well as the business records, welding, and custom loading areas.

Business Records. This area is organized around a business computer with basic accounting capabilities, including general ledger and accounts payable and receivable and integrated systems for inventory control. Ample file storage is provided for business and Bureau of Alcohol, Tobacco, and Firearms (BATF) transaction and file records.

Welding and Heat Treating Area. This area is equipped with a heavy-duty bench vise mounted on a counter facility that is designed for welding and metal fabrication. Both electric and gas welding units are available. Above this work area, a vented hood traps both the heat and the fumes generated by welding, forging, and hardening operations. A large filtered exhaust fan efficiently vents the area. On the opposing wall, a work counter supports a bench grinder and a hard wheel belt sander that are used for shaping and finishing. Mounted on the adjacent wall is a spindle grinder/polisher, which is useful in finishing an inside gun radius. Between the counters, mounted securely in concrete, stands a heavy-duty barrel vise for barreling operations.

Custom Loading Shop. Serving a dual function, this area accommodates special loading equipment, including single-stage and progressive presses, powder scales, powder measure, and vibrator/polisher, all selected to fill your specific requirements. Also, this area houses reference storage files, which include loading data and records, service records, gunsmithing reference and techniques, and manufacturers' updates. The loading facility may be expanded from in-house loading to custom or production loading, which would involve additional licensing requirements if loaded for resale. The process would be classified "manufacturing" or "remanufacturing" depending on your source of cases.

General Assembly. The primary work function performed in this area is reassembly. This workstation is designated for assembly of firearms that come from holding areas and require additional down-time for refinishing and customizing or for

delayed assembly that requires ordering or parts fabrication. The holding fixture is centrally mounted on a workbench with a generous layout area for reassembly. This design is equally well suited for its secondary function of scope mounting and bore sighting.

General Machining. This area contains the stationary machine tools required to perform those basic and most commonly required machine operations associated with gunsmithing. First, is a variable speed precision drill press fitted with appropriate holding fixtures, including an angle vise and a supplemental support cradle, to execute the required drilling operations. Second, is the lathe with a recommended bed length of not less than 36", which would be required to perform fitting operations on longer barrel blanks. Also, the recommended minimum hole size in the headstock would be $1^{3}/_{8}$" to avoid restrictions when turning basic diameter blanks. Finally, the milling operations are adequately handled by a combination horizontal/vertical machine that affords the necessary flexibility to perform the variety of milling operations required. Located near each piece of specialized equipment is a storage cabinet that houses associated accessories, gages, and tools.

Polishing Area. This isolated work area contains equipment used for surface preparation and refinishing, which produce high levels of dust. These machines include both buffers and grinders positioned beneath a vented hood to help trap residue dust. To supplement the polishing, an enclosed abrasive blasting cabinet is available that features an external access. Additional equipment includes a vertical belt sander, a band saw, and a belt/disc sander, all of which incorporate a vac/vent. This feature allows a portable vacuum to be connected to these machines when in use to help control dust emissions. These systems, in conjunction with the large filtered exhaust fan, provide a sufficient air exchange rate to ensure a dust-free atmosphere.

Repair Holding Area. This section is set aside as a storage area for repair work. Divided into two areas, this system separates the repaired guns from those waiting for repair. Space is used efficiently by employing racks to hold long guns and adjustable-hook wall boards to hold pistols and revolvers. This orderly system permits close monitoring, aids in maintaining accurate records (a federal requirement), and alerts you when repaired guns are not picked up on time. Remember, time is

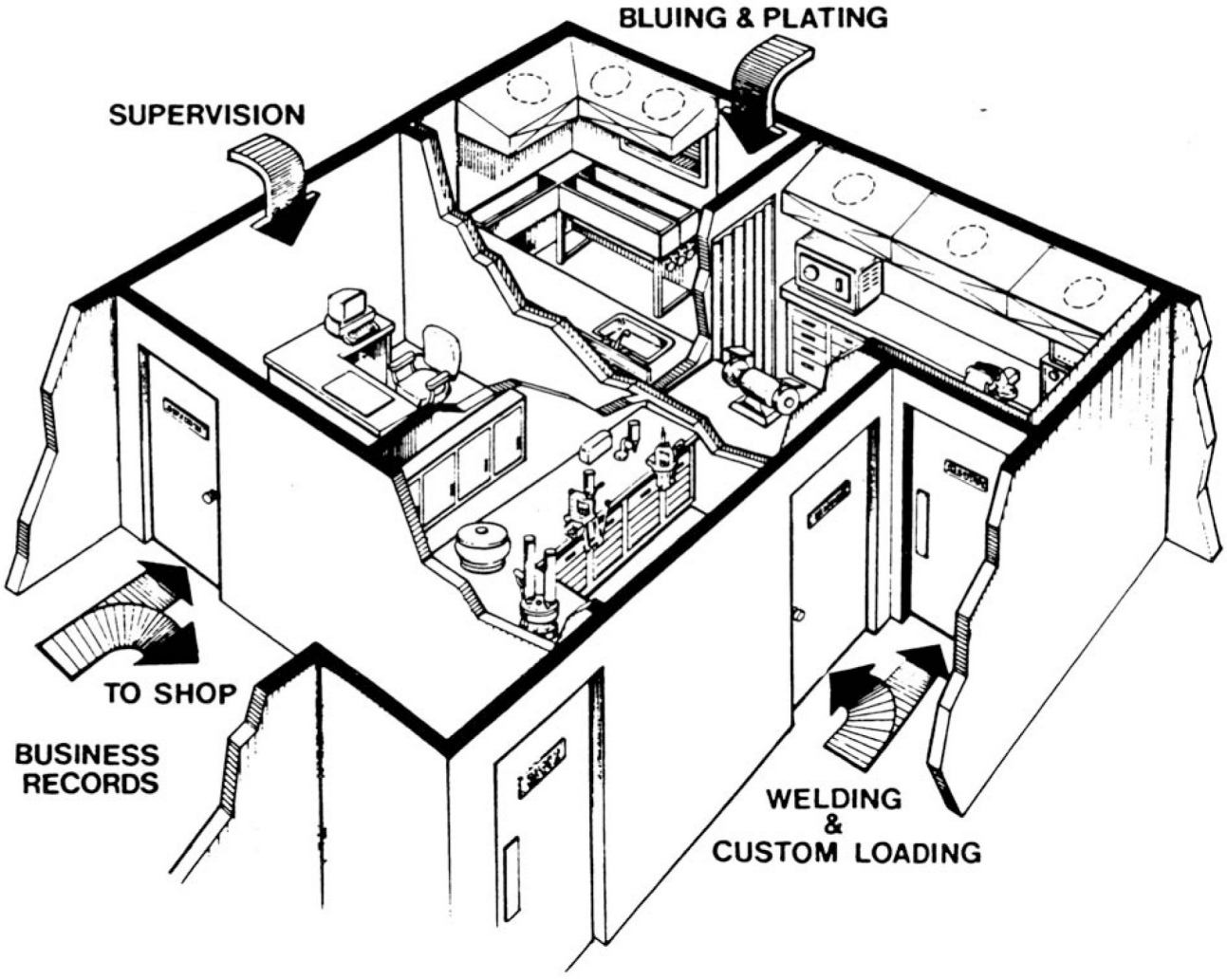


Figure 8: The cutaway view of four important areas in the professional gunshop: business records, bluing and plating, welding, and custom loading.

Area Identification Legend

A. Bluing and plating room ***
B. Business records
C. Controlled access to bluing and welding area
D. Controlled access to reloading area
E. Controlled access to retail sales area
F. Controlled access to shop area
G. Custom loading shop ****
H. Custom shop
I. Custom stock alteration and design
J. General machining and parts production areas
K. Hooded and vented spray booth
L. Polishing area
M. Repair station #1 **
N. Repair station #2 **
O. Shipping and receiving ***
P. Stock alteration and final finish ***
Q. Supervision
R. Synthetic stock alteration and design ***
S. Warranty records
T. Warranty repair area
U. Warranty repair station *
V. Welding and heat treating
W. Woodworking
AA. Workstation #1 ***
BB. Workstation #2 ***
CC. Workstation #3
DD. Workstation #4 ***
EE. Workstation #5 **
FF. Workstation #6 **

* with under-counter parts storage
** with under-counter tool storage
*** with under-counter supply storage
**** with under-counter component and die storage

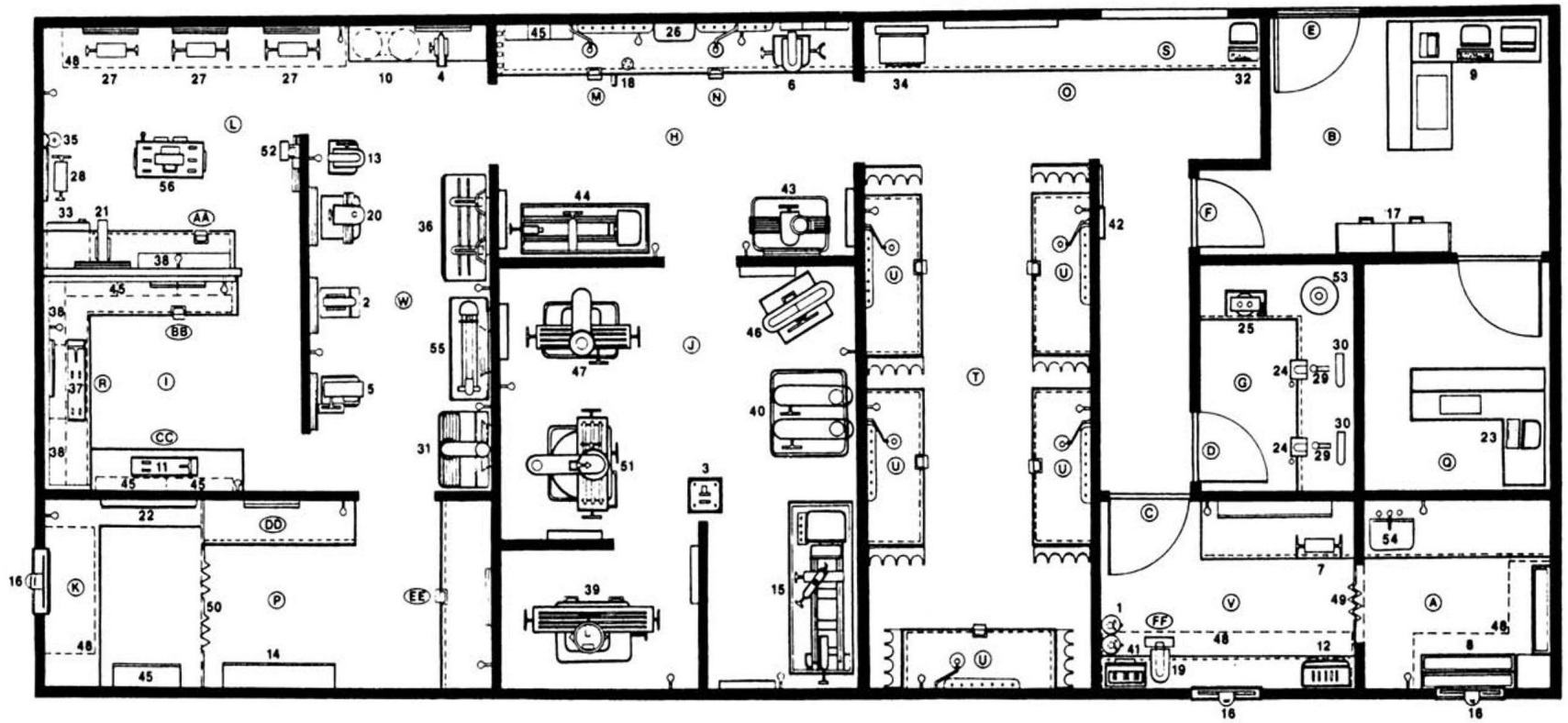


Figure 9: Floor plan layout of a modern production-gunsmithing facility.

money, and repaired work not picked up promptly idles your working capital and eliminates the profit on that repair work. Therefore, to avoid delays in payment, adopt a systematic notification system and maintain it.

Repair Receiving Area. This is a display case fitted with a padded or carpeted top for protection that is positioned adjacent to the general repair area. This location allows the gunsmith to remain in his or her work area while logging in guns for repair. This precludes the need to move from one area or department to another, a problem addressed earlier in this section.

Repair Station. This primary work area centers around a bench vise fitted with padded jaws. This holding fixture is mounted on top of a work counter that houses multiple drawers to provide storage for both tools and parts. A machinist's storage cabinet containing precision instruments is positioned on the counter and is easily accessible from the workstation. Frequently used hand tools are arranged on peg board panels or are stored on open racks for convenience and easy access. The recessed florescent lighting is supplemented by high-intensity boom lights situated above the workstation. Also suspended above the bench is a motorized grinder with a flexible shaft, featuring dual hand and foot controls. To facilitate cleaning, a terminal air jack with a self-coiling hose is suspended from the ceiling. To the rear of the work area, a heated, dust-free cabinet serves as a drying booth for stocks.

Retail Sales Area. This area is enhanced by lighted display counters with key-operated, sliding doors, accessible only from the rear for added security. This style of showcase offers an effective visual display and will undoubtedly increase retail sales, but the glass counter surface will require constant protection from breakage. It is possible to pad or carpet this surface permanently; however, padding will virtually eliminate the uppermost shelf from view, which normally generates 60-65% of the total sales volume in this style case. An alternative would be individual foam-backed counter pads that could be placed on the showcase when handling or displaying firearms above it, then subsequently removed. This style counter cover has been available from firearms manufacturers and offered to dealers as sales/service aids. A controlled access is centrally located between the showcases that form a perimeter to the retail sales area. This access permits you to enter the sales area but restricts consumer traffic from the work areas. You

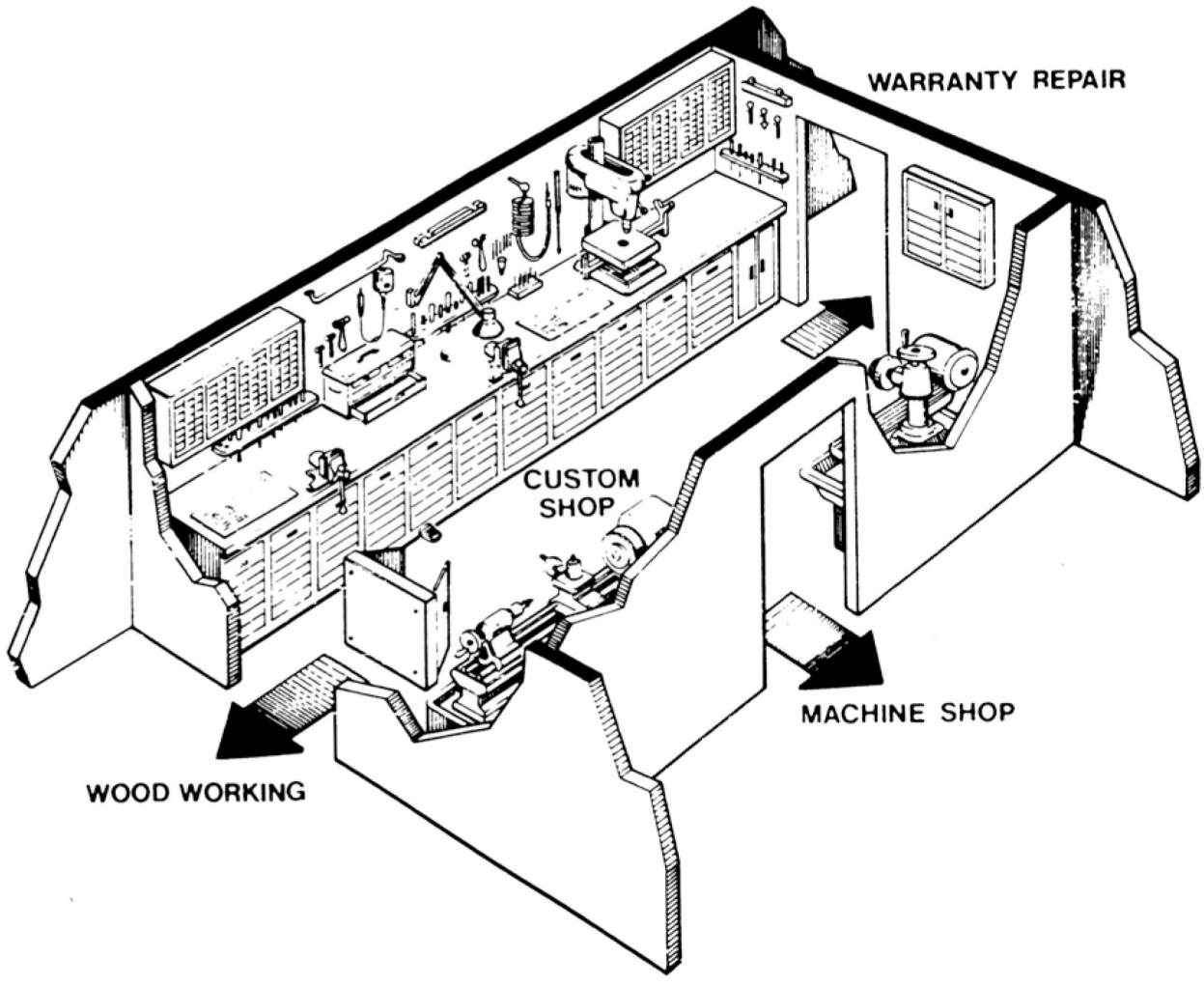


Figure 10: Cutaway view of gunsmith's custom shop

may conduct business efficiently in this well-designed layout. The lighted cases will display handguns, cutlery, and accessory items effectively and will provide the needed security required for these articles. Ammunition, reloading components, and additional shooting supplies may be arranged on shelving positioned on the wall behind the display cases. Above this shelving, long guns may be arranged on racks. This display is greatly enhanced by thoughtful arrangement, including appropriate grouping, proper identification, and correct tagging and pricing.

PRODUCTION SHOP LAYOUT

The floor plan in Figure 9 establishes machine placement and also illustrates appropriate separation of various shop operations. While some work studies indicate that placing machines close together enhances productivity, special consideration must be given to those activities that produce undesirable by-products like high levels of dust, intense heat, or excessive noise. It is essential, if not critical, that these by-products be controlled effectively.

Note that all dust-producing equipment has been isolated in one section and then further divided into subgroups (areas I, K, L, P, and W) to promote a more effective use of that equipment. To control the dust residue properly, a high-volume central vacuum system is used along with receiver ducts located on or behind each machine. Vented hoods are used in areas where operations produce the highest volumes of air contaminants (A, I, L, K, and V). To supplement these systems, filtered exhaust fans have been installed to maintain a sufficient air-exchange rate and ensure proper filtration. The benefits derived from the installation of these systems are threefold:

- They provide for a safer work environment.
- They extend the productive life of the equipment.
- They enhance the total efficiency concept in production.

As indicated by points E, S, and F in Figure 9, shop access from the retail sales area is restricted to employees only.

Also, note that the custom shop is centrally-located but is separated from the associated areas. This arrangement allows immediate access for the master gunsmith to all departments, which facilitates custom work while allowing for proper supervision.

The warranty service area is another optional expansion area that promotes high-volume repair and provides direct access to the manufacturer with higher discounts on parts acquisition. Direct access to the consumer through warranty repair provides yet another opportunity to expand sales through associated services.

The custom loading area may be considered optional and, if expanded to include production loading, would require a separate license and should be maintained through controlled access. The options involve the type and volume of loading,

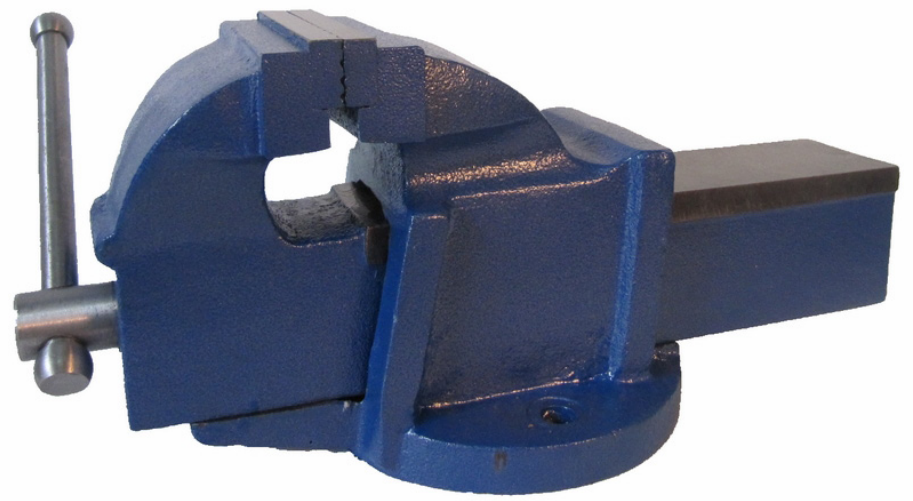


which could be summarized as high-volume production loading, specialized custom loading, or simple in-house loading for a specific requirement. Regardless of the application, immediate access to a loading facility will prove to be invaluable. For example, you may be required to test an obsolete rifle for which ammunition is no longer made. A custom loading facility would give you the tools to reload such ammunition right in your own shop.

TOOL AND EQUIPMENT LEGEND

The tools and equipment, designated by numerals on the floor plan in Figure 9, are as follows:

1. Acetylene and oxygen tanks
2. Band saw
3. Barrel vise
4. Belt/disc sander 1”
5. Belt/disc sander 6”
6. Bench drill press (with support cradle)
7. Bench grinder
8. Bluing tanks
9. Business computer terminal
10. Central vacuum
11. Checkering cradle
12. Cyanide furnace
13. Drill press (floor model)
14. Drying cabinet
15. Engine lathe (50” centers)
16. Exhaust fan
17. File storage
18. Foredom grinder (overhead)
19. Heavy-duty bench vise
20. High-speed wood mill
21. Hard wheel belt sander 2”
22. Holding area rack
23. Inventory control computer terminal
24. Loading press (metallic)
25. Loading press (progressive)
26. Machinist’s tool chest
27. Pedestal buffer
28. Pedestal grinder
29. Powder measure
30. Powder scales
31. Radial arm router
32. Record computer terminal
33. Refrigerated storage
34. Shipping equipment and scales
35. Spindle grinder/polisher
36. Stock duplicator
37. Stock vise
38. Supply storage
39. Surface grinder
40. Tandem drill presses
41. Tig welder
42. Time clock
43. Tool-and-cutter grinder
44. Toolroom lathe
45. Tool storage
46. Variable-speed drill press
47. Variable-speed vertical mill
48. Vented hood
49. Vented bluing booth barrier
50. Vented spray booth barrier
51. Vertical/horizontal mill
52. Vertical belt sander 2”
53. Vibrator/polisher
54. Water supply
55. Wood lathe



CUSTOM SHOP DETAILS

The cut-away aerial perspective view of the custom shop in Figure 10 illustrates the general layout of the two repair stations. These work areas are situated around two centrally located bench vises. These units are manufactured by Versa-Vise and feature a two-piece design composed of a post base and a detachable main housing that can be mounted horizontally or vertically. This unique design enables the user to mount work pieces in a variety of positions not possible in a standard universal vise. These vises are mounted on top of the work counters housing multiple drawers and storage areas. These units, originally designed as printers' type-storage cabinets, were selected because they provide a lot of storage area for both tools and parts. The compartmented drawers are individually labeled, provide for excellent separation and identification, and are ideally adaptable to our requirements.

A machinist's storage cabinet containing precision instruments is positioned on the counter between the two workstations, allowing access to both. Frequently used hand tools are arranged on pegboard panels or are stored in open racks for convenience and easy access. High-intensity boom lights situated above the counters supplement the lighting for the workstations. A motorized grinder with a flexible shaft and dual controls is suspended from a transverse rail by a spring mount. Also, a central air jack coupled to a coiled hose is suspended from the ceiling.

Other major equipment includes a bench model variable-speed drill press fitted with a supplemental support cradle (which will be discussed in the next lesson). A tool room lathe is positioned in the immediate area for small parts production and equipment maintenance. A tool-and-cutter grinder is also available to produce and maintain special tools and cutters required in both general gunsmithing and custom work. Located near each piece of specialized equipment is a storage cabinet housing associated accessories, gages, and tools.

SELF-TEST QUESTIONS

Please check your answers on page 19.

9. **True or False. A custom loading area in the gun shop is good for the owner's private use.**
10. **What type of appliance may be used to reduce dust in the gunshop?**
11. **What may be used in shop areas to reduce air contaminants?**
12. **What may be used in the gunshop to maintain a sufficient air exchange in areas where air contaminants are present?**

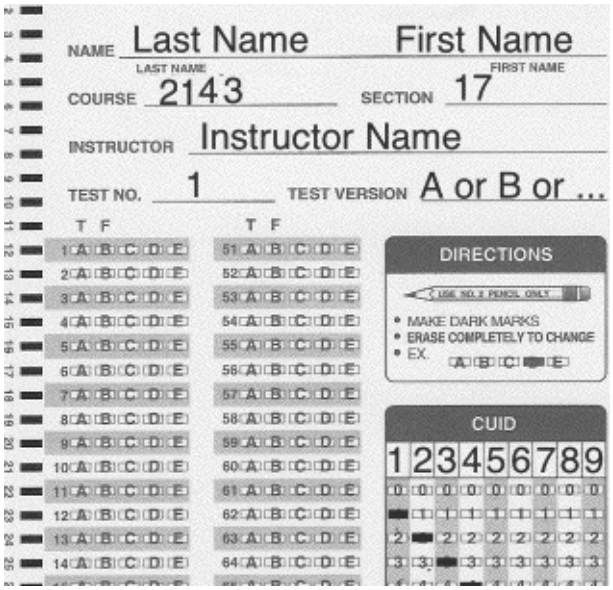
ANSWERS TO SELF-TEST QUESTIONS

1. False
2. Dehumidifier
3. Foam insulation
4. Local zoning codes or ordinances
5. True
6. 30 inches
7. As heavy as possible
8. To ensure that the bench will be sturdy and will not wobble.
9. False
10. High-volume portable vacuum
11. Vented hoods
12. Filtered exhaust fans

Lesson Questions

THIS IS LESSON NUMBER 2166.

Make sure you print your name, student number, and lesson number in the space provided on the Lesson Answer Form. Be sure to fill in the circles beneath your student number and lesson number.



REMINDER: A properly completed Lesson Answer Form allows us to evaluate your answers and send the results and additional study material. Do not hold your Lesson Answer Forms to send several at one time. You may run out of study material if you do not send your answers for evaluation promptly. You may also complete your exams and submit them online via the SDI Student Services page at www.sonoranlearning.com.

1. **The main purpose of vented hoods in welding and heat-treatment areas is to**
   a. Help heat the area.
   b. Keep all fumes confined to the area.
   c. Remove heat and harmful fumes.
   d. Speed up the process of welding or heat-treating.

2. **The bluing room should be separated from the general repair area because bluing chemicals are highly corrosive and will rust other tools.**
   a. True.
   b. False.

3. **The primary purpose of the general assembly area in a workshop is to**
   a. Gather your customers for meetings.
   b. Assemble/disassemble firearms.
   c. Meet with BATF agents.
   d. Provide a place for stocks to dry.

4. **One way to cut down on dust in the shop while power buffing or performing woodworking operations is to**
   a. Work outdoors.
   b. Connect a vacuum cleaner to the wheel guard of the tool.
   c. Use a strong, portable fan.
   d. Use water spray to keep the dust down.

5. **A workbench should be**
   a. Allowed to vibrate some to reduce friction.
   b. As large as practical and very solid.
   c. Very solid, but never very large.
   d. Accessible from all sides.

6. **The repair holding area of the gunshop is used to**
   a. Store guns until bluing has cured.
   b. Hold guns until they can be repaired or until customers pick them up.
   c. Hold guns that cannot be repaired.
   d. Dry stocks.

7. **Some of the items that may be found in a custom loading room of the gunshop include**
   a. A barrel-straightening fixture.
   b. A vibrator/polisher.
   c. Buffing wheels.
   d. A grinder.

8. **If custom loading is performed in the professional gunshop, a separate FFL**
   a. Must be obtained.
   b. Is not necessary to reload ammunition for customers.
   c. Is necessary only if you do not charge for the work.
   d. Is needed even if you only reload for yourself.

9. **When using display counters in the retail area of the gunshop, the counters should be accessible only**
   a. From the rear.
   b. From the front.
   c. From the side.
   d. From the front and rear.

10. **One of the main drawbacks of having a gunshop in the basement is that:**
   a. Security is very hard to control.
   b. Dampness may cause rust.
   c. It's difficult to insulate.
   d. It's too hot during summer months.

Gunsmithing Tools and Their Uses Lesson: 2167

OBJECTIVES 3

INTRODUCTION 3

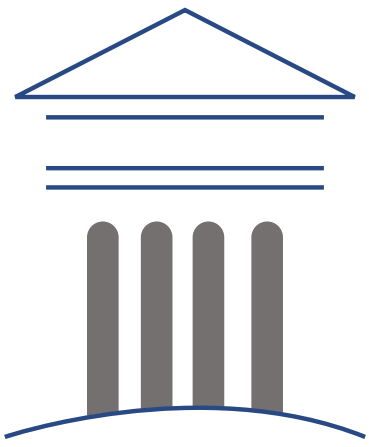
TOOLS TO GET YOU STARTED 4
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- Bench Vise 10
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LESSON QUESTIONS 24





Objectives

After completing this lesson, you should

1. Have an understanding of the types of screwdrivers used in the trade and why they are used.
2. Be familiar with the other tools necessary to perform quality work.
3. Understand the measuring tools used in the trade.

Introduction

High-quality work in any trade or profession can be accomplished only with high-quality tools and proper knowledge of their use. The gunsmithing profession is no exception. Therefore, the main objective of this lesson is to introduce the basic gunsmithing tools that are required for high-quality work. Further objectives include the proper use of these tools and how to select the best ones available for gun repair and general maintenance. Because of the critical nature of gun repair and the value of the guns being worked on, you must be very selective when choosing gunsmithing tools. The holding power of a screwdriver, for example, depends upon the quality of steel in its blade, the design of the blade, and the external force that may be applied to the screw head. For best results, the blade should also be selected to fit the width and depth of the screw slot.

The basic gunsmithing tools described in this lesson are found on the workbench of practically all professional gunsmiths. The tools listed cover the minimum needed to do good work on the typical firearm in need of repair. They are the foundation on which to build or expand your professional assortment of fine tools and instruments. They should be the best quality that you can afford.

- Gunsmith's screwdrivers
- Pin punch set
- Pliers
- Hammers
- Knife
- Spring vise
- Bench vise
- Sight-base file
- Pillar file
- Scribe hook
- Brushes
- Wood rasp
- India stones
- Allen wrench set

Tools to Get You Started

GUNSMITH SCREWDRIVERS

The selection of gunsmith screwdrivers should be carefully considered because a marred or otherwise damaged screw head is a sure indication that an amateur has done the job. The efficient holding power of a screwdriver depends on the quality of steel in its blade, the design of the blade, and the external force that may be applied to the screw head. The blade should also be fitted to the width of the slot for best results.

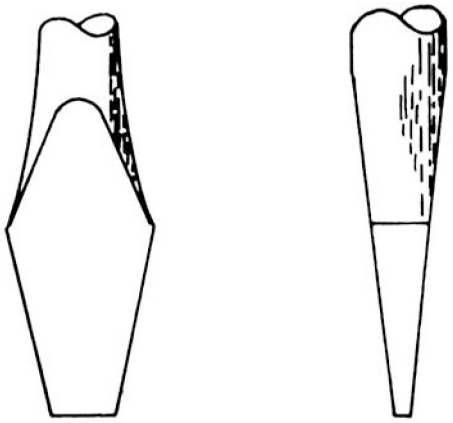


Figure 1: *This common double-wedge screwdriver is not the best choice for gun work.*

For instance, if a common double-wedge screwdriver, shown in Figure 1, were used in a deep screw slot, the blade would transmit its torque to the top of the screw slot, as shown in Figure 2. With such a small slot area coming in contact with the blade, there is a good chance that the screw will be scored, or worse yet, the screw head could break off. Wedge-shaped tips also tend to back the driver out of the screw slot - again causing damage to the screw head.

A screwdriver tip ground to properly fill a screw slot, as shown in Figure 3, is ideal for gun repair work since the torque is applied at the bottom of the slot where the screw is the strongest; the blade should fill the slot completely and should be the same width as the shank. See Figure 4 for an explanation of gunsmithing screwdriver measurement.

Grace gunsmith screwdrivers, made by Grace Metal Products, have long been a favorite with knowledgeable gunsmiths. They are made from a standard screwdriver taper but with the tip of each bit ground parallel for a short distance to give a better fit to heads of gun screws. They have a high-quality feel and will handle 95% of your needs around the gunshop. You will also need a stock bolt screwdriver with a 1/2" blade, about 15" long. A set of jeweler's screwdrivers will also come in handy.

Another good set of screwdrivers is made by Chapman Manufacturing Company. This set contains one screwdriver handle, an extension, twelve slotted-head adapters, two Phillips-head adapters, a midget ratchet, and one Allen hex-type adapter. This kit will handle nearly all of your gun repair needs, except for a long-shank bolt screwdriver.

The adapters for the Chapman screwdriver handle are relatively inexpensive and should be reshaped (if necessary) to conform to a specialized job such as an extra-thin screw slot. However, when grinding adapters be careful not to let the temperature get too hot (above 400°F) or they will lose their hardness.

Reshape the adapter so that it fits the screw slot exactly. Then inspect each adapter under a magnifying glass before use. Also, carefully clean off any burrs that may be present before attempting to remove any screw. Use great care at all times since one slip can damage the finish on an expensive firearm.

The strength of the individual adapter depends on its size, diameter, blade width, thickness, and the like. In general, the smaller the tip, the weaker it is, and therefore, the less torque that can be applied.

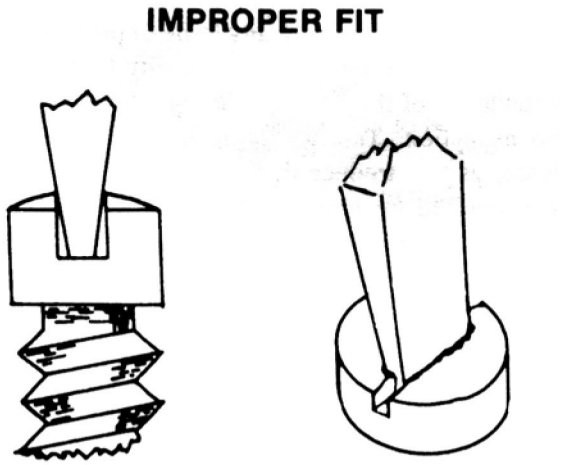


Figure 2: *Here is the double-wedge screwdriver in use. Note the lack of close fitting—the blade transmits its torque only to the top of the screw slot. As can be seen, this screw slot (right) was damaged by improper blade fit.*

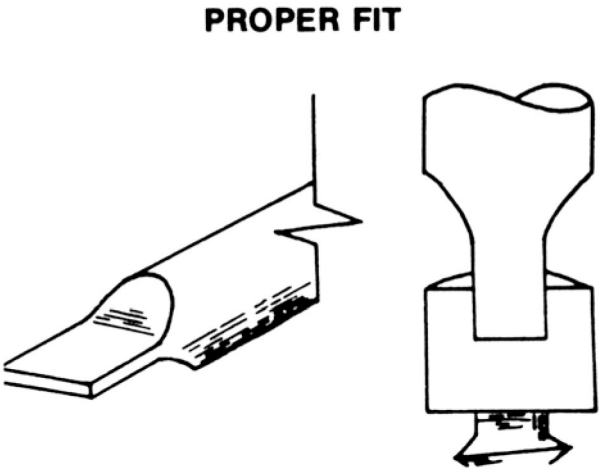


Figure 3: *This particular blade is ideal for gun work. It has been grounded to conform perfectly to a screw of specific dimensions. Notice that this screwdriver blade fits the screw slot perfectly.*

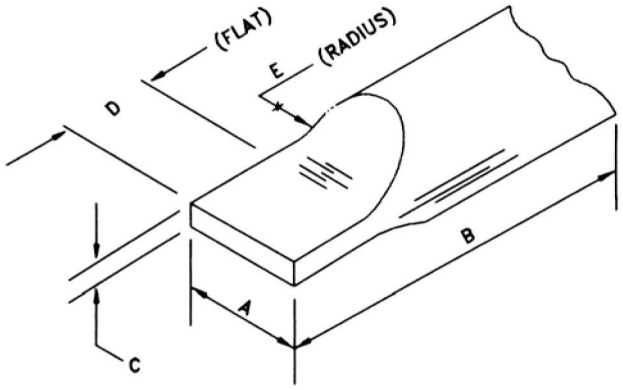


Figure 4: *How gunsmithing screwdrivers are measured: (A) blade width, (B) shank length, (C) blade thickness, (D) blade length, (E) radius of the curve from the flat portion of the blade to the outside of the shank. To fit a screw gun properly, all of these dimensions must match the screw head in questions.*

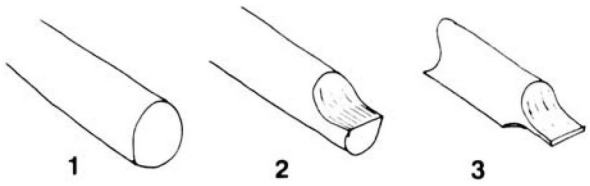


Figure 5: *To grind screwdrivers tips from tool-steel drill rods: (1) drill rod used as blank for gunsmithing screwdriver, (2) use circular grinding wheel to grind one side of drill rod, (3) reverse rod, grind other side.*

Even with a good set of gunsmith screwdrivers, you must understand that there are some screws that cannot be removed with a screwdriver. All screws are not made, fitted, or installed in the exact same manner. Neither are all screws manufactured with a proper "thread-to-thread" tolerance. Few of them are ever visually inspected before use and, therefore, they can carry a burr or chip which may jam them in position. Some screws–especially those used to secure gun sights—have a holding compound applied to them so they will not back out under recoil. It also makes them difficult, if not impossible, to remove with a screwdriver.

Tapping the screwdriver in the screw slot will sometimes help to loosen the screw. This tends to drive the screw forward in the thread slot, usually allowing movement. Liquid Wrench or WD-40 (commercial products used for loosening rusted metal screws and bolts) may also be tried. Heat applied to the surrounding area (not the screw itself) should be tried only as a last resort since intense heat will draw the hardness from most metals.

Remember, once a screw is broken, there is only one way to remove it. The broken screw must be drilled out and replaced the best way possible—often taking much time and effort.

Even though commercial gunsmithing screwdriver sets come with many different bit sizes, you might still have to grind a screwdriver tip to fit a particular screw slot. In fact, most professionals make their own screwdrivers out of drill rods and then install either a wooden or plastic handle on them for gripping. A circular grinding stone attached to a drill press will do the trick, but you will have to visually estimate the radius and width of the bit. It is easier to purchase an MMC Hollow Grinding Fixture set from Brownells, Inc. This set will enable you to grind screwdriver blades accurately or make your own. This device can be clamped to any bench grinder or drill press to hold screwdriver blades, and the design assures parallel blade faces and blade tips.

To grind screwdriver tips from tool-steel drill rods, use steel consisting of 50% carbon, 40% manganese, 1% silicon, and 0.5% molybdenum, the finest steel available for screwdriver blades (Figure 5). Once the tips have been ground to size, wrap them in stainless steel foil to prevent scales from forming during the hardening process. Using a propane torch, heat the rod to bright red, and just before it changes to red-yellow, quench the part in oil. To draw, preheat an oven to 300°F, put the part in the oven for an hour, and then allow it to air cool. This will make one of the toughest screwdriver blades available. Just be careful with the torch while heating the parts. Do not burn yourself or use an open flame around any combustibles.

When making your own screwdrivers, you will eventually want at least one screwdriver for each type of gun screw that you encounter in your work. The size and depth of screw slots can be measured with the measuring tools described later in this lesson, or their dimensions can be obtained from gun-screw dimension tables such as the one in Figure 6.

There will be certain screws (mostly on gun sights) that will require the use of a jeweler's, or instrument, screwdriver. One or two will do at first, but eventually it may be necessary to obtain a set of about five different blade sizes (Figure 7).

GUN SCREW DIMENSIONS

Firearm	Blade Width (inches)	Shank Length (inches)	Blade Thickness (inches)	Blade Length (inches)	Curve Radius (inches)
Remington and Winchester, plug screws	1/8	41/4	.023	.048	1/4
Lyman, Leupold, Redfield scope screws	3/16	41/4	.023	.046	1/4
B&L, Weaver, Buehler scope screws	3/16	41/4	.037	.046	1/4
Williams 10–32 screws	1/4	41/4	.041	.0625	1/4
Most Guard Screws	5/16	41/4	.040	.0625	1/4
Winchester, Browning O/U Ejector	3/16	41/4	.020	.050	1/4
Browning O/U trigger guard	3/8	41/4	.021	.046	1/4
Browning Auto Receiver Screws	1/4	41/4	.024	.062	1/4
Guard Screws and General Purpose	5/16	41/4	.034	.062	1/4
Redfield Streamlined Scope Mount Rings	11/64	41/4	.031	.046	1/4

Figure 6: Gun screw dimensions for several popular firearms and telescopic sights.

PIN PUNCH SET

A set of drift-pin punches is required for removing the assembly pins used in most firearms. A Grace pin punch set will handle 90% of your shop needs. Each punch is made to fit a certain pin in a gun action, and the kit consists of five different drift-pin punches, plus a starter punch and one center punch.

Brownells also offers a special gunsmith's replaceable punch set that allows the tips to be replaced should they bend or break. The handles are made of steel with removable knurled chuck to hold the pins. The pins may be ground down to the exact length required for each job—giving the user a set of custom punches with a minimum investment.

In general, there are four types of pins used in firearm assembly: common steel pins; split pins; roll, or spring, pins; and flared-tip, or serrated, pins as shown in Figure 8. Before attempting to remove any pin, examine it carefully to determine just what type it is. Then use the appropriate drift-pin punch to remove it. The object is to remove the pin without damaging it, the surrounding surface or finish, or internal parts.

When removing drift pins, you must first position the gun so the pin will have clearance to be driven out. A padded vise works most of the time, but sometimes this is going to a lot of trouble just to remove one pin. A hardwood block with a hole drilled through it (about 1" in diameter) keeps the gun high enough off the bench for driving out pins. A starter punch is used to get the pin started. This is the short, tapered, flat-nose punch found in most gunsmith pin punch sets. Hold the punch squarely on the pin and then give it a short, medium to heavy tap. If it resists, give it a harder blow. Once the pin moves, a pin punch just a bit smaller than the pin is used to drive it the rest of the way out.

If you suspect that the pin is serrated or flared, you must hit the pin on the opposite end from the tiny serrations to avoid damaging the pin or the gun parts. A close examination will reveal which end is the serrated end; use a magnifying glass if necessary.



Figure 7: Many gun screws will require the use of a jeweler's, or instrument, screwdriver—especially open and telescopic sights. Many action screws are also too small for a conventional gunsmith's screwdriver.

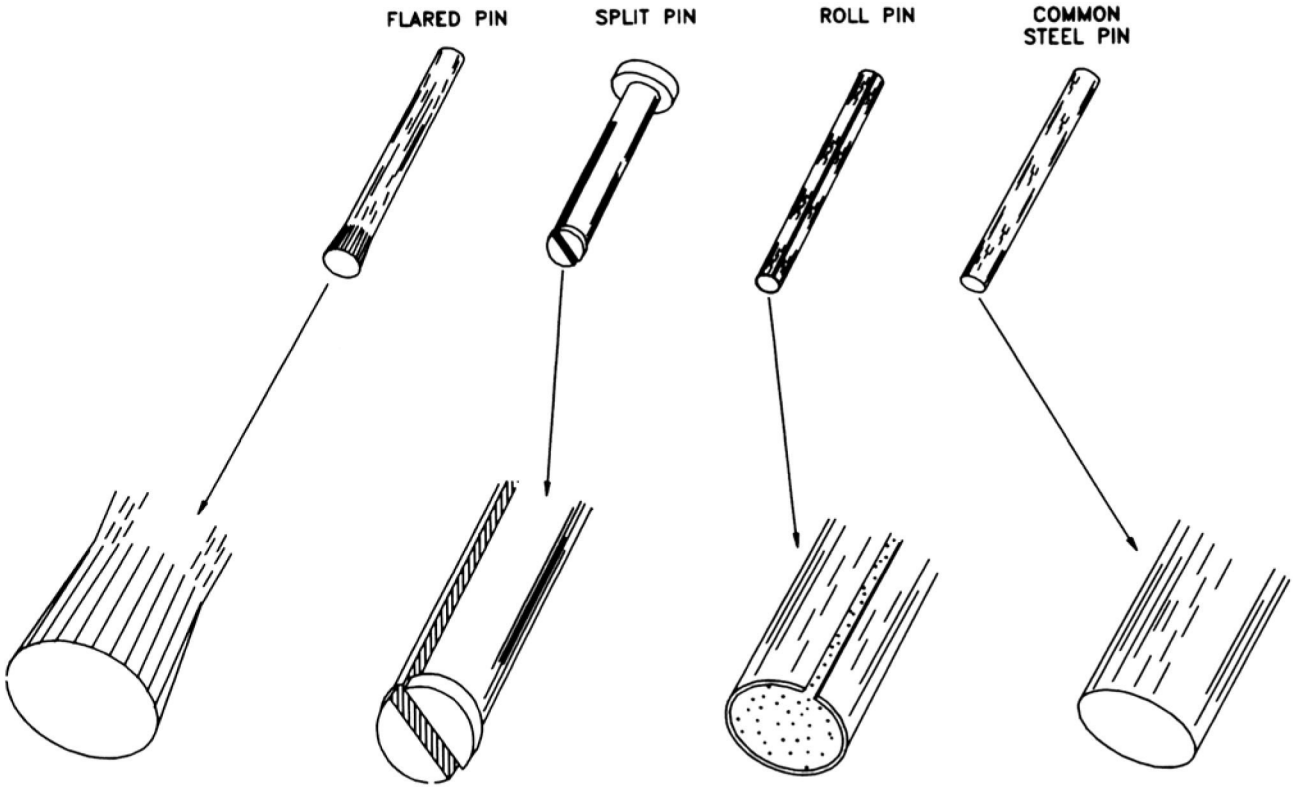


Figure 8: *The four types of pins used in both current and obsolete firearms*

The increasing use of roll, or spring, pins in modern firearms makes it necessary to use special roll-pin punches for removal. They permit the removal and reuse of the same pin without glaring damage to the pins. A kit of punches in sizes from $^{1}/_{16}$" $^{3}/_{16}$" will take care of most of your needs in the gunshop.

Select the proper size punch for the pin and then insert the pilot into the hollow pin until the driving shoulders rest on the end of the pin. Then drive out the pin as discussed previously. Be sure to clean and oil the pin before replacing it.

Besides removing pins and using center punches for drilling, punches in general have many other uses around the gunshop. For example, a stuck screw can sometimes be loosened by tapping it with a pin punch. Secure the firearm in a padded vise, then place the tip of the punch inside the outer edge of the screw slot and tap it with a hammer. This will usually start the screw turning when other methods have failed. The principle is the same as tapping a tight jar lid with a table knife to loosen it.

A center punch may also be used to correct minor headspace problems of single-shot, break-open shotguns temporarily. The inside curvature of the barrel lug is peened with a center punch as shown in Figure 9. The raised metal craters will cause the barrel to close tighter with the standing breech. In a similar manner, a center punch can be used to raise metal in the bottom of dovetail slots in barrels when they are too loose to hold dovetail sights properly. To correct this condition, rest the barrel on a solid object with some type of protection so as not to damage the barrel's finish, and then give several hits with the center punch directly in the dovetail slot. Try the dovetail sight and, if it's still not tight enough, raise more metal with the center punch until the correct fit is obtained.

You will need some special punches for removing and installing dovetail sights. Conventional pin punches will mar finishes every time.

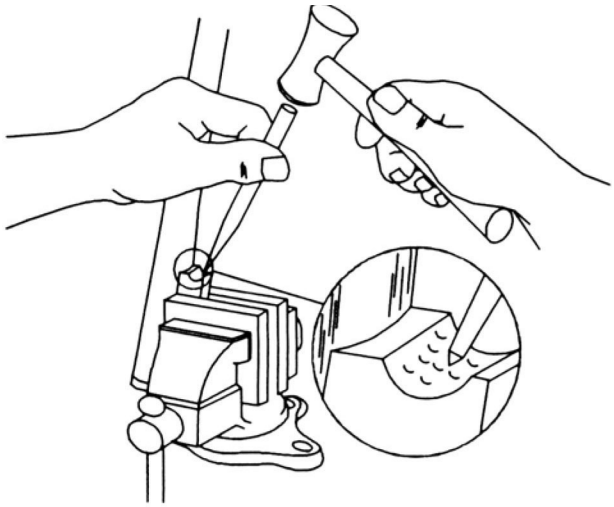


Figure 9: *Peening barrel lug to tighten barrel/receiver fit on single-shot shotgun.*

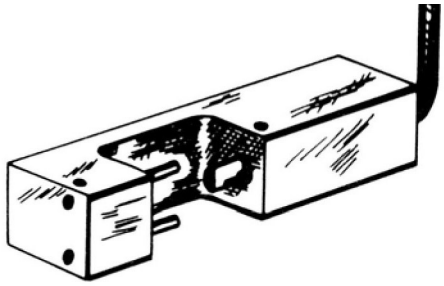


Figure 10: B-Square front-sight pusher pushes dovetail sights and blanks out ramps without hammering or damage. The pusher has two hardened posts opposite a pusher ram

A nylon drift punch is very handy for installing and removing dovetail sights. The perfect size is a 4" long piece of nylon 5/16" in diameter. This will take care of the majority of front-sight removals. However, sometimes you will encounter an extremely tight dovetail sight and the nylon drift punch will bend. In these cases, you will need a rectangular bronze punch, since it provides a far superior surface than round punches, with which only a small portion of the punch contacts the piece—often resulting in upsetting and deformation. By contrast, on many parts, such as sights, the square-end punch gives almost 100% contact - reducing tool and part damage. A good size is 1/4" x 1/4" square. Most come in 12" lengths and can be cut into several punches.

Another method of removing dovetail sights is with a front-sight pusher (Figure 10). B-Square's front-sight pusher pushes dovetail sights and blanks out ramps without hammering or damage. The pusher has two hardened posts opposite a pusher ram. Turning the brass bearing screw extends or retracts the ram.

PLIERS

Perhaps no other tool on the workbench is required to do more jobs than the various pairs of pliers that should be in any gunshop. The assortment shown in Figure 11 will fill nearly all gunshop requirements, from reaching inside a small action and inserting a small part, to holding red-hot screws or drift pins that are being blued by the oil-heat method. Insist on the steel varieties and not the cast-iron models found in dime stores and discount houses.

Adjustable combination pliers have been around a long time. They are a common household tool and have been used for everything from driving tacks to pulling teeth, but they have a definite place in the gunshop. In general, a slip joint holds the two parts of the pliers together so that the jaws can be opened or closed to hold large or small objects. Most adjustable combination pliers have two cutting edges at the back of the jaws for wire cutting, but their main purpose is for gripping — such as holding a small part against a grinding wheel.

Long-nose pliers are often called "needle-nose pliers" and are used with small objects in hard-to-get-at locations, such as starting the replacement of a pin or spring inside of an action. The tips of these pliers bend easily if they are misused and they should never be used for loosening or tightening a screw or nut. Starting them, yes; but tightening them, no!

Other types of pliers similar to long-nose pliers include round-nose pliers, half-round-nose pliers, and flat-nose pliers. All three types are used for similar situations as the long-nose pliers.



Figure 11: Assortment of pliers that has proven useful around the gunshop

Side-cutting pliers are used in the gunshop for cutting wire — like black-iron stovepipe wire used to hold barreled actions and parts while being blued. However, their use on hardened steel or heavy material will nick or dull the cutting edge quickly.

Pump pliers (often called channel-locks) have a quick adjustment for widening or narrowing the jaws to hold various materials, especially round objects. The interlocking tongues and grooves on the two parts of the pliers enable the jaws to be moved closer together or farther apart.

Self-adjustable locking pliers act as a small portable vise. These pliers have a toggle and floating wedge arrangement that automatically adjusts the jaws of the pliers to the size of the object they are being used on. Pressure on the handle then enables the jaws to lock around the object very tightly and remain in this position until reverse pressure is applied to release the vise grip.

The variety of cutting and gripping pliers just discussed come in a number of sizes and each has a specific purpose. Any of them can be ruined if used for the wrong job.

HAMMERS

Hammers have a variety of uses in benchwork, including driving pins, installing or removing sights, seating inlays, and peening dovetail sight bases to tighten sights.

One of the first hammers purchased by the gunsmith should be the no-mar type. These nylon, rubber, or leather-headed hammers can be used for many jobs around the shop where you have to pound but do not want to mar the metal or wood you are working on. Of the several sizes available, you will probably want to get the 1" diameter tip size first. You can also purchase a brass hammer tip that will screw into the 1" no-mar hammer. When this is used in combination with a no-mar plastic, nylon, or phenolic, tip, it makes an excellent all-purpose gunsmith hammer.

Metal-working hammers like the ones shown in Figure 12, may be classified with respect to peen as:

A) Ball peen

B) Straight peen

C) Cross peen

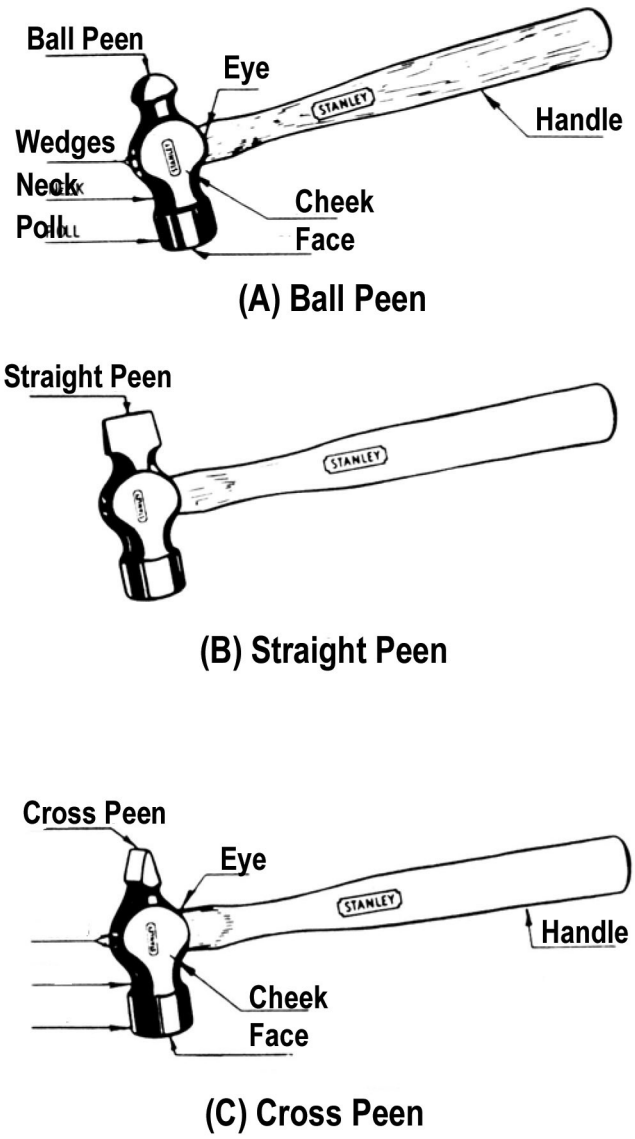


Figure 12: *Description of the different types of peening hammers frequently used by gunsmiths.*

They are used mainly to hammer metal—to indent or compress it, to expand or stretch that portion of the metal adjacent to the indentation. One use of peening hammers is to tighten dovetail sights. Remove the sight base and lightly peen the top of the dovetail slot, forcing the overhand downwards to grip the sight base tighter. Marred metal areas can sometimes be peened back into their original condition if you are careful. A gun part, such as a bar or shaft, can be straightened by peening with the convex portion of the hammer.



Figure 13: The rotating bench vice is one of the more useful items a gunsmith can have. It turns a full 360° in either upright or laid-flat position.

BENCH VISE

A bench vise mounted on a sturdy workbench is the first non-portable tool the gunsmith should buy. The rotating bench vice (Figure 13) is one of the most useful items a gunsmith can have. It turns a full 360° in either the upright or laid-flat position. The vise automatically locks in the desired position when the jaws are clamped tight. Serrated pipe jaws for round objects up to 1 1/2" in diameter are provided as well as a built-in anvil.

FILES

Files are available in many shapes and sizes, with teeth of varying coarseness. Probably the handiest size to start with is an 8" narrow hand file. This file is similar to a conventional pillar file (Figure 14), but has the advantage of one cutting edge and one safe edge.

The next file you may need is a sight-base file, which has two sides that do not cut. Not only is this file ideal for cutting dovetail slots for sight installations, but it also serves many other purposes: for example, when the user must file right up to a side wall or slightly undercut without damaging the sides of the cut.



Figure 14: Both edges of the pillar file are safe, so cuts may be made up to the faces without undercutting the sides of the work.

After purchasing these two files, you may want to start adding others to your inventory of tools. An 8" mill file and a 10" mill file (both in fine cut) will see plenty of work around a gunshop, and a 12" flat bastard cut can take off a lot of metal in a hurry. Next in line will be a set of gunsmith needle files in both medium and fine cuts.

Eventually, you will also want several 6" round files for adjusting screw and pin holes, scope mount holes, fine cuts on tightly curved parts, and all types of parallel round cuts. Four diameters—3/32", 1/8", 5/32", and 3/16"— will handle most gunsmithing needs. Cuts are normally No. 00 (very coarse), No. 0, No. 2, and No. 4 (very fine).

If you do much gunsmithing work, you will frequently have to deepen old screw slots, make slots in new screws, and touch up botched screw slots. Screw head files are just the thing for these jobs. Such files cut only on the edge. The wide flat sides are smooth and will not damage the screw head while filing.

Files are very simple tools, yet a person who knows how to use them can do remarkable things with them. For example, gunsmiths in Afghanistan frequently make their own gun parts using only files. Hand-filing is slower and more difficult than machine filing, but with patience, quite a lot can be accomplished. Files are meant to cut in one direction only. And unless the right amount of pressure is applied, the piece will be damaged. In addition, the teeth of the file get clogged with metal filing, if this condition is allowed to go unchecked, the file will no longer cut effectively and will also score the work. So when buying your first file, buy a file card—a wire brush made especially for cleaning the teeth of files. Common chalk rubbed across the teeth will minimize clogging (often called pinning), but you should still use the file card to ensure proper cutting.

Each file should be provided with either a plastic or wooden handle to protect the user's hands. A handle will give you a firmer grip on the file tang, but even more important, if the file binds or catches on the work, the sharp tang will not cut your hand or wrist.

HONING STONES

An assortment of gunsmith's honing stones (India and Arkansas) is almost indispensable for gun work. Sharpening trigger sears for smoother trigger operation and smoothing the metal-to-metal contact of all movable action parts are just a few of the many uses for honing stones.

HACKSAW

The hacksaw is a metal cutting tool that, like a file, cuts in one direction only. When using it, do not let the teeth drag over the cut on the backward movement. Rather, raise the saw blade slightly on the backward movement, applying pressure only on the forward stroke. This way, you will cut faster and smoother, and the blades will last much longer. Hacksaws are relatively inexpensive, so purchase the best one you can find. Look for a sturdy frame, and leave the dime-store varieties alone. The same is true for hacksaw blades. Buy the best high-speed blades you can find in the following teeth spacings: 18 teeth per inch for roughing cuts and for use on heavy stock; 24 teeth per inch for smoother, more accurate cuts, and 32 teeth per inch for cutting thin tubing.

BENCH KNIFE

A strong, sharp blade on your bench knife will come in handy for gun inletting, cutting leather slings to size, incising, and relieving. The knife shown in Figure 15 comes from Brownells. Besides this one, use a set of X-Acto knives. Keep one blade razor sharp and use the dull blades for rougher work.

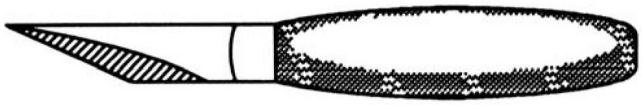


Figure 15: Brownell's bench knife.

SCREW CHECK'R

Since few beginners have a screw gauge and a micrometer, a Screw Check'r is included in the Brownells kits. This gauge will also give drill sizes.

DRILLS

A hand drill is relatively inexpensive and can suffice for most of the hobbyist's drilling. However, you will eventually need a drill press. With this, you can drill holes for mounting telescopic sights, drum-sand irregular wood shapes, and grind screwdriver tips. When a polishing bob is placed in the drill, you can use it to polish trigger guards and other small parts. Drill bits and taps are other considerations for threading screw holes. These can be purchased as needed, but it might be better of you buy one of Brownells's Sight and Scope Mounting Drill and Tap Kits No. 2. If you anticipate doing much scope mounting on rifles that have not been predrilled at the factory, this kit will pay for itself many times over.

DISASSEMBLY TOOLS

The Brownells Assembly/Disassembly Tool Kit contains three specialty tools for disassembling certain guns: a Colt Pistol Wrench; a Winchester Model 12/Ithaca 37 Wrench; and Extractor Spring Pliers.

POWER TOOLS

Buying power tools can quickly get expensive, but to save time and effort, it is advised to purchase a few. Make your first power tool a 1/4" or 3/8" portable electric drill. You will be able to use it and its many accessories as a drill press, a disc sander for shaping stocks and recoil pads, a buffer for polishing gun metal prior to bluing, a carding wheel to remove rust during the hot-water method of gun bluing, and a bench grinder.

SELF-TEST QUESTIONS

Please check your answers on page 23.

1. **Name the three types of peening hammers.**
2. **Name the two types of honing stones normally used by gunsmiths.**
3. **What is the purpose of a "safe" side on a metal-cutting file?**
4. **What are the four basic types of drift pins?**

Specialty Tools

About the time you think that you are equipped to tackle any project, you will have a gun that requires additional tools—either to disassemble it or repair it. Do not let this bother you. More than likely, an additional tool can be purchased, and you will have it when the situation arises again. One of the exceptions is the purchase of a tool to remove the stock bolt from some two-piece stocks. In most cases, a standard screwdriver with a 1/2" blade and 15" shank will work. However, recently, manufacturers have strayed from the conventional screw-slot bolt. Some have hex head bolts, some have screw-slot bolts, and others have a combination of both. All are difficult to remove and often require special tool setups to handle the force required to remove them correctly and to retighten them solidly. Also, many stock-bolt holes are only slightly oversized, requiring special thin-walled sockets.

Brownell's Stock Take-Down Tool Kit is designed to handle all stock take-down problems. The socket heads are correct to prevent slipping and burring. The drag link bit and socket screwdriver are rounded at the socket end, which automatically centers the blade in the stock-bolt hole and makes fitting it into the slot much easier than when using a conventional screwdriver. This set is expensive, but when you need it, nothing else will do. There are also other uses for it in gun work, so it is a good investment.



***Figure 16**: A midget offset screwdriver is unbeatable for removing screws in small places.*

Another frustrating problem is trying to loosen or tighten a screw in a small space, such as the trigger spring screw in some break-open, single-barrel shotguns. The receiver tangs prevent a direct approach using conventional screwdrivers, and you usually wind up bruising knuckles and botching screw heads. A midget offset screwdriver, such as the one in Figure 16, will help tremendously. The short 18° working arc is unbeatable for removing screws in small spaces. You can reverse the ratchet direction instantly by turning the tool over.

BENCH BLOCK

When trying to remove drift pins from various gun parts, you will discover that it is difficult to position the part solidly to take the blow and still provide an escape area for the drift pin to come through. A bench block will allow you to remove the drift pins easily from practically any weapon without damaging the gun or the pin itself (Figure 17).

To make a bench block, cut a scrap of 2" x 4" lumber to a 6" length and sand all edges smooth. Lay out and mark the groove and retrieval pocket. Make several saw cuts within the margin of the groove layout lines, then finish cutting to size with a wood chisel. Use a tight-fitting sanding block with sandpaper, and smooth all edges of the groove. Make diagonal saw cuts for the retrieval pocket and remove the remaining wood with a wood chisel. A 1/4" drilled hole will complete the project.

You may want to fill the pores of this wooden bench block and then varnish it to prevent the wood from soaking up the oil that drops off the various gun parts. To do so, sand the block smooth, apply wood filler, and resand it to bare wood after the filler is completely dry. Apply another coat and, when dry, apply a coat of spar varnish. When the varnish is dry, rub the block lightly with fine sandpaper. Evenly apply another coat of varnish. When this final coat is dry, the bench block is ready for use.

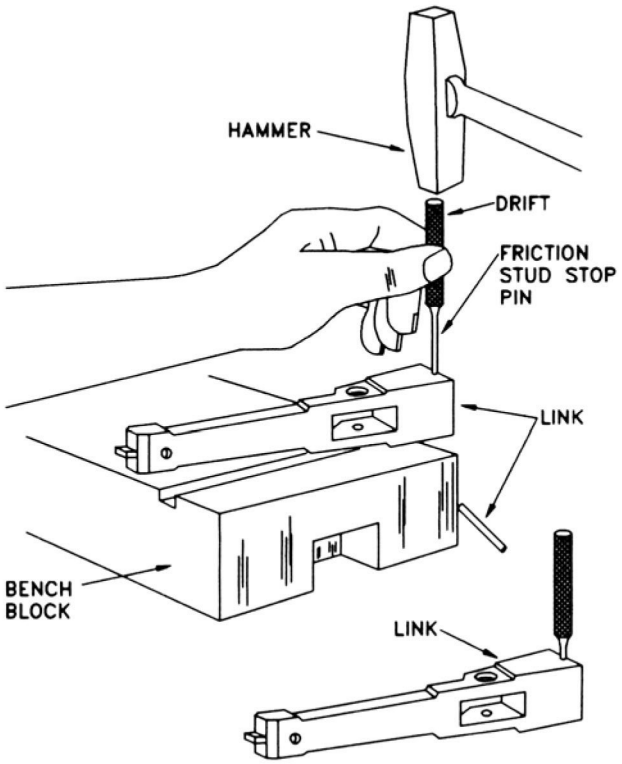


***Figure 17**: A simple bench block is useful for many things in gunsmithing.*

The dimensions given for this bench block are flexible. If another size would serve you better, change them. For example, a piece of 4" x 4" lumber may be better. In this case, other dimensions will remain the same, except that the 1/4" hole from the groove to the retrieval pocket will be longer, enabling the block to handle longer drift pins.

This bench-block project is relatively simple, but many people might be tempted to do the work without taking too many pains. It will probably work just as well, but it is a good idea to get into the habit of doing nothing but the finest work, even on the simplest of projects. A gunsmith once was given the job of refinishing an entire gun collection that had been slightly damaged by a small fire in the owner's home. After the work was completed, the owner admitted to some reluctance about entrusting the entire collection to just anyone. But after noticing the fine work that the gunsmith had put into a simple block of wood on the bench, any doubts the owner had, vanished. If the gunsmith took that much trouble with a block of wood that made little difference, the owner reasoned, the work must be really good when it counts.

TIME-SAVING DEVICES

A skilled gunsmith can turn out a large amount of work with only a few hand tools. However, few professionals rely solely on hand tools; most have shops equipped with special tools to make the work go easier and faster.

Power tools can also help the hobbyist turn out certain gun repair jobs faster, but few part-time gunsmiths can afford to invest in a large array of power tools. A good lathe, for example, could cost $3,500 or more, and a milling machine costs about the same amount. If you add accessories, the amount can quickly double. But eventually, every serious hobbyist is going to wind up with some power tools. The main objective is to be selective and not waste money.

PLAN BEFORE PURCHASING

The purchase of any good power tool is going to require a relatively large cash outlay, so careful planning is necessary to get the most for your money. A piece of equipment that will stand idle in your shop is not a good investment. Do not, for example, buy a drill press just because another gunsmith has one. The majority of that gunsmith's work may consist of mounting telescope sights on rifles, in which case, the drill press is almost indispensable. On the other hand, if your work consists mostly of bluing firearms, a power buffer to polish the metal parts prior to bluing would be a better investment. By the same token, if you specialize in making small replacement parts for obsolete firearms, a milling machine and a small, inexpensive lathe would be a good investment. Before purchasing any expensive power tool, be sure you have a need for it.

Once you decide that a certain power tool would be beneficial to you, begin gathering all the information available about the various types on the market. Look through tool catalogs, compare capabilities and prices, and then decide which model suits your needs the best. Compare the specifications of different models. Then ask people who have been using the tool how it performs, what they like about it, and what they do not like.

Also, keep in mind that the most expensive piece of equipment is not necessarily the best, or it might not be the best one for you. Carefully investigate each piece of equipment, and then decide which one is best on the merits of how it will suit your own needs. To quote John Ruskin:

"It's unwise to pay too much . . . but it's worse to pay too little. When you pay too much, you lose a little money . . . that is all. When you pay too little, you sometimes lose everything, because the thing you bought was incapable of doing the thing it was bought to do. The common law of business balance prohibits paying a little and getting a lot. It can't be done. If you deal with the lowest bidder, it is well to add something for the risk you run. And if you do that, you will have enough to pay for something better."

It would be difficult, if not impossible, to recommend an assortment of power tools to fit everyone's needs. But for hobbyists who will be doing average gun work and for those who eventually want to branch out into full-time careers, the following section lists power tools that might be needed. They are discussed in the recommended order of purchase.

DRILL PRESS

The first large power tool purchased for your shop should be a drill press and stand, since it will pay for itself time and time again. Besides its obvious uses—drilling holes in metal for mounting sights and such—the press enables you to do precision jeweling on gun bolts and other parts, it makes sling swivel installations easy, and it aids in inletting stocks when a Forster wood bit is used. In fact, after using the press for a while and learning to use the various accessories, you will wonder how you ever got by without it.

If a good drill press is too expensive at this time, do not bother buying an inexpensive one that will not bore true holes or handle the work. Instead, purchase a press that will attach to a hand-drill motor and make do with this until you can afford a better drill press.

The accessories for drill presses are numerous and permit all sorts of jobs to be done on the press.

If the press tilts for angle drilling, you can place an arbor into the press and attach buffing wheels for polishing gun parts prior to bluing, or wire wheels for carding during the hot-water bluing method. Swing the table away from the spindle, tilt the spindle out for accessibility, and you are in business.

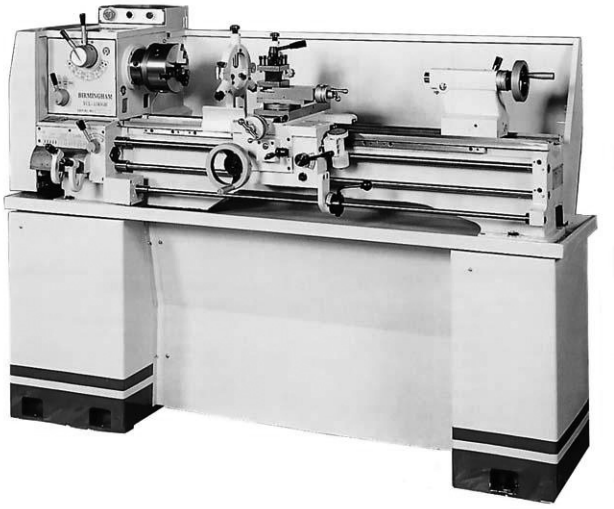


Figure 18: A metal-turning lathe is one of the best investments a gunsmith can make.

LATHE

Many experts would recommend a bench grinder as the second power tool for the gunshop. It is a very handy tool to have around. But since an inexpensive grinding wheel can be purchased for use in either the drill press or a small lathe that will accommodate most of the grinding operations encountered, a small bench lathe is recommended here instead. Once you learn to use the lathe, you will be able to make many other tools and accessories with it, including headspace gauges and chamber-ironing tools. You will be able to mill an occasional trigger guard or hammer, but be prepared to spend several hours on each. When selecting a lathe for gunsmithing work, the most important consideration is the size and amount of work that it will be used for. The lathe should be large enough to accommodate the various classes of work that will be handled. This is determined by the greatest diameter and length of work that will be machined in the lathe. If you anticipate many conversion jobs that require barrel turning, bolt facing, and chambering and threading of barrels, then you will need a lathe like the one in Figure 18. However, each lathe has advantages and disadvantages and the final decision to purchase one should be made only after you have analyzed your abilities, your anticipated specialty, and your probable future desires thoroughly. Milling attachments are also available for most lathes that will do a great deal of milling in the gunshop. The milling cut is controlled by the hand wheel of the lathe carriage, with the cross-feed screw of the lathe and the vertical adjusting screw at the top of the milling attachment.

BENCH GRINDER

A bench grinder will mainly be used to sharpen tools and drill bits, and to maintain the other tools used in gunsmithing work. It also grinds down metal surfaces rapidly and is excellent for such purposes prior to final finishing with a file or polishing wheel. With one or both grinding wheels removed, buffing wheels can be attached to the arbors to polish metal surfaces for gun bluing. Or, when wire wheels are used, it is possible to card metal surfaces when using the hot water method or slow-rusting process of gun bluing.

WELDING OUTFIT

Although it is not really a power tool, an oxyacetylene welding kit, used for welding, silver soldering, brazing, and heat-treating parts, should be the next purchase. Heating and bending or welding bolt handles is just one job the welding outfit will perform. There are countless parts for which replacements are not readily available that can be mended with a welding outfit and silver solder.

MILLING MACHINE

A milling machine can be a worthwhile investment if the shop is engaged in making a lot of gun parts from patterns or duplicates. By today's standards, a milling machine is really not too expensive, but the machine itself is only part of the story. When several milling cutters are required (and they usually are), the investment is quite large.

In general, a milling machine is designed to cut metal by means of a multi-tooth rotating cutter. The machine is constructed so that the workpiece is fed to a rotary cutter instead of a fixed cutter being applied to a rotating workpiece, as on a lathe.

The milling machine is ideal for the gunshop because it is also a complete drill press. Almost any small gun part, including a receiver, can be machined on this tool. In fact, the milling machine was developed for use in gun factories. A seasoned operator can use the machine to make all sorts of replacement parts or to make complete firearms.

HEAT-TREATING FURNACE

Several types of heat-treating furnaces are available in a wide range of prices. The Hupert Electric Heat-Treating Furnace, available from suppliers of gunsmithing tools, is designed specifically for precision heat-treating in gunshops. It is simple to operate and service.

The gunsmith who makes tools and parts, such as firing pins, drift pins, sears, reamers, and springs, will have to harden them correctly. Many use the color method of hardening in a gas flame, but the process cannot be controlled this way. The odds against obtaining the correct hardness every time are high. Therefore, for the shop that turns out a lot of this work, an electric furnace is a good investment.

For removing parts from the hot furnaces, one or more sets of tongs are necessary. Special tongs, available from Frank Mittermeier, Inc., are specially designed for handling small parts in heat-treating furnaces and are highly recommended. They are made from 1/4" stock and are about 16" long. Because these tongs ensure a positive grip on various objects, they permit the operator to handle parts easily from a distance.

MISCELLANEOUS POWER TOOLS

With the tools mentioned and the addition of a barrel vise and wrench, the experienced gunsmith will be able to handle almost any type of work encountered in the operation of a gunshop.

A look through any gunsmith supplier's catalog reveals a large array of gunsmithing tools that have time-saving capabilities. For example, electric checkering tools will speed up the process of checkering once you have practiced enough to use the tools correctly. Power buffers, by Baldor or B-Square, speed up the polishing process prior to bluing firearms. As a gunsmith, you might get involved in reloading ammunition, developing new wildcat cartridges, or creating new loads for factory cartridges. In such cases, you might want an electronic chronograph and maybe even a pressure gun to check the chamber pressure of your reloads.

SELF-TEST QUESTIONS

Please check your answers on page 23.

5. ***True or False.*** **A power buffer can speed up the process of removing the old finish prior to bluing gun metal.**
6. **What must a gunsmith purchase to put a basic milling machine to practical use?**
7. **Name one other use for an oxyacetylene welding outfit besides welding and silver soldering.**
8. **A very handy item that is made from 2" x 4" lumber is called a _____.**

Measuring Tools

The basic measuring tools consist of a good machinist's scale, outside and inside calipers, and the hermaphrodite caliper. With only these simple tools an experienced gunsmith can take measurements to a surprisingly high degree of accuracy. This is accomplished by developing a sensitive "feel" for the instruments and by carefully setting the calipers so that they "split the line" graduated on the scale.

The accepted method for setting an outside caliper to a steel scale is shown in Figure 19. Note that the scale is held in the left hand with the caliper in the right. One leg of the caliper is held against the end of the scale and is supported by the little finger of the left hand while the adjustment is made with the thumb and first finger of the right hand.

When measuring the diameter of a cylinder, the outside caliper is held exactly at right angles to the centerline of the work and is pushed gently back and forth across the diameter of the cylinder to be measured. When the caliper is adjusted properly, it should easily slip over the shaft of its own weight. The caliper should never be forced or it will spring, causing any further measurements to be inaccurate.

Inside calipers are adjusted in a similar way, except that the steel scale should be placed against a flat surface at the end of the caliper. The other end of the caliper may then be adjusted to the required dimension to obtain the reading.

STEEL RULE

Most modern machinist's steel rules are made of tempered stainless steel with a satin chrome finish. Some of the types available are illustrated in Figure 21, on the next page.

On the same order as steel rules are steel scales. They are used mainly for measuring machine shop drawing—which are often drawn to either a reduced or enlarged scale than the actual object—many shop drawings are not drawn to actual size.

HERMAPHRODITE CALIPER

The hermaphrodite caliper shown in Figure 20, is set from the end of the scale exactly the same as the outside caliper. This instrument is used in layout work for locating and testing centers, laying off distances from an edge, and the like.

On round work, such as cylinders, centers are usually located with either the hermaphrodite caliper or the center head attachment for a steel scale. In centering square, hexagonal, and other regular-sided stock, lines are scribed across the ends from corner to corner, and then center-punched at the point of intersection.

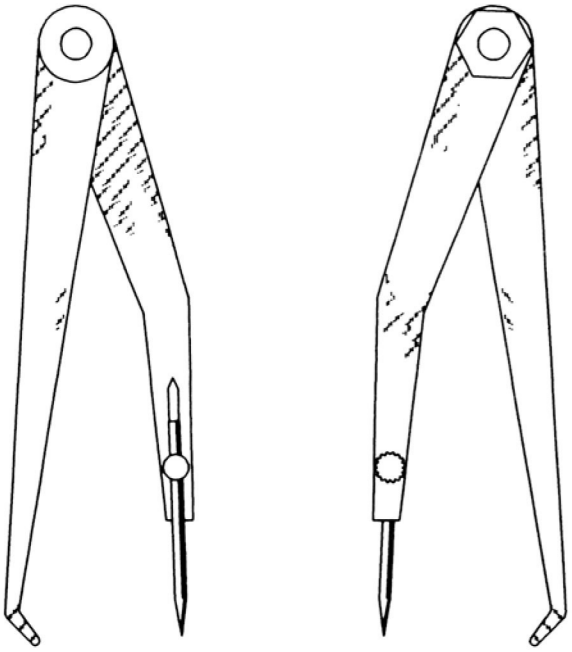


***Figure 20**: Hermaphrodite calipers.*

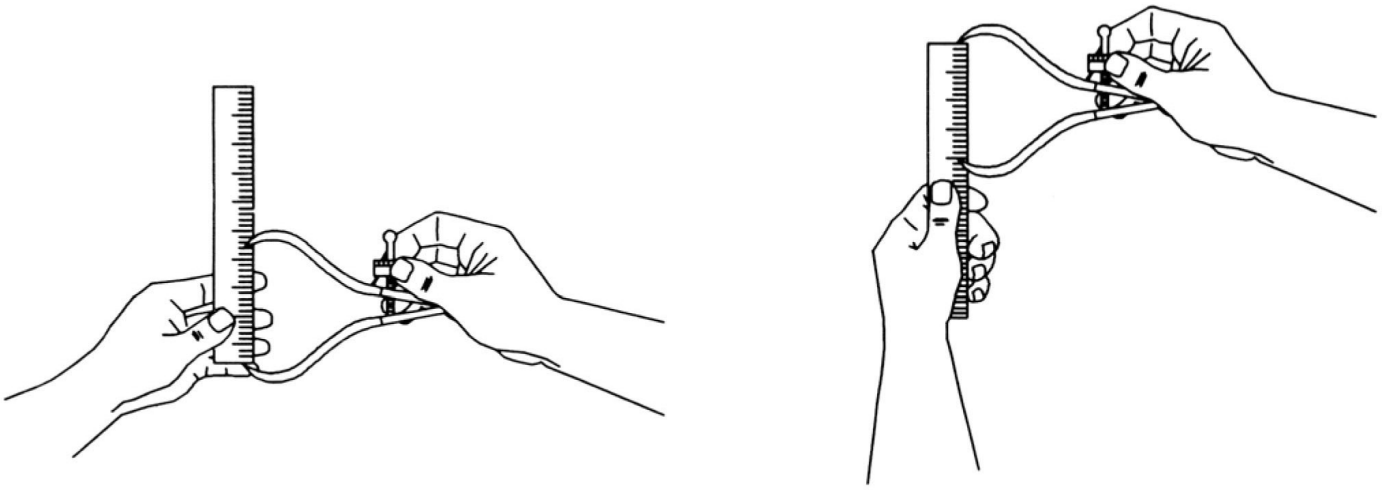


***Figure 19**: Method used for setting outside calipers to a steel scale.*

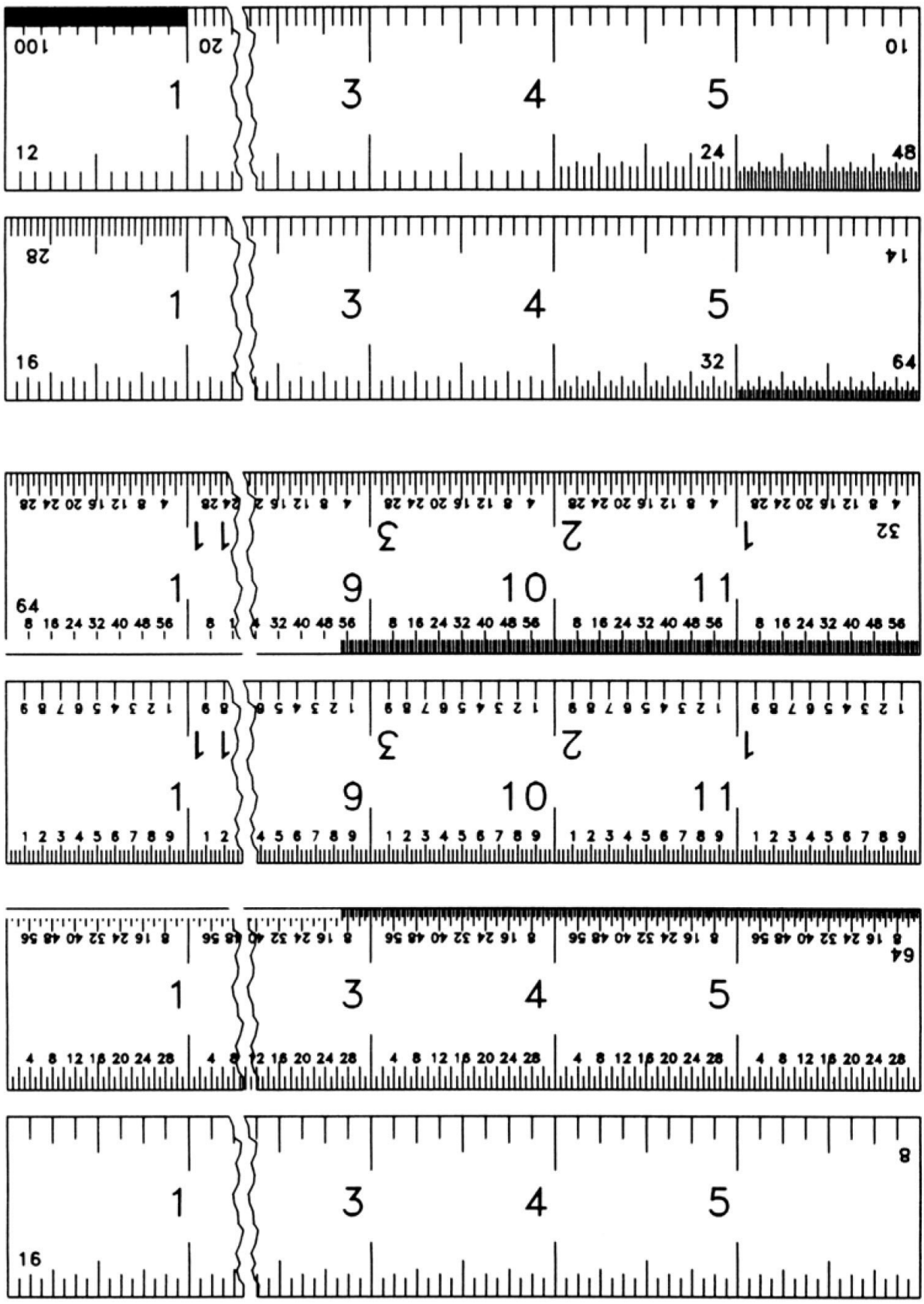


Figure 21: Several types of steel rules are available for use by the gunsmith.

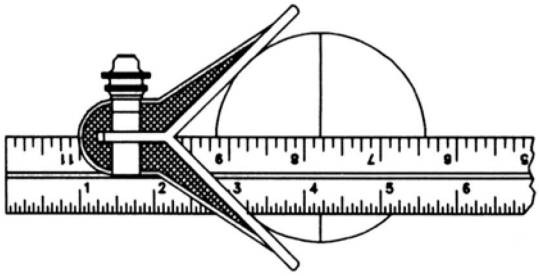


Figure 22: Setting the center head to obtain the center of a cirular object.

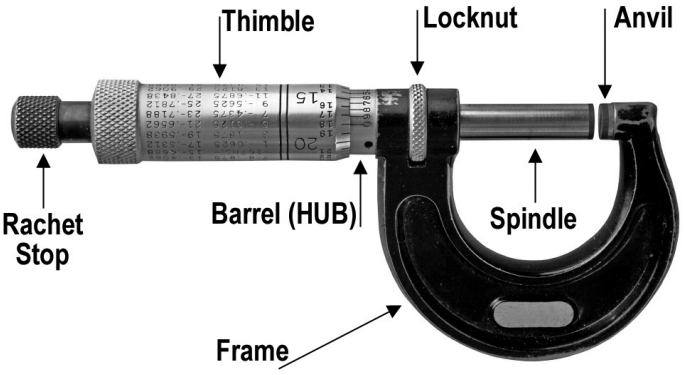


Figure 23: Vernier micrometer.

In using the hermaphrodite caliper, set the caliper to a little more than half the diameter of the work and trace four lines. Then hold the work in a vise and center- punch as accurately as possible in the center of these marks. A little chalk rubbed over the end of the work before scribing enables the marks to be easily seen.

When the center head is used with a scale, set the center head as shown in Figure 22 and trace two lines approximately at right angles. Use a sharp scriber and keep the lines as close to the edge of the scale as possible. Then hold the work in a vise and center punch at the intersection of the two lines.

MICROMETERS

Measurements made with a caliper and steel scale are usually not accurate enough for most gunsmithing operations. In such work, measurements must be taken in much finer detail than 1/64" (0.397 millimeter). For these measurements, more precise instruments are used, such as the micrometer, the dial indicator, and the vernier caliper.

One special form of caliper is called a *micrometer*, or *mike*. A typical micrometer is shown in Figure 23. The micrometer measures much more accurately than an ordinary caliper. In addition, the measurements can be read directly from the micrometer itself without the use of a separate ruler or steel scale. Instead of reading in fractions of an inch like many rulers, the micrometer measures in tenths, hundredths, thousandths, and sometimes ten-thousandths of an inch. That is, it uses the decimal system.

In the shop, the micrometer is usually called a mike, and measuring something with the mike is called miking. To use the micrometer to mike the diameter of a round shaft like a bullet or gun barrel.

Examine Figure 23 and identify the anvil, frame, spindle, hub, or barrel, and thimble of the outside micrometer. When you turn the thimble counterclockwise, the spindle moves away from the anvil, uncovering the markings on the hub and thimble. The measurement is read off the hub and thimble.

Note that the hub is marked off in uniform spacings of 0.025" (twenty-five thousandths of an inch) scale (Figure 24). The circumference of the thimble is marked off into 25 graduations. Each graduation represents 0.001" (one thousandth of an inch).

To make a measurement with a micrometer, the thimble is turned until the piece being measured is a light-drag fit between the anvil and the end of the spindle. Then, the measurement is read off the barrel and thimble. The barrel markings each indicate 0.025". Four of them make 0.1". If three of the figures are visible, as shown at the top of Figure 25, then the thimble will have uncovered 12 markings and the measurement will be at least 0.300".

Notice we said "at least." Noting the figures on the barrel is only the first step in reading the measurement. The second step is to notice exactly where the markings on the thimble stand with regard to the line on the barrel.

For instance, at the top in Figure 24, the thimble has been turned so that marking-number 4 lines up with the barrel line. This means that the thimble has been turned 0.004" past the 0.30" marks. Each thimble marking is equal to 0.001". The actual measurement being shown at the top is 0.304" (0.300 + 0.004).

Now, look at the middle and the bottom of Figure 25. In the middle, the thimble has been turned 4 thimble marking past the ninth barrel markings. The barrel markings indicate 0.225". The thimble marking, indicating 0.004", must be added to give an actual measurement of 0.229". As you can see, to get a reading on the mike, first note how many barrel markings have been exposed as the thimble is backed off. Each barrel marking represents 0.025". Then, notice the thimble marking aligned with the barrel line. Each thimble marking represents 0.001". Add the two to get the total. Now, notice the bottom measurement in Figure 25. Here the thimble has been turned to uncover only eight barrel markings so that the reading is 0.200". But the thimble has been turned until it is marking 24 lines with the barrel line. This figure is thus 0.024", and the total measurement is therefore 0.224" (0.200 + 0.024).

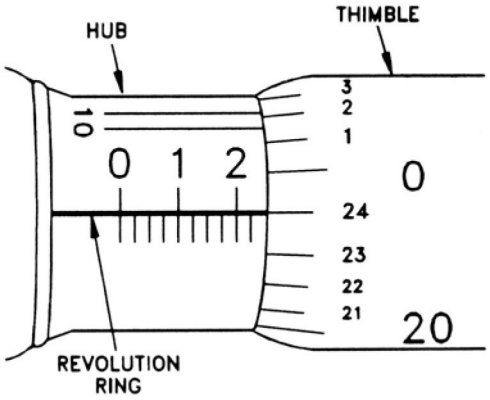


Figure 24: Hub and thimble markings on a micrometer.

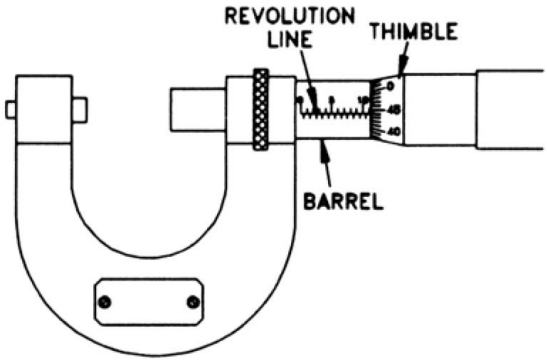


Figure 26: Simplified metric micrometer.

The metric micrometer, shown in Figure 26, reads in millimeters (mm) and hundredths of a millimeter (0.01). The barrel is marked off in millimeters above the line and half millimeters (0.50 mm) below the line. The thimble is divided into divisions of 0.01 mm. To read the measurement shown on the micrometer in Figure 26, add the reading on the barrel, 11 mm, to the reading on the thimble, 0.45 mm. The total measurement is 11.45 mm. As you can see, reading a metric micrometer is probably easier than reading a mike marked in inches. The micrometer has very precisely cut screw threads in it, and rough treatment will ruin it.

The micrometer should not be thrown about carelessly on the work bench. It should be kept in a special drawer or container where it is protected from dirt and the danger of other tools being dropped on top of it. It should be wiped clean after every use. Never clamp the micrometer on the piece being measured. The thimble should be tightened only enough to cause the micrometer to drag slightly as it slides over the piece. Clamping will distort the threads and frame and could ruin the micrometer.

Never try to measure a piece being turned in a lathe with the piece revolving. The micrometer might tighten on the piece and be torn out of your hand. This could ruin the work and the micrometer, and you could be injured.

Many variations of the micrometer are used in shop work. For example, there are inside micrometers for measuring hole diameters. In addition, much of the precision power machinery in the shop has micrometer adjustments. Tools such as milling

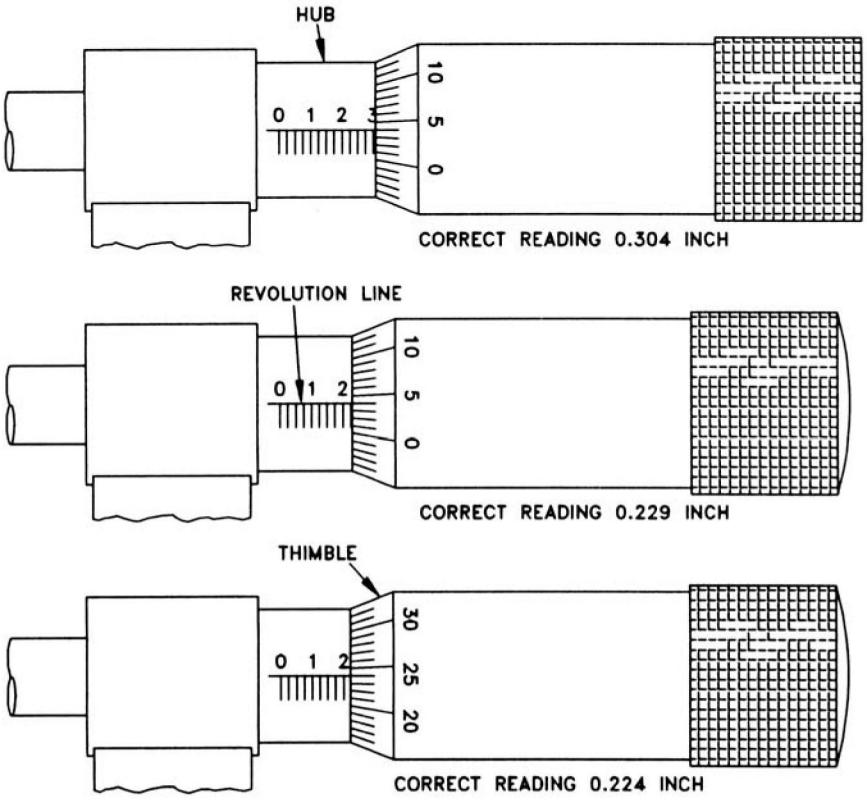


Figure 25: Reading a micrometer.

machines, lathes, and tool-post grinders have micrometer adjustments so that the machining operations can be carefully controlled.

Inside micrometers are used to measure hole diameters, such as the diameter, or bore, of a shotgun barrel. A depth micrometer is frequently used when rebarreling a rifle to check the distance precisely from the action shoulders to the face of the bolt.

DIAL INDICATOR

The dial indicator is a gauge that uses a dial face and a needle to register measurements. A typical dial indicator is shown in Figure 27. The dial indicator has a movable contact arm. When the arm is moved, the needle rotates on the dial face to show movements in thousandths of an inch.

The dial indicator is used mainly in the gunshop to measure end play on gun barrels when turning and threading for rebarreling jobs. When the barrel is chucked in the lathe, the dial indicator is set in a position so that the plunger comes into contact with the inside of the chamber. The lathe's headstock is then turned by hand (not power) and the movement of the dial indicator's pointer is noted. Adjustments are made to the barrel until the barrel rotates within the accepted tolerance, which will ensure "true" chamber and barrel threads.

VERNIER CALIPER

The main disadvantage of using ordinary calipers, such as we discussed earlier, is that they do not give a direct reading of the measurement taken. To find the actual measurement, the setting of the caliper must be measured with a steel scale or rule.

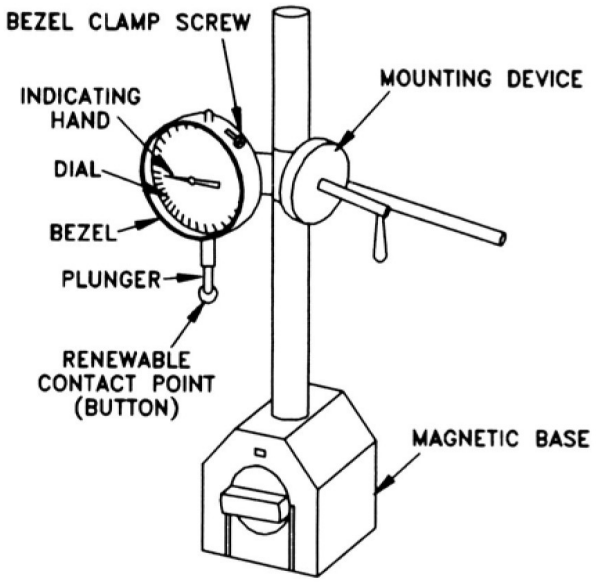


Figure 27: A dial indicator.

In 1631, Pierre Vernier, a French mathematician, invented an accurate, direct-reading scale used in making linear measurements. When Vernier's scale was combined with an ordinary caliper, the result was a measuring instrument called a vernier caliper. Basically, the vernier caliper is made of two graduated steel rules, such as the one shown in Figure 28, on the next page. One rule is fixed and is called the fixed rule or frame. The fixed rule is attached to one end of the frame. The second rule

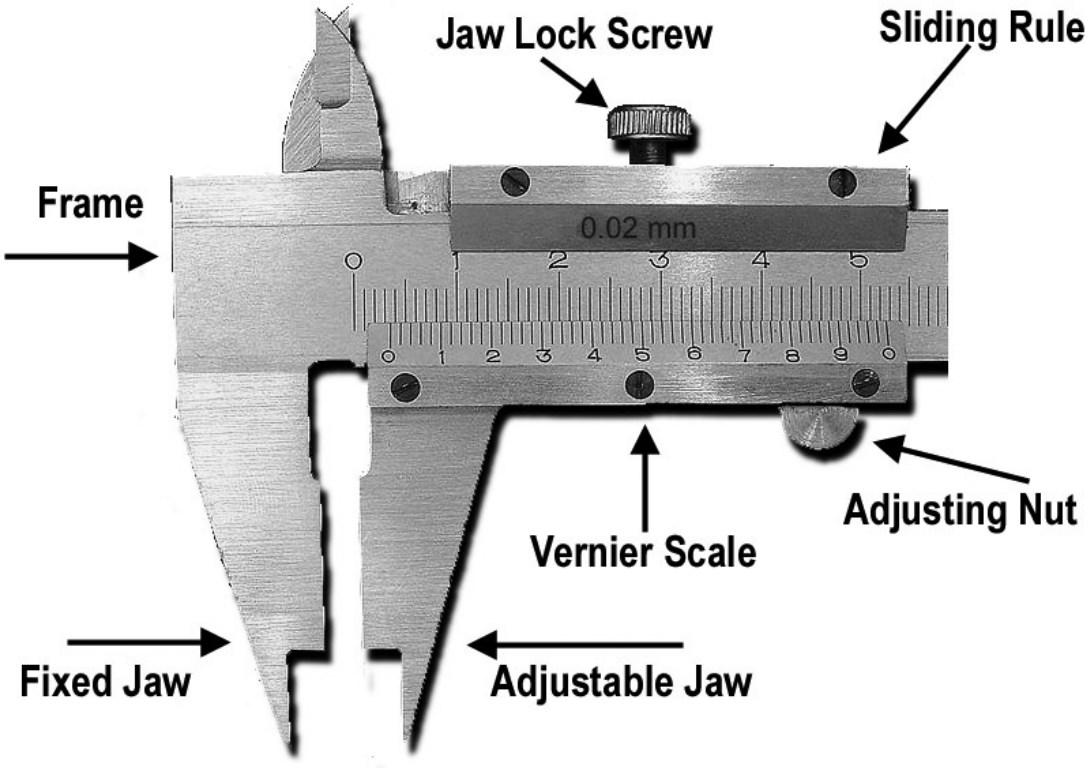


Figure 28: A vernier caliper.

is movable and slides along the frame. One end of the sliding rule has the other measuring jaw attached. This jaw is called the adjustable, or sliding, jaw.

To measure an outside diameter with a vernier caliper, place the object snugly between the jaws of the caliper. Figure 29 shows a vernier caliper measuring an inside diameter. Some vernier calipers have slightly different scales on one side to be used for reading inside diameters. Other vernier calipers have different 0 marks to be used when reading inside diameters.

Figure 30 shows a simplified metric vernier caliper that can be used for practice. On this caliper, the fixed scale is divided into 1 mm sections. The movable vernier scale is divided into 10 lines, each representing of a millimeter (0.10 mm). To read the metric vernier caliper, count the number of millimeters on the fixed scale that precede the vernier scale 0. Then, look at the vernier scale until a line is located that coincides exactly with a line on the fixed scale. Count each line on the vernier scale from 0 to the point where the two lines coincide. Since each line is 0.10 of a millimeter, be sure to count by tens. This is the decimal portion of the reading, which must be added to the first reading to obtain the complete measurement.

Micrometers and calipers are available in many different types. Besides the ultra-accurate conventional measuring instruments, many professionals are using the electronic types that offer the advantage of direct reading of each measurement, plus an automatic conversion button to change from English to metrics. One such instrument is the Fowler Ultra-Cal electronic caliper shown in Figure 31. This instrument 21 reads to .0005 in or .01 mm easily, even in the dim light, which ensures accuracy. The inch/metric reading feature permits immediate change to the standard preferred by the user. The floating zero feature allows one to zero instantly at any position, permitting the reading of deviations from the nominal size without performing any math.

Headspace gauges (Figure 32) are highly specialized gauging units designed to be used as sets consisting of two precision ground chamber buttons which utilize the "go, no-go" tolerance principle. A less common third gauge, designated as a

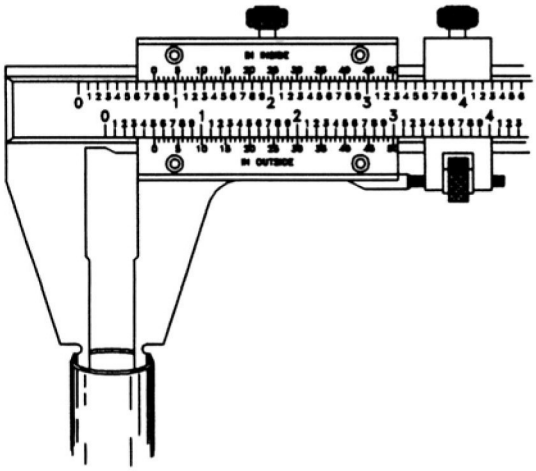


***Figure 29**: Using vernier caliper to measure an inside diameter.*

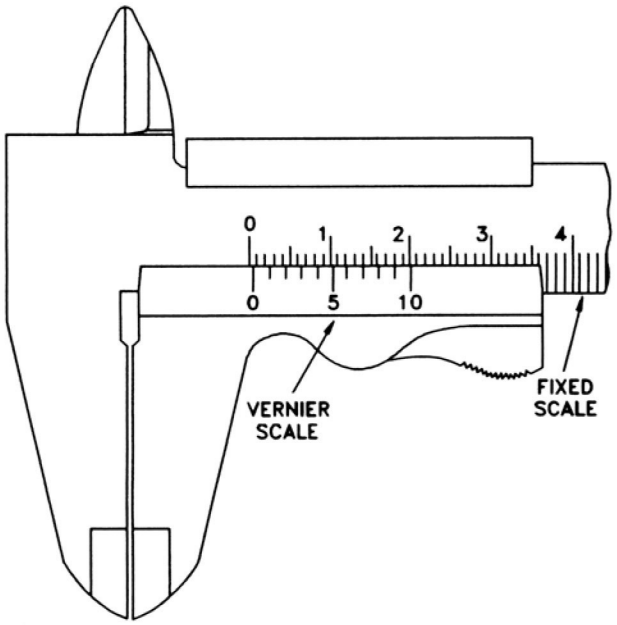


***Figure 30**: A simplified metric vernier caliper.*

"field" gauge sometimes supplements this set. This additional gauging reference was employed as a military rating denoting a chamber exceeding the "no go" dimension tolerance but was still considered to be within safety limits.

Thickness, or feeler, gauges offer the gunsmith a method to measure a very small gap accurately between two parts such as between the barrel and receiver of break-open single-shot shotguns. The easiest way of doing this is by inserting a slip of metal that is just the right size and then determining the thickness of the slip. In practice, a number of blades of different thicknesses are assembled together in a convenient holder as shown in Figure 33.

The thicknesses of blades in common use range from .0015"—.025", but it is not necessary to have a gauge with every intermediate size for ordinary work in the gunshop. The usual pattern has a number of blades which can be arranged in combinations to give all the desired sizes. For example, a blade .003" and another .002" can be used in combination to form a .005" measurement. Any number of combinations are possible with the thickness gauge, but it is always advisable to use a minimum number of blades in a combination to reduce the possibility of error due to imperfect contact between the blade faces. There are numerous applications for the feeler gauges in the gunshop. Take the single-shot shotgun as mentioned previously. Thousands of break-open single-shot shotguns are constantly being used throughout the world, and have been since before the turn of the century. Many of these have developed headspace problems which can be dangerous to the shooter. The experienced gunsmith will merely hold these guns up to a light source, with the action closed, and if daylight can be seen between the barrel and receiver, a headspace problem exists. However, to determine exactly how much the thickness gauge is very useful. When the headspace problem is not too severe, it can be corrected by peening the inside curvature of the

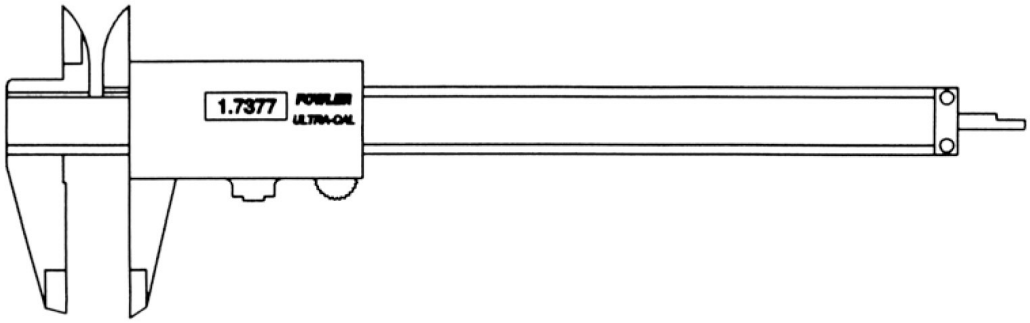


Figure 31: Electronic caliper.

barrel lug with a center punch, as mentioned previously. The raised metal craters will cause the barrel to close tighter with the standing breech. However, this corrective action should be considered temporary at best.

Screw-pitch gauges have multiple leaves secured in a holder very similar to that on a set of feeler gauges. Each leaf or blade has several teeth, which are accurately shaped to the profile of a standard thread form as illustrated in Figure 34. A particular gauge is applicable only to threads of the form for which it is designed, American standard, Whitworth, or another standard type. The leaves of the gauge are made to suit the pitches of any screw thread, and it should be noted that the diameter of the screw has no connection with the application of the gauge.

Each blade is stamped with the number of threads per inch which it represents and also, in some makes, with double depth of thread expressed in thousandths of an inch or metric designations. This gauge can be extremely useful in the gunshop.

To determine the pitch of a thread with the aid of this gauge, the threads should be cleaned, and then the teeth of the gauge should be tried against them until a blade is found that matches exactly. It is advisable to hold the screw up to a light so that very small gaps between the thread and the gauge teeth can be seen. A mistake can be made if you are not careful, because, on fine threads particularly, a gauge one size more or less than the screw thread is only very slightly different. But, that slightly different screw can result in a damaged and dangerous firearm that is improperly assembled.

SELF-TEST QUESTIONS

Please check your answers on page 23.

9. *True or False.* **Another name for the feeler gauge is the gauge.**
10. **Headspace gauges are commonly found in three sizes: _____, _____, and _____.**
11. **What is the name of the Frenchman who invented the direct-reading scale for measuring instruments?**
12. **What measuring instrument is used to "mike" an object such as the diameter of a bullet?**

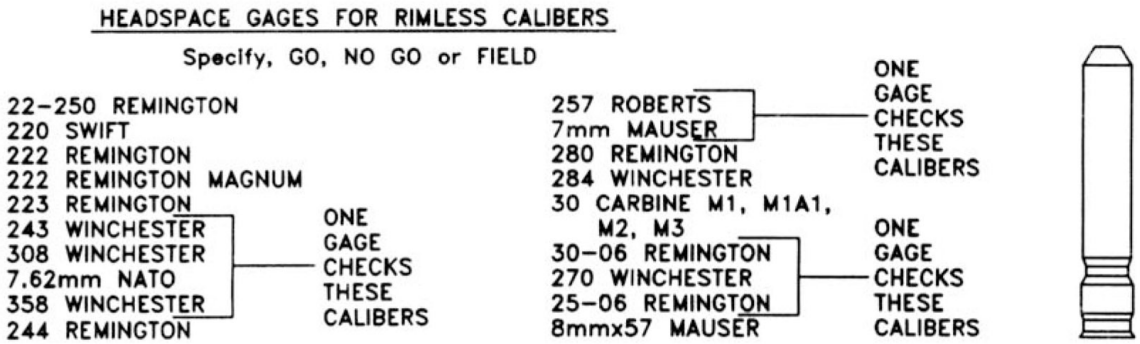


Figure 32: Headspace gauge.



Figure 33: Thickness gauge

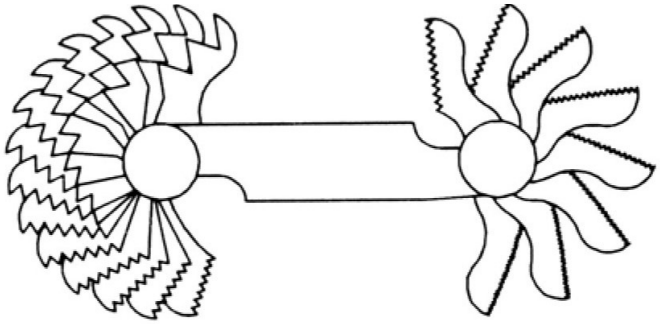


Figure 34: Screw-pitch gauge

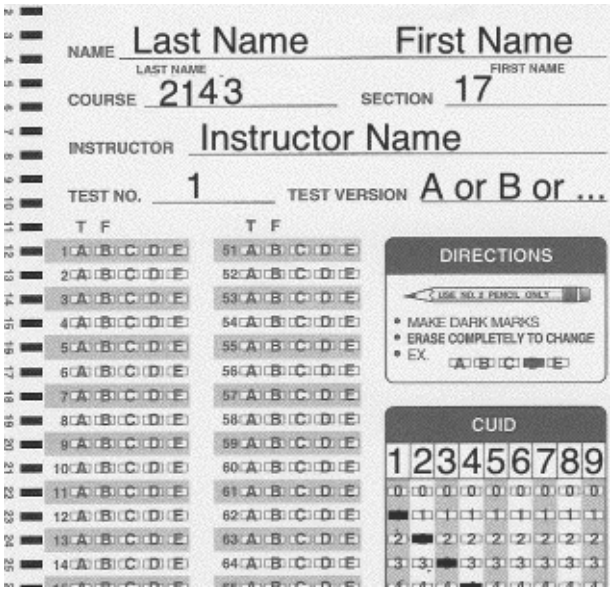
Answers to Self-Test Questions

1. Ball-peen, straight-peen, and cross-peen
2. India and Arkansas
3. To prevent unwanted filing or damage to surfaces adjacent to the area being filed.
4. Flared-tip pins, rolled pins, common steel pins, and split pins
5. True
6. Several types of mill cutters
7. Heating military bolts for bending to accept scope mounts
8. Bench block
9. Thickness gauge
10. Go, no go, and field
11. Pierre Vernier
12. Micrometer

THIS IS LESSON NUMBER 2167.

Make sure you print your name, student number, and lesson number in the space provided on the Lesson Answer Form. Be sure to fill in the circles beneath your student number. Code the lesson number as shown.

REMINDER: A properly completed Lesson Answer Form allows us to evaluate your answers and send the results and additional study material to you. Do not hold your Lesson Answer Forms to send several at one time. You may run out of study material if you do not send your answers for evaluation promptly. You may also complete your exams and submit them online via the SDI Student Services page at www.sonoranlearning.com.



Lesson Questions

1. **The type of screwdriver best suited for gunsmithing work is**
   a. A double-wedge type.
   b. A screwdriver with hollow-ground tips ground to exactly fit the screw slot.
   c. A triple-wedge type.

2. **One method that can be used to loosen a tight screw is to**
   a. Tap the screwdriver a few times while the blade is in the screw slot.
   b. Use Lock-Tite compound on the threads.
   c. Use compressed air.
   d. Heat the screw.

3. **One way to tighten a loose break-open, single-shot shotgun action is to**
   a. File the barrel lug.
   b. Polish the barrel lug.
   c. Peen the barrel lug.
   d. Tighten the barrel lug with a wrench.

4. **The Versa-Vise is designed to rotate a full**
   a. 90°.
   b. 180°.
   c. 270°.
   d. 360°.

5. **The tools used to withdraw items from a heat-treating furnace are called**
   a. Tongs.
   b. Gibs.
   c. Tibs.
   d. Tombs.

6. **When measuring an object with a micrometer, the micrometer threads should be tightened**
   a. As far as possible with the hand.
   b. Only until a slight amount of resistance can be felt.
   c. With a wrench to obtain an exact measurement.
   d. Until resistance is felt and then backed off 1/4 turn.

7. **Which of the following tools may be used to find the center of a cylinder?**
   a. Hermaphrodite caliper.
   b. Vernier caliper.
   c. Vernier micrometer.
   d. Compass.

8. **One use of the dial indicator in gunsmithing work is to**
   a. Read the velocity of a bullet.
   b. True the barrels when secured in a lathe chuck.
   c. Measure the chamber pressure of a fired cartridge.
   d. Gauge the caliber of a gun.

9. **The headspace gauges most used in gunshops are the**
   a. Go and no-go gauges.
   b. Go and field gauges.
   c. No-go and field gauges.
   d. Field and benchrest gauges.

10. **One type of gauge that may be used to check the space from a shotgun's standing breech to the barrel/chamber face is a**
   a. Thickness gauge.
   b. Screw-pitch gauge.
   c. Depth micrometer.
   d. Vernier caliper.

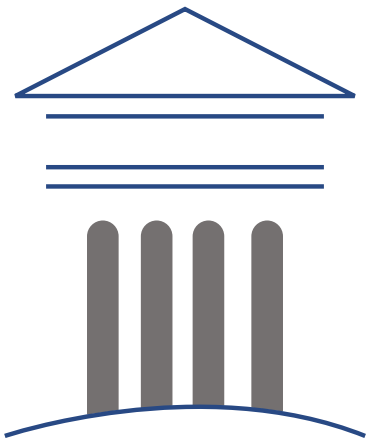
Firearms Identification
Lesson: 2168

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Objectives

After completing this lesson, you should know

1. How many Winchesters were made with the "1 of 1000" marking.
2. What year the U.S. government stopped using flintlocks.
3. Where proof marks are found on side-by-side, European-made shotguns.
4. How to use Cerrosafe.

Introduction

Before a fair trade can be made with a used gun, at least one of the parties involved and preferably both must be able to identify the firearm and its variations. For example, suppose a customer walks into your shop with a Colt Government Model 19ll Al pistol in excellent condition and wants to sell it for $850. You have seen similar pistols in the same condition offered for $250, so you do not purchase it. If you looked closer, you would have seen that the pistol was manufactured by Singer, one of the manufacturers licensed by Colt during World War II. This particular model is rare, and is worth about $3,000. If you had identified the pistol correctly, you would have had a good deal at $850.

Let us take another example. Suppose you have a chance to buy a Winchester Model 1873 in .44-40 in very good condition. You quickly determine that this is a high-quality model made with walnut, checkered stock, and some minor engraving on the metal. You check your pricing guides and find that the retail value of this gun is around $3,000. Since a model of this high quality will probably not move as quickly as a standard gun, you figure that you must discount the gun 40 percent. You multiply the retail price of $3,000 by. 60 and come up with $1,800. You offer the seller this amount. However, the seller holds out for $4,000; you refuse.



Figure 1: This is one of the ways that a "1 of 1000" Winchester was identified. The markings appeared at the top of the barrel, immediately in front of the receiver. Also look for "1 of 100", another rarity.

Again, if you had closely inspected the top of the barrel, you may have seen the inscription "One of One Thousand," as shown in Figure 1, or simply "1 of 1000." Furthermore, if you had researched the rifle, you would have found that this was a "1 of 1000" Winchester Model 1873, of which only 136 were produced. This rifle was manufactured with special care to guarantee better accuracy. Due to the rarity of this model, it is one of the most desirable collector Winchesters and now demands a price of $50,000 or more for specimens in very good condition, although the rifle originally sold for only $100.

Sources of Information

The purpose of this lesson is not to identify every firearm that has been manufactured, but rather help you categorize various firearms so that you may more easily identify them. You will also learn where to look for reference material when you encounter a very rare model. Remember, this lesson is to help you identify firearms. Future lessons will instruct you on pricing and trading. Old gun catalogs are one of the best sources of information for identifying old guns, and every serious dealer in used guns should purchase any old catalogs he or she can find. Original catalogs can be expensive, but there are many reprints on the market at reasonable prices that will work just as well to help you identify firearms. One source for these old catalogs is INFO-ARM, PO. Box 1262, Champlain, NY 12919-1262. Write for their current price list of old catalogs that are available. You do not have to buy all of them at one time; simply buying one or two every week or so will start your collection. Eventually, you will have an excellent library of old catalogs that will help you identify the majority of obsolete firearms that you will encounter. Collecting old gun catalogs is a hobby in itself and a fine way to educate yourself as a serious gun dealer or collector.

Researchers, historians, and firearm experts have compiled numerous helpful reference books describing firearms of the past. All of these are worthwhile, and you should obtain all you can afford. Since these books can be expensive, from $10 to $75 or more, you should first look for them at your local library. If, after examining a book, you feel you must have it in your personal library for daily reference, then is the time to buy it. Otherwise, you could easily spend thousands of dollars on reference books that you will seldom need.

GENERAL CHARACTERISTICS OF TYPICAL FIREARMS

The matchlock, shown in Figure 2, was one of the first practical firearm locks and consisted of a semicircular—shaped piece of metal pivoted to the side of the gun. At the end opposite the pivot was a slow match, designed to hold a cord that was treated with saltpeter to make it burn slowly. The holder gripped the tip of this cord at one end of a C-shaped piece of metal. The shooter pushed the cord to contact the priming powder, which fired the weapon.

Around the year 1500, the matchlock was greatly improved with the invention of the serpentine match holder, which was a piece of metal bent to resemble an "S". The bottom portion of the S initially became the trigger; a short time later a sear was added, allowing the shooter to pull back the matchlock and hold it, preventing firing until the shooter was ready. This led to the introduction of gun sights, and aim became more accurate.

Rifling was also introduced about the same time, along with efforts to make a multi-shot gun. Some firearms featured revolving cylinders similar to the revolvers in use today, while others employed multi-load barrels as well as double, triple, and other combinations of barrels. However, all of these inventions suffered from lack of a good ignition system.

The wheel lock came next. This ignition system operated in much the same way that our modern cigarette lighters work. A serrated steel wheel rotated against a flint which threw sparks down into a priming pan to ignite the charge in the barrel. To fire the wheel lock, the shooter wound a heavy spring to the "ready" position. The shooter then aimed the arm and pulled the trigger. That started the wheel spinning and throwing sparks in all directions.

In the mid-1500s, the snaphaunce lock evolved. This lock consisted of a hammer that held a piece of flint, just like the

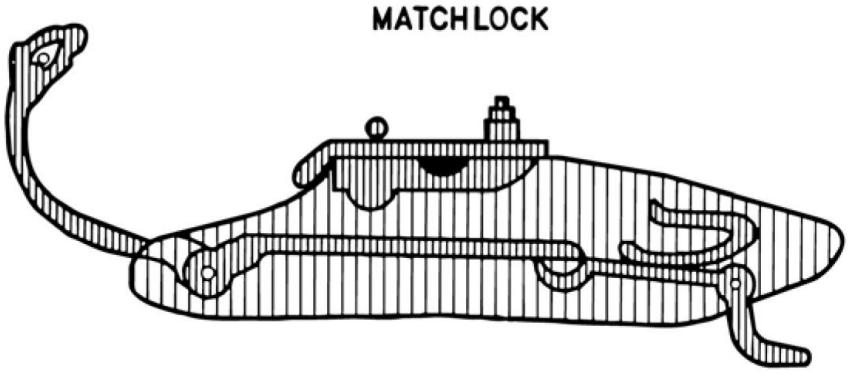


Figure 2. The matchlock was one of the first practical gun ignition systems.

flintlocks of nearly 100 years later. When the hammer was released by the trigger, it fell forward and struck near the touch hole, causing sparks to fly and enter the priming pan, igniting the charge and discharging the firearm, similar to the later flintlocks. In fact, the development of the snaphaunce led to the flintlocks that were used until the Civil War.

During the early 1600s, the flintlock system was developed (Figure 3). It was basically a snaphaunce with the addition of an angled steel plate that covered the priming pan by use of a hinge at either the front or the back. As the hammer was released, it struck the angled surface of this hinged plate called a "battery." The striking of the hammer containing flint against the battery threw back the cover, exposing the priming powder contained in the pan. It also showered sparks into the priming powder to fire the weapon. The flintlock was used by the U.S. military in both rifles and pistols until 1842.

During this same period, paper cartridges were developed and breechloading firearms were put to practical use, although sparingly. The Hall rifle, shown in Figure 4, was the first breechloader adopted by the U.S. government. It was a flintlock with a tip-up action. Upon releasing a lever, the front end of the breech section tipped up, loaded, and pushed back down into alignment with the barrel. The U.S. Army 4 model was .52 caliber and was used in the Seminole War in Florida.

The Jenks rifle, shown in Figure 5, was invented by William Jenks in 1838. It was the forerunner of the Merrill rifle and was used in Florida in 1841 by U.S. troops. The hammer, which operated horizontally, was its most outstanding feature.

The Greene rifle was the first bolt-action gun used by U.S. troops. It was used in the late 1850s. The bolt handle was in the rear and was released by pressing down a spring catch on the tang. It was a percussion arm and had the nipple underneath with a ring-shaped hammer. The .535 cartridge had the bullet

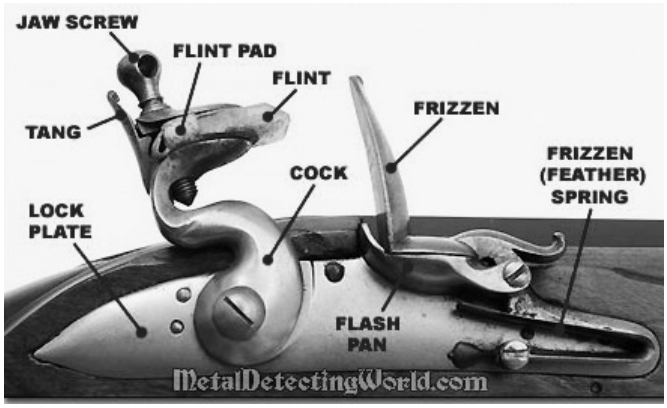


***Figure 3**. The flintlock system was used by the U.S. government until 1842.*

in the rear, so there were always two bullets in the gun when it was loaded; the rear bullet acted as a gas check. About 900 of these rifles were used in the Civil War. Breechloaders that followed included the Sharps and Hankins rifle, the Ballard rifle, and the Merrill alteration of the Model 1861 Springfield rifled musket. No less than a dozen other experimental breechloaders and variations were used up to the turn of the century. The most popular of these were the Trapdoor Springfields, in .50-70 and .45-70 calibers.

Repeating U.S. handguns followed the same general pattern as the rifles, except they were used more extensively by officers. Figure 6 shows most of the pistols and revolvers used by the U.S. government, from the Rappahannock Forge flintlock pistol to the Model 1917 Colt double-action revolver.

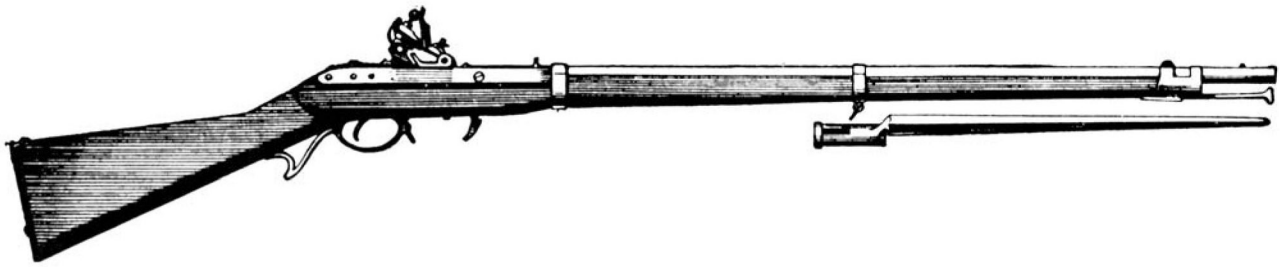


***Figure 4**. The Hall rifle was the first breeachloader used by the U.S. government.*

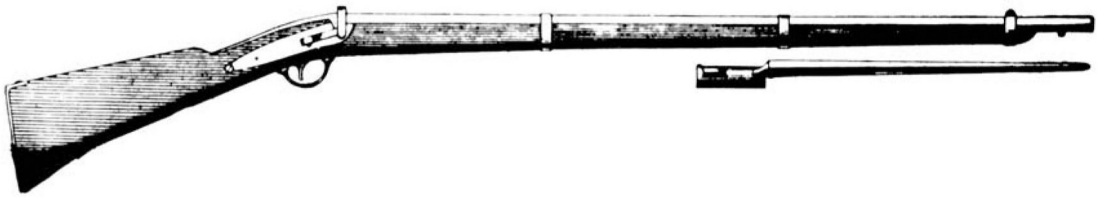


***Figure 5**. The Jenks rifle, invented by William Jenks in 1838, had a hammer that operated horizontally.*

US PISTOLS
FLINTSTOCK, PERCUSSION AND CARTRIDGE TYPES

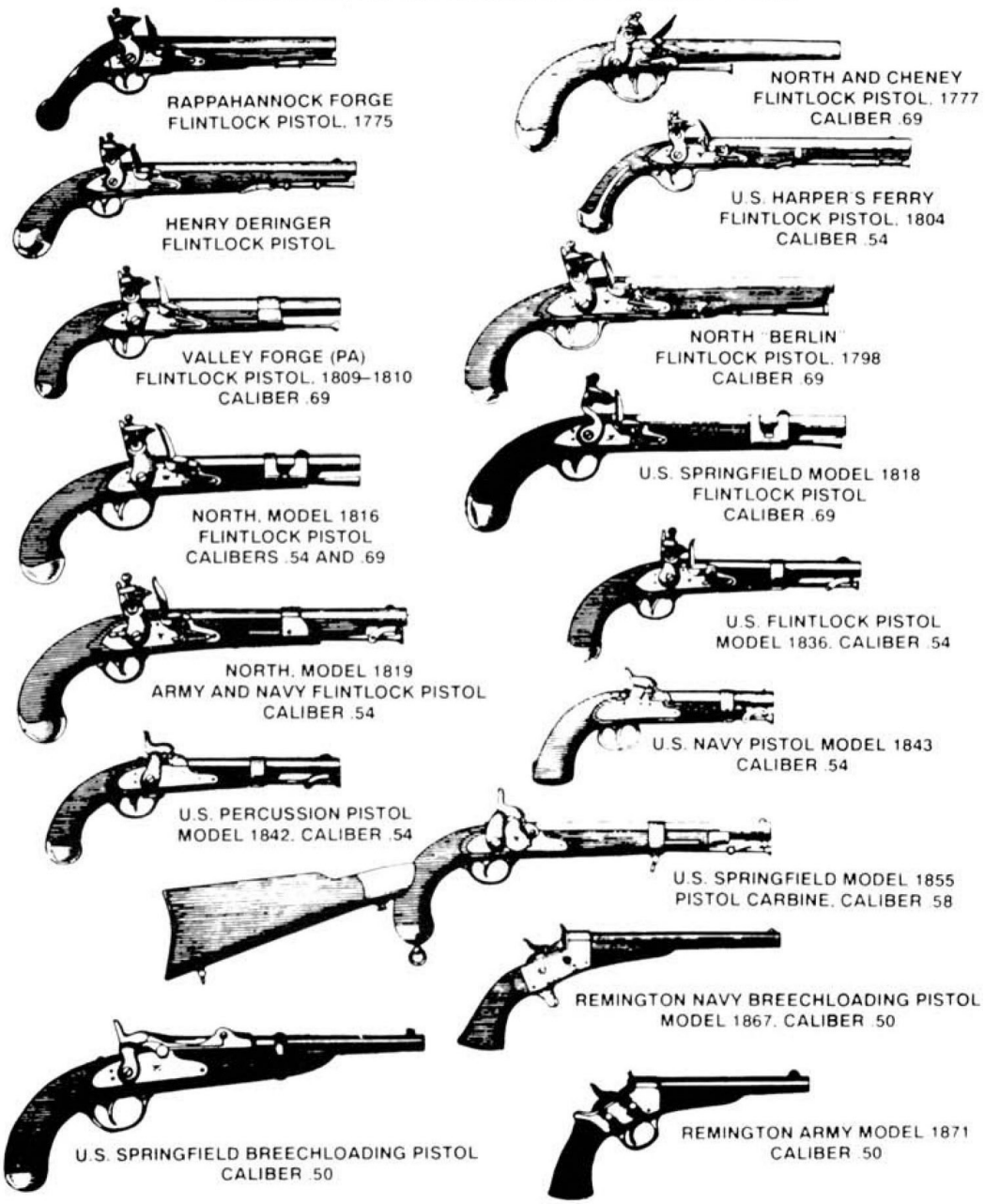


Figure 6. *Representative samples of pistols and revolvers used by the U.S. government, from the earliest flintstock pistols (this page) to the Colt Model 1917 double-action revolver (following pages).*

REVOLVERS USED BY THE U.S. GOVERNMENT

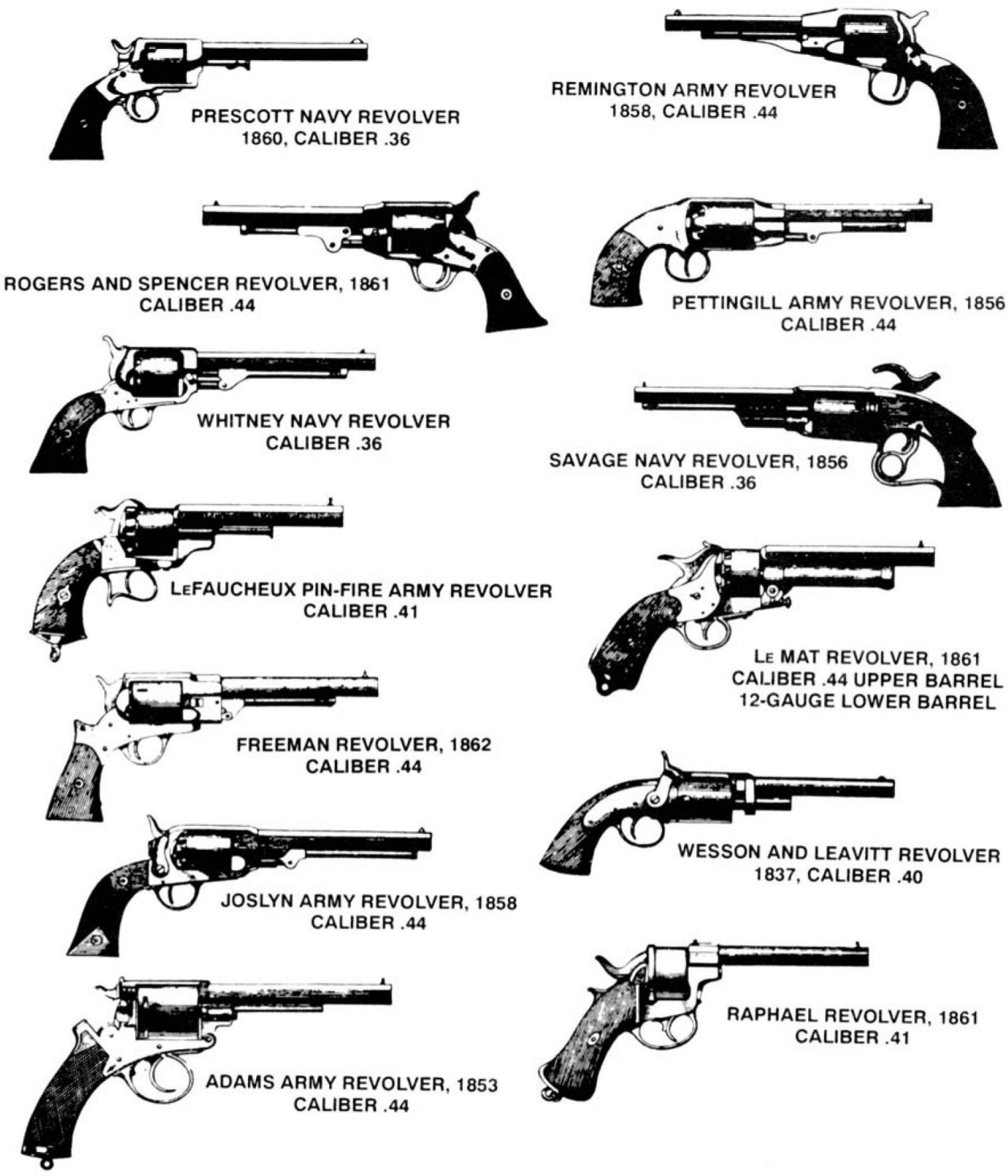


Figure 6 (continued). *Pistols and revolvers used by the U.S. government, from the earliest flintstock pistols*

REVOLVERS USED BY THE U.S. GOVERNMENT

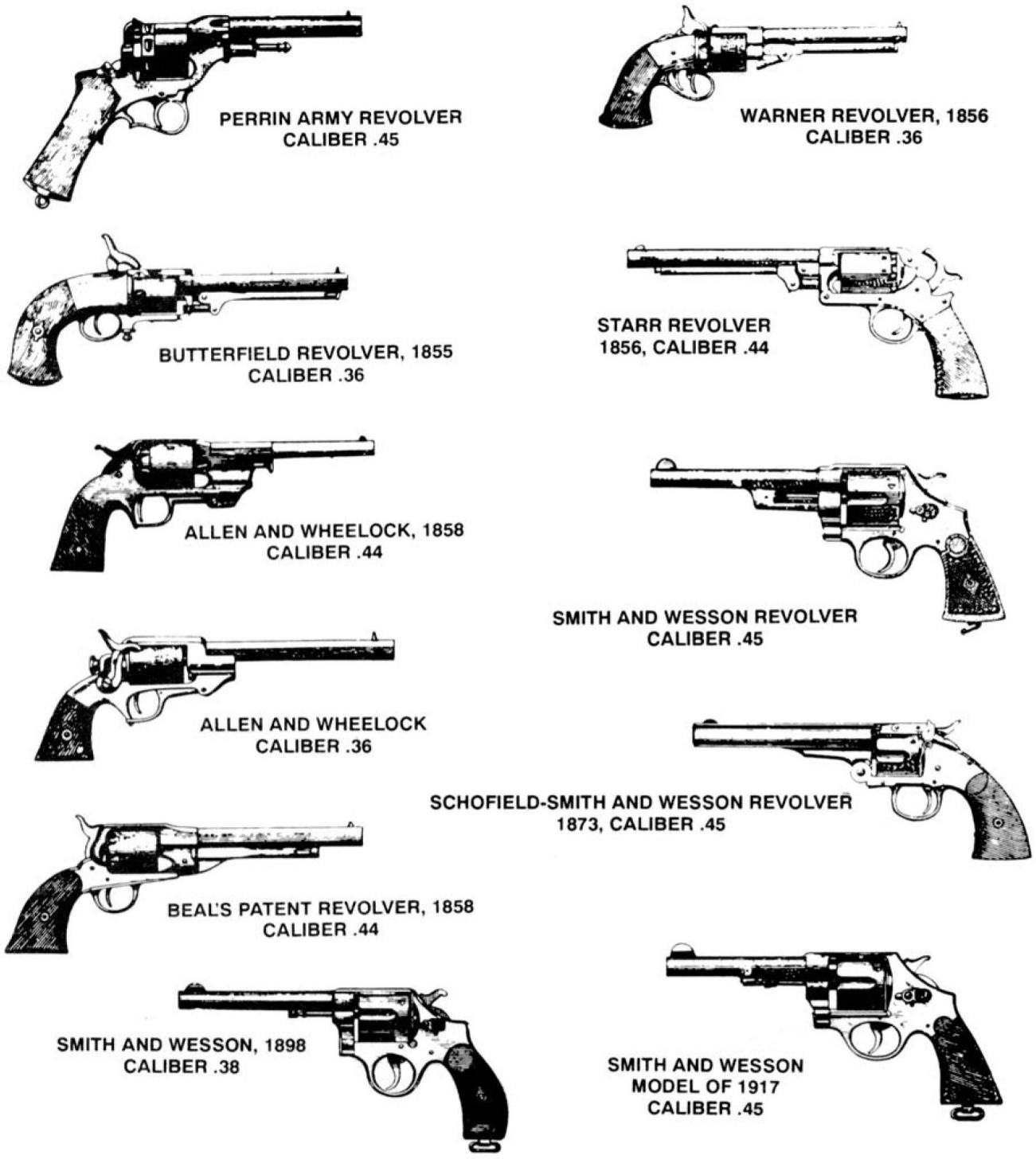


Figure 6 (continued). *Pistols and revolvers used by the U.S. government, from the earliest flintstock pistols*

COLT HANDGUNS

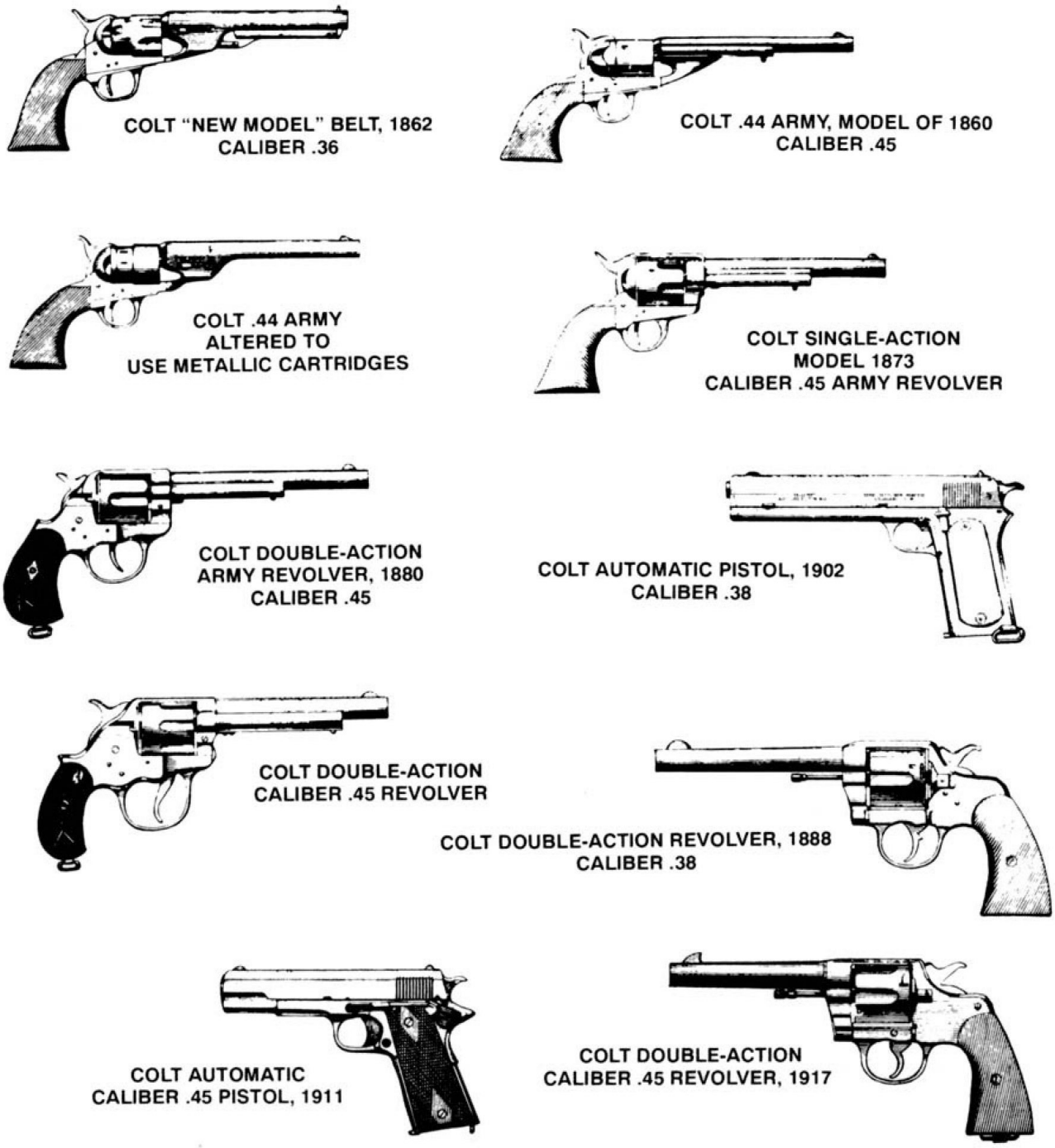


Figure 6 (continued). *Pistols and revolvers used by the U.S. government, from the earliest flintstock pistols*

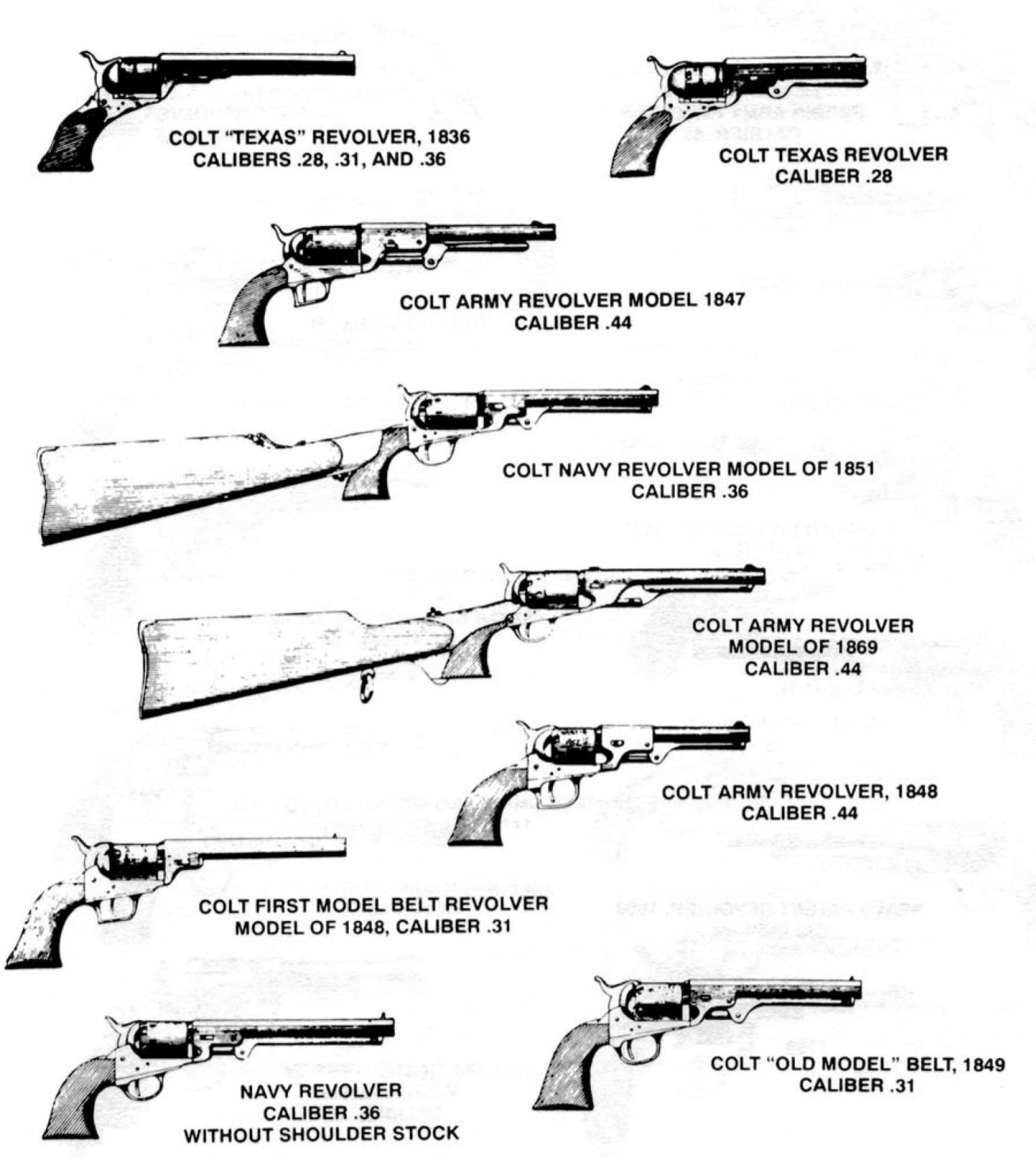


Figure 6 (continued). *Pistols and revolvers used by the U.S. government, from the earliest flintstock pistols*

SHOTGUNS

The shotgun evolved from a need to improve the accuracy of early firearms, which needed multi-load balls to hit a target. Small shot was invented about 1750 — the same time that single- and double-barreled shotguns were made in England. They were all matchlock muzzleloaders. By 1850, single-and double- barreled shotguns were commonplace in the United States. Most were percussion-primed muzzleloaders or side-locks with exposed hammers. By 1860, a number of breech-loading shotguns, using pinfire and centerfire cartridges, were on the market.

Basically, two types of actions were used in early double-barreled shotguns: the box lock and the sidelock. Both are still in use today. The famous L. C. Smith firearms are the only American-made firearms that utilized the sidelock. The box lock was usually less expensive to manufacture and proved to be strong and reliable.

The first successful American repeating shotgun was the Winchester Model 1887, a lever- action black powder repeating shotgun available in 10 and 12 gauges. This model was later updated for smokeless powder around the turn of the century and called the Model 1901. Neither version of this lever-action ever gained much popularity because the slide-action shotguns were slimmer and faster to operate. The Winchester Model 1893 and the Marlin Model 1898 were popular among those hunters who preferred repeaters over the traditional side-by-side doubles. Double-barreled shotguns were still the most popular arms far into the twentieth century, mainly because the repeaters were heavier than the doubles and did not point very well.

To give characteristics of every gun manufactured from 1450 to date would take several volumes, but we have touched on the subject here to give the feel of the general types of guns. Most of the firearms manufactured since 1900 are listed in *Gun Trader's Guide* published by Stoeger Publishing Company. Many firearms manufactured prior to 1900 are listed in *Antique Guns —The Collector's Guide*, also published by Stoeger Publishing Company. Anyone interested in identifying obsolete firearms should have copies of both guides.

SELF-TEST QUESTIONS

Please check your answers on page 17.

1. ***True or False.*** **Old gun catalogs should never be referred to when trying to identify a firearm; only the latest up-to-date catalogs should be used.**
2. **What is the name of the first practical firearm lock?**
3. ***True or False.*** **The flintlock was used only for rifles and shotguns, never handguns or pistols.**
4. **What is the name of the rifle that utilized a horizontally mounted hammer?**

PROOF MARKS

Almost all foreign guns carry proof marks indicating that the weapon has been tested. These marks can also be used as a guide in identifying the gun. They can tell you the country of origin, the caliber, the gauge, and the type of tests executed. This is why it is extremely necessary to obtain a good proof mark reference and know how to use it if you are dealing in foreign arms. One of the better references is Standard Directory of Proof Marks by R. A. Steindler. This book fully describes the proof laws of each country and lists the changes in those laws. The text covers illustrated proof marks from about 1900 to today.

Figure 7 shows how proof marks are helpful in identifying foreign firearms. An unidentified doublebarrel shotgun had these proof marks inscribed on the underside of the barrels under the fore-end. The proof marks on other weapons are usually in a similar location, and as a rule of thumb are found on all arms produced in Europe and the British Isles.

A marking on top of the barrels on the rib of the shotgun in question indicated that the barrels were "Belgium Laminated Steel," so Belgian references were the obvious place to begin looking. Look at the markings in Figure 8. It was found that #1 (ELG) was the definitive proof mark in use from July 11, 1893 to the present. From this, we know that the shotgun had to be manufactured after 1893. The #2 marking is the gauge mark and indicates that the shotgun is 12 gauge. This mark was in use from October 4, 1898 to June 30, 1924, so we now know that the shotgun was manufactured between 1898 and 1924. Mark #3 indicates acceptance after inspection following definitive proof. The fancy "S" with the asterisk in #4 is the individual inspector's countermark. Mark #5 is an additional inspector's mark, and the 18.0 in #6 is the choke designation, used until 1924. We also know that a recessed choke was marked with the muzzle diameter only, but as a fraction with both numbers the same in our example, 18.0/18.0. The sidelock has the inscription "W M. Parkhurst," so we can assume that Parkhurst was the maker.



From the information gathered so far, we know that the shotgun barrels for this particular gun were manufactured in Belgium between 1898 and 1924. They are Damascus steel (laminated steel) and are not safe with modern smokeless loads. The maker is apparently W M. Parkhurst.

The proving of firearms has been compulsory in England and Belgium since 1672. In 1892, Germany adopted the English standards. While there are a large variety of proof marks, the ones shown in Figure 8 are the most common. Keep this chart handy when trying to identify English and European firearms.

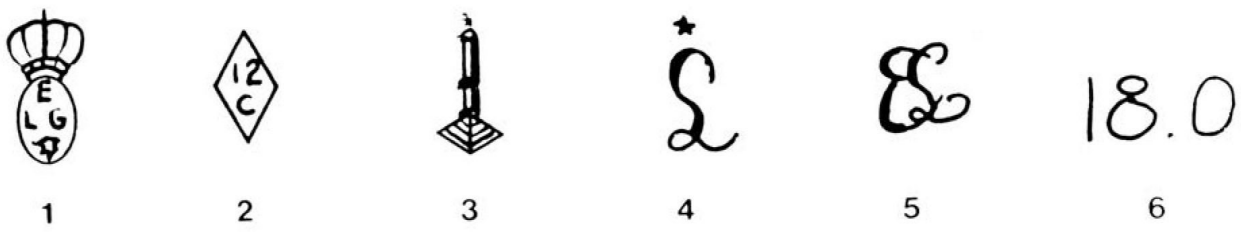


Figure 7: *Proof marks found on an unidentified Belgian-made shotgun.*

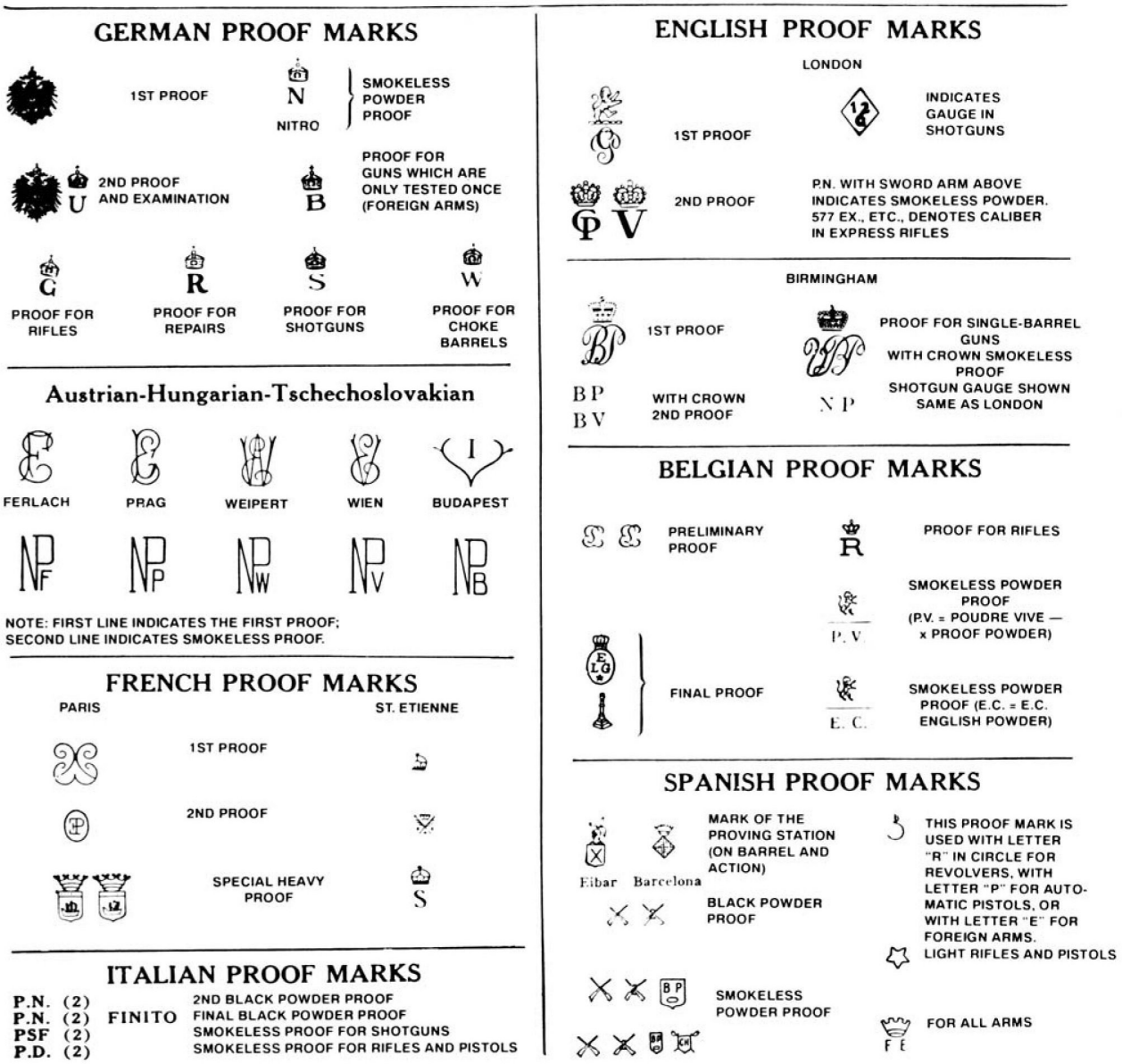


Figure 8: Some of the common proof marks found on an English and European fireams.

TIPS FOR IDENTIFYING FOREIGN FIREARMS

The first item to consider when trying to identify a foreign firearm is to establish the country or place of origin. Proof marks are the simplest way to accomplish this, so using the proof marks found in Figure 8 and a good reference book will help tremendously in pinpointing the origin of a particular weapon.

Firearms that originate in countries other than Europe and England, or weapons manufactured prior to proof marks, are not as easily identified. It takes much study and experience to identify some of them. However, almost every firearm made will have some markings other than proof marks, and the gunsmith or dealer should become acquainted with the more conventional ones.

Learning the characteristics of various languages is one way to help pinpoint the origin of a particular weapon. This may seem like a difficult task, but notice we did not say you had to speak or be able to read the language—just know the characteristics of each. For example, most people can easily recognize the characters of oriental languages. Chinese and Japanese are very similar and look almost identical to the inexperienced person. However, when compared side by side, it does not take long to see the difference between Korean and Japanese or Chinese characters. The same is true for Western languages. German and Austrian words look much the same, while French and Spanish have their similarities, too.

Therefore, if the gun dealer learns the basic characteristics of Spanish, German, Arabic, etc., he or she will at least have a good basis for starting an I.D. search of a particular weapon. Once the approximate area of the gun's origin is known, reference books will be of endless value and usually will describe the gun in question.

SELF-TEST QUESTIONS

Please check your answers on page 17.

5. **Since what year has proving of firearms been compulsory in England and Belgium?**
6. **The proof marks in Figure 9 are from three different countries. What country is "A" from?**
7. **What country is proof mark "B" (Figure 9) from?**
8. **What country is proof mark "C" (Figure 9) from?**

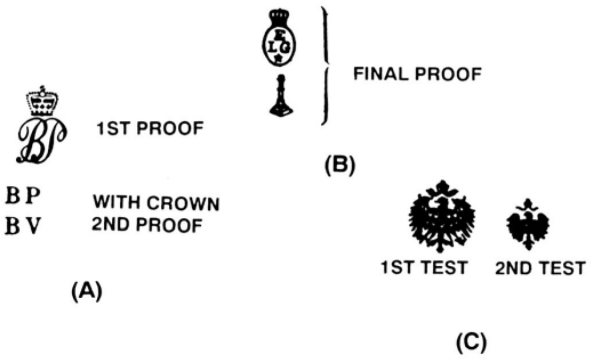


Figure 9: Proof marks from three different countries. Can you name them?

Making Chamber Casts and Measuring Bore

There are numerous occasions when a chamber cast will prove beneficial for categorizing and identifying guns. Besides enabling you to determine the exact dimensions of a chamber, such casts are also helpful in measuring the amount of freebore and the bore and groove diameters.

Choosing a suitable casting material requires a substance that has a low melting point to prevent possible changes or damage to the gun metal. Once hardened, it should undergo a minimum of shrinkage or expansion. It should not absorb moisture, and it should be safe for home use. Brownells, Inc. sells a special chamber-casting alloy called Cerrosafe that is ideal for making chamber and bore castings. If you are unable to locate Cerrosafe, or you do not have a supply on hand when an unidentified gun comes into the shop, other materials, although inferior, may be substituted. A box of children's crayons, from which the paper has been removed, may be melted and poured into the chamber. Watch the heat, though, as some crayons contain flammable materials. Available in half-pound ingots, Cerrosafe has a low melting point (about 150°F) and may be reused repeatedly. To use, melt a sufficient amount in a ladle, lead melting pot, or even an old pan or skillet. Melt over low heat. You can even melt it on the kitchen stove or a hot plate. Use a cleaning rod to drive a couple of tight-fitting cleaning patches down from the breech to a point about 2" into the rifling (or bore, in the case of a shotgun). These patches will seal the Cerrosafe in the chamber area and prevent it from dripping down further into the bore. Make sure the wood from the gun is removed, and just before pouring the melted Cerrosafe into the chamber, heat the chamber area slightly - just hot enough so you cannot touch it. This heating will help eliminate air bubbles in the casting. You should also coat the chamber walls with a light coat of oil by spraying a quick shot of WD-40 into the chamber. While the alloy is melting, mount the rifle or shotgun in a vertical position in a padded vise; have the muzzle pointed downward, which means the breech or chamber end will be up. Then ladle the molten Cerrosafe into the chamber until the chamber is filled. If it overflows, do not worry about it; after it cools it's easy to peel off from almost any material. Let the cast set in the chamber for a few minutes, then rearrange the gun in the vise so it is in a horizontal position. Using a short plastic tip on your cleaning rod, insert the rod with the tip into the barrel from the muzzle until it meets the resistance of the cleaning patches in the bore, then lightly tap out the patches and casting. If you need only a bore casting, make the cast from the muzzle end. Just plug the bore as before, with cleaning patches a couple of inches below the muzzle, pour in the molten casting material, wait a few minutes, then drive the casting out with the cleaning rod, this time from the chamber end.



Figure 11: Cerrosafe alloy.

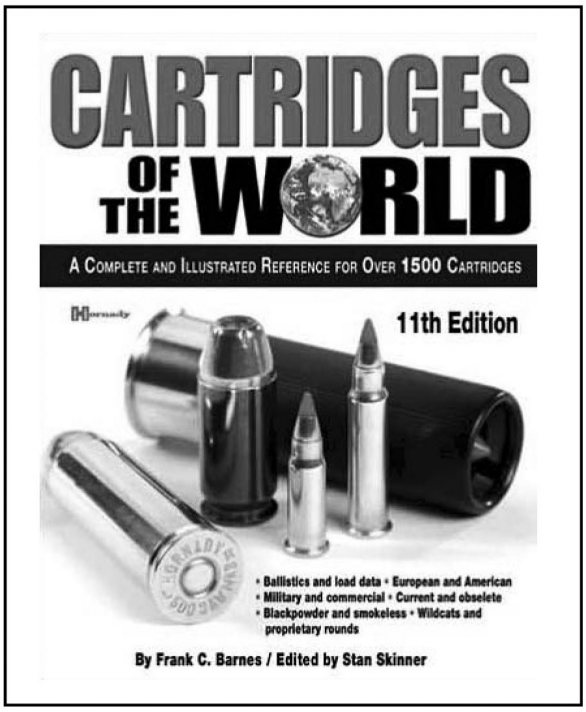


Figure 10: This book is one of the most useful cartridge references available.

Whichever type of cast you make, do not take the measurements right away, since Cerrosafe shrinks somewhat during the first 30 minutes of cooling. However, after that it expands again. Casts are permanent, and you can save them and measure them anytime with precision tools, or you can melt them at a later date when you need a new cast.

READING THE CAST

Once you have measured the cast, you can then start your research. For example, suppose you came across an old German drilling, a firearm that obviously had side-by-side, 16- gauge shotgun barrels and a rifle barrel beneath an unknown caliber. Your objective is to find out what caliber the rifle barrel is chambered. One of the best reference sources for cartridge identification is Cartridges of the World, shown in Figure 10 by Frank C. Barnes and published by DBI Books, Inc. (the publisher of Gun Digest). So let use this reference and see if we can find the proper cartridge for this drilling. Since we know from the proof marks that this drilling was made in Germany, we look in the reference book under "European Sporting Rifle Cartridges." The measurements show that the

bore is about .365 inch. In metrics, this is the equivalent of 9.3 millimeters. Furthermore, the case measures about 3.27 inches, or 72 millimeters. Looking in the appropriate chart in Cartridges of the World, we find a 9.3 x 72Rmm listed. We compare the remaining dimensions: neck diameter, base diameter, and rim diameter. All seem to match. Consequently, we have determined that this drilling is chambered for the 9.3 x 72R cartridge - one that was common for drillings of this type (Figure 12). In determining the cartridge for an unknown rifle, first try to determine the country of origin. Use proof marks when appropriate. Then make a chambers cast as described previously, categorize the rifle type (military, sporting, etc.), and use the appropriate table in Cartridges of the World to try to find a match. Unless you run across a real rarity, 98% of all cartridges encountered can be identified with this one book. You should obtain a copy as soon as possible.

SELF-TEST QUESTIONS

Please check your answers on page 17.

9. **If Cerrosafe is not available for a chamber cast, what common items may be used instead?**
10. **Once a chamber cast is made, removed from the chamber, and cooled, what is the next step?**
11. **What is one good reference source for identifying cartridges when the measurements are known?**
12. **When using Cerrosafe to make a chamber cast, approximately how long should you wait before taking measurements?**

Cartridge	Case type	Bullet dia.	Neck dia.	Shoulder dia.	Base dia.	Rim dia.	Case length	Ctge. length	Berdan primer dia.	RWS primer No.	Old DWM case No.
8 x 65RS Brenneke	A	.323	.348	.421	.464	.520	2.56	3.65	.217	5603	558A
8 x 68Smm Magnum	C	.323	.354	.473	.522	.510	2.65	3.38	.238	1698	—
8 x 72Rmm Sauer	B	.324	.344	—	.429	.483	2.84	3.40	.254	1775	574
9 x 71mm Peterlongo	C	.350	.386	.420	.464	.466	2.80	3.28	.216	2610	783
9 x 56mm Mannlicher	C	.356	.378	.408	.464	.464	2.22	3.56	.217	5603	491E
9 x 57mm Mauser	C	.356	.380	.428	.467	.468	2.21	3.10	.217	5603	491A
9 x 57Rmm Mauser	A	.356	.380	.424	.467	.515	2.21	3.08	.217	5603	491B
9 x 63mm	C	.357	.384	.427	.467	.468	2.48	3.28	.217	5603	491D
9 x 70Rmm Mauser	A	.357	.385	.418	.467	.525	2.76	3.37	—	—	474B
9.3 x 48Rmm	B	.365	.382	—	.433	.492	1.89	2.35	.254	1775	246
9.3 x 53mm Swiss	C	.365	.389	.453	.492	.491	2.11	2.80	—	—	—
9.3 x 53Rmm Swiss	A	.365	.391	.455	.494	.563	2.11	2.83	—	—	—
9.3 x 57Rmm	B	.365	.389	—	.428	.486	2.24	2.80	.254	1775	77E
9.3 x 57mm Mauser	C	.365	.389	.428	.468	.469	2.24	3.23	.217	5603	491
9.3 x 62mm Mauser	C	.365	.388	.447	.473	.470	2.42	3.29	.217	5603	474
9.3 x 64mm Brenneke	C	.365	.391	.481	.504	.492	2.52	3.43	.217	5603	—
9.3 x 70Rmm	B	.365	.387	—	.427	.482	2.75	3.45	.254	1775	77F
9.3 x 72Rmm	B	.365	.385	—	.427	.482	2.84	3.27	.254	1775	77D
9.3 x 72Rmm Sauer	A	.365	.390	.422	.473	.518	2.83	3.34	.254	1775	—
9.3 x 74Rmm	A	.365	.387	.414	.465	.524	2.93	3.47	.217	5603	474A
9.3 x 80Rmm	B	.365	.386	—	.430	.485	3.14	3.50	.254	1775	77B
9.3 x 82Rmm	B	.365	.386	—	.430	.485	3.21	3.72	.254	1775	77C
9.3 x 65Rmm Collath	A	.367	.384	.420	.443	.508	2.56	3.01	—	—	—
9.3 x 54Rmm Hebler	A	.369	.398	.462	.484	.550	2.12	2.92	—	—	—
9.1 x 40Rmm	B	.374	.385	—	.404	.446	1.60	2.00	—	—	91
9.5 x 47Rmm	A	.375	.409	.497	.513	.583	1.85	2.37	.254	1775	23
9.5 x 57mm Mannlicher (9.5 x 56)	C	.375	.400	.460	.471	.473	2.25	2.94	.217	5603	531
9.5 x 73mm Miller-Greiss Magnum	C	.375	.402	.531	.543	.541	2.86	3.50	.217	5603	473
10.25 x 69Rmm Hunting-Express	A	.404	.415	.480	.549	.630	2.72	3.17	.254	1775	214
10.3 x 60Rmm Swiss	A	.415	.440	.498	.547	.619	2.36	3.08	—	—	—
10.5 x 47Rmm	A	.419	.445	.496	.513	.591	1.85	2.40	.254	1775	29
10.75 x 73mm (404 Jeffery)	C	.421	.450	.520	.544	.537	2.86	3.53	.217	—	555
10.3 x 65Rmm Baenziger	B	.423	.431	—	.462	.505	2.56	3.15	—	—	164
10.75 x 57mm Mannlicher	C	.424	.448	.465	.468	.468	2.24	3.05	—	—	—
10.75 x 63mm Mauser	I	.424	.447	.479	.493	.467	2.47	3.22	—	—	515 ?
10.75 x 65Rmm Collath	B	.424	.451	—	.487	.542	2.56	3.02	—	—	—
10.75 x 68mm Mauser	C	.424	.445	.470	.492	.488	2.67	3.16	.217	5603	515A
10.8 x 47Rmm Martini Target	A	.441	.463	.512	.516	.591	1.75	2.23	.254	1775	146
11.2 x 60mm Schuler (Mauser)	I	.440	.465	.512	.512	.465	2.35	2.86	.217	5601	—
11.2 x 72mm Schuler	I	.440	.465	.510	.536	.469	2.80	3.85	.217	5601	—
12.7 x 70 Schuler (500 Jeffery)	I	.510	.535	.615	.620	.578	2.94	3.50	.254	2703	—

All dimensions in inches unless shown otherwise.

A—Rimmed Bottlenecked
B—Rimmed Straight
C—Rimless Bottlenecked
E—Belted Bottlenecked
G—Semi-rimmed Bottlenecked
I—Rebated Rimless

Figure 12. Sample page from Cartridges of the World giving dimensions of several European sporting cartridges.

Answers to Self-Test Questions

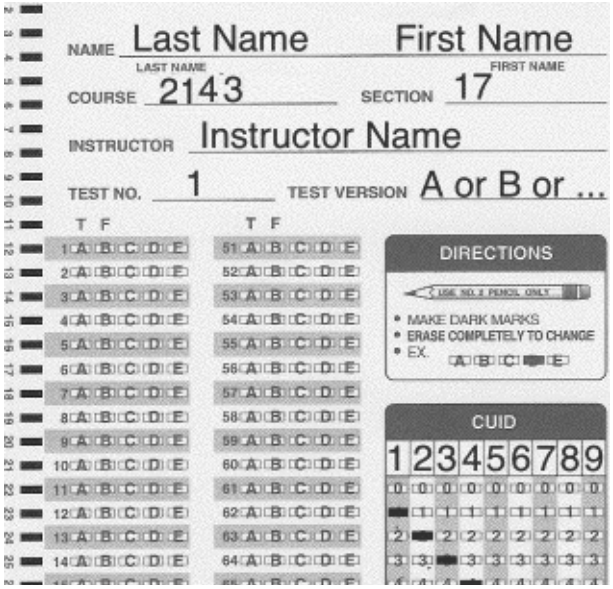
1. False. Catalogs are excellent references
2. Matchlock
3. False
4. The Jenks rifle
5. 1672
6. Birmingham, England
7. Belgium
8. Germany
9. Children's crayons
10. Take accurate measurements of the cast
11. Cartridges of the World by Frank C Barnes and published by DBI Books
12. 30 minutes

Lesson Questions

THIS IS LESSON NUMBER 2168.

Make sure you print your name, student number, and lesson number in the space provided on the Lesson Answer Form. Be sure to fill in the circles beneath your student number and lesson number.

REMINDER: A properly completed Lesson Answer Form allows us to evaluate your answers and send the results and additional study material to you. Do not hold your Lesson Answer Forms to send several at one time. You may run out of study material if you do not send your answers for evaluation promptly. You may also complete your exams and submit them online via the SDI Student Services page at http://www.sonoranlearning.com.



1. **What is one thing that must be done before a fair gun trade can be made?**
   a. Both parties must have an FFL.
   b. At least one of the parties must be able to identify the gun.
   c. You must know how many of the model in question were manufactured.
   d. The exact dates of manufacturer must be known.

2. **How many "1 of 1000" Model 1873 Winchesters were produced?**
   a. 116.
   b. 126.
   c. 136.
   d. 156.

3. **What is the name of one of the first practical gun ignition systems?**
   a. Wheel lock.
   b. Matchlock.
   c. Flintlock.
   d. Caplock.

4. **Which of the following characteristics are true about the Hall rifle?**
   a. It was a breechloader.
   b. It was a muzzleloader.
   c. It used a metallic cartridge case.
   d. It was never used by the U.S. government.

5. **When did the U.S. government stop using the flintlock system?**
   a. 1817.
   b. 1842.
   c. 1866.
   d. 1873.

6. **What two calibers were used in the Trapdoor Springfield rifle?**
   a. .44 Henry and .50-110 Winchester.
   b. .40-82 WC.F and .38-70 WC.F
   c. .50-70 and .45-70.
   d. .32-20 and .44-40.

7. **What is the name of the first breechloader used by the U.S. government?**
   a. Jenks rifle.
   b. Springfield.
   c. Hall rifle.
   d. Remington rolling-block rifle.

8. **What is the name of the substance offered by Brownells, Inc. that is recommended for making chamber and bore casts?**
   a. Playsafe.
   b. No.3 Alloy.
   c. No.2 Alloy.
   d. Cerrosafe.

9. **Where are proof marks normally found on side-by-side, double-barrel shotguns made in Europe?**

   a. Inside the chamber areas.

   b. Bottom side of barrels under the fore-end.

   c. Inside the trigger guard.

   d. Behind each trigger.

10. **As a general rule, which of the following statements is true about proof marks?**

    a. They may be found on all firearms manufactured in the United States and Canada.

    b. They may be found on all firearms manufactured in Europe.

    c. They usually are found on all European firearms manufactured after 1672.

    d. They are found on all European and English firearms up to 1930.