STUDY UNIT 5 – PART 1

FIREARMS DESIGN – HANDGUNS

REVOLVERS

The revolver is probably the oldest form of repeating firearm. Working models of wheel-lock ignition revolvers are recorded as early as the 15th century. The first true working revolver is generally credited to Samuel Colt. It is said that Colt patterned his design after a ship's wheel. There were, of course, other "revolvers" before Colt's time. In these, however, a group of individually loaded barrels revolved around a pivot, as in the case of the Collier. Colt's concept is the most familiar, in which a single barrel is fed by a revolving cylinder containing chambers or charge holes, with the cylinder alone rotating around a central axis.

When is a Revolver a Pistol?

Strictly speaking, the term "pistol" can be applied to all handguns. So when we speak of pistols, will this include revolvers? NO. For our purposes here, we will refer to single-shot and semi-automatic handguns as pistols, and to revolving-cylinder guns as revolvers. We will carry these more specific definitions to more clearly point up differences in the functions of revolvers and non-revolving chambers in handguns.

Basic Revolver Actions

Revolver actions consist of two types – single-action and double-action. Generally, and contrary to popular belief, revolvers are much more intricate and complicated in design than semi-automatic pistols. And, though they are rugged in *design*, revolvers have a reputation for *being fragile.*

Generally, revolvers are capable of firing far more powerful cartridges than semi-automatic handguns. A noted exception is the .44 Auto Mag, which has more gumption than even the .44 magnum, .41 magnum, and .357 magnum revolvers. In the hands of an expert, the .41 and .44 magnum revolver cartridges are capable of taking most American big game at reasonable ranges.

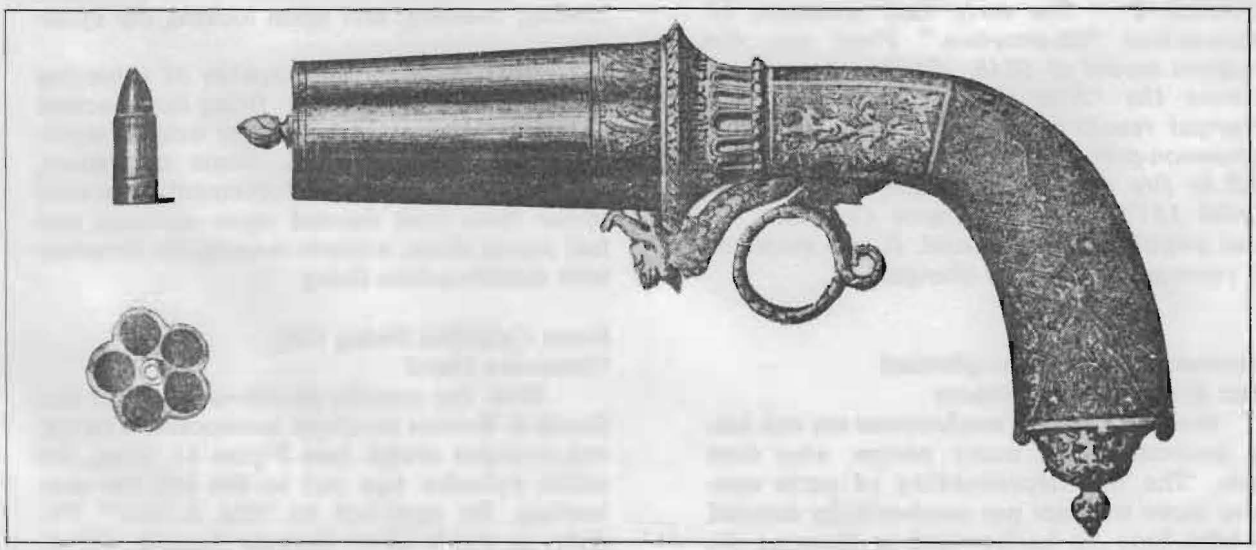


FIGURE 1 — One of the earliest "revolvers," the Lefaucheux Pepperbox pin-fire pistol, was introduced at a London gun show in 1851. Its "double-action" design cocked the piece and rotated one of the five barrels into firing position with each pull of the trigger.

FIGURE 2 — The early Colt revolvers, all single-action "six-shooters." From top: the Dragoon model of 1848, .44 cal., percussion-primed; the "New Army" model of 1860, principal revolver of the Civil War, .44 cal., percussion-primed; the Model 1872, the first Colt to fire metallic cartridges, .45 cal.; Colt Model 1873, first solid-frame Colt and the most popular ever produced. It was made for 70 years with few or no changes.

Revolvers are More Complicated Than Most Shooters Believe

Modern revolver mechanisms are not easily understood by many people who own them. The interdependability of parts confuses those who are not mechanically minded or who have no background in firearms design, etc. But when you study them and understand them, revolvers are not difficult to repair.

Probably the three major handgun manufacturers in the United States today are Colt, Smith & Wesson, and Ruger. All make fine-quality revolvers for various rimmed cartridges from the .22 long rifle on up to the magnums. While mechanically operating in similar fashion, they employ different mechanical principles. Consequently, methods which correct adjustments in one make will not apply to other makes.

Fine revolvers are also currently manufactured by Harrington & Richardson, High-Standard, Iver Johnson, Firearms International, Dan Wesson, and Charter Arms Corporation. Other revolvers, many of which are copies of famous American handguns, are being exported to the U.S. by foreign manufacturers. The quality of these imports can range from excellent down to the cheap "Saturday night specials," which have little, if any, justification for existence.

The Difference Between Single and Double-Action Revolvers

Modern American-made revolvers operate both by single-action and by double-action. A single-action revolver is one in which each round in the chamber is readied for firing by *manually* pulling the hammer back to full-cock position. The hammer in its rearward movement cams or lifts the cylinder locking device, turns the cylinder to the next round, then locks the cylinder into position for firing.

A double-action revolver can be cocked manually, or simply by squeezing the trigger. In the latter case, when the trigger is squeezed, a device known as the "hammer strut" (in most revolvers) pushes the hammer rearward, thus cocking the arm while simultaneously freeing, rotating, and again locking the cylinder.

Most shooters are capable of achieving good accuracy only when firing single-action because of the excessive trigger weight required to fire double-action. Some marksmen, however, notably law enforcement personnel whose lives may depend upon accurate and fast repeat shots, achieve remarkable accuracy with double-action firing.

Some Cylinders Swing Out, Others are Fixed

Both the popular double-action Colt and Smith & Wesson revolvers incorporate a swing-out cylinder design (see Figure 4). Thus, the entire cylinder *tips out* to the left for easy loading. Be sure not to "flip it out," TV-style, or you'll likely damage the arm. Other, usually less expensive revolvers load like a single-action Colt (see Figure 5): the cartridges are loaded or ejected one at a time through

FIGURE 3 — Reproductions of early percussion Colts are made by a number of U.S. and foreign manufacturers. Shown is the 1847 Walker by Navy Arms.

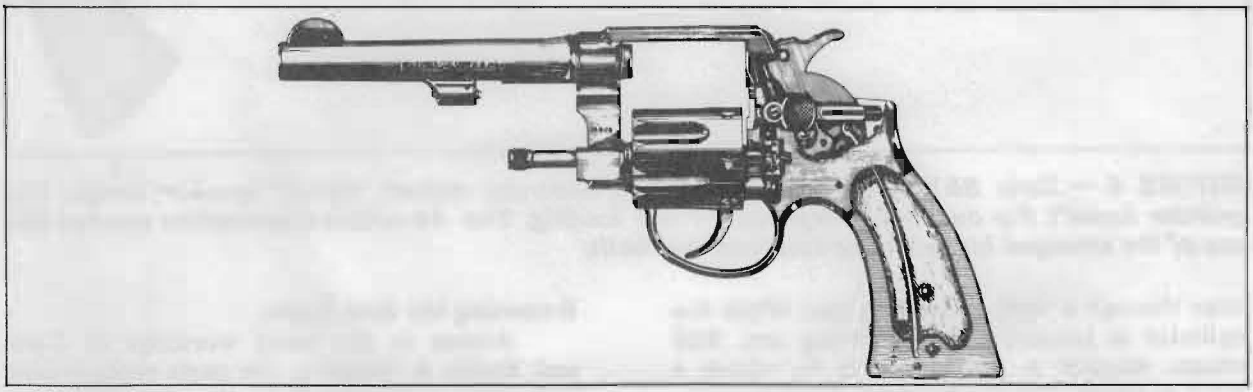


FIGURE 4 — Design details of typical swing-out type revolver with mechanism sectionalized.

FIGURE 5 — Famous Colt single-action revolver owned and carried by General "Blood and Guts" Patton during World War II. The barrel, cylinder, and even the loading gate are silver-plated and profusely engraved. The grips are of ivory.

FIGURE 6 — Early S&W Schofield, Model 1875, illustrates typical "tip-up" revolver design. The cylinder doesn't flip out, but is exposed for rear loading. This .45-caliber single-action six-shot was one of the strongest hinged-frame revolvers ever built.

time through a port, or loading gate, while the cylinder is rotated but not swung out. Still others employ a tip-up action in which a latch is released at the top rear of the receiver (see Figure 6). The rear of the rotating, but fixed cylinder is then exposed for loading and unloading.

Before going on, please do Programmed Exercise 1. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

PROGRAMMED EXERCISE 1

1

1. In teaching a beginner to shoot a double-action revolver, how would you start him out to ensure the best possible accuracy?

2. "Swing-out," "rotating but fixed," and "tip-up" describe varieties of what revolver action?

Answers on Page 6

Removing the Side Plates

Access to the inner workings of Colts and Smith & Wessons, for parts replacement or repair, is by removing the side plates on the receiver frame. On the Colt, this movable side plate is on the left side of the gun; on the Smith & Wesson it is on the right side. These side plates are easily lifted by first removing the grip. Then, with screwdrivers that fit, the screws holding the side plates in place are removed. Never attempt to pry the side plates loose; merely tap the bottom of the frame with a screwdriver handle. This releases the tightly fitted plates so they can be removed with the fingers (see Figure 7). Solid-frame revolvers are a bit more difficult to "get into," but, like anything else, the secret is in knowing how.

On Colt revolvers, cylinders rotate clockwise when viewed from the rear. Smith & Wesson revolvers rotate cylinders in the opposite direction. Positioning of the "hand" or "lifter" which turns the cylinder determines right or left rotation of the cylinder. If the hand is on the left, the cylinder turns right and vice versa.

This "hand" is usually attached to the trigger. In the trigger's rearward motion (whether through linkage when the hammer is manually cocked in single-action, or by trigger pressure when firing double-action), the hand pushes up and rotates the cylinder.

FIGURE 7 — Sectionalized view of a typical modern revolver, of the type used by about 95% of U.S. police and law enforcement personnel. The mechanism is exposed by removing the side plate shown to the right.

Another device, called a cylinder lode, is also attached to the trigger through linkage. At a certain point in the trigger's travel, the cylinder stop drops down through its recess in the bottom of the frame and releases the cylinder so it can rotate. When revolvers are "out of time," a frequent complaint, it means that unlocking and locking of the cylinder do not occur at the specified point of trigger travel; and that the cylinder is either not locked securely or the barrel is not aligned correctly with the cylinder at the moment of discharge.

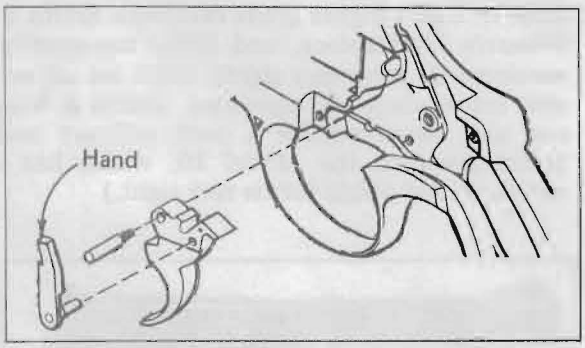


FIGURE 8 — Typical "hand" arrangement is typified by the Colt Official Police Revolver. The hand locks into the trigger which, when placed in position within the frame, permits the hand to extend up and engage the notches in the rear of the cylinder. When the trigger is pulled (double-action), the hand pushes against the cylinder notch, rotating the cylinder one turn. Through linkage, the same thing happens when the hammer is pulled back for single-action firing.

Why Autos are Believed Most Accurate

Many competitive shooters prefer automatic pistols since it is widely believed that the chambers in the cylinder of a revolver vary in accuracy potential. This may be true when the drilling and concentricity of all chambers are not perfectly uniform, but usually this is true only to a slight degree and is not noticeable to the average shooter. It is a fact, however, that any misalignment of the cylinder and barrel, due either to the gun being out of time or a chamber hole being off center, will produce poor accuracy.

If the cylinder is too far off center, the bullet will shear or scrape lead as it exits the cylinder and enters the belled rear end of the barrel.

Such guns also "spit" lead out the side and are, understandably, unpopular on the firing range. Such "unsociable" behavior can be readily determined by wrapping the gun in white paper or placing white paper on a stand about six inches to either side of the gun and firing. If the gun is "spitting," perforations, flecks of lead appear on the paper. All revolvers permit some gas escape at the barrel/chamber juncture. If, however, such gas escape is excessive and particles of carbon and lead fly to the side, that gun should be repaired.

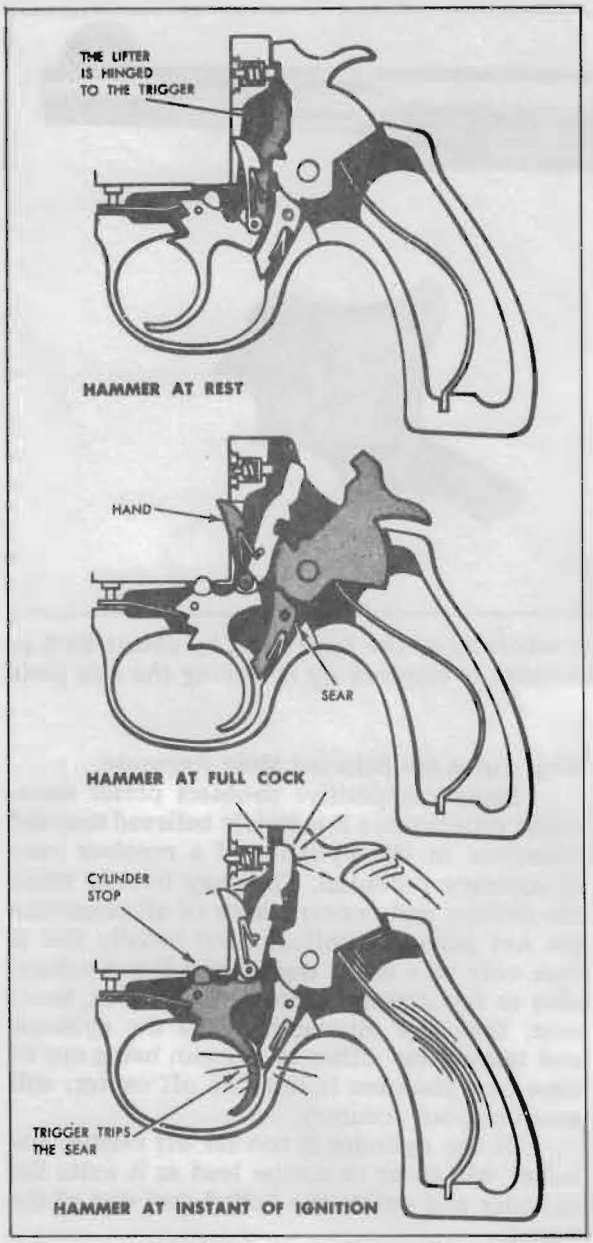


FIGURE 9 — Cross-section drawings illustrate the sequence of moving parts in the hammer assembly of a typical top-break Iver Johnson revolver. (Photo courtesy National Rifle Association)

ANSWERS

1

1. Suggest that he fire the gun single-action. This eliminates the heavy trigger pull experienced when firing double-action.
2. Cylinder or loading.

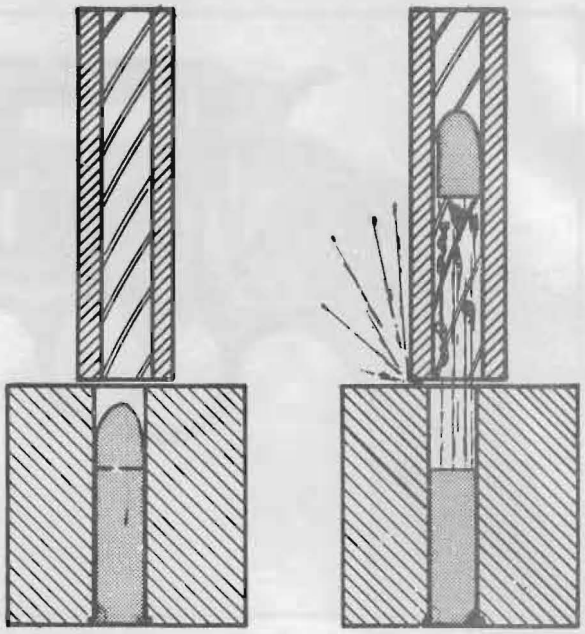


FIGURE 10 — When a bullet isn't perfectly aligned with the bore (out of time), a portion of the bullet is sheared off when it engages the bore, resulting in miserable accuracy and powder and lead splattering to the side.

Revolver Sights

The quality of the sights on the various revolvers is usually reflected in the basic price of the gun. Cheap revolvers ordinarily have fixed sights consisting of a blade or Patridge-type front unit, and a milled square notch at the top rear of the receiver. Many older guns merely have a U notch in the receiver for the rear sight. Generally, the higher the price of the gun, the more sophisticated the sights. Most of Colt's higher grade revolvers, Smith & Wesson's Masterpiece, and other top-quality revolvers all carry rear sights which are adjustable for windage and elevation. (Smith & Wesson also manufactures a plain military and police revolver, the Model 10, which has a square milled notch for its rear sight.)

FIGURE 11 — Handguns used in match target shooting, such as the Colt Woodsman .22 illustrated, are always equipped with precision sighting equipment.

Telescopic Sights are Available for Handguns

While some shooters equip their revolvers with telescopic sights (such as the Bushnell Phantom), optical sights and bases are not factory equipment. Telescopic revolver sights necessarily incorporate a long eye relief so that the handgun may be held at arm's length and still provide a satisfactory field and view of the target. Pistol scopes are often used on hunting handguns, both varmint and big game varieties.

FIGURE 12 — Special scopes with long eye relief are made exclusively for handguns and are usually used for varmint, small game, and big game hunting.

Before going on, please do Programmed Exercise 2. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

PROGRAMMED EXERCISE

2

Match the sight designs from the top list with the type of handgun (from the bottom list) on which you would most likely find it by placing the correct letters in the blanks.

_____ 1. Fixed-blade or Patridge front unit with a milled square rear notch.

_____ 2. U notch in the receiver for the rear sight.

_____ 3. Sights adjustable for windage or elevation.

_____ 4. Telescopic sight.

A. Higher-grade revolvers

B. Least expensive

C. Handguns used for hunting

D. Older revolvers

Answers on Page 8

Revolver Cartridges

Modern revolvers are chambered for various .22 rim-fire cartridges, the rimmed .32-caliber center-fire, .38 Special, .38 Smith & Wesson, .357 magnum, .41 magnum, .44 Special, .44 magnum, and .45 long Colt.

Older revolvers are often chambered for a variety of different and often obsolete cartridges, such as the .32 and .38 rim-fire. There are also a few revolvers chambered for rifle cartridges, such as the Ruger chambered for the .30-caliber carbine cartridges.

Probably the greatest advantage of a revolver over the semi-automatic pistol is that the former can handle a variety of high-intensity cartridges. Most automatic guns are of either short-recoil or blowback design, neither of which can normally accommodate powerful, high-pressure cartridges.

The Revolver is Reliable, But Complex

Many police authorities consider revolvers more reliable and less apt to jam and cause trouble in an emergency. And, actually, the revolver's action is less susceptible to failure because of the intrusion of dirt or sand, which *is the case* with large-caliber automatics.

Usually a revolver is faster with the first shot, when fired either double or single-action, than an automatic. Succeeding shots, however, are usually slower, particularly if the revolver is of single-action design.

AUTOMATICS

The design of automatics is older than most shooters realize. We think of their origin as being more recent, but American patents for auto-loading pistols were first filed in 1863 (see Figure 13).

Self-loading or semi-automatic type pistols are exceedingly popular today and have been for many years. These guns operate by either the simple blowback design, the short-

FIGURE 13 — The first successful auto-pistol was the American-designed but German-manufactured Borchardt, first produced in 1893. It used a bottleneck cartridge very similar to the modern 7.63mm Mauser pistol cartridge.

recoil design, or a combination of both. Semi-automatic pistols operate and complete all functions of firing in the same way as the automatic long guns. After chambering the first round manually, all that is required of the shooter from then on is trigger pressure. The gun completes all the other functions automatically.

Semi-automatic pistols come in many exterior design shapes. Older and obsolete types have a magazine in front of the trigger guard (see Figure 14). Those of modern manufacturers usually contain the magazine within the grip.

The Famous Colt 1911

Possibly the most familiar semi-automatic handgun is the Browning-designed Colt 1911 .45-caliber. This gun has served our armed forces and those of many allies since its adoption in 1911 when it "beat out" the Savage and Luger auto pistols and others. This Colt is the oldest still issued handgun in current use. Less rugged handguns adopted by other nations at about the same time have since been retired and replaced, while the Colt goes on like "Old Man River."

Today the Colt .45 is still in demand as a defense gun and, in its various refined versions, bows to no other for the accuracy demanded by competitive target shooters. Since this particular gun is so well known, we will use it to illustrate the seven firing functions of the short-recoil design in automatic pistols. Now let's get into the seven functions.

Short-Recoil Designs

After (1) *firing*, the barrel and receiver travel to the rear together for a short distance. At a predetermined point (with the Colt .45

ANSWERS

2

1. B 2. D 3. A 4. C

about 3/8"), the barrel (2) *unlocks* from the rest of the recoiling mechanism and the action is opened. The barrel, which is attached to the receiver by means of a small, oval-shaped pivoting link, is arrested in its rearward travel by this link, which draws the barrel down and away from the slide as the slide proceeds to the rear.

Since the barrel is stopped, the slide in its rearward motion (3) *extracts* the fired case from the chamber. After the case is out of the chamber, it is (4) *ejected* out of the gun by an ejector mounted at the top left rear of the frame. As the slide reaches the end of its rearward travel, it has also (5) *cocked* the hammer and depressed the disconnector. The magazine forces a new cartridge up in line with the breech. As the slide moves forward under the force of the recoil spring, it depresses the disconnector, strips, and (6) *feeds* a cartridge from the top of the magazine and starts it toward the chamber. As the slide continues forward, it engages the barrel and moves it forward and upward, pivoting on the oval link attached to the frame. The barrel is then cammed so that two ribs cut at right angles to the axis of the barrel engage recesses milled in the top of the slide, thus (7) *locking* the action. The front end of the barrel is positioned within the slide by a bushing through which the barrel moves back and forth when firing.

FIGURE 14 — An early Mauser military pistol chambered for 7.63mm and 9mm Mauser and 9mm Luger cartridges. Note that the magazine is positioned forward of the trigger, not in the butt like modern auto-pistols. Cutaway photo shows details of Mauser mechanism and magazine, action closed.

The secret of accuracy in the .45 automatic pistol is in this bushing, or barrel sleeve, which returns the barrel to the same position after each shot. Match-type .45 Colts have bushings which are lapped or precisely matched to the contour of the barrel. Match, or accurized, Colts also have a slightly longer pivot link between the barrel and frame, permitting the barrel to move slightly farther ahead, thus jamming it more tightly into cocking position and providing a better breech seal. These modifications, plus removal of any vertical or side "play" between the frame and the slide, are what make a Colt 1911 accurate.

Another example of short-recoil design is the famous Luger pistol. The Luger employs

M1911A1 Automatic Pistol.

Caliber: .45 M1911 cartridge, ball ammunition.
Magazine: Box type, single line. Capacity 7 cartridges.
(Note: Capacity of pistol is 8 cartridges, 1 in firing chamber and 7 in magazine.)
Muzzle Velocity of Government Cartridge: 830 feet per second.
Muzzle Velocity of Commercial Cartridge: 860 feet per second.
Weight of Bullet: 230 grains, lead with metal jacket.
Muzzle Striking Energy, Government Cartridge: 340 foot pounds.
Muzzle Striking Energy, Commercial Cartridge: 378 foot pounds.
Barrel Length: 5 inches.
Overall Length of Pistol: 8½ inches.
Weight of Pistol: 39 ounces.
Sights: Partridge type, fixed.
Accurate Range: 50 yards.
Maximum Range: About 1600 yards elevating pistol to 30°.
Pistol Operated by: Recoil.
Locked: Ribs on top of barrel lock in slots on underside of slide near breech until period of dangerous breech pressure is passed.
Type of Fire: Single shot only. One squeeze of trigger is necessary to fire each shot. Should more than one be fired by a single squeeze, pistol is dangerous and disconnector needs replacing.
Magazine Release Catch: Button on left side near trigger. Pressing it will eject magazine from handle.

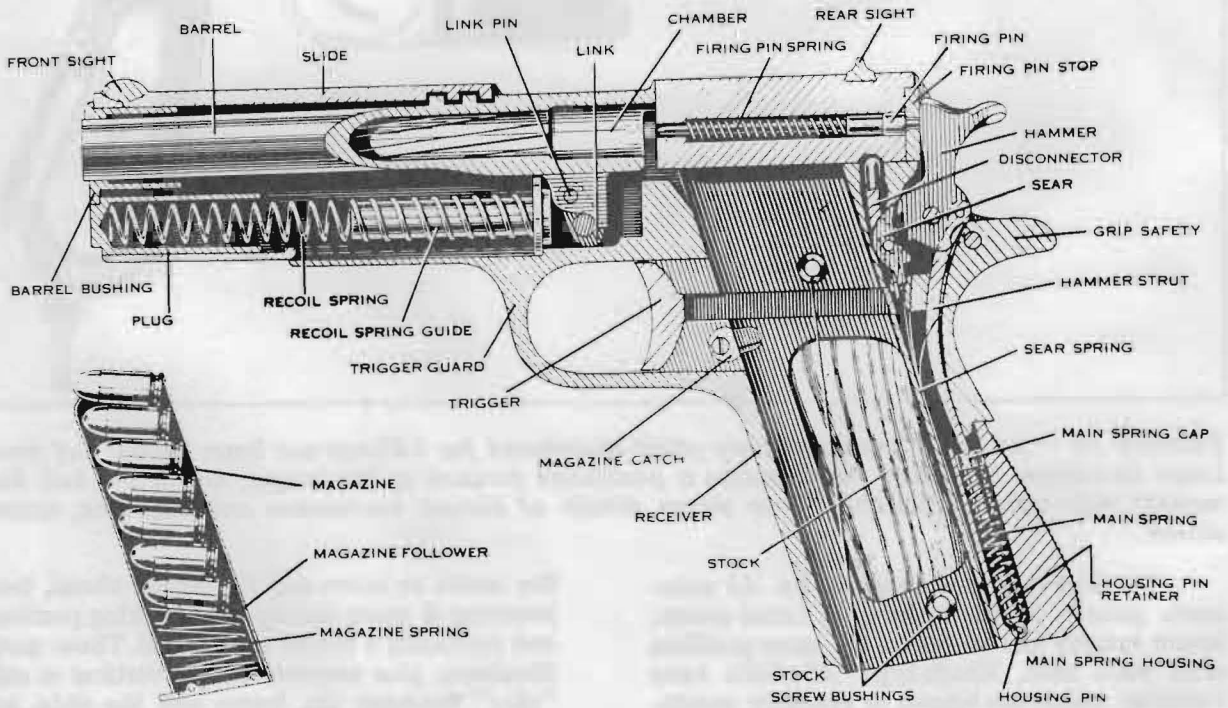


FIGURE 15 — Famous Colt 1911A1 pistol, which had the longest service life of any military handgun. Sectioned drawing shows component parts.

a toggle-type action that operates like a knee joint. It breaks in the middle and rises, thus absorbing and softening the recoil force. Both the barrel and the action recoil for a short distance before the barrel is stopped by the toggle, then arrested in its rearward motion by the barrel stop.

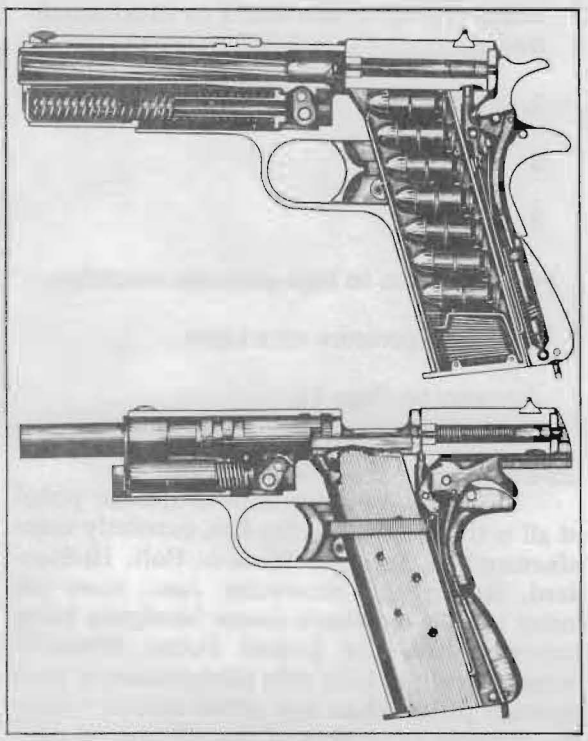


FIGURE 16 — Details of the locking and firing mechanisms for the Colt 1911A1. The top drawing shows the action closed with the pivoting barrel link at rest. The bottom drawing reveals the details when the action is open and cocked. Note how the barrel has swung back and down on the pivot link during unlocking.

Blowback Design

Most lower-powered semi-automatic handguns use the popular blowback design. "Blowback" means exactly that — a heavy slide or breech block is "blown back" slowly by the backward pressure of gas from a fired cartridge. Let's discuss the seven functions of operation in the blowback. After discharge — (1) *firing* — the block is blown back by gases. Being heavier than the bullet, yet acted on by the same amount of force, the block moves more slowly than the bullet. Consequently, by the time the bullet is out of the barrel, the block is only starting to (2) *unlock* and move to the rear. As it travels to the rear, it (3) *extracts* the fired case from the chamber, (4) *ejects* it from the gun, then (5) *cocks* the hammer. As it moves forward, it strips a round from the magazine and (6) *feeds* it into the chamber while (7) *locking* the action.

Handguns of blowback design are easily recognized by the method of barrel attachment to the frame. If the barrel is solidly attached to the frame or the receiver while the receiver housing or "slide" moves back and forth, that gun is blowback-operated. If the barrel is hinged by means of links or slides within the receiver, then it is probably of short-recoil design. Also, as a general rule, handgun cartridges developing medium to moderate pressures, such as the Colt .45, utilize the short-recoil design. A blowback design pistol attempting to handle such pressures would need a bolt of great weight to compensate for the gas force, resulting in an extremely heavy and unwieldy handgun.

Machine guns, however, can utilize the blowback design even in cartridges of medium to moderate power (such as 9mm Luger and

FIGURE 17 — Cutaway views of the famous Luger pistol. Drawing to the left shows the action closed. The righthand drawing shows the action open, with toggle raised. Note the different positions of the recoil spring hook-up in the rear of the grip.

FIGURE 18 — The Colt .25 Pocket Auto (top) and its big brother, chambered for the .32 and .380 ACP cartridges, are examples of blowback design, suitable only for relatively low-pressure cartridges.

.45 automatic Colt) because the bolt and slide assembly is relatively heavy. The Thompson submachine gun has a bolt that weighs much more than the slide of a .45 Colt recoil-operated handgun, so it can handle the .45 Colt ACP cartridge.

FIGURE 19 — The Reising submachine gun, cal. .45 ACP. Because of its heavy breech block, this blowback-type gun can handle more powerful cartridges than a blowback-type handgun.

Since moderate and medium-powered cartridges are usually incompatible with blowback handguns, this design is usually combined with such low-pressure cartridges as the .22 rim-fire, .25 NCP, .32 ACP, and .380 ACP.

Before going on, please do Programmed Exercise 3. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

PROGRAMMED EXERCISE

3

Identify the following guns or terms as being typical of blowback or short-recoil design.

1. .45 Colt
2. .25 Colt
3. Luger
4. Medium to high-pressure cartridges
5. Low-pressure cartridges

Answers on Page 14

.22-Caliber Rim-Fire Auto Pistols

The most popular semi-automatic pistol of all is the .22-caliber rim-fire, currently manufactured by Smith & Wesson, Colt, Hi-Standard, Ruger, and Browning. Also, there are many similar blowback-design handguns being imported into the United States. Probably more .22-caliber long rifle ammunition is fired through pistols than any other caliber — with the possible exception of the .38 Special used by most police departments.

An interesting variation is a short-recoil design .22-caliber long rifle conversion unit especially designed for the Colt .45. In this unit, a separate slide, barrel, extractor, and recoil spring are affixed to the Colt .45 frame. The rear portion of the .22 barrel is a separate "floating chamber" which allows expanding gases to get between the barrel and the chamber, thus exerting greater pressure against the face of the breech, moving the chamber itself — cartridge case and all — to the rear. This particular modification permits the tiny .22-caliber cartridge to deliver adequate recoil to function the arm at a fraction of the cost of .45-caliber ammunition.

Single-Shot Pistols

At one time in the United States, a variety of single-shot, rim-fire target pistols was available. Today such guns are not in much demand since many semi-automatic .22's deliver better than "single-shot" accuracy. However, for deliberate "free pistol" shooting, the single-shot is still the thing. Most guns used for this "free shooting" are highly specialized and usually manufactured in Europe.

FIGURE 20 — Modern .22-caliber auto-pistols are invariably of blowback design. Shown is the Victor by High Standard.

An exception was the electronically triggered free pistol used by American shooters in the 1968 Olympic Games in Mexico, which was designed by Major Frank Green.

Another currently manufactured and extremely popular single-shot pistol is that made by Thompson-Center in New Hampshire. This particular gun features a breaking or tip-up frame (similar to single and double-barrel shotguns) and interchangeable barrels which can be switched merely by punching out a pin, installing the new barrel, and reinserting the pin. The Thompson "Contender" pistol is chambered for cartridges ranging from the .22-caliber long rifle to the center-fire .22 Jet, .22 Hornet, new .30 Herrett, .30 U.S. carbine, .38 Special, .357 magnum, .45 long Colt, and .410-gauge shotshell.

An older single-shot pistol which is now a collector's piece is the Stevens Model 10. It is similar in appearance to a semi-automatic .22, but operates on a swinging bolt and is a true single-shot. Colt and Smith & Wesson both built single-shot pistols for target work, known as the Camp Perry and Perfected (or Olympic) models respectively. These pistols are considered collector's items today.

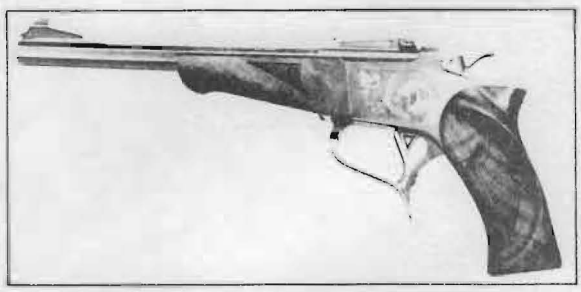


FIGURE 21 — The modern "Contender" by Thompson-Center Arms Co. has proved enormously successful through its barrel-interchangeability feature, and chamberings for a multitude of standard, Wildcat, (and even rifle) cartridges.

Older handguns, made from before 1900 to 1910, and some guns manufactured today (classed as "Saturday Night Specials"), often have weak frames, reflect shoddy workmanship, and should not be trusted with full or high-powered loads.

It is unwise to modify any revolver such as the .44 Special or .38 Special to accept longer magnum cartridges by lengthening the chambers. While the bore and cylinder size may be the same, the metal in the non-magnum gun may not be stressed to handle the high pressures generated by magnum loads.

By the same token, do not attempt to place magnum powder charges in standard-length cartridge cases. This can be even more dangerous than rechambering for magnum shells because such a load generates more pressure per square inch in the small case than in the larger magnum case, and vastly increases the chance of the gun blowing up.

Each of the pistols and revolvers we have mentioned here, plus many more, will be discussed separately and in greater detail in an appropriate Gun Shop section.

Now you are ready to go into cartridge development. Part 2 of Study Unit 5 begins with the development of metallic cartridges and goes into fundamental *practical* considerations for all gun pros. You may turn to Part 2 of Study Unit 5 as soon as you're ready.

ANSWERS

3

1. Short-recoil.
2. Blowback.
3. Short-recoil.
4. Short-recoil.
5. Blowback.

NOTES

NOTES

DEVELOPMENT OF THE METALLIC CARTRIDGE CASE

THE RIM-FIRE CARTRIDGES

The self-contained metallic cartridge case, which vastly improved the efficiency of late 19th-century military and sporting arms, ironically first developed as a shooting gallery "toy."

While Tyler Henry is credited with inventing the first rim-fire metallic cartridge for large-bore rifles (the .44 Henry), the first successful self-contained metallic cartridge was developed about 15 years earlier by Frenchman Louis Flobert in 1845. He also invented a small rifle and pistol for his cartridge. The new Flobert system became popular among French society folks, with the "popping" of Floberts punctuating many an afternoon garden party where even the ladies joined in the shooting fun.

Flobert's design consisted of a soft copper case, priming mixture, and a .22-caliber round lead ball. No powder charge was used; the priming compound served as the sole propellant. Horace Smith and Daniel Wesson, two of the more enterprising American gunmakers of the time (and founders of the gun firm which today bears their names), improved the basic Flobert BB cap cartridge. They lengthened the copper case, added a charge of blackpowder, and substituted a conical bullet for Flobert's ball projectile. The result was the .22 short which was introduced in 1857. The cartridge is essentially the same today, except for the type of powder used.

Rim-Fire Cartridges Have Been Made in Many Calibers

While the first rim-fire cartridges were of .22 caliber, they have been made in a variety of calibers up to and including a big-bore .58. Around 1900, approximately 75 different rim-fire calibers were loaded by American manufacturers. The "lowly" .22 has always been the runaway favorite, with more .22-caliber ammunition sold today than all other calibers combined!

FIGURE 1 — The Flobert system, a small rifle and/or pistol and the world's first self-contained metallic cartridge, was invented in France in 1845 and soon became a "society toy." Yet the official French army rifle of 1870, the Dreyse needle gun, used a paper cartridge. (Drawing courtesy 1914 French "Manufrance" catalog)

With the exception of several tiny and obscure 2mm-4mm center-fire cartridges made in Germany for indoor target shooting, the lowest powered cartridge currently available is the .22-caliber BB (bulleted breech) cap. This cartridge, designed for indoor targets and pests (sure kills on rats guaranteed with heart or brain shots), has been discontinued by American manufacturers. The round is still made in Europe and is (or was) imported into the U.S. by the Stoeger Arms Co.

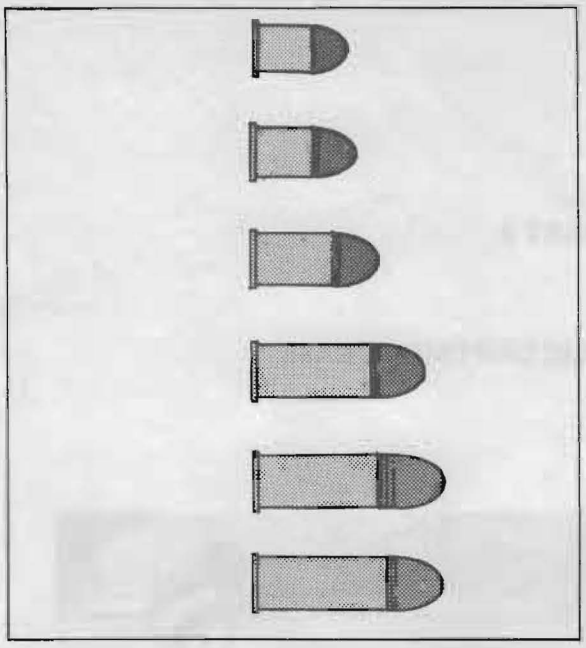


FIGURE 2 — Evolution of the .22-caliber rim-fire. From top: .22 BB cap, .22 CB cap, .22 short, .22 long, .22 long rifle, and the short-lived .22 extra long.

The CB (conical bullet) cap, another short-range target .22, halfway between the BB cap and .22 short in power, is also obsolete. These cartridges have been replaced by a .22 short shooting gallery round employing a sintered iron, spatter-proof bullet. Sintering, in this application, is the process of heating and compressing powdered iron into a solid bullet which disintegrates on impact, eliminating the danger of ricochets.

Contrary to popular belief, the .22 short, as loaded today, is surprisingly powerful and a big seller. It is used for low-cost "plinking," pest control, and target shooting. Expensive, match-quality target rifles are made exclusively for the .22 short competition cartridge and are used in international shooting matches.

The .22-Caliber Long is "Short" on Efficiency

There is little justification for the .22 long cartridge, which mates the .22 long rifle case with the 29-grain .22 short bullet. The velocity of the long is only about 100 fps faster than the .22 short, about the same as the .22 long rifle with its harder hitting 40-grain bullet. Modern .22 rifles (with the exception of those chambered exclusively for the short) are chambered to produce optimum accuracy with the bullet of the long rifle cartridge barely engaging the rifling. The long bullet "jump" (or freebore) before the shorter 29-grain short or long bullet enters the rifling is detrimental to accuracy. See Figure 5.

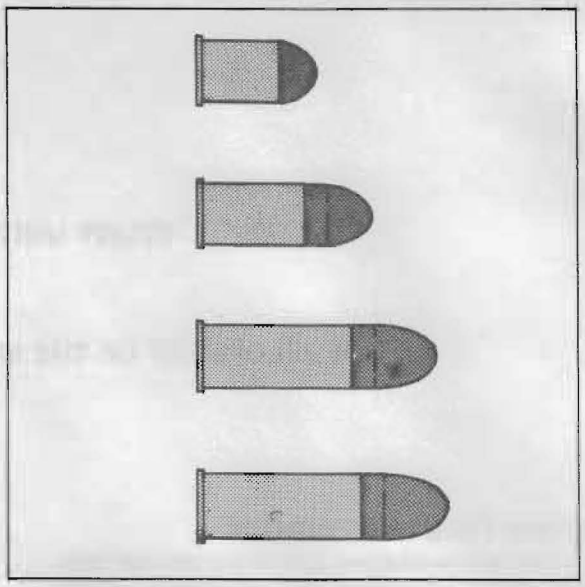


FIGURE 3 — The .32-caliber rim-fire series of cartridges, now obsolete, was patterned after the .22's, but was used primarily in handguns. The last guns for these cartridges were discontinued about 1936. From top: .32 extra short, .32 short, .32 long, and .32 long rifle.

The .22 long was introduced in 1871, about 16 years earlier than the .22 long rifle. Only one or two manufacturers still make the cartridge, mostly as a convenience for the misguided.

The .22 long rifle cartridge, on the other hand, is probably the world's most highly developed cartridge — and in target or match quality, the most accurate of any commercial round, rim-fire or center-fire. Long rifle target ammunition is manufactured for both rifles and handguns, with the pistol variety incorporating a faster burning powder for maximum efficiency in the shorter barrels. Extreme care is observed in the manufacture of .22 target grade ammunition. However, even "standard" hunting ammo is surprisingly accurate, and often capable of 1" MOA groups. Manufacturing tolerances for .22 rim-fire ammunition are not as critical as for the center-fire type, and slight variations between individual rounds cause little difference in accuracy.

The .22 Long Rifle Cartridge is Powerful Home Protection

Aside from its effectiveness as a small game and target cartridge, the .22 long rifle has a largely unsuspected capability for home and self-defense. With a 40-grain bullet moving at 1,285 fps, muzzle energy is 147 foot pounds — more "stopping power" than is provided by such common "defense" guns as the .25 ACP (73 foot pounds), the .32 long Colt and .32 New Police Colt (each about 100 foot

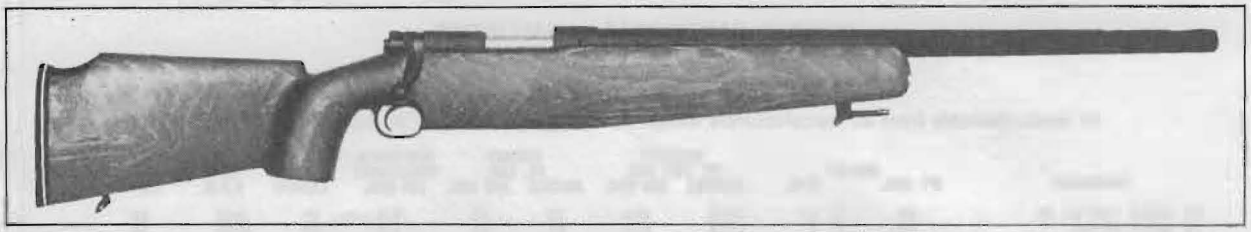


FIGURE 4 — Top-quality competition rifles, such as the Winchester 70 shown, are usually chambered for the .22 long rifle cartridge, but are sometimes chambered for the .22 short. A slower, usually 1-24" twist is then utilized.

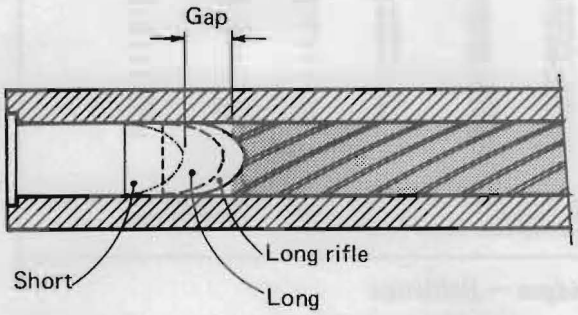


FIGURE 5 — Standard .22 rifles are chambered for the long rifle cartridge, with the bullet just engaging the rifling. When a long or short cartridge is chambered, the bullet must "jump the gap" before it reaches the rifling. This "jump" is usually detrimental to accuracy.

pounds), and the .32 S&W long (115 foot pounds). It is right up there with the .38 S&W (146-grain bullet, 150 foot pounds) and the .38 short Colt (150 foot pounds). See Tables 1 and 2 for comparative rim-fire/center-fire ballistics.

The light weight and low recoil and noise levels of the .22 long rifle cartridge enable most beginning shooters to gain a proficiency and accuracy they might not attain at all with a bellowing, sharp-kicking, big-bore handgun. As such, the "pipsqueak" .22 long rifle can be potent short-range medicine indeed, in the hands of a cool shot.

The .22 Winchester magnum rim-fire (.22 WMR), moving a 40-grain bullet at 2,000 fps, is an even deadlier home defense choice, delivering 355 foot pounds of muzzle energy. This equals the 9mm Luger and exceeds the .38 Special in most loadings!

The "Magnum" .22's

The .22 WMR was developed by Winchester in the late 1950's. With its slightly longer case and larger jacketed bullet (.224" in diameter as opposed to .222" for standard .22's) and higher velocity, it delivers more than twice the muzzle energy of the .22 long rifle. The .22 WMR has an effective small game range of about 150 yards as compared to the 100-yard maximum for the .22 long rifle.

CENTERFIRE HANDGUN CARTRIDGES — BALLISTICS

Winchester-Western, Remington-Peters, Norma, Federal, Browning, and S&W/Fiocchi

Most loads are available from W-W and R-P. All available Norma loads are listed. Federal cartridges are marked with an asterisk. Other loads supplied by only one source are indicated by a letter, thus: Norma (a); R-P (b); W-W (c).

Cartridge	Bullet Gr.	Bullet Style	Muzzle Velocity	Muzzle Energy	Barrel Inches
22 Jet (b)	40	SP	2100	390	8⅜
221 Fireball (b)	50	SP	2650	780	10½
25 (6.35mm) Auto*	50	MC	810	73	2
256 Winchester Magnum (c)	60	HP	2350	735	8½
30 (7.65mm) Luger Auto	93	MC	1220	307	4½
32 S&W Blank (b, c)	No bullet		—	—	—
32 S&W Blank, BP (c)	No bullet		—	—	—
32 Short Colt	80	Lead	745	100	4
32 Long Colt, IL (a)	82	Lub.	755	104	4
32 Colt New Police	100	Lead	680	100	4
32 (7.65mm) Auto*	71	MC	960	145	4
32 (7.65mm) Auto Pistol (a)	77	MC	900	162	4
32 S&W	88	Lead	680	90	3
32 S&W Long	98	Lead	705	115	4
32-20 Winchester	100	Lead	1030	271	6
32-20 Winchester	100	SP	1030	271	6
357 Magnum (b)*	158	SP	1550	845	8⅜
357 Magnum	158	MP	1410	695	8⅜
357 Magnum	158	Lead	1410	696	8⅜
357 Magnum (a)	158	JHP	1450	735	8⅜
9mm Luger (a)	116	MC	1165	349	4
9mm Luger Auto*	124	MC	1120	345	4
38 S&W Blank	No bullet		—	—	—
38 Smith & Wesson	146	Lead	685	150	4
38 S&W (a)	146	Lead	730	172	4
38 Special Blank	No bullet		—	—	—
38 Special, IL (c)	150	Lub.	1060	375	6
38 Special, IL (c)	150	MP	1060	375	6
38 Special	158	Lead	855	256	6
38 Special	200	Lead	730	236	6
38 Special	158	MP	855	256	6
38 Special (b)	125	SJHP	Not available		
38 Special (b)	158	SJHP	Not available		
38 Special WC (b)	148	Lead	770	195	6
38 Special Match, IL (c)	148	Lead	770	195	6
38 Special Match, IL (b, c)	158	Lead	855	256	6
38 Special Hi-Speed*	158	Lead	1090	425	6
38 Special (a)	158	RN	900	320	6
38 Short Colt	125	Lead	730	150	6
38 Short Colt, Greased (c)	130	Lub.	730	155	6
38 Long Colt	150	Lead	730	175	6
38 Super Auto (b)	130	MC	1280	475	5
38 Auto, for Colt 38 Super (c)	130	MC	1280	475	5
38 Auto	130	MC	1040	312	4½
380 Auto*	95	MC	955	192	3¾
38-40 Winchester	180	SP	975	380	5
41 Remington Magnum (b)	210	Lead	1050	515	8¾
41 Remington Magnum (b)	210	SP	1500	1050	8¾
44 S&W Special	246	Lead	755	311	6½
44 Remington Magnum	240	SP	1470	1150	6½
44 Remington Magnum	240	Lead	1470	1150	6½
44-40 Winchester	200	SP	975	420	7½
45 Colt	250	Lead	860	410	5½
45 Colt, IL (c)	255	Lub., L	860	410	5½
45 Auto	230	MC	850	369	5
45 ACP (a)	230	JHP	850	370	5
45 Auto WC*	185	MC	775	245	5
45 Auto MC (a, b)	230	MC	850	369	5
45 Auto Match (c)	185	MC	775	247	5
45 Auto Match, IL (c)	210	Lead	710	235	5
45 Auto Match*	230	MC	850	370	5
45 Auto Rim (b)	230	Lead	810	335	5½

IL—Inside Lub. JSP—Jacketed Soft Point WC—Wad Cutter
RN—Round Nose HP—Hollow Point Lub—Lubricated
MC—Metal Case SP—Soft Point MP—Metal Point
LGC—Lead, Gas Check JHP—Jacketed Hollow Point

TABLE 1 — Center-Fire Handgun Cartridges — Ballistics

RIMFIRE CARTRIDGES — BALLISTICS

Remington-Peters, Winchester-Western, Federal & CCI

All loads available from all manufacturers except as indicated: R-P (a); W-W (b); Fed. (c); CCI (d).

CARTRIDGE	BULLET WT. GRS.	BULLET TYPE	VELOCITY FT. PER SEC. MUZZLE	VELOCITY FT. PER SEC. 100 YDS.	ENERGY FT. LBS. MUZZLE	ENERGY FT. LBS. 100 YDS.	MID-RANGE TRAJECTORY 100 YDS.	HANDGUN BARREL LENGTH	BALLISTICS M.V. F.P.S.	BALLISTICS M.E. F.P.
22 Short T22 (a, b)	29	C, L*	1045	810	70	42	5.6	6"	865	48
22 Short Hi-Vel.	29	C, L	1125	920	81	54	4.3	6"	1035	69
22 Short HP Hi-Vel. (a, b, c)	27	C, L	1155	920	80	51	4.2	—	—	—
22 Short (a, b)	29	D	1045	—	70	—	—	—	—	(per 500)
22 Short (a, b)	15	D	1710	—	97	—	—	—	—	(per 500)
22 Long Hi-Vel.	29	C, L	1240	965	99	60	3.8	6"	1095	77
22 Long Rifle T22 (a, b)†-1	40	L*	1145	975	116	84	4.0	6"	950	80
22 Long Rifle (b)†-2	40	L*	1120	950	111	80	4.2	—	—	—
22 Long Rifle (b)†-3	40	L*	—	—	—	—	—	6¾"	1060	100
22 Long Rifle (d)†-4	40	C	1165	980	121	84	4.0	—	—	—
22 Long Rifle Hi-Vel.	40	C, L	1285	1025	147	93	3.4	6"	1125	112
22 Long Rifle HP Hi-Vel. (b, d)	37	C, L	1315	1020	142	85	3.4	—	—	—
22 Long Rifle HP Hi-Vel. (a, c)	36	C	1365	1040	149	86	3.4	—	—	—
22 Long Rifle (b, c)	No.	12 Shot	—	—	—	—	—	—	—	—
22 WRF [Rem. Spl.] (a, b)	45	C, L	1450	1110	210	123	—	—	—	—
22 WRF Mag. (b)	40	JHP	2000	1390	355	170	1.6	6½"	1550	213
22 WRF Mag. (b)	40	MC	2000	1390	355	170	1.6	6½"	1550	213
22 Win. Auto Inside lub. (a, b)	45	C, L	1055	930	111	86	—	—	—	—
5mm Rem. RFM (a)	38	PLHP	2100	1605	372	217	Not Available			

†—Target loads of these ballistics available in: (1) Rem. Match; (2) W-W LV EZXS, Super Match Mark III; (3) Super Match Mark IV and EZXS Pistol Match; (4) CCI Mini-Group. C—Copper plated L—Lead (Wax Coated) L*—Lead, lubricated D—Disintegrating
MC—Metal Case HP—Hollow Point JHP—Jacket Hollow Point PLHP—Power-Lokt Hollow Point

TABLE 2 — Rim-Fire Cartridges — Ballistics

The reason for the .22 WMR's longer case and "oversize" bore is to prevent the uninformed shooter from firing this more powerful, higher pressure cartridge in conventional (and generally less ruggedly built) .22-caliber rifles. Both Colt and Ruger offer revolvers with interchangeable .22 long rifle and .22 WMR cylinders, permitting use of either cartridge (see Figure 6). The bores are, of course, of .224" diameter. When the smaller .222" long rifle round is used in the larger barrel, the relatively soft bullet expands under pressure, forming a snug seal within the bore. Accuracy, while not gilt-edged, is acceptable.

FIGURE 6 — A popular and well built revolver, designed to shoot both .22-caliber standard rim-fire and the slightly larger bore .22 WMR, is the Colt "New Frontier" shown. Interchangeable cylinders are provided.

Another .22-caliber cartridge which once enjoyed considerable popularity is the now obsolete .22 Winchester rim-fire (.22 WRF), also known as the .22 Remington Special. This cartridge uses a bullet of 45 grains with a bore diameter of .228", oversize for the same reason as the modern .22 WMR. Velocity is 1,450 fps, slightly better than the standard .22 long rifle with its 40-grain bullet. Although rifles for this first .22 "magnum" have not been made for nearly 40 years, ammunition for them is still offered by the major ammo-making companies. Rifles of .22 WRF or .22 Remington Special chambering are rare today, and are considered collector's prizes (see Figure 7).

A .22 "extra long" cartridge with 40-grain bullet and a longer case than the long rifle, but with equal ballistics, was listed in ammunition catalogs between 1880 and 1935. Few rifles were made for this round because of the longer action required, and it never gained much popularity.

Two other relatively unknown .22 cartridges are the .22 Winchester Automatic and .22 Remington Automatic smokeless cartridges. These were designed for the first Winchester and Remington auto-loading rifles, and had an oddball case size to prevent standard-size blackpowder cartridges from being used in, and fouling, these early autoloaders. Winchester still makes its version of this cartridge, though rifles haven't been manufactured since 1936.

The .22-Caliber Shotshell

A type of .22 ammo that once enjoyed modest sales is the .22-caliber shotshell containing a small amount of No. 12 "dust" shot. When fired in the smoothbore .22 rifles formerly manufactured by Remington and Mossberg, the round is reasonably effective on

FIGURE 7 — The Remington Model 12 standard-grade pump rifle was chambered for the .22 Remington Special cartridge. Models were also available in chamberings for "standard" .22's.

short-range pests and on the small clay pigeons made for this tiny trap and skeet load.

When fired in a rifled bore (as they usually are), pellet deformation and shot-column dispersion, caused by the rifling, render the round nearly worthless.

In the late 1960's, Remington spent a lot of time and money developing a .32-caliber rim-fire shotshell for use in coin-operated shooting galleries, but dropped the project for reasons unknown.

The 5mm Remington Rim-Fire Magnum

The recently developed 5mm Remington cartridge, while not a .22 (it is actually .204" caliber), deserves mention because it is of rim-fire design and was undoubtedly "inspired by" the success of the .22 WMR. Ballistics are similar, although the 5mm Remington has a slight edge in velocity, muzzle energy, and trajectory. It is the most powerful of the currently manufactured rim-fire cartridges, and the only one to incorporate a bottleneck or tapered-shoulder case design (see Figure 8).

Let's See How the "Rim-Fire" Cartridge is Constructed

As you know, "rim-fire" refers to the method of detonating the powder charge. Unlike a center-fire cartridge, which carries a separate primer in the cartridge base, a rim-fire cartridge has a thin layer of *extremely explosive* priming mixture spread on the inside rim of the case head (see Figure 9). This priming compound is so sensitive that a sharp blow anywhere on the rim, such as is delivered by a firing pin, explodes the priming substance, which in turn ignites the powder charge.

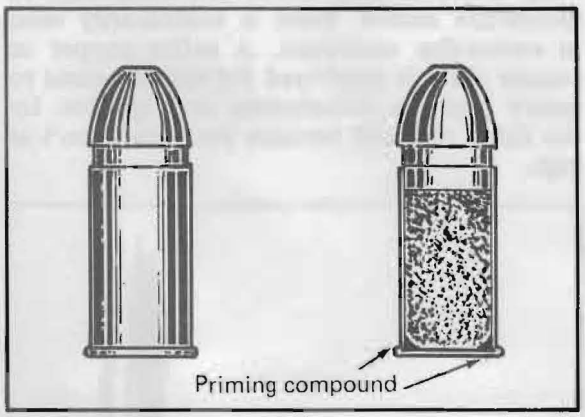


FIGURE 9 — Rim-fire cartridges are primed by "spinning" the priming compound into the rim recess by centrifugal force.

A .22-caliber rim-fire case starts out as a small disc of copper or of a special brass alloy which is punched in the center, then drawn into a cylindrical shape by specialized machinery. The enclosed end is then "bumped" to expand the case head evenly, thus creating the rim necessary for extraction of the case and headspacing. The open end is then trimmed to its specified short or long length. Next, the priming compound is placed in the case. Because of its sensitivity when dry, it is handled in a semi-liquid state. The mixture is dropped into the case, which is then spun so that centrifugal force drives the priming compound into the hollow recess under the rim perimeter. The primed cases are then dried to "fix" the priming material. Powder is metered into the case and the bullet is seated. Following application of the bullet lubricant (if any), the finished rounds are screened for uniformity, the defective cartridges are kicked out,

FIGURE 8 — The 5mm Remington rim-fire is the hottest rim-fire cartridge offered today. Cartridge and rifle were introduced in 1970.

and the "approved" products are boxed for distribution to the nation's shooters.

While the process sounds complicated (and it is), rim-fire ammunition is much less costly to make than center-fire types. Ultra-sophisticated, highly automated equipment handles every stage of manufacture, turning out thousands of flawless cartridges per hour. Rim-fire ammunition cannot, of course, be reloaded — but this is unimportant because of the relatively low manufacturing (and retail) cost, which is only about one-tenth that of center-fire ammo. Brass is customarily used in center-fire cartridges. A softer copper or copper alloy is employed for rim-fire cases to assure positive indentation and ignition by the firing pin, and because pressures aren't as high.

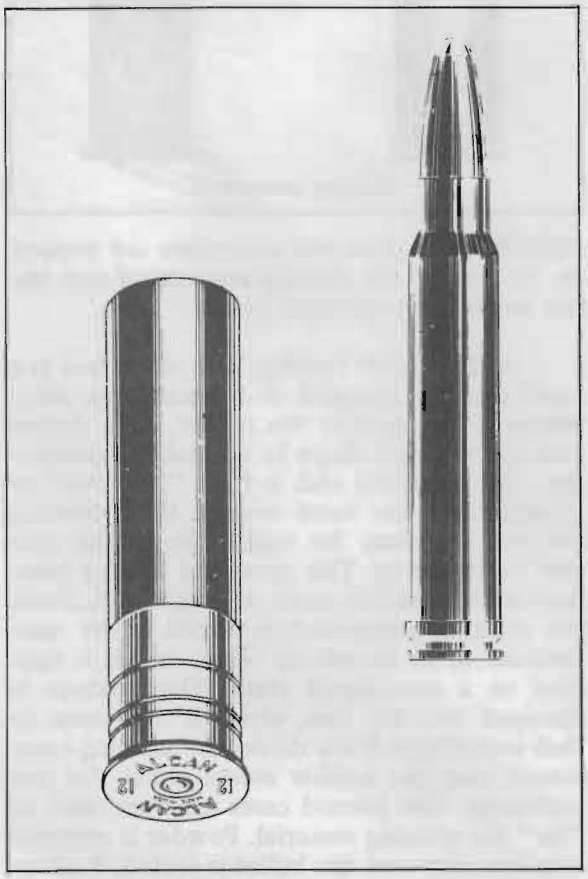


FIGURE 10 — Metallic cartridges and shotshells, although vastly different in purpose and components, share one similarity. The brass head of the shotshell and the metallic case are both manufacturer-punched and drawn out of thin brass on the same type of machinery.

Before going on, please do Programmed Exercise 1. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

PROGRAMMED EXERCISE

1

Match the descriptions in the bottom column with the terms in the top column by placing the letters in the blanks provided.

___ 1. .22-caliber BB (breeched bullet)

___ 2. .22 short

___ 3. .22 long

___ 4. .22 long rifle

___ 5. .22 WMR

___ 6. .22 WRF

___ 7. .22-caliber shotshell

___ 8. 5mm Remington

A. Used for plinking and target shooting.

B. Obsolete cartridge still offered for collectors' guns.

C. Effective fired in a smooth-bore, but worthless when fired through a rifle.

D. Most powerful currently manufactured rim-fire cartridge.

E. Lowest powered cartridge currently available.

F. Most highly developed and accurate commercial round.

G. Has twice the muzzle energy of the .22 long rifle.

H. Combines the .22 long rifle case with the 29-grain .22 short bullet.

Answers on Page 8

.22-Caliber Bullets and Bore Sizes

Standard, non-magnum .22 bullets are .222" in diameter and are available in 29-grain weight for both short and long cartridges, and in 40-grain weight for long rifle cartridges. Available bullet types are the 29-grain sintered variety for shooting gallery shorts, and the 29-grain and 40-grain solid round-nose and hollow-point hunting varieties.

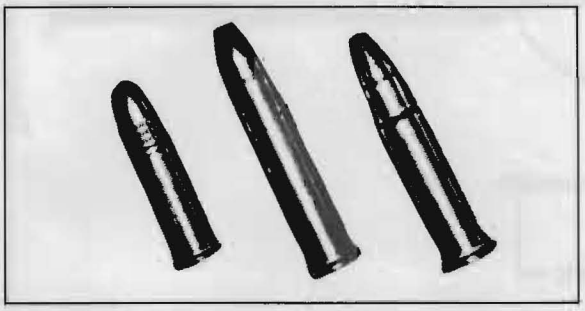


FIGURE 11 — Today's most popular rim-fire cartridges. From left: .22 long rifle, .22 Winchester magnum (both with 40-grain bullets), and 5mm Remington with 38-grain bullet.

The solid bullets are designed primarily for target work and are usually lubricated, making them messy to handle and capable of causing malfunctions in tubular magazines. Lubed bullets can also collect sand and grit, which leads to barrel scratching.

Hollow-point hunting bullets are usually not lubricated, but are "washed" with a thin coat of copper or brass to prevent fouling and leading of the bore. This "wash" should not be confused with the copper jacket used on .224 WMR solid and hollow-point bullets. The .224 WMR's higher velocity (and friction) and greater chamber pressure would cause an unprotected lead bullet to soften when fired, leading to excessive leading of the bore and horrendous accuracy.

Rifling Twist in .22-Caliber Rifles

The longer the bullet, generally speaking, the faster the twist or curve of rifling necessary to spin and stabilize the bullet. Rifles and pistols of .22 caliber usually have a twist of 1-16 — one turn to 16 inches of barrel length. This 1-16 twist is a bit fast for stubby 29-grain bullets, but ideal for the longer .22 long rifle projectiles which are the most commonly used. (By way of contrast, center-fire .22's with long 70 to 80-grain bullets require a fast 1-9 or 1-10 twist for best accuracy.)

For the .22 WMR which is loaded only with a 40-grain bullet, a 1-20 twist is utilized. This slower twist is used because the velocity of the .22 WMR is about 40% greater than the standard .22 long rifle, which also has a 40-grain bullet. Both bullets are rotating at about the same speed when they exit the barrel, even though twist and velocity differ.

Some of the older .22's have even slower twists, but the 1-16 is considered the industry standard. Exceptions are rifles chambered for the .22 short, which usually have a twist of 1-24 for better accuracy.

Few Non-.22 Rim-fire Cartridges are Manufactured Today

In the last 40 years of the 19th century, and up until the 1920's, a great many rim-fire cartridges of larger than .22 caliber were manufactured in the U.S. for both rifles and pistols. The smaller bore .25, .32, and .38-caliber versions, the "newest," were the last to go. An exception was the long-lived, big-bore .41 Swiss Vetterli rifle (Figure 13), which was a modified .44 Henry with a turnbolt action. When the Vetterli army rifles became obsolete in Switzerland in about 1890, they were imported by the thousands into the U.S. and sold via mail order. Ammo was produced for this popular cartridge by American manufacturers for many years, but was discontinued around 1942.

The only rim-fire cartridges currently in U.S. production, other than the 5mm Remington, are the various .22's.

CENTER-FIRE CARTRIDGES

The first metallic cartridges appeared in the early 1840's, and while they contained propellant and projectile, they did not include a primer. The powder was ignited outside of the gun through a hole in the case by means of a percussion cap or a paper tape roll containing up to 25 sealed primers. The latter, invented by a dentist, Doctor Edward Maynard, was almost identical to the toy cap pistol "ammo" used today by children. (See Figure 14.)

Two men, Ambrose Burnside and the Dr. Maynard of primer-type fame, are generally credited with developing, independently, the first metallic cartridges. They used differently shaped cases and placed the ignition hole in different positions, but the principle of bullet and powder in the case, and "outside" ignition, was identical.

The first self-contained rimless case by Flobert, and the first center-fire cases, were both derived from the concept developed by Burnside and Maynard. The percussion cap had been around for years. It was invented by an Englishman, Joshua Shaw, and was based on the explosive "percussion powder" patented by Alexander Forsyth, a Scottish clergyman, in 1807. Shaw emigrated to America where he perfected the percussion cap. By

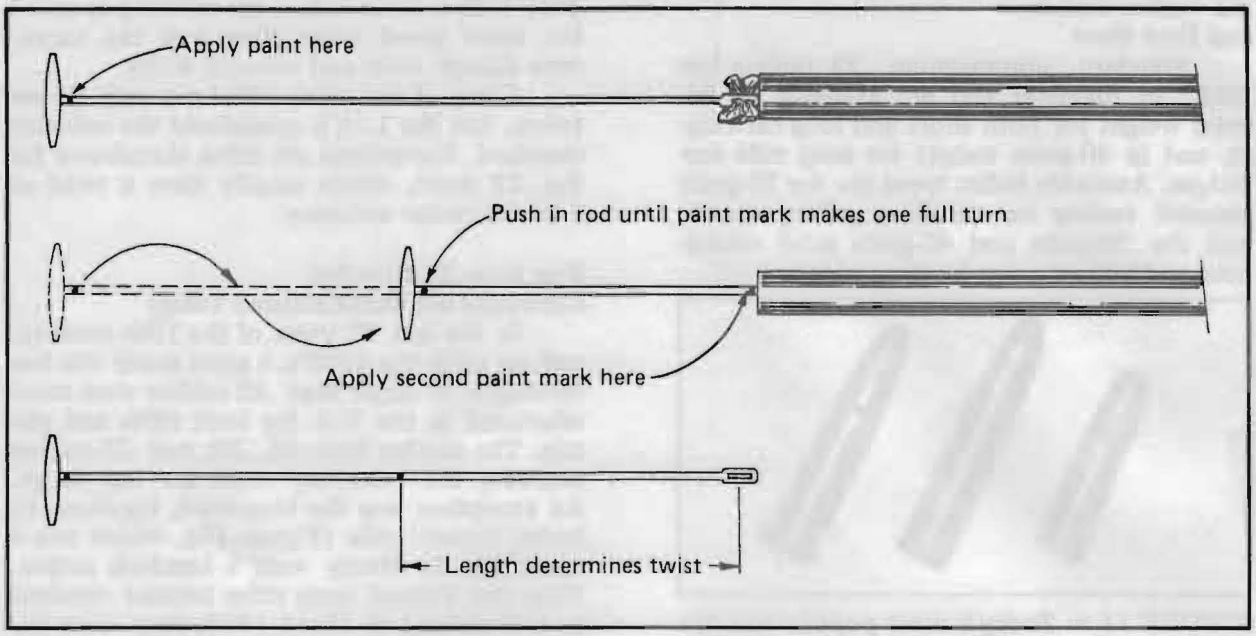


FIGURE 12 — The twist of any barrel can be determined with a cleaning rod, patch, and a bit of paint or nail polish. Affix as large a patch as possible to the tip of the rod, and (1) barely insert it into the muzzle. Mark the top of the rod with a dab of paint. (2) Force the rod into the barrel until the mark on the rod comes up again, thus completing one turn. Place another dab of paint on the rod immediately adjacent to the bore. Withdraw the cleaning rod. (3) Measure the distance from the patch to the second dab of paint. The twist is then one (turn) to the distance you measured. Medium and long pistol barrels may be measured the same way, but using a quarter-turn of rod (because of the short barrel) and then multiplying the distance the rod traveled for a quarter-turn by 4.

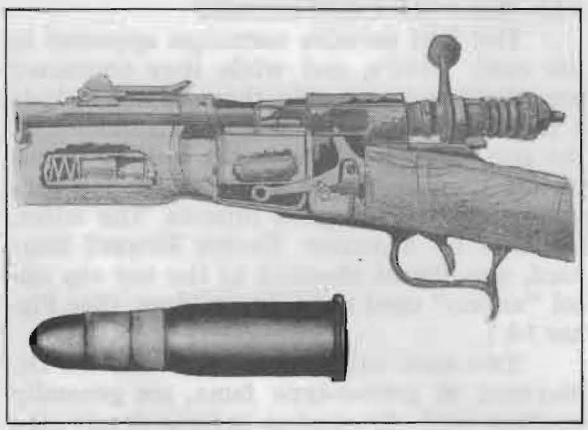


FIGURE 13 — The Swiss Vetterli rifle and rim-fire cartridge knocked down countless deer and black bear around the turn of the century. The rifle was unique in that both rim-fire and center-fire cartridges, identical except for ignition, were made for the gun.

1825 his invention, the ancestor of today's center-fire primer, was rapidly replacing the flintlock ignition system.

The "Folded-Head" Cartridge

The advantage of placing the percussion cap inside the cartridge, rather than mounting it on a nipple outside the gun, was obvious.

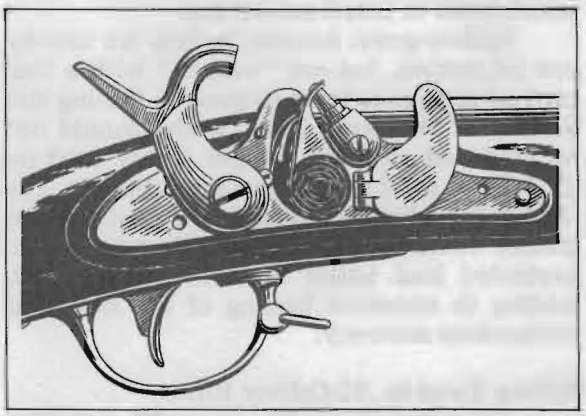


FIGURE 14 — Maynard tape primer system details. Individual charges or caps were sealed in paper. The invention later inspired children's "cap pistols."

ANSWERS

1

1. E 2. A 3. H 4. F 5. G

6. B 7. C 8. D

The U.S. Army, in the early 1860's, utilized a "folding-head" metallic cartridge in the original .50-70 government musket. Externally, this round looked like a rim-fire since the primer was not positioned in the cartridge head. The primer (known as the Benet type) was held inside the case by two deep indentations in the case wall positioned just ahead of the rim. Although generally unsatisfactory because of gas leakage and the fact that only low chamber pressure was possible, this cartridge was used by the U.S. Army from 1866 to 1873, when the famous "Trapdoor" Springfield in .45-70 caliber arrived on the scene. The "folded-head" round was the first true center-fire metallic cartridge.

FIGURE 15 — The first center-fire military cartridge in wide use was the .50-70 musket (.50 Govt.) of 1866. The original cartridge had a "folded-head" (Benet type) primer; later versions used conventional Boxer center-fire primers.

FIGURE 16 — The famous .45-70 U.S. Government cartridge of 1873 has been around for over 100 years and is now enjoying an upsurge in popularity. Smokeless powder loadings in modern rifles deliver impressive knockdown power on the largest American game.

Modern Primers Invented in the Late 1860's

Aware of the shortcomings of contemporary priming systems, two Army ordnance officers, both colonels, one American and the other English, decided (in 1866 and 1867 respectively) to devise a better priming system. Each came up with a vastly improved primer that shared similarities with the other. There were also differences.

The American officer's name was Berdan; the English officer's name was Boxer. Ironically, the American Berdan primer was destined for adoption in England and Europe; the English Boxer primer would become the "standard" in the U.S. Both systems are still in use, and in nearly their original forms.

Berdan and Boxer primers look alike externally, and are positioned similarly in the case head. There the similarity ends. The familiar Boxer primer is a self-contained unit with an integral cup, anvil, disc, and explosive primer pellet. When the firing pin strikes, the anvil is crushed against the primer pellet and a jet of flame flares through the flashhole in the bottom of the case, igniting the powder charge.

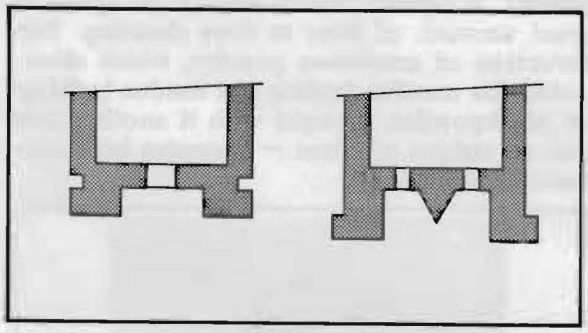


FIGURE 17 — Boxer-type primers have an integral primer and are designed for cases with a single flashhole and primer pocket (left). Cases for Berdan primers (right) have two or three flashholes and the anvil is part of the case. The Berdan primer has no anvil.

Berdan-primed cases have two and sometimes three flashholes, and an anvil which is formed as part of the case, in the bottom of the primer pocket. The biggest difference between the two primers (they function equally well) is that Boxer-primed cases lend themselves to reloading while Berdan-primed cases do not. The former are *easily* decapped and reprimed; the latter are not. Fired Berdan primers *can* be removed, but the process is tedious, involving the use of a small tool resembling an ice pick. Hydraulic pressure will also force out spent Berdans, but the method is wet and messy.

Why the U.S. Adopted Boxer Primers

The advantages and disadvantages relative to reloading greatly influenced which countries would adopt which type of primer, even in the 19th century. The European nations which opted for the Berdan system were interested in a military application where reloading adaptability wasn't important.

In the U.S., however, center-fire cartridges have been reloaded since their invention. The old buffalo hunter, after a day afield, would sit beside his campfire and patiently load ammunition for the next day's hunt while his crew skinned out the buffalo that had fallen that day. Easy primer extraction, which the Boxer system provided, was a must.

As a result, Boxer primers survived, and then gained wide acceptance in America. Today, all primers manufactured in the U.S., and there are several sizes, are of the Boxer design. Modern European ammunition is predominantly Berdan-primed, although the Boxer type is gaining in popularity.

Early Primers Caused Corrosion Problems

Up until the late 1920's, anyone who bought a firearm could expect to spend a good amount of time at bore cleaning. The invention of smokeless powder, which eliminated the massive fouling and residue buildup of blackpowder, brought with it another and just as serious problem — excessive bore corrosion and pitting.

The main explosive ingredient of primers used in both blackpowder and early smokeless cartridges was potassium chlorate (which converts to potassium chloride when burned), a chemical quite similar to sodium chloride (common table salt). When a gun was fired, the salts were spewed down the bore, and moisture-laden air soon brought about rust and corrosion. Pitting was actually worse with smokeless powders than with blackpowder, as the percentage of corrosive priming salts to powder volume was higher in the new powder.

Interestingly, the new smokeless powder was thought to be the villain. As a result, shooters cleaned their guns with various "nitro solvents" which did little more than spice up the air with their acrid fragrance. Such solutions did slow down the corrosion a bit, but shooters were better off relying on simple hot water to dissolve the damaging salts. A few people caught on and did use hot water cleaning, as blackpowder shooters had been doing for years. However, the majority of gun owners, despite liberal applications of elbow grease and "nitro solvent," wound up with pitted bores.

For this reason, it is almost impossible to find an old blackpowder or early smokeless period rifle, pistol, or shotgun with a near-perfect bore. Most are badly pitted, especially the small-caliber .22's and .25's, whose cartridges contained a higher ratio of primer salts to powder than did the big bores and shotguns.

Components That Did the Damage

It is difficult to conceive of a more destructive recipe for firearms than the ingredients of late 19th-century primers. According to *The Book of the Springfield* by E. C. Crossman, a typical mix (and one used in .30/40 Krag ammunition) was as follows:

Fulminate of mercury	60%
Potassium chlorate	22%
Ground glass	16%
Mealed powder	2%

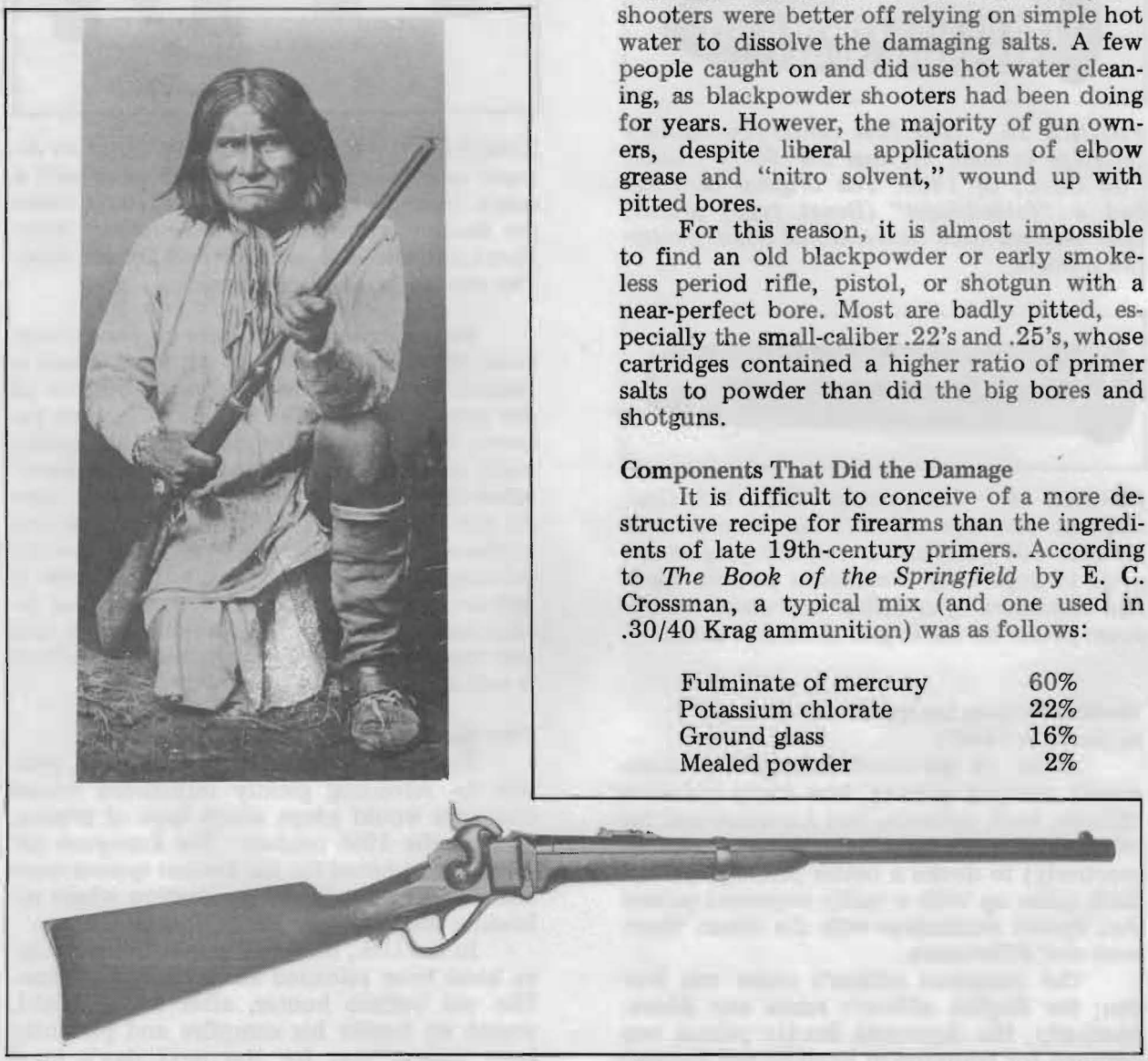


FIGURE 18 — Geronimo and most buffalo hunters used long-range, highly accurate rifles such as the converted Sharps shown here, firing metallic cartridges. Reloading fired cases was part of the job, and Boxer primers made the chore easy.

The mercury fulminate made the cases so brittle that reloading was dangerous; the potassium chlorate guaranteed rust; and the ground glass acted as an abrasive, causing marked barrel wear. Outside of these "slight" drawbacks, it was a good primer — producing a hot flame and instant ignition.

Winchester, in the 1920's, developed an improved primer composition for the U.S. Government known as the Frankfort Arsenal No. 70 formula. This recipe was almost as unfriendly to steel as its predecessors, but it was extremely stable and efficient. The No. 70 Frankfort primer mixture was used in nearly all American small arms ammunition during World War II, with the exception of the M1 carbine cartridge which contained a non-corrosive primer.

The No. 70 Frankfort mixture included a giant blob of potassium chlorate (53%), but did away with the fulminate of mercury and ground glass. Surplus World War II ammo is still available. If you or your customers plan on using it, remember that these cartridges most likely have corrosive primers. Bores should be cleaned with boiling water immediately after firing, followed by a good commercial solvent. Otherwise, prepare for a case of ingrown "ammo acne."

The Non-Corrosive Primers

Remington, in 1927, was the first ammo manufacturer to develop a non-corrosive primer, which the company dubbed "Kleanbore." It cleaned bores all right, and without corrosion (the potassium chlorate was eliminated); but other than this, Kleanbore priming (as originally made) wasn't the answer to much of anything. The mixture contained, among other ingredients, brass-brittling mercury fulminate and a whopping 20% to 28% ground glass. No wonder those bores were "Klean"! Most handloaders shrugged and went back to their Frankfort No. 70 primers and hot water bore cleaning.

Less sophisticated shooters were delighted with "Kleanbore" priming and Remington's sales skyrocketed. In self defense, other manufacturers developed similar non-corrosive priming mixtures using different amounts of essentially the same ingredients.

Today's non-corrosive primers are a different breed entirely from either the Frankfort No. 70 or early Kleanbore mixtures. The key ingredient is lead styphnate, an explosive but non-corrosive chemical first used in primers by the Germans in World War I, which replaced the fulminate of mercury. A second explosive chemical, tetracene, is included to increase the sensitivity of the primer and cause it to burn more evenly. In addition to the fuel and sensitizer (styphnate and tetracene), primers must have a fuel such as calcium silicide or antimony sulphide, and an oxidizer such as barium nitrate or potassium nitrate.

All modern primers contain varying amounts of these chemicals. Primer composition, even by one manufacturer, may change from time to time. The brand of primer you buy today may be quite different in makeup and performance from the same brand you purchased three to five years ago.

Influence of Primers on Velocity and Chamber Pressure

Some handloaders are under the impression that one brand of primer will produce the same ballistics as another, all else being equal. This simply isn't so. When you develop a good powder/bullet/primer combination, *don't change primers.* If you do, you may change chamber pressure as much as you would by adding or subtracting several grains of powder.

The primer is the heart of your cartridge. Just how much a "change of heart" can influence ballistics is demonstrated by Table 3 — based on a study by the Remington Ballistics Division.

Sample	Priming Mixture	Average Velocity	Average Pressure
A	1	2352 fps	53,700 psi
B	2	2316 fps	46,550 psi
C	3	2311 fps	42,220 psi
D	4	2298 fps	42,870 psi
E	5	2229 fps	32,120 psi

TABLE 3 — Effect of Priming Mixtures on Ballistics (same bullets, cases, powder, and powder charge)

Cartridge Case Manufacture

Another Berdan invention, and one that *was* quickly adopted in the U.S., was the Berdan drawn brass cartridge case, which first appeared in 1870. It soon made the contemporary rolled copper and earlier paper cases obsolete. (The latter were called "cartouches" by the French, from which "cartridge" was derived.) The Berdan case-drawing technique, with modifications, of course, is still used today in the manufacture of center-fire ammunition.

In forming the brass, a number of separate drawing operations are necessary, with annealing (heat-softening) between these operations vitally important. Brass becomes brittle when worked, and proper annealing controls the strength and "temper" of the brass. When

a case is too soft, it sticks to the gun's chamber and is difficult to extract; when too hard, it is brittle and may crack during the first firing or stand up under just one or two reloadings. A case that is annealed correctly will expand under pressure to conform to a chamber's exact contours, then spring back to nearly its original dimensions for easy extraction after firing.

The first U.S. center-fire cartridges were for large-caliber military rifles, originally .58, later .50 and .45, as designers learned that a given case capacity and powder charge would drive a lighter and smaller diameter bullet faster, with a better trajectory, and with just as much or more stopping power. (See Figure 20.)

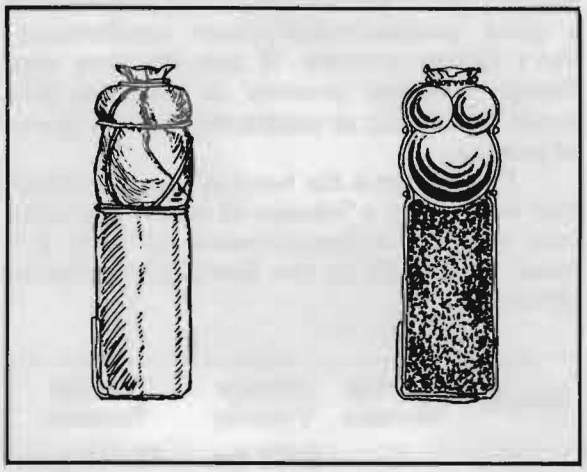


FIGURE 19 — The earliest cartridges were rolls of paper enclosing a ball projectile and powder. After tearing (or biting) the case open, the powder was poured down the barrel, the ball rammed home, and the paper wadded on top.

Before going on, please do Programmed Exercise 2. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

Evolution of the Bottleneck Case

Early center-fire cases were straight-walled. As the diameters of the bullets diminished, so did the case necks — resulting in cartridges of the now familiar bottleneck configuration. Ballisticians discovered that a bottleneck case, with the case diameter considerably larger than the bullet diameter, resulted in a shorter cartridge than a straight-walled case holding the same amount of powder. Shorter cartridges meant shorter, smoother functioning actions, and more of them could be stuffed into a tubular magazine. The bottleneck or tapered-neck cartridge was here to stay.

PROGRAMMED EXERCISE

2

Match the condition of brass in the top list with the way it will perform when fired (from the bottom list) by placing the letters in the blanks provided.

___ 1. Brittle brass

___ 2. Soft brass

___ 3. Annealed brass

A. Will expand under pressure, then retract.

B. Will crack easily.

C. Will expand to stick in the chamber.

4. Briefly describe the most important difference between the Berdan and the Boxer primers.

Answers on Page 14

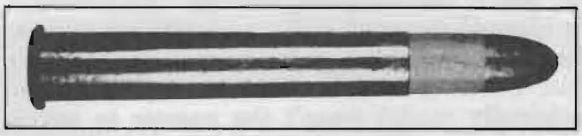


FIGURE 20 — The small-bore .44-100 Ballard cartridge, introduced in 1876, had a higher velocity and delivered more foot pounds of energy than most .50 and .58-caliber cartridges. A more favorable ballistics coefficient also provided a flatter trajectory.

The Great Shoulder Angle Controversy

In the early days when cartridge shoulder angles "just grew" out of straight-walled cases being necked down to smaller bore diameters, nobody thought too much about the effect of the new shoulder angle on pressure, velocity, accuracy, or combustion.

Today there are about as many opinions as there are gun nuts. To many, a sharp 35° to 40° angle is synonymous with power. This is like saying that a big engine block means super power, when in reality the block is only oversize to accommodate the oversize pistons which *are responsible* for the power.

FIGURE 21 — Early examples of bottleneck cartridge design, each based on a prior straight-wall design. From top: .40-90 Bullard, 1886; .40-90 Sharps, 1876; and .40-70 Remington, 1880.

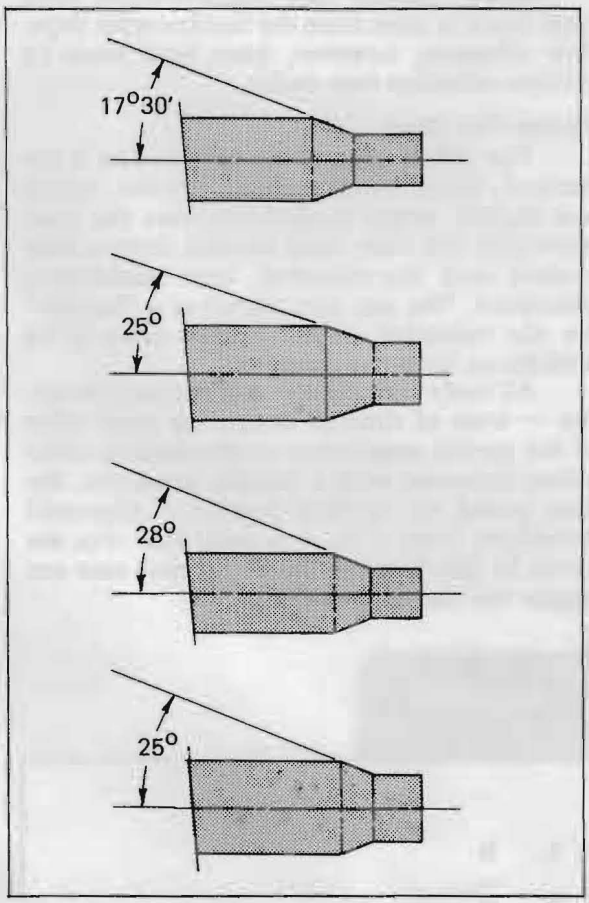


FIGURE 22 — Shoulder sharpness doesn't necessarily mean super performance. Note the diversity of angle in four of our hottest contemporary cartridges. From top: .25/06 Remington, 7mm Remington magnum, .22-250 Remington, and .300 Winchester magnum.

Most sharp-shouldered cases are "improved" Wildcats, with the shoulder of a standard case blown out by fire-forming to hold more powder than could the original case with its sloping shoulders. The angle has little to do with anything other than influencing powder capacity, and the more powder burned for a given bullet, the higher the velocity.

There are experts who will tell you that a sharp angle increases (or reduces) peak chamber pressure; others believe that a sharp shoulder hastens (or slows down) powder burning; still others are of the opinion that a shallow shoulder angle improves (or louses up) accuracy. The arguments go on and on. A sharp-shouldered case does *look* more "business-like," but that's about the only conclusion usually agreed upon!

Winchester, in bringing out its .458 and .300 Winchester magnums and creating two new cases basically from scratch, specified a relatively shallow 25° angle for each. Remington, in developing its equally powerful 7mm magnum, retained that same 25° angle. The .284 Winchester cartridge, designed to fit short actions, utilizes a sharp 35° shoulder. This angle was probably influenced more by how much powder Winchester wanted the short case to hold (which would dictate the shoulder position and angle) than by other considerations.

The venerable .30/06, now outclassed by the .30-caliber magnums, has a shallow 17° shoulder. The super-hot .25/06 has the same 17° shoulder as its parent. The Wildcat .25/.284, which is ballistically identical to the .25/06, has a super-sharp 38° shoulder.

Expediency, rather than iron-clad rule, establishes the shoulder angles of new commercial cartridges. And whatever angle is selected isn't all that important.

Smokeless Powder Demanded Stronger Guns and Cases

The invention of smokeless powder followed the accidental invention of dynamite, in 1867, by Alfred Nobel, a Swede, whose guilt over his contribution to military mayhem led to the later establishment of the Nobel Peace Prize. Smokeless powder was perfected in 1884 by Vieille, a French chemist. By 1886, several early military bolt-action rifles, including the 1886 French Lebel, were designed for smokeless cartridges. Because smokeless powder eliminated the "dead give-away," the puff of smoke that followed the discharge of a blackpowder arm, it was extremely desirable from a military standpoint. By the last quarter of the 19th century, nearly all European armies were equipped with smokeless arms. In the U.S., however, we were

still relying upon the blackpowder .45-70 Springfield.

During the Spanish-American War, while the then modern .30-40 Krag was ostensibly our mainstay, most American troops were still equipped with the old Springfields. The enemy, armed with 7mm smokeless Mausers, managed to kill or wound more than 1,400 of our 15,000 troops with their accurate, fast-firing, long-range rifles. It was a costly lesson for us!

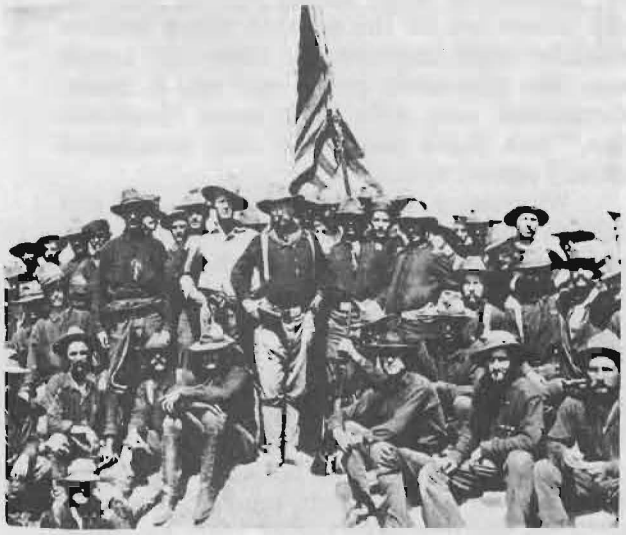


FIGURE 23 — The Battle of San Juan Hill was a costly victory for the U.S. when the smokeless repeating rifles of the enemy decimated our ranks, equipped for the most part with obsolete blackpowder Springfields. This photo shows Teddy Roosevelt and his Rough Riders before the battle.

Smokeless powder burns faster than blackpowder, increasing velocity while raising chamber pressure. Stronger guns were designed to contain these higher pressures. There was little, however, that could be done in those days to make the brass cartridge case proportionately stronger other than by thickening it (which raised pressures even higher) — which was like using a double-strength bag to hold a belligerent bobcat.

Despite fairly recent advances in metallurgy and the development of new and tougher brass alloys, the cartridge case has traditionally been the weakest link in the firing chain reaction. The steel in modern firearms, and their locking design, can safely handle pressures much higher than their ammunition generates. The brass is always the first to go, rupturing or cracking from overloads or repeated reloadings. This is a good thing, as the shooter can inspect the brass and tell that something is awry, but usually without injury to that shooter. See Figure 24.

FIGURE 24 — Flaws in cartridge case manufacture are fairly commonplace, especially with military ammo where the quality control isn't as rigid as for sporting ammunition. The case rupture shown resulted from too much hardening alloy in the metal "mix."

Many changes and improvements have been made in guns since the blackpowder days. Few advances, however, have been made in modern cartridge case design.

Center-Fire Cases

The oldest type of center-fire case is the rimmed, straight-wall variety. The rim, which was slightly larger in diameter than the case, prevented the case from moving farther than desired into the chamber, thus establishing headspace. The rim also served as a "handle" for the extractor, enabling fired cases to be withdrawn from the chamber.

All early cartridges — rim-fire and center-fire — were of rimmed design. As most rifles of the period were either single-shots or lever-action repeaters with a tubular magazine, the rims posed no feeding problems. (Rimmed cartridges, even .22's in a single-line clip, are prone to jam because the rim of one case can engage the rim of the next.)

ANSWERS

2

1. B
2. C
3. A
4. The Boxer primer can be reloaded easily while the Berdan cannot.

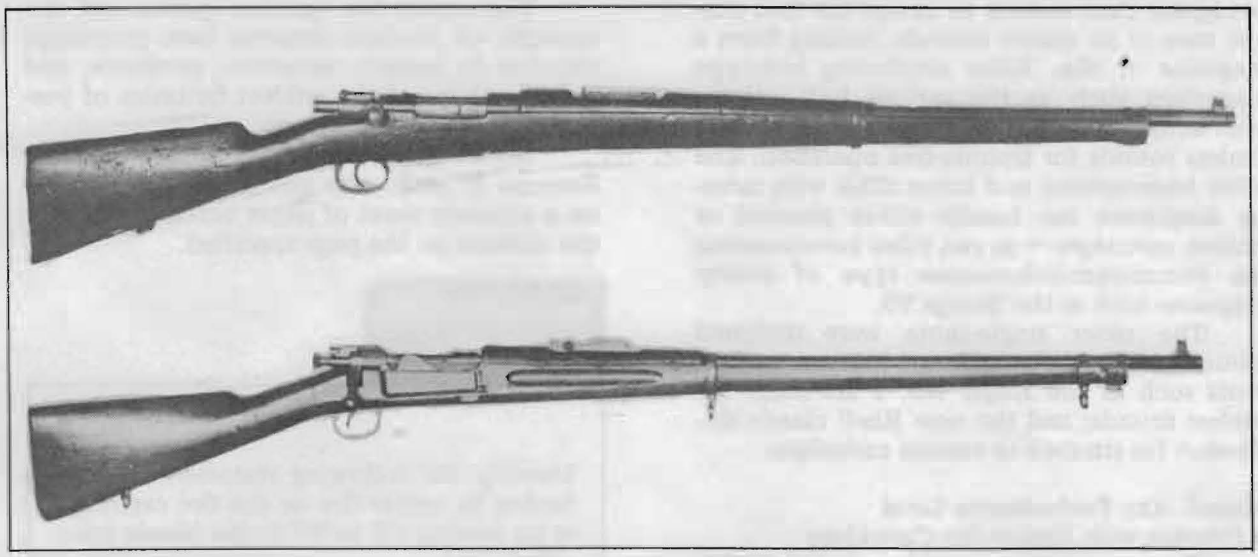


FIGURE 25 — The Spanish 7mm Mauser (top) was one of the first military rifles to use a rimless cartridge and staggered-column magazine. The contemporary U.S. Krag-Jorgensen service rifle (bottom) used the .30-40 rimmed cartridge and had an unsatisfactory box-type magazine. Both rifles were used in the Spanish-American War.

It was because of the jamming problem with rimmed cases, which couldn't be tolerated in a military weapon, that Paul Mauser designed the first rimless cartridge and the staggered-column magazine from which such cartridges would feed smoothly. The rimless case has a rim for the extractor to grasp, but it is considered "rimless" because the rim is of the same diameter as the case.

The rimless case is used almost universally in modern sporting arms; even the belted magnums are "rimless." By the turn of the century, almost every army in the world was using Paul Mauser's rimless design, with the exception of the U.S., whose issue rifle was the Krag — designed for the rimmed .30/40 Krag cartridge and incorporating a cumbersome, inefficient box magazine. In 1903 the U.S. finally came out with a rimless cartridge which led to the rimless .30/06 three years later.

Variations of the Rimless Design

A subdesign of the rimless case is the semi-rimmed .220 Swift, a cartridge introduced in the mid-1930's by Winchester, considered obsolete in the 1950's, and more or less revived the past few years. The production case was based on the 6mm Lee Navy cartridge of 1895 (see Figure 26). The parent case had an extremely thin rim, extending only a "hair" past the case diameter. This rim was rightfully considered too weak to provide satisfactory extraction for the proposed high-pressure Swift cartridge. A groove was cut just ahead of the rim, which provided a better "bite" for the extractor.

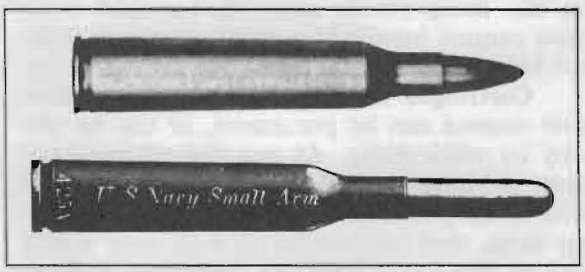


FIGURE 26 — The only current-production cartridge of semi-rimmed design is the .220 Swift (top), which is essentially a necked-down version of the 6mm Lee Navy cartridge (bottom) of 1895.

Another variation of the rimless design is the rebated .284 Winchester case. Here, the short case body is wider than the rim diameter. This cartridge, designed for short actions, has about the same powder capacity as the longer .30/06 case. When one wants a short case that holds a lot of powder, the only answer is to make it wider. Rebated cases have been made in Germany for years, but the .284 Winchester (and its Wildcat progeny) is the only domestic example of rebated design.

The belted magnums are also essentially rimless in that the rim is of the same diameter as the case, or very close. The belt just ahead of the extractor groove controls headspacing and provides extra case thickness where it's needed most.

Rimless Cases are Used in Most Modern Cartridges

Modern sporting and military rifles shoot rimless cartridges, and for the reason that

prompted Paul Mauser to design the first rimless case — to assure smooth feeding from a magazine or clip. Rifles employing box-type magazines such as the various bolt-actions, semi-autos, and clip-fed lever-actions, require rimless rounds for trouble-free operation. The older lever-actions and other rifles with tubular magazines can handle either rimmed or rimless cartridges — as can rifles incorporating the Mannlicher-Schoenauer type of rotary magazine such as the Savage 99.

The older single-shots were designed around rimmed cartridges. Modern single-shots such as the Ruger No. 1 are made for rimless rounds; and the new Riedl classic single-shot for rimmed or rimless cartridges.

Almost Any Performance Level is Possible with Center-fire Cartridges

The center-fire cartridge is inherently more versatile than the rim-fire, which in the .22 WMR and 5mm Remington cartridges has seemingly reached the peak of practical development. Because rim-fire brass must be soft for the firing pin to serve its function, such cases cannot handle high pressure — and without high pressure you don't get high velocity.

Cartridges of almost any performance level desired can be purchased, or can be created by wildcatting. At one end of the spectrum we have the .17-caliber Remington and even more powerful .17-caliber Wildcats, driving their tiny projectiles at well over 4,000 fps; at the other end we have the massive .460 Weatherby and comparable Wildcats, delivering more foot pounds of energy with one shot than could be generated by a platoon of blackpowder riflemen!

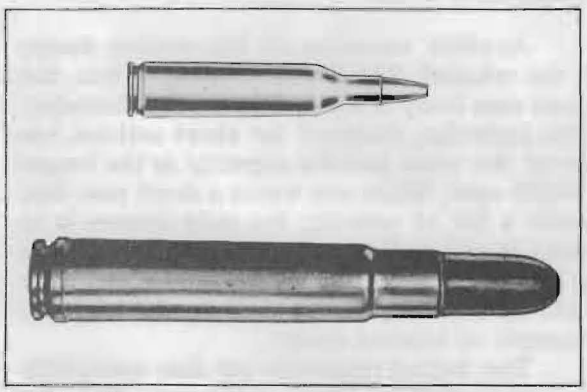


FIGURE 27 — The versatility of center-fire cartridges is represented by the tiny .17-caliber Remington which moves a 25-grain bullet at 4,025 fps, and the .460 Weatherby, the world's most powerful commercial cartridge, which pushes a 500-grain bullet at 2,700 fps. The muzzle energy of the .17-caliber cartridge is about 900 foot pounds; that of the .460 Weatherby is 8,090 foot pounds.

The center-fire ignition system and the strength of modern firearms have permitted shooters to achieve velocities, pressures, and accuracy beyond the wildest fantasies of yesteryear's firearms designers.

Before going on, please do Programmed Exercise 3. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

PROGRAMMED EXERCISE 3

Identify the following statements as referring to center-fire or rim-fire cartridges by placing CF or RF in the blanks provided.

___ 1. Can be reloaded.

___ 2. Much less expensive to manufacture.

___ 3. Has a brass case.

___ 4. Is more versatile.

___ 5. Can handle higher pressures.

___ 6. Has a thin layer of primer on the inside case head.

___ 7. Can achieve higher velocities.

___ 8. Has a soft copper or copper alloy case.

___ 9. Carries a separate primer in the cartridge base.

Answers on Page 19

Many Cartridges Have Common Ancestors

Modern cartridges of different calibers and made by different manufacturers often have the same head and case dimensions. The reason is that most new cartridges aren't really "new" at all, and are based on an existing cartridge case. The parent case may be necked up or down to accommodate a new caliber bullet; it may be shortened; or it may have a changed shoulder angle. A different extractor groove may be cut to make the forthcoming production cartridge fit an existing action. Yet the giveaway head and case measurements remain, providing a clue to ancestral origin.

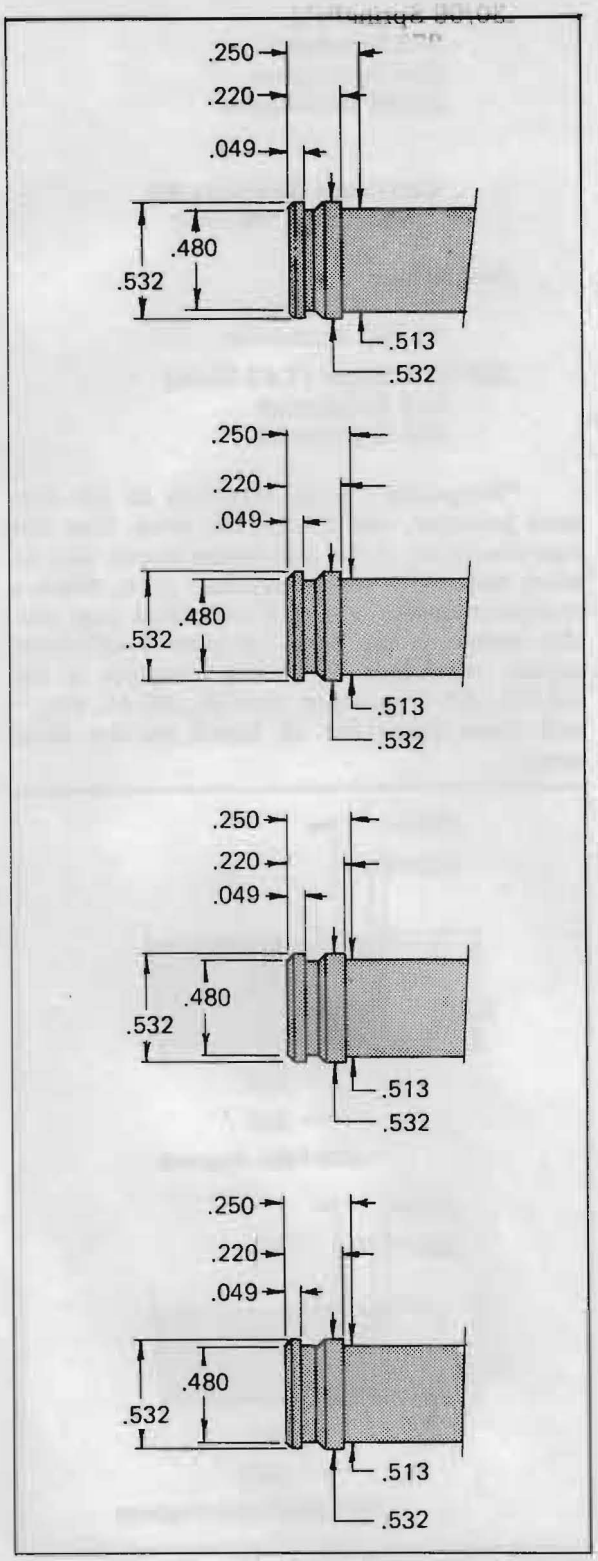


FIGURE 28 — A comparison of head, rim, groove, and belt measurements shows the common ancestry of today's most popular belted magnum cartridges. From top: .300 H&H of 1912, the "granddaddy of them all"; .338 (and .264 and .458) Winchester magnum; 7mm Remington magnum; 6.5 Remington magnum.

It has always been this way. When a big company cartridge designer (or a wildcatter, for that matter) sits down to dream up a new "Loudenboomer," he must have a basic case to work with, and one that when modified will be compatible with existing actions and/or a planned new action. He is not going to go to the trouble and expense of completely forming a new case of radical dimensions, experimenting with it, then discarding it and making another because the first wasn't quite right. No, he is going to fuss around with an existing cartridge.

The big manufacturers do, occasionally, develop an entirely new case, but this doesn't happen often. Even the comparatively new Winchester .264, .338, and .458 belted magnums share nearly identical head and case dimensions with the .375 Holland & Holland belted magnum which was introduced in 1912. This cartridge, and its shorter counterpart, the .300 H&H, were the parents of the Weatherby series cartridges.

The .264 (or .358) Winchester was, incidentally, the parent of the newer 7mm Remington magnum (cases are identical except for length and bore dimensions).

8mm Mauser Has More Descendants than an Arab Chieftan

As an example of how one cartridge can sire an entire dynasty of cartridges, consider the 8mm Mauser (8x57), which was one of the original Mauser designs and was introduced in 1888. Shortly thereafter, in the early 1890's, the 8mm Mauser was necked down to 7mm and slight changes were made in the head and extractor groove dimensions. The result was the famous 7mm Mauser (7x57), which is also the parent of several notable offspring.

The 8mm Mauser is the direct ancestor of the most famous cartridge of all time, the U.S. .30/06 — which is essentially a stretched-out and necked-down version of the 8x57. The '06 has, of course, spawned more progeny in commercial and wildcat cartridges than any other case. Included are the .300 Savage and its derivatives, and the .308 family of cartridges. The following lists just some of the commercial cartridges that share a common forebear, the 8mm Mauser . . .

Geneology of the 8mm (8x57) Mauser Cartridge

7mm (7x57) Mauser
- .257 Roberts
- 6mm Remington
- 5.6x57 (German super-velocity .224)

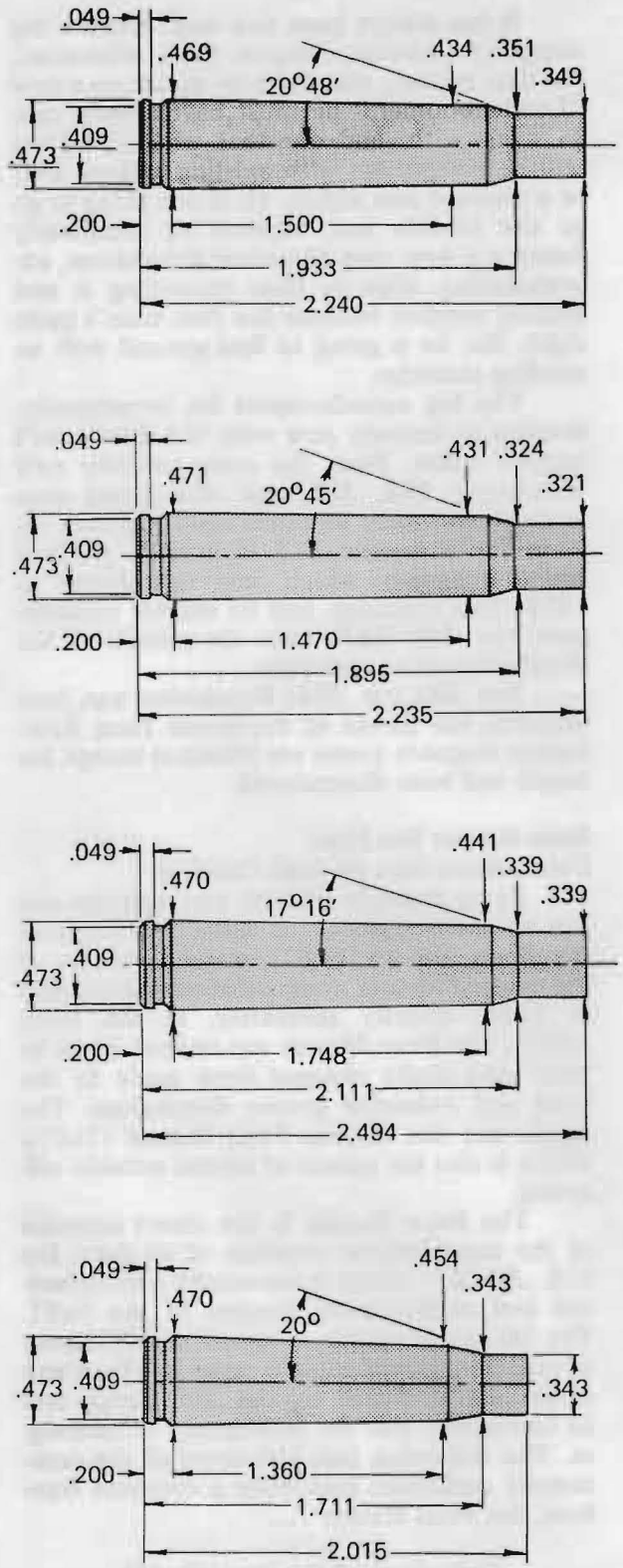


FIGURE 29 — The 8mm Mauser (top) has spawned more wildcat and commercial cartridges than any other case. Some of them (from top) are: 7mm (7x57) Mauser, .30/06 Springfield, and .308 Winchester. The case, head, and rim dimensions are the "giveaway."

.30/06 Springfield
- .270 Winchester
- .280 Remington
- .25/06 Remington

Cartridges Based on the Shortened '06 Case

.300 Savage
- .250-3000 Savage
- .22-250 Varminter

.308 Winchester (7.62 Nato)
- .243 Winchester
- .358 Winchester

"Swipe-itis" is so common in the firearms industry, and always has been, that few manufacturers make any bones about who or what inspired a new cartridge. Also, when a company develops a new case, that case usually serves as the basis for several different-caliber cartridges. An early example is the .30/30, .32 Winchester Special, .30/40, etc. — and these series are all based on the same brass.

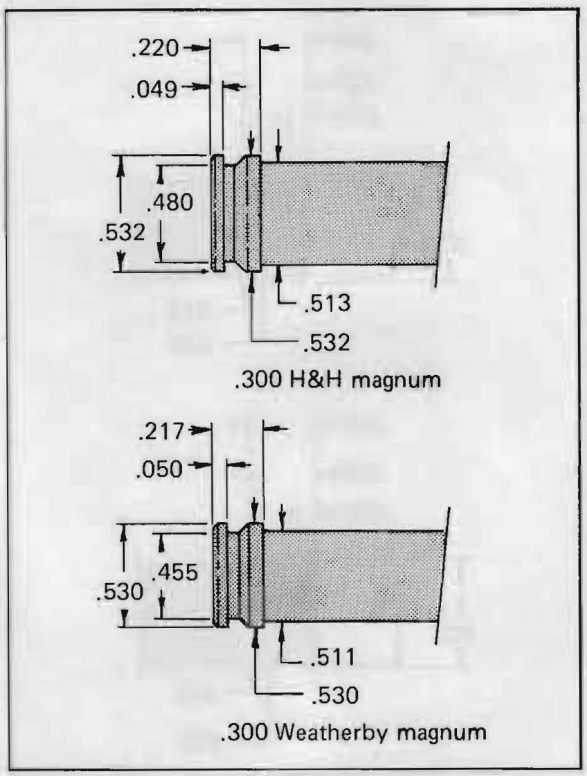


FIGURE 30 — The Weatherby cartridges were originally blown-out (fire-formed) versions of the .300 and .375 H&H magnum cases. A comparison of measurements shows how dimensions were slightly changed from the original H&H specifications when Norma of Sweden tooled up to commercially produce the Weatherby wildcats.

The .264, .338, and .458 Winchester belted magnums share the same case. All medium and large-bore Weatherby cartridges are based on the .300 H&H and .375 H&H cases respectively. The .275, 7mm, and .358 Apollos all share a common parent, the comparatively new .300 Winchester magnum case.

And so it goes. It is seldom indeed that a new case, new in every respect, is developed by any manufacturer. Following experimental work with modified parent cartridges, only slight (if any) changes are made in head and case specifications when tooling up for production.

A clue to ancestry is sometimes provided by which shellholder size is required for reloading. For example, the 8mm Mauser, .30/06, .270, .280 Remington, .300 Savage, and .308 Winchester (and the latter two cartridges' offspring) all utilize the same shellholder. There are exceptions, primarily because of changes in the size of the extractor groove, such as the 7mm Mauser. This cartridge is in the same 8mm-'06 family, but requires a different shellholder. Its direct offspring, the .257 Roberts and 6mm Remington, use the same size shellholder as the 7x57.

Most loading manuals reveal the parent case for a given cartridge with the idea of reworking parent brass to the newer caliber with appropriate forming dies. The 7mm Mauser cases can be reworked to .257 Roberts and 6mm Remington cases; .30/06 cases can be modified for use in 8mm, .270, .300 Savage, .308 Winchester, and a host of other caliber rifles. Drawings and dimensions of the various cases are also found in many loading manuals,

ANSWERS

3

1. CF 2. RF 3. CF 4. CF

5. CF 6. RF 7. CF 8. RF

9. CF

Cartridge	Pacific	RCBS	Lyman*	C-H	Bonanza	Redding
17 Mach IV	16	10	26	15	6	10
17/222	16	10	26	15	6	10
17/223	16	10	26	15	6	10
17 Remington	16	10	26	15	6	10
22 Hornet	3	12	4	Hornet	8	14
218 Bee	7	1	10	3	10	3
222 Remington	16	10	26	15	6	10
223 Remington	16	10	26	15	6	10
222 Remington Magnum	16	10	26	15	6	10
219 Donaldson Wasp	2	2	6	2	4	2
219 Zipper	2	2	6	2	4	2
224 Weatherby Magnum	17	27	3	224 Wea.	....	12
225 Winchester	18	11	5	4	7	4
22-250 Remington	1	3	2	1	1	1
220 Swift	4	11	5	4	7	4
243 Winchester	1	3	2	1	1	1
6mm/244 Remington	1	3	2	1	1	1
6mm/284	1	3	2	1	1	1
240 Weatherby Magnum	1	3	2	1	1	1
25-20	7	1	10	3	10	3
256 Winchester Magnum	6	6	1	12	3	12
25-35	2	2	6	2	4	2
250-3000 Savage	1	3	2	1	1	1
257 Roberts	1	11	2 or 8	4	1	1
257 Roberts Improved	1	11	2 or 8	4	1	1
25-06	1	3	2	1	1	1
257 Weatherby Magnum	5	4	13	6	2	6
6.5mm Japanese	34	15	5	6.5J	....	4
6.5 Carcano	21	9	28	14	....	1
6.5mm x 54mm Mannlicher Schoenauer	20	9	28	14	....	24
6.5mm x 55mm Swedish Mauser	19	2	27	2	7	1
6.5mm Remington Magnum	5	4	13	6	2	6
264 Winchester Magnum	5	4**	13	6	2	6
270 Winchester	1	3	2	1	1	1
270 Weatherby Magnum	5	4	13	6	2	6
7mm Mauser (7 x 57)	1	11	2	1	1	1
280 Remington	1	3	2	1	1	1
284 Winchester	1	3	2	1	1	1
7mm x 61mm Sharpe & Hart	35	26	13	7	....	6
7mm Remington Magnum	5	4**	13	6	2	6
7mm Weatherby Magnum	5	4	13	6	2	6
7.35mm Carcano	21	9	28	14	....	1
7.5 Schmidt-Rubin (7.5 Swiss)	2	2	6	2	....	....
30 M1 Carbine	22	17	19	30 M1	5	22
30-30 Winchester	2	2	6	2	4	2
300 Savage	1	3	2	1	1	1
308 Winchester	1	3	2	1	1	1
7.62 Russian	23	13	17	76	....	15
30-40 Krag	11	7	7	88	11	8
30-06	1	3	2	1	1	1
30-06 Improved	1	3	2	1	1	1
300 H&H Magnum	5	4**	13	6	2	6
308 Norma Magnum	5	4	13	6	2	6
300 Winchester Magnum	5	4	13	6	2	6
300 Weatherby Magnum	5	4	13	6	2	6
7.65 Belgian Mauser	24	3	2	1	1	1
303 British	11	7	7	88	11	8
7.7 Japanese	1	2	2	2	....	1
32 Winchester Special	2	2	6	2	4	2
8mm Mauser	1	3	2	1	1	1
8mm/06	1	3	2	1	1	1
33 Winchester	14	14	17	45-70	16	18
338 Winchester Magnum	5	4	13	6	2	6
340 Weatherby Magnum	5	4	13	6	2	6
348 Winchester	25	5	18	348	....	20
38 Special	6	6	1	12	3	12
357 Magnum	6	6	1	12	3	12
35 Remington	26	9	8 or 2	14	14	1
358 Winchester	1	3	2	1	1	1
350 Remington Magnum	5	4	13	6	2	6
35 Whelen	1	3	2	1	1	1
358 Norma Magnum	5	4	13	6	2	6
375 H&H Magnum	5	4	13	6	2	6
378 Weatherby Magnum	14	14	17	....	....	....
44 Remington Magnum	30	18	7	8	9	19
444 Marlin	27	28	148	88	27	19
45-70 Government	14	14	17	47	16	18
458 Winchester Magnum	5	4	13	6	2	6
460 Weatherby Magnum	14	14	17	....	....	....

*Lyman Tru-Line Junior Shell holders are suffixed by J.
Lyman All-American and Spartan shell holders are suffixed by X.
**Some SAKO and Norma cases may require a No. 26 shell holder.

TABLE 4 — Shell Holder Chart — Rifle Cartridges

which provide a further index to cartridge background. To repeat, the case and head diameter dimensions usually provide the clues.

PISTOL CARTRIDGE CASES — RIM-FIRE

What we have said thus far about rim-fire rifle cartridges also applies to rim-fire handgun cartridges. The .22 short was the first self-contained cartridge used in handguns. Today .22 rim-fire rounds are the only rim-fires manufactured for pistols.

In years past, a proliferation of rim-fire calibers was available for sidearms, some of which were used in both pistols and rifles (see Table 5). One of the most memorable of the rim-fires was the cartridge for the .41-caliber double Derringer pistol produced by Remington from 1866 to 1935. The Remington version was not designed by Henry Deringer (note the difference in spelling), whose original cap and ball .41-caliber single-shot pistol was introduced in the middle 1850's. Colt also produced a "Deringer" single-shot pistol in .41 rim-fire caliber from 1872 to 1912 (see Figure 31).

FIGURE 31 — The Colt single-shot (Deringer) cartridge pistol was first produced in 1872 after acquisition of patents previously held by National Arms Company.

The blunt, slow-moving 130-grain Deringer (or Derringer) bullet, originally pushed by 13 grains of blackpowder, was pure poison at across-the-table range, and many a gambler's argument was permanently settled with this tiny but mighty weapon. Today Derringers are still manufactured — but in .22 rim-fire and modern center-fire chamberings.

Another popular and widely sold rim-fire handgun was the .32-caliber pocket revolver made by Iver Johnson (Figure 32) and other manufacturers around the turn of the century. Low-powered and inexpensive, such revolvers were effective only at extremely short ranges. As such, they soon became known as "suicide specials." Ammunition of .32 rim-fire caliber hasn't been made for many years, and is almost impossible to obtain.

FIGURE 32 — Iver Johnson hinged-frame revolver, hammerless, double-action. It was made in several calibers, but the .32 S&W was the most popular. It was manufactured from 1895 to 1950.

Occasionally these handguns pop up for cleaning and repair. You're better off advising the customer to keep the gun as a memento (collector's value is small) and save repair costs, unless he has a supply of ammo laid away.

PISTOL CARTRIDGES — CENTER-FIRE

Center-fire handgun cartridges have much in common with center-fire rifle cartridges. They are manufactured in the same manner and are available in straight-wall, tapered-wall, and bottleneck configurations and in rimmed, rimless, and semi-rimmed versions. (To our knowledge, no one has yet come up with a belted magnum handgun case, but with the trend toward "magnumitis," it *could* happen.)

Handgun center-fire cases are essentially scaled-down versions of rifle cases — shorter (to work through the smaller handgun actions) and, as a result, less powerful. They also use smaller primers and faster burning powders. Almost all pistol cartridges, with the exception of a few ultra-velocity designs which we'll discuss in a moment, are of straight-wall or tapered-wall design.

REVOLVER CARTRIDGE CASES — CENTER-FIRE

Almost all revolvers and single-shot pistols use cartridges of the straight-wall, rimmed variety. (Exceptions are the special match-grade auto pistols made by Colt and Smith & Wesson that are chambered for the rimmed .38 Special revolver cartridge.) The rim, the same as with rimmed rifle cartridges, serves as a means of establishing headspace while providing a grip for the extractor. During World War II, Colt and Smith & Wesson produced the Model 1917 service revolver (see Figure 33) which was designed for a rimmed version of the .45 ACP (rimless) cartridge used in the Model 1911 semi-automatic service pistol. Unfortunately, somebody goofed — and the

Dimensional Data

Cartridge	Case type	Bullet dia.	Neck dia.	Shoulder dia.	Base dia.	Rim dia.	Case length	Cige. length	Twist	Primer
2.7mm Kolibri	D	.107	.139	—	.140	.140	0.37	0.43		B
3mm Kolibri	D	.120	.150	—	.150	.150	0.32	0.43		B
4.25mm Liliput	D	.167	.198	—	.198	.198	0.41	0.56		B
5mm Clement	C	.202	.223	.277	.281	.281	0.71	1.01		B
5mm Bergmann	D	.203	.230	—	.273	.274	0.59	0.96		B
5.5mm Velo Dog	B	.225	.248	—	.253	.308	1.12	1.35	8.2	S-B
22 Remington Jet	A	.223	.247	.350	.376	.440	1.28	1.58	10	S
221 Fire Ball	C	.224	.251	.355	.375	.375	1.40	1.82	14	S
25 ACP	D	.251	.276	—	.277	.298	0.62	0.91	16	S
256 Winchester Mag.	A	.257	.277	.378	.378	.440	1.30	1.53	14	S
6.5mm Bergmann	C	.264	.289	.325	.367	.370	0.87	1.23		B
7mm Nambu	C	.280	.296	.337	.351	.359	0.78	1.06	12.5	B
7.62mm Nagant (Russian)	B	.295	.286	—	.335	.388	1.53	1.53	9.5	B
7.62mm Tokarev	C	.307	.330	.370	.380	.390	0.97	1.35	10	B
7.63mm Mauser	C	.308	.332	.370	.381	.390	0.99	1.36	7.9	S-B
30 Borchardt	C	.307	.331	.370	.385	.390	0.99	1.34		S-B
7.63mm (7.65) Mannlicher	D	.308	.331	—	.332	.334	0.84	1.12	10	B
7.65mm (30) Luger	C	.308	.322	.374	.388	.391	0.75	1.15	9.8	S-B
7.65mm MAS (French)	D	.309	.336	—	.327	.337	0.78	1.19		B
7.65mm Roth-Sauer	D	.301	.332	—	.335	.335	0.51	0.84	14.2	B
32 ACP	H	.309	.336	—	.336	.354	0.68	1.03	16	S
32 S&W	B	.312	.334	—	.335	.375	0.61	0.92	16-18	S
32 S&W Long	B	.312	.335	—	.335	.375	0.93	1.27	16-18	S
320 Revolver	B	.317	.320	—	.322	.350	0.62	0.90	22	B
32 Colt	B	.313	.313	—	.318	.374	0.92	1.26	16	S
35 S&W Auto	D	.309	.345	—	.346	.348	0.67	0.97	12	S
7.5mm Swiss Army	B	.317	.335	—	.345	.407	0.89	1.29		B
7.5mm Nagant (Swedish)	B	.325	.328	—	.350	.406	0.89	1.35	18	B
8mm Nambu	G	.320	.338	.388	.408	.413	0.86	1.25	11	B
8mm Lebel Revolver	B	.323	.350	—	.384	.400	1.07	1.44	9.5	B
8mm Rath-Steyr	D	.329	.353	—	.355	.356	0.74	1.14	10	B
9mm Glisenti	D	.355	.380	—	.392	.393	0.75	1.15	10	B
9mm Luger	D	.355	.380	—	.392	.393	0.76	1.16	9.8	S-B
9mm Bayard	D	.355	.375	—	.390	.392	0.91	1.32		B
9mm Steyr	D	.355	.380	—	.380	.381	0.90	1.30		B
9mm Browning Long	D	.355	.376	—	.384	.404	0.80	1.10	12-16	B
9mm Makarov	D	.363	.384	—	.389	.396	0.71	0.97		B
357 S&W Magnum	B	.357	.379	—	.379	.440	1.29	1.51	18.8	S
380 Revolver	B	.375	.377	—	.380	.426	0.70	1.10	15.1	S-B
38 Long Colt	B	.357	.377	—	.378	.433	1.03	1.32	16	S
38 Special	B	.357	.379	—	.379	.440	1.16	1.55	16-18	S
38 S&W	B	.359	.386	—	.386	.433	0.78	1.20	16-18	S
38 Colt ACP & Super Auto	H	.358	.382	—	.383	.405	0.90	1.28	16	S
380 ACP (9mm Browning Short)	D	.356	.373	—	.373	.374	0.68	0.98	12-16	S
41 Long Colt	B	.386	.404	—	.405	.430	1.13	1.39	16	S
41 S&W Magnum	B	.410	.432	—	.433	.488	1.28	1.58	18	L
10.4mm Italian	B	.422	.444	—	.451	.505	0.89	1.25	10	B
44 S&W American	B	.434	.438	—	.440	.506	0.91	1.44	20	L
44 S&W Russian	B	.429	.457	—	.457	.515	0.97	1.43	20	L
11mm German Service	B	.426	.449	—	.453	.509	0.96	1.21	23	B
11mm French Ordnance	B	.425	.449	—	.460	.491	0.71	1.18	16.2	B
44 S&W Special	B	.429	.457	—	.457	.514	1.16	1.62	20	L
44 S&W Magnum	B	.429	.457	—	.457	.514	1.29	1.61	20	L
44 Colt	B	.443	.450	—	.456	.483	1.10	1.50	16	L
44 Webley	B	.436	.470	—	.472	.503	0.69	1.10	20	L-B
44 Bull Dog	B	.440	.470	—	.473	.503	0.57	0.95	21	S-B
11.75mm Montenegrin	B	.445	.472	—	.490	.555	1.40	1.73		B
45 Colt ACP	D	.452	.476	—	.476	.476	0.898	1.17	16	L
45 Auto-Rim	B	.452	.472	—	.476	.516	0.898	1.28	15-16	L
45 Colt	B	.454	.476	—	.480	.512	1.29	1.60	16	L
45 S&W Schofield	B	.454	.477	—	.476	.522	1.10	1.43	24	L
45 Webley	B	.452	.471	—	.471	.504	0.82	1.15		L-B
450 Revolver	B	.455	.475	—	.477	.510	0.69	1.10	16	L-B
455 Enfield (455 Colt)	B	.455	.473	—	.478	.530	0.87	1.35		L-B
455 Webley Revolver Mk-II	B	.454	.476	—	.480	.535	0.77	1.23	16-20	L-B
455 Webley Auto	H	.455	.473	—	.474	.500	0.93	1.23	10	B
476 Enfield	B	.472	.474	—	.478	.530	0.87	1.33		B
50 Remington Army	A	.508	.532	.563	.565	.665	0.57	1.24		L

Notes on handgun primers: Magnum pistol cartridges are usually loaded with special Magnum primers and the .22 Remington Jet and .256 Winchester are sometimes loaded with small rifle primers. During WW I, Frankford Arsenal made .45 ACP cases with special #70 primer of .204" diameter instead of the standard .210".

A—Rim, bottleneck
B—Rim, straight
C—Rimless, bottleneck
D—Rimless, straight
G—Semi-rimmed, bottleneck
H—Semi-rimmed, straight

Primer: S—Small rifle (.175"). L—Large rifle (.210"). B—Berdan type

Unless otherwise noted, all dimensions are in inches.

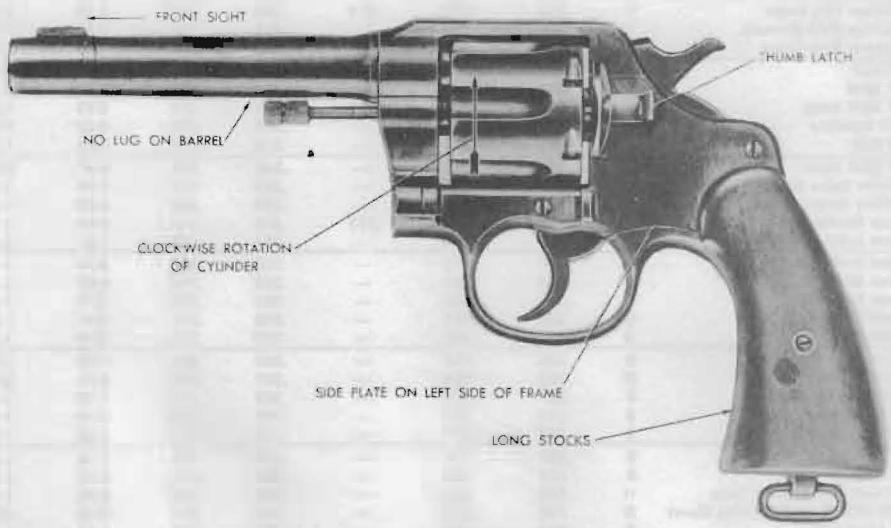
TABLE 5 — Pistol and Revolver Cartridges of the World; Current and Obsolete Center-Fire — Blackpowder and Smokeless

new rimmed cartridges simply weren't available. The new revolvers were then equipped with half-moon clips which held the rounds and served as auxiliary "rims," enabling them to digest the rimless .45-caliber ACP ammo, of which plenty was on hand. The S&W could fire without the clip in an emergency because the cylinder chambers had case mouth abutments; the Colt cylinders didn't. The point is, rims of some sort are a must for all revolver cartridges.

AUTOLOADING PISTOL CASES — CENTER-FIRE

As all modern center-fire autoloading handguns are clip or magazine fed, they must utilize cartridges of rimless or semi-rimmed design for positive feeding. Semi-rimmed 9mm Luger and such cartridges all have cases with some degree of taper. Semi-rimmed 9mm Luger and rimless .44 auto mag cases have sufficient taper (about .010") to prevent the cartridge from sliding forward in the chamber and to "fix" headspacing.

Others, such as the rimless .25, .32, .380, and .45 Colt ACP cartridges, have little taper (only about .003") and headspace with the mouth of the case jutting against an abutment at the front of the chamber. When reloading this type of cartridge, the case mouth



U. S. Colt Cal. .45 M1917 Revolver.

Caliber: .45 Model 1911 cartridge, used with half-moon clip.
Cylinder: 6 chambers.
Ballistics: About same as for automatic pistols.
Barrel Length: 5½".
Overall Length: 10¾".
Weight: 40 ozs.
Sights: Fixed.
Type of Fire: Single action or double action.

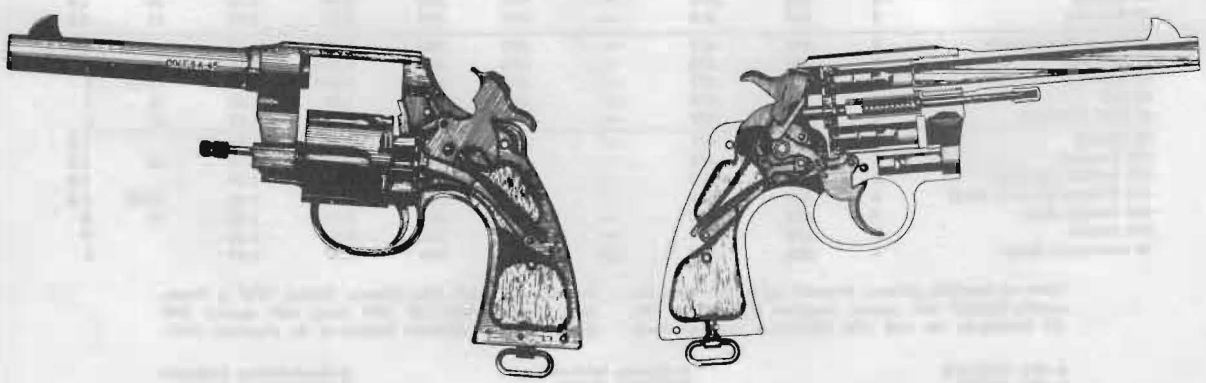


FIGURE 33 — The Colt M1917 service revolver, which was chambered for a rimmed version of the .45 Colt ACP rimless cartridge. The latter could be fired in the gun with the use of half-moon clips. Cutaway at left shows position of mainspring with hammer cocked and cylinder swung out. Right-hand drawing shows detail with all parts at rest.

cannot be crimped on the bullet less the case mouth be compressed to the point where it won't engage the chamber abutment, permitting the cartridge to slide too far into the chamber. Tight bullet neck tension is necessary in any autoloading cartridge because "slamming" of the action can drive a bullet deep into the case, causing malfunction. Correct tension with the various ACP cartridges is achieved by matching case neck thickness to bullet diameter, which is controlled by the right brass and expander plug combination.

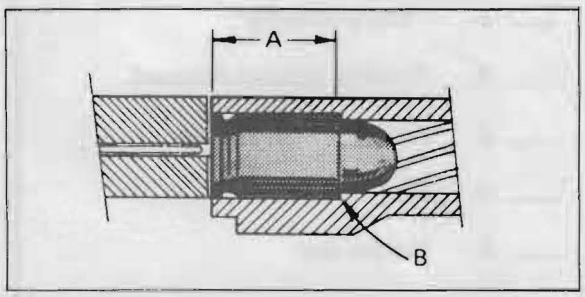


FIGURE 34 — Rimless pistol cartridges with little or no case taper, such as the ACP series, headspace on a case mouth abutment at the front of the chamber.

THE "ULTRA-VELOCITY" HANDGUN CARTRIDGES

Some of the bottleneck handgun cartridges are pistol cartridges only in that pistols have been made for them. Such cartridges were originally designed for rifles. Examples are the .22 Hornet and .30/30 Winchester, for which Thompson-Center Arms Co. chambered their fine Contender single-shot pistol, and the .256 Winchester, for which Thompson-Center and Ruger made handguns.

A tapered-wall pistol cartridge basically used in rifles is the .30-caliber U.S. carbine round. Ruger and Thompson-Center have also successfully marketed handguns for this cartridge.

Bottleneck cartridges developed exclusively for pistols include the rimmed .22 Remington Jet, for the S&W Model 57 revolver, and the rimless .221 Remington Fireball, designed for the Remington XP-100 bolt-action pistol. Thompson-Center has come out with the new .30-caliber Herrett for their Contender, which reportedly is one of the handgun powerhouses of all time!

There are still a few oldtime bottleneck pistol cartridges (and handguns for them) around, notably the .30-caliber Luger, the .30-caliber Mauser, and the WCF (Winchester center-fire) series. The WCF cartridges, no longer made, were low-pressure versions, for revolvers, of the rimmed .32-20, .38-40, and .44-40 rifle cartridges.

FIGURE 35 — The Remington XP-100 pistol utilizes the same bolt-action as the Remington M600 rifle and is chambered for one of the "new breed" tapered-neck handgun cartridges, the .221 Remington Fireball.

FIGURE 36 — One of the most popular and versatile "super-velocity" handguns is the Contender by Thompson-Center Arms Co. The Contender is available with interchangeable barrels in a variety of standard and wildcat chamberings.

FIGURE 37 — Cartridges originally designed for rifles, but that were also used in revolvers, are the WCF series illustrated. From top: .32-20 Winchester, .38-40 Winchester, and .44-40 Winchester. The latter was an overwhelming favorite on the Western frontier, and many a cowboy and gunfighter toted both handgun and rifle chambered for the same cartridge.

MODERN VS. OLDTIME PISTOL CASES

Modern handgun cartridge cases are considerably stronger than their early counterparts. Loading data in contemporary manuals, unless otherwise noted, is based on new rather than dated brass. The problem is the availability of both old and new cases for several vintage handguns, including those chambered for the .45 long Colt, .44 Special, and the rimmed version of the .45 Colt ACP. Use modern loading data and powders in old cases and you could have trouble! Either the gun, if it's old or defective, could let go — or the oldtime case will probably rupture. Most older handguns, and certainly old brass, simply aren't designed to withstand modern chamber pressures.

Older handgun cases were usually of what is called "balloon" head design. Modern cases are of web design. To determine what you have, if in doubt, hold the case mouth to the light and look inside. An old balloon-head case has a raised and rounded bump surrounding the flashhole; the web design is flat across the bottom of the case. Balloon-head cases should be used with caution and reduced loads only, if at all, as more likely than not the brass has become brittle with age.

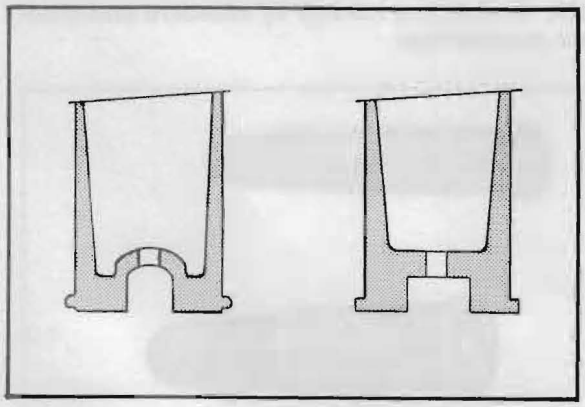


FIGURE 38 — Older type (blackpowder) cases were often of the "balloon" head design (left), with the primer pocket extending into the head and creating a bump or "balloon" around the flashhole. The conventional web-type design is shown at the right.

Before going on, please do Programmed Exercise 4. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

HOW AND WHY CARTRIDGES ARE NAMED

Cartridge nomenclature (i.e., the handles various manufacturers hang on their ammunition for identification) makes about as much sense as the dialogue between Alice and the Mad Hatter. Nothing is quite as it appears to be.

Take the .38-caliber handguns. They are actually .35's with a bore diameter of .357. The .25/06 stands for .25 caliber, with the case based on the .30/06 Springfield introduced in 1906. The .25-3000 is also .25 caliber, but it isn't the "cartridge of the future." The 3000 refers to the original velocity (fps) with an 87-grain bullet. Full-jacketed military cartridges are still called "ball ammunition," though G.I. "balls" haven't been fired for well over 100 years! Let's try to beat the numbers.

Initially, there wasn't much of a problem in "naming" cartridges. Early manufacturers dubbed their cartridges with three numbers;

PROGRAMMED EXERCISE

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Match the handgun cartridge designs in the top list with the characteristics that best describe them (from the bottom list) by placing the letters in the blanks provided.

___ 1. "Ultra-velocity"

___ 2. Rimless or semi-rimmed

___ 3. Straight-wall, rimmed

___ 4. Rim-fire

___ 5. Center-fire

A. Used on all modern center-fire autoloading handguns for positive feeding.

B. Scaled-down versions of rifle cases — only shorter and less powerful.

C. Cartridges originally designed for rifles, but used in handguns specially chambered for them.

D. Today, only .22 rounds are manufactured in this design for pistols.

E. Used for almost all revolvers and single-shot pistols.

Answers on Page 26

the first was the bore diameter, the second the grains of blackpowder used, and the third the weight of the bullet. The Model 73 Springfield, for example, fired a cartridge termed the .45-70-500, meaning that it was .45-caliber and used 70 grains of blackpowder to propel a 500-grain bullet.

Later, to streamline the terminology, the last (or bullet weight) number was dropped. Cartridge designations such as .30-30, .30-40, .38-50, etc., referring to bore diameter and blackpowder charge, became commonplace.

Smokeless Powder Confused the Issue

With the end of the blackpowder era, most manufacturers dropped the second (powder charge) number, sometimes carried the bore diameter to thousandths of an inch, and added their company name. We then had the .300 Savage, .270 Winchester, .35 Remington, etc. This policy continues to the present, what with the comparatively recent .243 and .308 Winchesters, .280 Remington, etc.

The magnums, which usually but not always incorporate a belt, carry the magnum tag at the end — the .264, .300, and .338 Winchester magnums. The first true belted magnums, the .375 and .300 H&H British cartridges, weren't called "magnums." In England they were and are termed "supers."

Sometimes the exact bore diameter is used (.308 for .30-caliber, .224 for centerfire .22's, etc.). Other times the number is rounded off. Most often the bore diameter of U.S.-made rifles is expressed in hundredths of an inch; a few are designated in millimeters — the 6mm Remington and 7mm Remington magnum, to name two. They could have been called the .243 Remington and .284 Remington magnum respectively, but why standardize? Anyway, there is a .280 Remington which is actually 7mm with a bore diameter of .284. Weatherby has a 6mm cartridge with a bore diameter of .243, which is known as the .240 Weatherby. Confused? Courage — it gets even more interesting!

Sales Appeal Often Influences a Cartridge's Name

Sometimes a copyrighted trade name, one supposedly loaded with pzazz, is used in lieu of the manufacturer's name. Examples are the .219 Zipper, the .218 Bee, and the .220 Swift. The Bee has a .223" bore diameter, and the other two have .224" bores. The .223 Remington, naturally, has a .224" bore.

On occasion, the cartridge inventor's name becomes part of the handle. Examples are the .257 Roberts, the .280 Ross, the Newton and Weatherby series, and the Ackley wildcats. Most cartridges, as has been pointed out, are based on existing cartridges. Sometimes, but not often, the parental origin is included in the cartridge title. Examples? The .22-250 (based on the .250-3000 Savage case) and the previously mentioned .25/06.

The most misleading figures in cartridge terminology are in the handgun category. Only the .357 magnum (which also fires .38 Special ammo) correctly describes its bore size. The various .32-caliber pistol cartridges are actually slightly oversize .30's; the .44's are in reality .42's. They do *sound* more powerful the way things stand.

Initials were frequently added onto various caliber designations by Winchester. WCF means Winchester center-fire, WRF means Winchester rim-fire, and WMR means Winchester magnum rim-fire. The ACP following .25, .32, .380, and .45 autoloader cartridges refers to automatic Colt pistol. (The pistols in question are semi-automatic, not "automatic" in function.)

European Cartridge Nomenclature

Continental cartridge makers, in comparison with the Americans, are staggering in their simplicity. They usually use only two numbers to describe the bore diameter and case length in millimeters, sometimes followed by the company's or inventor's name. The 7x57 Mauser has a 7mm bore and a case 57mm long; the 8x57 is 8mm in bore size with the same 57mm case. The Germans make many cartridges the average shooter never hears of, such as the 7x64, the 9.3x62, and a host of others — all using the same two-number metric designation.

European cases are invariably rimless, unless the last number is followed by an R — which stands (surprise!) for a rimmed version of the same cartridge designed for single-shot and double rifles. The letter J (referring to infantry version) sometimes appears in connection with R following the 8x57 (JR).

English Cartridge Nomenclature

Our British cousins like to turn things around. Their famous .300 H&H "Super" was originally a necked-down version of the longer .375 H&H "Super." In the U.S., if we wanted to include the parent case, we'd term this cartridge the .300-375 H&H. In England it is known as the .375-300. As another example, their famous .450/400 is not .45-caliber. It is a .40-caliber case which was originally .45-caliber and was necked down.

The term "Nitro Express" is used by the British in connection with their big-bore African cartridges to designate smokeless powder. A blackpowder loading for, say, a .45 cartridge

would be the .450 B.P. Express, as opposed to the smokeless .450 Nitro Express.

A parallel exists in the U.S. When the first and more powerful smokeless cartridges appeared, U.S. manufacturers labeled them "High Power" to differentiate between the new smokeless cartridges and the blackpowder versions that were being phased out.

The English are correct in calling shotgun rounds "cartridges." In the U.S. we incorrectly dub them "shells." This term actually applies to artillery, naval rifle (cannon), and mortar ammunition.

As you progress, you may wish to design your own *wildcat* cartridge. This term refers to any cartridge not commercially manufactured and is also misleading (most wildcats are "dogs"). Regardless of what you call it, you couldn't possibly make it more confusing than the other ammo inventors already have. Join the club, and make your own rules!

TO COMPLETE UNIT 5 . . .

After you have read your Unit 5 Gun Shop, you are ready to take Examination 5. Complete it and send it to School Headquarters for grading.

Then you can proceed to Unit 6. In Unit 6 you will be getting into bullets — their design and application, and troubleshooting and repairs for revolvers.

ANSWERS

4

1. C 2. A 3. E 4. D 5. B

FORMULA TO DETERMINE PROPER TWIST

In order to determine whether a rifle has the correct twist for the bullet that will be most commonly used, or when building a custom rifle or rebarreling, you can figure the proper twist with this simple formula:

> "The twist required is equal to 150 divided by the length of the bullet expressed in calibers, with the result multiplied by the bore diameter."

As an example of how this formula works, let's apply it to a 200-grain, .30-caliber jacketed bullet. (The formula won't work for cast lead bullets.) This .30-caliber 220-grain bullet has a length of 1.35 inches. To find its length in calibers, we divide the 1.35" bullet length by the .30 caliber.

$$.30\overline{)1.35} = 4.5$$

The bullet length expressed in calibers is thus 4.5. We then divide the 150 "Formula Figure" by this 4.5.

$$4.5\overline{)150} = 33.3$$

This 33.3 figure is then multiplied by the bore diameter of .30.

$$\begin{array}{r} 33.3 \\ \times\ .30 \\ \hline 9.990 \end{array}$$

In rounding off this figure, we get 10. The correct twist for a 220-grain, .30-caliber bullet is thus 1-10 inches. This formula was devised by an English ballistician, Sir Alfred Greenhill, in 1879, and was based on the then-new jacketed bullets. Although the bullets of the day were primarily round-nosed, the formula is still "in the ball park" with modern jacketed, spitzer-type bullets.

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