

NORDENFELT BREECH MECHANISM.

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(e) The *extractor lever* is connected to the double extractor, working on both sides of the cartridge case. The tongue of the extractor lever abuts on the extractor cam lever, which is on the main axis.

*Action of the Mechanism.*—The action of the mechanism is as follows:

For opening—

First. The lever carries the action cam slot over the action pin in the part which is concentric to its own motion, and therefore no movement of the mechanism takes place.

Second. The part of the action-cam slot which is not concentric to its own motion now engages the action pin, forcing the wedge down, which, acting on the beveled firing-pin projections, forces it back and compresses the main or firing spring. When the firing-pin lug is clear of the trigger, the wedge bearing acts on the upper trigger lug, forces up the trigger, which catches and retains the firing pin.

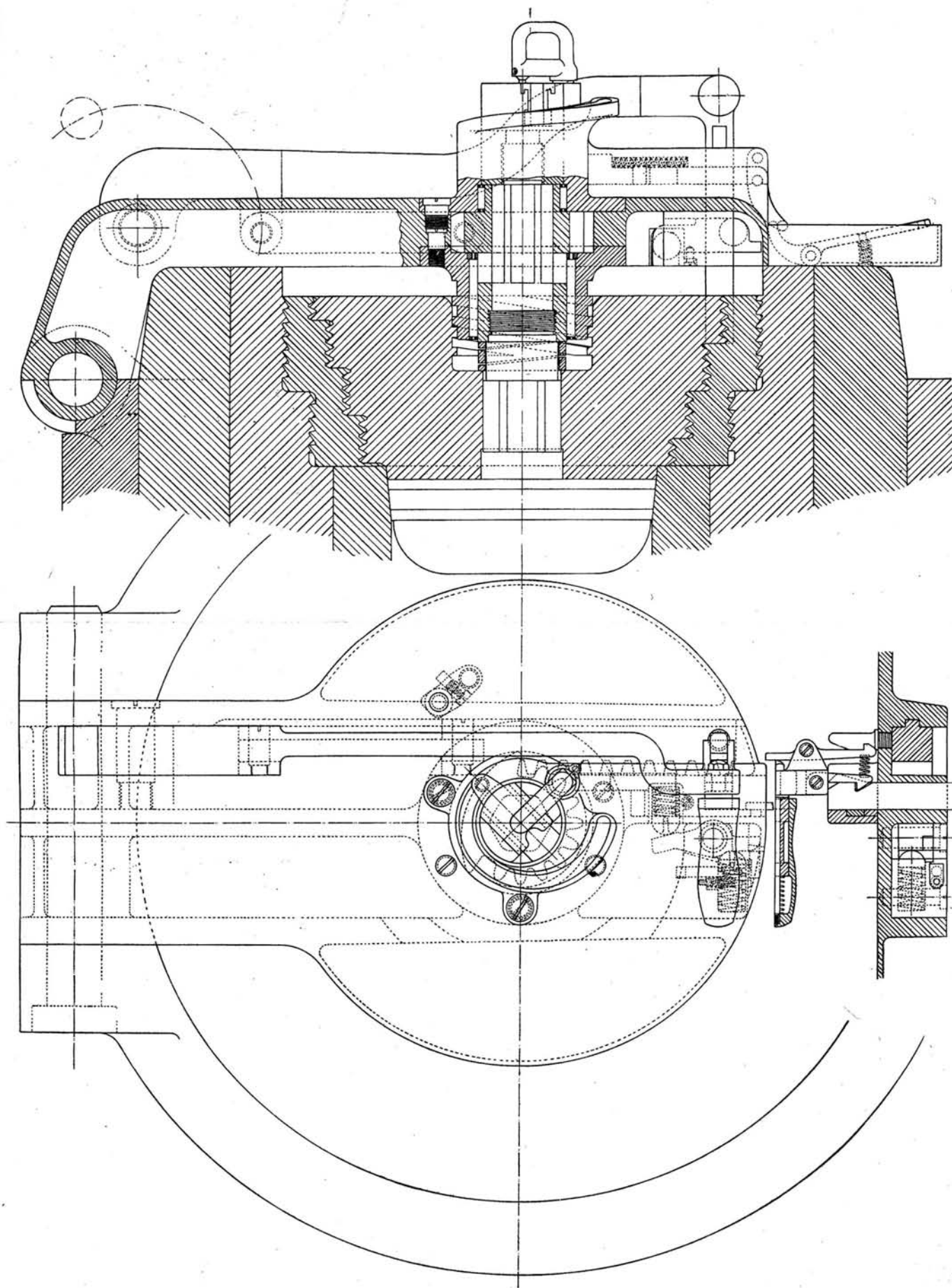
Third. When the action pin has reached the end of the cam slot, the extractor lever begins to be forced back by its tongue, being met by the raised portion of the extractor-cam lever, and the empty cartridge case is thus slowly started. The action pin having reached the end of the action cam slot, the lever still moving back causes the breechblock to rotate and fall back to the rear, and at the latter part of this movement brings the tongue of the extractor-cam lever in contact with the extraction lever, and thus throws the empty cartridge case rapidly to the rear. The lever is now at its furthest position to the rear.

For closing—

First. The breechblock is brought up and carried forward, pushing a fresh cartridge into the barrel.

Second. The cartridge being quite home, the action-cam slot engages the action pin in the part of the slot which is not concentric, and forces the wedge up into position, the action pin then passes into the concentric portion of the action-cam slot.

Third. The forward motion of the lever continuing, the bearing on the action cam is brought into contact with the under lug on the trigger, pushing the trigger up, thus relieving the firing pin and firing the gun.



HAESELER 8-INCH BREECH MECHANISM.

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The gun can not be fired before the breech is secured by the wedge:

First. As the inclined surface inside the wedge is formed in such a manner that the firing pin can not be made to strike the cap of the cartridge until the wedge is quite home and supported by the entire bearing surface. If the trigger is pulled before the breech is secured, the cocking lugs on the firing pin strike on the inclined surface of the wedge and the point can not strike the cap of the cartridge.

Second. The safety lug on the trigger is behind the corresponding lug on the wedge until the wedge is fully home, and consequently the sear nose of the trigger can not be forced to release the firing pin before the breech is secured.

**32. The Haeseler Rapid-fire, or Quick-fire, System of Operation** (Plate VII).—The spiral-threaded conical breechblock is recessed out in the rear portion. It bears on an axial stem which passes through a boss secured to the front face of the "carrier plate," by which the block is supported and on which the revolution takes place for locking and unlocking. On the outer surface of the carrier boss is a square thread (same pitch as the plug thread), which engages a female thread in a piece secured to the front end of the plug recess, so that when the plug revolves it is advanced or withdrawn to the point of engaging or disengaging the spiral threads of the plug and screw box. On the rear end of the plug's stem is keyed a pinion allowing a free longitudinal movement of the plug. The pinion works within a vertical slot in the carrier, and has no longitudinal movement. This "rotating pinion" is divided into two sections of unequal diameter; the smaller section has the larger diameter and is plain, while the larger has a periphery equal to the length of the rotation rack (about three-fourths circumference), on which are teeth. A transverse "rotating rack," having vertical teeth that engage those of the rotating pinion, slides right and left in a guide groove in the carrier beneath the center. The right end of this rack is connected to the hand lever by a horizontal link, with vertical axis. The operating lever is hinged to the right side of the carrier and has a vertical hand grasp on the left end. The carrier plate is hinged to the gun by a vertical hinge bolt.

The operation is as follows: The breech being closed, first, by pulling the hand lever to the rear, a stop bolt in the carrier is withdrawn from a longitudinal cut in the plug and screw box. (This is called "plug lock," and is designed to lock the plug to the screw box in the closed position, from any revolution.) Then the link pulls the rotating rack to the right, which results in revolving the plug to the unlocked position, at which movement the back of the lever brings up on the shoulder of the lug to which it is pivoted, the rotation is stopped, the center of motion is transferred to the carrier's hinge bolt, and both the plug and carrier swing out from the breech. The swing open is arrested by an extractor cam, rigidly fixed to the carrier, bringing up on the end of the extractor, which in the swinging open movement has been moved to the right until the edge of the extractor lock in the gun is reached. Then a lug on the extractor also brings up on the side of the gun, and is designed to relieve the extractor pin from the moment the plug is unlocked. A pin on its rear face is caught by a spring device, to prevent revolution of the plug in the carrier when out of the gun. The catch retaining the plug from rotation is not tripped until the carrier plate reaches the breech face.

The first movement of the plug to revolve, either for locking or unlocking the threads, is accomplished with great power, as the rotating rack works on the ends of the pinion's large diametrical section. The speed of revolution and amount of turn necessary to lock or unlock the plug's threads may be varied according to design.

## CHAPTER V.

### 12-INCH BREECH MECHANISM MARK VI.

1. The Mark VI B. L. R. Breech Mechanism, known as the Vickers-Maxim mechanism, is fitted to the later high-powered guns of 8-inch, 10-inch and 12-inch calibres.

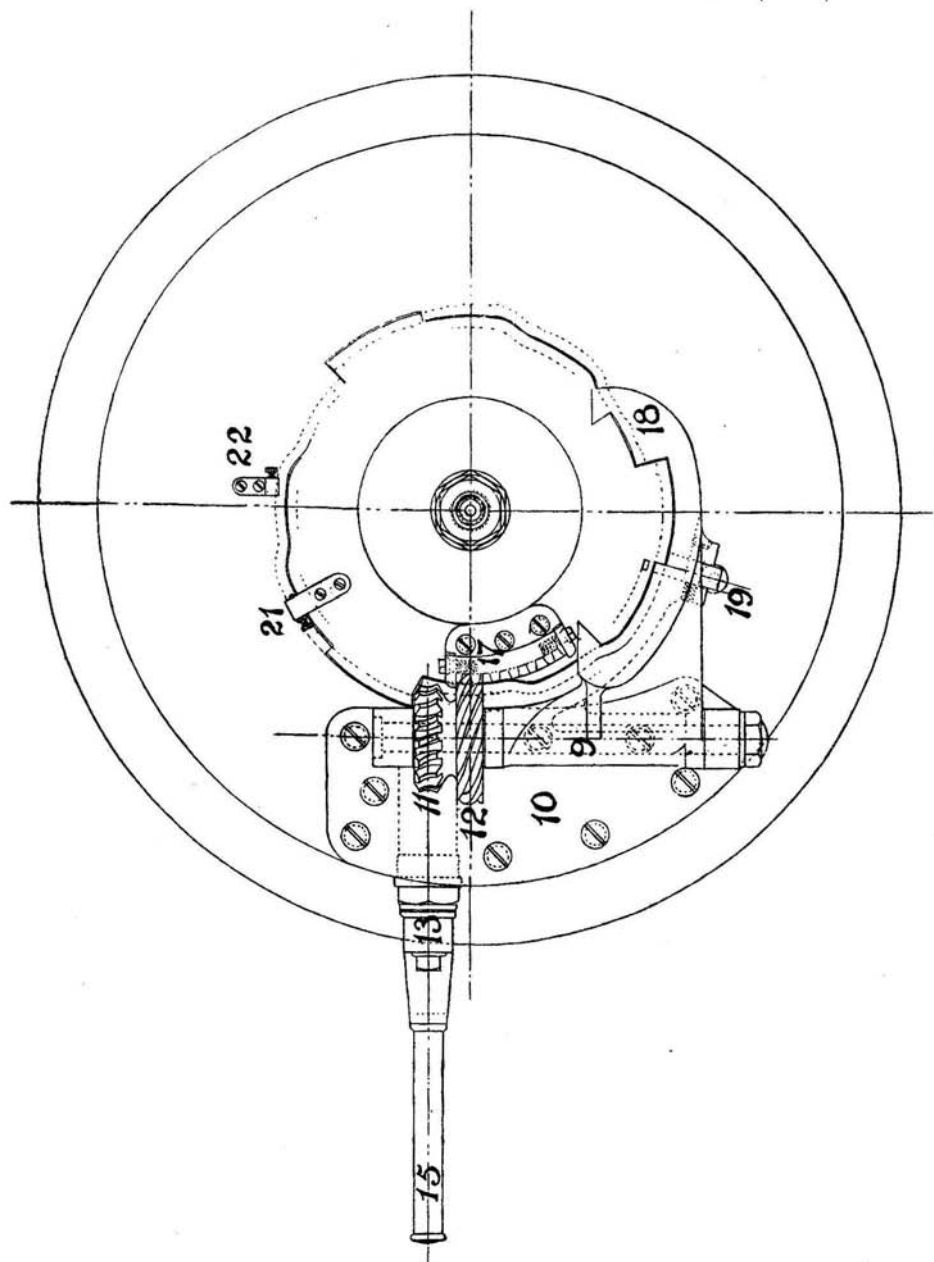
The *breechblock* (1) is of the "Welin" type, and, for the 12-inch mechanism, which is the size shown in the plates, the screw box and block are each divided into three sections; each section is divided into four steps, three of which are threaded cylindrical surfaces and the fourth a blank, thus giving the block a holding surface comprising three-fourths of its circumference. By using this, the Welin patent, a much shorter block may be used, giving greater ease of manipulation and requiring less weight both of gun and of breech mechanism. The De Bange gas check (2), with front (3) and rear (4) split rings, is used as previously described. The primer seat is in the rear end of the mushroom stem (6) on which is screwed the firing lock. The vent, or orifice through which the flame of the primer discharge reaches the powder, is through an axial hole in the mushroom stem. The mushroom (5) with gas-checking pad and rings is secured to the block by the locking nuts (7) screwed on the mushroom stem; since, during the process of locking and unlocking, the block is revolved about the mushroom stem, a ball-bearing washer (8) is inserted to reduce friction. Plates I, II and III show the block (in its unlocked position) in rear elevation, side elevation and in horizontal cross section, respectively.

2. The Operating Gear is of the system known as the "Improved Farçot Gear," which is in all the essentials the same as the "Modified Farçot"; the latter differs principally in having its hinge pin turn *with* the spiral pinion. The name *Farçot* is from the inventor; Lt.-Comdr. F. F. Fletcher worked out and adapted it to the U. S. naval guns, and it is sometimes called

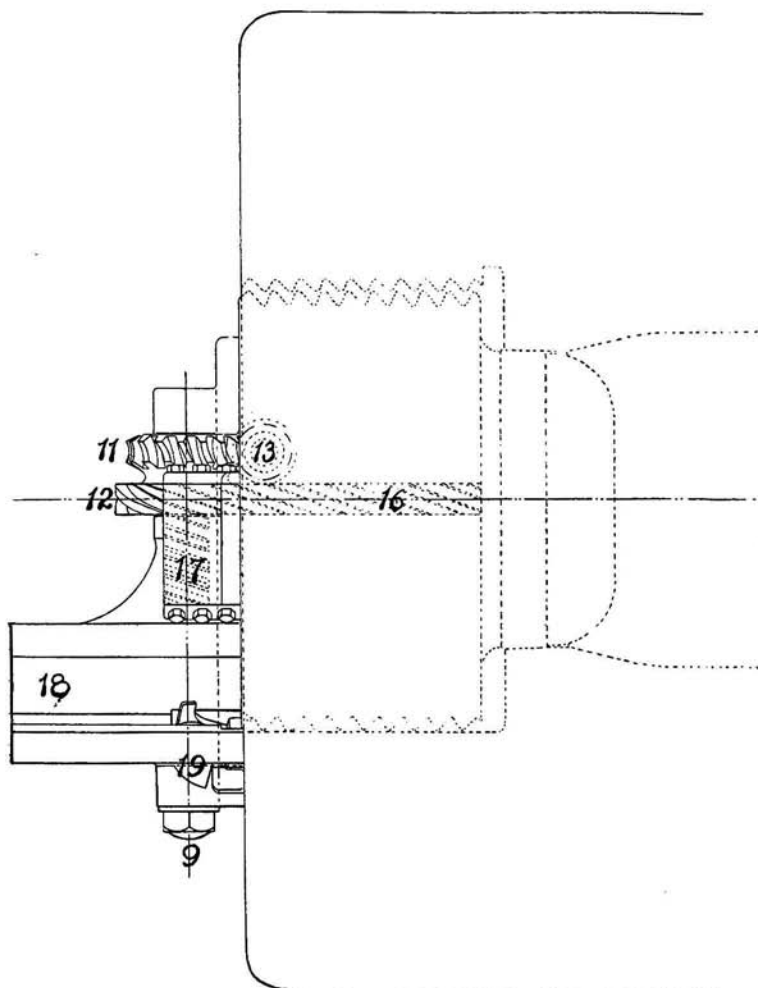


the "Fletcher system." Obviously with a breechblock of large size there must be three steps in the operation while closing or while opening; (a) *rotation* about the axis which locks or unlocks the threads of the block and the threads of the screw box; (b) *translation* along the axis of the bore of the gun between the positions of locking and of swinging; (c) *swinging*, by which the block is swung on a vertical hinge into or out of the line of the bore. In this system of operating gear, the three steps are accomplished in either direction by the continuous rotation of one crank, other movements being automatic; seven turns of the crank suffice to operate a 12-inch mechanism, which is a near approach to "quick" acting.

The operation in *opening* the breech is as follows: A vertical shaft (9), also acting as a plug-tray hinge pin, is journaled in a lug on a hinge plate (10) bolted to one side of the gun's breech face; the shaft itself carries on its upper end a worm wheel (11), and, on its central part in a horizontal plane through the gun's axis, a spiral pinion (12) with teeth inclined 20 degrees to the horizontal. A horizontal crank shaft (13) is journaled in the upper end of the hinge plate, or partly in the gun, or entirely in the gun if there is no hinge plate. It has a worm (14) that engages the worm wheel, and is actuated by a crank (15) on the outer end. Turning the crank will thus turn the vertical shaft and the spiral pinion. There is a system of spiral teeth, also inclined 20 degrees, cut on a rack, part of which is longitudinal (16), dovetailed and recessed in lengthwise to the plug, and part circumferential (17), or "fan-shaped," generally extending to the rear of the plug and secured to the rear face thereof. The spiral pinion engages this rack helix. On turning the crank, if the plug be locked, the spiral pinion engaging the circumferential or segmental rack will revolve the plug to unlock the threaded sections, and when this is accomplished the rotation is stopped by a suitable stop plate secured to the segment. The continued movement of the crank will now cause the pinion to act on the longitudinal part of the rack (rotation being prevented by edge of recess), and withdraw the plug onto the tray (18). When the plug is completely withdrawn, the tray latch (19) is automatically released, at the same time locking the plug on the tray, the movement of



MARK VI MECHANISM FOR 12-INCH GUNS.



MARK VI BREECH MECHANISM FOR 12-INCH GUNS.

translation is changed to swinging, and the plug and tray swing out clear of the breech about the vertical shaft, until brought up by the stop (20). The tray latch performs the double duty of holding the tray to the face of the breech while the mechanism is closed and, at the proper time, releasing it and locking the block to the tray. In *closing* the breech all the steps are carried out in the reverse order.

3. The breech mechanisms of earlier B. L. R's. are in most respects similar to the above except that the French interrupted screw or "ordinary" breechblock is used. The block is made to swing either way and in turret guns it always swings away from the center of the turret. Plate IV shows the breech mechanism of a 12-inch British naval gun in the closed and open positions. The block is also of the Welin type but the operating gear is considerably different from the one described above.

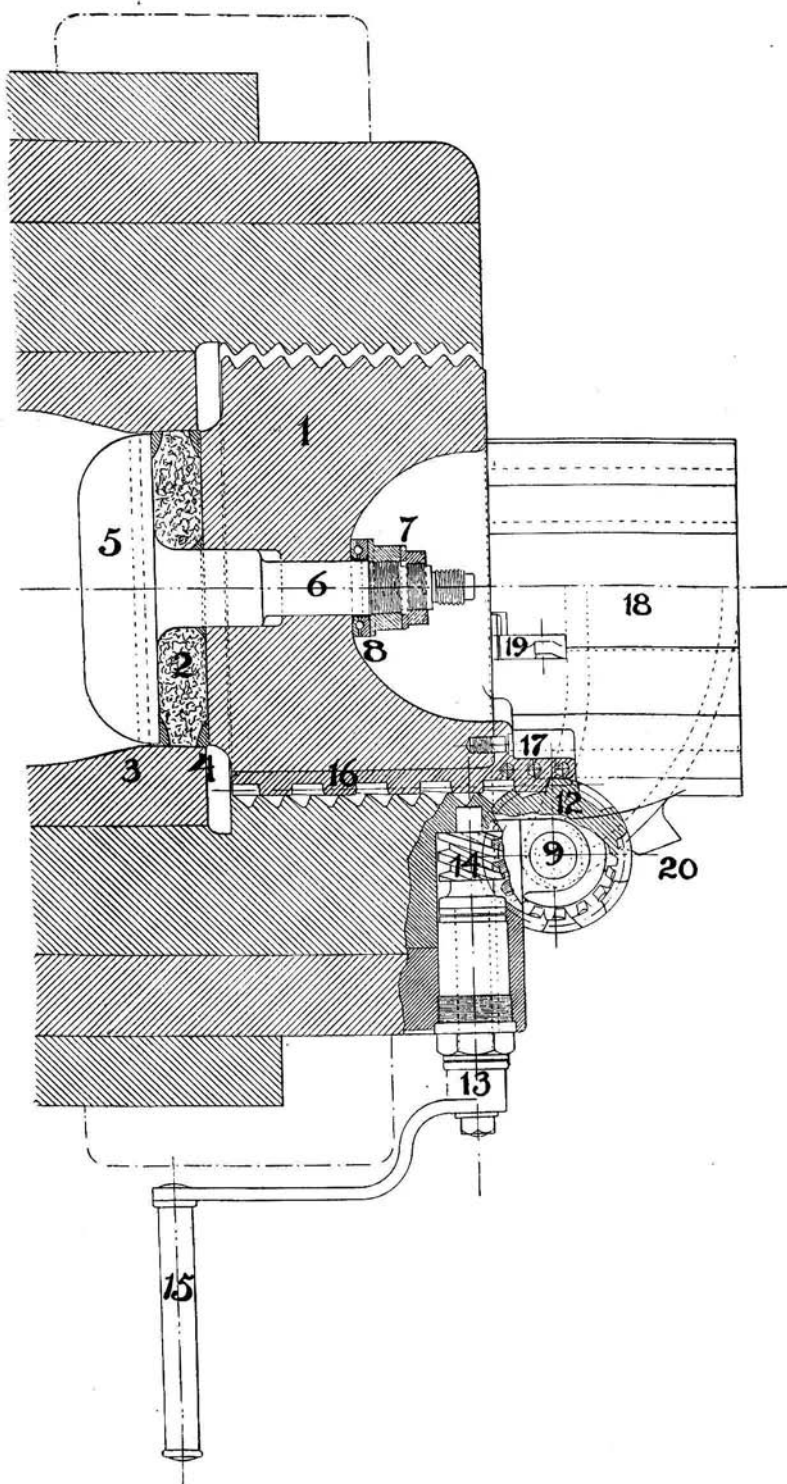
4. **The Mark VIII Firing Lock** (Plate V).—"Combination" primers, which explode either by percussion or by an electric current, are now used in all B. L. R's. and the Mark VIII lock has been designed to work in either manner without requiring changes or adjustments of any of its parts; the lock is in itself a breech mechanism of the sliding-wedge type. In the plate, Figs. 1, 2 and 3 are longitudinal sections, Figs. 4 and 5 are cross sections and Fig. 6 is a rear elevation; the lock is shown in its closed position with hammer down. A recent improvement, which precludes the possibility of the wedge being jarred open, has been given the title Mark VIII A, but it involves only a slight modification of the hammer stem.

The *receiver* (1), or main body of the lock, is screwed on the rear end of the mushroom stem and is secured by the spring locking catch (28) which enters a square slot in the stem; the primer is supported in its seat in the mushroom stem by the wedge (2) which closes behind it and is worked up or down to its closed or open position by twisting the hammer stem (6). Surrounding this stem and secured to it by a feather is a gear wheel (31) that connects through the idle gear (32) with a vertical rack on the left side of the wedge, by which the latter is operated. The friction pin (3), being pressed against the wedge by a spiral spring, drops into a recess and aids in holding the lock closed. The ex-

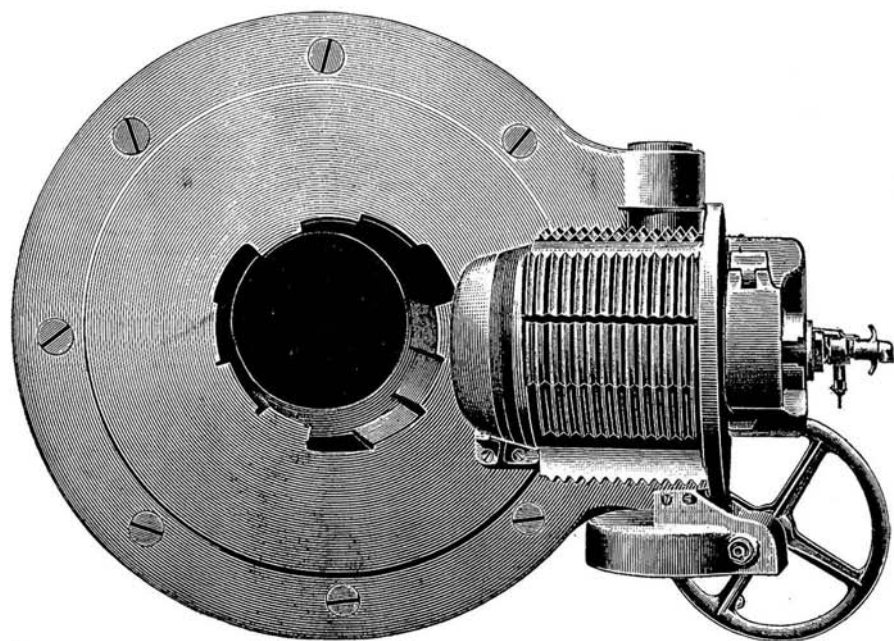
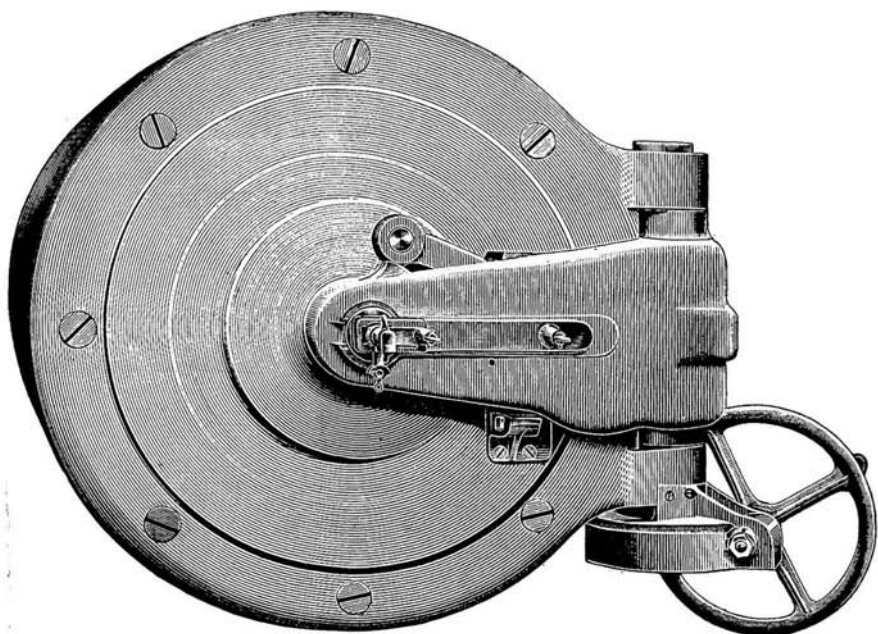
tractor (18) is normally held against the stem by its spring (19); when the wedge moves downward, the pawl (26) strikes the lower end of the extractor and ejects the primer case, after which the pawl slips by and the extractor is snapped back into place by its spring. In a recess in the wedge is placed the insulated firing pin (14) with its point resting against the primer and affording at its rear end a contact point for the hammer; the spring (37) exerts its force to hold the pin *away* from the primer.

The *hammer* (5) is mounted on the hammer stem (6), which turns in and moves back and forth in a tube cut in the left side of the receiver. When firing by percussion, the hammer, after closing the wedge, is drawn to the rear, compressing the firing spring (25) until the point of the sear (24) catches in a notch at about the middle point of the stem and holds the hammer in the cocked position. The firing lanyard is hooked to the trigger (21); no spring, other than the sear itself, is used in the sear and trigger device. The wedge cannot be operated when the hammer is cocked. When firing by electricity, the hammer is left in the position shown, after closing the wedge, thus establishing an electric connection from the contact lug (21) (Plate I), through the contact pieces (8 and 9) and the firing pin, to the primer. The sleeves of insulation (10, 11 and 17) are made of vulcanite.

A short wire makes the connection between the binding post (12) and the contact lug (21). To the other lug (22) is connected the electric firing wire; the two lugs touch and complete the circuit only when the breechblock is fully closed, and the only break in the circuit is then at the firing key. Premature firing by electricity is therefore impossible, but if the primer is put in place and the hammer cocked when the breech is open there is danger of premature discharge; for this reason, while firing by percussion at least, the gun should be primed and the hammer cocked only after the breechblock is entirely locked. Obviously this is a safe practice even when firing electrically (because of the percussion feature of the primer), and is the plan followed at present.



MARK VI BREECH MECHANISM FOR 12-INCH GUNS.



BREECH MECHANISM FOR 12-INCH BRITISH NAVAL GUN.

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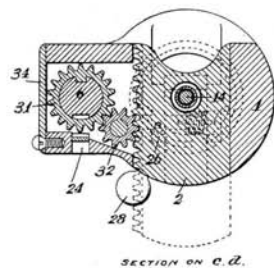


Fig. 4.

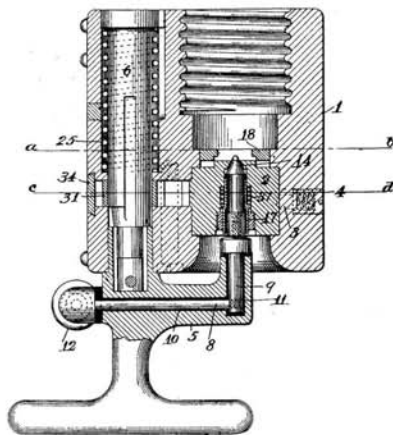


Fig. 1.

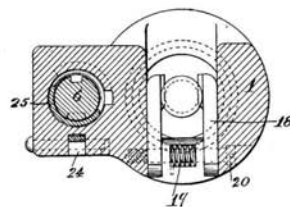


Fig. 5.

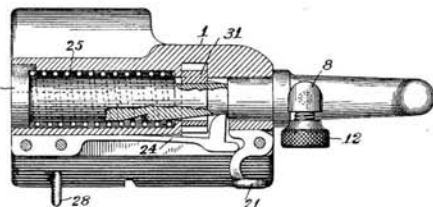


Fig. 3.

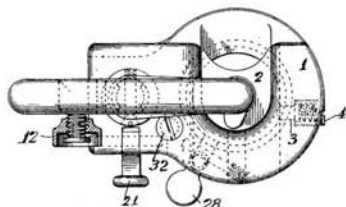


Fig. 6.

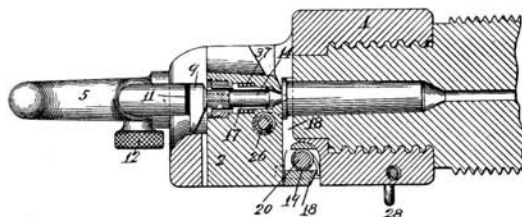


Fig. 2.

THE MARK VIII FIRING LOCK.

## CHAPTER VI.

### BREECH MECHANISMS FOR QUICK-FIRING GUNS.

1. The high-powered Q. F. guns at present in use or being constructed for naval purposes are of 5, 6 and 7-inch calibres; the latter being a new size. The first modern 5 and 6-inch naval guns built were also loaded separately with powder charges in bags and were fitted with the De Bange gas check, but they had slow-acting operating mechanisms; brown powder was used which necessitated considerable cleaning between rounds, and the guns were essentially "slow-firing"; (they are now as rapidly as possible being converted to R. F. guns). The "ordinary" or slow-firing guns, often called B. L. Rs., were succeeded by rapid-firing guns with a quick-acting system of operation; the 6-inch gun was still separately loaded but its powder charge and primer were put up in a cartridge case.

*Cartridge cases* form perfect gas checks and permit the use of any kind of powder without requiring any cleaning whatever between rounds, but, for large calibres, serious disadvantages attend their use: (a) They sometimes stick in loading or in extracting; (b) they involve an increase in the loading interval by the time consumed in removing the empty case; (c) after prolonged firing the empty cases will encumber the deck unless certain men are to be occupied in otherwise disposing of them; (d) when all the ammunition carried is considered, their weight is great; and (e) they are expensive and soon wear out. The adoption of a smokeless powder, which leaves no residue of combustion in the gun, has made it possible to discard cartridge cases and return to the former method of loading the powder charge separately in a bag,—placing the primer in the breechblock. Since a quick-acting system of operation was retained, the change has resulted in no increase in the firing interval; 6-inch Q. F. guns have fired eleven aimed shots per minute in target practice, and the disadvantages of using cartridge cases have been eliminated.

2. The quick-firing mechanisms, which are the 5-inch Mark IV, the 6-inch Mark VI and the 7-inch Mark I, differ only in minor respects. A 5-inch mechanism is shown in its closed position in Plates I and II. In Plate I, Fig. 1 and Fig. 2 show rear and horizontal profiles of the mechanism, Figs. 3 and 4 show the connection of the firing wire, and there are enlarged detached views of some of the working parts. In Plate II, Fig. 1 shows a vertical longitudinal section of the mechanism; Figs. 2, 3, 4 and 5 are views of the firing lock, being respectively a rear elevation, a horizontal section, a vertical longitudinal section, and a vertical section through the hammer stem.

The mechanism has the Welin breechblock, operated on the Vickers' system, fitted with a service designed firing lock. The principal parts of the mechanism are: The breechblock with mushroom and gas check; the carrier; the operating lever and pinion with rotating arm and rotating link; the loading tray, and the firing lock.

It is to be noted that: (a) The screw box is cut in a ring of metal (A) which screws into the jacket, abutting against the rear face of the tube, and is secured from turning by sunken screws; (b) the opening or closing of the breech involves only two steps, viz., *rotation* and *swinging*, there being no *translation*; to enable the block to swing directly in or out of place on the carrier hinge pin, the blanks of the block and screw box and, to a slight degree, the threads, are sloped away, forming curved surfaces which have the hinge pin as a center; (c) a loading tray is attached to the breech of the gun and is worked automatically by the operating gear; (d) the gun uses "combination" primers and no change or substitution is required in the firing lock when changing the method of firing; the lock is opened, closed, and the primer case ejected, automatically.

3. **The Breechblock** (1), of the Welin type, is divided circumferentially into three sections each of which are in turn divided into three steps. The lowest step, or one of least radius is left blank (3) and on the other two are cut screw threads (2) of slight pitch; a narrow gap is left between the steps for convenience in manufacture. On the rear end of the block is left a narrow collar which is of about the same radius as the highest step and is of

the same pitch as the threads of the block; it brings up against the rear thread of the screw box as the block swings into place. A circular recess is cut in the right lower edge of the block (between the blank and the thread) into which the locking-plunger is forced. The block is bored through longitudinally, forming a recess through which the mushroom stem (6) passes; the latter is in turn bored through, forming the primer seat and vent (10). The gas check, of the De Bange type with front split ring (8) and rear disk (9), is compressed between the front face of the block and the mushroom head (5). The latter is secured to the block by a nut (6a) on its stem; the spring (6b) is held between the nut and a bearing surface on the block in such a manner as to compress the gas-check pad; the compression is regulated by the amount the nut is set-up. The rear-most portion of the plug is still more cut away around the mushroom stem to receive the boss (15) of the carrier; the recess runs well into the block and has chased on its surface an interrupted thread (with two blanks), of square section which has the same pitch as have the threads of block and screw box. Four collars of square section but without pitch, also interrupted, are cut on the rear end of the mushroom stem upon which the firing lock is secured. The rotating stud (23) is screwed into the rear face of the block.

**4. The Carrier** (12), a brass L-shaped arm cored for lightness, is hinged to the lug (11) by the vertical hinge pin (14). It contains a slot in its right lower portion in which the operating-lever and pinion are pivoted on the vertical hexagonal bolt (19); also a recess in which the rotating arm (21) works on a horizontal pivot. Above and a little to the left is situated the locking plunger (13) which is pressed forward by a spiral spring, its motion being limited by a stop screw. From the forward side of the carrier, a boss (15) projects forward, to which the block is secured by an interrupted screw thread as described above. The boss is bored out to permit the mushroom stem to extend to the rear for the attachment of the firing lock.

**5. The Operating Gear** includes: the lever (16) and the rotating pinion (20) rigidly connected to each other by their hexagonal hinge pin (19) and working in the horizontal plane; and the rotating arm (21) and rotating link (22), which work in the vertical plane.

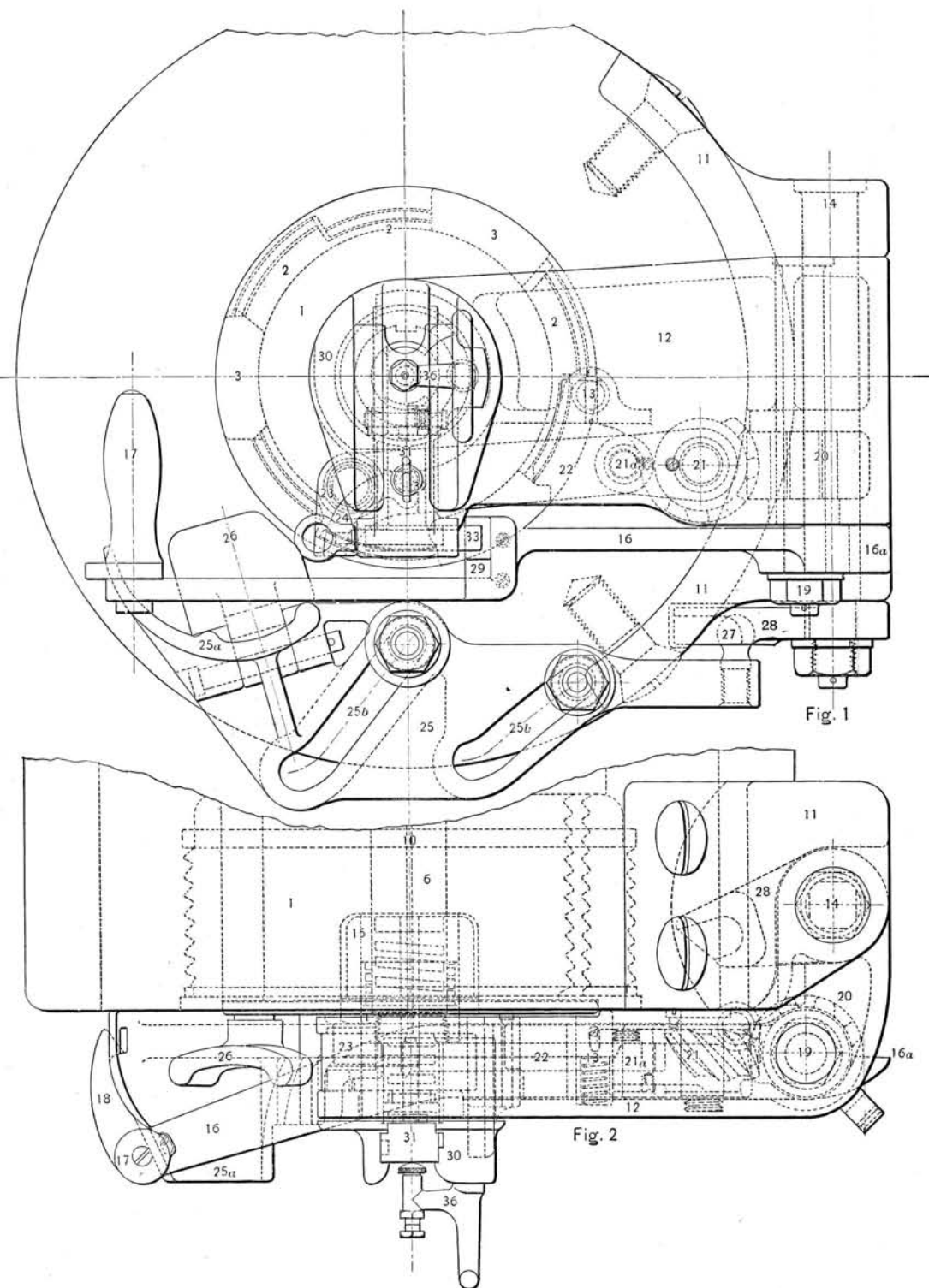
The *lever* (16) is a long steel bar, having at its left end the handle (17), within which is a spiral spring that actuates the lever lock (18) to secure the lever to the loading tray, as shown by the plates. The lever arm curves sharply at about its middle point, forming a cam groove (29) whose function lies in operating the firing lock. The *rotating pinion* (20), working on the same pivot with the lever and above it, has  $45^{\circ}$  "skew" teeth cut around the greater part of its periphery.

The *rotating arm* (21), working on a horizontal pivot, has, on its right and lower sides, "skew" teeth which gear with those of the pinion (20); its left side is drawn out into an arm two inches in length. The *rotating link* (22), entirely unattached to the carrier, is hinged to (21) by the horizontal pin (21a) and has in its left end a socket which receives the rotating lug (23). There is also a cam groove (24) in the rear face of the link which, with the cam groove (29), operates the firing lock.

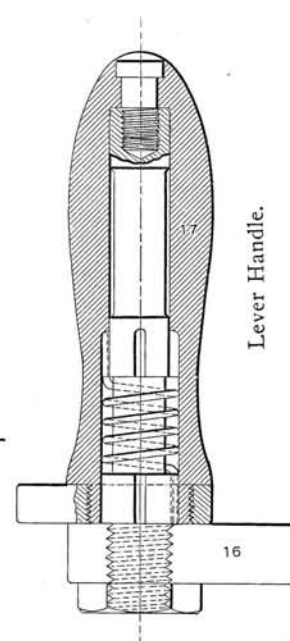
**6. The Loading Tray** (25) is an irregularly shaped brass casting held to the lower part of the face of the breech by two bolts working in curved slots (25b). The tray proper (25a) is at the left side of the casting—when the breech is opened it lies on a level with the bottom of the gas-check seat. The hinged lip (26) drops down, when the projectile is inserted, to protect the screw box, and automatically hinges itself up when the tray is lowered. In the left edge of (25a) is cut a notch over which the lever lock hooks. The *loading-tray lever* (28), fitting over a square section on the lower end of the hinge pin, and turning with it, has in its end a recess which engages the stud (27) of the loading tray.

**7. The Operation** of the mechanism, not considering the firing lock, comprises only *rotation* and *swinging*, and is performed as follows: To *open*:

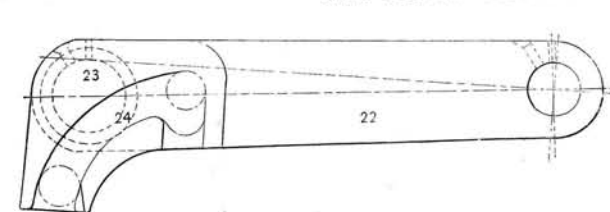
The handle of the operating lever is grasped and turned to the left, releasing the lever lock, and the lever is then swung to the right until the carrier strikes against the hinge lug (11), bringing the face of the block about parallel with the axis of the bore. *Unlocking*: As the lever is swung to the right, the pinion (20) turns with it and, gearing with the teeth on the hub of (21), throws the left end of the arm downward; this draws the link (22) and consequently the lug (23) to the right and the block is rotated



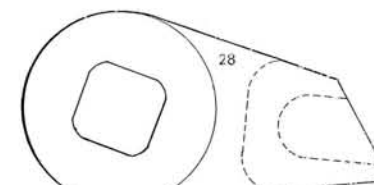
5-INCH Q. F. BREECH MECHANISM. MARK IV.



Lever Handle.



Rotating Link.



Loading Tray Lever.

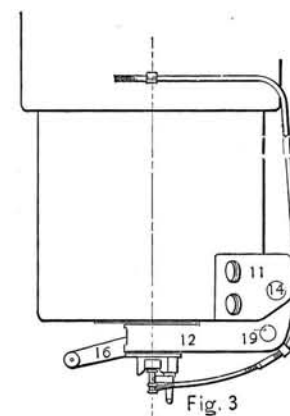
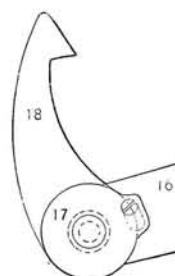


Fig. 3



Lever Lock.

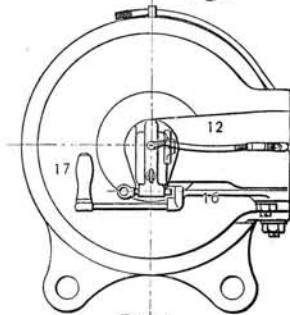
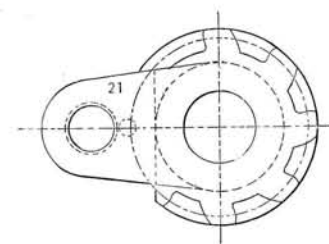


Fig. 4



Rotating Arm.

*Page 109b*

against the hands of a watch. This motion continues until the lug (16a) brings up against the carrier and the unlocking is completed. *Swinging*: The center of motion now changes to the hinge pin (14) and the block swings out of the gun on its carrier; when the latter leaves the face of the breech the locking plunger (13) springs forward into a recess in the rear edge of the block and holds it securely from further rotation while the breech is open. As soon as the block is clear of the gun, the loading-tray lever (28) engages the lug (27) and pulls it to the right; the motion of the tray being constrained by the shape of the slots (25b), it also rises, as well as moving to the right, so that, when the bottoms of the slots (25b) strike the bolts, the tray is in position for loading.

To *close*: *Swinging*. The lever being swung to the left, the loading tray is first moved down out of the way by the lever (28) before the block gets to it. At the end of the swinging movement, the rear thread of the plug strikes the rear screw-box thread, the locking plunger is forced rearward out of its recess in the block, leaving the latter free to begin—*locking*. The motion of the lever being continued on (19) as a center until it lies against the carrier and locks itself to (25a), the operating gear acts in the reverse direction to rotate the block to its locked position.

**8. The Firing Lock** employed on Q. F. guns, known as the Mark IX Lock, is adapted for combination primers to be fired either by electricity or by percussion; it is intended that, as far as possible, all firing be by electricity and that percussion firing be regarded as an alternative. The Mark IX lock (see Plate II) is in principle very similar to the Mark VIII lock for B. L. Rs., described in the preceding chapter, though it is greatly different in external appearance; it is, however, operated automatically instead of by hand and it is principally in this feature that the two locks differ from each other.

The receiver (30) is secured to the mushroom stem by interrupted collars, and its rear portion is larger than that of the Mark VIII lock—to accommodate a longer wedge. The wedge (31) extends well below the center of the breechblock and has in its lower portion the pin (32), which engages the cam groove (24) of the rotating link, and the pin (33) which engages the groove (29) of the operating lever. Both of these pins are held



against their cammed surfaces by spiral springs, as shown in the plate, and are so fitted that they may be retracted against their springs and turned until lugs (32a and 33a) enter grooves (31a) in the wedge by which they will be held out of action; the lock must then be operated by hand. In other respects, the wedge with its firing pin (35), extractor (34), friction pin, etc., is like that of the Mark VIII lock. The hammer (36), firing spring, sear (37), trigger (38), gear wheel and idle gear are also unchanged. The firing wire is attached to the hammer, as is shown on Plate I, Figs. 3 and 4, and the actual firing, whether by electricity or by percussion, is effected exactly as with the Mark VIII lock; the *firing* is not automatic—only the opening and closing of the lock and the ejection of the primer case.

*Operation:* (a) When the pins (32 and 33) are drawn in, out of action, the lock is operated by twisting the hammer to the right or left, while it is lowered. This may be done when the breech is closed or opened and the lock is to be operated in this way if it be desired to prime, re-prime after a miss-fire, or to remove the primer, *while the breech remains closed*.

(b) If the pins (32 and 33) be put in action, as is intended, the lock will be actuated automatically, as follows: Suppose the breech closed and the gun fired. As the lever is brought to the rear the cam groove (29) forces the pin (33) downward slightly, sufficiently to revolve the hammer a little, breaking the connection, but not enough to wholly open the wedge. The rotating link, moving to the right, brings (32) downward, by the action of the cam groove (24), and the wedge is lowered to its full travel and the primer sharply ejected. While the loading is being performed a new primer is placed in the lock. During the first part of the *locking* the link (22) acts in the reverse manner and partially closes the wedge, but its cam groove has not great enough travel to entirely finish the closing. However, just as the locking of the breechblock is completed and as the lever nears the end of its swing, the cam groove (29) strikes (33) sharply, closes the wedge and turns the hammer to its closed position, making the connection, and the gun is made ready for firing electrically. If it now be desired, or be necessary, to fire by percussion, the laniard is hooked to the trigger and the hammer cocked.

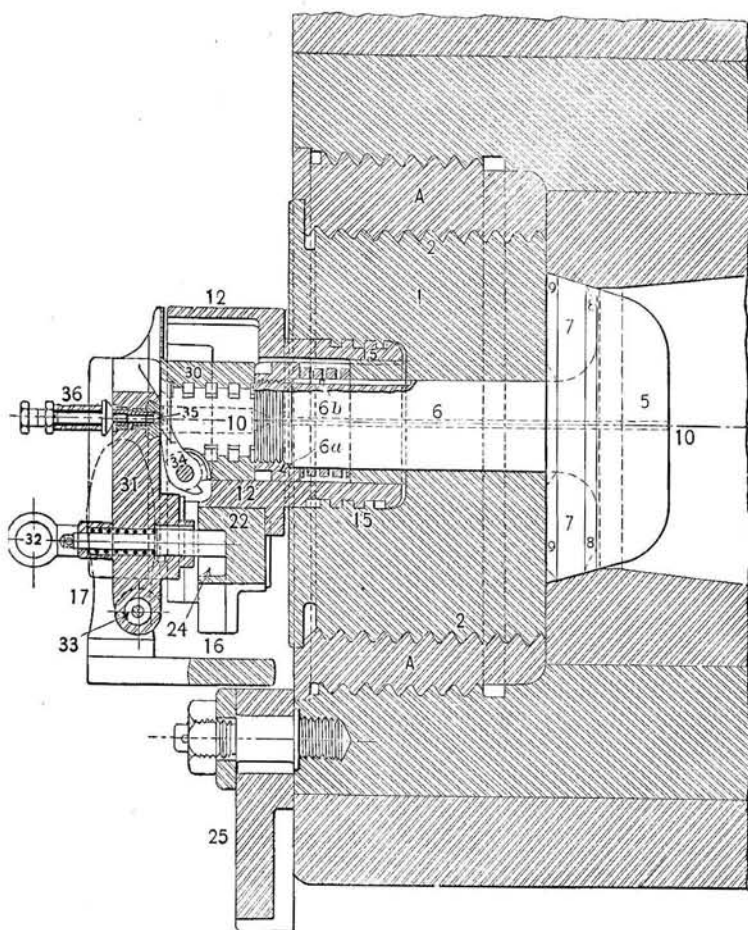


Fig. 1.

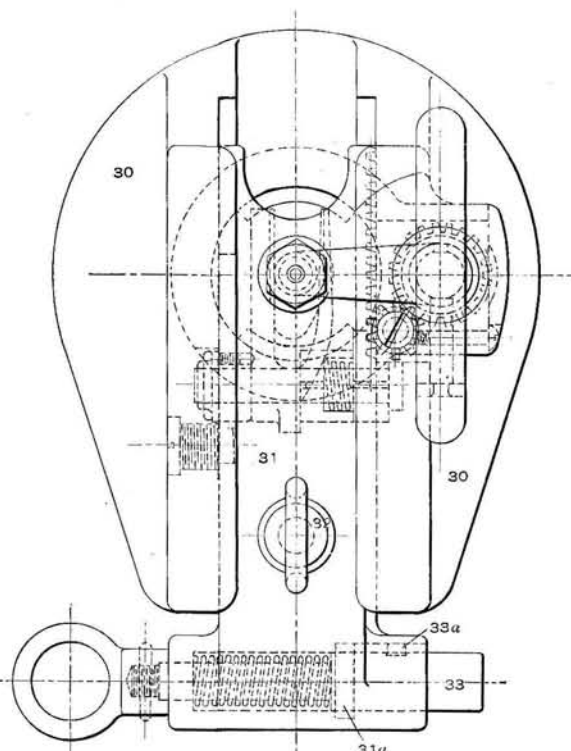


Fig. 2

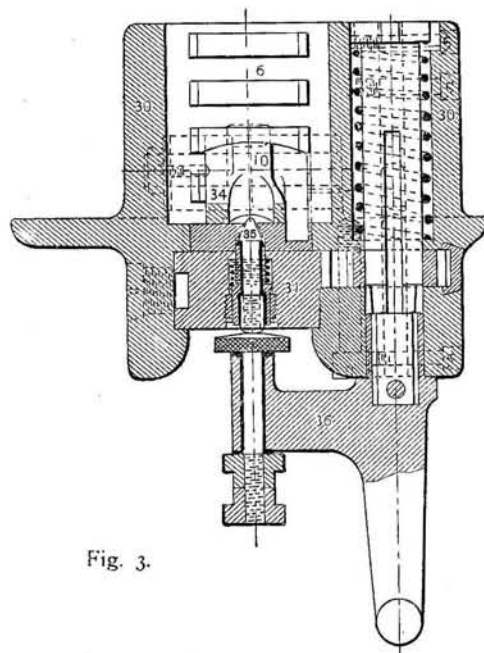


Fig. 3.

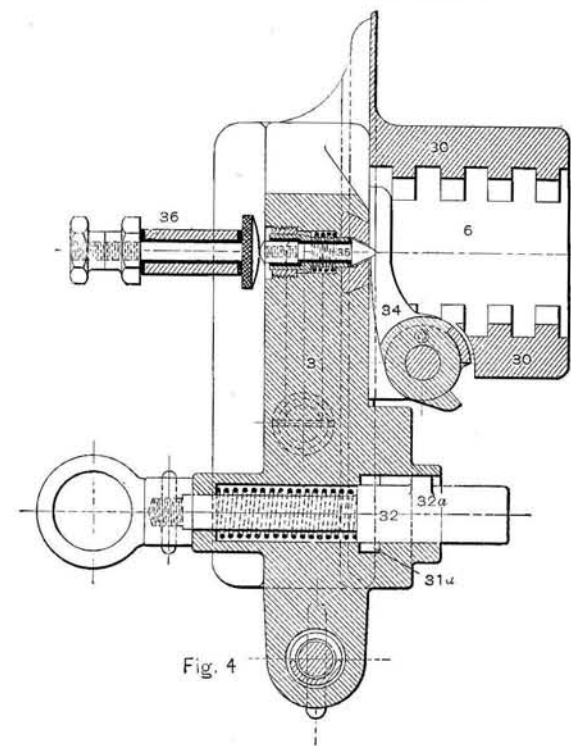


Fig. 4

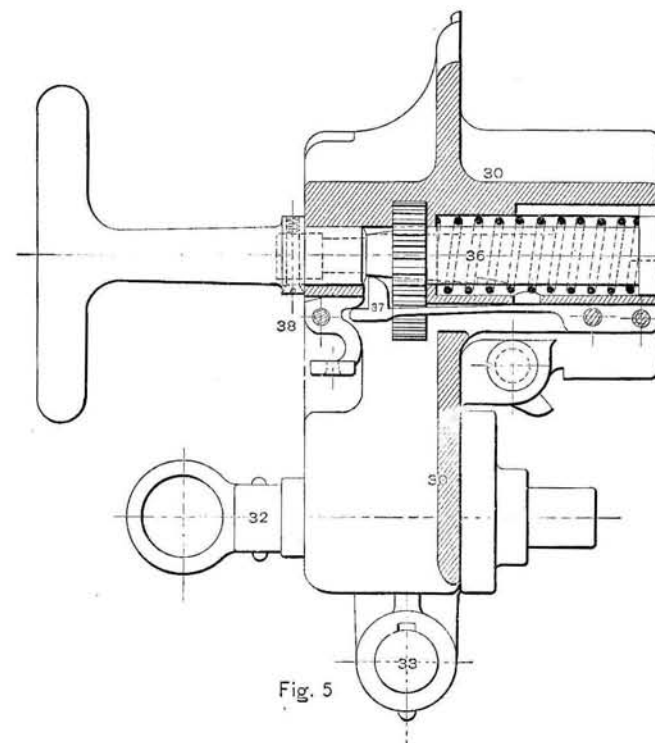


Fig. 5

*Page111b*

**9. Safety.**—The breechblock will not open when the gun is fired or at extreme elevation because: (a) No external force can so act on the block as to make the operating-gear work backward; (b) the lever lock prevents the operating lever from swinging open unless its handle has first been twisted to the left.

The gun cannot be fired prematurely, because: (a) The firing point is not in contact with the primer, or (b) the hammer with the firing pin, and (c) the hammer cannot be cocked, until the breech-lock is locked—as long as the lock is being worked automatically.

**10.** The 6-inch Q. F. mechanism is, with the exception of one or two minor details, the same as the above.

The 7-inch Q. F. mechanism is also similar except that the carrier, extending farther to the left, overlaps the block and engages a locking device on the left face of the breech, designed to secure the carrier to the gun while the block is swung into the screw box.

## CHAPTER VII.

### THE DASHIELL BREECH MECHANISM.

1. **The Dashiell R. F. Breech Mechanism**, named from its inventor, Lieut. R. B. Dashiell, U. S. N., belongs to the "interrupted-Screw system," and its distinctive features (barring the firing mechanism) lie in the method of operating the plug and in the extractor. The plug is supported when withdrawn from the screw box in a combined collar and tray, hinged to the gun, provided with an automatic tray latch similar to other service types. All the operating mechanism is carried on the tray casting, except the trigger, which is on the gun. The extractor is carried by the plug.

2. This type of mechanism is fitted to one 6-inch gun, 86 5-inch guns and 164 4-inch guns, and is for 5-inch guns the Mark II mechanism and for 4-inch guns the Mark III mechanism; a special firing mechanism is required for each of two varieties of primers used.

The plug (1) and screw box have four blank and four threaded sections (left-hand threads); the rear thread of the plug extends across the top blank in the locked position and acts as a stop, while pushing the plug into the screw box, by bringing up on the first screw-box thread. The following are the principal parts: Plug and face plate; combined collar and tray; tray latch and spring; hinge pin; rotating rack; translating arm and pin; operating lever and fulcrum pin; extractor and spring; firing mechanism—all made of steel. The plates show the block, in its closed position, with percussion firing mechanism; the electric mechanism is shown in a detached view.

3. **The Breech Plug** (1), threaded and slotted as above, has on its rear end a circular projection with an "undercut score" (9) for the upturned toe (44) of the translating arm. The upper and lower sections of the screw box are blanks, hence the bottom sec-

tion of the plug, in the unlocked position, is threaded. This section has a fore and aft groove cut through its center, to pass over the center tooth of the rotating rack (45).

There is a rectangular longitudinal hole (8) through the plug on the right side (in the closed position) for the extractor, a hole and dovetail (10) on the left side of the plug in the transverse horizontal plane for the sear, and a slot in the vertical plane for the cocking lever. In the axis of the plug is a longitudinal circular hole (7) for the firing pin. To the rear face of the plug is secured by screws a ring called the face plate (2), on the lower side of which, in the unlocked position, are a set of teeth (3) (to engage the rotating rack), a latch-trip toe, and a curved bearing surface on the right side to rest on the side of the tray. When on the tray the space between the left two teeth works on the guide rib (22) of the tray. To the upper rear face of the plug is secured a bracket (53) for the cocking lever.

The firing-pin hole is closed at the rear end by a nut called a "firing-pin guard" (55). This nut is threaded to screw in the plug, and on later mechanisms the screw is slotted so as to require only a quarter turn to put in place; a keep screw prevents turning. A hole is cut through the guard on the left side for the sear and a slot, for the cocking lever, in the top.

**4. The Combined Collar and Tray** (20) is in one casting, having on the right side two lugs (23) by which it is hinged to the gun; it supports the plug and all parts not on the gun and swings the whole clear of the breech for loading. The tray is provided on the underside with a lug (27) to carry the tray latch; on the upper left side with a guide rib (22); with a curved bearing surface on the right side to guide and support the plug; with a transverse groove (24) for the rotating rack, and with a vertical square hole near the rear end for the latch-trip toe (25).

On its right side the tray is hollowed out to admit the cogged arc of the operating lever; there is a vertical hole near the hinge, threaded on the bottom for the translating-arm pin (43), and a curved hole (29) in its bottom plate for the fulcrum pin, struck with a radius having the former pin as a center. On the upper rear face of the collar is a projection containing the cocking groove (21), the groove being undercut and closed at the top.

The two hinge lugs (23) fit over a hinge loop milled out on the right side of the gun; a vertical hole (30) being drilled through in which fits the hinge pin (32). Some of the early mechanisms had a set screw through the hinge loop which entered a recess in the pin to prevent the latter from lifting. In the closed position of the plug the center of the hinge pin, translating-arm pin, and the fulcrum pin are in a line parallel with the gun's axis,—one to the rear of the other in the above order. The right lower end of the tray projects beyond the gun and the transverse slot for the rotating rack (24) extends to the end. The lower lip or plate of this extension is joined to the tray proper and contains the curved slot for the fulcrum pin above mentioned.

**5. The Tray Latch (33)** is "automatic," being the pioneer of such types on United States Navy mechanisms. It is fitted to the Mark III 4-inch and Mark II 5-inch guns, as follows: The latch, pivoted on its pin (35) carried by the split lug (27) on the underside of the tray, is provided on the front end with a lever toe called the "latch catch" (33b) to engage the hook or tray catch (80) in the gun, and an upper toe or latch lock (33a) to rise in front of the plug when on the tray and prevent forward movement; and in the right lower side with a square shoulder that is engaged by the latch-lock bolt (36). On the rear end it has a hand trip (33d), and a vertical toe called the "latch trip" (33c) to be acted upon by a toe on the face plate in opening, to trip the latch. A flat spring (34) is secured by two screws to the underside of the tray, in the latch slot of the lug, the front end of which bears down on the front arm of the latch.

In the tray, at the front end on the right side of the latch, is a spiral spring surrounding a plunger (36) called "latch-lock bolt." It is provided with a small arm on the left side to secure the latch from any movement while the tray is clear of the gun, so that the plug cannot be started off by swinging over the latch lock against the tray latch spring.

**6. The Operating Gear.**—This consists of the rotating rack (45), translating arm (42), and hand lever (37). A rotating-rack stud (79) is screwed into the breech face of the gun to limit the movement of the rack in the operation of unlocking the plug.

**7. The Extractor (75)** is a flat bar, finishing at each end with

a hook or shoulder that passes through a fore and aft hole (8) in the plug, clear of the threaded parts, and is held down by a flat spring (76) on its back, bearing against one side of the hole.

The nib (75a) or front end of the extractor is broadened and suitably shaped to fit the rim of the cartridge case. A shoulder on the outer face at the forward end bears against a lug secured to the front face of the plug, when the extractor is in its forward or pulling position, so that slipping off the rim of the case is prevented; but in closing the extractor slides back to its rear position, when the nib can snap over the case's rim. An extractor-keeper screw (78) is provided, which passes through a threaded hole in the face plate and bears the rear end of the extractor toward the center to prevent the rear shoulder (75b) from ever sliding within the hole in the plug. The distance between the hooks being greater than the length of the plug, there is a certain amount of lost motion which is utilized in the extraction, for, when the plug is withdrawn, the extractor does not commence to pull on the empty case until the rear face of the plug brings up suddenly on the rear shoulder, giving a hammer effect to start the case to the rear.

**8. The Percussion Firing Mechanism** consists of the following principal parts: Firing pin; saddle; mainspring; cocking lever; cocking-lever bracket; releaser (sear); sear spring; and trigger mechanism, consisting of trigger box, trigger and trigger spring, all made of steel.

The firing pin (46) is a straight cylindrical piece with a cone-shaped head and point (46a). It is surrounded by a spiral spring (47) that lies between the head and a loose-fitting saddle or sleeve (48) moving fore and aft on the shank (46) of the pin. A nut (49) is screwed on the rear end of the pin. The nut has an annular groove (49a) used as a lock notch. The firing pin complete slides back and forth in the axial hole of the plug, partly guided by the firing-pin guard (55), and housed in by it.

A cocking lever (51) is pivoted on a pin in the cocking-lever bracket (53) secured to the plug above the center by four screws. Its upper end works in the cam-shaped cocking groove (21) in the collar, while the lower end is forked to fit over the saddle on the firing pin.

A sear (57) works to the right or left in a dovetail and hole in



the rear face of the plug; the inner end engages the cock groove of the firing-pin nut, while the outer end is shaped into a toe, projecting forward, that is engaged by the trigger.

The sear is guided and limited in its movement by a screw (58) passing through an elongated hole into the face plate, and is kept to its work or pressed in toward the plug's center by a flat sear spring (59) held in a dovetail in the face plate by a screw and bracket (60).

The trigger box (61) fits in a horizontal transverse slot on the left side of the gun, and is secured to the gun by screws (62). This carries the trigger (63), which is a bell-crank lever, pivoted at its elbow, the inner arm forming a rear projecting toe to engage the sear, while the outer arm is connected to the firing lanyard which leads forward so that a pull moves the inner arm or toe to the left. The trigger spring (65) is spiral, seats in a hole in the gun and bears to the rear on the trigger arm, to keep the trigger toe clear of the toe of the sear in operating the plug. Incidentally the strength of the spring somewhat regulates the amount of pull on the lanyard.

**9. The Electric Firing Mechanism**, designed to fit the same recess in block that the percussion mechanism is installed in, consists of a firing case, insulated firing pin, and an attachment lug. The firing case contains the insulated firing pin, and is put on the breech plug in place of the firing-pin guard, being secured by the same screws. The attachment lug replaces the trigger box, and is secured with the same screws.

The firing case (66) consists of two tubular pieces (an axial and a radial arm) made of steel. The former has its rear end enlarged, threaded, and slotted to correspond with the firing-pin guard, the front portion fitting neatly into the axial hole in the plug for the percussion firing pin. The latter piece screws into the former near the rear end and at right angles. The hole in the rear end of the axial piece, closed by a plug, is for convenience in manufacture.

The firing pin (67, 68) consists of an axial (67) and a radial (68) arm, or inner and outer piece, screwed together at right angles (near one end) after being placed within the tubular insulation (69), which is surrounded by the firing case. Each arm

consists of three parts, an inner and an outer piece joined by a spiral spring soldered over a small spindle left on each piece. The outer piece of the axial pin has the conical head and point which makes contact with the primer; the outer piece of the radial pin makes contact with the contact piece of the attachment lug, and has a shoulder (left in turning the outer part to a smaller diameter) to keep the insulation in place. The insulation is made of vulcanite or wood-fiber tubing, as per drawing.

The attachment lug (70) is bored out to contain a contact or terminal piece (73) and a spring terminal socket (72), which are screwed together and secured by the insulation (74) of vulcanite, as per figure. For guns having telescopic sights on the mount, the attachment lug has a part leading forward to contain the spring socket, which is joined at right angles to the contact piece. One end of the firing wire is pushed in the spring socket, while the other goes to the battery, one pole of which is grounded on the mount. When the breech is fully closed, the insulated firing pin makes contact with the insulated piece in the lug and only then, so that when the firing key is pressed, the circuit is completed and the primer exploded.

**10. Action of the Breech Mechanism as a Whole.—Opening.**—(Supposing the breech closed and the hand lever folded across the breech face.) By the continuous swing of the hand lever to the rear and right, the plug is unlocked and withdrawn on the tray; the percussion firing mechanism, if fitted, is cocked, the case extracted, and the plug and tray swung out clear of the breech.

**Unlocking.**—The first movement of the hand lever, on the fulcrum pin as a center, through its cogged arc moves the rotating rack to the left. This revolves the plug until unlocked, at which point the rack brings up against the stud on the gun. During this revolution the upper end of the cocking lever, moving in the cocking groove in upper part of the collar, is thrown forward, which results in the forked lower end, engaging the saddle of firing pin, moving the firing pin to the rear until the groove in the nut is engaged by the inner end of the sear, the latter snapping over the nut into the groove. This cocks the mechanism. The cocking lever will now be clear of its groove in the collar.

**Translation.**—The center of the lever's movement is now trans-

ferred to the right cog immediately below the translating-arm pin, and a continued pull on the lever will result in the fulcrum pin moving to the right in the curved slot in the tray and carrying the translating arm with it. The hand lever and translating arm move in unison on the latter's pin as an axis, and the upturned toe of the translating arm withdraws the plug onto the tray. The plug is guided by the rib on the tray and a blank sliding on the guide surface at the right side of the tray. It is kept from any rotary movements by the threaded section and teeth on the face plate lying between the tray guides, while a groove cut in the threaded section passes over the center tooth of the rack. Near the latter part of the plug's withdrawal onto the tray, a trip toe on the face plate (beveled off to the rear in a curve) rides over the latch-trip toe, and trips the latch. The front end of the latch, on rising, is disengaged from the tray catch or hook on the gun and frees the tray. At the same time the latch hook, too, rises up in front of the plug and secures the latter from longitudinal movement on the tray, while the latch-lock bolt is forced out by its spring and engages *under* the shoulder left on the latch, preventing movement of the latter as long as the tray is clear of the gun's breech face. The movement of the hand lever and translating arm is arrested by the fulcrum pin bringing up on the end of the curved slot in the tray, at which movement the above operations have just taken place.

*Swinging open.*—Further movements of the lever will now result in swinging the plug and tray away from the breech on the hinge pin as an axis, until the front side of the tray's extension brings up on the side of the gun. The front face of the plug will now be in a plane parallel with the gun's axis, the breech will be clear, and the gun can be loaded after the old case has been removed. If the electric firing mechanism be fitted, the contact is simply broken when the plug is revolved. It will be noticed that the hand lever has three success centers of rotation (41, 31 and 32) during the swing to the right.

**II. Closing.**—*Swing and translation.*—The reverse movement of the hand will result in the reverse operations. When the tray strikes the breech face, the latch-lock bolt will be pushed to the rear to disengage the latch, and, if the hand lever is at all "smartly



*Page 119b*

worked," the plug will start into the screw box, being forced in by the translating arm, which now, with the lever, moves about the former's pin. The latch turns to engagement with the tray catch by the action of its spring the moment the plug starts to the front and clears the latch-trip toe. This frees the latch-lock toe from the plug's front face. The translation of the plug into the screw box is arrested by the last thread on the plug bringing up on the rear thread of the screw box, and the fulcrum pin having reached the end of its curved slot, it arrests the movement of the translating arm.

*Locking.*—The hand lever will now turn about the fulcrum pin as a center, which results in moving the rack and locking the plug; the motion is stopped by the hand lever bringing up on the tray. During the revolution of the plug, the upper end of the cocking lever, moving in the groove in the collar, is pushed to the rear. This pushes the sleeve on the firing pin forward and the firing spring is compressed. The last movement in closing brings the sear toe in engagement with the trigger toe, and until then the sear cannot be moved.

*Firing.*—On pulling the firing lanyard attached to the outer arm of the trigger, the sear will be moved to the left, the firing pin will be disengaged, will fly forward under the action of the spring and strike the primer of cartridge case, firing the gun. If the electric mechanism be fitted, the last movement on locking the plug results in bringing the outer arm of the insulated firing pin in contact with the contact piece of the attachment lug. If the circuit through the battery be completed, the gun will be fired, as the inner arm or point of the firing pin is in contact with the primer.

**12. Safety of the Breech Mechanism.**—The breech will not open on firing on account of the reaction of the operating lever, friction and shape of the screw threads, and friction of the gearing.

The gun cannot be fired until the breech is fully closed: *First*, with the percussion firing mechanism, because (a) the collar is so shaped that the sear has not sufficient movement until the plug is fully locked, when the toe on the sear comes to a cut in the collar, and this is the only position in which the trigger is engaged; (b) the firing-pin spring is not sufficiently compressed until the plug is locked; (c) the firing pin would not have sufficient throw

for the point to strike the primer until the plug is fully locked, as the cocking lever holds the saddle in some intermediate position; (d) the point of the firing pin cannot strike its primer in closing, as it is always within the nose of the plug by reason of the cocking lever bringing it to the rear in the act of unlocking. [It is possible, however, that a percussion primer may be exploded by the blow of the breechblock while closing on the base of the cartridge case; this accident has occurred abroad with serious consequences and the danger of it exists wherever percussion primers are used with swinging breechblocks of this or other types.] *Second*, with the electric firing mechanism, because (a) no contact is made between the firing pin and the attachment lug's contact pieces until the plug is locked.

**13. Notes on the Dashiell Breech Mechanism.**—If the cartridge case sticks so that the extractor can not pull it out, the breech may be opened by inserting a screw-driver as a pry between the rear end of the extractor and its hole. The extractor nib may be sprung over the lip of the case and the plug can be withdrawn. Then use hand extractor.

Sometimes in trying to open the plug after firing it may be found that the plug cannot be rotated by pulling on the lever. In this case, if a copper drift or piece of wood be placed against the outer end of the rack and struck a few light blows while pulling the lever, the plug will be moved.

If it be desired to see the firing point, open the breech, pull on the sear, then pull back the upper end of the cocking lever. This will push the point through the nose of the plug; but observe before closing again to push *forward* the cocking lever and cock the firing pin on the sear; otherwise the lever will not enter the groove in collar, and may be bent or broken.

## CHAPTER VIII.

### THE FLETCHER BREECH MECHANISM.

1. **The Fletcher Breech Mechanism** for rapid-firing guns, the invention of Lieut. F. F. Fletcher, U. S. N., belongs to the "interrupted-screw" system and its distinctive features lie in the method of operating the plug. The plug is supported when withdrawn from the gun by a collar, or carrier ring, to which it is automatically locked by a locking bolt which has other important functions as well; the extractor is pivoted in a slot through the jacket of the gun and is not carried by the plug.

The Fletcher system, which is the last in which two varieties of primers with a special firing mechanism for each is employed, is more recent and, at the time of its adoption, succeeded the Dashiell system; the operating system is distinctive and requires few parts. The Fletcher mechanism is fitted to 34 4-inch guns, known as the Mark IV 4-inch mechanism; to 113 5-inch guns, known as the Mark III 5-inch mechanism, and to 60 6-inch R. F. guns, known as the Mark IV 6-inch mechanism. All of the 4-inch and 6-inch slow-fire guns have been, or are now being, converted to R. F. guns with this mechanism. The same system of operation, considerably modified, is employed in the high power, smokeless powder R. F. guns of 3-inch and 4-inch calibre now being constructed.

The plug (1) and screw box have four threads and four blanks; the threads do not occupy the entire length of the plug, the rear part being left wholly blank for the carrier ring. The principal parts are: Plug, carrier ring, locking device, operating lever and hinge pin, extractor and pin, and firing mechanism (percussion or electric); all parts are made of steel. To obviate the necessity of forging a lug on the right side of the jacket, a hinge plate (4) is bolted to the rear face of the jacket to furnish a bearing for the hinge pin.



2. **The Breechblock** (1), threaded and slotted as above, has a rack (2), with teeth inclined  $45^{\circ}$  to its axis, cut on its right upper quadrant in rear of the threaded portion and extending partially around the circumference. In the left hand upper quadrant of the plug is cut a guide slot extending circumferentially  $45^{\circ}$  and continued parallel to the axis for a distance equal to the amount of withdrawal of the plug through the carrier ring; at its forward end, this slot is gradually deepened and ends in a circular depression in the plug into which the locking bolt drops as the breech is being opened. Along the axis of the plug is cut a longitudinal circular hole for the firing pin; its rear end is partially closed by an adapter nut when using the electric firing mechanism (it is not shown in Plate I, but a later model is shown in Plate II which indicates the thread for the adapter nut). The rear end of the block is also slotted through along its vertical diameter, when closed, to form a recess in which the cocking bar of the percussion firing mechanism works.

3. **The Carrier Ring** (6) hinged on the right side upon the same pin (7) around which the operating lever (9) turns, is cut on its inner circumference with blanks and raised portions to allow the plug to move forward and back in it. The carrier ring (6) is slotted through radially in the upper left quadrant for a locking device which locks the carrier ring to the gun when it is swung to and locks the plug in the carrier ring when the former is withdrawn. Thus in this system the carrier ring acts as collar and plugtray combined, and no part of the mechanism, with the exception of the operating lever, projects beyond the face of the breech when the mechanism is closed.

The cammed recesses (68) on the inside of the carrier ring receive and actuate the ends of the cocking bar as the plug is rotated.

4. **The Locking Device** in the carrier ring (6) consists of a lever (18) pivoted at its center, with a spiral spring (20) under its left end and carrying a locking bolt (16) on its right end; the upper end of the bolt locks the carrier ring to the gun when the mechanism is closed and its lower end locks the plug to the carrier ring when open.

The functions of this device are most important since, besides

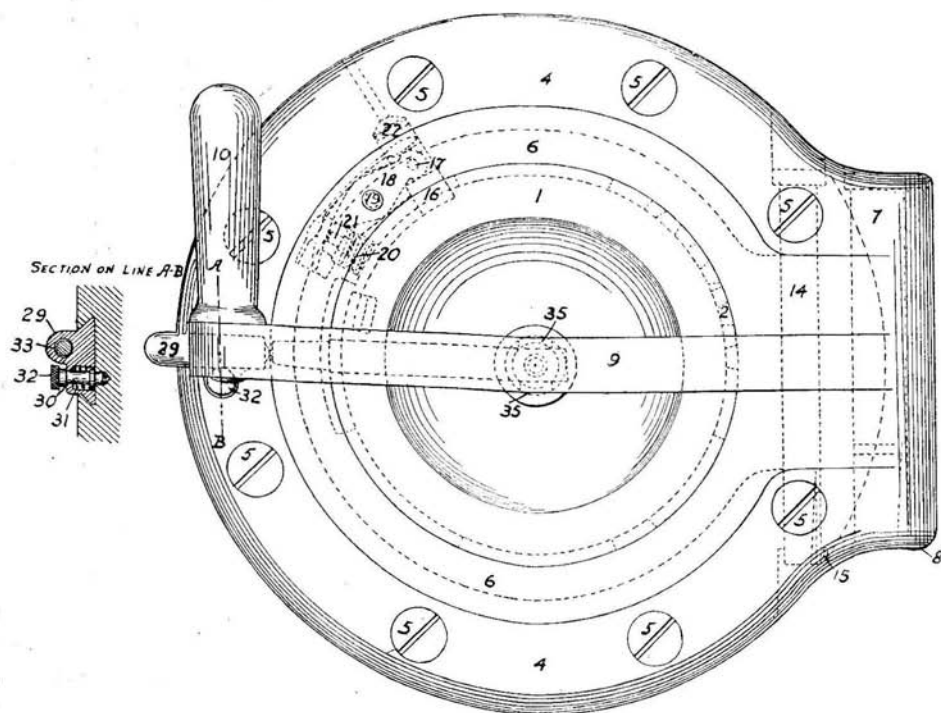


FIG. 1. Plug locked. Electric Firing Mechanism.

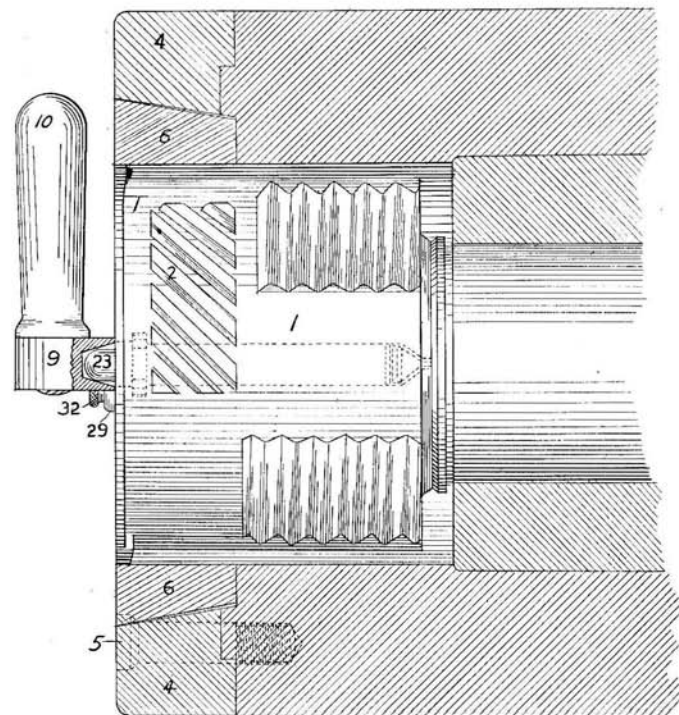


FIG. 2. Plug locked

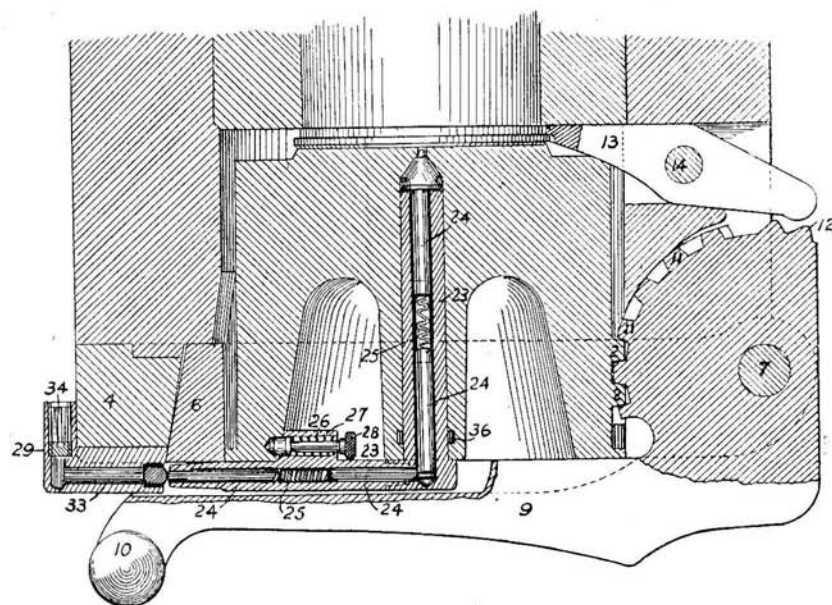


Fig. 3. Horizontal section.

*Page 123b*

performing all the duties of the tray latch in the Dashiell mechanism it also guides the plug and fixes the instant of changing the *swinging* movement to *translation*, etc.

5. **The Operating Lever** (9) has a handle (10) riveted to its left end, and pivots on the hinge pin (7) on the right side of the breech. Its rear right-hand surface is shaped to act as a cam on the outer end of the extractor (13), and its front right-hand surface is shaped into a segment of a circle and cut with five  $45^\circ$  teeth (11) to fit the circumferential rack teeth on the plug and four vertical teeth (12) of the same section as the *threads* of the plug.

6. **The Extractor** (13) is a lever turning about a pin (14) through its center and cut on its inner end to fit under the rim of the cartridge case.

Both hinge pin (7) and extractor pin (14) are held in place by spring locks (8, 15). In guns of the latest manufacture, however, these locks are dispensed with.

7. The operation of the mechanism in one direction comprises, as in the Dashiell system, three steps—*unlocking*, *translation* and *swinging* open, or vice versa. The action of the system, excluding, for the present, consideration of the firing mechanism, is as follows:

*Opening.*—The plug being closed and locked, the locking bolt (16) has its inner end at the upper end of the circumferential part of the guide slot in the plug, and its outer end engaged in a recess (22) in the hinge plate (4), thus locking the carrier ring (6) to the breech of the gun; the rear tooth on the lever (9) is engaged with the lower tooth of the circumferential rack (2) on the plug, and the extractor claw is under the rim of the cartridge case. The lever (9) is swung to the right, through an angle of  $59^\circ$ , thereby successively engaging its teeth (11) with those of the rack (2) on the plug and causing the latter to rotate  $45^\circ$  to the left, disengaging its threads from those of the screw box and leaving it free to be withdrawn. At this moment the locking bolt (16) reaches the end of the circumferential part of the guide slot in the plug and thus prevents the latter from being rotated farther. At the same instant the first of the withdrawing teeth (12) on the lever (9) has come opposite to the middle of a threaded

portion of the plug and on continuing the rotation of the lever (9) these teeth successively engage the threads of the plug and so cause the latter to move to the rear through the carrier ring (6); the locking bolt (16) now moving in the portion of the guide slot which is parallel to the axis of the plug. An angular movement of the lever of  $44^{\circ}$  completes the withdrawal of the plug. At this moment the inner end of the locking bolt (16) reaches the depression at the front end of the guide slot, the spring forces the other end of the locking lever (18) up, thereby pushing the locking bolt (16) down and disengaging it from the recess (22) in the hinge plate (4), and the plug, locked to the carrier ring (6) in its withdrawn position, is free to swing open with the latter.

A further rotation of the lever of  $96^{\circ}$  swings the carrier ring and plug clear of the breech aperture. During the last  $41^{\circ}$  of this motion the rear face of the lever (9) acts as a cam on the outer end of the extractor (13), causing it to withdraw the cartridge case, at first slowly and with great force, and then quickly.

**8. Closing.**—In the reverse operation of closing the mechanism, when the carrier ring (6) swings to, the beveled edge of the locking lever (18) strikes the inner surface of the hinge plate (4) and is forced down into the carrier ring (6), thereby lifting the locking bolt (16) out of its seat at the front end of the guide slot in the plug. Then as the plug moves forward, the slope of the bottom of the guide slot (3) lifts the locking bolt (16) farther and forces its outer end into the recess (22) in the hinge plate (4), thus again locking the carrier ring (6) to the breech of the gun. When the plug is closed, the teeth (11) of the lever (9) engaging the rack (2) in the plug act as an efficient lock to prevent the plug from being rotated by any pressure on its face due to firing.

**9.** It will be observed that in closing the mechanism the action of the locking device is positive throughout, but that in opening, a spring (20) is required to start the locking bolt from its recess in the hinge plate. To provide against the unlikely failure of this spring, a small hole is bored down through the hinge plate into the locking-bolt recess, through which any small pin or rod can reach the locking bolt and force it down in case it sticks.

**10. The Electric Firing Mechanism** consists of a steel case (23) formed of two parts screwed together at right angles to each

other, through which extends an insulated firing pin (24). On the radial arm of the case is a spring catch (26) for locking the attachment in place, and on the axial arm are two lugs (35). The *firing case* (23) is pushed into the plug with the radial arm vertical, the two lugs entering a slot in the face of the plug, and is then turned  $90^\circ$  to the left, the lugs (35) turning into a recess (36) so as to prevent the case from being blown out, and the spring catch holding it in the proper position. In the later type the recesses (36) are replaced by the adapter nut (not shown) which is to be screwed on when substituting electric for percussion mechanism. The insulated firing pin (24) consists of four parts, the two inner ones screwed together at the joint of the case, and the two outer ones separated from the inner ones by spiral springs (25) which press them against primer and attachment lug.

The *attachment lug* (29) is another steel case fitting into a dovetail in the left side of the hinge plate, and held there by a spring catch (30). An insulated circuit, with a contact piece (33) at one end and a spring socket (34) at the other, extends through it.

The operation of the electric firing mechanism is as follows: When the plug is pushed home the point of the firing pin (24) is pressed against the electric primer in the base of the cartridge case, and when the plug is turned and locked the other end of the firing pin comes opposite and is pressed against the contact piece (33) of the attachment lug, thereby giving an insulated metallic connection from the electric primer to the spring socket (34).

One pole of the electric battery is permanently connected to the metal of the mount, and the other pole is connected by an insulated wire passing through the firing key to the spring socket (34). Consequently, the connection being made, closing the firing key ignites the primer. The wire from the firing key ends in a metal cone which fits the spring socket (34), and this wire may be of a length such that the recoil of the gun breaks the connection at that point. It is evident, however, that in no case can the gun be fired electrically until the plug is completely locked, because until then the firing pin is not in contact with the attachment lug. If a blow back from the primer occurs, the escaping gas forces the

firing pin (24) back slightly, when the head of the pin seals the front end of the firing case (23) and prevents injury to the insulation.

11. **The Percussion Firing Mechanism** (Plate II), designed to fit the firing-pin recess of the block, is, like that of the Dashiell system, of the type in which the firing pin is drawn to the rear while opening the breech and the firing spring compressed as the breechblock is locked during closing. The principal parts are: The firing pin and spring, the cocking bar, the sear bar and spring, and the trigger box and trigger. The firing pin (44) has a conical head ending in the firing point (47); on its rear end is screwed a head (45) with a cannellure in which the sear is caught. The firing spring (46) surrounds the firing pin between its head and the cocking bar (43). The latter, a nearly straight bar of steel, works back and forth on the firing pin in slots cut through the plug; its extremities are rounded to fit the cammed grooves (68) of the carrier ring. The sear bar (49), bearing the sear (49a), is dovetailed in across the horizontal diameter of the plug, closed position, and the sear spring (51) forces this sear toward the firing pin and the sear bar toward the trigger (63). The trigger box (62) is of the same shape as the attachment lug of the electric mechanism and is secured to the gun in the same way; it contains the trigger pivoted at (64); the spring (65) forces the trigger in a direction opposite to that in which the lanyard, attached to the outer end, acts.

The *operation*, assuming the mechanism cocked for firing, is as follows: When the lanyard is pulled, the sear is forced to the right by the trigger until the firing pin is freed; it flies forward from the force of the firing spring and the gun is fired. As the breechblock is unlocked by turning to the right, the cocking bar also rotates, its ends move along the grooves (68) in the carrier ring, and it is brought to the rear with the firing pin; at the moment that the unlocking of the plug is completed, the firing pin reaches the limit of its rearward motion and the sear snaps over its head. Then as the translation of the plug begins, the ends of the cocking bar emerge from the grooves (68) and the mechanism is retained in this position of full cock, firing spring slack, until the last step in closing. During the relocking of the plug,



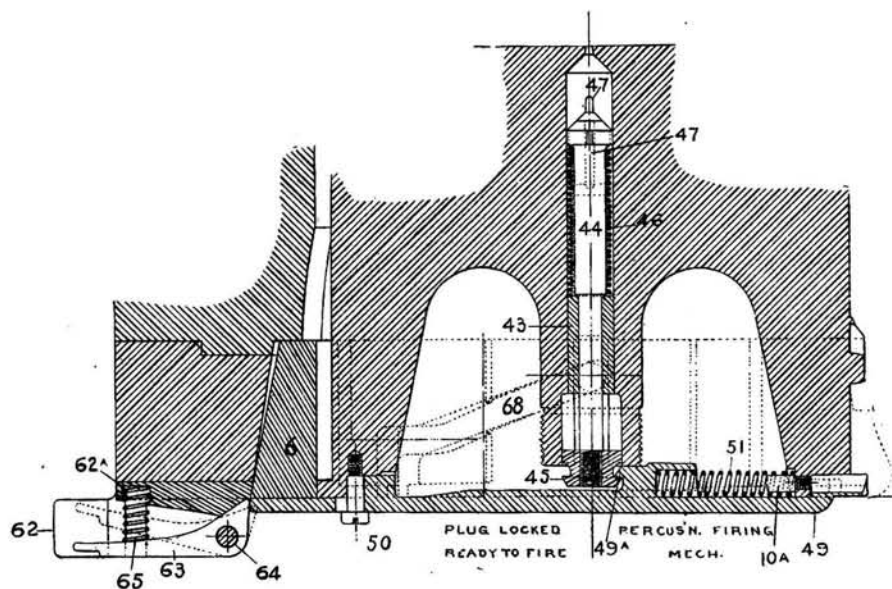


Fig. 1. Horizontal section.

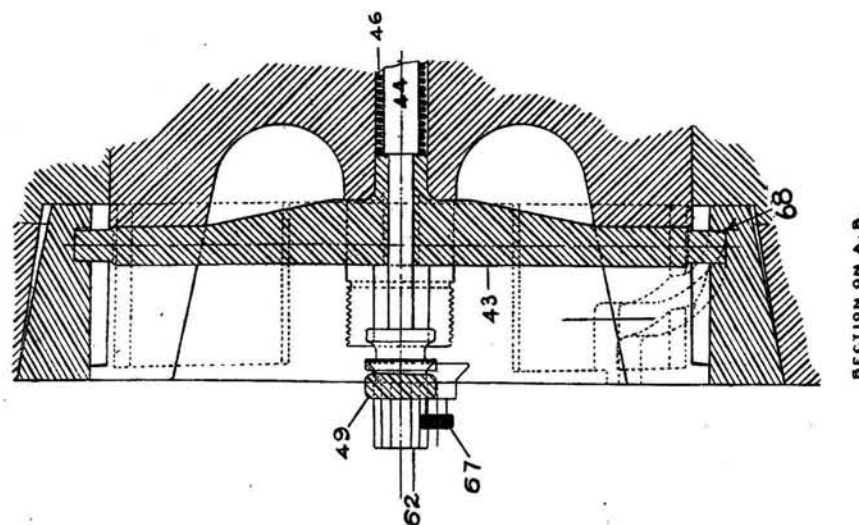


Fig. 2. Plug locked ready to fire.  
Vertical section.

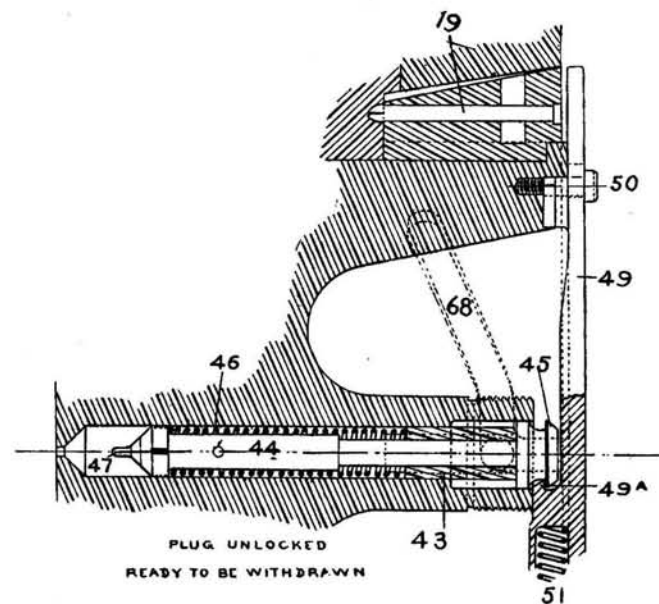


Fig. 3.

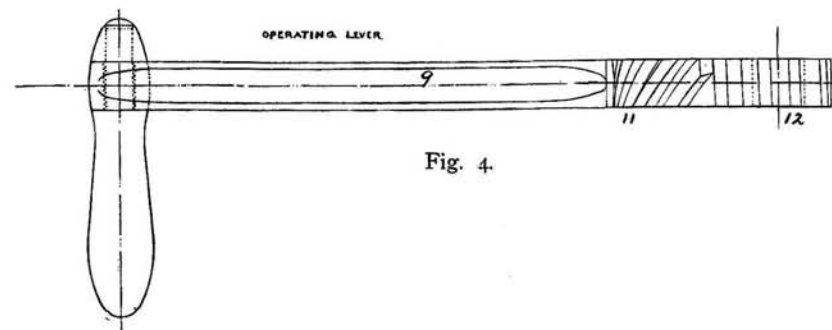


Fig. 4.

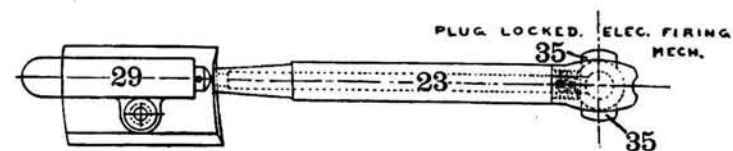


Fig. 5.



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the cocking bar is forced *forward* by the grooves (68), which it has re-entered, and, the firing pin being held to the rear by the sear, the firing spring is compressed. Finally, just as the locking motion is completed, the left end of the sear bar is brought into contact with the trigger and the gun is again ready for firing.

The gun cannot be fired prematurely by percussion, because :

- (a) The firing pin, having been retracted during the opening of the plug, cannot project through the plug and strike the primer while closing unless—through weakness of the sear spring—the sear has failed to grasp and hold the head of the firing pin and even in that case a strong blow of its point upon the primer is unlikely since the cocking bar limits its throw.
- (b) The firing spring is not compressed until the plug is at least partially locked.
- (c) The carrier ring will not permit the sear bar a movement to the right sufficient to release the firing pin until the plug is completely locked. The danger of a percussion primer being exploded by the mere concussion of the breechblock against the cartridge case, while closing the breech, exists in this as in all other swinging-block systems.

The firing point may be examined while the breech is open by pushing the sear bar down and the cocking bar forward, whereupon the firing point will be projected through the face of the block; the sear must be re-engaged on the firing-pin head before closing or the mechanism will not be cocked.