Revolutionary Development & Working of Rifle

**ABSTRACT**

A **firearm** is a weapon which projects either single or multiple [projectiles](http://en.wikipedia.org/wiki/Projectile) at high velocity through rapid, confined [burning](http://en.wikipedia.org/wiki/Combustion) of a [propellant](http://en.wikipedia.org/wiki/Propellant). This process of rapid burning is technically known as [deflagration](http://en.wikipedia.org/wiki/Deflagration). In older firearms, the propellant was typically [black powder](http://en.wikipedia.org/wiki/Black_powder) or [cordite](http://en.wikipedia.org/wiki/Cordite), but modern firearms use [smokeless powder](http://en.wikipedia.org/wiki/Smokeless_powder) or other propellants. Most modern firearms (with the notable exception of [smoothbore](http://en.wikipedia.org/wiki/Smoothbore) firearms) have [rifled](http://en.wikipedia.org/wiki/Rifling) barrels to impart spin to the projectile for improved flight stability.

Hand-held firearms, like [rifles](http://en.wikipedia.org/wiki/Rifle), [carbines](http://en.wikipedia.org/wiki/Carbine), [pistols](http://en.wikipedia.org/wiki/Handgun) and other small firearms, are rarely called "guns" in the restricted sense among specialists. [Machine guns](http://en.wikipedia.org/wiki/Machine_gun) fire small-caliber ammunition (generally 14.5 mm or smaller), and many machine guns are crew-served [infantry support weapons](http://en.wikipedia.org/wiki/Infantry_support_weapon), requiring the services of more than one crewman, just like artillery guns. Generally, an automatic firearm designed for a single user is referred to as an [automatic rifle](http://en.wikipedia.org/wiki/Automatic_rifle). Other terms, including "firearm" itself, have been defined in specialized *ad hoc* ways by various [legislation](http://en.wikipedia.org/wiki/Legislation).

In recent centuries, firearms have become the predominant weapons used by mankind. [Modern warfare](http://en.wikipedia.org/wiki/Modern_warfare) since the late [Renaissance](http://en.wikipedia.org/wiki/Renaissance) has relied upon firearms, with wide-ranging effects on [military history](http://en.wikipedia.org/wiki/Military_history) and history in general. This created a whole new kind of battle, which molded modern-era armies.

1. **INTRODUCTION**

A rifle is a [firearm](http://en.wikipedia.org/wiki/Firearm) designed to be fired from the shoulder, with a barrel that has a helical groove or pattern of grooves ("[rifling](http://en.wikipedia.org/wiki/Rifling)") cut into the barrel walls. The raised areas of the rifling are called "lands," which make contact with the projectile (for small arms usage, called a [bullet](http://en.wikipedia.org/wiki/Bullet)), imparting spin around an axis corresponding to the orientation of the weapon. When the projectile leaves the barrel, the spin averages out curve from imperfections improving accuracy and prevents tumbling which improves range, in the same way that a properly thrown [American football](http://en.wikipedia.org/wiki/American_football) or [rugby](http://en.wikipedia.org/wiki/Rugby_football) ball behaves. The word "rifle" originally referred to the grooving, and a rifle was called a "rifled gun." Rifles are used in [warfare](http://en.wikipedia.org/wiki/War), [hunting](http://en.wikipedia.org/wiki/Hunting) and [shooting sports](http://en.wikipedia.org/wiki/Shooting_sports).

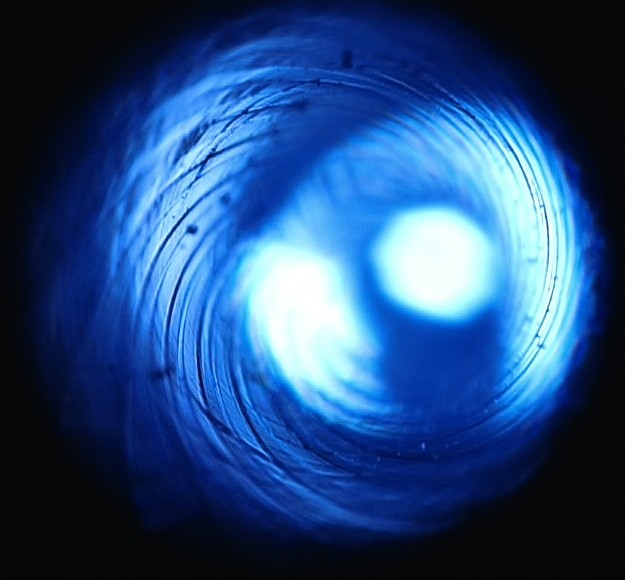
Typically, a bullet is propelled by the contained [deflagration](http://en.wikipedia.org/wiki/Deflagration) of an explosive compound (originally [black powder](http://en.wikipedia.org/wiki/Black_powder), later [cordite](http://en.wikipedia.org/wiki/Cordite), and now [nitrocellulose](http://en.wikipedia.org/wiki/Nitrocellulose)), although other means such as compressed air are used in [air rifles](http://en.wikipedia.org/wiki/Air_rifles), which are popular for [vermin control](http://en.wikipedia.org/wiki/Pest_control), [hunting](http://en.wikipedia.org/wiki/Hunting) small game, [formal target shooting](http://en.wikipedia.org/wiki/Shooting_at_the_Summer_Olympics) and casual shooting ("[plinking](http://en.wikipedia.org/wiki/Plinking)").

In most armed forces the term "gun" is incorrect when referring to small arms; in the military, the word "gun" means an artillery piece or crew-served machine gun. Furthermore, in many works of fiction a rifle refers to any weapon that has a [stock](http://en.wikipedia.org/wiki/Stock_%28firearm%29) and is shouldered before firing, even if the weapon is not rifled or does not fire solid projectiles (e.g. a "laser rifle").

Formerly, rifles only fired a single projectile with each squeeze of the trigger. Modern [assault rifles](http://en.wikipedia.org/wiki/Assault_rifle) are capable of firing more than one round per trigger squeeze; some fire in a fully automatic mode and others are limited to bursts of three to five rounds per squeeze. Thus, modern assault rifles overlap somewhat with [machine guns](http://en.wikipedia.org/wiki/Machine_gun). In fact, many light machine guns (such as the Russian [RPK](http://en.wikipedia.org/wiki/RPK)) are adaptations of existing assault rifle designs. Generally, the difference between an automatic rifle and a machine gun comes down to weight and feed system; rifles, with their relatively light components (which overheat quickly) and small magazines, are incapable of sustained automatic fire in the way that machine guns are. While machine guns may require more than one operator, the rifle is an individual weapon.

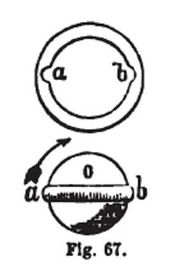
**2. HISTORICAL OVERVIEW**

The origins of rifling are difficult to trace, but some of the earliest practical experiments seem to have occurred in Europe during the 15th century. [Archers](http://en.wikipedia.org/wiki/Archery) had long realized that a twist added to the tail feathers of their arrows gave them greater accuracy. Early muskets produced large quantities of smoke and soot, which had to be cleaned from the action and bore of the musket frequently, either through the action of repeated bore scrubbing, or a deliberate attempt to create "soot grooves" that would allow for more shots to be fired from the firearm. This might also have led to a perceived increase in accuracy, although no one knows for sure. True rifling dates from the mid-15th century,[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)] although military commanders preferred smooth bore weapons for [infantry](http://en.wikipedia.org/wiki/Infantry) use because rifles were much more prone to problems due to powder fouling the barrel.



Rifles were created as an improvement to smooth bore muskets. In the early 18th century, [Benjamin Robins](http://en.wikipedia.org/wiki/Benjamin_Robins), an English mathematician, realized that an elongated bullet would retain the momentum and kinetic energy of a musket ball, but would slice through the air with greater ease.[[1]](file:///D:\DOCUMENTS\seminaar\Rifle.htm#cite_note-0) The black powder used in early muzzle loading rifles quickly fouled the barrel, making loading slower and more difficult. Their greater range was also considered to be of little practical use, since the smoke from black powder quickly obscured the battlefield and made it almost impossible to target the enemy from a distance. Since musketeers could not afford to take the time to stop and clean their barrels in the middle of a battle, rifles were limited to use by [sharpshooters](http://en.wikipedia.org/wiki/Marksman) and non-military uses like hunting.

Muskets were [smoothbore](http://en.wikipedia.org/wiki/Smoothbore), large caliber weapons using ball-shaped ammunition fired at relatively low velocity. Due to the high cost and great difficulty of precision manufacturing, and the need to load readily from the muzzle, the musket ball was a loose fit in the barrel. Consequently on firing the ball bounced off the sides of the barrel when fired and the final direction on leaving the muzzle was unpredictable. Muskets had to be long so the muzzles of the rear rank’s muskets projected well forward of the faces of the front rank.



The performance of early muskets was sufficient for the styles of warfare at the time, whereby soldiers tended to stand in long, stationary lines and fire at the opposing forces. Aiming and accuracy were not necessary to hit an opponent. Muskets were used for comparatively rapid, unaimed volley fire, and the average conscripted soldier could be easily trained to use them. The (muzzle-loaded) rifle was originally a sharpshooter's weapon used for targets of opportunity and deliberate aimed fire, first gaining notoriety in warfare during the [Seven Years War](http://en.wikipedia.org/wiki/Seven_Years_War) and [American War for Independence](http://en.wikipedia.org/wiki/American_War_for_Independence) through their use by American frontiersmen. Later during the [Napoleonic Wars](http://en.wikipedia.org/wiki/Napoleonic_Wars), the British 95th Regiment (Green Jackets) and 60th Regiment, (Royal American), as well as American sharpshooters and riflemen during the [War of 1812](http://en.wikipedia.org/wiki/War_of_1812), used the rifle to great effect during skirmishing. Because of a slower loading time than a musket, they were not adopted by the whole army. Since rifles were used by sharpshooters who didn't routinely fire over other men’s shoulders they didn’t need to be long, which made for a handier weapon and also meant that the tight-fitting balls didn’t have too long a distance to be rammed down the barrel.

The invention of the [minie balls](http://en.wikipedia.org/wiki/Minie_balls) in the 1840s solved the slow loading problem, and in the 1850s and 1860s rifles quickly replaced muskets on the battlefield. Many rifles, often referred to as [rifled muskets](http://en.wikipedia.org/wiki/Rifled_musket), were very similar to the muskets they replaced, but the military also experimented with other designs. Breech loading weapons proved to have a much faster rate of fire than muzzle loaders, causing military forces to abandon muzzle loaders in favour of breech loading designs in the late 1860s. In the later part of the 19th century, rifles were generally single-shot, breech-loading — designed for aimed, discretionary fire by individual soldiers. Then, as now, rifles had a stock, either fixed or folding, to be braced against the shoulder when firing. The adoption of cartridges and [breech-loading](http://en.wikipedia.org/wiki/Breech-loading) in the 19th century was concurrent with the general adoption of rifles. In the early part of the 20th century, soldiers were trained to shoot accurately over long ranges with high-powered cartridges. World War I Lee-Enfield’s rifles (among others) were equipped with long-range 'volley sights' for massed firing at ranges of up to 1.6 km (1.0 mile). Individual shots were unlikely to hit, but a platoon firing repeatedly could produce a 'beaten ground' effect similar to light artillery or machine guns; but experience in [World War I](http://en.wikipedia.org/wiki/World_War_I) showed that long-range fire was best left to the machine gun.

Currently, rifles are the most common firearm in general use for [hunting](http://en.wikipedia.org/wiki/Hunting) purposes (with the exception of bird hunting where [shotguns](http://en.wikipedia.org/wiki/Shotguns) are favored). Rifles derived from military designs have long been popular with civilian shooters.

**3. DEVELOPMENT IN 19th CENTURY**

During the [Napoleonic Wars](http://en.wikipedia.org/wiki/Napoleonic_Wars) the British army created several experimental units known as "Rifles", armed with the [Baker rifle](http://en.wikipedia.org/wiki/Baker_rifle). These Rifle Regiments were deployed as skirmishers during the Peninsular war in Spain and Portugal, and were more effective than skirmishers armed with muskets due to their accuracy and long range.



### 3.1 Muzzle loading

Gradually, rifles appeared with cylindrical barrels cut with helical grooves, the surfaces between the grooves being "lands". The innovation shortly preceded the mass adoption of [breech-loading weapons](http://en.wikipedia.org/wiki/Breech-loading_weapon), as it was not practical to push an overbore bullet down through a rifled barrel, only to then (try to) fire it back out. The dirt and grime from prior shots was pushed down ahead of a tight bullet or ball (which may have been a loose fit in the clean barrel before the first shot), and, of course, loading was far more difficult, as the lead had to be deformed to go down in the first place, reducing the accuracy due to deformation. Several systems were tried to deal with the problem, usually by resorting to an under-bore bullet that expanded upon firing.

The original muzzle-loading rifle, with a closely fitting ball to take the [rifling](http://en.wikipedia.org/wiki/Rifling) grooves, was loaded with difficulty, particularly when foul, and for this reason was not generally used for military purposes. Even with the advent of rifling the bullet itself didn't change, but was wrapped in a greased, cloth patch to grip the rifling grooves.

The first half of the 19th century saw a distinct change in the shape and function of the bullet. In 1826 [Delvigne](http://en.wikipedia.org/wiki/Henri-Gustave_Delvigne), a French [infantry](http://en.wikipedia.org/wiki/Infantry) officer, invented a breech with abrupt shoulders on which a spherical bullet was rammed down until it caught the rifling grooves. Delvigne's method, however, deformed the bullet and was inaccurate.

Soon after, the [Carabine à tige](http://en.wikipedia.org/wiki/Carabine_%C3%A0_tige) was invented by [Louis-Etienne de Thouvenin](http://en.wikipedia.org/wiki/Louis-Etienne_de_Thouvenin), which provided for a stem at the bottom at the barrel that would deform and expand the base of the bullet when rammed, therefore enabling accurate contact with the rifling. However, the area around the stem would clog and get dirty easily.

#### Minié system - The "Rifled Musket"

One of the most famous was the Minié system, invented by French Army Captain [Claude Etienne Minié](http://en.wikipedia.org/wiki/Claude_Etienne_Mini%C3%A9), which relied on a conical bullet (known as a Minié ball) with a hollow skirt at the base of the bullet. When fired, the skirt would expand from the pressure of the exploding charge and grip the rifling as the round was fired. The better seal gave more power, as less gas escaped past the bullet, which combined with the fact that for the same [bore](http://en.wikipedia.org/wiki/Gauge_%28bore_diameter%29) ([caliber](http://en.wikipedia.org/wiki/Caliber)) diameter a long bullet was heavier than a round ball. The extra grip also spun the bullet more consistently, which increased the range from about 50 yards for a smooth bore musket to about 300 yards for a rifle using the Minié system. The expanding skirt of the Minié ball also solved the problem that earlier tight fitting bullets were difficult to load as black powder residue fouled the inside of the barrel. The Minié system allowed conical bullets to be loaded into rifles just as quickly as round balls in smooth bores, which allowed [rifle muskets](http://en.wikipedia.org/wiki/Rifled_musket) to replace muskets on the battlefield. Minié system rifles, notably the [U.S. Springfield](http://en.wikipedia.org/wiki/Springfield_Model_1861) and the [British Enfield](http://en.wikipedia.org/wiki/Pattern_1853_Enfield) of the early 1860s, featured prominently in the [U.S. Civil War](http://en.wikipedia.org/wiki/U.S._Civil_War), due to their enhanced power and accuracy.



Over the 19th century, bullet design also evolved, the bullets becoming gradually smaller and lighter. By 1910 the standard blunt-nosed bullet had been replaced with the pointed, ['spitzer' bullet](http://en.wikipedia.org/wiki/Spitzer_%28bullet%29), an innovation that increased range and penetration. [Cartridge](http://en.wikipedia.org/wiki/Cartridge_%28weaponry%29) design evolved from simple paper tubes containing [black powder](http://en.wikipedia.org/wiki/Black_powder) and shot, to sealed brass cases with integral [primers](http://en.wikipedia.org/wiki/Percussion_cap) for ignition, while black powder itself was replaced with [cordite](http://en.wikipedia.org/wiki/Cordite), and then other nitro-cellulose-based [smokeless powder](http://en.wikipedia.org/wiki/Smokeless_powder) mixtures, propelling bullets to higher velocities than before.[[2]](file:///D:\DOCUMENTS\seminaar\Rifle.htm#cite_note-GlobalSecurity-1)

The increased velocity meant that new problems arrived, and so bullets went from being soft lead to harder lead, then to [copper jacketed](http://en.wikipedia.org/wiki/Full_metal_jacket_bullet), in order to better engage the spiraled grooves without "stripping" them in the same way that a screw or bolt thread would be stripped if subjected to extreme forces.

### 3.2 Breech loading

From 1836, breech-loading rifles were introduced with the German Dreyse [Needle gun](http://en.wikipedia.org/wiki/Needle_gun), and followed by the French [Tabatière](http://en.wikipedia.org/wiki/Tabati%C3%A8re) in 1864 and the British [Snider-Enfield](http://en.wikipedia.org/wiki/Snider-Enfield). Primitive chamber-locking mechanisms were soon replaced by [bolt-action](http://en.wikipedia.org/wiki/Bolt-action) mechanisms, examplified by the [Chassepot](http://en.wikipedia.org/wiki/Chassepot) in 1866. Breech loading was to have a major impact on warfare, as breech-loading rifles can be fired at a rate many times higher than muzzle loaded rifles and significantly can be loaded from a prone rather than standing position. Firing prone (i.e., lying down) is more accurate than firing from a standing position, while a prone rifleman presents a much smaller target than a standing soldier. The higher accuracy and range, combined with reduced vulnerability generally benefited the defence while making the traditional battle between lines of standing and volleying infantry men obsolete.

### 3.3 Cartridge storage

An important area of development was the way that cartridges were stored and used in the weapon. The [Spencer repeating rifle](http://en.wikipedia.org/wiki/Spencer_repeating_rifle) was a breech-loading manually operated [lever action](http://en.wikipedia.org/wiki/Lever_action) rifle, that was adopted by the United States. Over 20,000 were used during the American Civil War. It marked the first adoption of a removable [magazine](http://en.wikipedia.org/wiki/Magazine_%28firearms%29)-fed infantry rifle by any country. The design was completed by [Christopher Spencer](http://en.wikipedia.org/wiki/Christopher_Spencer) in 1860.[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)] It used copper [rimfire cartridges](http://en.wikipedia.org/wiki/Rimfire_ammunition) stored in a removable seven round tube magazine, enabling the rounds to be fired one after another. When the magazine was empty, it could be exchanged for another.



**4. DEVELOPMENT IN 20th CENTURY**

[World War I](http://en.wikipedia.org/wiki/World_War_I) and [World War II](http://en.wikipedia.org/wiki/World_War_II) had significant impacts on the design and use of the rifle. By the time of the first world war, the rifle had already been established as the stock weapon for modern infantry.

Until the early 20th century rifles tended to be very long; an 1890 [Martini-Henry](http://en.wikipedia.org/wiki/Martini-Henry) was almost 2 m (6 ft) in length with a fixed [bayonet](http://en.wikipedia.org/wiki/Bayonet). The demand for more compact weapons for [cavalrymen](http://en.wikipedia.org/wiki/Cavalry) led to the [carbine](http://en.wikipedia.org/wiki/Carbine), or shortened rifle.

The advent of massed, rapid firepower and of the [machine gun](http://en.wikipedia.org/wiki/Machine_gun) and the rifled [artillery](http://en.wikipedia.org/wiki/Artillery) piece was so quick as to outstrip the development of any way to attack a [trench](http://en.wikipedia.org/wiki/Trench_warfare) defended by riflemen and machine gunners. The carnage of [World War I](http://en.wikipedia.org/wiki/World_War_I) was perhaps the greatest vindication and vilification of the rifle as a military weapon.

Experience in [World War I](http://en.wikipedia.org/wiki/World_War_I) led German military researchers to conclude that long-range aimed fire was less significant at typical battle ranges of 300 m. As mechanisms became smaller, lighter and more reliable, [semi-automatic rifles](http://en.wikipedia.org/wiki/Semi-automatic_rifle), including the [M1 Garand](http://en.wikipedia.org/wiki/M1_Garand_rifle), appeared. [World War II](http://en.wikipedia.org/wiki/World_War_II) saw the first mass-fielding of such rifles, which culminated in the [Sturmgewehr 44](http://en.wikipedia.org/wiki/Sturmgewehr_44), the first [assault rifle](http://en.wikipedia.org/wiki/Assault_rifle) and one of the most significant developments of 20th century small-arms.

During and after [World War II](http://en.wikipedia.org/wiki/World_War_II) it became accepted that most infantry engagements occur at ranges of less than 300 m; the range and power of the large [battle rifles](http://en.wikipedia.org/wiki/Battle_rifle) was "overkill"; and the weapons were heavier than the ideal. This led to Germany's development of the [7.92 x 33 mm *Kurz*](http://en.wikipedia.org/wiki/7.92_x_33_mm) (short) round, the [Karabiner 98](http://en.wikipedia.org/wiki/Karabiner_98), the [MKb-42](http://en.wikipedia.org/wiki/Sturmgewehr_44), and ultimately, the assault rifle. Today, an infantryman's rifle is optimised for ranges of 300 m or less, and soldiers are trained to deliver individual rounds or bursts of fire within these distances.

By contrast, civilian rifle design has not significantly advanced since the early part of the 20th century. Modern hunting rifles have fiberglass and carbon fiber stocks and more advanced [recoil](http://en.wikipedia.org/wiki/Recoil) pads, but are fundamentally the same as infantry rifles from 1910. Many modern [sniper rifles](http://en.wikipedia.org/wiki/Sniper_rifle) can trace their ancestry back for well over a century, and the [Russian](http://en.wikipedia.org/wiki/Russia) 7.62 x 54 mm cartridge, as used in the front-line [Dragunov Sniper Rifle](http://en.wikipedia.org/wiki/SVD_%28rifle%29) (SVD), dates from 1891.

**5. TECHNICAL ASPECTS**

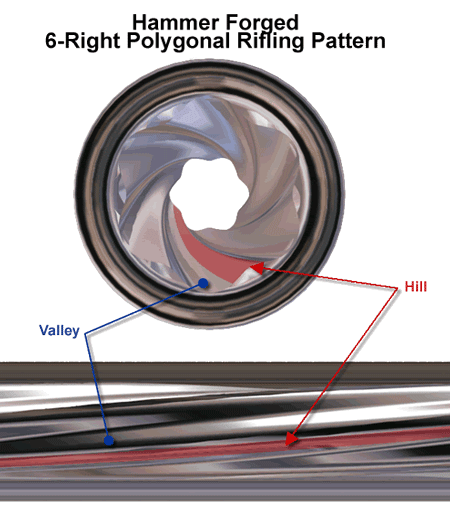
### 5.1 Rifling

**Rifling** is the process of making helical grooves in the [barrel](http://en.wikipedia.org/wiki/Gun_barrel) of a [gun](http://en.wikipedia.org/wiki/Gun) or [firearm](http://en.wikipedia.org/wiki/Firearm), which imparts a spin to a [projectile](http://en.wikipedia.org/wiki/Projectile) around its long axis. This spin serves to [gyroscopically](http://en.wikipedia.org/wiki/Gyroscope) stabilize the projectile, improving its [aerodynamic](http://en.wikipedia.org/wiki/Aerodynamics) stability and accuracy.

Rifling is described by its twist rate, which indicates the distance the bullet must travel to complete one full revolution, such as "1 turn in 10 inches" (1:10 inches), or "1 turn in 25.40 cm" (1:25.4 cm). A shorter distance indicates a "faster" twist, meaning that for a given velocity the projectile will be rotating at a higher spin rate.



The combination of length, weight and shape of a projectile determines the twist rate needed to stabilize it – barrels intended for short, large-diameter projectiles like spherical lead balls require a very low twist rate, such as 1 turn in 48 inches (122 cm).[[1]](file:///D:\DOCUMENTS\seminaar\Rifling.htm#cite_note-0) Barrels intended for long, small-diameter bullets, such as the ultra-low-drag, 80-[grain](http://en.wikipedia.org/wiki/Grain_%28mass%29) 0.224 inch bullets (5.2 g, 5.56 mm), use twist rates of 1 turn in 8 inches (20 cm) or faster.[[2]](file:///D:\DOCUMENTS\seminaar\Rifling.htm#cite_note-1)



In some cases, rifling will have twist rates that increase down the length of the barrel, called a *gain twist* or *progressive twist*; a twist rate that decreases from breech to muzzle is undesirable, as it cannot reliably stabilize the bullet as it travels down the bore.[[3]](file:///D:\DOCUMENTS\seminaar\Rifling.htm#cite_note-2)[[4]](file:///D:\DOCUMENTS\seminaar\Rifling.htm#cite_note-lilja_accurate-3) Extremely long projectiles such as [flechettes](http://en.wikipedia.org/wiki/Flechette) may require impractically high twist rates; these projectiles must be inherently stable, and are often fired from a [smoothbore](http://en.wikipedia.org/wiki/Smoothbore) barrel.

### 5.2 Barrel wear

As the bullet enters the barrel, it inserts itself into the rifling, a process that gradually wears down the barrel, and also causes the barrel to heat up more rapidly. Therefore, some [machine-guns](http://en.wikipedia.org/wiki/Machine-gun) are equipped with quick-change barrels that can be swapped every few thousand rounds, or in earlier designs, were water-cooled. Unlike older carbon [steel](http://en.wikipedia.org/wiki/Steel) barrels, which were limited to around 1,000 shots before the extreme heat caused accuracy to fade, modern [stainless steel](http://en.wikipedia.org/wiki/Stainless_steel) barrels for target rifles are much more resistant to wear, allowing many thousands of rounds to be fired before accuracy drops. (Many shotguns and small arms have [chrome](http://en.wikipedia.org/wiki/Chrome_plating)-lined barrels to reduce wear and enhance corrosion resistance. This is rare on rifles designed for extreme accuracy, as the plating process is difficult and liable to reduce the effect of the rifling.) Modern ammunition has a hardened lead core with a softer outer cladding or jacket, typically of an alloy of copper and nickel - [cupro-nickel](http://en.wikipedia.org/wiki/Cupro-nickel). Some ammunition is even coated with molybdenum-disulfide to further reduce internal friction - the so-called 'moly-coated' bullet.

### 5.3 Rate of fire

Rifles were initially single-shot, muzzle-loading weapons. During the 18th century, breech-loading weapons were designed, which allowed the rifleman to reload while under cover, but defects in manufacturing and the difficulty in forming a reliable gas-tight seal prevented widespread adoption. During the 19th century, multi-shot [repeating rifles](http://en.wikipedia.org/wiki/Repeating_rifle) using [lever](http://en.wikipedia.org/wiki/Lever-action), [pump](http://en.wikipedia.org/wiki/Pump-action) or linear [bolt actions](http://en.wikipedia.org/wiki/Bolt_action) became standard, further increasing the rate of fire and minimizing the fuss involved in loading a firearm. The problem of proper seal creation had been solved with the use of brass cartridge cases, which expanded in an [elastic](http://en.wikipedia.org/wiki/Elastic_%28solid_mechanics%29) fashion at the point of firing and effectively sealed the breech while the pressure remained high, then relaxed back enough to allow for easy removal. By the end of the 19th century, the leading bolt-action design was that of [Paul Mauser](http://en.wikipedia.org/wiki/Paul_Mauser), whose action—wedded to a reliable design possessing a five-shot magazine—became a world standard through two world wars and beyond. The [Mauser rifle](http://en.wikipedia.org/wiki/Mauser_rifle) was paralleled by Britain's ten-shot [Lee-Enfield](http://en.wikipedia.org/wiki/Lee-Enfield) and America's 1903 [**Springfield Rifle**](http://en.wikipedia.org/wiki/M1903_Springfield_rifle) models (the latter pictured above). The American M1903 closely copied Mauser's original design.

### 5.4 Range

Barrel [rifling](http://en.wikipedia.org/wiki/Rifling) dramatically increased the range and accuracy of the musket. Indeed, throughout its development, the rifle's history has been marked by increases in range and accuracy. From the [Minié rifle](http://en.wikipedia.org/wiki/Mini%C3%A9_rifle) and beyond, the rifle has become ever more potent at long range strikes.

In recent decades, large-caliber anti-materiel rifles, typically firing 12.7 mm and 20 mm caliber cartridges, have been developed. The US [Barrett M82A1](http://en.wikipedia.org/wiki/M82_Barrett_rifle) is probably the best-known such rifle. These weapons are typically used to strike critical, vulnerable targets such as computerized command and control vehicles, radio trucks, radar antennae, vehicle engine blocks and the jet engines of enemy aircraft. Anti-materiel rifles can be used against human targets, but the much higher weight of rifle and ammunition, and the massive recoil and muzzle blast, usually make them less than practical for such use. The Barrett M82 is credited with a maximum effective range of 1,800 m (1.1 mi); and it was with a .50BMG caliber McMillan [TAC-50](http://en.wikipedia.org/wiki/TAC-50) rifle that Canadian Master Corporal [Rob Furlong](http://en.wikipedia.org/wiki/Rob_Furlong) made the longest recorded (until 2010) confirmed sniper kill in history, when he shot a [Taliban](http://en.wikipedia.org/wiki/Taliban) fighter at a range of 2,430 m (1.51 mi) in [Afghanistan](http://en.wikipedia.org/wiki/Afghanistan) during [Operation Anaconda](http://en.wikipedia.org/wiki/Operation_Anaconda) in 2002.[[3]](file:///D:\DOCUMENTS\seminaar\Rifle.htm#cite_note-2)

### 5.5 Bullet Rotational Speed (RPM)

Bullets leaving a rifled barrel can spin at over 100,000 [revolutions per minute (rpm)](http://en.wikipedia.org/wiki/Rotational_speed) depending on the muzzle velocity of the bullet and the [pitch](http://en.wikipedia.org/wiki/Rifling#Twist_rate) of the rifling. The rotational speed of the bullet can be calculated by using the formula below. The formula divides the number of inches in a foot (12) by the rate of twist that the barrel has. This number is multiplied by the muzzle velocity (MV) and the number of seconds in a minute (60). For example, a bullet with a muzzle velocity of 3,000 feet per second (910 m/s) leaving a barrel that twists once per foot (1/12") would rotate at 180,000rpm.[[5]](file:///D:\DOCUMENTS\seminaar\Rifle.htm#cite_note-4)

* **MV x (12/twist rate in inches) x 60 = Bullet RPM**

Example using a barrel that has a twist rate of 1 turn in 8" with a muzzle velocity of 3000 ft/s:

* **3000 x (12/8) x 60 = 270,000**

Excessive rotational speed can exceed the bullet's designed limits and the resulting centrifugal force can cause the bullet to disintegrate in a radial fashion.

### 5.6 Caliber

Rifles may be chambered in a variety of calibers, from .17 to .50 caliber. The term [caliber](http://en.wikipedia.org/wiki/Caliber) essentially refers to the width of the bullet fired through a rifle's barrel. Larger caliber bullets have more overall power, but small caliber bullets can reach higher velocities and have better overall penetrative power[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)]. Armies have consistently attempted to find and procure the most lethal and accurate caliber for their firearms.

The standard calibers used by the world's militaries tend to follow worldwide trends. These trends have significantly changed during the centuries of firearm design and re-design. Muskets were normally chambered for large calibers, such as .50 or .59, with the theory that these large bullets caused the most damage. During World War I and II, most rifles were chambered in .30 caliber, a combination of power and speed. Examples would be the British .303 Lee-Enfield, the American .30-06 M1903 Springfield, and the German 8mm Mauser K98. Within the past 40 years, however, military calibers have become smaller yet, with most armies favoring 5.56 mm or smaller rounds. Examples of firearms in this caliber are the American 5.56 mm M16 and the Russian 5.45 mm AK-74. The switch from .30 to 5.56 mm weapons was because the new rounds are lighter, which means a soldier can carry more of them, and because many military strategists believe the smaller bullet has better penetration power.

**6. LOADING AND FIRING MECHANISM**

### 6.1 Muzzle-loaded hand cannon

The original predecessor of all firearms, the [hand cannon](http://en.wikipedia.org/wiki/Hand_cannon) was loaded with gunpowder and the shot (initially [lead shot](http://en.wikipedia.org/wiki/Lead_shot), later replaced by cast iron[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)]) through the muzzle, while a fuse was placed at the rear. This fuse was lighted, causing the gunpowder to ignite and propel the cannonball. In military use, the standard hand cannon was tremendously powerful, while also being somewhat useless[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)] due to relative inability of the gunner to aim the weapon, or control the ballistic properties of the projectile. Recoil could be absorbed by bracing the barrel against the ground using a wooden support, the forerunner of the [stock](http://en.wikipedia.org/wiki/Stock_%28firearm%29). Neither the amount of gunpowder, nor the consistency in projectile dimensions were controlled, with resulting inaccuracy in firing due to [windage](http://en.wikipedia.org/wiki/Windage), the difference in diameter between the [bore](http://en.wikipedia.org/wiki/Caliber#Alternative_measurements_of_bore) and the shot. The [hand cannons](http://en.wikipedia.org/wiki/Hand_cannon) were replaced by lighter carriage-mounted [artillery](http://en.wikipedia.org/wiki/Artillery) pieces, and ultimately the [arquebus](http://en.wikipedia.org/wiki/Arquebus).

### 6.2 Muzzleloader

[Muzzle-loading](http://en.wikipedia.org/wiki/Muzzleloader) muskets (smooth-bored long guns) were among the first small arms developed. The firearm was loaded through the muzzle with gunpowder, optionally some wadding and then a bullet (usually a solid lead ball, but musketeers could shoot stones when they ran out of bullets). Greatly improved muzzleloaders (usually rifled instead of smooth-bored) are manufactured today and have many enthusiasts, many of whom hunt large and small game with their guns. Muzzleloaders have to be manually reloaded after each shot; a skilled archer could fire multiple arrows faster than most early muskets could be reloaded and fired, although by the mid-18th century, when muzzleloaders became the standard small armament of the military, a well-drilled soldier could fire six rounds in a minute using prepared cartridges in his musket. Before then, effectiveness of muzzleloaders was hindered by both the low reloading speed and, before the firing mechanism was perfected, the very high risk posed by the firearm to the person attempting to fire it.

One interesting solution to the reloading problem was the "Roman Candle Gun". This was a muzzleloader in which multiple charges and balls were loaded one on top of the other, with a small hole in each ball to allow the subsequent charge to be ignited after the one ahead of it was ignited. It was neither a very reliable nor popular firearm, but it enabled a form of "automatic" fire long before the advent of the machine gun.

#### 6.3 Matchlock

[Matchlocks](http://en.wikipedia.org/wiki/Matchlock) were the first and simplest small arms firing mechanisms developed. Using the matchlock mechanism, the powder in the gun barrel was ignited by a piece of burning cord called a "match". The match was wedged into one end of an S-shaped piece of steel. As the trigger (often actually a lever) was pulled, the match was brought into the open end of a "touch hole" at the base of the gun barrel, which contained a very small quantity of gunpowder, igniting the main charge of gunpowder in the gun barrel. The match usually had to be relit after each firing.

#### 6.4 Wheellock

The [wheellock](http://en.wikipedia.org/wiki/Wheellock) action, a successor to the matchlock, predated the flintlock. Despite its many faults, the wheellock was a significant improvement over the matchlock in terms of both convenience and safety, since it eliminated the need to keep a smoldering match in proximity to loose gunpowder. It operated using a small wheel much like that on [cigarette lighters](http://en.wikipedia.org/wiki/Cigarette_lighters) which was wound up with a key before use and which, when the trigger was pulled, spun against a flint, creating the shower of sparks that ignited the powder in the touch hole. Supposedly invented by [Leonardo da Vinci](http://en.wikipedia.org/wiki/Leonardo_da_Vinci), the [Italian](http://en.wikipedia.org/wiki/Italy) [Renaissance man](http://en.wikipedia.org/wiki/Polymath), the wheel lock action was an innovation that was not widely adopted.

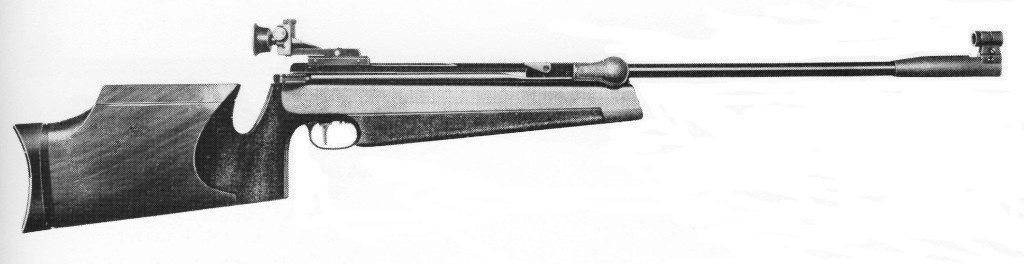
#### 6.5 Flintlock

The [flintlock](http://en.wikipedia.org/wiki/Flintlock) action was a major innovation in small arms design. The spark used to ignite the gunpowder in the touch hole was supplied by a sharpened piece of flint clamped in the jaws of a "cock" which, when released by the trigger, struck a piece of steel called the "[frizzen](http://en.wikipedia.org/wiki/Frizzen)" to create the necessary sparks. (The spring loaded arm that holds a piece of flint or pyrite is referred to as a cock because of its resemblance to a rooster.) The cock had to be manually reset after each firing, and the flint had to be replaced periodically due to wear from striking the frizzen. (See also [flintlock mechanism](http://en.wikipedia.org/wiki/Flintlock_mechanism), [snaphance](http://en.wikipedia.org/wiki/Snaphance), [miquelet](http://en.wikipedia.org/wiki/Miquelet)) The flintlock was widely used during the 18th and 19th centuries in both muskets and rifles.

**7. TYPES OF RIFLE**

**7.1** [**Air gun**](http://en.wikipedia.org/wiki/Air_gun)

An **air gun** (also **air rifle** or **air pistol**) is a [rifle](http://en.wikipedia.org/wiki/Rifle), [pistol](http://en.wikipedia.org/wiki/Pistol), or [shotgun](http://en.wikipedia.org/wiki/Shotgun) that fires [projectiles](http://en.wikipedia.org/wiki/Projectile) by means of compressed [air](http://en.wikipedia.org/wiki/Pneumatics) or other [gas](http://en.wikipedia.org/wiki/Gas), in contrast to a [firearm](http://en.wikipedia.org/wiki/Firearm), which burns a propellant. Most air guns use metallic projectiles as ammunition. Air guns that only use plastic projectiles are classified as [airsoft guns](http://en.wikipedia.org/wiki/Airsoft_gun)

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**7.2** [**Spencer rifle**](http://en.wikipedia.org/wiki/Spencer_rifle)

The **Spencer repeating rifle** was a manually operated [lever-action](http://en.wikipedia.org/wiki/Lever-action), [repeating rifle](http://en.wikipedia.org/wiki/Repeating_rifle) fed from a tube [magazine](http://en.wikipedia.org/wiki/Magazine_%28firearm%29) with cartridges. It was adopted by the [Union Army](http://en.wikipedia.org/wiki/Union_Army), especially by the [cavalry](http://en.wikipedia.org/wiki/Cavalry), during the [American Civil War](http://en.wikipedia.org/wiki/American_Civil_War), but did not replace the standard issue [muzzle-loading](http://en.wikipedia.org/wiki/Muzzle-loading) [rifled muskets](http://en.wikipedia.org/wiki/Rifled_musket) in use at the time. The **Spencer carbine** was a shorter and lighter version.



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**7.3** [**Semi-automatic rifle**](http://en.wikipedia.org/wiki/Semi-automatic_rifle)

A **semi-automatic rifle** is a type of [rifle](http://en.wikipedia.org/wiki/Rifle) that fires a single [bullet](http://en.wikipedia.org/wiki/Bullet) each time the [trigger](http://en.wikipedia.org/wiki/Trigger_%28firearms%29) is pulled, automatically ejects the spent cartridge, chambers a fresh cartridge from its [magazine](http://en.wikipedia.org/wiki/Magazine_%28firearms%29), and is immediately ready to fire another shot.

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* 1. [**Automatic rifle**](http://en.wikipedia.org/wiki/Automatic_rifle)

**Automatic rifle** is a term generally used to describe a [self-loading rifle](http://en.wikipedia.org/wiki/Self-loading_rifle) chambered for a rifle cartridge, capable of delivering both [semi](http://en.wikipedia.org/wiki/Semi-automatic_firearm)- and [full automatic](http://en.wikipedia.org/wiki/Automatic_firearm) fire. This "select-fire" capability, as well as the (general) use of [magazine](http://en.wikipedia.org/wiki/Magazine_%28firearms%29)-fed rifle [ammunition](http://en.wikipedia.org/wiki/Ammunition), differentiate it from other classes of automatic firearm such as the [machine gun](http://en.wikipedia.org/wiki/Machine_gun) and [submachine gun](http://en.wikipedia.org/wiki/Submachine_gun).

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* 1. [**Assault rifle**](http://en.wikipedia.org/wiki/Assault_rifle)

An **assault rifle** is a [selective fire](http://en.wikipedia.org/wiki/Selective_fire) [rifle](http://en.wikipedia.org/wiki/Rifle) that uses an [intermediate cartridge](http://en.wikipedia.org/wiki/Intermediate_cartridges) and a [detachable magazine](http://en.wikipedia.org/wiki/Magazine_%28firearms%29).[[1]](http://en.wikipedia.org/wiki/Assault_rifle#cite_note-0)[[2]](http://en.wikipedia.org/wiki/Assault_rifle#cite_note-1)[[3]](http://en.wikipedia.org/wiki/Assault_rifle#cite_note-2)[[4]](http://en.wikipedia.org/wiki/Assault_rifle#cite_note-3) Assault rifles are the standard [infantry weapons](http://en.wikipedia.org/wiki/Small_arms) in most modern [armies](http://en.wikipedia.org/wiki/Army). Assault rifles are categorized in between [light machine guns](http://en.wikipedia.org/wiki/Light_machine_gun), which are intended more for sustained automatic fire in a light support role, and [submachine guns](http://en.wikipedia.org/wiki/Submachine_gun), which fire a pistol cartridge rather than a rifle cartridge.

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* 1. [**Anti-materiel rifle**](http://en.wikipedia.org/wiki/Anti-materiel_rifle)

An **anti-materiel rifle** (**AM**) is a [rifle](http://en.wikipedia.org/wiki/Rifle) that is designed for use against military equipment ([matériel](http://en.wikipedia.org/wiki/Mat%C3%A9riel)) rather than against other combatants

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* 1. [**Bolt action**](http://en.wikipedia.org/wiki/Bolt_action)

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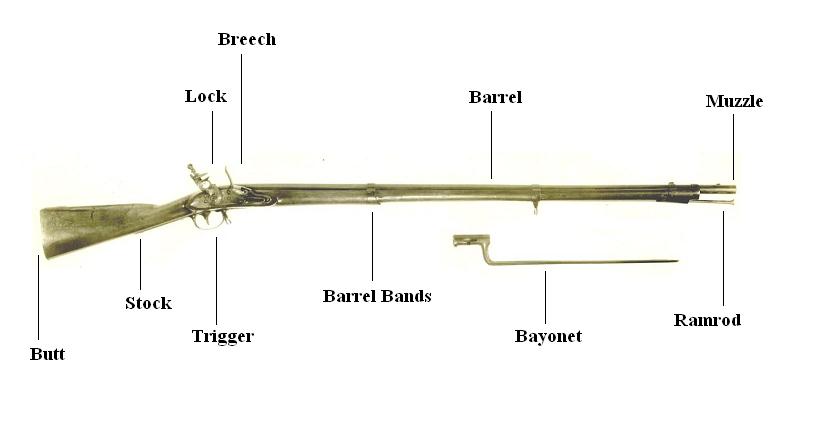
* 1. [**Carbine**](http://en.wikipedia.org/wiki/Carbine)

A **carbine** is a [firearm](http://en.wikipedia.org/wiki/Firearm) similar to a [rifle](http://en.wikipedia.org/wiki/Rifle) or [musket](http://en.wikipedia.org/wiki/Musket). Many carbines, especially modern designs, were developed from rifles, being essentially shortened versions of full rifles firing the same [ammunition](http://en.wikipedia.org/wiki/Ammunition), although often at a lower [velocity](http://en.wikipedia.org/wiki/Velocity)

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* 1. [**Musket**](http://en.wikipedia.org/wiki/Musket)

A **musket** is a [muzzle](http://en.wikipedia.org/wiki/Muzzle_%28firearm%29)-loaded, [smooth bore](http://en.wikipedia.org/wiki/Smooth_bore) [long gun](http://en.wikipedia.org/wiki/Long_gun), fired from the shoulder. Muskets were designed for use by [infantry](http://en.wikipedia.org/wiki/Infantry). The musket replaced the [arquebus](http://en.wikipedia.org/wiki/Arquebus), and was in turn replaced by the [rifle](http://en.wikipedia.org/wiki/Rifle). The term "musket" is applied to a variety of weapons, including the long, heavy guns with [matchlock](http://en.wikipedia.org/wiki/Matchlock) or [wheel lock](http://en.wikipedia.org/wiki/Wheel_lock) and [loose powder](http://en.wikipedia.org/wiki/Gunpowder) fired with the [gun barrel](http://en.wikipedia.org/wiki/Gun_barrel) resting on a stand, and also lighter weapons with [Snaphance](http://en.wikipedia.org/wiki/Snaphance), [flintlock](http://en.wikipedia.org/wiki/Flintlock) or [caplock](http://en.wikipedia.org/wiki/Caplock) and bullets using a stabilizing spin ([Minié ball](http://en.wikipedia.org/wiki/Mini%C3%A9_ball)), affixed with a bayonet.

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* 1. [**Recoilless rifle**](http://en.wikipedia.org/wiki/Recoilless_rifle)

A **recoilless rifle** (**RCLR**) or **recoilless gun** is a lightweight [weapon](http://en.wikipedia.org/wiki/Weapon) that fires a heavier projectile than would be practical to fire from a recoiling weapon of comparable size. Technically, only devices that use a [rifled](http://en.wikipedia.org/wiki/Rifling) barrel are recoilless *rifles*. [Smoothbore](http://en.wikipedia.org/wiki/Smoothbore) variants are recoilless *guns*. This distinction is often lost, and both are often called recoilless rifles

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* 1. [**Sniper rifle**](http://en.wikipedia.org/wiki/Sniper_rifle)

In [military](http://en.wikipedia.org/wiki/Military) and [law enforcement](http://en.wikipedia.org/wiki/Law_enforcement_agency) terminology, a **sniper rifle** is a [rifle](http://en.wikipedia.org/wiki/Rifle) used to ensure more accurate placement of bullets at longer ranges than other [small arms](http://en.wikipedia.org/wiki/Small_arms). A typical sniper rifle is built for optimal levels of [accuracy](http://en.wikipedia.org/wiki/Accurizing), fitted with a [telescopic sight](http://en.wikipedia.org/wiki/Telescopic_sight) and chambered for a military [centerfire](http://en.wikipedia.org/wiki/Centerfire_ammunition) [cartridge](http://en.wikipedia.org/wiki/Cartridge_%28firearms%29)

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**8. APPLICATIONS**

* Main use of rifle is on the warfront.
* Widely used for hunting purpose.
* Air rifles are used to target practice
* It is used in national games for shooting purpose.
* In rock climbing it also used as gripper**.**

**9. CONCLUSION**

In this seminar, I have presented the revolutionary development and working of Rifle. Above all I discus all new developed model of rifle and its working operation. For any country his army is first power. That’s why for any army should must have latest weapon for strength. So this overview of development of rifle gives an idea about changing day by day. We can get more power in this field by making a suitable technology by knowing today.

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