Primers and Firing Mechanisms

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Primers

When a cannon has been loaded with powder and projectile, the final step is to fire the gun by igniting the powder. This was not always as simple as it might seem. The earliest cannon were probably fired from the muzzle; not too difficult with loosely fitting stone cannonballs. Either loose powder or a fuze could be used, but neither was very reliable, and both were dangerous because they placed the gunner at the muzzle of the gun at the time of firing.

The next step was to bore a hole from a depression cast into the top of the barrel to the powder chamber. This hole and depression could be filled with loose powder and ignited, first probably by a glowing coal, later by a slow match, and finally by portfire, a flammable compound one half inch in diameter wrapped in a paper. While the portfire represented a substantial improvement, wind or rain could still prevent the gun from firing.

The next step was the quill priming tube made from a feather quill with the larger end split and a cup formed with yarn. Powder, moistened with camphorated alcohol or spirits of wine, filled the quill around a thin wire. When the wire was withdrawn, it left a hole in the powder running the length of the tube, which produced almost simultaneous ignition down the tube. A strand of quick match and a paper cover were pasted on the top of the tube. This quill was fired by means of a lock mechanism and an explosive wafer laid on top of the quill. [Fig.1] Before the Civil War, the army produced a brass tube which functioned in the same manner as the quill. Several lock designs were used, the principal problem being to ensure that the blast did not destroy the lock.

The U.S. Navy did not adopt the army method, due to concerns about flying pieces of brass tube in the close confines of a man-of-war. For the same reason, the army often continued to use quills for casemated guns.

By the Civil War, most army cannon were fired by friction primers. A brass tube 1.75 inches long and 0.19 inches in diameter was filled with musket powder, its lower end sealed with wax. Near the upper end a second, smaller tube, filled with a friction composition, was inserted perpendicular to the main tube. A short serrated wire was pushed into the small tube, surrounded by the friction composition, a mixture of sulphuret of antimony and chlorate of potassa. In action, the long tube was inserted in the vent and a lanyard was attached to a loop at the end of the serrated wire. Pulling on the lanyard dragged the serrated wire through the friction composition, igniting it and therefore the musket powder below it, which in turn flashed down the vent and ignited the charge in the gun. [fig. 2](1)

In 1879, Lt. Col. J.M. Whitmore, at Frankford Arsenal, reported that friction primers suffered from the three faults: The brass “becomes rotten” when exposed to damp or salty air; the wax seal was sometimes forced out when the primer was warmed, either by storage in a warm place or being placed in a gun heated by firing; and forming the loop weakened the brass wire where the lanyard would be attached.

The last problem had been solved by simply altering the construction technique, the second one by substituting pasty shellac varnish for the wax. As a solution to the first problem, Whitmore recommended making the primers out of copper rather than brass. The small additional expense would be more than repaid by the greater lasting strength of the copper. He also recommended the adoption of copper for electric primers.(2)

In 1884, the chief of ordnance reported that with the firing of large charges in heavy guns, the rush of gases was damaging the vents, and some vent-sealing device was needed. The most logical answer was an obturating primer. In its simplest form, the obdurating primer screwed into the vent, and was therefore not blown out. Three types were to be tested at the proving ground: two models of friction primers "closely allied to the Krupp obturating friction primer," and an electric primer designed at the Frankford Arsenal.

That same year, Col. John Hamilton reported on an artillery practice conducted at the Narrows in New York Harbor, with 15 and 20-inch Rodman smooth-bore and 4 1/2-inch siege rifled guns. His detailed report described the use of Frankford Arsenal electrical primers, model of 1883, which he asserted to be "far more satisfactory than any others which I have seen used. . .," with not one failure to ignite the cartridge and fire the gun, even though the primer in the 20-inch Rodman was 20 inches from the cartridge. Hamilton emphasized the value of volley firing, which required "reliable primers of uniform resistance and sensitiveness," wired so as to be fired together. He recommended permanent wiring in place of the twin-conductor insulated wire reeled out for the practice. [fig. 3](3)

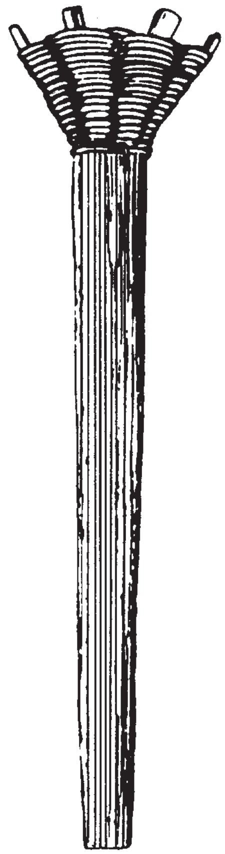
The electrical primers were fired by Laffin and Rand "exploders," probably designed for blasting work. One experimental model, on loan from the manufacturer, used a spring mechanism which was wound before firing. When a key was pressed, a detent was released and the spring drove the armature of a dynamo, generating current to fire the guns.

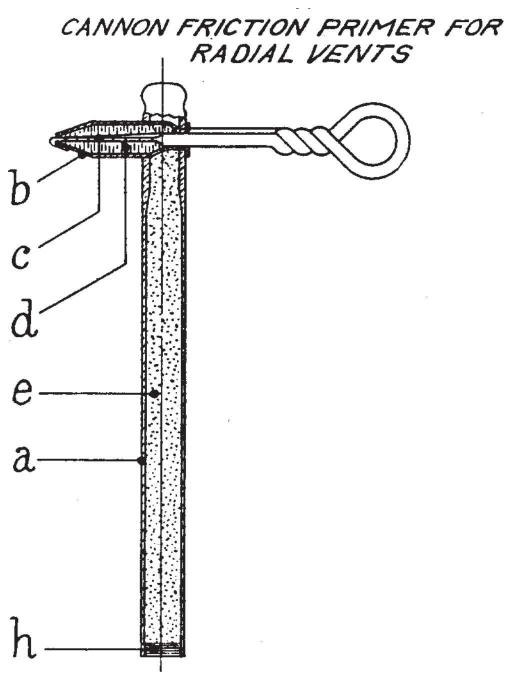
Although these exploders worked satisfactorily, Hamilton recommended a voltaic firing battery, because it ". . .may be arranged so that the guns may either be fired instantly upon the touch of a key, or it may still be arranged so as to fire at the expiration of a definite period after the firing-key is touched." Beyond that, he looked forward to "When, as will eventually happen, guns are worked by dynamo-electrical engines, such separate firing appliances will not be required."(4)

The next year, the chief of ordnance reported that the testing had given "fairly satisfactory results, at least with the friction primers," but the primers were not yet sufficiently perfected for issuance to the artillery.(5)

By 1886, satisfactory obturating primers, both friction and electric, had been developed. When fired, the blast forced the primers sealed, and screw threads kept the primers in the vent. An interrupted screw head worked well in large caliber guns, but for smaller guns, a smaller primer with a full screw head had been developed. The bodies of the primers were of brass, with heads flattened so that a wrench could be used to insert or remove the primer from the vent. A wire projecting from the end of the friction primer was twisted to form a loop for the lanyard, while a twisted pair of insulated wires emerged from the rear of the electric primers. [fig. 4](6)

During the next year, further testing of obdurating primers for breechloading cannon produced several recommendations. The Ordnance Board recommended a full, rather than interrupted, screw design, as well as rounding the edges of the threads. More seriously, the foil which sealed the end of the primer to retain the gunpowder sometimes dislodged in transportation or storage, allowing the powder to escape and rendering the primers useless. The board noted that the defective seal would have to be remedied, but did not suggest how.(7)





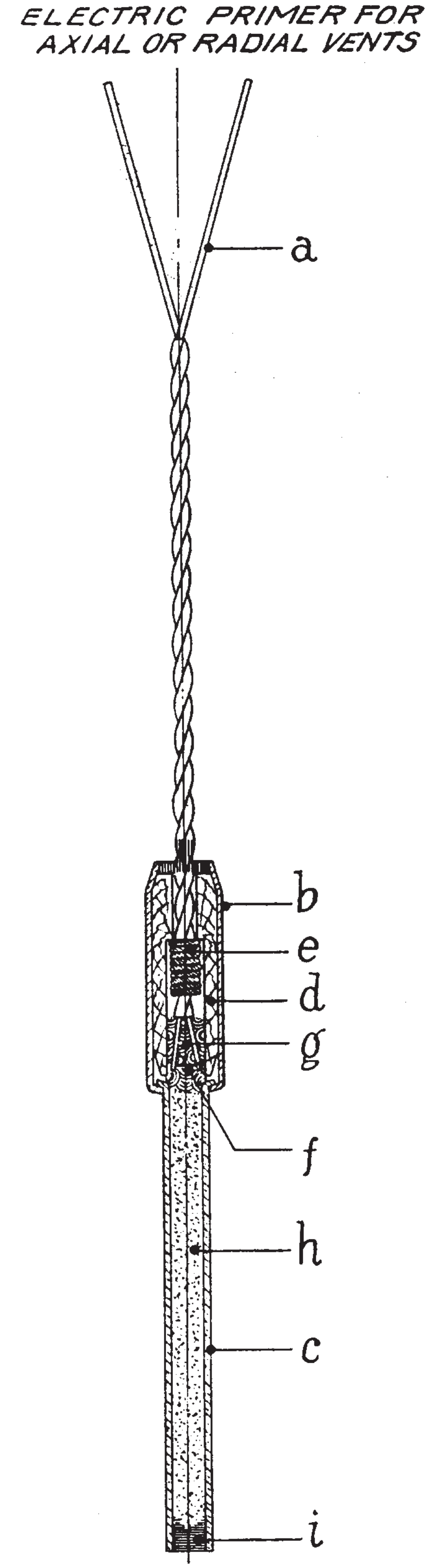


Fig. 1- (upper left) Quill priming tube (Warren Ripley, *Artillery and Ammunition of the Civil War,* p.231)
Fig. 2- (lower left)Non-obturating friction primer (*Primers for Use in Service Cannon*)
Fig. 3- (right) Non-obturating electric primer (*Primers for Use in Service Cannon*)

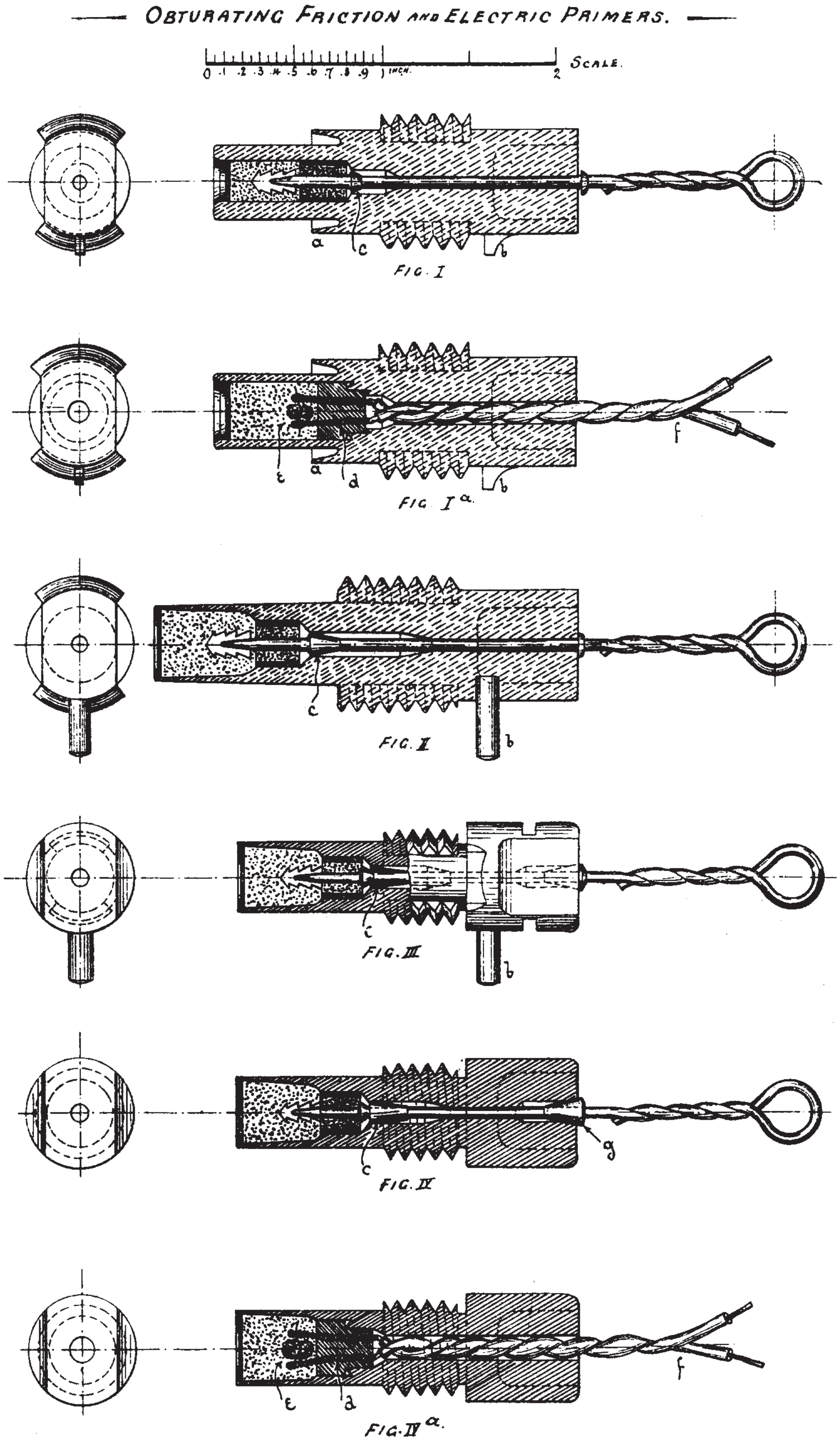


fig. 4-Screw-obturating friction and electric primers (ARCO, 1886, p. 248, Appendix 28, plate 1)

By 1891, electric primers were constructed with a coil of platinum wire, heated by the current passing through it, which in turn ignited a "wisp of gun-cotton." Electric primers allowed firing the gun from a distance, and also volley fire. Connecting the primers in series required more battery cells and might result in a more sensitive primer exploding first and opening the circuit. When wired in parallel, however, if a more sensitive primer fired first, it only increased the current passing through the remaining primers. If the battery was weak, the guns could be fired in a ripple fashion, resulting in a practically simultaneous volley.

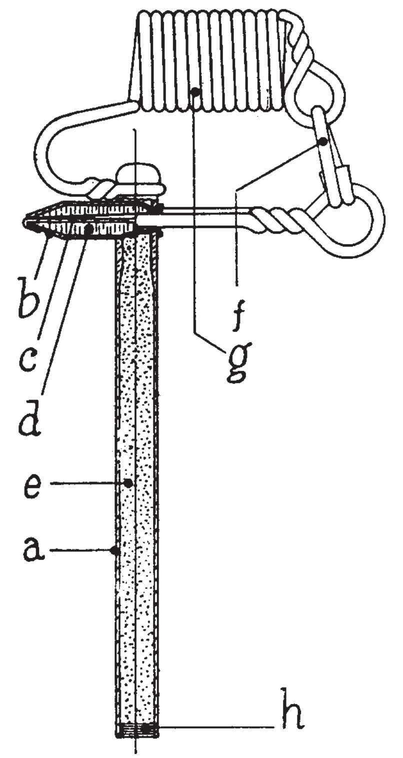
The standard friction primer remained non-obturating, since breechloading guns with axial vents had yet to be issued to the artillery. These were the same as those of the Civil War, except that for large guns, a pellet of compressed powder might be placed under the column of fine powder, so that it would be shot, burning, into the chamber. Since muzzle-loading cannon had radial vents, obturation was not essential, the primer being fired upward. Breechloading guns, however, required obturating primers to prevent the primer from being blown rearward, endangering the crew, and such designs were produced for test firings. [fig. 5](8)

In 1893, the friction primer was still non-obdurating for radial vents. It was charged with 10 grains of small arms powder, sealed by beeswax mixed with tar. The friction composition was made up of 52.74 parts of antimony trisulphide, 35.16 parts of chlorate of potash, 3.3 parts of gum arabic, 4.4 parts flower of sulphur, and 4.4 parts ground glass. Colonel Whitmore's recommendation must have finally found favor, as the primers were now made of copper, in place of brass. The wire loops were tested to withstand a 90-pound pull.(9)

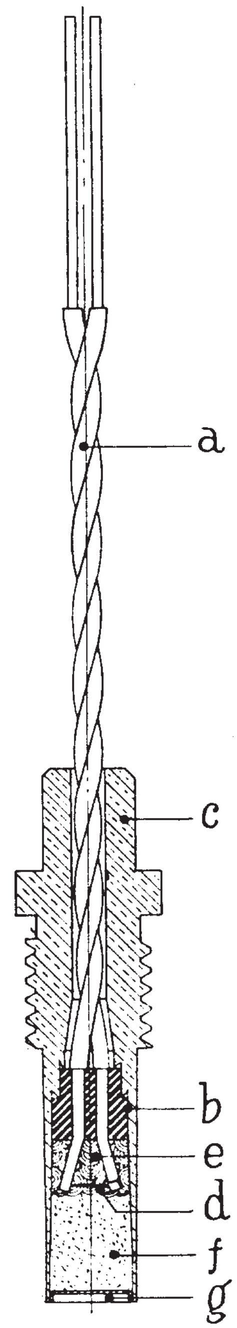
One improvement was made in the non-obdurating friction primers, in the interests of safety. A coil of wire was attached to the primer body and the lanyard, so that when the primer was expelled by the blast of firing, it remained attached to the lanyard and did not endanger the crew. First implemented in 1893, and improved three years later, this primer could be used with both radial and axial vents. [fig. 6]

Primers received little attention until the end of the decade, when the bulk of the breechloading heavy seacoast guns were placed in service and the shift to smokeless powder accelerated. In 1900, single-wire obturating electric primers were developed, and electric primers were provided for 5 and 6-inch rapid-fire guns. [fig. 7] The biggest advance, however, was the first development of obturating electric friction primers without screw threads.(10) The old primers had to be screwed into the spindle of the breech mechanism with a wrench and unscrewed after firing. This had become the most time consuming part of the gun drill, which was unacceptable. The solution lay in the development of a firing lock which would fit on the spindle and accept an unthreaded primer. This required both safety and certainty of action, and was not achieved immediately, but steady progress was made. By 1902, a satisfactory design had been developed and tested, and the modification of existing guns to take what became designated the M1903 firing lock was in progress. [fig. 8] By this time, the guns were normally fired by electricity, but an alternative means for firing by percussion or friction was needed in case the electric system should fail. (Percussion primers are fired by the strike of a firing pin on the primer; friction primers are fired by pulling a wire through a friction compound.) The choices were either separate electrical and mechanical primers, or a combination electric-mechanical primer. The second choice seemed best, but the details remained to be worked out. The navy used an electric-percussion primer, but this required the firing pin to be in constant contact with the primer for electrical operation. The Ordnance

CANNON FRICTION PRIMER FOR AXIAL VENTS.



TWO WIRE OBTURATING ELECTRIC PRIMER FOR SIEGE CANNON WITH OLD MODEL VENTS.



OBTURATING FRICTION PRIMER FOR OLD MODEL VENTS.

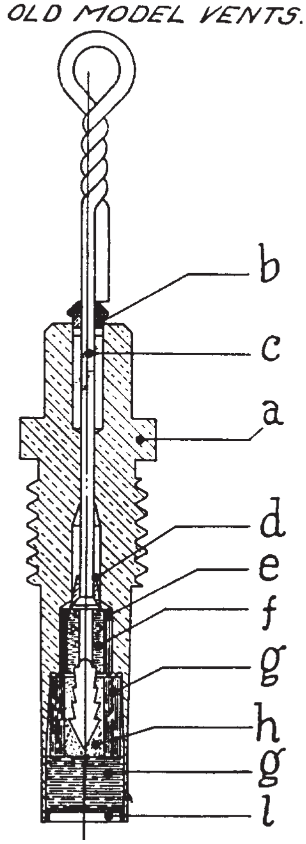


Fig. 5- (upper left) Non-obturating friction primer with spring
(*Primers for Use in Service Cannon*)
Fig. 6- (lower left) Screw-obturating friction primer
(*Primers for Use in Service Cannon*)
Fig. 7- (right) Screw-obturating electric primers
(*Primers for Use in Service Cannon*)

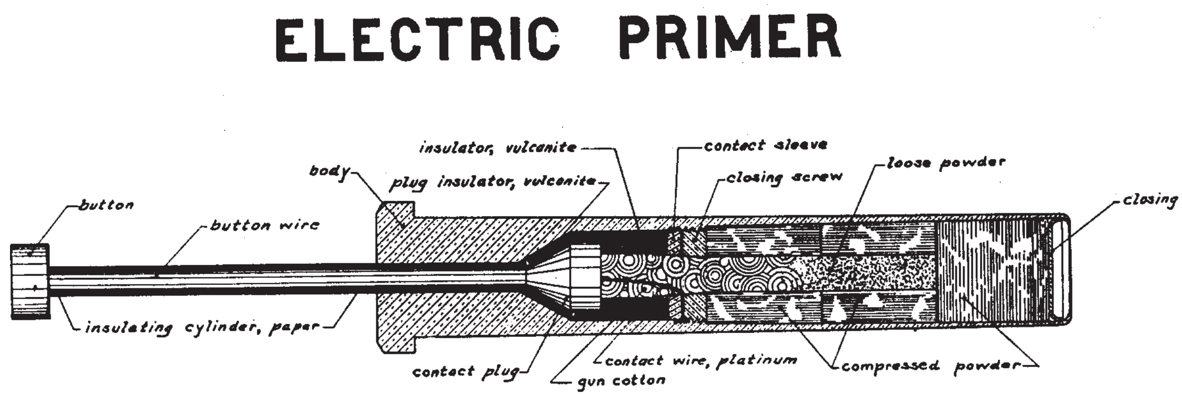


fig. 8-Electric primer (*Gunner's Instruction, Mortar Companies, 1917-1918,* p. 28)

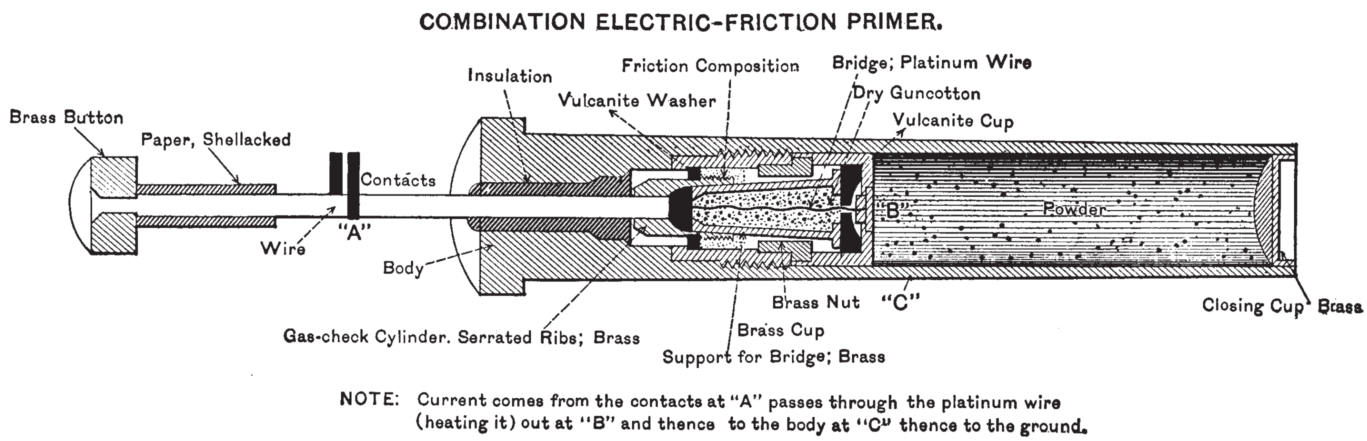


fig. 9- Combination electric-friction primer (Harold E. Cloke, *The Gunner's Examiner,* 1908, p. 78)

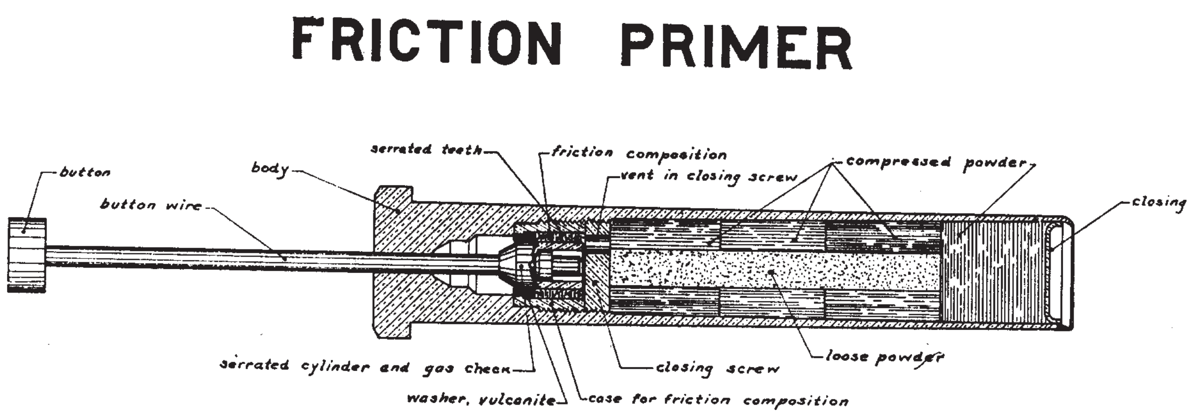


fig. 10-M1914 friction primer (*Gunner's Instruction, Mortar Companies, 1917-1918,* p. 28)

Department considered this unsafe, and developed a combination electric-friction primer. [fig. 9](11)

In 1906, the Ordnance Department reported that changes were necessary in the firing mechanisms of 5 and 6-inch guns to allow them to fire the same primers as larger guns. These changes were completed, and it was expected that the new mechanism would soon be supplied to all 5 and 6-inch guns. In 1906, all seacoast carriages had electric firing circuits installed. By 1907, the chief of ordnance reported that all seacoast guns, 5-inch or larger, had primer seats modified to accept the new combination electric-friction primer, and failures had become very infrequent. That same year, the West Point text, *Ordnance and Gunnery*, stated that "the principal primer used in our service" was the combination electric-friction primer, but also described a service primer fired by friction alone. In addition, special primers were used for drill and saluting purposes, and for fixed ammunition. The next year, 1908, Captain Buckey in the Harbor Defenses of Puget Sound stated that the only primers used with the breechloading mortars were the drill primer and the combination electric-friction primer, used both for action and target practice.(12)

In 1910, *The Service of Coast Artillery*, reflecting earlier practice, continued to illustrate screw primers for old-model vents, and a friction primer for new-model vents. The *Gunner's Instruction* of the same year, however, listed only drill and combination electric-friction primers for seacoast guns of 5-inch or larger.(13)

In 1914, 100 2-wire and 200 single-wire simple electric primers were sent to the Sandy Hook Proving Ground for testing. The Ordnance Board reported: "New design found entirely satisfactory. There were no failures in 200 primers fired."(14)

The drill regulations issued that same year report that "Service friction primers are adjusted in manufacture to require a pull of about 25 pounds to start the wire to the rear, and about 40 to 45 pounds to pull the teeth through the compressed friction pellet and explode it." The primer was to be fired by a "strong, quick pull (not a jerk), using as short a lanyard as practicable." Primers were packed in hermetically sealed metal boxes, inside wooden containers.(15)

By 1915, there were five categories of primers: friction, electric, percussion, combination, and igniting. Igniting primers were used with subcaliber ammunition, percussion primers with fixed ammunition for rapid-fire guns. Both will be described separately.

Primers for Use in Service Cannon, as revised in 1915, listed seven types of friction primers for field, siege, and coast artillery. One was for use only in radial vents, and a second was the same design with the spring coil to allow it to be safely fired in axial vents. Both were non-obturating. The first model obturating primer, installed with a wrench, was listed, along with two models designed for new model vents with firing locks. Only the newest, the model 1914, was listed specifically for seacoast cannon. [fig. 10] The older model was listed only for siege cannon. Drill primers corresponding to these two primers were also listed.

A similar assortment of electric primers was shown. Only the most recent model was listed for seacoast guns. Designed for new style vents with firing locks, it looked virtually identical to the model 1914 friction primer.

The combination electric-friction primer was described as "adopted for use in all seacoast cannon except those using percussion-firing ammunition." It also had the same form as the electric and the friction primers.(16)

The *Gunner's Instruction, Mortar Companies, 1917-1918,* illustrated only four primers for seacoast artillery use, all with the same external dimensions: drill, friction, electric, and combination electric-friction. All were designed for use with the model 1903 firing lock. Additionally, the text mentions igniting and percussion primers. The percussion primer was limited to use in small arms and 3-inch rapid-fire guns, while the igniting primer was used in the base of the 18 pdr. subcaliber cartridge case. The electric primer was used in service practice and in action, the combination primer was used in subcaliber practice, and the friction primer was used only as emergency backup, when the electric primer failed to function.(17)

The 1917 textbook, *Ordnance and Gunnery,* states that the electric primer was cheaper and safer than the combination primer, and "will probably replace that primer to a considerable extent."(18)

During WW-1, friction primers proved less than satisfactory, as fouling caused difficulty in working the firing lock. When the vent was insufficiently cleaned out, the result was liable to be a misfire, when cleaned out to vigorously, the result was liable to be a back fire. By 1922, the combination electric-friction primer was no longer mentioned.(19)

During the early 1920s, 16-inch guns and howitzers and some railway guns, including the 14-inch railway gun M1920MII, were developed using the Mk. I firing lock and the Mk. XV MI combination percussion-electric primer. If the electric element failed, it could still be fired by percussion, but if it did not fire by percussion, it could not be fired electrically. When firing by percussion, the lanyard first cocked and then fired the lock, like a double action revolver. [fig. 11] In addition, the 155 mm G.P.F. gun utilized the Mk. II A 21-grain percussion primer. [fig. 12](20)

In 1929, the 4th Coast Artillery Regiment reported that in Panama, subject to extreme humidity hovering around 90%, it was baking its primers to eliminate moisture.(21) By 1930, the Artillery Board had studied the many cases of primer failure which had plagued the coast artillery and recommended that the electric primer be abandoned and the percussion primer adopted as standard. It noted that the percussion primer had served the field artillery without difficulty, and the recommendation was forwarded to the Ordnance Department.(22)

The 1932 *Ordnance and Gunnery* still listed the combination electric-friction primer, no longer being made but still used "to some extent." This status continued through 1938, but by WW-2, the combination electric-friction primer finally disappeared.(23) Both friction and electric primers were listed, and the electric primer was now distinguished from the friction primer by a groove around the head of primer. Several methods of supplying power to the electric primers had been tried. Drawing power from the fortification power plant presented the danger of broken wires, and also the danger of unexpected voltages in the wires. Batteries, both storage and dry cell, worked, but required careful attention. Hand magnetos, like those used to fire detonating caps, did not furnish sufficient current for reliable operation, so special hand-operated magnetos were furnished for all guns and mortars. Safe and certain, these required little care.(24)

During WW-2, the 8-inch Mk. VI Mod. 3A2 navy gun and the 6- inch gun T-2/M-1 used the Mk. VII Mod. II firing lock, which in turn used a combination percussion-electric primer. When fired electrically, the circuit was broken until the gun was in battery and the breech-

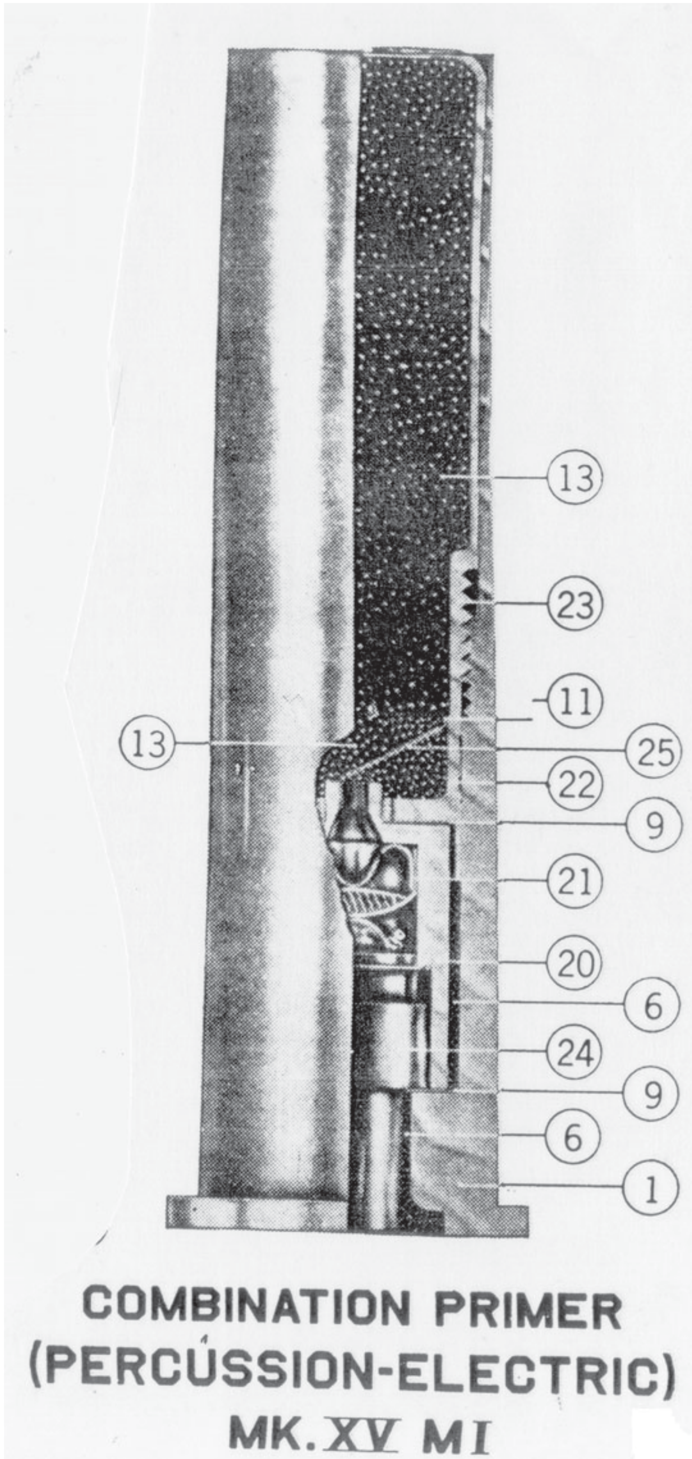


Fig. 11-Combination percussion-electric primer (Thomas J. Hayes, *Elements of Ordnance*, p. 576)

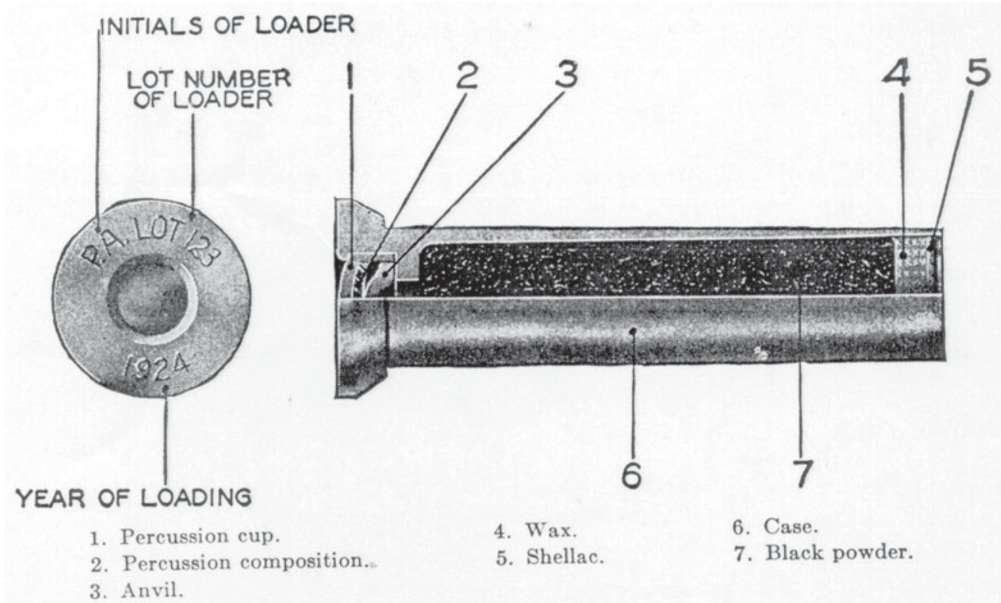


Fig. 12-155 mm percussion primer (Earl McFarland, *Textbook of Ordnance and Gunnery*, p. 511)

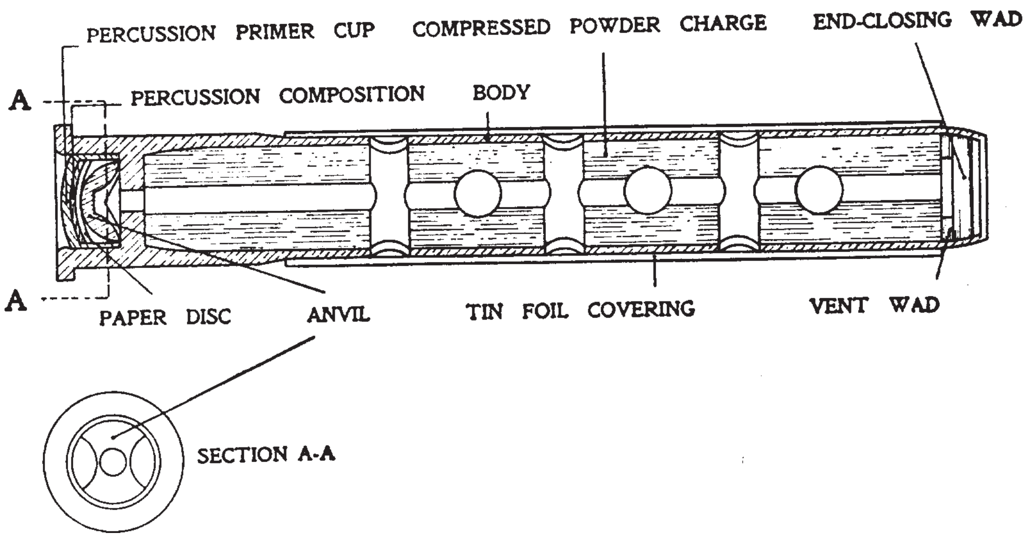


Fig. 13-110 grain percussion primer (Earl McFarland, *Textbook of Ordnance and Gunnery*, p. 511)

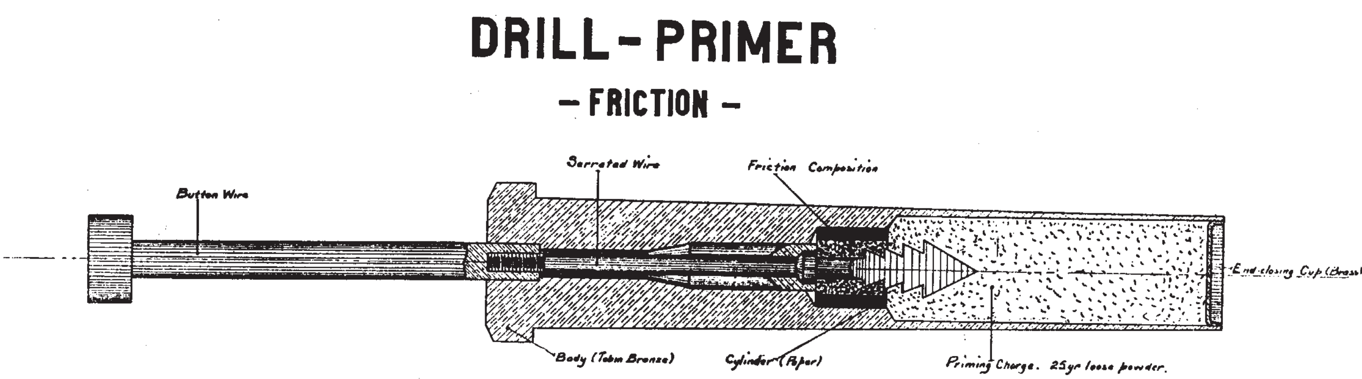


Fig. 14-Igniting primers (Earl McFarland, *Textbook of Ordnance and Gunnery*, p. 515)

block was closed. When firing by percussion, there were no safety features, so the gun was always fired electrically whenever possible.(25)

In 1947, as the coast artillery approached its end, Mk. XV MI percussion-electric primers were in use for 16-inch and 8-inch Mk. VI Mod. 3A2 guns. For older guns still using the M1903 firing lock, the M30 electric primer remained standard, but M1914 friction primers continued to be used in the event of the failure of electric power.(26)

Primers for Fixed Ammunition

In addition to the separate-loading big guns, fixed ammunition, used in the smaller guns, required primers for the base of the cartridge cases. The 4.7 and 6-inch Armstrong guns and Bethlehem Steel's M1902 3-inch gun also initially used electric primers, which fit in the cartridge case like percussion primers. By 1903, percussion primers containing 110 grains of black powder became standard. A 20-grain percussion primer was developed for use in 1-pdr. subcaliber tubes, and a small saluting primer substituted for the 110-grain primer when firing blank charges of black powder.[fig. 13] Beginning in 1913, the breech mechanisms of the M1902 guns were changed to allow only percussion firing, but this does not seem to have been completed by 1922.(27)

By 1932, problems had arisen in manufacturing the 110-grain primer. The primer body had black powder compressed into it, with ventholes drilled through the side to allow the flame to ignite the powder with a blowtorch effect, rather than an explosive one. Difficulty arose when drilling holes through the compressed powder, and a new model 110-grain primer was developed which used loose powder of coarse grain. These M28 primers remained unchanged through the end of the coast artillery, used in 3-inch and 90 mm guns. The Mk. IIA 20-grain percussion primer, used with 37 mm subcaliber ammunition, was supplanted by the M23 series during WWII.(28)

Igniting Primers

One unusual category of primer was the igniting primer, used with subcaliber ammunition. The igniting primer resembled the issued primers for fixed ammunition, but had no independent igniting element. The igniting primers, 110-grain for 18-pdr. subcaliber cartridge cases, and 20-grain Mk. I for 1-pdr. cases, were inserted in the subcaliber case like the percussion primers. When the primer was fired in the gun, the flame entered the rear of the igniting primer and ignited it, setting off the charge in the cartridge case. [fig. 14](29)

Drill Primers

A last category of primers was used strictly for drill. To avoid the expense of the regulation primers, non-obdurating primers were used with adaptors for saluting, subcaliber, and

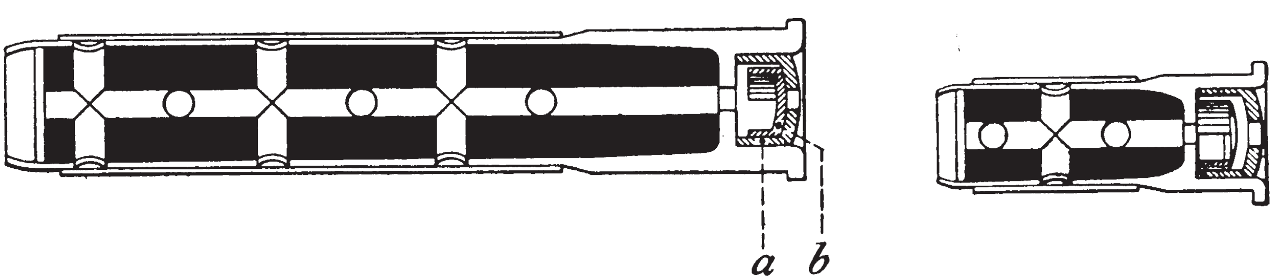


Fig. 15-Drill primer (*Gunner's Instruction, Mortar Companies, 1917-1918*, p. 28)

practice firings. Since they did not allow duplication of the use of service primers, special drill primers were developed by 1903. [fig. 15] These friction primers were much less expensive to fire than the service primers, and could be easily reloaded at the post. These primers are not described after WW-1; how long they remained in use is not known.(30)

Firing Mechanisms

When the use of screw primers became too time consuming, and with the expansion of the use of rapid-fire guns using fixed ammunition, the Ordnance Department began to develop firing mechanisms for seacoast guns. A number of different models were used, some only for a short time, but the most common were the following:

M1903 Firing Mechanism (fig. 16)

About the time the coast artillery began to use smokeless powder, it became clear that screwing in the obdurating primer was too time consuming. As a result, the Ordnance Department began to develop a firing mechanism which would use a non-screw primer. The problem was complicated by the use of both friction and electric primers, but progress was made rapidly. By 1902, the chief of ordnance reported that considerable progress had been made, and the design had been tested in service, in target practice, and during maneuvers. The results had been satisfactory, although some modifications would be made.

In 1903, Watervliet Arsenal had installed a number of small machines to manufacture the new firing mechanisms, and by 1907, all seacoast guns using separate loading ammunition had been modified to accept the new mechanisms. The M1903 was standard for the larger guns. The firing mechanism used on some 5 and 6-inch guns was very similar; although a bit problematical. In some manuals the army merely identified them as firing locks, without a model designation, in others, they were designated by the gun model (e.g., M1905A2), in still others, they were described as M1903. In any event, they were essentially the same as the M1903. This mechanism was retained on the pre-WWI generation of coast artillery guns and the even the disappearing 16-inch gun M1919 mounted at Ft. Michie, although a few 6-inch barbette guns received new percussion-electric firing mechanisms during WWII.

The mechanism allowed firing by either lanyard (friction) or by electricity. It sat on the spindle, which was an extension of the mushroom head projecting from the rear of the breechblock. A hinged collar was attached to the spindle by means of two grooves which engaged ribs on the spindle. The collar was threaded on the outside to accept a housing, which was locked to the collar by a spring pin when screwed fully home. When installed, the housing was held stationary, while the collar rotated. A guide bar projecting from the right side of the housing fit into a groove in the breechblock, causing the mechanism to rotate on the spindle as the breechblock was rotated.

A slide catch held the slide in either the up or down position. When the primer was inserted, the slide catch was released and the firing leaf was slid under the button of the primer. When firing by friction, the lanyard was attached to the lower end of the leaf. When the lanyard was pulled, the firing leaf pulled on the button, drawing the wire through the primer. When firing by electricity, the magneto or outside power source was connected to the primer through the two brass arms of the contact clip, which was held in place by a nut bearing against the firing leaf.

The primer fit on the fork of an ejector, which was pivoted at the top. When the slide was moved up, it caused the ejector to pivot, pulling out the primer.

For safety, a bar engaged the firing leaf until the block was completely closed, preventing firing by lanyard. In the same manner, a circuit breaker was not closed until the block was completely closed, preventing electrical firing.(31)

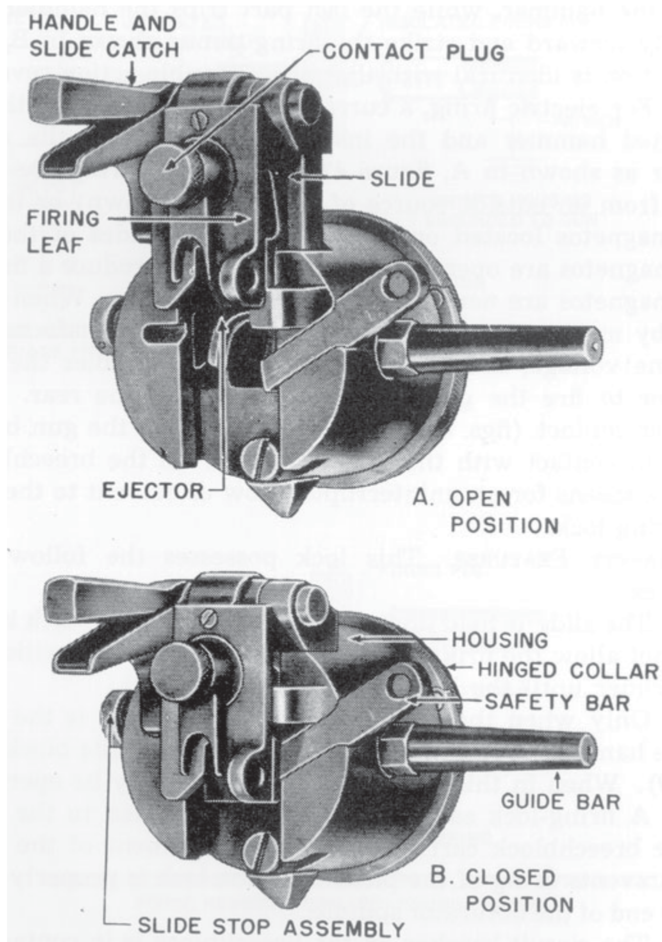


Fig. 16-M1903 firing mechanism (TM 4-210, fig. 43, p. 44)

Firing Lock Mk. I (fig. 17, 18)

This mechanism was used on 16-inch guns and howitzers (except for the M1895 gun and the M1919 gun on the M1917 disappearing carriage), and some railway guns, including the 14-inch railway gun M1920MII. It fired either electrically or by percussion, using the Mk. XV Mod. 1 primer.

The lock and the spindle each had matching slotted screw threads, so the lock fit on the spindle by merely rotating it 1/4 turn. The principal parts of the lock were the housing, slide, operating bar, cocking lever, hammer, and extractor.

The operating bar and the slide moved together, the bar moving in a slot in the bearing plate on the rear face of the block, while the slide moved in grooves in the housing. When the block was opened, the bar was pulled down, lowering the slide and uncovering the primer. As the slide was lowered, it worked against a cam which rotated the extractor to the rear, ejecting the primer.

When the block was closed, the retracting lever was used to pull the operating bar down manually, the primer was inserted in the slide, and the operating bar was raised. For percussion firing, the lanyard was attached to the hole in the cocking lever. Pulling the lanyard first cocked, then tripped the hammer, allowing it to strike the firing pin, like a double action revolver.

For electric firing, electricity passed through the insulated hammer and firing pin. A circuit-breaker attached to the block broke the circuit until the block was closed.(32)

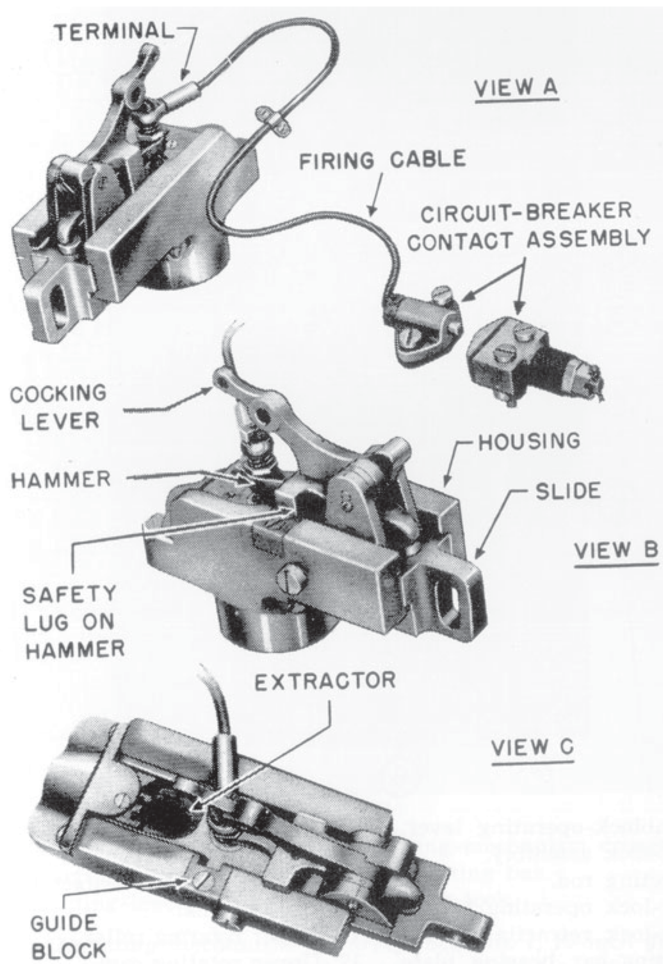
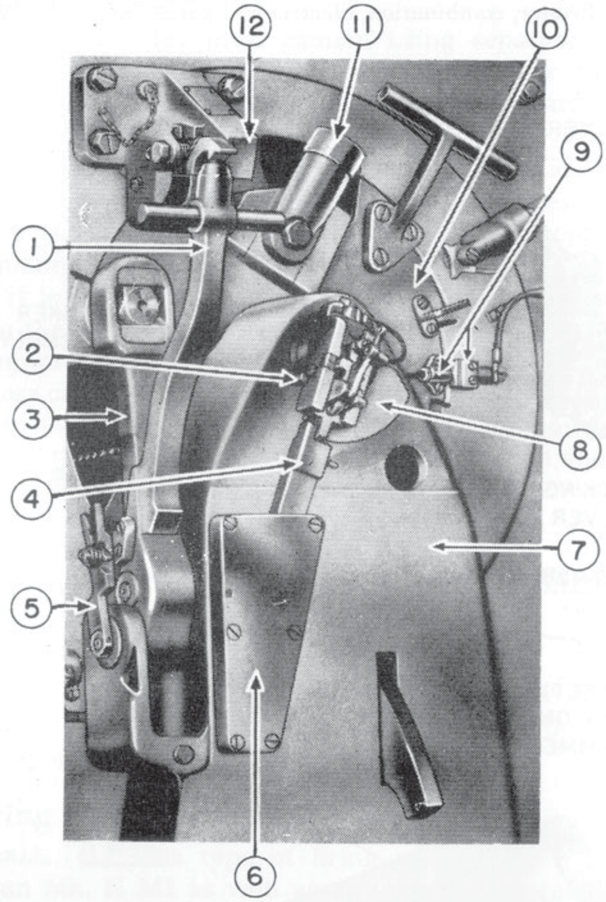


Fig. 17-Firing lock Mk. I (TM 4-210, fig. 39, p. 39)



1. Breechblock-operating lever.
2. Firing-lock assembly.
3. Connecting rod.
4. Firing-lock operating bar.
5. Firing-lock retracting lever.
6. Operating-bar bearing plate.
7. Breechblock carrier.
8. Firing-lock safety arc.
9. Circuit-breaker contact assembly.
10. Breechblock.
11. Upper rotating roller.
12. Upper rotating cam.

Fig. 18-Firing lock Mk. I (TM 4-210, fig. 40, p. 40)

Firing Lock Mk. VIII Mod. II (fig. 19)

The Mk. VIII Mod. II lock used on the 8-inch gun Mk. VI Mod. 3A2 was a percussion-electric mechanism. The lock fit over the rear of the spindle, held in place by a wedge much like a wedge type of breech mechanism. A firing pin extended through the wedge, which was raised or lowered by twisting the hammer.

For electrical firing, the hammer was pulled back 1/16 inch and twisted counterclockwise, then twisted clockwise, bringing it into contact with the rear of the firing pin. Electric current flowed through the hammer and pin into the primer.

For percussion firing, the primer is inserted in the same manner, then the hammer was gently pulled back and turned counterclockwise about 45°. Pulling the hammer again cocked the lock, then the hammer was rotated back clockwise, engaging a sear and placing the hammer in line with the firing pin. When the trigger was pulled by the lanyard, the sear was disengaged from the hammer, which was driven forward onto the firing pin.

Since there were breaks in the electrical firing system which prevented the gun from being fired electrically until the block was closed and the gun was returned to battery, but no safety features for percussion firing, the gun was fired electrically whenever possible.(33)

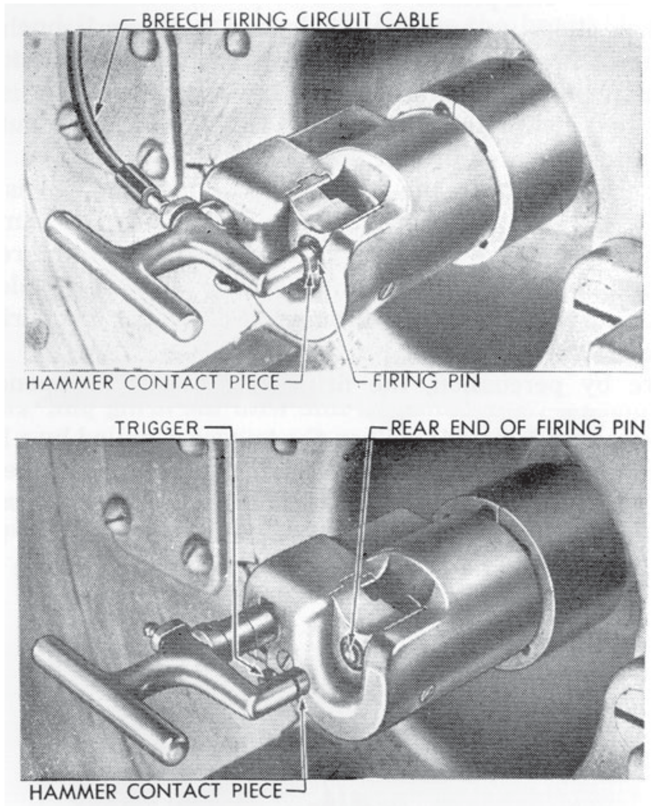


Fig. 19-Firing lock Mk. VIII Mod. II (TM 4-210, fig. 53 & 54, p. 54)

M1918 Firing Mechanism (fig 20, 21)

The 155 mm G.P.F. gun, M1917A1 and M1918M1, and the 240 mm howitzer, M1918 and M1918M1, used a percussion firing mechanism. A firing mechanism housing was screwed to the spindle, and a firing block with handle was screwed into the housing. The inside of the firing block was threaded to accept a primer holder, which held a primer in place by a coil spring. The spring also separated the firing pin from the primer.

After the gun was fired, the latch was released and the handle of the firing block was turned, allowing the firing block to be removed and the primer replaced. After the gun was loaded and the breechblock was closed, the firing block was returned to the housing. A safety plunger prevented the complete insertion of the firing block until the breechblock was fully closed, and a flange prevented the hammer from striking the firing pin unless the firing block was screwed all the way in.

The primer was fired by pulling the lanyard attached to the bottom of the hammer, causing it to pivot and strike the firing pin.(34)

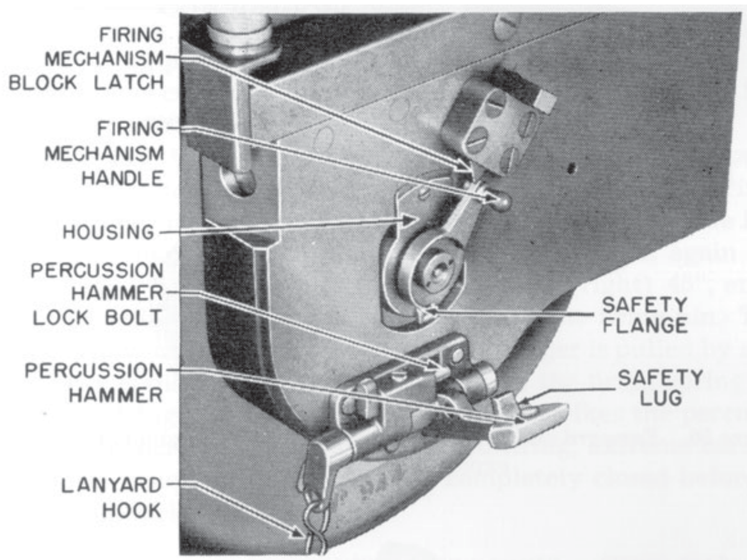


Fig. 20-155 mm firing mechanism (TM 4-210, fig. 49, p. 51)

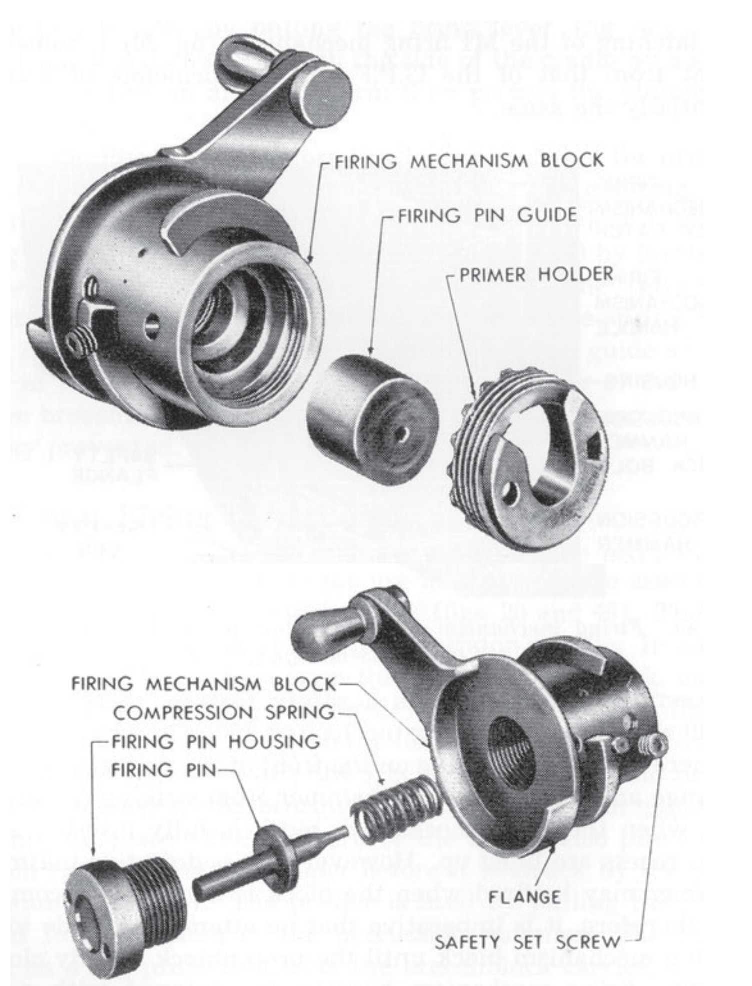


Fig. 21-155 mm firing mechanism (TM 4-210, fig. 50 & 51, p. 52)

Continuous-pull Firing Mechanism (fig. 22)

The M1902 3-inch (15-pounder) gun originally used a continuous-pull percussion mechanism combined with electric, but all M1902 guns were eventually converted to eliminate the electric mechanism. M1902M1 and M1903 3-inch (15-pounder) guns used a continuous-pull percussion mechanism to fire the primers at the base of their metallic cases. As the lanyard on the M1902, or the lanyard or firing lever on the M1903, was pulled to the rear, it first cocked the firing pin spring by pressure on the firing pin holder sleeve. As the lanyard was pulled further to the rear, the sear was disengaged, allowing the firing pin to move forward and strike the primer. The recoil of the gun slacked the lanyard, allowing the spring to retract the firing pin, preventing damage to the pin or the cartridge case. If the M1902 breech was closed with an uncocked firing pin, the round could be fired accidentally; the M1903 would not do so unless the firing pin had broken or jammed.(35)

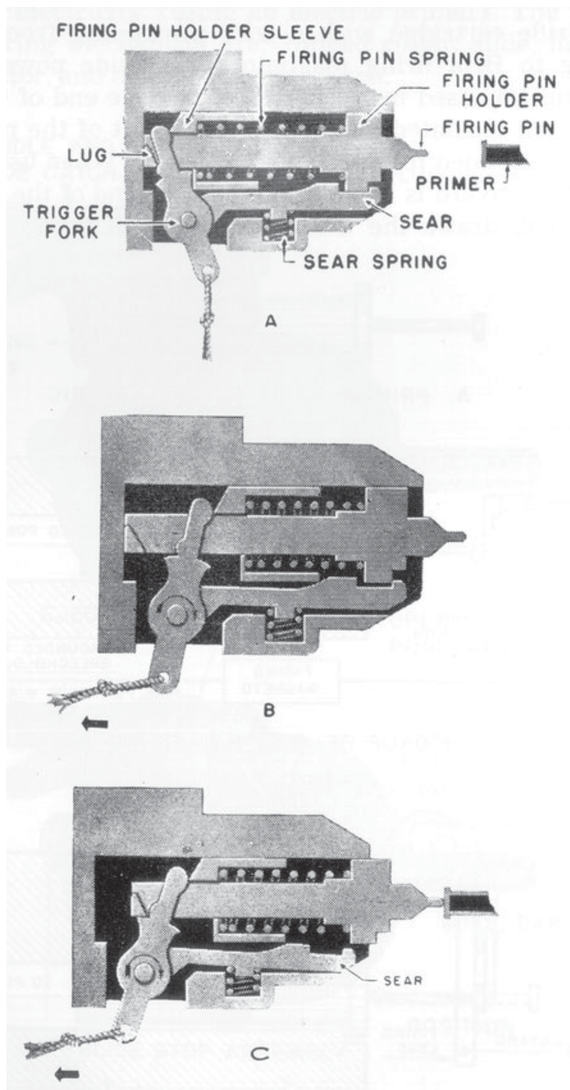


Fig. 22-Continuous-pull firing mechanism (TM 4-210, fig. 45, p. 46)

Inertia-type Firing Mechanism (fig. 23)

The 90 mm gun used this modification of the continuous-pull mechanism. When the breechblock dropped to the open position, the automatic cocking lever rotated, causing a rearward motion of the lower arm of the cocking lever. This lower arm engaged a cocking lug, pulling the firing pin guide to the rear and compressing the firing spring. In this position, the sear engaged the sear lug in the bottom of the guide, preventing the guide from moving forward. The gun was fired by pulling out on the firing lever, which in turn pressed the sear inward, causing the guide to slip through the slot in the sear and cause the guide, stop, spring, and firing pin to fly forward. Just as the pin struck the primer, the spring was stopped when the firing spring stop struck the breechblock bushing, but the pin and guide continued on, firing the primer. This motion compressed the retracting spring, which retracted the guide and pin after firing, preventing damage to the pin or breechblock.(36)

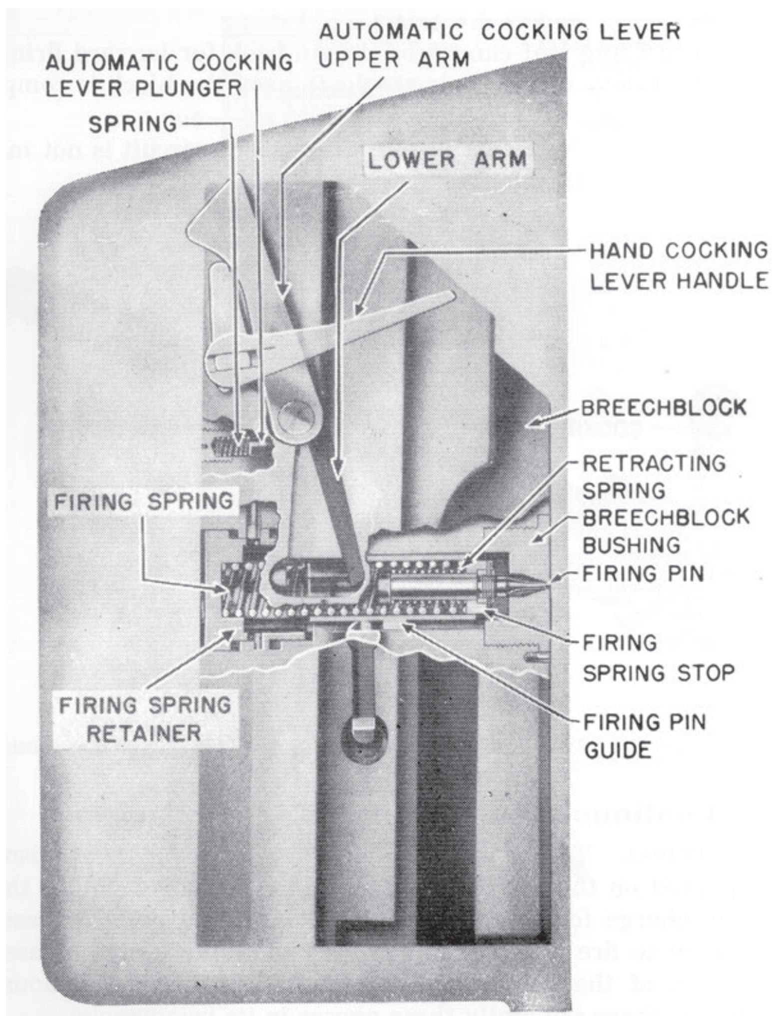


Fig. 23-Inertia-type firing mechanism (TM 4-210, fig. 47, p. 48)

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