STUDY UNIT 4 – PART 1

FIREARMS DESIGN AND DEVELOPMENT – SHOTGUNS

THE FIRST SHOTGUNS

The direct ancestor of today's shotguns was the smoothbore flintlock of the 15th to 17th centuries. Because of its abominable accuracy with a single ball at *any* range, even the intended victim of a shotgun wedding had a good chance to escape being "groomed" if he had the courage to run. The fact is that soldiers and hunters (including American colonists) often relied upon multiple-ball loads. These were deadly at 50 yards and more, and made hitting a lot easier — especially on moving targets.

Such firearms, with their long, heavy barrels and relatively large "shot pellets," were seldom if ever used for small game. Indeed, small shot wasn't even invented until about 1750, when somebody dreamed up the idea of pouring molten lead through a perforated container placed above a bucket of water in which the lead droplets solidified (the same basic process used today in making drop shot). Prior to this discovery, the buckshot-size pellets were either molded or crudely cut to size from lead bars.

The first single and double-barrel shotguns, and a few guns with multiple revolving barrels, also came on the scene about 1750, in England. They were all matchlock muzzleloaders (see Figure 1).

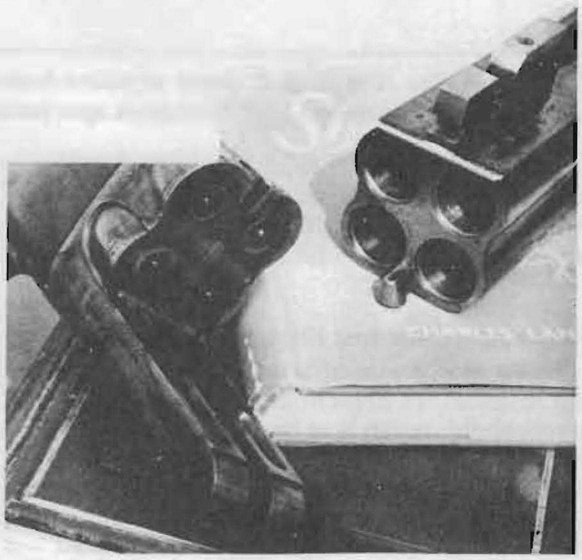


FIGURE 1 — Some early shotguns had multiple barrels which rotated around a central axis. Others, like the English gun above, invented by Charles Lancaster, had multiple fixed barrels. Lancaster also developed the first breechloading center-fire double.

Early Shotgunning in America

The idea of sport-shooting birds on the wing and small game on the run didn't really occur to most American hunters before 1800. The object of hunting was to put meat on the table, and flock-shooting of birds on the ground or in the water was perfectly acceptable in view of the limited availability of small shot. The concept of shotgunning *for sport* is generally credited to an English gunsmith, Joseph Manton, who was turning out superb doubles balanced for "pointing at all manner of moving game" in the early 1800's. Wealthy Americans, visiting abroad, became enamoured with the new "sport" and brought home many of the expensive and beautiful Manton muzzleloaders. Some were undoubtedly copied by American manufacturers.

By 1850, single and double-barrel shotguns were commonplace in the U.S., and outwardly quite similar to today's scatterguns. They were percussion-primed muzzleloaders, sidelocks with exposed hammers for the most part, but their general configuration was "modern" (see Figure 2). Then, as now, the maximum effective range was from about 40 to 45 yards. Modern loads and technology haven't increased range and power all that much.

These early sporting guns were both cumbersome and dangerous to use, requiring the shooter to burden himself with an assortment of percussion caps, blackpowder, shot, and wads — all in separate boxes or flasks — plus a ramrod to tamp home the charges.

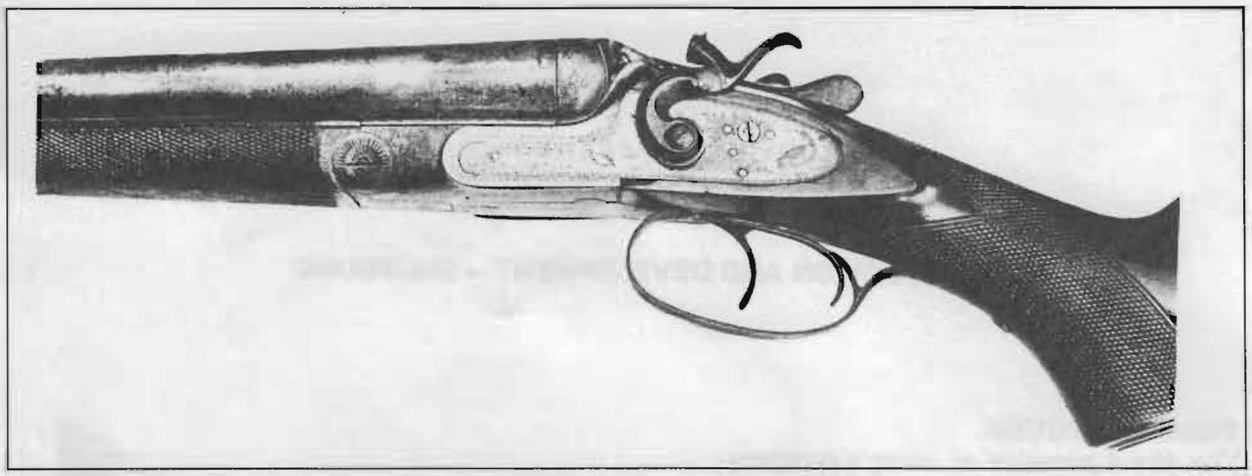


FIGURE 2 — The fine W & C Scott exposed-hammer double was typical of the shotguns used by affluent American, English, and European sportsmen from about 1850 to the early 1900's.

More than one hunter, having fired one barrel of his double, lost his hand (or head) attempting to load the empty tube — thus jarring the other *loaded* barrel into firing.

The First Breechloading Shotgun

While many attempts were made to invent a satisfactory breechloading shotgun, the first successful design was based on the Lefaucheaux pin-fire cartridge patented in 1836. Self-contained shotshells using pin-fire ignition (see Figure 3) and a breechloading double for these shells were designed and introduced by Lefaucheaux in 1850. In 1851, an Englishman named Charles Lancaster brought out the first center-fire breechloading double.

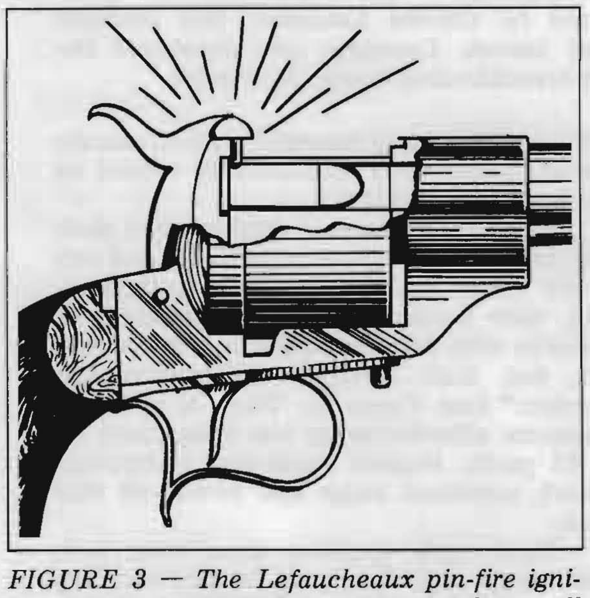


FIGURE 3 — The Lefaucheaux pin-fire ignition system was widely used in pistols as well as in shotguns and rifles. The above cutaway drawing shows the priming system as used on an early revolver.

These developments heralded the end of the muzzleloading era, although toploaders remained in fairly wide use until the early 1900's. By 1860, a number of breechloading shotguns, using pin-fire and the new center-fire cartridges, were on the market. The pin-fire shotshell has proved long-lived, as it is still manufactured and used in many parts of Europe.

ALL "RIFLE-TYPE" ACTIONS HAVE BEEN USED FOR SHOTGUNS

Over the years, every type of action used successfully in rifles was tried in shotguns. All but two "rifle-type" actions proved successful: (1) a lever-action such as the M1887 and M1901 Winchester (see Figure 4), and (2) the many bolt-action scatterguns once made by many manufacturers. Lever and bolt-actions proved too slow in operation to ever win much popularity. Lever-actions were discontinued long ago; and, though the bolt-action is still manufactured by a few companies, its appeal is to customers to whom low price is apparently the only consideration.

The slide-action or "pump" shotgun is the overwhelming favorite in the U.S. (as the double is in Europe), followed by the autoloader. Side-by-side and over-and-under doubles, and the beginner's single-shot, account for proportionately smaller shares of sales.

THE SINGLE-SHOT BREAK-OPEN SHOTGUN

The first gun for the youthful wingshooter is usually the cheap, sturdy "single barrel" of break-open design. This feature makes for a safe gun, permitting quick inspection for barrel obstructions and determining "if it's loaded." Also, the gun can be

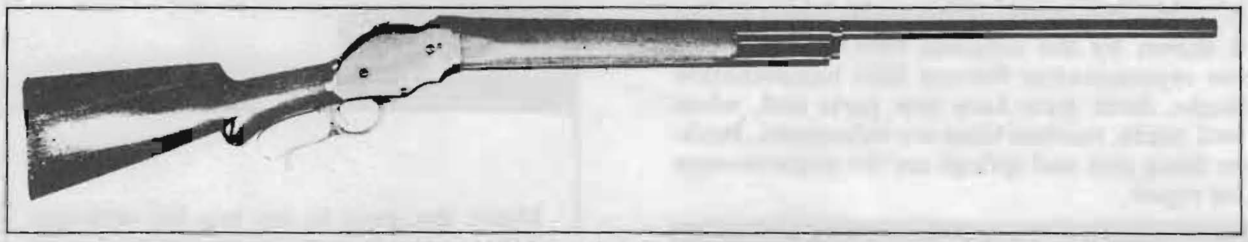


FIGURE 4 — The Winchester M1901 (above) and the earlier M1887 lever-action shotguns were produced for over 30 years, and many are still around. Never fire an M1887 with modern smokeless shotshells as this model was designed for blackpowder shells only.

quickly broken open for safe passage over or through fences.

Single barrels of different makes vary in major details. Some, like the Winchester M37A (see Figure 5) have an exposed hammer which must be manually cocked. The hammer serves as a "safety." Others, such as the Savage M220 (see Figure 6), are hammerless with the hammer concealed in the action. These guns cock when the action is opened, and a safety (usually automatically activated) is positioned on the top of the tang, which is the best possible location on any shotgun or rifle.

Most single barrels have automatic, but non-selective ejectors, meaning that both fresh and fired shells are kicked into the "wild blue" when the action is opened. (Beginners soon learn to cover the chamber when opening such guns.)

The method of breaking open, or releasing, the action also varies among manufacturers. Some use a pivoting lever at the top of the tang; others have a release lever at the side of the action. The Ithaca Model 66 (see Figure 7) uses a "lever-action" type release, and at least one gunmaker employs a simple push-button arrangement.

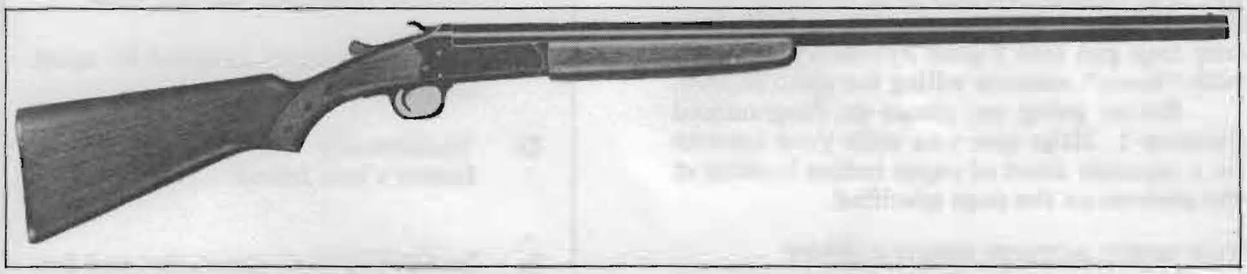


FIGURE 5 — Typical of the exposed-hammer, single-shot design is the Winchester M37A.

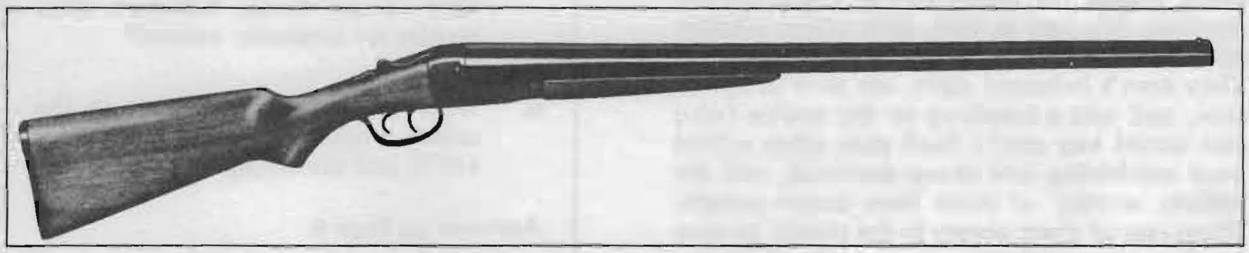


FIGURE 6 — The single-shot Savage M220, with its concealed hammer, is simple in design, sturdy, and relatively inexpensive.

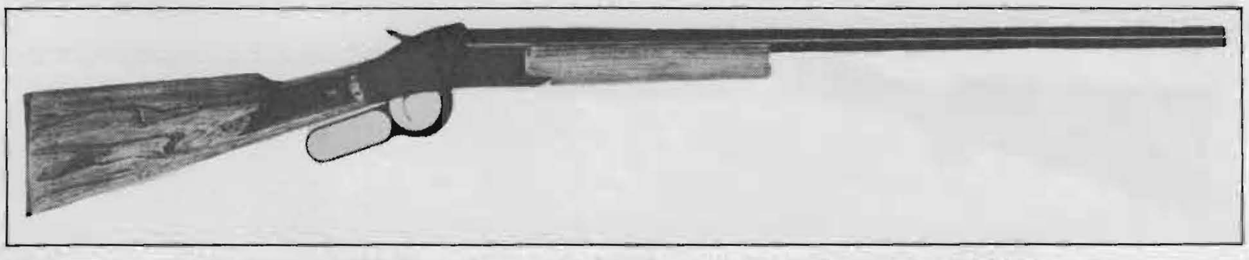


FIGURE 7 — The Ithaca M66 has a lever which, when swung down, opens the action. The exposed hammer must be manually cocked before each shot.

The simplicity of the single-barrel action is shown by the cutaway view (Figure 8) of the representative Stevens M94 hammer-style single. Such guns have few parts and, when well made, malfunctions are infrequent. Broken firing pins and springs are the major reasons for repair.

FIGURE 8 — The small number of parts and simplicity of design inherent in the single-barrel action are shown in this cutaway of the Stevens M94 exposed-hammer shotgun.

The single barrel is traditionally the boy's and farmer's friend. However, slick, beautifully made and finished single barrels are often the first choice of crack trap shooters. Such deluxe single barrels as the Ithaca SKB Century trap gun (see Figure 9) cost about $500, with "fancy" versions selling for up to $5,000.

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.

THE BOLT-ACTION SINGLE-SHOT

The bolt-action shotgun can be likened to the dodo bird. It's about as ugly, never had much reason for being, and is bound for extinction. It's just as well. Bolt-action scatterguns neither look nor handle like shotguns. They aren't balanced right, are slow in operation, and add a handicap to the novice (who else would buy one?). Such guns often reflect poor machining and cheap materials, and are seldom worthy of more than minor repairs. When one of them comes in for repair, be sure to give your customer an accurate estimate.

PROGRAMMED EXERCISE

1

Match the guns in the top list with the statements in the bottom list that best identify them by placing the letters in the blanks provided.

____ 1. Lever-action shotgun

____ 2. Single-barrel shotgun

____ 3. Pin-fire ignition system

____ 4. Manton muzzleloading double shotgun

A. The first successful breechloading shotgun design.

B. Discontinued as a shotgun design because operation was too slow.

C. The first shotgun designed for sport shooting.

D. Traditionally the boy's and the farmer's best friend.

5. Because of their simplicity, and few moving parts, single-barrel action shotguns seldom need repair. When they do go wrong, however, what repairs are generally needed?

6. What is a major difference in the action between the Winchester M370 and the Savage M220L?

Answers on Page 6

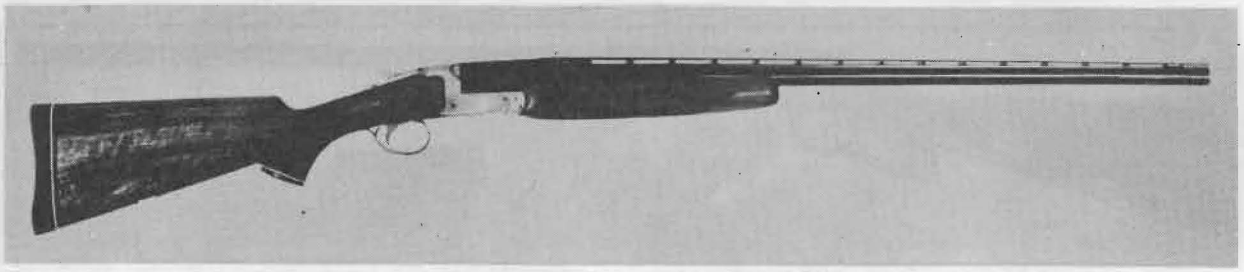


FIGURE 9 — The Ithaca Century trap gun is representative of the deluxe single-shots preferred by dedicated trapshooters. Note the typically straight trap-style stock.

Your bill may amount to more than he paid for the gun — especially if it's old. And you need to keep this gun (because of non-payment) like you need the measles.

A bolt-action shotgun, when fitted with iron sights for rifled-slug use, makes a good short-range deer "rifle" — which is precisely what the action was designed for in the first place!

THE DOUBLE-BARREL SHOTGUN

Early wing-shooters evidently felt the need for a follow-up shot as keenly as their modern contemporaries, as most of the first shotguns were double-barreled. Doubles haven't changed much during the past 80 or 90 years. Most of the various types of actions were perfected in the 1880's and remain basically the same today. The big changes are primarily in barrels, which are now shorter and far stronger, and they have changed in stock design. The single selective trigger is also comparatively new.

FIGURE 10 — American colonists frequently hunted medium game such as wild turkeys with smooth-bore muskets and a load consisting of one large ball and a quantity of smaller shot. Such a charge was known as "buck and ball." (Illustration by R. O. Ackerman, reproduced courtesy of The Shotgun Digest)

There are two basic types of doubles — the traditional side-by-side and the relatively recent over-and-under. The actions are essentially the same, as are the methods of lock-up, extraction, and ignition. For years the side-by-side was considered the "queen" of the shotguns, the finest for waterfowl and upland game, because of its superior balance and "pointability." Today, more gunners prefer the over-and-under. Whether this favoritism is due to the single sighting plane or "snob appeal" is open to conjecture. In any event, the side-by-side is again gaining in popularity — possibly because of our current preoccupation with the past.

CHARACTERISTICS OF THE BETTER DOUBLES

Generally, the finest double shotguns (regardless of barrel arrangement) incorporate a single selective trigger which enables either barrel to be fired first, and selective automatic ejectors that kick out fired shells, but merely raise loaded shells for manual extraction.

Doubles of lesser quality usually have a single, non-selective trigger that automatically fires the bottom or right barrel first, or double triggers, plus extractors which don't eject fired or fresh shells, but lift them slightly for removal by hand.

Cracker barrel arguments, pro and con, over single selective versus double triggers have been going on for years. The single trigger permits faster one-two firing, an advance selection of barrel (and choke), and more room within the trigger guard. The oldtime double triggers provide an instant change of barrel which can be useful, say, when a flock of ducks zooms in and out from nowhere. (So who's got time to think about which trigger?)

The double trigger is less likely to malfunction (in the side-lock design, if one stops working you've still got a single shot) and it does make possible cheaper doubles. The double trigger, incidentally, is preferred in Europe.

The Non-Selective Single Trigger

There are several advantages the non-selective single trigger has over the double trigger, though some are largely theoretical. First, the pull length of a single trigger doesn't vary as it does with the double triggers, where the pull on the front trigger is usually 14 inches, and on the rear about 13½ inches. There are, however, few shooters whose hitting ability is much influenced by this small variation.

Second, single triggers are generally thought to be faster. Because of the time lag after recoil, when the shooter must recover and regain his sight picture, this is doubtful. It's more a matter of getting used to a double trigger. Any number of initiates have pulled

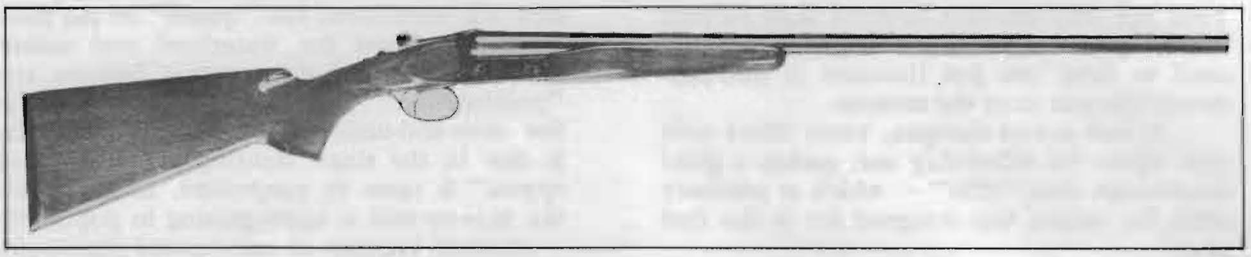


FIGURE 11 — Modern side-by-side doubles, such as the Browning illustrated, are usually manufactured in Europe where labor costs are somewhat lower. Nevertheless, this gun must retail for about $250 because of the handwork involved.

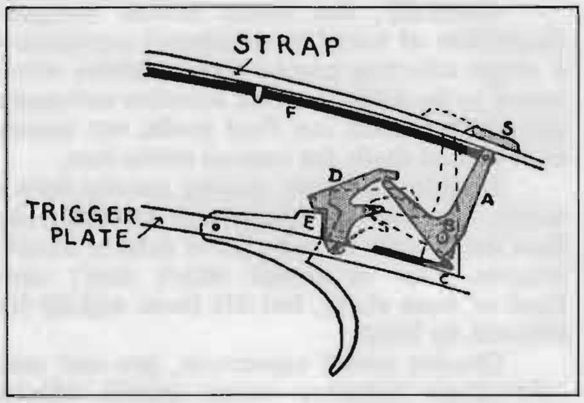


FIGURE 12 — Basic workings of the shotgun safety on single and double-barreled guns. S is the safety slide in "Safe" position. Lever A is operated by the slide and pivots at B. The spring stud C holds the lever in position. Safety stop D prevents the trigger E from firing. Rod F connects Lever A to the action lever, which automatically cocks and places the gun on "Safe" when the action is opened. The dotted lines show the position of the parts when the safety is in the "Fire" position.

repeatedly at the front trigger, trying to get off a second shot, while a duck or pheasant flapped serenely out of range.

A third advantage has more substance — that of providing more finger room within the trigger guard. When hunting or shooting in cold weather, gloves are more a necessity than a luxury. And it's almost impossible to stuff a gloved finger into the guard of a gun with twin triggers.

The final advantage is that a single trigger ends the knuckle bruising some shooters suffer with the twin trigger when the back of the front trigger raps the front of the trigger finger as the second tube is fired. This is generally due more to loose and improper gun holding than the double triggers, but don't tell that to anyone with a swollen and aching knuckle. (You may have your own problem with "knuckles".)

A single trigger which fires two barrels is necessarily a good deal more complicated than

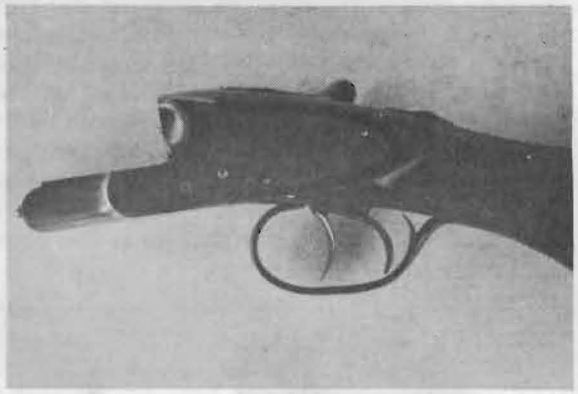


FIGURE 13 — Double triggers, like those on the L. C. Smith, leave scant room to cram a gloved finger between the front and back triggers.

the double trigger. Aside from the mechanical and linkage problems, a human factor must be taken into consideration. When a man fires

ANSWERS

1

1. B
2. D
3. A
4. C
5. Broken firing pins and springs.
6. The Winchester M370 has an exposed hammer, must be manually cocked, and the hammer serves as a safety. The Savage M220L is hammerless, the hammer is concealed in the action, and it has an automatically activated safety.

his gun, recoil moves the trigger away from his finger. When the gun comes forward after recoil, the shooter instinctively presses the trigger again. To prevent the second barrel from firing in response to this second, involuntary trigger squeeze, a block or "delay" feature must be built into the mechanism.

There have been literally hundreds of different single-trigger designs, all of which take the second, involuntary pull into consideration. Some designs require two pulls (intermediate and actual) to fire the second barrel; other systems ignore the involuntary pull or incorporate a time lag which blocks the second pull until the shooter has settled down after the first shot. An example of the "time lag" design is the Holland trigger (see Figure 14).

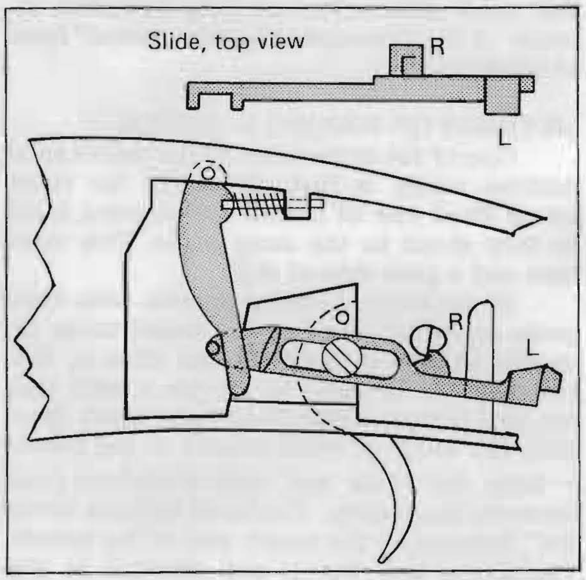


FIGURE 14 — The time-lag principle of the single trigger. A slide (top) has arms protruding on either side, R and L, which release the trigger sears, first right, then left, when the trigger is pulled twice. Side view of action shows right arm, R, engaging right barrel sear. After firing, the slide is driven forward by a spring until arm L engages the left barrel sear. The distance between the two arms, and the tension of the slide spring, determine the "time lag" before the second barrel can be fired. The shooter's "involuntary" squeeze occurs during this "time lag," when the slide is moving and the sears aren't engaged.

The Selective Single Trigger

The selective single trigger is, understandably, even more complicated than the non-selective type. In addition to blocking the involuntary pull, it must also afford the shooter the option of firing either barrel first, usually by sliding a crossbolt at the base of the trigger guard. Considering their complexity, modern selective triggers are surprisingly reliable.

One of the best selective trigger systems is that used on the Browning doubles. It is of inertia design, meaning that the firing of one barrel (and recoil) arms the second. Despite its excellence and popularity, the Browning trigger has one drawback. In case of a misfire in the first barrel, the second barrel isn't armed and won't fire. The shooter then has the choice of either breaking the action and extracting and inserting a new shell, or dropping the butt on the ground. This effectively arms the second barrel, but isn't the safest procedure. The gymnastics performed by a Browning owner, cursed with a faulty primer while a flock of ducks sails overhead, can be downright impressive.

As there are well over 150 different selective trigger designs, the systems for popular guns will be covered within appropriate Gun Shop units. For now, the cutaway view of the Browning inertia system (see Figure 15) will give you a general idea of what is involved.

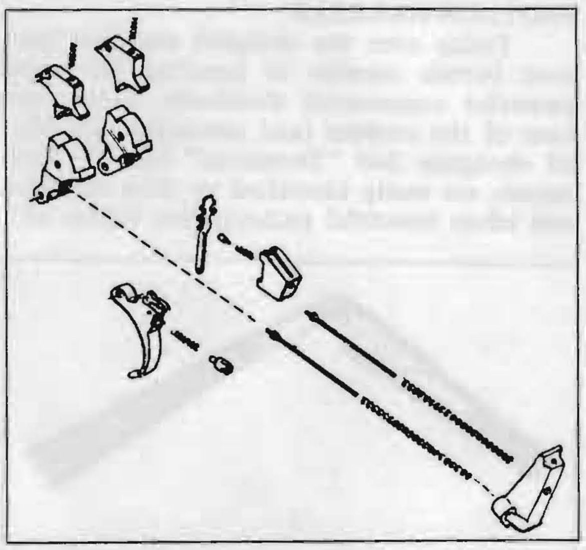


FIGURE 15 — Inertia system selective triggers, such as that on the Browning, are activated by recoil. When the action is opened, the gun is cocked. Barrel selection is governed by the position of the selector block. Upon firing, recoil moves the heavy inertia block to the rear, arming the sear for the second barrel.

ADVANTAGES OF DOUBLES OVER MORE MODERN SHOTGUNS

Doubles have several undeniable advantages over pumps and auto-loaders. They are inherently safer, allowing fast breakdown for barrel inspection. This breakdown feature also comes in handy when stumbling in the lightening sky toward a duck blind, and when negotiating fences. Doubles with the same barrel length as pumps and autos are several inches shorter, and consequently better balanced and faster to swing on target. They afford a choice of two chokes for varying ranges. Also, doubles invariably have a sliding safety on the tang, which is easier and faster to get at than the crossbolt and trigger guard versions.

A major "shortcoming" of the double to some negativists is the lack of a third shot. Suffice it to say that third shots (except when pass-shooting at waterfowl) are most effective in working off the frustration built up by missing the first two shots. The amount of game taken with round number three, as opposed to game bagged with the first two rounds, is negligible.

Doubles are also a reloader's delight. The easy access to the chambers and the usual positive extraction enable the double to digest the imperfectly resized hulls that would quickly jam a pump or auto-loader.

SHOTGUN BARRELS

Today even the cheapest shotguns have steel barrels capable of handling the most powerful commercial shotshells. Before the turn of the century (and smokeless powder), all shotguns had "Damascus" barrels. Such barrels are easily identified by their speckled and often beautiful patterns (see Figure 16).

FIGURE 16 — Damascus barrels were made by winding strips of steel (top) around a mandrel. When hammered and welded, a distinctive pattern evolved which is the "trademark" of laminated barrels. (Drawings courtesy National Rifle Association)

Damascus, twist, or laminated barrels (the terms are synonymous) were made by tightly wrapping a ribbon of three or four narrow strips of steel around a barrel-shaped core. The "ribbon" was then hammered and welded into a tube. Quality varied, and even the best barrels contained minor flaws from grit or coal dust that drifted into the metal during the welding process.

These flaws weren't particularly dangerous with the low-pressure blackpowder shells of the day. But the man who fires a modern smokeless shotshell in any Damascus barreled shotgun, even one in "like new" condition, is taking a chance. Under high pressure, the welded seams and/or flawed areas let go — with disastrous results to the shooter.

Yes, a Damascus pattern is pretty. So is a diamond-back rattler.

The term "Damascus," incidentally, has nothing to do with the ancient city where the finest "Damascus blades" were once made. The name does reflect an early Victorian example of the "excellence by association" form of advertising.

METHODS OF JOINING BARRELS

One of the procedures which makes good doubles costly is that of joining the tubes into a fixed pair of barrels and aligning them so they shoot to the same point. This takes time and a great deal of skill.

In the barrel finishing process, with high-grade imported doubles, the round tubes are usually shaped at the butt end (that is, flattened on the bottom) to provide a solid base for the lumps. Aside from their pivot function, the lumps — when brazed to the barrels — form the initial and most important joint between the barrels. This bond extends about 2½" forward of the breech end of the barrels. The lumps and barrels are attached in any one of several ways. Figure 19 shows two traditional systems used in high-priced guns.

In the interest of economy, many modern doubles use the monobloc method of joining barrels, whereby the breech ends of the barrels are inserted into a block and the whole unit is forged together. The lumps are then machined out of the block.

Next, the barrel loop (see Figure 21) is positioned between the barrels and brazed into place. The barrel loop serves two purposes: (1) it *spaces* the barrels approximately midway between the breech and the muzzle; and (2) the extension on the bottom of the barrel loop engages the recess in the forearm hardware, thus affording a means of anchoring the forearm to the barrels.

The next step is to position and solder several "packing pieces" (see Figure 22) at intervals between the muzzle and the breech. (On cheaper guns, these packing pieces are not shaped, but are merely bits of metal soldered or brazed into place to keep the barrels

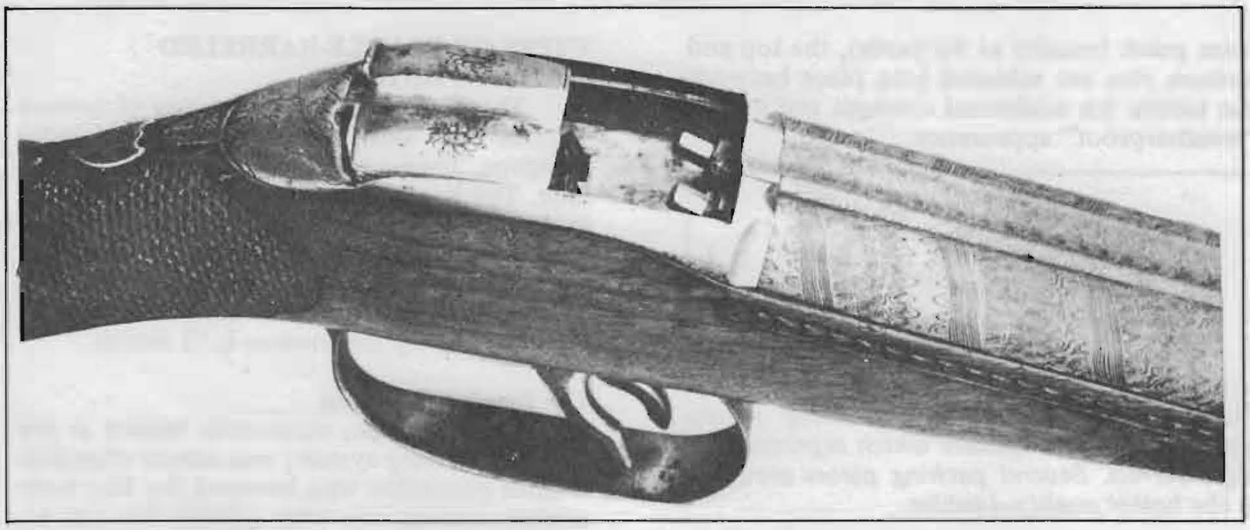


FIGURE 17 — Early Belgian Damascus double had a sliding safety cover to protect the shooter's eyes from the exploding percussion caps. Note the unusual double trigger configuration.

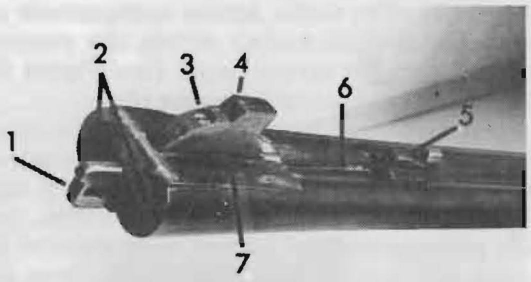


FIGURE 18 — Barrel components of the L. C. Smith: (1) top extension, (2) extractors, (3) extractor screw, (4) lumps, (5) barrel loop or bolt, (6) bottom rib, (7) flats (both sides of lumps).

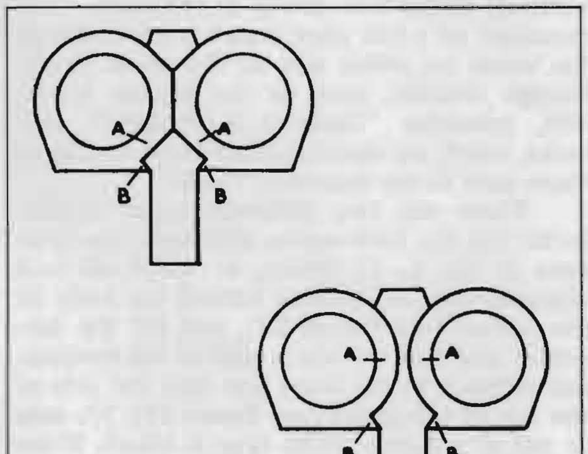


FIGURE 19 — Two pre-monobloc methods used in high-priced doubles of brazing together the breech ends, lumps, and top extensions. In the top drawing, the top extension is part of the sighting rib.

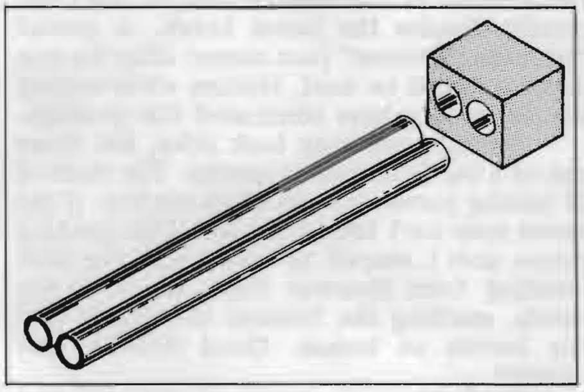


FIGURE 20 — Twin tubes and a block drilled to accommodate the tubes, with the holes establishing the correct positioning of the barrels in relation to each other and to the block, illustrate the principle of the monobloc method of barrel joining.

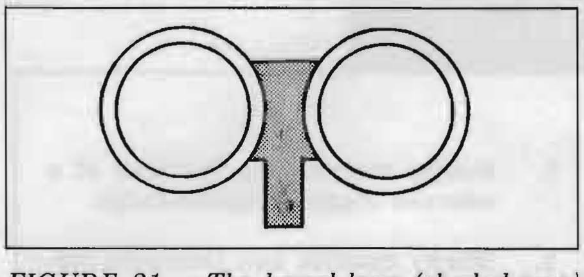


FIGURE 21 — The barrel loop (shaded area) spaces the barrels at the midway point and provides the means of securing the forearm to the barrels, by any of a variety of design principles.

apart.) The packing pieces are soldered into position. They will later be heat-softened to permit any necessary readjustment of the barrels. When barrels deliver shot charges to the same point (usually at 40 yards), the top and bottom ribs are soldered into place between the barrels for additional strength and a trim, "weatherproof" appearance.

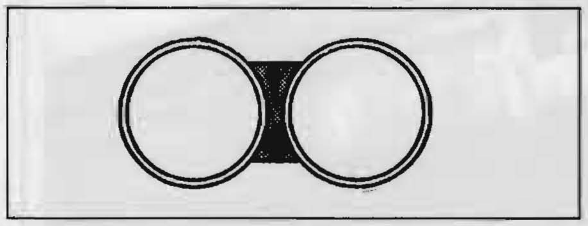


FIGURE 22 — Contoured packing pieces (shaded area) are spacers which separate and align barrels. Several packing pieces are used in the better quality doubles.

Incidentally, soldering techniques have vastly improved over the years. Attempts to reblue some of the oldtime doubles will completely dissolve the barrel bonds. A special "browning process" (not named after the gun designer) must be used. Modern silver solders and/or brazing have eliminated this problem.

Double guns may look alike, but there can be a big difference in quality. The method of joining barrels is most often the key. If the barrel loop isn't brazed on, and if the packing pieces aren't shaped or contoured, the heat resulting from frequent firing can melt the bonds, enabling the forearm to separate and the barrels to loosen. Good doubles cost money!

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

1. Briefly describe the function of a selective trigger of inertia design.

2. Briefly describe how Damascus barrels were made.

3. What advantages does the single trigger have over the double trigger?

4. What problem could you run into in attempting to reblue some of the oldtime doubles?

Answers on Page 12

TYPES OF DOUBLE-BARRELED SHOTGUN ACTIONS

There are basically two types of actions used in both side-by-side and over-and-under shotguns. They are the box lock and the side lock. The box lock is used almost universally in American doubles because it is strong, reliable, and relatively inexpensive to manufacture. The side lock, the aristocrat of double shotgun actions, is represented among U.S. doubles only by the famous L. C. Smith.

The Box-Lock Action

The box lock, commonly known as the Anson & Deeley system, was named after two English gunsmiths who invented the first hammerless action, one that cocked the gun by opening the action and swinging the barrels downward. Figure 24 shows a cutaway of the working parts of a typical box-lock design. In box locks, the major action components are contained and mounted within the receiver, with the trigger components (see Figure 25) attached to a removable trigger plate.

A box-lock double can usually be recognized by the "boxy" appearance of the action, with the rear of the action at a straight right angle to the sighting axis. Occasionally, fake side plates are added to box locks (behind the actual action) for "side lock" appearance, and to provide extra room for engraving. They serve no functional purpose.

The Side-Lock Action

The second major type of double-barrel action is the side lock, which has two separate cocking, firing, and safety mechanisms, each mounted on a side plate which is inletted into the wood on either side of the stock. Some foreign doubles, such as the Mauser Model 580, advertise "Holland & Holland" side locks, which are also detachable and similar to those used in the venerable "Elsie."

There are two different types of side locks: (1) the back-action side lock, the type used in the L. C. Smith, in which all lock components are situated behind the body of the action (see Figure 26), and (2) the bar-action side lock, in which part of the mechanism extends to the front and into the side of the bar of the action (see Figure 27). It's easy to tell at a glance which type is which. If the mainspring is positioned behind the hammer, it is a back-action side lock; if the mainspring is in front of the hammer, it is of the bar-action type.

Side Locks and Box Locks Both Cock on Opening

Side locks and box locks are cocked in essentially the same manner, when the action

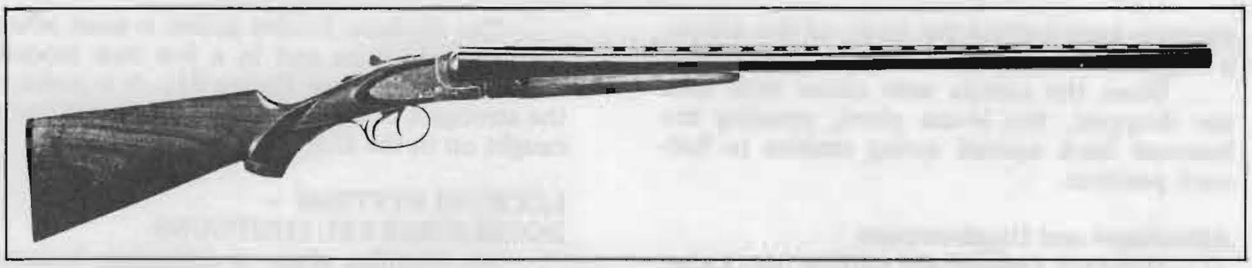


FIGURE 23 — *The L. C. Smith is the only American side-lock in current production. The contemporary version, though made from the original tooling, incorporates a ventilated rib that is offensive to many double-gun "traditionalists."*

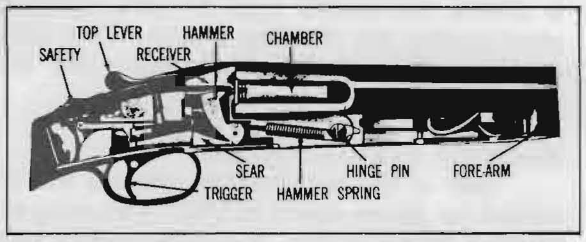


FIGURE 24 — *Cutaway view of the box-lock design. (Courtesy NRA)*

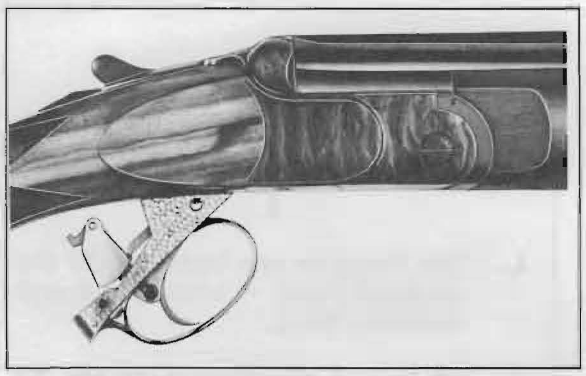


FIGURE 25 — *The trigger mechanism of a box lock is mounted on a detachable trigger plate.*

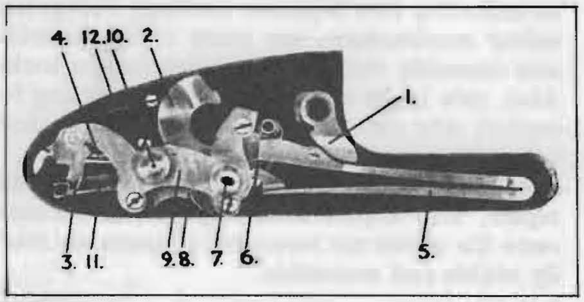


FIGURE 27 — *Bar-action side locks, like the Purdy (above), typically have the mainspring mounted in front of the hammer. Components are as follows: (1) compressor, (2) hammer, (3) intercepting safety, (4) sear spring, (5) mainspring, (6) swivel, (7) hammer axle, (8) sear nose, (9) bridle, (10) sear peg, (11) sear, (12) safety spring.*

is opened and the barrels are downward. Figure 28 shows the cocking lever arrangement in a box lock; Figure 29 shows the cocking lever arrangement in a side lock. Note that the lever in a box lock is much shorter. The reason is that the hammer, which is cocked by the lever, is closer to the lever because the action is within the receiver. In side locks, with the

FIGURE 26 — *Back-action side locks have all lock components mounted to the rear of the side plate, with the mainspring positioned behind the hammer. The gun shown is the AYA M37, a super-deluxe Spanish double.*

hammer back behind the body of the action, a longer lever is required to reach the hammer.

When the barrels with either type lock are dropped, the levers pivot, pressing the hammer back against spring tension to full-cock position.

Advantages and Disadvantages

Side-lock doubles are seldom seen today (except in modern replica hammer doubles, which are all side locks) because of the high manufacturing costs. The locks themselves, constituting two separate cocking, firing, and safety mechanisms, are more costly to make and assemble than the more simple box locks. Also, side locks require precision inletting for perfect side plate-to-wood contact. This, too, takes time, spelled money.

Side locks are easier to dismantle, clean, repair, and adjust than box locks because, once the plates are removed, all parts are readily visible and accessible.

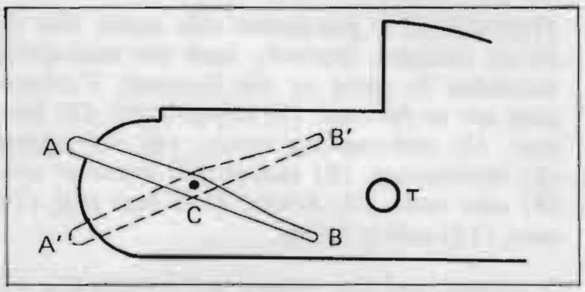


FIGURE 28 — Box locks require a short-action lever for cocking because the hammer is within the body of the receiver.

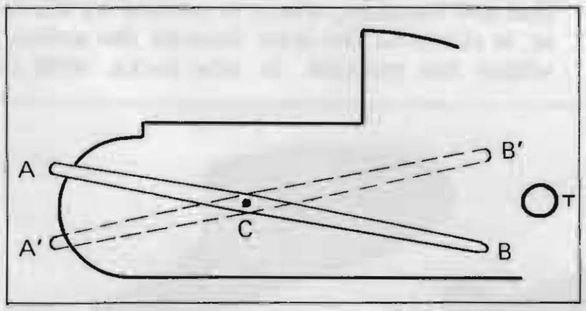


FIGURE 29 — Side locks require longer-action levers because the hammers, mounted on the side plates, are to the rear of the receiver.

The Dickson or "Blitz" Action

A third type of action is the Dickson round action or "Blitz," patented in 1880, which has been termed the "connecting link" between the side and box locks (see Figure 30). The dual locks are mounted entirely on the trigger plate, which is inserted from underneath. As with the side locks, the locks are positioned behind the body of the action.

The Dickson double action is most often found in old guns and in a few new models made in Europe (see Figure 31). It is perhaps the strongest of all double actions, but it never caught on in the U.S.

LOCKING SYSTEMS — DOUBLE-BARREL SHOTGUNS

All doubles share a common feature. The barrels (or lumps) pivot on a crossbolt or hinge pin when the action is opened, thus cocking or closing the gun. When the action is closed, the barrels must be held rigidly in place against the standing breech. There are a number of methods of accomplishing this lock-up.

The Purdy Underbolt System

One of the best lock-up systems was invented by James Purdy in 1867; following expiration of his patent, it became widely used by many manufacturers. The Purdy system is still used in many modern doubles. The system

ANSWERS

2

1. The firing on one barrel — and the resultant recoil — arms the second barrel for firing.

2. By tightly wrapping a ribbon of three or four narrow strips of steel around a barrel-shaped core and hammering and welding the "ribbons" into a tube.

3. a. Pull length of single trigger doesn't vary as double trigger pull lengths do.

   b. Single trigger is *thought* to be faster.

   c. Single trigger provides more finger room.

   d. Single trigger doesn't allow bruising "finger raps" when second tube is fired.

4. Because of the bonding solder used in these oldtimers, heat in the reblueing process would probably dissolve the barrel bonds.

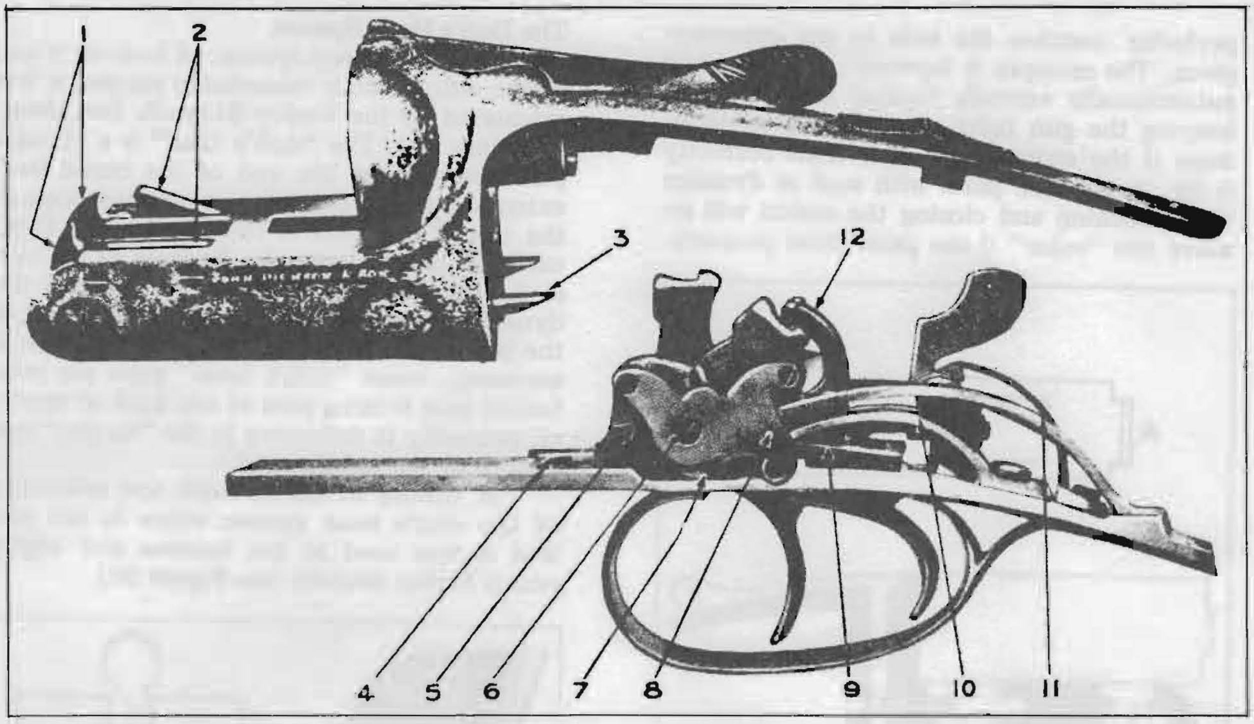


FIGURE 30 — The Dickson "round action" and component parts: (1) extractor kickers, (2) ejector compressors (right, unset; left, set), (3) ejector rod (cocked), (4) cocking lever, (5) ejector lug, (6) tumbler axle, (7) sear nose, (8) sear peg, (9) sear, (10) sear spring, (11) mainspring, (12) intercepting safety.

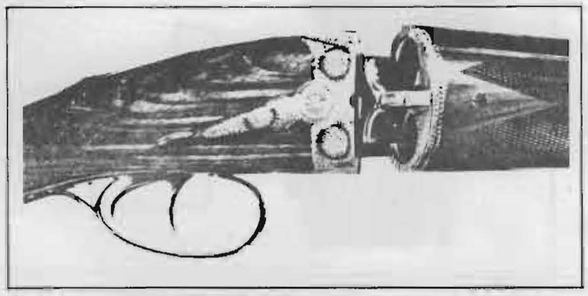


FIGURE 31 — A few over-and-unders were made by the Scotch gunmaking firm of Dickson & Son. This vintage example was built on a modified round action.

FIGURE 32 — All doubles break open on the hinge principle. The method of securing the barrels to the standing breech varies.

is characterized by a flush joint between the breech end of the barrels and the standing breech. There is no extension from the barrels into a recess at the top of the receiver as with other designs.

The lock-up takes place within the receiver by a sliding bolt which is cammed forward and backward by the tang lever (see Figure 33). When the lever is pressed to one side, the bolt slides out of the notches cut in the lumps, permitting the action to open. When the action is closed, the lever is moved in the opposite direction. This causes the bolt to slide forward, engaging the lump notches and locking the barrels in firing position. Usually one bolt is used, sometimes two. These bolts are usually slightly wedge-shaped to automatically compensate for wear.

The Greener Crossbolt System

The Greener system uses an extension from the butt end or rib of the barrels, which fits into a matching recess in the receiver (see Figure 34). This extension has a hole in the end through which a crosspin enters when the action is closed, thus firmly locking the barrel. When the action is opened by pressing the cocking lever, the crosspin is cammed out of the extension, thus freeing the barrels.

The Greener system is one of the strongest and most reliable, providing the crosspin perfectly matches the hole in the extension piece. The crosspin is tapered. As it wears, it automatically extends further into its hole, keeping the gun tight. A good way to determine if the crosspin and hole mate correctly is by coating the parts with soot or Prussian blue. Opening and closing the action will remove the "color" if the parts meet properly.

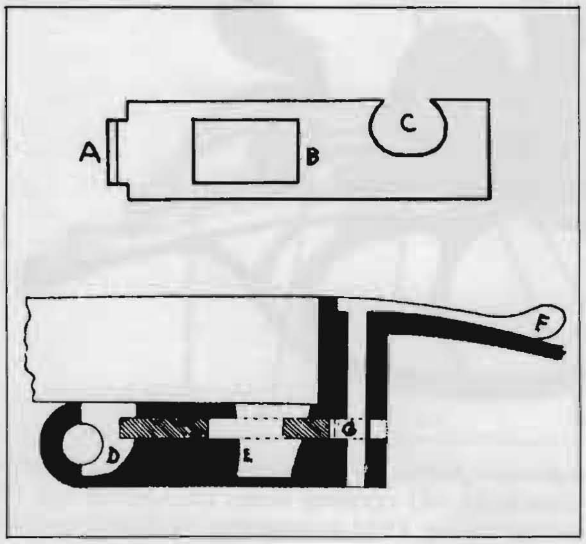


FIGURE 33 — The Purdy double-bolt system. Two lumps are utilized which fit into recesses in the receiver. Each lump has a notch at the rear. The action bolt (top drawing) has two bearing edges at A and B which engage the slots in the lumps at D and E (bottom drawing) when the action is closed, thus locking the gun. When the tang lever F is pushed to the side, the action bolt is cammed backward by the cam G engaging the round slot C in the action bolt. This disengages the action bolt from the lumps, permitting the action to open.

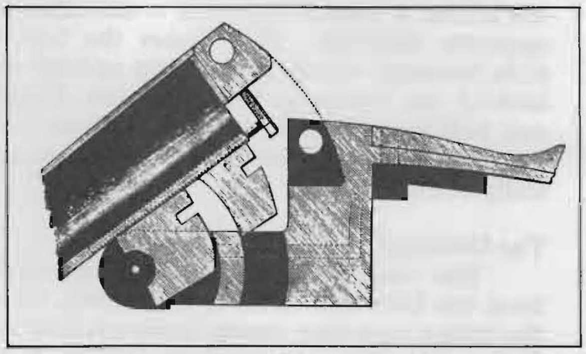


FIGURE 34 — The Greener system employs an extension at the end of the barrels which swings in and out of a recess in the receiver. When the gun is closed, a crossbolt enters the hole in the extension. Some guns use a combination Greener crossbolt/Purdy underbolt, as shown above. Note the notches at the rear of the lumps.

The Doll's Head System

The doll's head system of lock-up is one of the oldest, and is remarkably simple. It was originated by the Wesley-Richards firm about a century ago. The "doll's head" is a circular protruberance at the end of the barrel butt extension which fits into a matching recess in the top of the receiver (see Figure 35). Ordinarily there is no crosspin. Because of the beveled angles of the head and recess, and the dynamics of recoil, the lock-up is strongest at the moment of firing. Although no crosspin is necessary, some "doll's head" guns are reinforced with locking pins of one kind or another, primarily in deference to the "no pin" suspicions of the uninformed.

A tribute to the strength and reliability of the doll's head system exists in the fact that it was used in the famous and highly prized Parker doubles (see Figure 36).

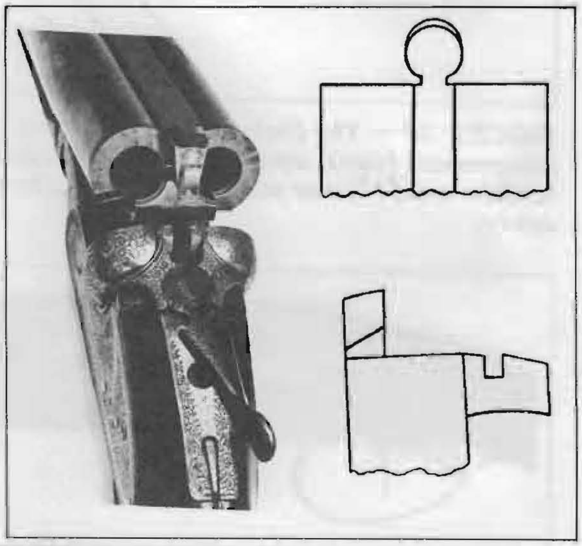


FIGURE 35 — The "doll's head" lock-up system (above) is used in double rifles as well as in double shotguns. Top and side-view sketches show the bevel which makes lock-up strongest at the moment of firing.

FIGURE 36 — Parker shotgun, one of the most valuable of all American vintage doubles, and a prime example of the doll's head lock-up system.

The Rotary Bolt System

Possibly one of the finest shotgun locking methods is the rotary or Baker bolt used in the L. C. Smith, Ithaca, and Fox double barrels. Here, the extremely heavy barrel extension with a rectangular cutout is engaged by a notched cylinder or bolt (see Figure 37). The engaging surfaces are tapered to provide firm lock-up, even with progressive wear. There's an old saying that "nobody ever saw a loose L. C. Smith." The rotary bolt system is the reason.

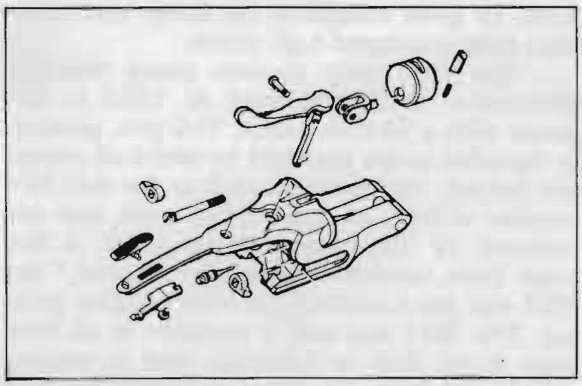


FIGURE 37 — Cutaway view of the L. C. Smith's locking system, showing the cylinder bolt which engages the cut-out in the barrel extension.

Matching Tapered Dowel Pin System

You'll seldom run across the matching tapered dowel pin system of lock-up as it's most commonly used in doubles of European manufacture and isn't as strong as the other lock-up systems. Here, spring-loaded tapered steel pins protrude at either side of the standing breech. When the action is closed, the pins retract and then engage matching recesses in the butt end of the barrels. The system was used in early Beretta doubles for a time, but has apparently been discontinued.

FIGURE 38 — Beretta MSO-2, made in Europe, was one of the few recently produced doubles to incorporate the rare tapered dowel pin lock-up method.

OVER-AND-UNDER DOUBLES

The "top stackers" come in a variety of lock types and lock-up systems. They are essentially the same as their side-by-side brothers except for barrel arrangement. A problem shared by all stacked-tube shotguns exists in the positioning of the lumps. When placed on the bottom of the lower barrel, as is usually the case, the gun is so thick through the receiver and forearm that it looks clumsy. Some of the better imported over-and-unders, notably those from England, mount the lumps on the sides of the bottom barrel, resulting in a more esthetically pleasing appearance.

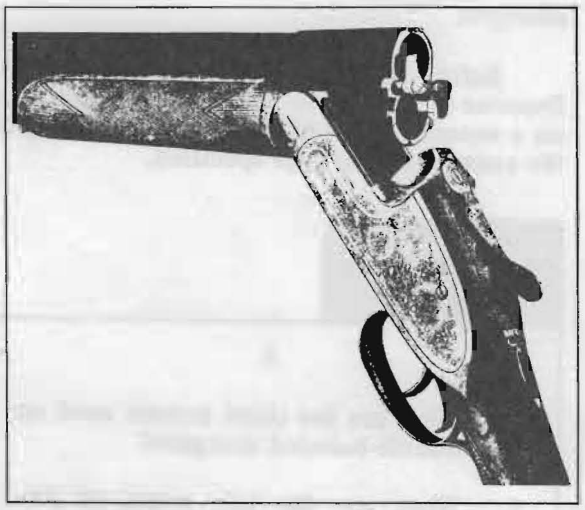


FIGURE 39 — The finest over-and-unders incorporate "split lumps" at the sides, as shown. When the lumps are at the bottom, the forearm stock is disproportionately thick, and clumsy in appearance and handling.

STOCK ATTACHMENT

The vast majority of double gun stocks are secured to the action by means of a "thru bolt" which is inserted through a cavity in the buttstock and into threads in the receiver. A very few older guns utilize an anchor method whereby the front of the buttstock slips between the tang and receiver bottom and is secured by small wood screws (such as with the Browning autos). This system is extremely weak and is seldom used on doubles. Side-lock stocks are notoriously weak in comparison with stocks used with box locks because so much wood is removed to permit inletting of the side plates, and at a point where the stock should be the strongest. In effect, only four "fingers" of wood hold a side-lock stock to the receiver. For this reason, wood selection with particular attention to grain must be observed with side locks to achieve even mediocre strength. This attention to proper stock wood selection also helps boost the price of side locks.

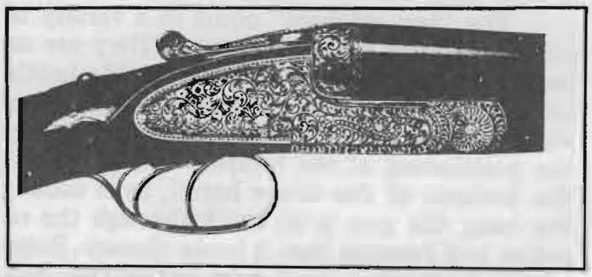


FIGURE 40 — Side-lock stocks, because of the large amount of wood that must be removed to accommodate the side plates, are notoriously weak where a stock should be the strongest.

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

1. What are the three actions used on double-barreled shotguns?
2. What are the two types of side locks?
3. What are the five kinds of locking systems used on doubles?
4. If part of the action extends to the front, into the bar of the action, and the mainspring is *in front of* the hammer, what kind of an action does your shotgun have?

Answers on Page 18

THE PUMP-ACTION SHOTGUN

John Moses Browning, the famed firearms designer, is probably best known for his semi-automatic rifle, pistol, and shotgun designs. His genius also brought to sportsmen the slide-action or pump shotgun, which has long been the first choice of American hunters. Actually, Browning's first repeating shotgun was the 10 and 12-gauge Winchester M1887 blackpowder lever-action, and its smokeless counterpart, the M1901, which was produced up until 1914. Neither version of this lever-action ever gained much popularity.

The first true pump was the Spencer of 1888, which was poorly made and not very efficient. The Winchester M1893, Browning's first pump, rapidly gained a following because of its simple, sturdy, exposed-hammer design. A few years later the renowned Winchester M1897, an improved version of the M1893, was introduced. It was destined to become the most beloved pump gun ever made, known as the "Old Corn Sheller" (see Figure 41). This nearly indestructible arm was produced until 1957 in 12 and 16-gauge with 26 to 32-inch barrels and in all choke borings. Today, Winchester 97's are much in demand, and when in good condition (as many are, basically) they command high prices.

The first truly modern pump was the Winchester M12, marketed in 1913 in 20-gauge with a 25-inch barrel. This gun, generally regarded as the standard by which all pumps are judged, was discontinued in the mid-60's because of high manufacturing costs, and was replaced by the current Model 1200. A few years later, because of "popular demand," the M12 was reintroduced and with a higher price tag. The M12 was and is available in all bore sizes from .410 to 12-gauge, and in various grades and barrel lengths. In 1953, an M12 with the serial number 1,000,000 was presented to General Hap Arnold. It's likely that nearly two million of these fine pumps have been made to date.

The First Remington Pumps

Remington, renowned for fine doubles at the beginning of the 1900's, entered the slide-action business in 1907 with its Model 10 — a hammerless, bottom-loading and ejecting gun offered in 12-gauge only (see Figure 43). Sales of this arm must have been outstanding as the company discontinued its line of doubles in 1910. (Not until recently did Remington again offer doubles.) In 1917 Remington brought out the M17, which was essentially a 20-gauge version of the M10.

These guns were produced until 1929, when the basic design was modified and the M29 was introduced, in 12-gauge only. Shortly after, the Model 31 came out, which quickly gained acclaim for its slick and smooth action (see Figure 44). This gun ejected at the side, and was made in 12, 16, and 20-gauge in various choke borings and barrel lengths until 1949.

At that time the famous and currently made Model 870 was introduced. Although engineered to reduce manufacturing costs, the M870 was and still is considered one of the smoothest operating pumps ever made (see Figure 45).

Other Manufacturers Joined "the Act"

The booming sales of slide-action shot-

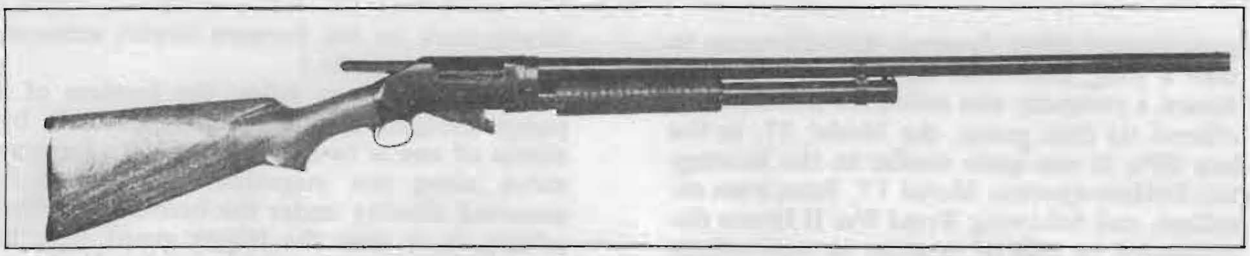


FIGURE 41 — Winchester Model 1897, the gun that made American hunters favor the pump over all other types of actions.

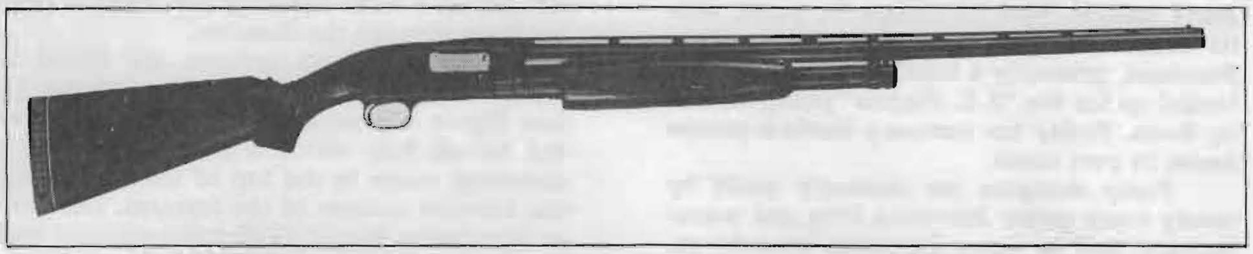


FIGURE 42 — The Winchester Model 12, so popular that even a sky-high price brought it out of retirement.

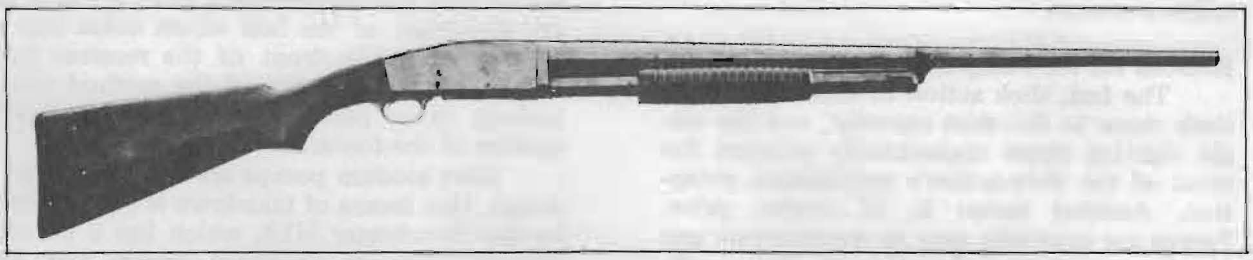


FIGURE 43 — The Remington Model 10, the company's first pump. Wide acceptance of this gun brought an end to Remington's production of doubles.

FIGURE 44 — The Remington Model 31 had a remarkably smooth action, and ejected shells out the side.

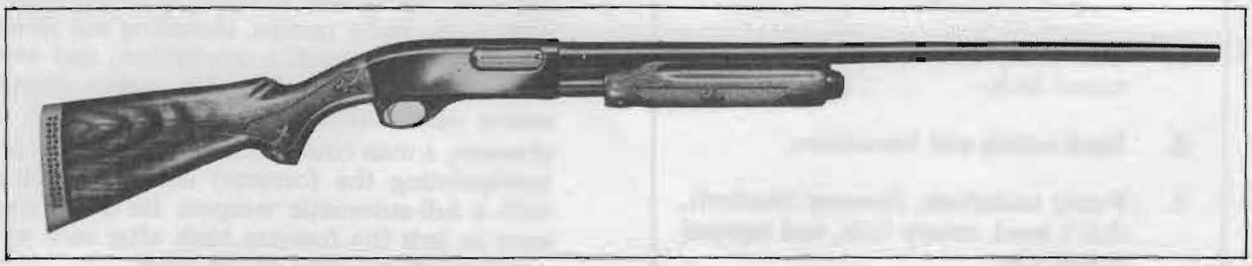


FIGURE 45 — The Remington Model 870 is the latest in the line of Remington pumps.

guns caused other firearms manufacturers to take a long, hard look at their sales figures. Ithaca, a company also noted for fine doubles, offered its first pump, the Model 37, in the late 30's. It was quite similar to the Remington bottom-ejection Model 17. Sales were excellent, and following World War II Ithaca discontinued its line of doubles to concentrate on the much-in-demand Model 37.

Other double gun manufacturers followed suit. The Savage-Stevens Company has made various types of pumps for years, with its Model 77 in current production. High-Standard, primarily a handgun manufacturer, tooled up for the "J. C. Higgins" pump offered by Sears. Today the company markets pumps under its own name.

Pump shotguns are currently made by nearly every major American long gun manufacturer, and by many European firms for export to the U.S. Repeaters of any type, for some reason, are "frowned upon" in England and on the Continent, where the double reigns supreme.

Reasons for the Pump's Popularity

The fast, slick action of modern pumps, their three to five-shot capacity, and the single sighting plane undoubtedly account for most of the slide-action's enthusiastic reception. Another factor is, of course, price. Pumps are relatively easy to manufacture and require a minimum of handwork. As a result, they can be sold for much less than a good double or auto-loader.

Pumps — How They Lock Up

Pump shotguns are similar in design to pump rifles and are activated in the same manner, by moving the forearm back to unlock, extract, and eject, forward to feed, chamber, and lock up in readiness for firing. (Some cock on the forward stroke, some on the backward stroke.)

As with pump rifles, the forearm of a pump shotgun is attached to the bolt by means of one or two action bars. The forearm slides along the magazine tube, which is mounted directly under the barrel. An action release, in or near the trigger guard, permits the locked-up action to be opened and unloaded without firing the gun. Many pumps also have a magazine cutoff that allows shells to be unloaded from the magazine without jacking them through the chamber.

Various lock-up systems are found in pump shotguns. The Winchester Model 12 (see Figure 47) has a locking lug at the rear of the breech bolt which is cammed up into a matching recess in the top of the receiver by the forward motion of the forearm. The newer Winchester Model 1200 has a rotating bolt head with four lugs which engage matching recesses in a chamber extension made of stronger steel than the chamber itself. The Model 870 Remington has a locking block at the top front of the bolt which slides into a recess at the top front of the receiver (see Figure 48). Irrespective of the method used, lock-up takes place with the final forward motion of the forearm.

Most modern pumps are of "takedown" design. One means of takedown is exemplified by the Winchester M12, which has a barrel/magazine/forearm assembly which may be quickly dismounted from the receiver. More common is the method exemplified by the Remington 870 and the Ithaca 37, where only the forearm and barrel are removed, leaving the magazine assembly attached to the receiver. There are a few older pumps around of solid-frame design, like the Savage M30.

Why New Pumps Have Trigger Disconnectors

All currently manufactured pumps have a device known as a disconnector trigger mechanism, which prevents the gun from firing while the action is closed with the trigger held back. Early pumps, including the Model 12, didn't have such a mechanism, and were understandably popular with police departments (and Dillinger types). With a bit of practice, a man could stroke off five shots (by manipulating the forearm) nearly as fast as with a full-automatic weapon. He didn't even have to jerk the forearm back after each shot — the recoil did most of the work.

When smoothing out feeding problems or other maladies, be particularly careful not to bend or shorten the disconnector. If you

ANSWERS

3

1. Box lock, side lock, and Dickson round lock.
2. Back-action and bar-action.
3. Purdy underbolt, Greener crossbolt, doll's head, rotary bolt, and tapered dowel pin.
4. Bar-action side lock.

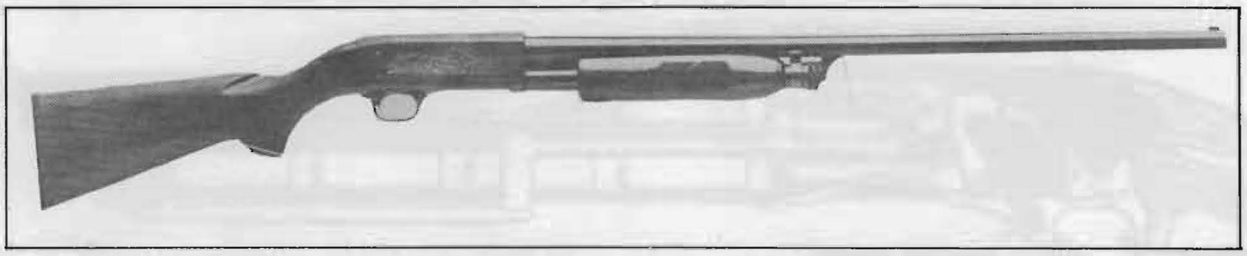


FIGURE 46 — The famous Ithaca Model 37. Its time-proven design is still essentially the same as when the gun was introduced in the 30's.

do, you may be returning something very close to a full automatic to your customer.

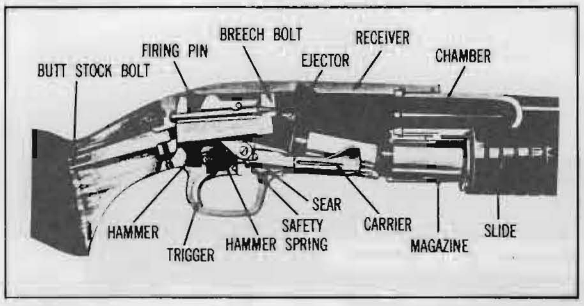


FIGURE 47 — Cutaway view of the Winchester Model 12, showing action components and method of lock-up.

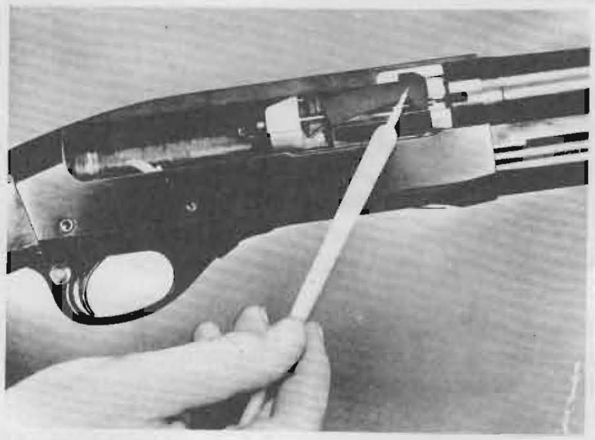


FIGURE 48 — Cutaway view of the Remington Model 870 shows how the bolt locks into the barrel extension. (Photo courtesy Complete Book of Rifles and Shotguns)

Some pumps, like the Weatherby Patrician and the Winchester M12, have separate disconnectors. Other pumps, such as the Remington M870 and Ithaca M37, incorporate a sear design whereby the sear does double duty as a disconnector. The parts listings and exploded view drawings included with the appropriate Gun Shop units are the tip-off. If a "disconnector" is not listed, then that particular gun has a "double-duty" sear. (The same situation holds true for auto-loading shotguns.)

Pump Shotgun Safeties

The hammers on pumps are usually connected to and continued within the trigger mechanism. Safeties are of the crossbolt type which do not lock the hammer, but merely block the trigger. Pumps can sometimes be jarred off sear, even with the safety on. Remember this.

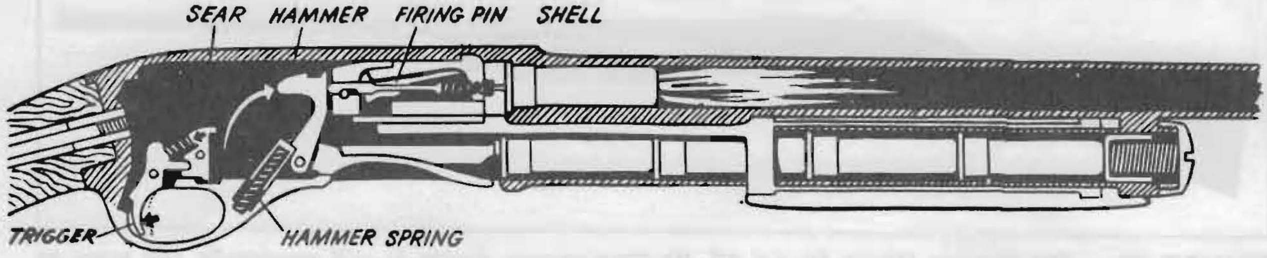
SEMI-AUTOMATIC SHOTGUNS

Auto-loading scatterguns have been around longer than most people realize — since 1905, when the memorable Remington Model 11 (see Figure 50) appeared on the sporting scene. This gun, like most early and successful firearms designs, was the invention of John M. Browning. His long relationship with Winchester seemingly ended with the semi-auto, as Winchester refused to make the gun for him on a royalty arrangement. Remington went along with Browning's royalty idea in return for the American sales rights.

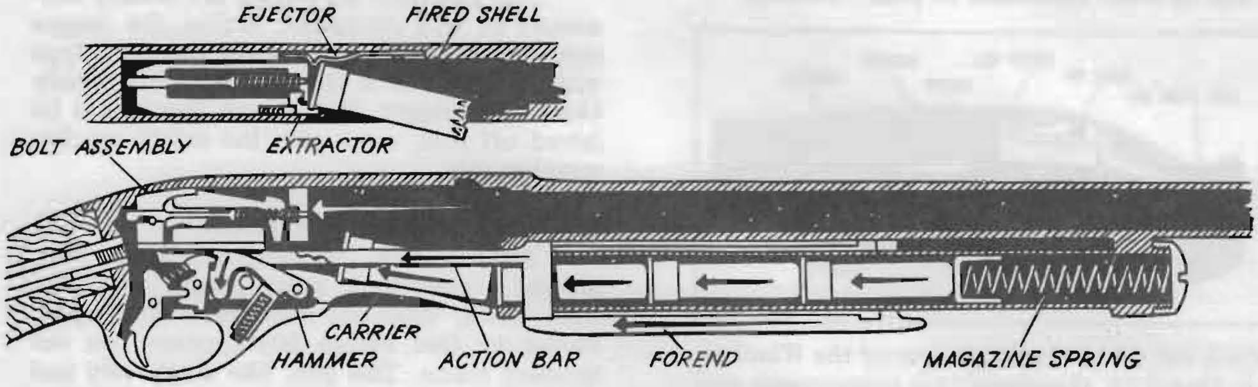
Browning, apparently no slouch at business either, then arranged for the same semi-auto to be manufactured by Fabrique Nationale of Belgium under his own name. This basic shotgun dominated the semi-auto field for many years, until the Browning patents ran out. Today guns incorporating variations of the basic Browning design are made by several U.S. and foreign manufacturers.

THE LONG-RECOIL OPERATION

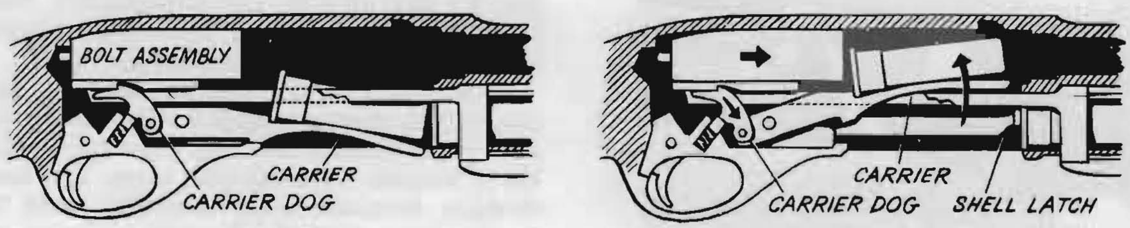
The Remington Model 11, the Browning Model 5, and its fairly recent imitations are all of long-recoil design. After firing, the barrel and breech bolt recoil backward together, the full length of the action. The powerful recoil spring then drives the barrel (which has been disengaged from the breech bolt) forward. The breech bolt, left behind, still clutches the fired shell in its extractor. As the barrel (in its forward movement) clears the fired shell, the shell is popped out to the side by the ejector. The breech bolt then begins its forward movement, picking up a new shell from the carrier and pushing it into the chamber. The barrel and breech bolt are again locked together and the gun is ready for firing.



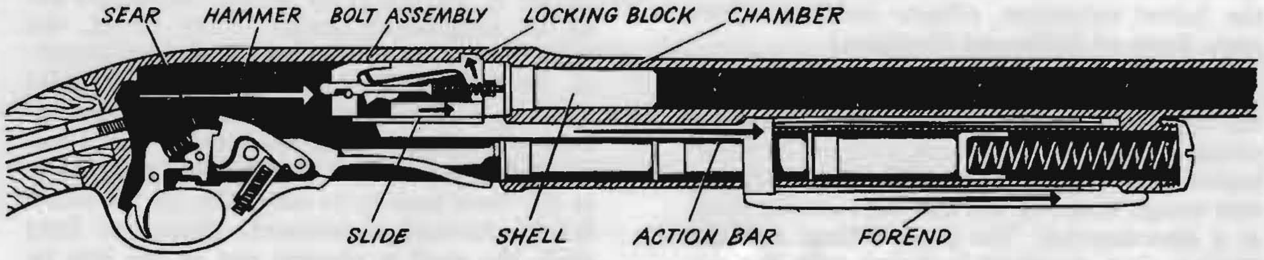
1. When the gun is loaded and cocked, pulling the trigger releases the sear, permitting the hammer to strike the firing pin, which in turn detonates the primer.



2. Pulling the forearm to the rear moves the action bar and bolt assembly to the rear. The fired shell is ejected (see top drawing), the hammer is forced down into the cock position, and the next shell moves onto the carrier.



3. The lefthand drawing shows how the bolt assembly, when fully back, engages the carrier dog. When the bolt assembly moves forward (righthand drawing), the carrier dog is forced downward, which pivots the carrier, thus bringing the new shell into loading position. Simultaneously, the shell latch moves to the right, thus blocking the remaining shells in the magazine.



4. As the forearm, action bar, and bolt assembly continue in their forward travel, the new shell enters the chamber. Meanwhile, the sear engages the hammer, locking it in readiness for firing. In the final forward movement of the forearm, the slide pushes the locking block up into its recess, thus locking the action.

FIGURE 49 — The inner workings of the modern pump shotgun (example: Remington Model 870).

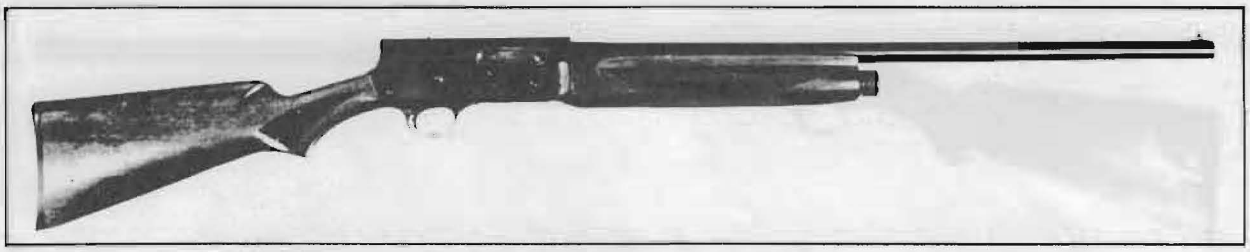


FIGURE 50 — The Remington Model 11, John M. Browning's first semi-automatic shotgun. The "Browning" made by FN of Belgium was and is basically the same gun.

FIGURE 51 — Manufacturers and distributors introduced auto-loading shotguns based on the same long-recoil design. Examples: the Savage 750 (top) and the Herter SL18 (bottom).

Firing a long-recoil rifle or shotgun can be a bone-jarring experience because of the "double whammy" involved. You get one jolt when the shell goes off and another when the barrel and breech bolt slam into the rear of the receiver. When the springs and friction rings are properly adjusted, the effect isn't too bad.

THE SHORT-RECOIL SYSTEM

Only three American shotguns employed the short-recoil system: the Browning double automatic (the only two-shot auto-loader) and the Winchester Models 50 and 59. All three guns were discontinued after comparatively short production runs.

The Browning double auto is more pleasant to shoot than its long-recoil "pappy" as there is no "double jolt." In the short-recoil system, the barrel and breech block recoil together only about 3/4" after firing. At this point the barrel is stopped by counter-balanced springs. The breech bolt continues to the rear, clutching the fired case in its extractor. When the breech bolt reaches the rear of the action, the ejector kicks out the spent shell. The barrel, meanwhile, has returned to battery (firing) position. The breech bolt, now moving forward, picks up a fresh shell from the carrier, thrusts it into the chamber, and returns to lock-up. The gun is again ready to fire.

The Winchester 50 is of modified short-recoil design. The barrel remains fixed after firing, while the recoiling element is a "floating chamber" within the breech end of the barrel. This floating chamber is forced back a short distance by gas pressure, thus forcing a spring-loaded weight down a tube in the butt-stock. This weight, in its return, unlocks the action — forcing the breech block to the rear and the floating chamber forward into its original position. The breech block, moving forward, picks up and chambers a fresh shell, thus completing the cycle.

The short-lived Winchester Model 59 was similar to the M50 except that it incorporated a fiberglass barrel. It was discontinued in 1965.

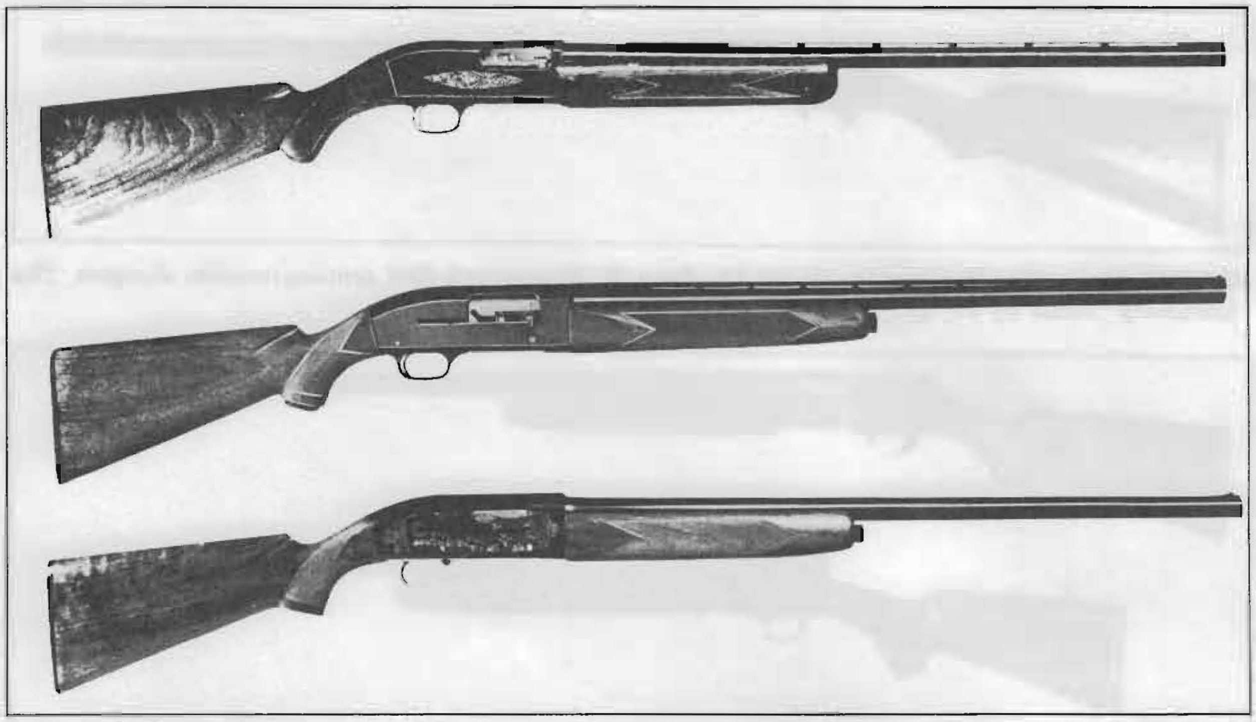


FIGURE 52 — The above guns, the Browning double automatic and the Winchester 50 and 59, are examples of the short-recoil system. No shotguns employing this action principle are in current U.S. production.

THE GAS-OPERATED SYSTEM

The majority of current auto-loaders are gas-operated. Such shotguns are manufactured by High-Standard, Ithaca, Smith & Wesson, Remington, Winchester, and several foreign gunmakers. All use a metering device which taps off expanding gases at some point under the barrel. These gases then exert force directly or indirectly against a piston which activates the action. Most manufacturers of gas-operated auto-loaders claim "reduced recoil" for their products. Actually, the recoil is still there, but is spread over the longer time required for a gas-operated mechanism to complete its firing-reloading cycle. The effect is therefore a push rather than a sharp jolt.

Earlier gas-operated shotguns such as the Remington M58 (see Figure 53) and some of the vintage High-Standards had a metering knob or vent at the forearm tip which could be set for either high or low-based shells. Most modern shotguns are self-metering in that they select, automatically, the correct amount of gas pressure needed to operate the action. As in semi-auto rifles and pistols, the seven operational functions of all firearms are accomplished automatically in auto-loading shotguns — with the exception of pulling the trigger.

LEVER-ACTION SHOTGUNS

Although the lever-action shotgun was the first repeating shotgun, the design never gained favor with scattergunners. The popular pump design, which evolved at almost the same time, ruined whatever chance the lever variety had.

Following the discontinuance of the Winchester M1901 in 1920, no lever-action shotgun was produced by an American manufacturer until Marlin, in the mid-1930's, came out with their .410 lever gun. It was popular

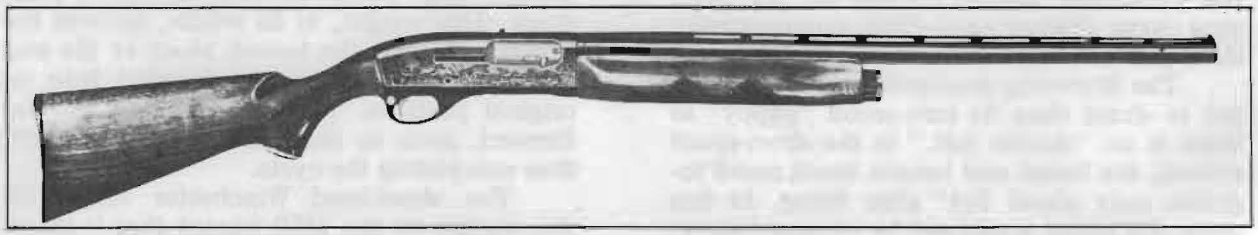
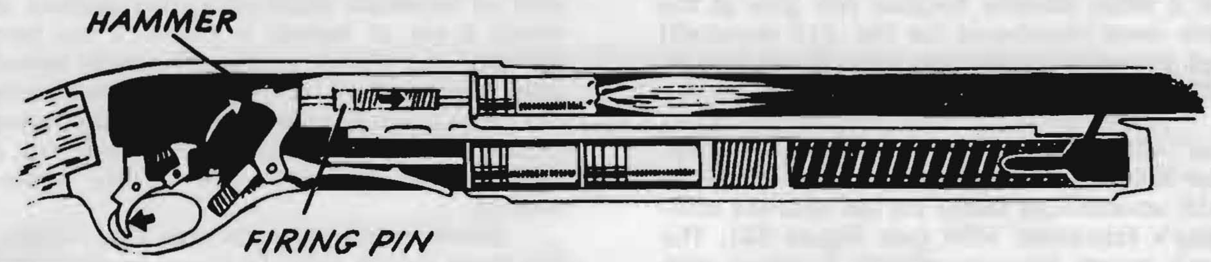
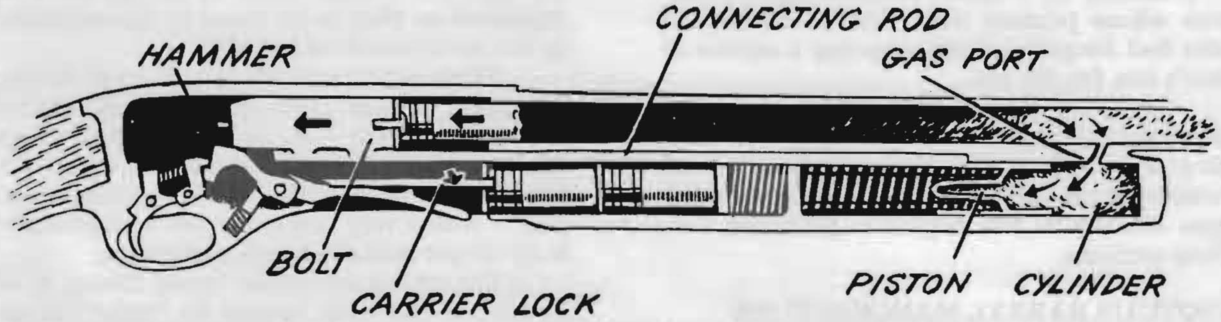


FIGURE 53 — The old Remington Model 58 incorporated an adjustable gas metering design to vary settings for high and low-base shells.

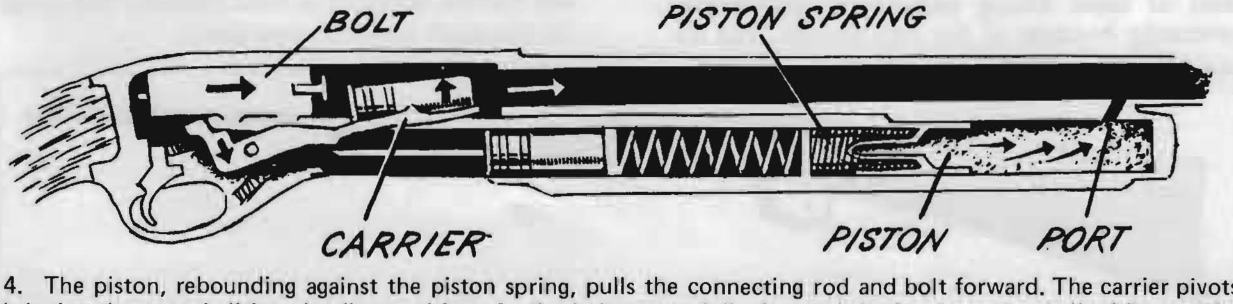


1. With the gun cocked and loaded, squeezing the trigger releases the hammer, which hits the firing pin, causing the primer to detonate.



2. Gas pressure generated by the explosion is vented down through the gas port and into the gas cylinder. The gas then forces the piston and connecting rod to the rear, thus moving the bolt back from the chamber. As the bolt moves to the rear, it extracts the fired shell, cocks the hammer, and opens the carrier lock.

3. As the bolt reaches the rear of its travel, the ejector pushes out the fired hull, which permits the magazine spring to push a new shell onto the carrier.



4. The piston, rebounding against the piston spring, pulls the connecting rod and bolt forward. The carrier pivots, bringing the new shell into loading position. As the bolt moves fully forward, it chambers the shell while reaching lock-up position. The remaining gas escapes through the gas port into the barrel.

FIGURE 54 — The inner workings of a gas-operated shotgun (Remington Model 58).

for a while (mostly because few guns at the time were chambered for the .410 shotshell) and stayed in production until World War II. After the war it wasn't revived.

About the only other lever-action "shotgun" of note was the .410 version of the popular Savage 99. At one time Savage offered a .410 smoothbore barrel for use with the company's takedown M99 (see Figure 55). The gun's rotary magazine didn't function with shotshells, nor was it supposed to. The combination was a single-shot, pure and simple, and it worked fine. Quite a few 99's with interchangeable rifle and .410 barrels were sold — primarily to Western ranchers and sportsmen whose primary need was for a rifle, but who had frequent chances to bag a chukar or fool's hen for the pot.

That, in a general way, gives you the background and functions of the various shotguns and their action systems. Detailed instructions on disassembly and repair of the guns mentioned will appear in pertinent Gun Shop sections.

SHOTGUN BARREL MANUFACTURE

Shotgun barrels fall into two classifications: (1) those for single-barreled guns, and (2) those used in doubles of either side-by-side or over-and-under configuration. The barrels for single-barrel guns, whether of break-action single-shot, pump, or semi-automatic design, are basically economical to manufacture. Low retail cost is a big reason why the single-barrel repeater is used by so many hunters and why it has become "traditionally American."

In the rest of the world, such shotguns are seldom seen in the field. (An exception is in Belgium, where the superb Browning autoloaders have been made for years.) Many foreign manufacturers make single-barrel repeaters, but almost exclusively for export to the United States.

The Double-Barrel Shotgun

Double-barrel shotguns call for a great deal of hand fitting and expert knowledge, primarily because of the two barrels. The degree of expertise reflected in the manner in which a set of barrels is joined is the best measure of a double's value. The fairly recent monobloc method of joining double barrels has been helpful in reducing manufacturing costs. Even so, the expense of producing a good double shotgun in this country is prohibitive.

Doubles not only require two barrels, but those barrels must be joined together and also to the lumps — that part of the gun on which the action pivots to break or lock. The lumps-barrel juncture then has to be fitted to the water table and to the standing breech. Finally, the barrels have to be adjusted or regulated so they both shoot to approximately the same center of impact.

These procedures all require hand fitting, soldering, and/or brazing by highly skilled workmen. In the U.S., master gunmakers are rare — and the few around demand high salaries. Because of this, the double-barreled shotgun — with a very few expensive exceptions — is no longer manufactured in America.

The object of careful barrel fitting is, of course, to get both barrels to "print" at approximately the same place. With cheaper doubles, the fine attention to detail required to accomplish this objective is economically impossible. Consequently, some of these doubles present the shooter with a truly amazing difference in pattern placement. Probably the best way to point up poor barrel fitting is to shoot a rifled slug in each barrel, at the same aiming point. Very few doubles, including the high-grade makes, will print the slugs within eight inches of each other at about 40 yards, where the barrels theoretically converge.

Double-barreled tubes are assembled in several different ways. Some are merely joined at the lumps and at the muzzle by a band. The early Finnish Valmet guns employed this type of construction, as did the old Remington M32 over-and-under. The new Remington M3200 also uses this system. By way of contrast, Winchester's superb M21 (see Figure 56) features a mechanical dovetail system to join the barrels, which is at least partially the cause of the gun's astronomical price.

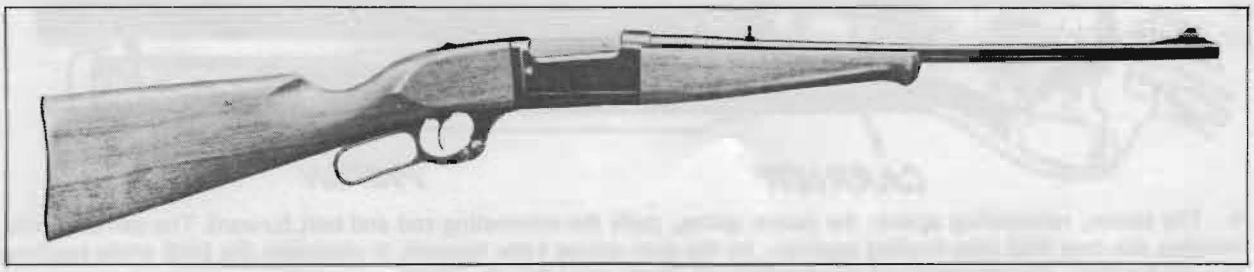


FIGURE 55 — The popular and long-lived Savage Model 99 was once a shotgun. An interchangeable .410 barrel was offered with the M99 takedown model.

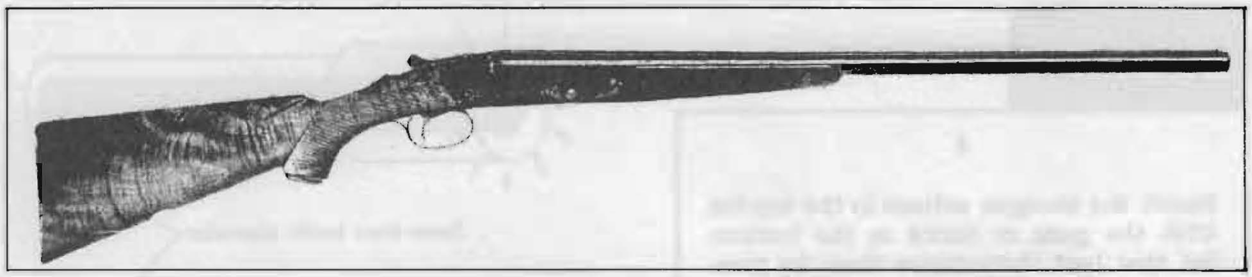


FIGURE 56 — The Winchester Model 21, one of the finest doubles made today, and one of the most expensive.

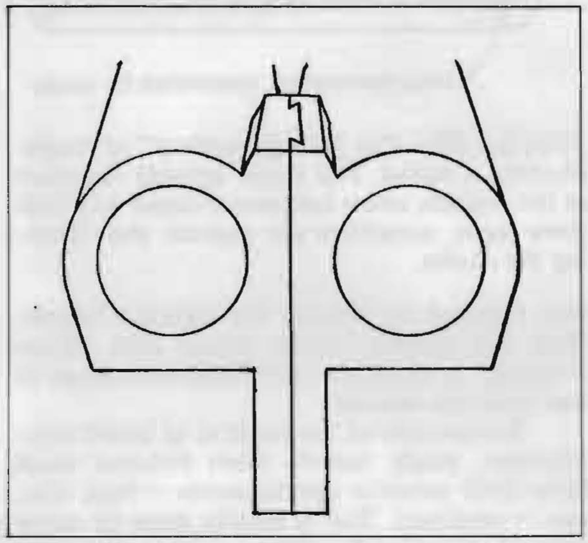


FIGURE 57 — The dovetail barrel joining method was used only in the highest priced doubles of yesteryear. Today this basic system is found in only a few costly guns, including the Winchester Model 21.

The importance of proper barrel joining is obvious when one considers what happens when a shooter fires one barrel exclusively (as often happens at trap). The fired barrel becomes noticeably longer as it expands with the heat, and if the barrel bonds aren't secure, something has to give — usually the solder.

Most double tubes today are assembled and joined by the monobloc method, whereby the breech ends of the barrels are inserted in a block, turned to a tight press fit, and sweated into the single lump forging. The barrels are then cleaned, a rib is soldered to the top and bottom of the barrels, and the ends of the ribs are plugged. Presto! — a set of shotgun barrels — but still expensive.

The Ventilated Rib — Pro and Con

Ventilated ribs are frequently affixed to better-grade single and double-barrel shotguns. They were originally used on trap guns, which are fired rapidly for fairly long periods. As the barrel heats up, heat waves or "mirage" can distort or even obscure the target. The venti-

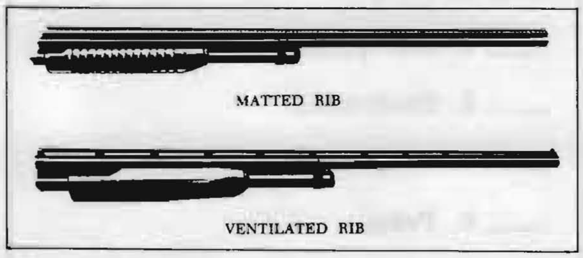


FIGURE 58 — The ventilated rib was designed to accomplish rapid barrel cooling of overheated trap and skeet guns. On field shotguns, the purpose is largely decorative. Matted ribs are usually used on less expensive shotguns.

lated rib was designed to minimize mirage by allowing air to circulate between the barrel and the rib. The idea worked out pretty well.

Today, however, the ventilated rib is mounted on all manner of shotguns, including field guns that aren't fired often enough to warm toast. They may improve the sighting plane (it's debatable) and they don't add much weight. They are certainly "in style." On a classic double, however, the ventilated rib, in the opinion of many, is as out of place as a hood scoop on a vintage Rolls Royce.

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.

Steps in Barrel Manufacture

Most of today's cheap single barrels are made from extruded steel tubing which is chamber-reamed at one end and choked simply by running the muzzle of the tube into a swaging die.

Until recently, some of the better-grade domestic barrels were manufactured by straight-boring hollow steel billets, in much the same way a rifle barrel is bored. However, in the shotgun procedure, the outside of the barrel conforming to the choke area was left larger than the rest of the barrel in the turning process (see Figure 59). This portion was then hammered down until the entire barrel exterior from breech to muzzle was uniformly tapered. The exterior front of the barrel, which

PROGRAMMED EXERCISE

4

Match the shotgun actions in the top list with the guns or terms in the bottom list that best characterize them by placing the letters in the blanks provided.

_____ 1. Lever

_____ 2. Gas-operated

_____ 3. Short-recoil

_____ 4. Long-recoil

_____ 5. Pump

A. Browning double auto.

B. Remington M870.

C. .410 version of the Savage 99.

D. The most popular current auto-load design.

E. The Browning Model 5 and its recent imitation.

6. Describe briefly how you can check out barrel fit in a double.

Answers on Page 28

was wider before hammering, then had a smaller interior diameter, close to the dimensions of the desired choke. This was known as the "stamp method" of rough-choking a shotgun barrel. Such barrels were then chamber-reamed, polished inside, and then the roughed-out "choke" reamed to exact size. This was, however, an old-fashioned and extremely expensive way to manufacture shotgun barrels

As a result, Ithaca and a few other companies went to a system (see Figure 60) whereby a steel billet is heated with an induction coil, then hammered down over a mandrel. (This is essentially the hammer-forging method used in making rifle barrels.) When the barrel was removed from the mandrel, the choke and various barrel dimensions had been formed and the bore had been "semi-polished." Only minor interior polishing was required. The barrel exterior was then turned

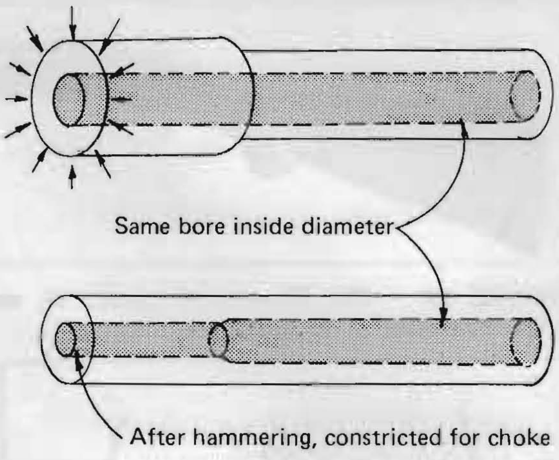


FIGURE 59 — The "stamp method" of rough-choking a barrel. The larger outside diameter at the muzzle, when hammered down to a uniform taper, constricts the muzzle, thus forming the choke.

and finished to remove the hammer marks. With this system, which Ithaca calls "Roto Forging," a barrel can be beaten into shape in less than one minute!

Irrespective of the method of barrel manufacture, single barrels when finished must have their exterior apurtenances — lugs, ribs, etc. — attached. This is usually done by some type of induction brazing or welding, although some firms still use silver solder to attach lugs and ventilated ribs.

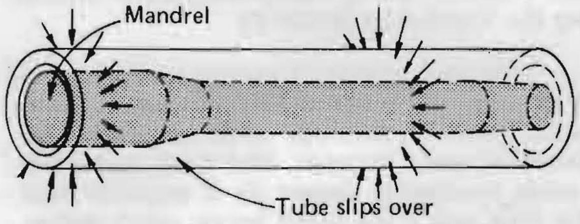


FIGURE 60 — Shotgun barrels, like rifle barrels, are sometimes hammer-forged. In the process, the blank barrel tube is slid over a mandrel (top). After hammering the exterior of the barrel, the interior takes on the shape, in reverse, of the mandrel — thus forming the basic interior dimensions.

Barrel Dimensions, Interior

Starting from the breech end of the double or single barrel, there are, in most guns, a minimum of five interior barrel dimensions. The first is the rim clearance cut, which immediately precedes the chamber; the next is the chamber itself. A tapering cut is then made or formed from the front of the chamber to a point slightly forward which constitutes the forcing cone. From there on, the bore is usually straight until it constricts at the choke (see Figure 61).

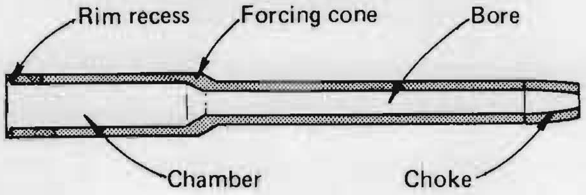


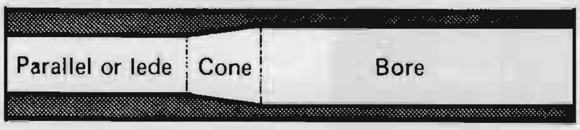
FIGURE 61 — Cutaway showing the five interior dimensions of a shotgun barrel, which are either cut or largely formed by a mandrel.

A Discussion of Choke Dimensions

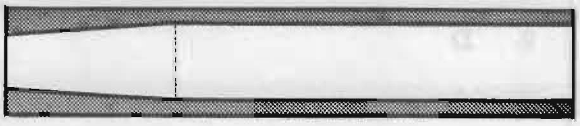
There are several different types of chokes (see Figure 62). Some are very short; others are as long as 3½" to 5". Some are swaged down to a uniform diameter the entire length of the choke; still others have areas of constriction and expansion within the choke. Regardless of the system, they all have the same purpose — that of placing a predictable amount of shot in a given circle at a specified range.

Double guns of the 1930's and earlier varied widely in the diameter of their so-called "standard" chokes, which were standard only for the particular manufacturer. Today the vast majority of barrels are choked to a standard set of specifications established by SAAMI (Small Arms and Ammunition Manufacturers Institute). These specifications are more or less arbitrary, primarily for convenience in establishing engineering and machining standards as modern shotguns usually shoot much tighter patterns than a given choke marking indicates.

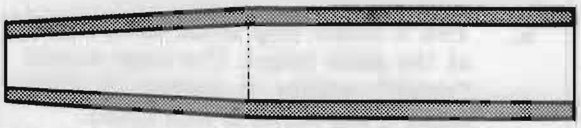
The problem is that these SAAMI specifications are based on the now obsolete wad and filler shotshell. The plastic shot cup used in modern shotshells keeps the shot together longer, resulting in reduced pattern spreads. It has been reliably reported, for example, that these modern shot cup shells, when fired



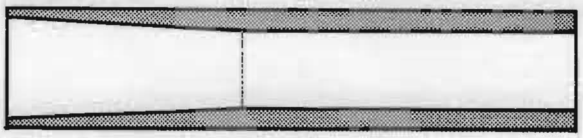
The standard or English-style choke. The choke is actually the cone behind the parallel lede.



The cone or taper choke commonly used on better-grade U.S. shotguns.



The swage choke used on most single-barrel guns. Note the long taper to avoid metal "crimping" in the forming die.



The seldom-seen reverse or bell choke for making very wide patterns.

FIGURE 62 — Representative chokes.

in guns choked "improved cylinder" by SAAMI specifications, often deliver consistent 65% (improved-modified) patterns, rather than the 45-50% patterns expected with improved cylinder choking. As a result, many manufacturers now choke most of their shotguns "modified." The reason? These guns shoot tighter or just as tight patterns as the "full-choke" guns of seven to ten years back.

And that's about it for now about shotguns. When you're ready to go again, we'll take up shotgun ballistics in Part 2 of Unit 4.

ANSWERS

4

1. C
2. D
3. A
4. E
5. B
6. Fire a rifled slug from each barrel at the same target. The slugs should "print" within 8 inches of each other if the barrel is well fitted.

STUDY UNIT 4 – PART 2

SHOTGUN BALLISTICS

THE LONG AND SHORT OF BALLISTICS

Unlike rifles, which are long-range precision instruments, the shotgun is primarily a short-range arm. It is nevertheless equally as deadly on both large and small game, with appropriate projectiles.

Shotgun performance or ballistics hasn't changed a great deal in the last century. Range has been extended perhaps ten yards. The same amount of shot is still used for a given gauge and given type loads, and the velocity of the pellets is nearly the same. The biggest improvements in shotgun ballistics over the past 100 years resulted from the invention of the choke and the plastic shot cup, which did more to increase effective range than did smokeless powder.

Modern shotshells are more efficient than their blackpowder counterparts, but their biggest contribution is in the convenience and dependability they afford the shooter. The misfires, swollen cases, and frequent bore cleaning one could count on with yesteryear's shotshells have all but been eliminated.

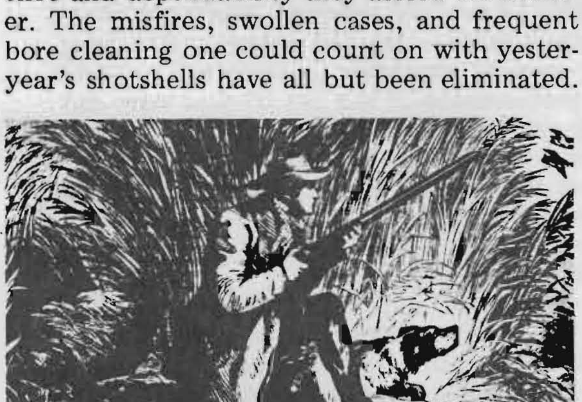


FIGURE 1 — Duck and goose hunting for sport became popular following the invention of the shotgun. This 1858 depiction shows a teal hunter with an exposed hammer percussion double.

However, few targets are hit today that couldn't be downed with equal facility by the nimrod of the 1850's with his blackpowder muzzleloader.

THE SHOTSHELL

Today's plastic commercial shotshell, to which few shooters give a second thought after ejection, are marvelously simple, with only a few components. However, only a few years ago, shotshells involved 14 components (according to Remington), more than 200 separate manufacturing operations, and frequent inspections.

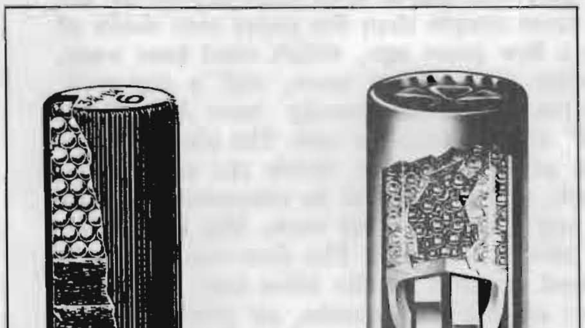


FIGURE 2 — Commercial shotshells of a few years back (left) incorporated as many as 14 components. Modern shells (right), with a plastic case, built-in base wad, and plastic shot cup, have far fewer components. Intermediate or transitional shells utilized the plastic shot cup with over-shot, over-powder, and base wads.

The rimmed brass heads of a shotshell are made in much the same way as metallic cartridges, and the primers are basically the same, but there the similarity ends. The brass head provides a pocket for the primer and supports the case, which today is usually made of plastic and incorporates a built-in base wad. Manufacturers generally use high brass for their heavy, high-velocity duck and pheasant loads, and low brass for trap, skeet, and field loads which contain less powder and shot. There is little, if any, difference in strength between high and low-base brass, as any knowledgeable shotshell reloader knows. However, the shooting public associates high-base with power, so the manufacturers go along with the misconception.

Unlike rifle and pistol cartridges, in which the primer snugs in a pocket in the case head, shotshell heads contain a sleeve or primer cup which channels the fire from the exploding primer through the base wad and directly into the powder charge. Powders used in shotshells are necessarily quicker burning and designed to produce lower chamber pressure — from 8,000 to 12,000 psi — than rifle and pistol powders. However, the familiar maxim "The heavier the projectile, the slower burning the powder" applies to both rifles and shotguns.

Contemporary shotshells, with their plastic cases and plastic shot cups or pistons, are far more simple than the paper case shells of just a few years ago, which used base wads, powder wads, filler wads, and a top wad. Modern shotshells usually have the "base wad" molded into the case. The plastic piston seals off the powder, holds the shot in its pouch, and is of a size to eliminate the need for any spacer or filler wads. The top is simply pie-crimped shut. The shot cup is usually flanged or split at the sides (see Figure 3). After exiting the muzzle, air pressure peels back these flanges, permitting the cup to drop away from the shot column. During the recent plastic evolution period, shotshells frequently contained a combination of fiber or paper wads and a plastic shot cup.

These plastic cups accomplish two things ballistically. First, they prevent the shot from scraping along the sides of the barrel, which causes pellet deformation. Thus patterns are better, with few "flyers." Second, the cup keeps the shot together longer, resulting in tighter patterns (and longer effective range).

Dram Equivalent Designations

In the blackpowder days, shotshell powder was measured in bulk (drams) rather than by weight. The top, over-shot wad was customarily marked with numbers designating the drams of blackpowder, as well as the amount of shot and shot size, such as "3-1/4—1-1/8—6." This was (and still is) a popular 12-gauge game load. The 3-1/4 referred to drams of blackpowder, the 1-1/8 to the ounces of shot, and the 6 to shot size.

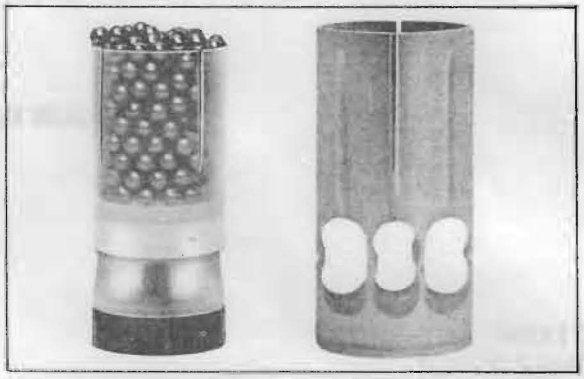


FIGURE 3 — Shot cups like the Federal (left) and Remington power piston (right) are flanged for rapid separation of cup and shot after leaving the muzzle. The center pillar crushes back at recoil, acting as a shock absorber and thus reducing the effect of recoil.

The first smokeless powders delivered the same velocities and pressures as blackpowder, and three drams of smokeless produced the same performance as three drams of blackpowder. Shooters relied upon these over-wad numbers as an index of shot velocity, range, and pattern.

As smokeless powders improved, becoming more dense and delivering more power for a given bulk measure, the dram numbers no longer made sense. (Three drams of smokeless would blow any shotgun into a jagged jigsaw puzzle.) The shotshell manufacturers, not wanting to confuse shooters, continued labeling their shells in the old manner — but using only enough smokeless powder to duplicate the performance of the old blackpowder and early smokeless loads. Therefore, the powder number is based on "blackpowder equivalent" — not the amount of smokeless powder contained in the shell.

Shotshell Projectiles

Shot is basically lead and comes in a variety of sizes — suitable for everything from bumble bees (some bored, off-season gunners use .22 shotshells on this unsuspecting quarry) to black bear. It is made by pouring molten lead through a perforated shower pan which is mounted at a considerable height over a tank of water. The lead "drop shot" falls through the air, gaining its "roundness" enroute, and hardens in the water. The shot size is, of course, dictated by the size of the perforations in the shower pan.

AMERICAN STANDARD SHOT SIZES

No.	12	11	10	9	8	7½	6	5	4	2	Air Rifle	BB	4 Buck	3 Buck	1 Buck	0 Buck	00 Buck
Diameter in Inches	.05	.06	.07	.08	.09	.095	.11	.12	.13	.15	.175	.18	.240	.250	.300	.320	.330

FIGURE 4 — There is an easy way to remember average diameters of shot sizes 12 through 2. Take any shot size and subtract it from .17. As an example, No. 6 shot has a diameter of .11. Subtract .06 from .17 and you have .11.

A bit of arsenic is added to the lead to quicken the "rounding" of the drop shot while falling. Chilled shot is harder because the lead has been alloyed with antimony, and is less prone to deform in the barrel. Electro-copper-plated shot is also made, which is the hardest of all, preferred by duck and goose hunters for long-range shooting.

Shotgun Slugs

While buckshot is still legal and useful on deer and bear in some brushy areas (the South, primarily), the 12-gauge rifled slug is most often used for big game. At best, it is a short-range proposition, with cylinder-choked and iron sight-equipped guns usually shooting no better than 6" to 8" groups at 50 or 60 yards. Beyond this point, due to the rapid fall-off of the initial 1,500 fps (approximate) velocity, the energy delivered declines rapidly.

There are three types of slugs used today: (1) the conical Foster-type cast rifled slug patented in 1947, with vanes that theoretically rotate the projectile (they do, slightly); (2) the dumbbell-shaped Balle Blandeau; and (3) the Brenneke (see Figure 5).

FIGURE 5 — The three types of shotgun slugs used today. The Foster design is shown at 12 o'clock, the barbell-shaped Balle Blandeau at the bottom. Two newer types of rifled slugs are the Brenneke (left) and the Vitt (extreme right).

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.

Shotshell Combustion

When the primer detonates, the combustion chamber is literally flooded with fire, which ignites the powder charge. The propellant burns rapidly and creates a large quantity of gas. This gas, expanding against the plastic piston, forces the side walls or skirt of the piston against the walls of the case, creating a gas-tight seal. As the pressure increases, the plastic piston with its cup of shot starts moving forward, causing the crimp to open. The shot cup then leaves the case and enters the forcing cone, which slightly compresses the piston's diameter for even better obturation (gas sealing). The piston and shot then travel down the barrel together and enter the choke, where the shot cup and separating shot column are again slightly constricted. Separation of shot and cup largely takes place as the shot charge leaves the barrel. The flanges on the piston peel back from air pressure, and the shot column is on its way.

The Importance of Chamber/Shotshell Length

Shotshell length is critical as chamber length is based on the opened shell with the crimp folded out (see Figure 6). For example, a 2-3/4" AA Winchester factory-new 12-gauge shell, taken at random from a factory box, measures 2.290" in length. The same case, after firing and with the crimp open, measures 2.6737" — not quite 2-3/4", but within the manufacturer's (and gun's) tolerances.

When a too-long shell is crammed into a too-short chamber, interesting and dangerous things happen when the gun is fired (see Figure 6). The crimp opens and extends into the forcing cone where it doesn't belong. The shot cup, under terrific pressure from the expanding gas, does work its way through the partially blocked forcing cone, but only by raising chamber pressure sky-high. In its struggle to get through, the seal between the shot cup and bore usually breaks, permitting gases to jet up the sides of the cup. These gases mingle with and partially upset the shot cup while it moves up the barrel, thus "blowing" the pattern full of holes. The extracted shell is frayed on the ends (just like the shooter's nerves — after ten shots and no hits).

PROGRAMMED EXERCISE

1

Match the shotshell projectiles in the top list with the descriptions from the bottom list that best characterize them by placing the letters in the appropriate blanks.

____ 1. Chilled shot

____ 2. Drop shot

____ 3. Electro-copper-plated shot

____ 4. Buckshot

____ 5. Conical (Foster)

____ 6. Sabot

____ 7. Brenneke

A. Short-range projectile useful for big game, but being replaced by the rifled slug.

B. Rifled slug with very dense twist and weighted base.

C. Moderately hard, lead alloyed with antimony, not prone to deform the barrel.

D. Composed of lead with arsenic added. Because it is the *least hard* shotshell projectile, it is most apt to deform the barrel.

E. The hardest shotshell projectile, made of coated lead.

F. Most familiar American slug, with rifled vanes.

G. Hourglass-shaped rifled slug.

Answers on Page 6

The combination of new 3" 12 and 20-gauge magnum shells and "old" 2-3/4" chambers makes this occurrence quite commonplace. Many guns can take the punishment, at least for a while, but with blown patterns the usual result, the magnum super power anticipated is completely absent.

To a lesser extent, this same problem is encountered with older 16 and 20-gauge shotguns, some of which have short 2-1/2" chambers. A great many of these guns were made in the U.S. and Europe around 1910. The giveaway to short chamber size is usually a frazzled mouth on a standard fired case. Some of these guns, if sufficiently thick through the forcing cone area and in good condition, can have their chambers lengthened to 2-3/4" (forget the magnums!).

BARREL DIMENSIONS

Shotgun barrels differ in interior diameter at various points in a given barrel. For instance, the chamber of a standard 12-gauge shotgun is 2-3/4" long, with an I.D. (inside diameter) of about .790" (slightly larger than the diameter of a 12-gauge shell). Where the chamber ends, the forcing cone begins. This is a short, tapered section (the length varies, depending on the manufacturer) which narrows the chamber diameter down to .729" — the I.D. of the barrel up to the choke, where the I.D. is again reduced. In the old days, achieving these specifications took a lot of precision reaming. Today it's largely done by hammer-forging a billet over a mandrel incorporating these dimensions in reverse, or by working straight tubing with swages and dies.

The Reason for Choking

The invention of choke boring is usually credited in the U.S. to an old market hunter, Fred Kimbal, who came up with his idea in the 1880's. (England and most foreign countries, incidentally, have their own "Fred Kimbal." It's more than likely that as the shotgunning sport grew worldwide, more than one mind was bent on figuring how to get better patterns than were offered by the straight cylinders of the day.)

Shotgun chokes come in different lengths, styles, and configurations. They're all designed to accomplish the same thing, to control the pattern spread and shot density in a given area at a specified range. For purposes of illustration, a choke may be likened to a garden-hose nozzle. The more open the choke, the wider the spread of shot; the tighter the choke (within reason), the narrower the diameter of shot spread (see Table 1).

Therefore, guns designed for long-range shooting utilize tight, full chokes. Guns used

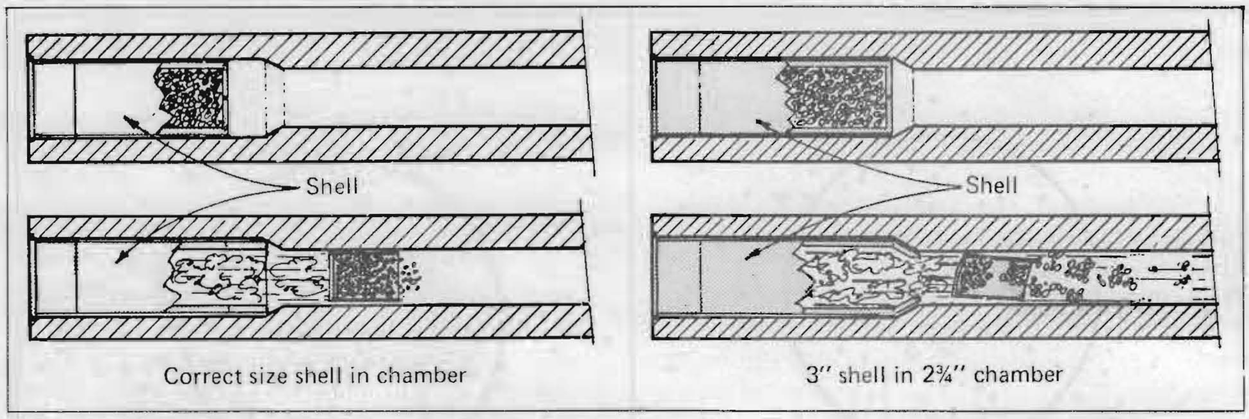


FIGURE 6 — Left, diagram of a correct size shotshell in chamber, before and after firing. At the right you can see the difference, and the result, when an oversize shotshell is fired.

on close-in game rely upon wide-open improved cylinder or cylinder chokes. For years manufacturers never agreed upon what constituted a "full" or "improved cylinder" choke, or on about anything else concerning arms and ammunition. In the 1920's there were many different shotshell loadings on the market, all with different shot powder charges, and of many different lengths. In short, there was no such thing as standardization.

Diameter of Spread
(covered by the main body of the charge at listed ranges)

Choke	20 yards	30 yards	40 yards
Cylinder	32 inches	44 inches	58 inches
Imp. Cyl.	26 inches	38 inches	51 inches
Modified	21 inches	32 inches	45 inches
Full	16 inches	27 inches	40 inches

Above figures supplied by a leading shotshell manufacturer.

TABLE 1

As a result of this confusion and the need for common standards and guidelines, the Sporting Arms & Ammunition Manufacturers Institute (SAAMI) was formed. Soon there were only comparatively few "standard" shotshell loads manufactured, to everyone's relief. Specifications were issued as "industry standards" on chambers, barrels, cartridges, shotshell dimensions, choke, etc. (see Table 2). The participating manufacturers weren't held to these specs, but were expected to observe minimum tolerances.

BORE AND CHOKE DIAMETERS
(Representative U.S. Standards)

		Full Choke		Modified		Imp. Cyl.		Full Cyl.	
Gauge	Bore	Diam.	Pts.	Diam.	Pts.	Diam.	Pts.	Diam.	Pts.
10	.775	.735	40	.750	25	.765	10	.775	-0-
12	.729	.694	35	.710	19	.720	9	.729	-0-
16	.667	.639	28	.652	15	.660	7	.667	-0-
20	.617	.592	25	.603	14	.610	7	.617	-0-
28	.550	.528	22	.538	12	.545	5	.550	-0-
.410	.410	.393	17	.402	8	.406	4	.410	-0-

TABLE 2 — The above are SAAMI-recommended measurements. Dimensions observed by shotgun and choke reamer manufacturers usually vary slightly.

The standard chokes in the U.S. are full choke, improved modified, modified, improved cylinder, cylinder, and skeet. As a rule of thumb, a full-choke barrel will place 70% of its shot inside a 30" circle at 40 yards; an improved modified choke between 60% and 70%; modified 55% to 60%; and improved cylinder 45% to 50%. Cylinder-bored barrels are not usually true cylinders in that they have a slight constriction and deliver 30% to 40% patterns. Skeet boring No. 1 is almost the same as the cylinder "non-choke"; skeet boring No. 2 is slightly tighter than improved cylinder. All percentages are taken at 40 yards except in the case of the .410, where pattern percentages are established at 30 yards.

Each degree of choke is supposedly determined by the number of points, or thousandths of an inch, a barrel is reduced or narrowed from the SAAMI bore specs. For example, a 12-gauge full choke narrows the standard .729 bore by .040" at the muzzle. Improved modified choking reduces the bore .030"; modified choking .020"; and improved cylinder between .003" and .010" — which also holds true for No. 1 and No. 2 skeet bores.

Theoretically, cylinder bores have no choke or constriction. However, most manufacturers choke their cylinder bores .002" to .005", in the interest of avoiding blown patterns (see Figure 8). Regardless of SAAMI standardization, the degree of choke stamped on the barrel doesn't mean that the gun will throw the percentage pattern it is supposed to. Manufacturers' tolerances still vary considerably, and one man's full choke is frequently another man's modified. The biggest cause of incorrect choke labeling is, however, the plastic shot cup. With ammunition using this device, improved-cylinder guns often deliver modified patterns, and modified guns print full-choke patterns.

The only way to really know what a given gun is doing is to pattern it on a 30" circle

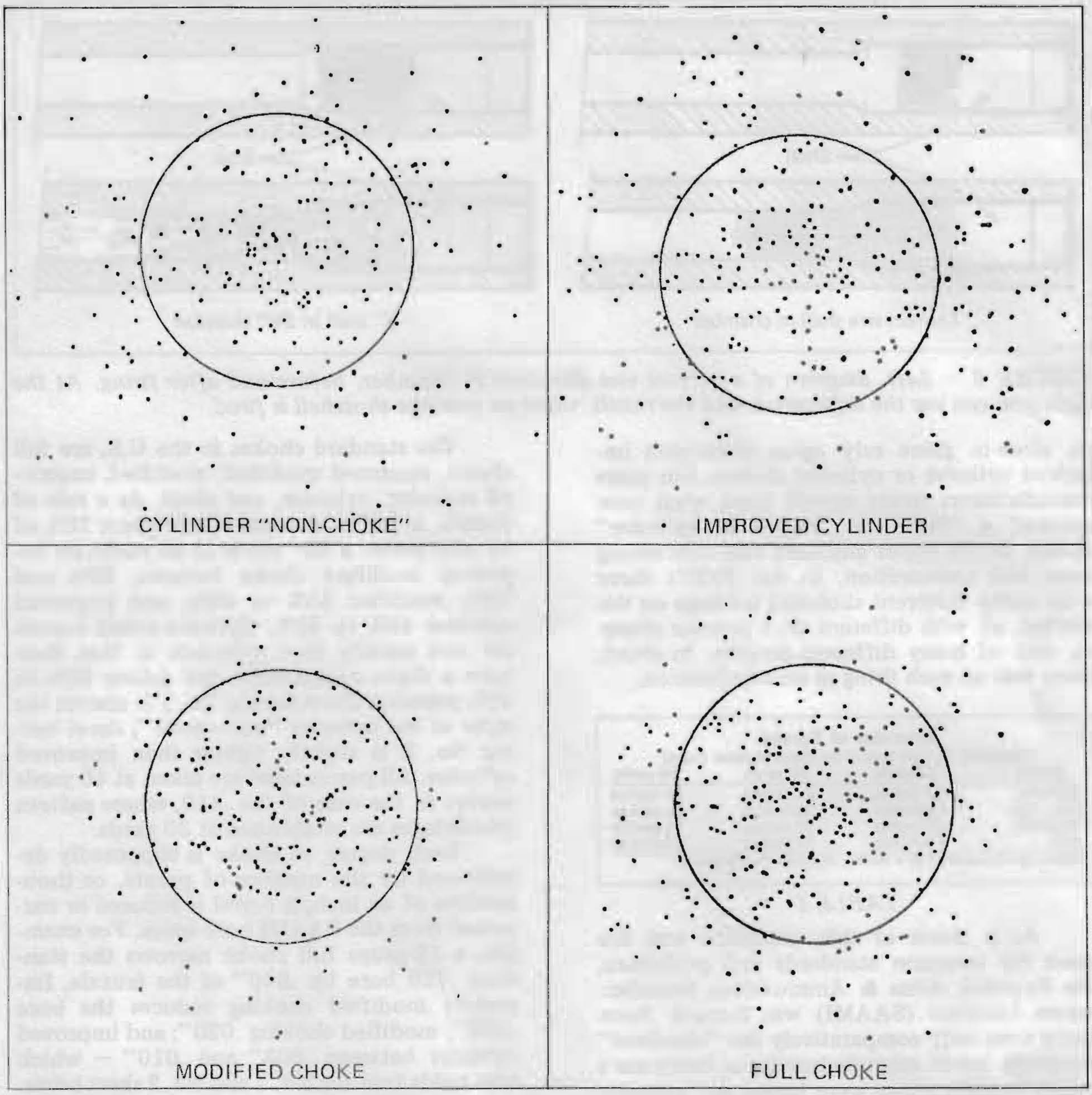


FIGURE 7 — Relative densities at 40 yards. The above patterns simulate densities, relative to choke diameter of a 20-gauge shotgun with one ounce of shot.

at 40 yards and count the pellets, then figure the percentage yourself — dividing the number of hits within the circle by the number of pellets in the shell.

ANSWERS

1

1. C 2. D 3. E 4. A 5. F
6. G 7. B

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.

PLASTIC CUPS PROTECT SHOT

Before the development of the plastic piston and shot cup, which prevents most of the shot from even touching the barrel, a large percentage of pellets were deformed by barrel contact as they flew toward the muzzle. Some became "flyers," streaking off on tangents; others, because of greater air resistance, lost velocity quickly and arrived late, if at all, at the target. Blown patterns, with gaping holes

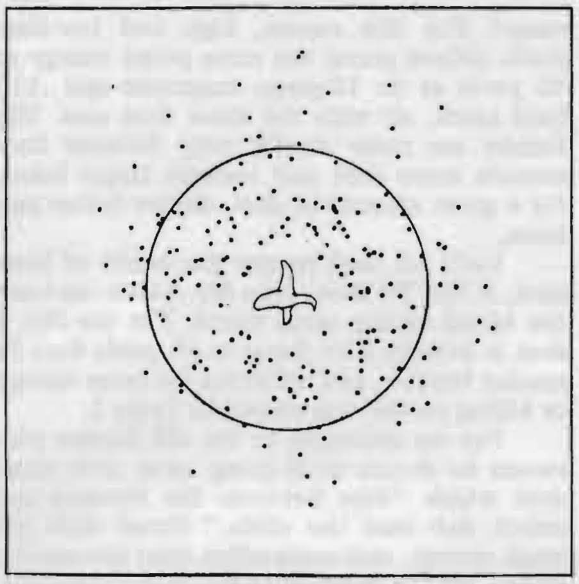


FIGURE 8 — You can see how easy it would be for a bird to slip through a blown pattern caused by no choke, or caused by using magnum-length shells in standard chambers.

APPROXIMATE SHOT COUNTS, STANDARD LOADS

Shot Size	Gauge	Ounces	Pellets Per Load
4	12	1-1/4	170
6	12	1-1/4	280
7-1/2	12	1-1/4	435
7-1/2	12	1-1/8	395
8	12	1-1/8	460
9	12	1-1/8	660
4	16	1-1/8	150
6	16	1-1/8	250
7-1/2	16	1-1/8	390
8	16	1-1/8	450
9	16	1	585
4	20	1	135
6	20	1	225
7-1/2	20	1	350
8	20	1	410
9	20	7/8	510
Buck			
No. 4			27
No. 3			20
No. 1			16
No. 0			12
No. 00			9

AVERAGE SHOT NUMBERS, PER OUNCE

Shot Size	Number of Pellets
BB	50
2	88
4	136
5	172
6	223
7	299
7-1/2	350
8	409
9	585
10	868
11	1,380
12	2,385

TABLE 3

PROGRAMMED EXERCISE

2

1. What signs indicate that shotshell length is too long for a particular gun's chamber?

Match the listed chokes in the order that they place the greatest percentage of shot in a 30" circle at 40 yards by placing the letters in the blanks provided.

____ 2. 70%

____ 3. 60% to 70%

____ 4. 55% to 60%

____ 5. 50% to 55%

____ 6. 45% to 50%

____ 7. 40% to 45%

____ 8. 30% to 40%

A. Modified

B. Skeet boring No. 1

C. Full choke

D. Improved modified

E. Skeet boring No. 2

F. Cylinder

G. Improved cylinder

Answers on Page 8

through which a feathered or clay bird could easily slip, were commonplace. With today's plastic shot cup, patterns are almost uniformly excellent.

Contrary to popular belief, chokes have little or no effect upon the velocity of shot, or its energy, at any range. A tight choke does build barrel pressure a bit more than a cylinder choke, but the resultant velocity increase is so slight it's hardly measurable.

Shot Pellet Velocity

Compared to a high-powered rifle projectile, a shot pellet's velocity is downright leisurely, ranging from roughly 1,100 to 1,350 fps — about the same as a .22 long rifle bullet (see Table 4). This 250 fps variation is about the muzzle velocity difference between low-base and high-base shotshells, the latter of which contain more shot and powder. It's appropriate at this point to mention that a 3" magnum shotshell does not necessarily provide a higher pellet velocity than does a standard 2¾" high-base shell. Magnum loads do throw larger amounts of shot, but sometimes at slower velocities than standard high-base loads. The increased number of shot in the magnum's pattern and increased hits on the target are what do the job — not ultra-velocity. The more pellets absorbed by a game bird, the greater the "power" of the load that dropped that bird.

The energy of any pellet is dependent not only on its muzzle velocity, but also on its ability to retain velocity and energy. And this depends almost entirely on the size of the shot.

Exterior Ballistics of the Shotgun Pellet

Shotgun pellets are of a spheroidal shape, and while easy to manufacture they possess about the poorest ballistic shape imaginable. A round shot has a low sectional density and its ballistics coefficient shouldn't even be discussed it's so bad!

Small shot loses velocity very rapidly. Large shot, on the other hand, retains its velocity quite well over the longer ranges. The speed at which a round object (a shot) can be driven through the air can work to its own disadvantage. Air resistance against this object varies as to the square of its velocity. In other words, when velocity is doubled, air resistance is increased fourfold; when velocity is tripled, air resistance becomes nine times greater. The law of diminishing returns is thus invoked at around 1,300 fps.

This means that the velocity of a pellet at the muzzle (and game isn't killed at the muzzle) hasn't all that much to do with how fast that pellet is moving when it strikes a bird at 40 or 50 yards. Because of air resistance, a pellet starting out at 1,150 fps, and another pellet exiting the muzzle at 1,350 fps, will both be moving at about the same velocity at the range where the target is hit.

Therefore, shotshells are loaded with "at target" velocity in mind, to reduce chamber pressure and recoil. Why increase the velocity, pressure, and recoil when the pellet moves very little faster where it counts, at game range? For this reason, high and low-base shells deliver about the same pellet energy at 40 yards as do 10-gauge magnums and .410 field loads, all with the same shot size. The former are more deadly only because they contain more shot and because larger bores, for a given amount of shot, deliver better patterns.

Let's get back to our discussion of large shot. A No. 7½ shot and a No. 4 shot can leave the barrel at the same speed. Yet the No. 4 shot is moving a lot faster at 40 yards than its smaller brother, and delivers a lot more energy or killing power — as shown in Table 1.

Pay no attention to the old hunter who swears he shoots birds going away with small shot which "slips between the feathers and smack dab into the vitals." Small shot has small energy, and more often than not merely rattles off the feathers of full-plumaged birds, except at very close ranges.

Steel Shot

Extensive experiments have been conducted by some of the major shotshell manufacturers using shot material other than lead. Lead is pure poison to ducks, and heavily shot-over ponds and marshes over a period of years become heavily "salted" with shot that too often winds up in the gizzards of waterfowl. Once the pellets are ingested into a bird's system, death usually results. An estimated two to three million waterfowl perish annually from lead poisoning.

The lethality of lead shot has therefore become of great concern to hunters, manufacturers, conservationists, and the U.S. Government. In the middle 1960's, attempts were made to coat the lead pellets. Both metallic and non-metallic insulations were used, but to no effect. The grinding action of a bird's gizzard quickly ground off tin, copper, and magnesium coatings. Plastic and nylon coatings fared no better.

Iron shot was tried, but abandoned as impractical. There were problems in production, the shot damaged shotgun barrels, and

ANSWERS

1. A "blown" pattern — or a pattern with holes in it — and a frazzled mouth on the fired case.

2. C 3. D 4. A 5. E 6. G

7. B 8. F

SHOTSHELL BALLISTICS

MUZZLE VELOCITY	SHOT SIZE	VELOCITY (fps) 20 yds.	40 yds.	60 yds.	ENERGY PER PELLET (ft.-lbs.) MUZZLE	20 yds.	40 yds.	60 yds.	TIME IN FLIGHT (sec.) 20 yds.	40 yds.	60 yds.	DROP (In.) 20 yds.	40 yds.	60 yds.
1330 fps	BB	1085	915	790	34.37	22.87	16.27	12.23	.0502	.1107	.1815	0.5	2.4	6.4
	2	1045	860	730	19.07	11.77	7.98	5.76	.0513	.1148	.1908	0.5	2.6	7.0
	4	1010	815	685	12.70	7.34	4.77	3.35	.0522	.1187	.1993	0.5	2.7	7.7
	5	990	790	655	10.08	5.60	3.56	2.46	.0528	.1210	.2047	0.5	2.8	8.1
	6	970	765	630	7.61	4.04	2.50	1.70	.0535	.1238	.2108	0.6	3.0	8.6
	7½	930	715	580	4.88	2.38	1.41	0.93	.0548	.1291	.2228	0.6	3.2	9.6
	9	880	660	525	2.92	1.28	0.71	0.45	.0566	.1364	.2392	0.6	3.6	11.0
1315 fps	BB	1075	905	785	33.60	22.45	15.91	11.97	.0508	.1118	.1830	0.5	2.4	6.5
	2	1035	855	725	18.64	11.56	7.86	5.69	.0518	.1159	.1923	0.5	2.6	7.1
	4	1005	810	680	12.42	7.22	4.71	3.32	.0527	.1197	.2009	0.5	2.8	7.8
	5	985	785	655	9.86	5.51	3.51	2.43	.0533	.1221	.2062	0.6	2.9	8.2
	6	960	760	625	7.44	3.98	2.47	1.68	.0540	.1248	.2124	0.6	3.0	8.7
1295 fps	2	1025	845	720	18.01	11.28	7.71	5.60	.0525	.1173	.1944	0.5	2.6	7.3
	4	990	800	675	12.04	7.05	4.62	3.26	.0534	.1211	.2030	0.6	2.8	8.0
	5	970	780	650	9.56	5.38	3.45	2.40	.0540	.1235	.2083	0.6	2.9	8.4
	6	950	750	620	7.21	3.89	2.43	1.66	.0547	.1262	.2145	0.6	3.1	8.9
	7½	910	705	575	4.63	2.30	1.37	0.91	.0560	.1316	.2265	0.6	3.3	9.9
	9	865	650	520	2.77	1.23	0.70	0.45	.0579	.1388	.2428	0.6	3.7	11.4
1255 fps	BB	1035	880	765	30.60	20.81	15.05	11.37	.0529	.1160	.1894	0.5	2.6	6.9
	2	995	830	705	16.98	10.67	7.43	5.36	.0541	.1201	.1994	0.6	2.8	7.7
	4	965	785	665	11.31	6.72	4.45	3.16	.0549	.1240	.2074	0.6	3.0	8.3
	5	950	765	640	8.98	5.13	3.32	2.32	.0555	.1264	.2128	0.6	3.1	8.7
	6	930	740	610	6.77	3.71	2.34	1.61	.0562	.1292	.2189	0.6	3.2	9.2
	7½	890	690	565	4.35	2.19	1.31	0.88	.0575	.1345	.2309	0.6	3.5	10.3
	8	880	675	550	3.69	1.80	1.07	0.70	.0581	.1367	.2358	0.6	3.6	10.7
	9	845	640	515	2.60	1.18	0.68	0.44	.0594	.1418	.2473	0.7	3.9	11.8
1240 fps	2	990	820	705	16.58	10.53	7.28	5.33	.0545	.1214	.2006	0.6	2.8	7.8
	4	960	780	660	11.04	6.59	4.38	3.12	.0555	.1252	.2092	0.6	3.0	8.4
	5	940	760	635	8.76	5.04	3.27	2.29	.0561	.1276	.2145	0.6	3.1	8.9
	6	920	730	610	6.61	3.65	2.30	1.58	.0568	.1303	.2206	0.6	3.3	9.4
	7½	885	690	560	4.24	2.16	1.30	0.87	.0581	.1357	.2332	0.6	3.6	10.5
1235 fps	4	955	780	660	10.95	6.55	4.36	3.10	.0557	.1256	.2097	0.6	3.0	8.5
	5	940	755	635	8.69	5.01	3.25	2.28	.0563	.1280	.2151	0.6	3.2	8.9
	6	920	730	605	6.56	3.62	2.29	1.58	.0570	.1307	.2212	0.6	3.3	9.4
	8	870	670	545	3.57	1.76	1.05	0.69	.0588	.1382	..2384	0.7	3.7	11.0
1220 fps	2	975	815	695	16.04	10.26	7.13	5.23	.0553	.1230	.2029	0.6	2.9	8.0
	4	945	775	655	10.69	6.43	4.29	3.06	.0563	.1268	.2115	0.6	3.1	8.6
	5	930	750	630	8.48	4.92	3.21	2.25	.0569	.1292	.2169	0.6	3.2	9.1
	6	910	725	605	6.40	3.56	2.26	1.59	.0576	.1319	.2230	0.6	3.6	9.6
	7½	875	680	560	4.11	2.11	1.28	0.86	.0589	.1372	.2350	0.7	3.6	10.2
	8	860	665	540	3.48	1.73	1.03	0.69	.0594	.1394	.2399	0.7	3.8	11.1
	9	830	630	505	2.46	1.14	0.65	0.42	.0607	1445	.2514	0.7	4.0	12.2
1200 fps	4	935	765	650	10.34	6.27	4.20	3.01	.0571	.1284	.2140	0.6	3.2	8.8
	5	915	740	625	8.21	4.80	3.14	2.22	.0577	.1308	.2193	0.6	3.3	9.3
	6	900	720	600	6.19	3.47	2.22	1.54	.0584	.1336	.2255	0.7	3.4	9.8
	7½	865	675	555	3.97	2.06	1.26	0.85	.0597	.1389	.2375	0.7	3.7	10.9
	8	850	660	540	3.37	1.69	1.02	0.68	.0603	.1410	.2423	0.7	3.8	11.3
	9	820	625	505	2.38	1.11	0.64	0.42	.0615	.1462	.2538	0.7	4.1	12.4
1185 fps	2	955	795	685	15.14	9.83	6.81	5.06	.0568	.1259	.2073	0.6	3.1	8.3
	4	925	760	645	10.08	6.15	4.13	2.97	.0577	.1297	.2159	0.6	3.2	9.0
	5	910	735	620	8.00	4.72	3.08	2.19	.0583	.1321	.2212	0.7	3.4	9.4
	6	890	715	595	6.04	3.41	2.18	1.52	.0590	.1348	.2274	0.7	3.5	10.0
	7½	855	670	550	3.88	2.02	1.24	0.83	.0604	.1401	.2394	0.7	3.8	11.1
	8	845	655	535	3.29	1.66	1.00	0.67	.0609	.1423	.2442	0.7	3.9	11.5
	9	815	620	500	2.32	1.10	0.63	0.41	.0622	.1474	.2557	0.8	4.2	12.6
1165 fps	4	915	750	635	9.74	5.98	4.04	2.91	.0586	.1314	.2185	0.7	3.3	9.2
	5	895	730	615	7.74	4.58	3.03	2.15	.0592	.1338	.2238	0.7	3.5	9.7
	6	880	705	590	5.84	3.32	2.14	1.49	.0599	.1366	.2300	0.7	3.6	10.2
	7½	845	665	545	3.75	1.97	1.22	0.82	.0612	.1419	.2420	0.7	3.9	11.3
	8	835	650	530	3.18	1.62	0.98	0.66	.0618	.1440	.2469	0.7	4.0	11.8
	9	805	615	495	2.24	1.07	0.62	0.41	.0630	.1492	.2584	0.8	4.3	12.9
1155 fps	4	905	745	635	9.58	5.90	4.00	2.80	.0591	.1323	.2198	0.7	3.4	9.3
	5	890	725	615	7.60	4.52	3.00	2.17	.0596	.1347	.2252	0.7	3.5	9.8
	6	875	700	585	5.74	3.28	2.12	1.48	.0603	.1374	.2313	0.7	3.6	10.3
	8	830	645	530	3.18	1.60	0.97	0.65	.0622	.1449	.2482	0.8	4.0	11.9
	9	800	610	495	2.20	1.06	0.62	0.40	.0635	.1500	.2597	0.8	4.3	13.0
1150 fps	9	800	610	195	2.18	1.05	0.61	0.40	.0637	.1505	.2604	0.8	4.4	13.1
1145 fps	7½	835	655	540	3.62	1.93	1.19	0.81	.0621	.1437	.2447	0.7	4.0	11.6
	8	825	640	525	3.07	1.58	0.96	0.65	.0627	.1458	.2496	0.8	4.1	12.0
	9	795	610	495	2.16	1.04	0.61	0.40	.0639	.1510	.2610	0.8	4.4	13.1
1135 fps	4	895	740	630	9.25	5.74	3.91	2.83	.0600	.1342	.2226	0.7	3.5	9.6
	5	880	715	605	7.34	4.40	2.93	2.09	.0606	.1365	.2279	0.7	3.6	10.0
	6	860	695	580	5.54	3.19	2.07	1.45	.0612	.1393	.2341	0.7	3.7	10.6
	7½	830	655	540	3.56	1.90	1.18	0.80	.0626	.1446	.2461	0.8	4.0	11.7

TABLE 4 (courtesy Gun Annual 1974)

iron (because of its comparatively light weight) proved impractical ballistically.

Steel shot appears to have a small chance of eventually replacing the lead variety. With the plastic shot cup, which minimizes shot/barrel contact, barrel abrasion from steel shot appears to be minimal. However, the steel pellets, peening off the choke constriction, do cause greater wear than lead. Special steel alloys may solve this problem, and the manufacturers are working on it.

Steel, lacking lead's specific gravity, loses velocity faster. Thus larger-size shot than would normally be used for given game is necessary. This problem is compounded by the fact that more steel pellets are required per ounce of shot than lead pellets. Where to put them? Standard chamber lengths preclude loading as many steel shot in a given shell as could be loaded with the same size lead shot.

Many experts feel that the cripples lost to steel-loaded shotshells, with their lower velocity at target and fewer pellets, would at least equal the number of birds lost to lead poisoning. Hopefully, a solution will soon be found.

Shotshell Nomenclature

The practice of referring to a shotgun's bore size by "gauge" goes back to muzzleloading days. The number of balls for a given musket that added up to a pound determined the "gauge." Hence, a 12-gauge took 12 balls, a 16-gauge 16 balls, etc.

In the muzzleloading era, a hunter could have about any gauge he wanted, depending on what size tube was available. Shotguns of 11, 13, 17, and 19-gauge find their way into collectors' hands every so often. Today gauges have been standardized and guns are made only in 10, 12, 16, 20, and 28-gauge, and in .410 caliber (see Figure 9). The latter is a measurement of bore diameter. It could be called a 64-gauge, but the firearms industry, if it attempted to clarify the .410 issue, would only cause further confusion.

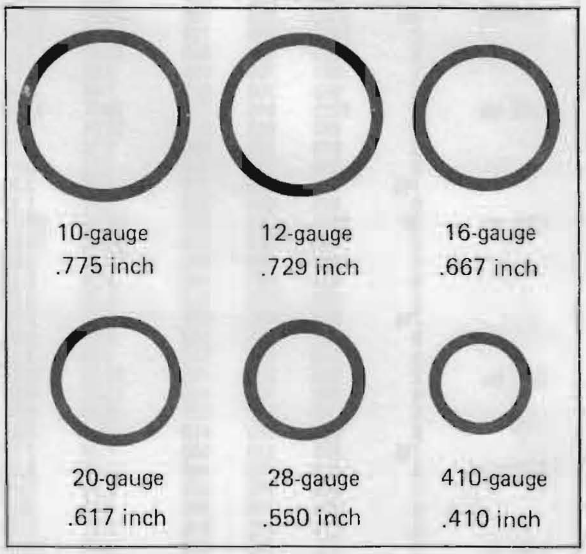


FIGURE 9 — Average bore sizes of the six shotgun gauges commonly used today.

APPROXIMATE PELLETS PER LOAD

Weight (oz.)		No. 2	No. 4
1	Lead	88	134
	Steel	124	189
1⅛	Lead	98	151
	Steel	140	213
1¼	Lead	109	168
	Steel	155	236
1⅜	Lead	120	184
	Steel	171	260
1½	Lead	131	201
	Steel	186	284
1⅝	Lead	142	218
	Steel	202	307
1⅞	Lead	164	251
	Steel	233	354

Lead pellet numbers based on 1% antimony content.

COMPARATIVE BALLISTICS OF LEAD AND STEEL SHOT

	RANGE (yds.)	20	30	40	50	60
No. 2 Steel	Velocity (f.p.s.)	965	815	710	625	555
	Energy per Pellet (ft. lbs).	7.64	5.45	4.14	3.21	2.53
	Time of Flight (sec.)	.0510	.0849	.1244	.1695	.2205
No. 4 Lead	Velocity (f.p.s.)	970	840	740	660	590
	Energy per Pellet (ft. lbs.)	6.72	5.04	3.91	3.11	2.49
	Time of Flight (sec.)	.0519	.0852	.1235	.1666	.2147
No. 4 Steel	Velocity (f.p.s.)	935	785	675	590	515
	Energy per Pellet (ft. lbs).	4.71	3.32	2.46	1.88	1.43
	Time of Flight (sec.)	.0517	.0869	.1283	.1761	.2307
No. 6 Lead	Velocity (f.p.s.)	940	800	700	620	550
	Energy per Pellet (ft. lbs).	3.81	2.76	2.11	1.66	1.30
	Time of Flight (sec.)	.0529	.0876	.1270	.1736	.2252

Figures were established from recent industry firing tests. Initial velocity of lead shot was 1330 f.p.s. Initial velocity of steel shot was 1375 f.p.s.

TABLE 5 — Relative shot count, lead and steel pellets. (Courtesy The American Rifleman)

The larger gauges make better game-getters than the small gauges, for the simple reason that more shot arrives on target at the same time (see Figure 10). For example, a full-choked 12-gauge and a full-choked 20-gauge, each shooting one ounce of shot, may score identical 70% patterns on the test board. Yet in the game field, the 20-gauge frequently cripples while the 12-gauge drops birds right now. What's the reason for the difference in killing power? *The length of the shot string.* Because of the 20's smaller bore diameter, the pellets have to more or less line up and await their turn to exit. In the 12, many more of these pellets "run out the door" at the same time. A duck, winging into the 12's pattern, finds that pattern rather crowded. The same duck, flying into the 20's circle, encounters far fewer pellets, or maybe none at all. A fairly large percentage of shot has either passed through the circle or hasn't yet arrived. A long shot string usually means more hits, but more cripples or missed targets. In effect, the pattern is wide but thin. Remember, too, that a shotgun — unlike a rifle — doesn't rely upon one projectile to down the quarry. Multiple hits are required — usually three to five — to provide the cumulative energy necessary to kill cleanly.

BARREL LENGTH AND GUN WEIGHT ARE IMPORTANT FACTORS

For purposes of balance and weight, most shotgun barrels are from 26" to 30" in length. Some duck and goose hunters swear their long 32" barrels hit harder and reach out farther than "stubby" standard barrels (well, they *are* closer to the duck!). The truth is that today's progressive smokeless powders require only 18" to 24" of barrel to burn the powder completely and to produce maximum efficiency. Longer barrels only create friction, which actually slows down the shot charge! Longer barrels, aside from satisfying mistaken beliefs, are most valuable in that they provide a longer and better sighting radius.

The weight of standard shotguns varies a bit according to manufacturer, but most strive to keep their product as light as possible. Sometimes they overdo it, with the gun being far too light for its gauge. The result is horrendous recoil. As a general rule, a shotgun should weigh 100 ounces for every ounce of shot used. Anything under this ratio produces extremely heavy recoil; anything over this ratio is just too heavy except for use in a duck blind.

Most 12-gauge doubles and autos weigh

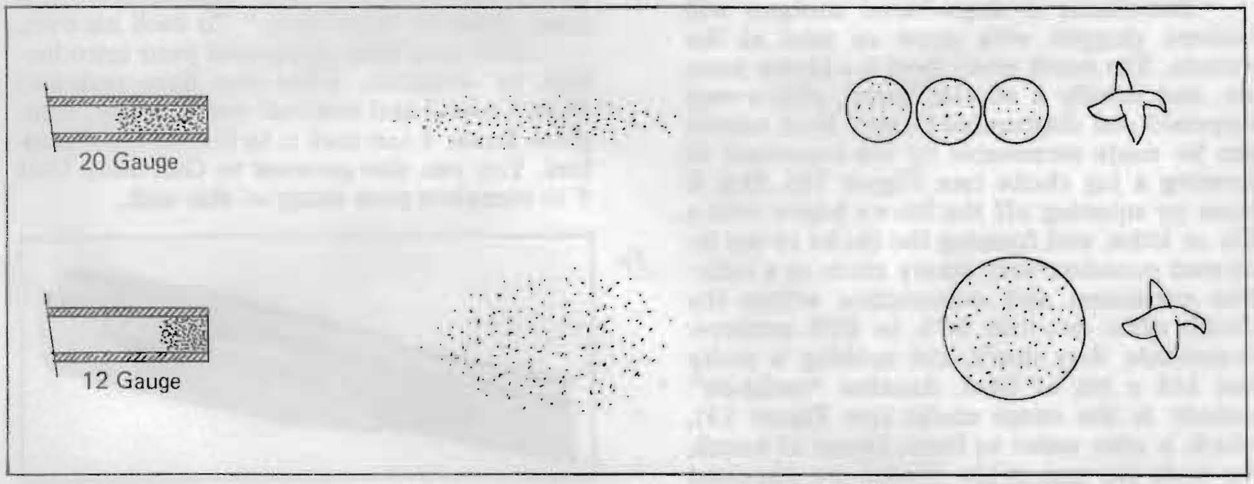


FIGURE 10 — An ounce of shot from a 20-gauge and a 12-gauge is dispersed over a different time interval. The longer shot string of the 20 takes longer to arrive, creating a broad, thin pattern and usually more cripples.

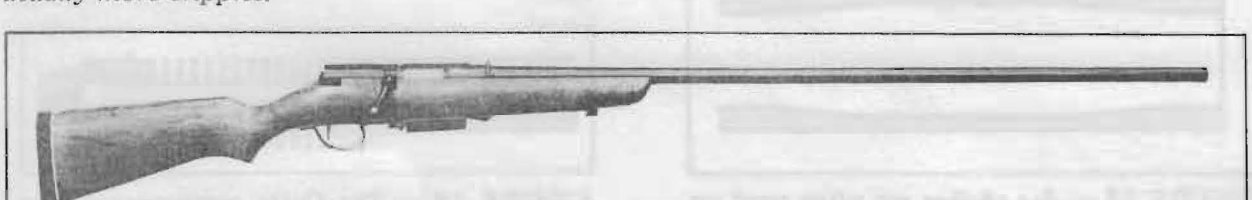


FIGURE 11 — Traditional goose guns with long 32" to 36" barrels actually slow the shot velocity because of increased shot/barrel friction. The long sighting radius does permit better "holding" on long-range targets.

from seven to eight pounds, pumps about a pound less. Comparable 20-gauge guns run from a pound to a pound and a half less. Weight is important. Even an extra pound can weigh like the wages of sin, after a full day afield.

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

1. What makes the real difference in target power between a 12-gauge and a 20-gauge?

2. What is the advantage of a longer barrel on shotguns? What is the disadvantage?

Answers on Page 14

VARIABLE CHOKE DEVICE

Sometimes a single-barrel shotgun will become clogged with snow or mud at the muzzle. The result when fired is a blown muzzle, and usually a shorter barrel, plus a very surprised and disgruntled hunter. Such barrels can be made serviceable by the expedient of forming a jug choke (see Figure 12). This is done by squaring off the blown barrel with a file or lathe, and forming the choke to the indicated contours with emery cloth or a hone. The expansion and constriction within the choke often produce 50% to 55% patterns. Sometimes they don't, but nothing is really lost but a bit of time. Another "make-do" remedy is the swage choke (see Figure 13), which is even easier to form. Means of installing both jug and swage chokes are discussed in the accompanying Gun Shop sections.

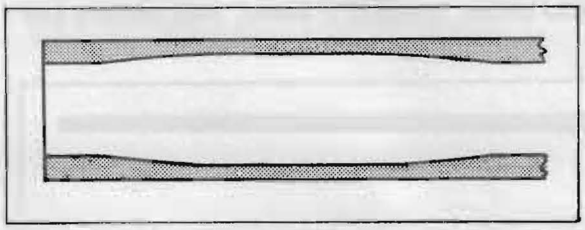


FIGURE 12 — Jug chokes are often used on guns that have lost their muzzle section for one reason or another. A "jug," while comparatively easily formed, doesn't guarantee good patterns.

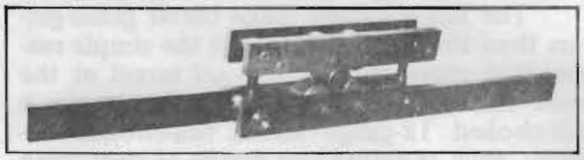


FIGURE 13 — The barrel swager by B-Square accomplished any degree of choke wanted by squeezing (swaging) the muzzle between bronze rollers. Ventilated ribs must be removed from the choke area during swaging.

A better way to correct the situation is by installing a variable choke device such as the poly choke (see Figure 14) or the Cutts compensator (see Figure 15), and there are many other types. These products do an excellent job: the poly choke by constricting and opening a collet-type aperture by rotating an external sleeve, the Cutts through interchangeable tubes.

These devices are also particularly useful with some of the older single-barrel, full-choke guns that have a habit of shooting like rifles with today's plastic cup ammo. These variable-choke instruments are quite popular, but are objected to by a few shooters who feel the devices interfere with and spoil the lines of the gun. This is a bit hard to understand, as modern autos and pumps are purely functional in design and appearance, with scant claim to "classicism." To each his own.

Now you have completed your introduction to shotguns. After you have reviewed Parts 1 and 2 and feel that you're ready, complete Exam 4 and mail it to School Headquarters. You can also proceed to Gun Shop Unit 4 to complete your study of this unit.

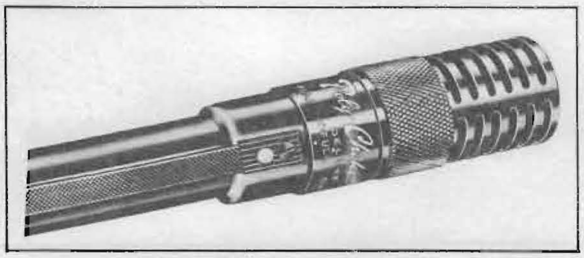


FIGURE 14 — The poly choke provides nine different choke settings by turning the knurled collar.

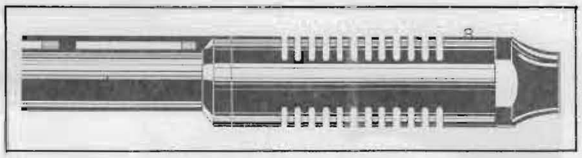


FIGURE 15 — The Cutts compensator long used interchangeable tubes for various chokes. Now an adjustable collet-type tube is also available, thus incorporating the previously exclusive advantage of the poly choke.

ANSWERS

3

1. Length of the shot string.

2. Beyond 30 inches, the length only provides a better sight radius. Beyond 30 inches, more length does little more than create more friction.

NOTES

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