# CHAPTER 1

# FIREARM

OBJECTIVES:

- To know the different types of firearm
- To know what is the mechanism of an firearm
- To know the role of firearm in ballistics

## Brief History of Firearms

The earliest type of handgun was simply a small cannon of wrought iron or bronze, fitted to a frame or stock with metal bands or leather thongs. These weapons were loaded from the muzzle end of the barrel with powder, wad and ball. A small hole at the breech end of the barrel, the *touch hole*, was provided with a pan into which *a priming charge* of powder was placed. On igniting this priming charge, either with a hot iron or lighted match, fire flashed through the touch hole and into the main powder charge to discharge the weapon.

These early weapons could have been little more than psychological deterrents being clumsy, slow to fire and difficult to aim. In addition, rain or damp weather had an adverse effect on the priming charge making it impossible to ignite.

Their first reported use is difficult to ascertain with any degree of certainty, but a number of instances are reported in Spain between 1247 and 1311. In the records for the Belgian city of Ghent, there are confirmed sightings of the use of hand cannons in Germany in 1313. One of the earliest illustrations concern- ing the use of hand cannons appears in the fifteenth century fresco in the Palazzo Publico, Sienna, Italy.

The first recorded use of the hand cannon as a cavalry weapon appeared in 1449 in the manuscripts of Marianus Jacobus. This shows a mounted soldier with such a weapon resting on a fork attached to the pommel of the saddle. It is interesting to note that the use of the saddle pommel to either carry or aim

## Early hand cannon

The hand guns could be the origin of the word ‘pistol’, the early cavalry word for the pommel of the saddle being ‘pistallo’.

Combinations of the battle axe and hand cannon were used in the sixteenth century, and a number of these can be found in the Tower of London. One English development of this consisted of a large mace, the head of which had a number of separate barrels. At the rear of the barrels, a concealed chamber containing priming powder led to all the barrels. When the priming compound was ignited, all the barrels discharged at once.

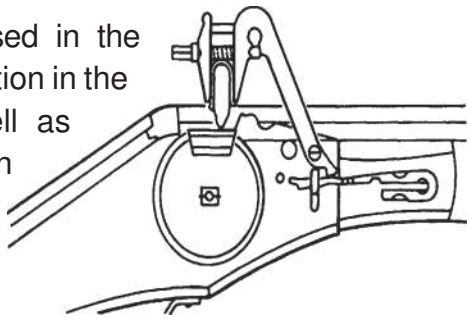
## The matchlock

This was really the first major advance in pistols as it enabled the weapon to be fired in one hand and also gave some opportunity to aim it as well.

The construction of the matchlock was exactly the same as the hand cannon in that it was muzzle loaded and had a touch hole covered with a priming charge. The only difference was that the *match*, a slow-burning piece of cord used to ignite the priming charge, was held in a curved hook screwed to the side of the frame. To fire the gun, the hook was merely pushed forward to drop the burning end of the match into the priming charge. As these weapons became more sophisticated, the curved hook was embellished and took on the form of a snake and became known as the weapon’s *serpentine*.

Eventually, the tail of the serpentine was lengthened and became the forerun- ner of the modern trigger. Further refinements included the use of a spring to hold the head back into a safety position. The final refinement consisted of a system whereby when the tail of the serpentine was pulled, the match rapidly fell into the priming compound under spring pressure. This refinement, a true trigger mechanism, provided better ignition and assisted aiming considerably

### *The wheel lock*



With the advent of the wheel lock the lighted match used in the matchlock was no longer necessary. This important innovation in the field of firearms design made ambush possible as well as making the firearm a practical weapon for hunting. When fired from the shoulder, the wheel lock was often referred to as an ***arquebus*** from the shape of the butt which was often curved to fit the shoulder.

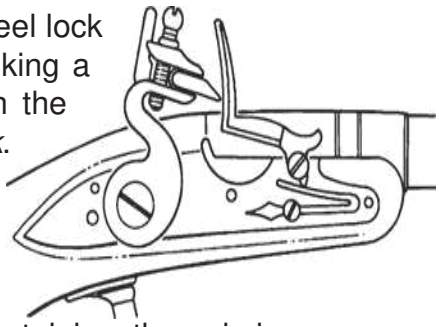
Another name, strictly only for much heavier calibre weapons, was the ***hacque****-but*, which literally means '**gun with a hook'**. This referred to a hook projecting from the bottom of the barrel. This hook was placed over a wall, or some other object, to help take up the recoil of firing.

In its simplest form, the wheel lock consisted of a serrated steel wheel, mounted on the side of the weapon at the rear of the barrel. The wheel was spring-loaded via a chain round its axle with a small key or spanner similar to a watch drum.When the wheel was turned with a spanner, the chain wound round the axle and the spring was tensioned. A simple bar inside the lockwork kept the wheel from unwinding until released with the trigger. Part of the wheel protruded into a small pan, the *flash pan or priming pan*, which contained the priming charge for the touch hole. The serpentine, instead of containing a slow-burning match, had a piece of iron pyrite fixed in its jaws. This was kept in tight contact with the serrated wheel by means of a strong spring. On pressing the trigger, the bar was withdrawn from the grooved wheel which then turned on its axle. Sparks produced from the friction of the pyrite on the serrated wheel ignited the priming charge which in turn ignited the main powder charge and fired the weapon.

### *The snaphaunce*

The **snaphaunce** first appeared around **1570**, and was really an early form of the flintlock. This mechanism worked by attaching the flint to a spring-loaded arm. When the trigger is pressed, the cover slides off the flash pan, then the arm snaps forward striking the flint against a metal plate over the flash pan produc- ing sparks to ignite the powder.

***The flintlock***



The ignition system which superseded that of the wheel lock was a simple mechanism which provided a spark by striking a piece of flint against a steel plate. The flint was held in the jaws of a small vice on a pivoted arm, called the *cock*. This was where the term to '**cock the hammer'** originated.

The steel, which was called the **frizzen**, was placed on another pivoting arm opposite the cock, and the pan containing the priming compound was placed directly below the frizzen.

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- ***Miquelet*** – a weapon with the mainspring outside the lockplate, but with a frizzen and priming pan cover all in one piece. In this lock type, the pan cover was automatically pushed out of the way as the flint struck the frizzen.
- ***True flintlock*** – a weapon with a mainspring inside the lock plate and with the frizzen and priming pan cover in one piece. This also had a half-cock safety position enabling the weapon to be carried safely with the barrel loaded and the priming pan primed with powder. This system was probably invented by Mann Le Bourgeoys, a gunmaker for Louis XIII of France, in about 1615.

***The percussion system***

The flintlock continued to be used for almost **200 years** and it was not until 1807 that a Scottish minister, **Alexander John Forsyth**, revolutionized the ignition of gunpowder by using a highly sensitive compound which exploded on being struck. This compound, *mercury fulminate*, when struck by a hammer, produced a flash strong enough to ignite the main charge of powder in the barrel. A separate priming powder and sparking system was now no longer required With this invention, the basis for the self-contained car- tridge was laid and a whole new field of possibilities was opened up.

Once this type of ignition, known as ***percussion priming***, had been invented, it still took some time to perfect ways of applying it. From 1807 until 1814, a wide range of systems were invented for the application of the percussion

***The pinfire system***

Introduced to the United Kingdom at the Great Exhibition in London in **1851** by **Lefaucheux,** the pinfire weapon was one of the earliest true breech-loading weapons using a self-contained cartridge in which the propellant, missile and primer were all held together in a brass case.

In this system, the percussion cup was inside the cartridge case whilst a pin, which rested on the percussion cup, protruded through the side of the cartridge case. Striking the pin with the weapon's hammer drove the pin into the priming compound causing it to detonate and so ignite the main propellant charge

The pinfire was at its most popular between **1890** and **1910** and was still readily available in Europe until 1940. It had, however, fallen out of favour in England by 1914 and was virtually unobtainable by 1935.

***The rimfire system***

Whilst the pinfire system was a significant step forward, it did have a number of drawbacks, not least of which was the propensity of the cartridge to discharge if dropped onto its pin. This problem was all but eliminated by the rimfire which, like the pinfire, was exhibited at the Great Exhibition in 1851.

The **rimfire cartridge** is a thin-walled cartridge with a hollow flanged rim. Into this rim is spun a small quantity of a priming compound. Crushing the rim with the firing pin causes the priming compound to explode, thus igniting the propellant inside the case.

The initial development of this system was made by a Paris gunsmith, **Flobert**, who had working examples of it as early as **1847.**

It was, however, some time before it gained acceptance, and it was not until 1855 that Smith and Wesson manufactured the first revolver to fire rimfire cartridges. This was a hinged-frame 0.22□ calibre weapon in which the barrel tipped up by means of a hinge on the top of the frame. This enabled the cylinder to be removed when loading and unloading the weapon.

***The Dreyse needle fire rifle***

The **Dreyse needle gun** was a military breech-loading rifle, famous as the main infantry weapon of the Prussians, who adopted it for service in 1848 as the Dreyse Prussian Model 1848.

Its name, the needle gun, comes from its needle like firing pin, which passed through the cartridge case to impact a percussion cap glued to the base of the bullet.

The Dreyse rifle was the first breech-loading rifle to use the bolt action to open and close the chamber, executed by turning and pulling a bolt handle.

The Dreyse rifle was invented by the **gunsmith Johann Nikolaus von Dreyse (1787–186**7) and was first produced as a fully working rifle in 1836. From 1848 onwards, the new weapon was gradually introduced into the Prussian service, then later into the military forces of many other German states. The employment of the needle gun radically changed military tactics in the nineteenth century.

***The centre fire system***

This was the great milestone in weapon and ammunition development. In centre fire ammunition, only the primer cup needed to be soft enough to be crushed by the firing pin. The cartridge case could thus be made of a more substantial material which would act as a gas seal for much higher pressures than could be obtained with rimfire ammunition.

***Rifling***

**Rifling** is the term given to the spiral grooves cut into the bore of a barrel which impart a stabilizing spin to the bullet. This spin keeps the bullet travelling in a point-first direction and lessens any tendency for it to depart from its straight line of flight. As such, this was a very significant event in the evolution of firearms.

Some writers assign the invention of spiral-grooved barrels to Gaspard Kollner, a gunmaker of Vienna, in the fifteenth century. Others fix the date at 1520 and attribute it to Augustus Kotter of Nuremberg.

German weapons bearing the coat of arms of the Emperor Maximilian I and made between 1450 and 1500 have spiral-grooved barrels and are in fact the earliest identifiable rifled guns.

***Rifling twist rate calculation***

One of the first persons to try to develop a formula for calculating the correct rate of twist for firearms was George Greenhill, a mathematics lecturer at Emmanual College in Cambridge, England.

His formula is based on the rule that the twist required in calibres equals 150 divided by the length of the bullet in calibres. This can be simplified to

Formula: $$\text{Twist} = 150 \times D^2/L$$

where ***D* = bullet diameter in inches** and ***L* = bullet length in inches.**

$$\text{Rifling Twist Rate Required} = CD^2/L \times \sqrt{SG}/10.9$$

**Rifling twist necessary to stabilize various calibers.**

| Caliber | Twist rate required |
|---|---|
| 0.22 Short | 1 in 24″ |
| 0.22 Long rifle | 1 in 16″ |
| 0.223 Remington | 1 in 12″ |
| 0.22-250 Remington | 1 in 14″ |
| 0.243 Winchester | 1 in 10″ |
| 6 mm Remington | 1 in 9″ |
| 0.25-0.6 Remington | 1 in 10″ |
| 0.257 Weathersby Magnum | 1 in 10″ |
| 6.5 × 55 Swedish Mauser | 1 in 7.5″ |
| 0.260 Remington | 1 in 9″ |
| 0.270 Winchester | 1 in 10″ |
| 7 mm-0.8 Remington | 1 in 9.25″ |
| 7 mm Remington Magnum | 1 in 9.25″ |
| 0.30 Carbine | 1 in 16″ |
| 0.30-30 Winchester | 1 in 12″ |
| 0.308 Winchester | 1 in 12″ |
| 0.30-0.6 Springfield | 1 in 10″ |
| 0.300 Winchester Magnum | 1 in 10″ |
| 0.303 British | 1 in 10″ |
| 0.357 Magnum | 1 in 16″ |
| 0.357 Sig Saner | 1 in 16″ |
| 0.380 Automatic Colt Pistol | 1 in 10″ |
| 9 mm Parabellum | 1 in 10″ |
| 0.40 Smith & Wesson | 1 in 15″ |
| 0.45 Automatic Colt Pistol | 1 in 16″ |
| 0.444 Marlin | 1 in 38″ |
| 0.45-70 Government (US) | 1 in 20″ |

Whilst it is of little circumstance, the question as to the revolutions made per minute by the bullet has been asked on several occasions. The formula for cal- culating this is as follows:

$$\frac{MV\ x\ 720}{Twist\ rate\ in\ Inches}$$

**For example:**

9 mm PB bullet at 1200 fps fired in a barrel with a 1 in 10 twist rate will have a rotational speed of 1200 □ 720/10 = 86 400 rpm

0.223□ bullet at 3000 fps fired in a barrel with a 1 in 12 twist rate will have a rotational speed of 3000 □ 720/12 = 180 000 rpm

***The revolver***

A **revolver** is a weapon with a revolving cylinder containing a number of firing chambers (basically a revolving magazine) which may be successively lined up and discharged through a single barrel.

In the long history of revolvers, no name stands out more strongly than that of **Samuel Colt**. But as we have seen earlier, Colt did not, despite his claims to the contrary, invent the revolver.

The earliest forms of the revolver include **a snaphaunce revolver** made in the days of **King Charles I**, said to have been made before **1650** and an even earlier weapon made during the reign of **Henry VIII** some time before **1547.**

***Self-loading pistols***

The principle of the self-loading pistol was grasped long ago, but without the necessary combination of a self-contained **cartridge**, **smokeless propellant** and **metallurgical advances**, it was not possible to utilize the principles involved.

It is reported in Birche's History of the Royal Society for **1664** that a mechanic had made a claim of being able to make a pistol which could '**shoot as fast as presented and stopped at will'.**

Whilst patent records from 1863 show numerous attempts to develop a self-loading pistol, it was not until 1892 that the first successful weapon appeared. This was a weapon patented by the Austrian Schonberger and made by the company Steyr. It was a blowback design and was made for the 8 mm Schonberger, a very powerful cartridge

***Bolt action Rifle***

In **bolt-action weapons**, a turning bolt slides in an extension to the barrel, which is basically the same system as in a turn bolt used to lock a door. Pushing the bolt forward brings the bolt face into battery with the breech end of the barrel and cocks the striker (or firing pin). Turning the bolt then locks it into place via bolt lugs engaging with slots in the barrel extension. Other bolt-action weapons cock the striker on the opening of the bolt Straight-pull bolt actions also exist in which the rotary motion required to turn the bolt locking lugs into their recesses is applied by studs on the bolt which slide in spiral grooves cut into the barrel extension.

***Self-loading rifles.***

**Self-loading rifles** are, with the exception of the lowest power weapons, of the locked-breech type.

These are generally very similar to those used in locked-breech pistols, but of a much stronger design to cope with the higher pressures involved

**There are basically two types of self-loading rifle action:**

- ***Short recoil*****,** in which the bolt and breech block are only locked together for about 0.75□ of rearward travel before unlocking. It then operates as a normal self-loading pistol.
- ***Long recoil*****,** in which the barrel and breech block are locked together for the full distance of the recoil stroke. After reaching the end of its travel, the barrel is then unlocked and pushed forward by spring action ejecting the spent cartridge during its forward motion. When the barrel is fully forward, the breech

***Pump action.***

In pump-action weapons (sometimes also referred to as *slide action*), the breech block is attached, via operating rods, to a moveable fore-end. On pulling back the fore-end, the mechanism locking the breech block to the barrel is released. By pulling the fore-end to the rearmost extent of its travel then pushing it forward, the empty cartridge case is ejected, a fresh round is loaded into the chamber and the action is cocked

***Shotguns***

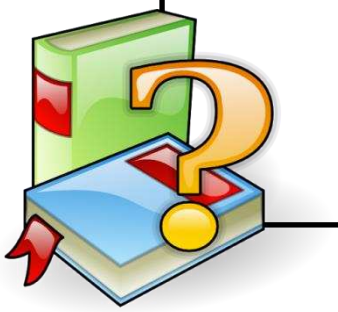
**Shotgun actions** are basically the same as those found in rifles, with single/ double-shot weapons with barrels hinged to the frame for loading/unloading bolt action, self-loading and pump-action. Barrels can be either positioned one on top of the other, over and under or 'superposed' or 'side by side'.


In the smaller calibres, that is, 0.22□, 9-mm and 0.410□, double-barrelled shot pistols are occasionally encountered.

Shotgun/rifle combinations are popular in Europe and can consist of one shotgun barrel and one rifle barrel (*vierling*), two shotgun barrels with one rifle barrel (*drilling*) or two rifle barrels and one shotgun barrel (also called *a drilling*).

Reference:

Firearm and Ballistics by B, J Heard



Video Link:

https://youtu.be/EjQrhDKDWFk

https://youtu.be/ZbV3jkgaEek

https://youtu.be/cGbV8hp0pqU