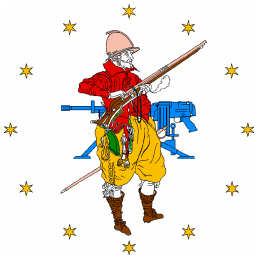

Foundation for European Societies of Arms Collectors

A short history of firearms

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Firearms, a short history

The weapon might well be man's earliest invention. Prehistoric man picked up a stick and lashed out at something or someone. This happened long before man learned to harness fire or invented the wheel. The invention of the weapon was to have a profound impact on the development of man. It provided the third and fourth necessities of life, after air and water: food and protection. It gave prehistoric man the possibility to hunt animals that were too big to catch by hand and provided protection from predators, especially the greatest threat of all: his fellow man. The strong man did not sit idly while intelligent man used the weapon he invented to match his brute force and soon came up with a weapon of his own, thus forcing intelligent man to come up with something better. The arms race had started. This race has defined the history of mankind. To deny the role that weapons in general and firearms in particular have played in deciding the course of history is like denying history itself.

The early years

During the Stone Age axes, knives and spears appeared and around 6000 BC the bow made its debut. This was the first weapon, after the throwing spear, that could be used at some distance from the intended target, though possibly slings also were used to hurl stones. The bow and arrow was the portable projectile weapon of choice until the end of the Middle Ages. To improve the range and make those projectile weapons more manageable many new variations were developed like the gastrophetes and the crossbow. The power source, however, remained the release of a certain amount of mechanical energy from a device; energy that had to be put into the system by hand.

A crossbow from about 1500

Edged weapons and arrow-heads were initially made of flint. Around 4000 BC metalworking developed and knives, axes and the tips of arrows and spears were made of bronze, to be replaced from around 2000 BC by iron. The production of iron bladed weapons and armour reached a high level of sophistication, culminating in Japanese swords like the Katana.

One of the weapons that represent the ultimate in Japanese swordsmithing: the Katana

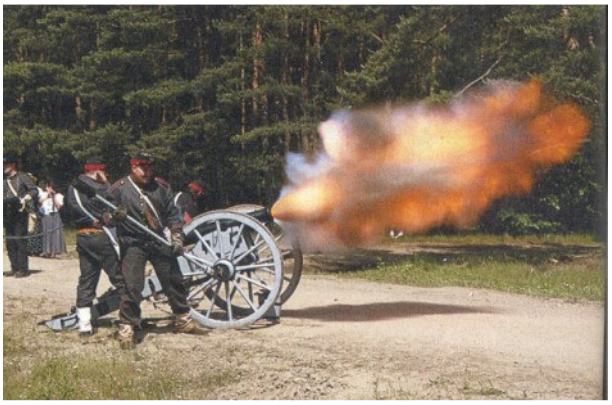
This period also saw the development of large-scale warfare, necessitating the introduction of large projectile throwing weapons or "machines" like the ballista, the trebuchet and the catapult. These weapons were the predecessors to modern artillery.

The trebuchet: a siege machine from the Middle Ages

Gunpowder

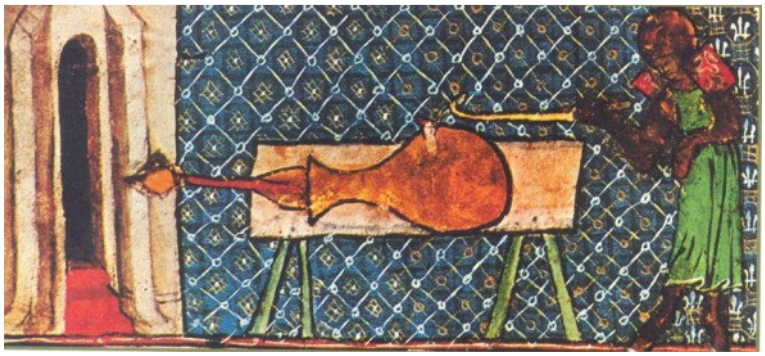
It is not certain who invented gunpowder, though many countries lay claim to it. It is generally assumed that the recipe for gunpowder was first put onto paper around 1260 in England. This gunpowder consisted of a mixture of saltpetre, sulphur and charcoal, a recipe that, for six centuries, remained virtually unchanged.

Gunpowder, nowadays known as "black powder", is a relatively mild explosive. When ignited in the open air it does not explode, it only burns violently. When ignited in a closed vessel it produces moderate pressures. Because of the impurities in the basic material, upon firing, black powder produces a lot of flames and sparks and a large cloud of grey smoke. The expression "the fog of war" comes from the enormous amounts of smoke that used to hang over the battlefields. The residue of burning black powder is very corrosive and weapons that are left unattended after firing black powder will very quickly develop extensive rust.



Firing a black powder weapon produces a lot of fire and smoke

Initially black powder was used to make noise, like with firecrackers. Around 1300, however, the first cannons appeared. The first picture of a cannon is in a manuscript from 1327, while the first recorded use of the cannon was at the battle of Crécy in 1346.



The first cannon as shown in "De Notabilitatibus, Sapienttis et Prudentiis Regum" by Walter de Milemete, 1327

Those first cannons were crudely made, vase shaped objects placed on a wooden support but soon barrels were made from iron bars that were welded together and placed on something that could be called a carriage. Those cannons were loaded by pouring an amount of powder into the muzzle, followed by a wooden plug and a stone ball. The powder was ignited by pushing a glowing poker through a small hole in the side of the barrel (the touch hole). The fit of the ball in the barrel was not very tight (hence the wooden plug) so the weapons were very inaccurate. One might say that the ball could be fired "in the general direction of the enemy". Probably the psychological effect of the fire, smoke and noise was bigger than the danger of being hit.

A breech loading cannon from the Middle Ages

Contrary to popular belief even those early cannons were not exclusively muzzleloaders. In the early Middle Ages several cannons were produced that were loaded from the rear end of the barrel: the breech. This made it easier to load a cannon that was placed in an enclosed space like a castle tower and made it possible to fire several shots in quick succession. These breechloading cannons consisted of a barrel that was open at the rear and a separate chamber containing the powder and ball. Before firing this chamber had to be fixed to the breech of the barrel by means of wedges or a rope.

Because of their inherent inaccuracy the first cannons could only be used effectively against large targets. The most notable event was the fall of Constantinople in 1453 where the Turks used large cannons to breach the city walls, signalling the end of the Byzantine Empire.

Portable weapons

Two handgonnes from about 1375

The first portable firearms were nothing more than scaled down cannons. They were introduced around 1380 and generally referred to as "handgonne". These weapons consisted of a cast barrel (or several barrels together) attached to the end of a pole. While the shooter held the pole under his arm he used a glowing poker to fire the gun with his other hand.

Soon the rather unsatisfactory handgonne was replaced by a weapon that had a stock: a wooden construction that could be used to support the weapon against the body while firing. It was called an "arquebus". Also the ignition system was changed (around 1411) from a glowing poker to a slow burning match (wick, fuse) held in a clamp attached to the side of the gun. Some years later a spring mechanism was added to this clamp so that the shooter could simply aim the gun and fire it by pushing a button: the trigger mechanism had been invented.

A matchlock musket

Though the initial development of the firearm took place on the larger weapons (the cannons), from this moment on most technical developments started in the area of small arms. Rifling, ignition systems etc. first appeared on hand weapons, the cannons following later. The rest of this history will therefore be limited to hand firearms.

New ignition systems

These first hand firearms, known as matchlock- or serpentine firearms, were relatively large weapons. Using them required some skill (especially for loading) and not a little courage, for the metallurgy of the day was not yet very sophisticated and it regularly happened that these weapons blew up on firing, posing a bigger threat to the shooter than to the target.

Using a burning match (or fuse) to fire a weapon has many disadvantages. The biggest is the easy discovery. The Enemy could see the glow of the burning match or even smell it. The Dutch expression "to smell a match" (meaning "to sense danger") stems from the time when the Spaniards were using matchlock guns. The Dutch fighters ("Geuzen") could smell the burning fuse of the Spanish guns and thus be alerted to an ambush.

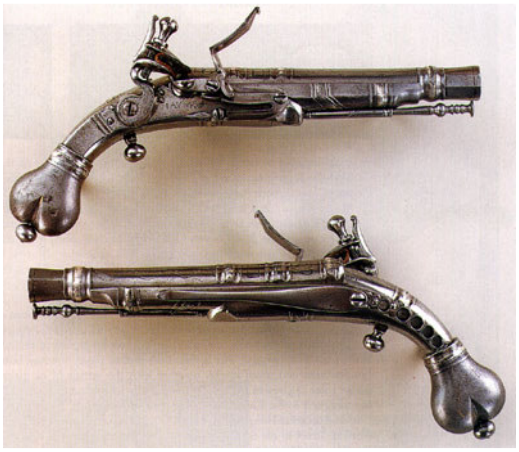
At the beginning of the sixteenth century, in Italy, a solution to this problem was invented by Leonardo da Vinci. It is pictured in the “Codice Atlantico”.

A mechanism with a spring was attached to the side of the weapon. When released, the spring drove a serrated wheel against a piece of pyrite causing sparks. The sparks ignited the powder in the powder pan, which in turn, through the flash hole, ignited the main charge. This was a great improvement for now the weapon could be carried cocked and ready to fire anytime. Also it made it possible to fire the weapon with one hand, a must for cavalry soldiers. It even became a more viable weapon for hunting as the game would not be disturbed by the sight and smell of a burning match.

Two seventeenth century wheellock firearms. Right a hunting rifle, below a grenade launcher

Many variations of the wheel lock firearm exist. In its heyday many new concepts were developed like the rain tight lock and the volley gun (a weapon that fired a number of shots together or in quick succession, the machinegun of the day). Still, the wheellock was a complicated and thus expensive weapon to make. It was financially not possible to issue it to large numbers of soldiers so it remained a weapon for the elite.

The solution to these problems, the socalled snaphaunce lock, was invented in Italy around 1547. Dutch, Swedish and English gunmakers improved on the design but the flintlock as we know it today received its final form in France in 1610. The flintlock still uses a pan that is filled with powder to ignite the main charge through the flash hole but it does away with the pyrite and wheel and instead relies on the striking of a flint against a steel plate (the “frizzen”) to make sparks. The flintlock is a much simpler design than the wheellock and therefore much cheaper to make. It did not need to be made by highly experienced gunsmiths to be functional. Suddenly it became possible to equip a whole army with flintlock muskets. Also the lock was more reliable, easier to maintain and the system could be made reasonably watertight. It was a very important development and firearms started to be made in large numbers and many variations, from small pocket pistols to seven barrel volley guns. The flintlock firearm reached a very high level of sophistication.

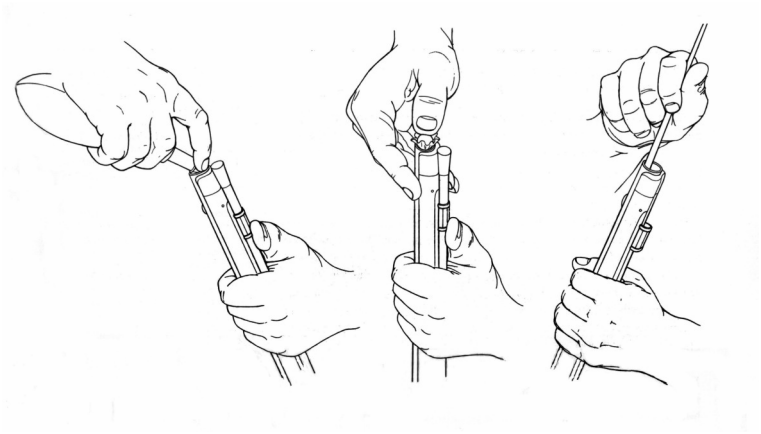


A Scottish set of all- metal flintlock pistols, 1730

All armies in the world started to equip their soldiers with these weapons and they were produced by the tens of thousands. Battles were now fought with these weapons as main armament, supplemented by cannons (though the pike, sabre and bayonet still played a very important role) and the fog of war, caused by the enormous amounts of smoke produced by these guns, descended onto the battlefields.

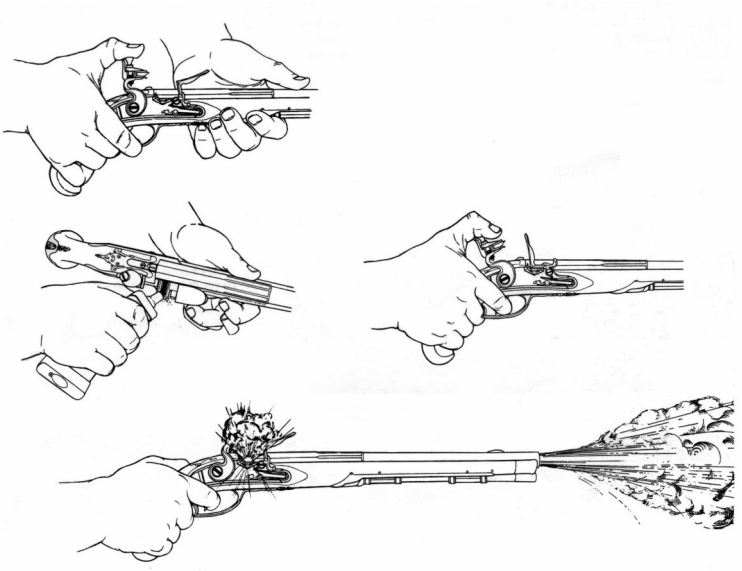
A German hunting rifle

Loading and firing a muzzleloading flintlock pistol



First the weapon is checked for any smouldering powder residue. Then a measured amount of black powder is poured down the barrel through the muzzle. A ball (sometimes with a cloth patch) is placed on the muzzle and forced some way down with the thumb or a short rod. Then the ball is forced all the way down the barrel by means of the ramrod.

The weapon is now held horizontally and the hammer cocked halfway. The frizzen is lifted and a small amount of very fine powder is poured into the pan (a cavity next to the flash hole). The frizzen is then closed and the hammer cocked all the way. When pulling the trigger the hammer moves forward, the flint hits the steel frizzen and pushes it forward, thus exposing the powder in the pan. At the same time the rubbing of the flint against the metal produces sparks. The sparks ignite the powder in the pan and through the flashhole this flame ignites the main charge, which expels the ball. After this the whole process of loading and firing can be repeated.



The emergence of the rifle

At about the same time an important development took place inside the barrel. Around the end of the 14th century German gunsmiths discovered that helical grooves inside a barrel (the "rifling") made the bullet rotate in flight, which gave much better accuracy. Initially this system was only used for hunting. Though as early as 1641 a small number of military units were issued rifles, it was not until the American war of independence, where the frontiersmen with their hunting rifles easily outshot the English infantry with their smoothbore muskets, that the advantages of the rifle in the military context became truly obvious. Even then only elite corpses were issued them. The main objection to them was that firing a ball from a rifled barrel required a very tight fit between ball and barrel. The enormous fouling that black powder causes made loading the rifle, after a few shots had been fired, very difficult and time consuming for the ball literally had to be hammered down the barrel. Please note that we are still talking about the flintlock age.

In the early 19th Century, ways of speeding up the loading process of rifles and, later, of improving their long range performance, culminated in the Minie bullet (patented 1849), which was of cylindro-conoïdal form and had a hollow base. Made under size for the bore, it loaded quickly and easily, and the pressure of the propellant gasses expanded its base to fit the bore and engage the rifling.

Two breech loading flintlock rifles. The one on the right has removable chambers

Mass production and interchangeability of parts

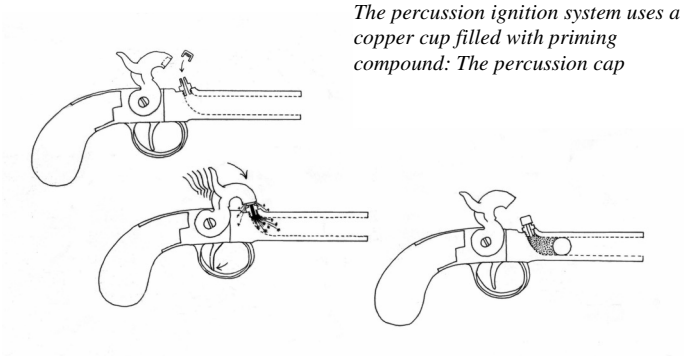
In America a development took place in the firearms industry that was to have a profound impact on manufacturing in general, not only of firearms. Up to then every firearm was made individually: Piece by piece all parts were made and fitted. This meant that no parts could be interchanged from one weapon to the other. Repairs could only be performed by a very skilled gunsmith. It also meant that production times were long and demanded very skilled labour. In 1798, faced with a shortage of firearms, the government of the fledgling United States of America, placed an order for 10,000 flintlock muskets with an industrialist called Eli Whitney. Whitney devised a system in which parts were made to certain specifications and tolerances and were checked by means of callipers and dies. In this he continued a methodology first used in France for the production of the model 1777 musket. Also he designed production machinery that could be operated by unskilled workers. Through this system he managed to produce the 10000 muskets in record time. With this he laid the foundation for modern mass production and interchangeability of parts, features that are essential to modern day production.

Percussion

As stated before, firing a flintlock weapon results in two flashes and a bang. The first flash comes from the powder in the pan being ignited. The second is the shot actually leaving the barrel. Those flintlock firearms fired the ball (or shotload) with a relatively low speed. Game (ducks, deer, rabbits etc.) were often alerted by the flash of the ignition and managed to get away before the ball or the shot could reach them. This rather frustrated a Scottish clergyman, Alexander Forsythe, and he set out to find a solution for this problem. After some experimentation he (an amateur chemist) came up with an ignition system that revolutionized firearm technology and laid the basis for the modern firearm.

The original lock as designed by rev. Alexander Forsythe. It is generally known as the "Scent bottle lock".

The clergyman had learned that certain chemical compounds were so sensitive to shock that they would ignite or explode when struck with a hammer. He developed a way to use these materials, now known as priming compounds, to ignite the powder charge in a firearm and took out a patent in 1807. Further development eventually resulted in an ignition system in which a copper cup, holding the priming compound, was placed on a hollow anvil (the nipple) at the rear of the barrel. Striking the copper cup caused the compound to ignite, thus, through the hollow anvil that acted as flash hole, igniting the powder charge in the barrel. The system is known as "percussion ignition" and the copper cup as "percussion cap".



The percussion ignition system uses a copper cup filled with priming compound: The percussion cap

The introduction of percussion ignition and the percussion cap (c. 1814) started what is often referred to as "the age of invention" in firearm technology. Of course we are still talking mainly about muzzle loading weapons but the percussion system so much simplified production, shooting and maintenance that large-scale production could be undertaken and a major market for firearms, both civil and military, started to develop. In the years following the invention of the percussion lock a large number of developments took place that finally, towards the end of the 19th century, resulted in the firearm as we know it today.

A Prussian percussion carbine, model 1823

The revolver

A percussion pepperbox

From the beginning of firearm history there was a need to be able to fire more than one shot without reloading. Very early in the development of firearms multi-barrel designs were used. In handguns a multi barrel firearm is known as a pepperbox. The biggest disadvantage of the pepperbox is its weight, due to the large number of barrels. Around the year 1800 the gunsmiths Collier and Wheeler developed firearms in which a cylinder with several chambers was placed behind the barrel. To fire the next shot the cylinder only had to be rotated. The disadvantage was that each chamber had to have its own pan with powder (we are still talking about flintlock weapons) and few of the weapons were produced.

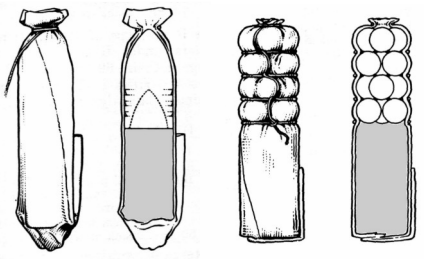
The development of the percussion cap suddenly made the revolver a viable weapon and Samuel Colt took out a number of patents in 1836, for a weapon in which the cylinder automatically rotates to the next position when the hammer is cocked. The revolver he designed forms the basis for all modern revolver type weapons, though a large number of inventors, particularly in England and the USA, came up with their own designs. This development made the repeater a practical weapon.

The first practical revolver: the Colt Paterson

The system had some inherent drawbacks that made it less suitable for application in rifles. One was that during firing some lead and gas escapes sideways through the gap between the cylinder and the barrel. This gas would hurt the shooters arm. For the time being the single shot muzzle loader remained the most practical shoulder weapon. For handguns the revolver system proved to be so practical that it is still, in improved form, in use today.

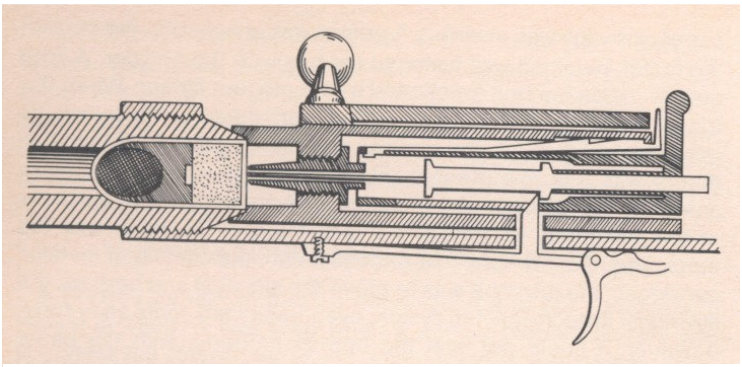
Breech loading

As said before, in this period there were already weapons that were loaded from the breech with a ball and loose powder or with some kind of package, mostly consisting of an amount of propellant and a projectile held together in a combustible wrapper. In these weapons the breech was closed by a mechanism like a falling block or rotating bolt but the percussion primer still had to be placed separately onto the nipple, which formed part of the weapon.



Paper cartridges for percussion breechloading firearms

In the beginning of the 19th century, in France, Pauly started the development of the cartridge. His idea was to combine the projectile, the propellant charge and the primer into a single unit: the self-contained cartridge. His design was far ahead of its time and it took until 1840 before the idea caught on.



The Dreyse rifle, in which the needle shaped firing pin strikes the priming compound (placed in a cavity in the rear of the bullet) after passing through the powder

The first really practical design was developed by Dreyse in Germany. It consisted of a ball and a powder charge packed in combustible paper. The primer compound was placed in a recess in the rear of the ball. After placing the cartridge in the chamber of the barrel the rotating bolt was closed.

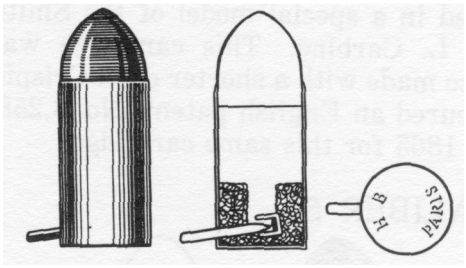
When the trigger was pulled a long, slender, firing pin (called a needle) pierced the paper and went through the powder charge, hitting the primer compound in the back of the ball. This caused the shot to go off, at the same time burning up the paper that contained the components. This shows that a cartridge does not necessarily have to have a case of brass: a paper cartridge is just that: a cartridge. This rifle could be considered the grandfather of the modern bolt-action rifle.

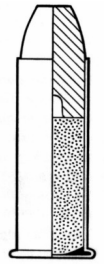
There was one big problem with the Dreyse needle fire rifle and its French counterpart the Chassepot. The high pressure of the burning powder had to be sealed by the mechanism of the rifle and if the system did not have a very tight fit, leakage resulted in injury to the shooter. Fouling by powder residue had the same effect. Pauly's initial ideas contained the solution to the problem: the powder, ball and primer were contained in a metal case that, during firing, sealed the gap between the breech of the barrel and the bolt or breechblock. Initially cartridges were made that contained only powder and ball, while the primer still had to be placed separately. Later the priming compound was incorporated in the case, resulting in the so-called metallic- or self-contained cartridge.

The self-contained cartridge

The development of the cartridge did not happen at one time and in one place. The main difference in construction of cartridges is in the way the ignition is incorporated into the case. In the beginning every gunsmith and every arsenal came up with their own ideas, some more practical than others. Because of the potentially big market, a large number of patents were taken out, hence the expression “patent ignition”. Very few of those designs survived more than a few years, particularly because a number of those designs were only meant do avoid infringement on patents that had already been taken out. Once those patents had expired the, sometimes awkward, other designs were discarded and production concentrated on the proven designs.

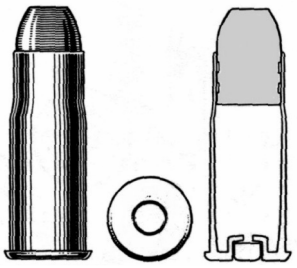
The first practical self-contained cartridge was patented in France in 1835 by Casimir Lefaucheux. It was a design in which the primer was positioned inside the case, with a firing pin resting on it. This firing pin protruded from the side of the case. When hit by the hammer this pin would cause the priming compound to explode, igniting the propellant. This cartridge is known as the pinfire cartridge.



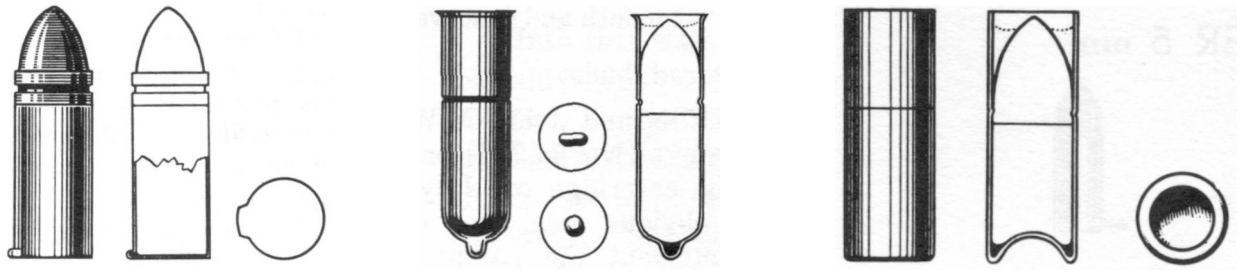


In 1831 and 1849 two patents were taken out by, respectively, J.A. Roberts and L.N.A. Flobert. These patents essentially covered the same principle though Flobert was to become better known. In these patents the case is very thin-walled. The rim at the bottom is hollow and the priming compound is placed inside this hollow rim. The eccentrically placed firing pin strikes the rim and dents it, thus crushing and igniting the priming compound.

The third design actually comprises a number of different patents, all of the same basic principle. In this cartridge a specially shaped percussion cap is placed in a cavity in the centre of the case bottom. The patents for this kind of ignition were taken out in the USA and England in the period 1850 to 1870, by inventors like Pottet, Needham, Morse, Boxer and Berdan. These cartridges are collectively known as centrefire cartridges.



Each of the cartridges mentioned above had their strong points and drawbacks. The pinfire cartridge was unsafe for if the pin was struck by accident (like when the cartridge was dropped) the cartridge could explode outside the weapon. Also they could not be used for magazine repeating systems. The rimfire cartridge had a very thin wall and could not withstand high pressures (the Flobert patent actually covered a cartridge that did not contain powder, propelling the ball only by the force of the explosion of the priming compound). Besides that, the rimfire cartridge can not be re-used or reloaded. The most practical of the designs was definitely the centrefire system.



Lipfire *Teatfire* *Cupfire*

There were other systems: a cartridge in which the primer compound was placed in a hollow lip at the bottom of the case (lipfire), a cartridge in which the primer compound was placed in a hollow teat protruding from the bottom of the case (teatfire), a cartridge in which the primer compound was placed in a hollow rim that was struck by the firing pin in an outward movement (cupfire) to name but a few. None of these cartridges were interchangeable. As said, these designs were all much less practical than the first three and stayed on the scene for a very short period.

It should be noted that the success in designing metal cartridges was very much due to the development of new metalworking techniques that allowed brass to be formed into long, slim cups. New mechanical production methods and the concept of mass production also made it possible to produce these items in the large numbers necessary. Development of firearms and ammunition went hand in hand with the development of production techniques during the industrial revolution.

Converted weapons

The Civil War in America (1861-65) demonstrated that breech loading, and indeed repeating, rifles had developed to a point where they were militarily practicable. The adoption of the Chassepot by France in 1866, an 11mm single shot breechloader using a combustible cartridge and with a ballistic performance significantly superior to not only the German Dreyse but also the British Enfield muzzleloader, provided the necessary spur. Nations that could afford it searched for a modern high performance breechloader, while converting their muzzle loaders as an economic interim measure. The Springfield "Trapdoor" and Snider conversions are among the better known.

A percussion muzzleloader converted to breechloader: The Springfield Trapdoor rifle

Designed from the outset as a breechloader: The Remington Rolling Block rifle

New models, designed from the outset as breechloaders, appeared on the market like the American Remington "Rolling Block", the British Martini Henry, the German Mauser 71, the Austrian Werndl, the Swiss Vetterli, the French Gras and the Dutch Beaumont M 1871.

After repeating weapons like the American Spencer had proven themselves in combat, again many governments chose to convert the weapons they had in stock; in this case from single shot to repeater. The Dutch Beaumont M 71 rifle was fitted in 1888 with a four round magazine and became the Beaumont M 71/88. A number of weapons, because of the way they were constructed, did not lend themselves to conversion and were quickly relegated to a secondary role. New types of repeating weapons were being developed from scratch, both for the military and the civilian market. The Henry repeating rifle was developed into a very practical weapon by the Winchester company, while in Europe bolt action repeaters like the Mauser 71/84 appeared.

The Dutch Beaumont rifle before and after modification from Beaumont model 71 into Beaumont-Vetterli model 71/88 by the addition of a magazine

The cartridge revolver

In handguns a similar development took place. The difference was, however, that in handguns the concept of multishot weapons had already been established with the introduction of the revolver. As soon as cartridge rifles appeared their breech loading concept was applied to handguns, initially in single shot and multi barrel weapons but later in revolvers.

In the USA, contrary to the situation with rifles, the concept of the breech loading cartridge revolver was covered by a patent so wide that it included every breech loading design imaginable. This patent, known as the Rollin White patent, was bought by the company Smith and Wesson which, almost at the same time, took out a patent on a rimfire cartridge very similar to the one patented by Flobert. The result was that, until the moment the Rollin White patent expired in 1869, Smith and Wesson was the only company that could produce breech loading cartridge revolvers in America. This was the reason that so many "weird" systems (like the muzzle loading teatfire cartridge) were developed. They were only meant to avoid infringing on the patent held by Smith and Wesson.

Smith and Wesson initially chose to produce only revolvers for rimfire cartridges, thus creating double exclusivity. By the time the Rolling White patent expired the rimfire cartridge was thoroughly embedded in the market and many companies followed suit. At that moment, in order to be able to use more powerful and more reliable cartridges, Smith and Wesson started producing revolvers for centrefire cartridges. Colt quickly followed with their now famous Model 1873: the "Peacemaker".

"The gun that won the west": The Colt Single Action Army, model 1873, better known as "Peacemaker"

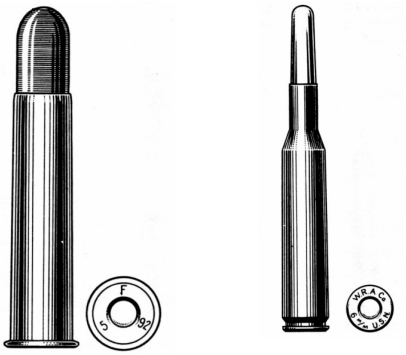
Rollin White or Smith and Wesson never took out a patent in Europe. The development of the revolver in Europe followed a similar, though separate path. As there was no all-encompassing patent, gunsmiths did not have to develop all kinds of separate systems to avoid infringement so fewer "exotic" systems appeared.

A French Javelle patent pinfire revolver from 1865

The introduction of the Lefaucheux pinfire cartridge had preceded Floberts' rimfire cartridge by 10 years and it had established itself as a very practical breech loading cartridge for single- and multibarrel weapons. It did not lend itself for repeating systems but was soon used in revolvers. Though the rimfire cartridge was used in a number of military and civilian weapons it did not gain the popularity it enjoyed in the USA, often being relegated to the role of target- or "parlour" gun. At almost the same moment as in the USA (1869) the breechloading centrefire revolver was developed in England.

Smokeless powder

In 1846 a Swiss Chemist called Schönbein discovered that cotton could be nitrated, resulting in a very fast burning material with high chemical energy content. The material was rather unstable and it was not until 1885 that Vieille in France managed to stabilise this powder and make its performance consistent. The properties of this new powder made it vastly superior to the black powder of the day and even to the nitrated wood pulp powder that had been invented in 1864 by the Prussian major Schultze. It had a much bigger chemical energy content, it could generate much higher pressures, it produced less fouling of the barrel and, most importantly, on firing it produced much less fire and smoke. This last property gave it the name of "smokeless powder" though in Europe the term "nitro powder" is also used. The new powder was such an enormous improvement that the French government accepted it for use in 1886. The powder revolutionised firearms construction.



The .45-70 cartridge from 1871, loaded with black powder, is three times as heavy as the 6mm Lee Navy of 1897

One thing should be realised: It is not only the powder itself that caused the revolution in firearms technology. Technical developments that were part of the industrial revolution had changed the way metals, particularly steel, were produced and processed. For the first time it was possible to produce high-grade steel; steel that was able to withstand the high pressure that nitro powder produced.

Typical modern handgun ammunition, loaded with smokeless powder and jacketed bullets

The appearance of smokeless powder at one stroke made everything that had been produced before obsolete. Black powder firearms depended on a very big, heavy bullet moving at moderate speed to deliver the energy. Now light, high-speed bullets could do the same. Because the bullets were lighter a soldier could carry more ammunition. Also the smaller bullet made it possible to use the rifle at longer distance and deliver more energy to the target. Less fouling meant that the weapon did not have to be cleaned so often while the absence of smoke made the position of the shooter less obvious and less obscured the visibility on the battlefield.

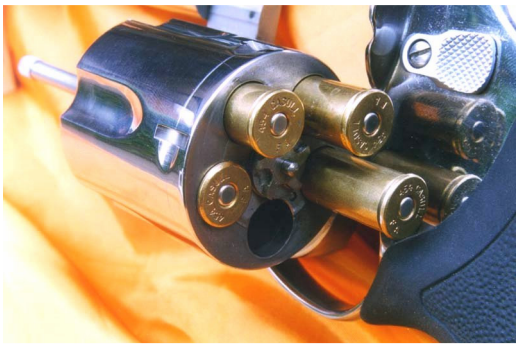
Almost from the start new cartridges were developed for the new powder. They included a big reduction in calibre, lowering of the weight of the bullet and the introduction of the metal clad bullet (sometimes referred to as "full metal jacket" bullet). This was necessary because the speed of the bullet from these new weapons was so high that the lead would melt in the bore. The rifles, though the mechanisms did not change much, became much stronger and, for the energy they delivered, much lighter. Because smokeless powder produced pressures so much higher than black powder it was not possible for governments to simply convert their existing stocks of black powder weapons for the use of the new powder if they wanted to use that powder to its full potential.

The French army was the first to adopt a rifle using smokeless powder in 1886 but the other countries in the world quickly followed. By the beginning of the twentieth century most big nations had converted to rifles for smokeles powder: England had the Lee Enfield, Germany the Mauser 88 and 98, France the Lebel, Austria the Steyr Mannlicher, Italy the Mannlicher Carcano, Russia the Mosin-Nagant and the USA the Krag-Jorgensen. The transition was very fast (As a result of this haste, many first world countries adopted systems that possessed significant flaws). Even though it took some time to phase out the black powder weapons, they were very quickly relegated to second line functions.

The first rifle of the new generation: the French Lebel of 1886

Smokeless powder in handguns

With handguns the same happened. The revolvers in use with most governments were rather large and bulky. Smokeless powder made it possible to make revolvers that were smaller and lighter and that is particularly important for this type of weapon. The old designs, generally, were not suitable to handle the much higher pressures of the modern powders so new designs were necessary. Some older designs, like the Colt Peacemaker, stayed on the market. Still, even these weapons had to undergo a number of changes to make them suitable for smokeless powder. The resulting weapons were generally not much more than a beefed up version of an old design and, though useable, they were far from optimal.

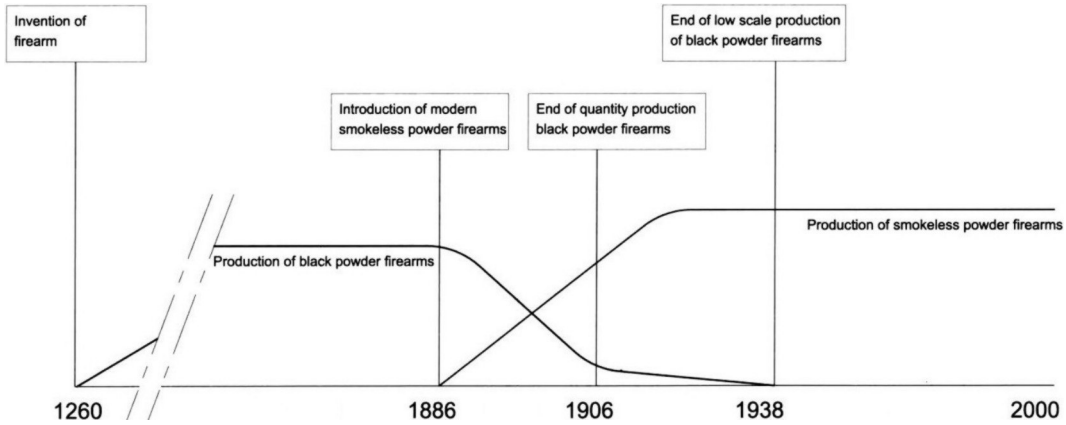


A modern revolver with solid frame and swing out cylinder, suitable for the use of smokeless powder

The transition from black powder to smokeless powder

Black powder did not disappear immediately. In the civilian world (like in the military in peacetime) cost and conservatism play a big role and black powder was used until long after the military had changed over. It can be said, however, that after smokeless powder appeared, very few weapons were introduced that were designed to use only black powder, though some already existing designs continued to be produced for a while. As late as 1938 a small number of muzzle loading weapons was produced in Belgium for export to India and in Japan a muzzle loading "emergency" pistol was designed during the Second World War. These were the exceptions to the rule. General production of black powder weapons had virtually ceased by 1906 and became irrelevant at the beginning of the First World War when large-scale production of modern firearms started in order to support the war effort.

Production of black powder firearms versus smokeless powder firearms



The pinfire cartridge never made the transition to smokeless powder. The construction of the cartridge was such that it could not stand the high pressures that smokeless powder generates. Very few pinfire weapons were produced after 1900 though the very last pinfire shotguns were produced in Sweden in 1942.

The large caliber rimfire cartridge fared little better. Though this ammunition was produced with charges of smokeless powder, in order to be safe for use in the weapons of old design the charge had to be greatly reduced. Besides that, the thin walled cartridge could not stand the high pressure of full load smokeless charges. It would rupture at the point where the firing pin hit the rim, with gas escaping and hurting the shooter. The large calibre rimfire quickly lost terrain to the centrefire cartridge.

One of the very last weapons firing a large calibre rimfire cartridge to stay in production was the Remington Derringer, a two shot pocket pistol. This weapon was in production in unchanged form from 1866 till 1935 but lost out to modern designs.

1866 till 1935: The Remington Derringer in calibre .41 rimfire

The .22 was long considered a typical calibre for target shooting with "parlour guns"

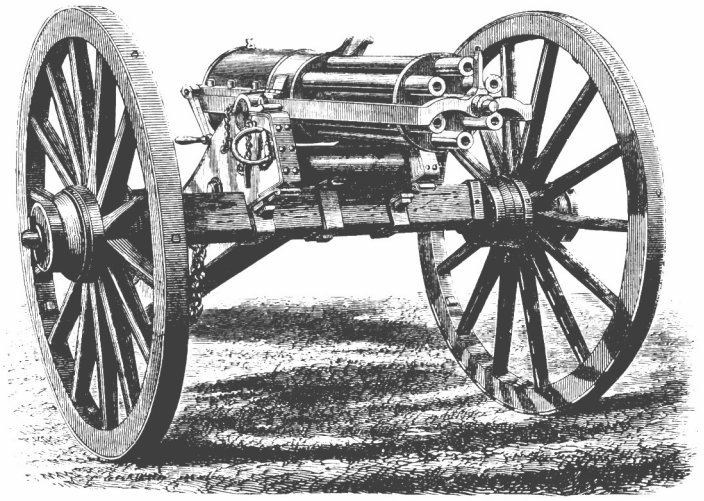
There is (of course) an exception to the rule and that is the .22 rimfire group of cartridges. Weapons in this calibre are used for target shooting, hunting very small game and pest control. These weapons are generally cheap and sturdy and that explains their popularity. Ammunition in this calibre (in a number of variations like .22 short, .22 long rifle and .22 magnum) is still in production, be it with charges of smokeless powder. Firing a modern .22 cartridge in an old (black powder) firearm is considered a very unsafe practice.

Effectively the centrefire cartridge and the .22 rimfire cartridge are the only ones that really survived the transition from black powder to smokeless powder and are still relevant today.

Automatic firearms

An important factor in battle is the ability to fire a large number of projectiles in a very short time. From the very beginning of firearm development this has been the goal of firearm designers, including famous ones like Leonardo da Vinci. Designs with several barrels firing at the same time appeared as early as the fourteenth century. In the American Civil War and the Franco-Prussian war multi-barrel weapons were used in support of the infantry. The Civil war also saw the introduction of what is considered the grandfather of the modern machinegun: the Gatling gun. The Gatling gun was a weapon in which, through a manually operated mechanism, a number of barrels could be loaded, fired and reloaded. The barrels were placed in a cluster rotating around a central axis.

The Gatling gun was not a machinegun in the narrow sense of the word as we use it today. Because the operation of the weapon was effected by manually cranking a handle, the Gatling gun should be considered an extreme form of repeating firearm rather than a machinegun. It is sometimes referred to as a "mechanical machinegun". Such weapons can only be called real machine guns when they are fitted with electric or hydraulic motors, making it possible to operate them by simply pushing a button. This kind of weapon did not come into use until 1956.

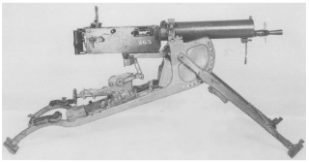


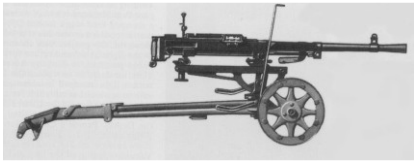
The model 1873 Gatling gun

The first true machine gun was developed by Hiram maxim in 1884. It was a weapon that used the recoil of the firing cartridge to extract the cartridge case, feed a fresh round from a cloth belt into the barrel and fire it. The Maxim 1884 used a flywheel to store the energy to operate the mechanism. During testing, though the design functioned, one of the biggest drawbacks showed itself: the enormous amount of smoke the weapon produced and the fouling of the mechanism. This would make use in a military situation very impractical. Still, a limited number of these weapons were sold to the military.

The grandfather of all machineguns: the prototype Maxim model 1884

The development of smokeless powder suddenly made the machine gun a practical weapon. After the appearance of smokeless powder a large number of machine gun designs were introduced in a very short time. Machine guns of different construction were being developed and put into production in many of the larger nations of the world, each country supporting their own companies like Browning and Colt (USA), Vickers (England), Skoda (Austria), Madsen (Denmark) and Hotchkiss (France). At the beginning of the First World War all armies had a number of machine guns in their inventories and, next to the artillery, the machine gun was a primary factor in shaping the nature of battle of that war. Technical developments of the machinegun were, from that point on, mainly aimed at making the weapon more flexible, more portable and easier to produce.





Machineguns of the twentieth century: a German Spandau from 1908, a Russian Goryunov from 1943 and a Belgian MAG from 1958. The basic principles have hardly changed since smokeless powder was introduced.

It should be noted that, when reference is made to “machine guns”, only one group of weapons is meant. This is the group of heavy weapons that has a mechanism that continues to operate as long as the trigger is pulled and the ammunition supply lasts. Often, in order to stress this fact, a machine gun is called a “full-automatic” weapon. A weapon that fires only one shot every time the trigger is pulled is called a “semi-automatic” weapon.

Semi-automatic firearms

Machine guns were relatively heavy weapons. Up to this point in time most developments in firearms technology had started with the typical infantry weapon: the rifle. It is indicative for the technological problems the new, powerful powder posed that the next important development was not connected with the infantry rifle but with the other side of the spectrum, the pistol.

The revolver had reached maturity by the late 1880's. No dramatic developments have taken place since then. The semi-automatic pistol was the new development. This development went hand in hand with the development of handgun cartridges using the new powder. There are no black powder semi-automatic pistols. The first reliably functioning, semi-automatic pistol was made by Hugo Borchardt in Germany. It was a design based on the Maxim machinegun and rather bulky and cumbersome. It used a bottleneck cartridge loaded with smokeless powder and had a locking system with a toggle mechanism. The weapon was too big to be practical but was soon succeeded by its most famous descendant: the Luger pistol.

The first semiautomatic pistol: the Borchardt model 1893

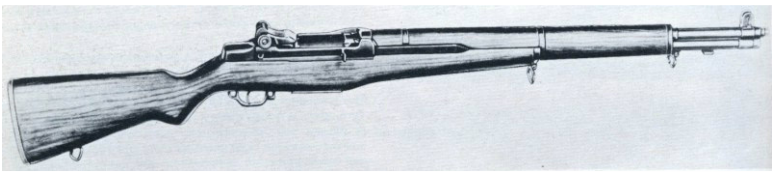
The Colt model 1911 pistol
in 1911 (left) and now (right)
The details have changed,
the basic principles stayed the same

The first semi-automatic pistol to be produced in really large numbers was the Mauser model 1896. It was a much better and more reliable design than the Borchardt. In the United States John M. Browning developed a system in which a tilting barrel was used as a locking system and after some development this type of pistol was accepted by the United States army as the model 1911. This weapon is still, in virtually unmodified form, in use all over the world.

The first semi-automatic rifle to be produced in significant numbers was, interestingly enough, a .22 rimfire made by Winchester in 1903. It was meant for the civilian market for pest control, hunting and plinking. In 1905 the same company introduced a semi-automatic rifle firing a centre fire cartridge of relatively low power.

Two firsts for Winchester: on top the model 1903 semiautomatic carbine in calibre .22 long rifle rimfire
below the model 1905 semiautomatic carbine in the medium power calibre .32 Winchester centerfire

Though Madsen in Denmark introduced a semi-automatic rifle firing a full power rifle cartridge in 1896, the first one to see any military action was a 1908 Mexican designed rifle built in Switzerland, the Mondragon. This weapon saw very limited service in the First World War and was used as armament in aeroplanes because it was too delicate to be used in the trenches. Between the two world wars a number of semi-automatic rifles were developed but very few countries adopted any for their armies. Even in the Second World War only the armies of the United States and the USSR were (partially) equipped with semi-automatic rifles; the others used bolt-action rifles based on designs from the end of the nineteenth century.

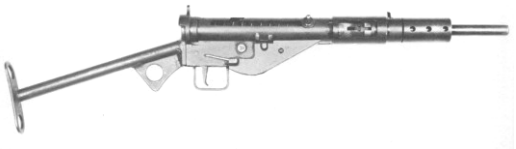


The Garand M1, calibre .30. One of only two full power semi-automatic rifles to be used in larger numbers during the Second World War

It should be noted that, apart from the very first Maxim 1884 machineguns, there are no full- or semi-automatic firearms for black powder cartridges. Also, apart from very recent developments, there are no such weapons for cartridges other than those with rimfire ignition in calibre .22 and with centrefire ignition.

Full automatic shoulder weapons, the submachinegun and the assault rifle

During the trench warfare of the First World War a new class of weapons saw the light that was particularly suited for use in confined spaces. It was the submachinegun: a full-automatic carbine firing pistol cartridges. This weapon was to become the most important infantry weapon next to the rifle. It was further developed between the wars but it was only during the Second World War that it received the form that we know today, in weapons like the English Stengun, the German MP 40 and the American M3 "Grease gun".



The British Stengun Mk 2

The world's first assault rifle: The German Sturmgewehr 44

A class of weapons that could be considered a cross between the full power rifle and the submachinegun is the assault rifle. The concept was developed in Germany around 1942 and comprised a short rifle firing a medium power cartridge and capable of full-automatic fire.

This capability of full-automatic fire is the essential property of the assault rifle. The concept culminated in the Sturmgewehr 44, a weapon that can be considered the father of all modern assault rifles like the Colt M 16 and the Kalashnikov AK 47.

The world's most famous assault rifle: The Russian Kalashnikov AKS 47

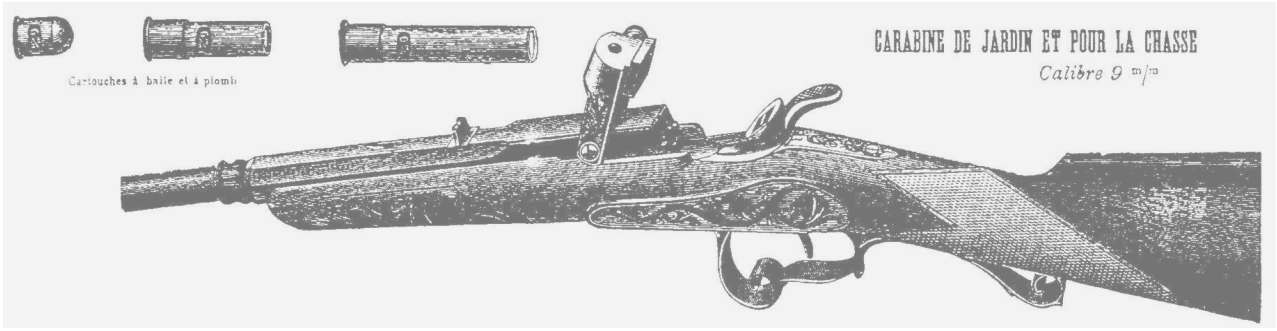
It cannot be said that, since the First World War, no new firearms have been developed. It is very true however that most of the weapons that are in use today are based on designs that first appeared in the years between the introduction of smokeless powder and the first world war. Modern bolt-action rifles are based on the Mauser 98, Steyr 95 and Lee Enfield designs, modern machineguns are based on many designs from that period. The Colt 1911 pistol is even still in use. Materials have changed. Plastic and aluminium have been introduced, together with precision casting techniques, welding and other mass production methods. Magazine capacities have increased. The basic principles of the functioning of the weapons have, however, stayed the same.

Names, numbers and markings

Firearms production was not always as strictly regulated as it is today. For a long time firearms were considered nothing more than a tool necessary for hunting or making war. The fact that firearms were very expensive to produce limited the possession of them to the upper classes and governments of states. In case of war firearms were sometimes issued from state arsenals to the drafted soldiers. In certain places firearms were banned by local- or state law. This generally was meant to preserve the power of the government or the ruling classes. A typical example is Japan where firearms were banned in order to preserve the prominent position of the samurai.

The Winchester model 1866, used extensively in the American West

Because there were few rules concerning the possession of firearms and because they were produced (before the industrial revolution) by many local gunsmiths, hardly ever serial numbers were placed on those weapons. Also, records of production were not kept by those gunsmiths, though often they did sign their weapons with their names. It was only after the revolution in Russia that European governments, out of fear for a revolution in their own country, started a large scale ban on- or registration of firearms. Even then certain firearms (particularly hunting weapons) were exempt from those regulations and did not have to be registered. In the USA even today few firearms are registered and up to the nineteensixties some firearms did not even have serial numbers.



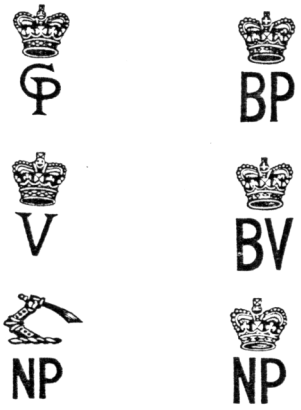
Hunting weapons were produced by many local gunsmiths.. Very few have any identifiable markings, from which maker, production year or model could be identified, though most firearms produced in Europe carry proofmarks.

This all makes it very difficult to find out when exactly a particular weapon was produced. Of military weapons it is generally known when a certain model was introduced and often records have been kept on the production- and serial numbers. Even these records, however, are rarely complete and have sometimes been lost due to wars being fought over the territory where the records were being kept. Much information about the production of arms in Liege, Belgium was destroyed during the two world wars that were fought in that area.

Of civilian firearms much less information is available, particularly because there were so many gunsmiths who, in total independence of each other, could design and build firearms. It is rarely known exactly who designed a certain weapon and at what point in time. Also these individual gunsmiths often continued, on requests of customers, to produce weapons that had been rendered obsolete by new designs.

Proofmarks

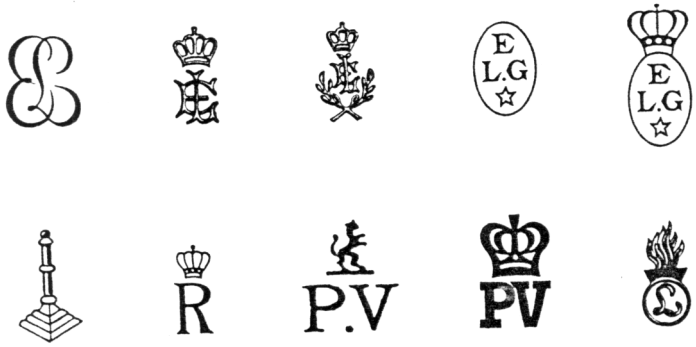
In a number of European countries laws are in place that are to guarantee the quality of the firearms produced, in the interest of public safety. These laws proclaim that every firearm has to be inspected by a government-approved organisation (a "proof house") before being released for sale. Such an inspection includes a visual check and the firing of the weapon with a so-called proof load. This proof load is a powder charge that produces pressures well above the pressures the weapon is designed for. If the weapon survives the proof firing it is considered safe. The fact that a firearm has undergone proof firing is indicated by a marking or stamp on the weapon put there by the representative of the proof house.



Examples of British proofmarks. NP stands for "nitro powder"

Examples of German proofmarks. The N stands for "nitropulver": smokeless powder.

The introduction of smokeless powder, with its high pressure, made proofing the weapons even more important as it was necessary to be able to see whether a weapon could safely be fired with this new powder. All countries that had (and have) proof laws in place introduced special markings to indicate "smokeless proof". These countries include Belgium, England, France, Italy, Germany, Austria and Spain, the main firearms producers in Europe. The USA does not have proof laws, though some companies proof fire the weapons themselves and mark them as such.



Examples of Belgian proofmarks. PV stands for "poudre vive": smokeless powder

A British pepperbox made around 1829 by Budding. The barrels have black powder proofmarks of the proofhouse in Birmingham

Credits

The pictures used in the preceding pages come from a number of sources. Per page those are, from top to bottom, left to right.

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5	PF, RM, PF, PF	14	A, A
6	RH, RH	15	FA, A, PW
7	RM, RM, DB	16	IVH, RK, RK, FN
8	RH, GP, FM, B&B	17	B&B, B&B, AH
9	HCL, RM	18	RK, RK, DWJ, RK
10	HCL, HCL, HCL	19	B&B, A
		20	DWJ, PF

The abbreviations stand for:

FA: Galerie Fischer, Luzern, Switzerland
IVH: Ian V. Hogg, Great Britain
DWJ: Deutsches Waffen Journal, Swäbisch Hall, Germany
RM: Roman Matuszewski, Muzeum Wojska Polskiego, Warsaw, Poland
HLP: Harold L. Peterson, USA
PF: Peter Finer, Morton-on-Marsh, Great Britain
RH: Robert Held, Certaldo, Italy
DB: David Buehn, Los Angeles, USA
GP: Gregory Pedlow, Mons, Belgium
FM: Frederick Myatt, England
B&B: Butterfield & Butterfield, San Francisco, USA
HCL: Hershel C. Logan, USA
KG: Kristopher Gasior, Fredericksburg, USA
FA: Frontier Americana, West Palm Beach, USA
PW: Paul Wahl, USA
FN: Fabrique Nationale, Herstal, Belgium
AH: American Handgunner Magazine, San Diego, USA
RK: Rudy H. G. Koster, Amsterdam, the Netherlands

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