

Basic Muzzle Loader Technology

By: Paul S. Williams (gammahammer@yahoo.com)

Source material from: www.traditionsfirearms.com

Firearms Technology

Firearms are basically simple devices that operate in a similar manner to an internal combustion engine. All firearms rely on pressure generated by the controlled burning of a fuel (gunpowder) to propel a relatively light weight piston (bullet) forward at high velocity. Like all technologies, the simple concepts that are utilized become somewhat more complex in actual implementation, however not to an extent that the machine can't be easily understood by taking a view of each component in turn and then combining them together to form a system. A Basic Gun

The simplest gun possible is the medieval muzzle loading "hand cannon." This gun consists of cylindrical tube that is closed at one end and open at the other, with a small-diameter hole drilled into the closed end.

The operation of such a gun is quite simple. First, it must be loaded by pouring a charge of powder into the muzzle and then placing a projectile over the powder charge. The barrel is then pointed at the target and the powder charge is manually ignited by placing a hot wire or other heat source directly into the powder charge. This causes the powder charge to burn rapidly and generate a large volume of gas behind the projectile. This gas exerts considerable pressure on the projectile, which in turn accelerated out the barrel and flies to the target. It is interesting to note that this basic principle of operation has survived intact from the most primitive "hand cannons" of the 1500s to the most modern electrically-fired 6-barrel electrically operated cannons such as the M-61 20mm canon mounted on the F-16 fighter plane!

Ignition Methods

Considerable refinement has been done to the basic gun since its invention. The earliest refinement added was to add a pivoting arm to hold a slowly burning match. This permitted the user of the weapon more freedom of movement, as it was no longer necessary to be near a fire to heat the ignition wire immediately before plunging it into the powder charge. It also made aiming the gun considerably easier. However, these matchlocks still had disadvantages. The first was the necessity of having burning material in close proximity to the bulk powder used to load the gun. The second is the need to constantly attend to the match to ensure that it is properly positioned and lit. Therefore, such a gun can not be kept in a state of constant readiness. Also, for night time operation, the glow of the burning matches would give away the position of troops and made surprise attacks far more difficult to execute.

In order to overcome these limitations, new ignition methods were invented. In turn, these are the Wheel Lock, Flintlock, and Percussion, and Electrically Fired Primer methods.

Wheel Lock

The wheel lock operates in a manner similar to the common butane lighter. In a wheel lock, a steel wheel is held in place against spring pressure, and a piece of flint is held in contact with it. Near the flint is a small pan containing gunpowder and a flash hole connecting the pan with the main powder charge in the barrel. When the trigger of a wheel lock is pulled, the wheel is

released and is spun by the spring. The flint then sends a shower of sparks into the pan and ignites the priming charge. The flame from the priming charge passes through the flash hole and ignites the main powder charge. Such a design has many advantages over the earlier match lock, as the weapon could be kept ready for immediate action and there was no need to keep a lit match near bulk powder. However, such mechanisms were very expensive and difficult to produce, and somewhat prone to failure.

Flintlock

The cost and delicacy of the wheel lock lead to the invention of the flintlock. A flintlock uses a piece of flint held in a hammer. The hammer moves in an arc and strikes a steel frizzen to produce sparks that ignite the priming charge. The priming charge doesn't ignite the main charge instantly in this design, rather there is a slight delay accompanied by a somewhat brilliant flash in the priming charge's pan before the main charge fires. This makes flintlocks somewhat more difficult to shoot accurately than more modern designs.

Flintlocks were far simpler and easier to produce than wheel locks, and were widely adopted and used for over 200 years. Indeed, flintlocks are still produced to this day and used in special hunting seasons in many states.

Percussion Ignition (Caplock)

While flintlocks were a huge improvement over both the wheel lock and matchlock systems, they were still susceptible to misfires due to worn flints and frizzens, plugged flash holes, and dampness in the priming charge. They also had a small, distracting, time delay between the flash of the priming charge and the ignition of the main charge. Advances in chemistry in the 19th century resulted in the discovery of explosives that detonated when struck with a sharp blow.

These newly discovered chemicals were incorporated into a percussion caps. These caps contained a small quantity of a percussive explosive inside a small metal cup that fit over a hollow nipple attached to the breach of a gun barrel. The first guns to use these caps were modified flintlocks where the frizzen was replaced with a nipple and the hammer modified slightly to simply strike a blow to the cap.

When hit by the hammer, the explosive mix in the cap detonated and sent a hot flame through the nipple and into the powder charge, which then ignited. This process is nearly instantaneous, as opposed to delays of up to a few hundredths of a second for all of the preceding ignition techniques. This resulted in a gun that fired as soon as the trigger was pulled.

Percussion caps also greatly reduced the chances of misfires. The percussive mixture in the cap could be sealed against moisture, and the tightly-fitting cap reduced the chance that water could contaminate the main powder charge. The caps were also much faster to install than pouring a small charge of powder into a flintlock's flash pan. A final advantage of the caplock system is that it eliminated the distracting priming charge flash of the flintlock design and made firearms using this system easier to shoot accurately.

Percussion ignition was originally used in muzzle loaded firearms, but the principle permitted the introduction of breach loading firearms and cap-and-ball revolvers. Most modern small arms still use the percission ignition system, although nowadays the cap is fixed in a cartridge

that is inserted into the firing chamber as a pre-assembled unit consisting of a primer, powder charge, bullet, and casing.

Muzzleloading Firearms

All of the preceding firearms are called "muzzleloaders," as they are loaded by first pouring a charge of powder down the barrel, then seating a projectile over it with a ramrod. Naturally, this is a slow and somewhat tedious process (especially when trying to reload during a battle with enemy bullets being fired at the person trying to accomplish the task!). This slow loading process actually determined the order of battle for centuries, where armies would first engage with an exchange of canon fire, followed by massed troops in formation or on horseback approaching one another and firing one or two volleys per rank (row) of soldiers, with the outcome of the battle determined by fighting with swords and bayonets.

The vast majority of firearms prior to the introduction of percussion ignition were smooth-bored muskets. A musket design has more in common with a modern shotgun than a rifle.