CHAPTER VII.

BREECH MECHANISMS.

701. Definition.—*A breech mechanism* is a mechanical device for closing the rear end of the chamber or bore of a breech-loading gun. The term includes the breech block or plug, all mechanism contained in or with it, and the necessary operating gear.

702. Requirements for a breech mechanism.—The following may be said to be the principal requirements for a successful breech mechanism:

1. **Safety.**—To be safe: (a) The gas must be prevented from escaping to the rear; this sealing, or obturation, must be automatic, greater pressure increasing the sealing or obturation. (b) Fitting of the breech mechanism should reduce the gun strength by a minimum amount, never below an adequate factor of safety. (c) The parts must have ample strength to prevent any portion from being broken or blown to the rear. (d) The danger of premature discharge must be minimized. (e) The breech block must be securely locked to prevent opening on firing.

2. **Ease and rapidity of working.**—This is necessary for rapid continuous fire. Hence, this should include facility of loading, and certainty of extraction for rapid-fire guns.

3. **Not easily put out of order.**—It must be able to meet service conditions and hard usage. Parts should have a reserve of strength. All parts of the mechanism should be so designed as to be protected against injury.

4. **Ease of repair.**—Parts most exposed to wear should be so designed as to permit easy replacement. This should also include accessibility of parts, so that breakage of any part will not disable the mechanism for any length of time.

5. **Interchangeability.**—Not only should individual parts be made interchangeable by accurate workmanship, but the whole mechanism should be capable of being mounted on similar guns.

703. The breech block or plug is the movable piece closing the breech of a gun. In most built-up guns it is carried by the jacket; in the latest large guns, however, it is carried within a screw-box liner, or bushing. The above term applies to any shape of piece, or for any system of closure. In small arms and certain special guns, the term

breech "bolt" is often used, instead of "plug" or "block," and "breech action" is a better term in this case than "breech mechanism."

704. Systems of breech blocks.—The following are the principal systems of breech blocks that have been used in the Navy: (1) the rotating block with interrupted screw, (2) vertical sliding wedge, (3) horizontal sliding wedge, (4) combined sliding and rotary systems, (5) the sliding bolt system. (Plates I and II.)

System (1), the rotating block with interrupted screw, is used for all major and intermediate caliber guns now in service except for the 5-inch anti-aircraft guns. Systems (1), (2), and (3) are used on the various 3-inch guns. Secondary rapid-fire or cartridge-case guns, such as the various field guns, boat guns, saluting guns, and sub-caliber guns, use systems (2), (3), and (4). Military rifles, as well as certain automatic guns and machine guns, generally use the sliding-bolt system.

Special guns, such as automatic guns and machine guns, more properly use a "breech action," in which the different steps in closing the breech and operating the entire mechanism are very intimately connected. The system in these cases is defined by the name of the gun.

705. An interrupted-screw plug is a plug which has two or more sections of the thread removed in the direction of the axis. Similar interruptions are made in the female thread of the screw box in the gun, in order that the plug may be entered or withdrawn in one motion and only a portion of a turn be given to lock or unlock it in the screw box. The rotating block may be: (a) eccentric for use in guns firing case ammunition so that the firing pin will not be in line with the cartridge case primer until the block has been completely rotated and locked, (b) concentric for use in guns firing bag ammunition. The interrupted-screw system, also called "slotted screw," is divided into three classes: (1) French interrupted screw; (2) Elswick interrupted screw; and (3) Welin interrupted screw.

The French interrupted screw at one time was the most common system of fermeture. The breech plug, cylindrical in shape, has cut on its circumference a male thread, the character of which varies according to particular designs. It is then divided into a number of equal sections in the longitudinal direction (always divisible by two; usually six, eight, or twelve), and the threads of alternate sections are then planed or slotted out; a minimum of 50 per cent of the holding strength of the screw thread is thus sacrificed in the slotted sections. The female thread in the screw box is similarly slotted. In closing the breech, the threaded sections of the plug are brought opposite to the blank sections of the screw box; the plug is pushed in either by hand, or by some mechanism, to the proper distance; and a fraction of a turn to the

right or left is given, to interlock the threaded sections, the amount of turn necessary depending upon the number of sections into which the circumference has been divided. Six sections (three threaded and three blank) require 60°; eight sections (four threaded and four blank) require 45°, etc. The system is independent of the method of operating the mechanism. (Plate II, Fig. 1.)

The Elswick interrupted screw differs from the French type, in that the forward part of the plug is conical and the rear part cylindrical. The threaded sections of the coned portion and the threaded sections of the cylindrical part are staggered. The advantages claimed for this arrangement are: (1) The working of the mechanism is facilitated, as the plug can be swung clear of the screw box without translation; (2) arrangement of the threaded sections distributes the strain around the entire circumference of the plug; (3) the cone-shaped plug increases the cross-section of the jacket at the forward end of the plug where the stresses in the gun are greatest. (Plate II, Fig. 2.)

The Welin interrupted screw or *stepped-thread* system has the block divided circumferentially into a number of groups of blanks and threaded sectors of increasing radius, so disposed that when the plug is unlocked the smaller threaded sectors of the plug clear the next larger threaded sectors of the screw box. Each group of sectors consists of one blank and two or more threaded sectors. Three or four such groups of sectors are arranged around the circumference of the plug. This arrangement of threads gives a larger percentage of holding strength for a given length of plug and requires a minimum amount of rotation. (Plate II, Fig. 3.)

706. The vertical sliding-wedge system, exemplified in the Hotchkiss and 3-inch semi-automatic guns has a rectangular wedge-shaped block (containing the firing mechanism) that slides up and down in a vertical mortise within the square-shaped breech of the gun, guided by vertical ribs. It is moved by means of a crank, journaled in the right cheek of the mortise; a stud on the other end of the crank moves in a cam groove in the side of the block. The wedge completely closes the mortise when up, and gives only a sliding movement to the cartridge case in shoving it home. (Plate I, Fig. 2.)

The horizontal sliding-wedge mechanism is similar to the vertical sliding-wedge system except the block moves in a horizontal direction. This form of breech plug is used in 3-inch 23-cal. AA guns. (Plate I, Fig. 2.)

The combined rotary and sliding-wedge system is exemplified in our service in the Nordenfelt 6-pounder and 3-pounder rapid-fire guns only. The breech block may be said to consist of two parts, the block and the

FIG. 1. INTERRUPTED SCREW.
ALL MAIN BATTERIES.
4" PLUG.

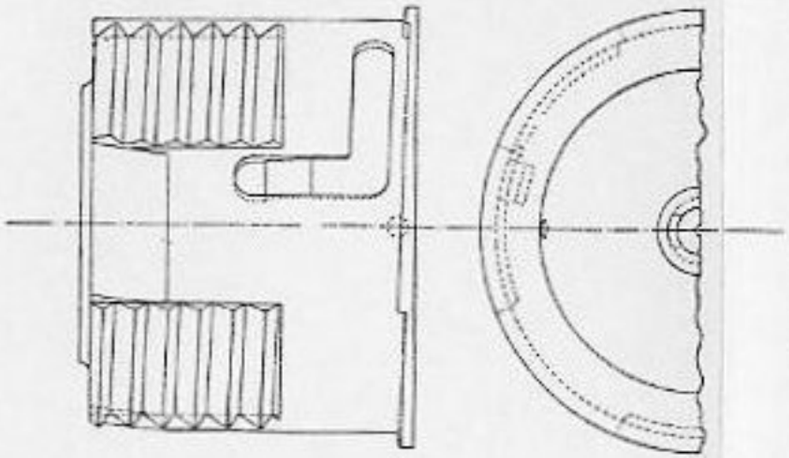


FIG. 2. SLIDING WEDGE.
NOTCHKISS 6-PDR.

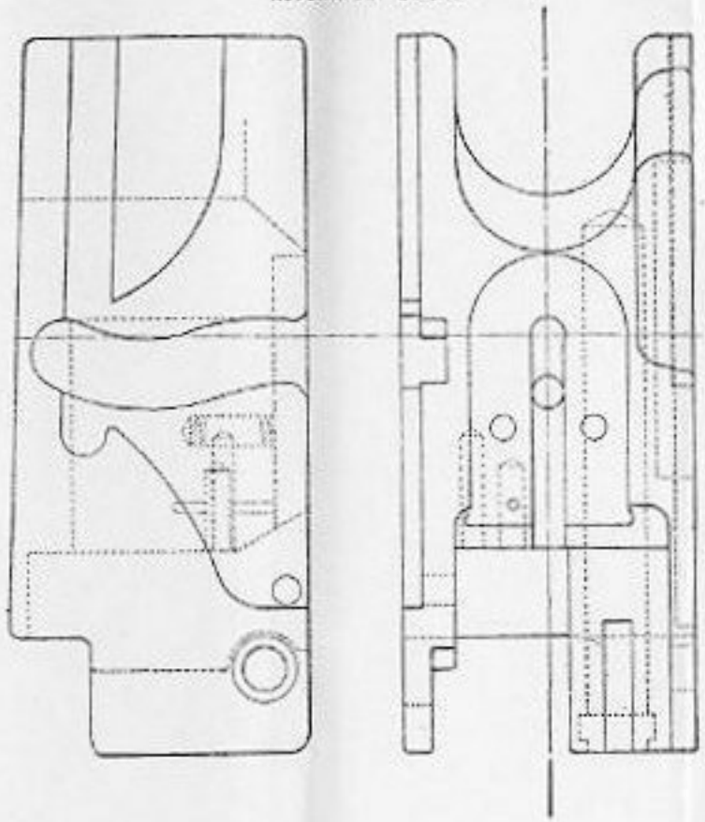


FIG. 3. SLIDING AND ROTARY BLOCK.
DRIGGS-SCHROEDER 6-PDR.

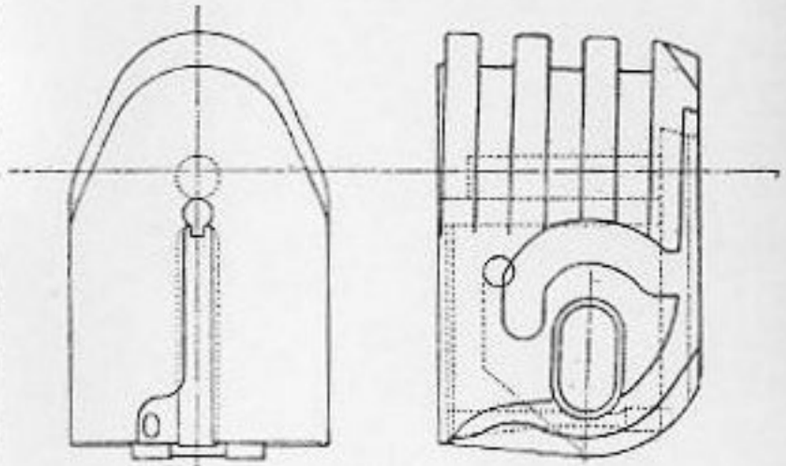
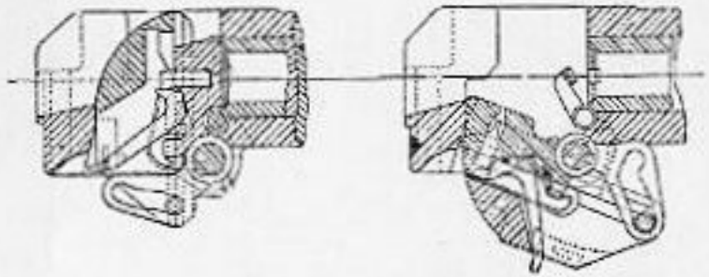
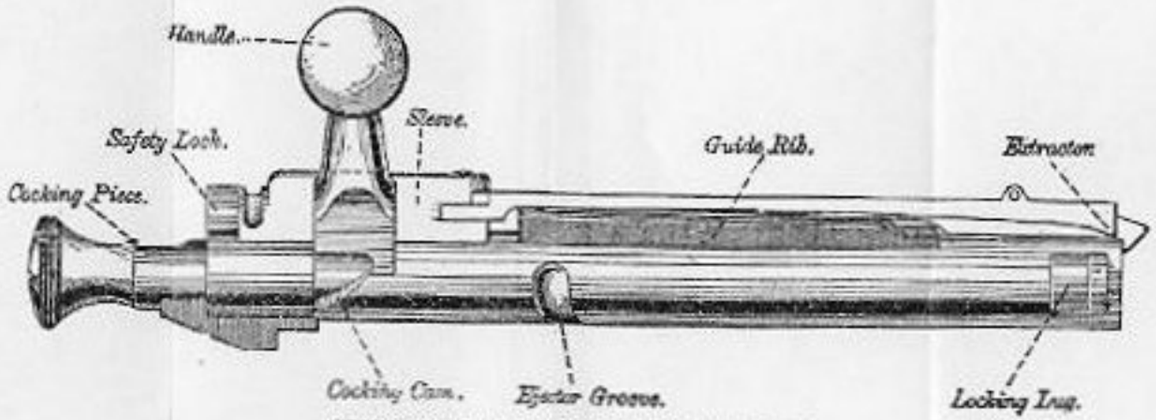


FIG. 4. COMBINED ROTARY AND SLIDING WEDGE.
NORDENFELT 6-PDR.





SYSTEMS OF BREECH-BLOCKS.

FIG. 1 FRENCH INTERRUPTED SCREW.

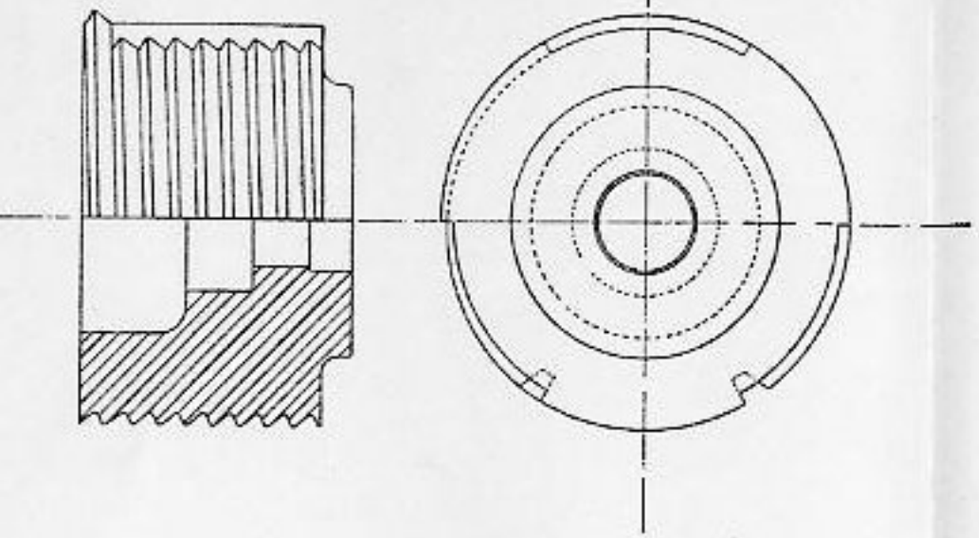


FIG. 2 ELSWICK INTERRUPTED SCREW.

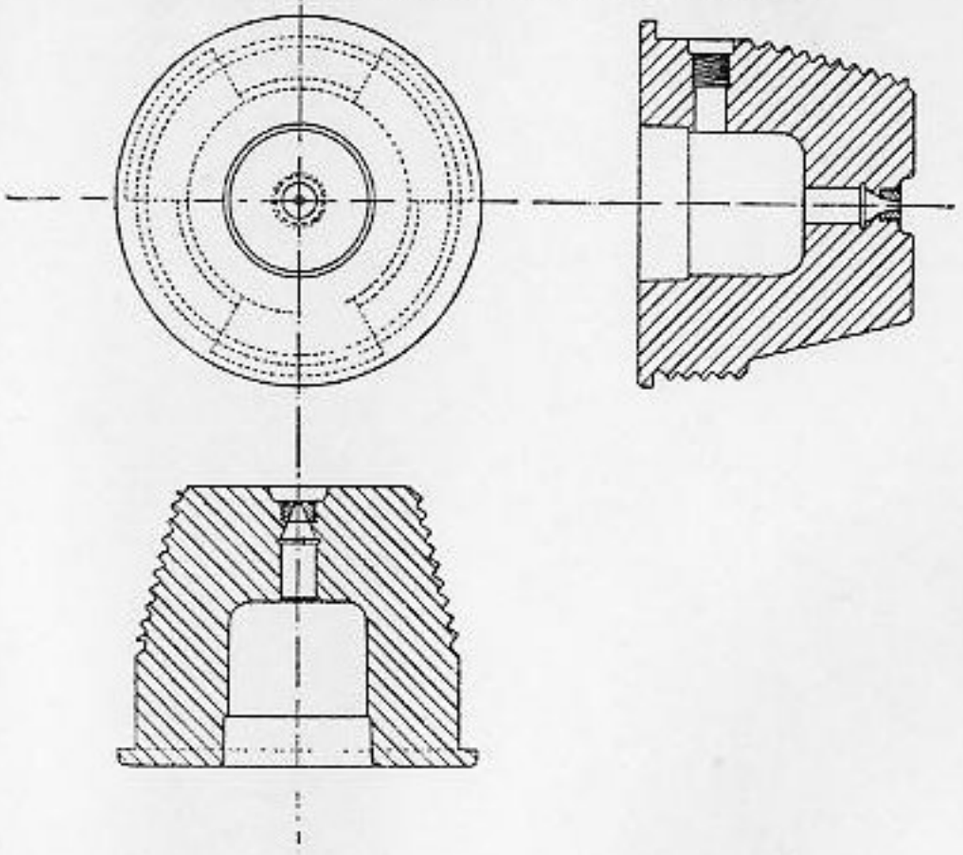
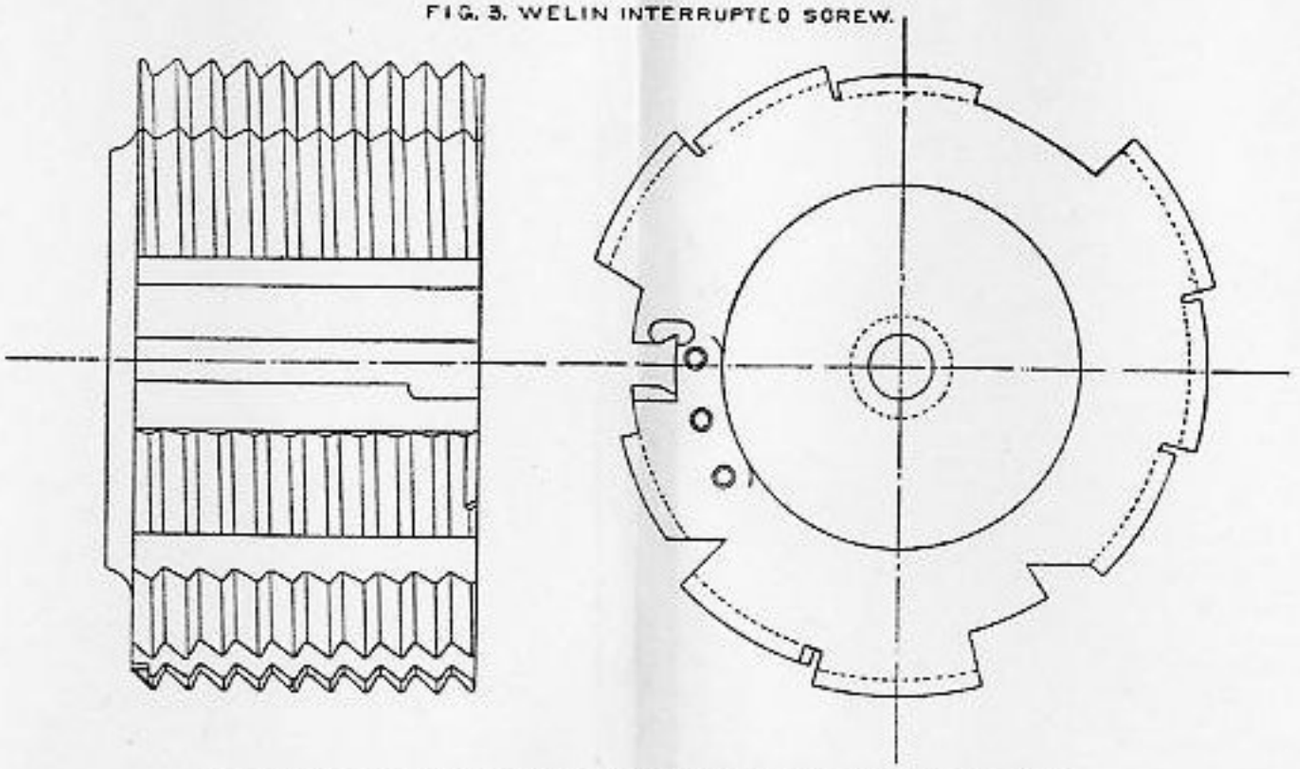


FIG. 3. WELIN INTERRUPTED SCREW.



THREE SYSTEMS OF INTERRUPTED-SCREW THREAD.

wedge, the latter sliding on the front face of the former in the locking or unlocking movement; while to cover or uncover the bore, both rotate about a transverse axis, the top falling to the rear in opening. (Plate I, Fig. 4.)

The sliding and rotary-block system.—In this system, to open the mechanism the block slides downward and is then rotated on a transverse axis, the upper part falling to the rear. This system is exemplified in our service by the Driggs-Schroeder guns. It has a rectangular block with rounded top, working entirely within the breech housing and is locked by means of collars on top of the block engaging corresponding grooves in the housing. The grooves are inclined slightly to the front, so the final movement in closing is upward and to the front, pushing home the cartridge case. The operation is through a cam within the block, moving against curved surfaces in the block's recess; the cam is moved by a transverse axis. (Plate I, Fig. 3.)

The sliding-bolt system.—In this system a more or less cylindrical piece, containing at least the firing pin and spring or hammer, moves longitudinally in a "receiver" attached to the gun barrel, and may be worked either by hand, as for small-arm rifles, or by certain mechanism, as in the Colt automatic gun. The bolt may have only a direct movement to the rear and front, giving the name "straight pull," or have a part attached which is turned for locking or unlocking, giving the name of "turn bolt." (Plate I, Fig. 5.)

707. Types of breech mechanism used on intermediate and major caliber guns.—The Smith-Asbury system of operation is employed on breech mechanisms of 4-inch, 5-inch, 6-inch, 14-inch, and 16-inch guns. The 12-inch breech mechanisms now in service (and a few of the original 14-inch breech mechanisms remaining on the *New York* and *Texas*) employ the Farcot operating mechanism for opening and closing the Welin-type plug. In the Farcot system a worm shaft and gearing rotate the plug, translate the plug axially to the rear until it is received upon and latched to the plug tray. Continued rotation of the crank handle on the worm shaft then unlocks the plug tray from the breech and permits the plug tray to swing the plug clear for loading.

The 8-inch breech mechanism installed on the heavy cruisers is of the carrier type operated by a Bureau of Ordnance design. A short continuous swing of the operating lever, by means of a crank and cams, accomplishes the rotation of the plug and withdrawal of the plug from the screw-box liner.

708. Types of quick-acting breech mechanisms.—There are five principal types: (1) quick-fire; (2) rapid-fire; (3) semi-automatic rapid-fire; (4) automatic rapid-fire; (5) machine gun.

A quick-fire breech mechanism is one which can be easily and rapidly operated. It is used on bag guns and hence requires a gas check, gas ejector, and firing lock suitable for bag ammunition.

A rapid-fire breech mechanism is one which can be easily and rapidly operated and which is fitted to case guns. It requires an extractor and special firing mechanism suitable for case ammunition.

There is, in reality, no distinction between the rapid fire and the quick fire, so far as the operating gear is concerned; but the names are given because of the differences in the breech mechanisms and the differences in the loading drill which result from differences in assembly of the ammunition. In loading a rapid-fire gun, no *bore clear* signal is required.

The term "quick fire" is apparently indiscriminately used abroad for guns having a quick-acting mechanism, whether using metallic cartridge case or powder charges in bags. It is well that a distinction should be made, as in the U. S. Navy, by the use of the terms "case guns" and "bag guns."

Semi-automatic rapid-fire breech mechanisms are quick acting, part of the operation being by hand and part automatic. This gives rise to the name, both as "rapid fire" and as "semi-automatic."

Automatic rapid-fire breech mechanisms are those in which all the operations are performed automatically by utilizing the energy of recoil. The name also defines the gun.

The breech actions of machine guns are essentially quick acting, and their special features are the distinctive features of the gun.

SYSTEMS OF GAS CHECKS.

709. Gas check.—This is a device to prevent the escape of the powder gas to the rear around the breech block or through the vent.

The following are the **principal characteristics** governing the design of a gas check:

1. It should function at all temperatures that may be encountered in service due to weather conditions, that is, from approximately 5° to 110° F., and also be unaffected by the variations in temperature due to firing the gun. Temperature increases as high as 200° F. have been observed when firing a 3-inch rapid-fire gun.

2. In order that the mechanism will function with ease, the device should not adhere too strongly to its seat.

3. It should be elastic enough to conform to its seat, but also rigid enough so as not to be deformed to such an extent as to prevent successive functioning.

4. It should respond equally as well to the lowest as to the highest pressure developed in the gun.

5. It should exert a pressure on its seat greater than, or at least equal to, the gas pressure.

To meet the above requirements it is necessary to consider, first, the type, and second, the application of the gas check.

710. There are in general two types of gas checks, the *plastic* and the *elastic*.

The first plastic materials used for gas checks were fibrous materials such as cardboard or papier-mâché. Experiments were also made with soap, but the soap liquefied due to the action of the heat. The materials actually in use are composed of about 65 per cent of a mineral fiber such as asbestos, and 35 per cent of tallow. The tallow keeps the gas check plastic and causes the fiber to flow under the action of the heat and pressure.

The advantage of the *plastic gas check* is that it conforms to any irregularities of its seat caused by erosion or accident. The disadvantages are the fact that it is apt to adhere to its seat too strongly, or to be deformed while the block is open with the result that the mechanism will not function with ease. Plastic materials do not retain a definite form, but may easily be deformed and reformed under pressure. The pressure is transmitted equally in all directions, as in a fluid, and to a greater degree than in elastic solids.

Plastic gas checks function satisfactorily when the gun is not fired too rapidly and with proper care a large number of rounds may be fired without changing the pad. They are used on all bag guns in our Navy.

711. Elastic gas check material may be divided into two classes, rigid and flexible, depending upon the resistance they offer to deformation. Steel is the most rigid and rubber compounds are the most flexible materials that have been used. Rubber compounds give a good seal for a few rounds, as they conform easily to their seats, but they are apt to adhere to the gun or block which makes it difficult to operate the breech mechanism. They are sensible to variations in temperature, being too soft at high and too hard at low temperatures. They are also attacked by the powder gas and oil. Elastic gas checks are made of copper, brass or steel.

An elastic gas check conforms to its seat under pressure except when small irregularities exist in the surface of the gas-check seat, hence the sealing depends upon the condition of the surfaces in contact. On the other hand, there is less tendency to adhere to its seat as the device returns to its original form as soon as the pressure is relieved, and it is not so easily deformed when the block is open.

712. Automatic sealing.—Sealing of the breech of the gun against the passage of the flame and gases of combustion is effected in the U. S. Navy by gas checks in which the pressure on the seat is built up automatically by the pressure of the powder gas. There are two methods of automatic sealing (a) by expansion and (b) by compression.

(*a*) *Sealing by expansion* is obtained by the use of a metal cartridge case, Fig. 701. The action of the gas is to expand the cartridge case against the wall of the chamber of the gun. The amount of this expansion being equal to the clearance between the case and chamber, plus the deformation of the gun due to the pressure of the powder gas. The total expansion should not exceed the elastic expansion of

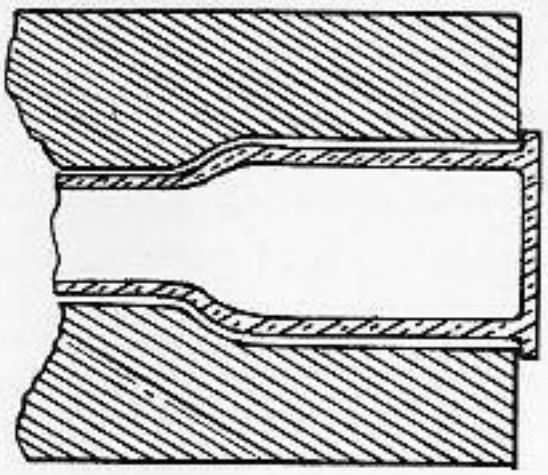


FIG. 701.

the case, as otherwise the case may be permanently deformed or cracked and offer too much resistance to ejection. For this reason the metal should not be too hard or too soft.

When the charge is first ignited a small quantity of gas passes between the case and the wall of the chamber, but due to the small area, and great length of the channel, the resistance to its passage is high and the pressure builds up so rapidly in the case that the sealing takes place very quickly. The surface in contact is so large that small local irregularities do not affect the seal.

The case should be sufficiently thick at the base to prevent the metal from being forced into the joint between the breech block and the gun, but sufficiently thin at the mouth to insure easy expansion.

(*b*) *Sealing by compression* is generally obtained by the use of a plastic gas check as in the De Bange system, Fig. 702. A ring-shaped pad of plastic material, A, contained in an envelope, B, is held between the breech block, C, and the "mushroom," D, by the spindle of the mushroom which passes through the pad and breech block.

The action of the gas pressure is to force the head of the mushroom to the rear, thus building up pressure in the plastic material which is

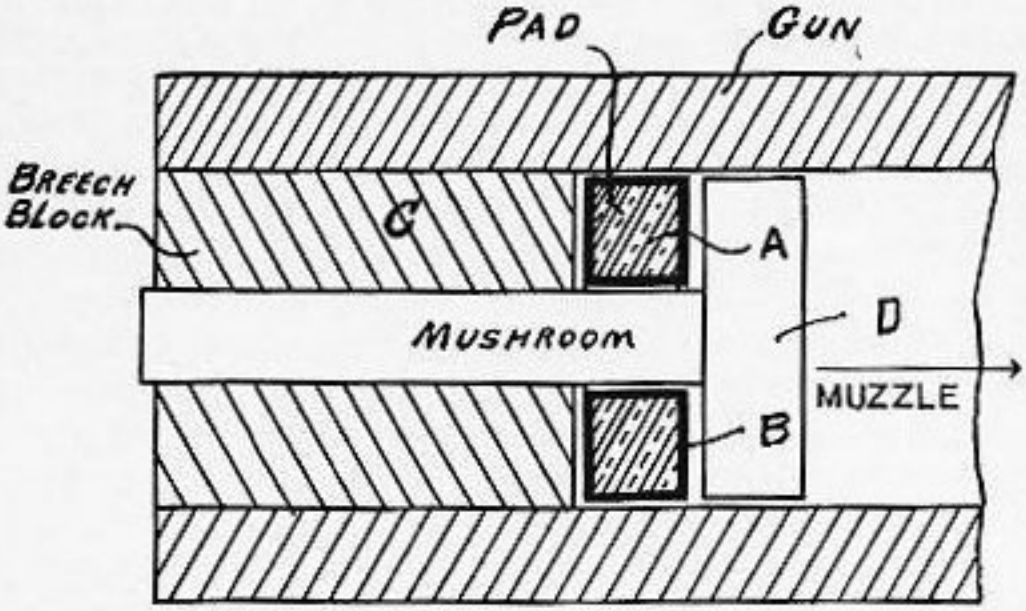


FIG. 702.

transmitted in all directions and presses the envelope against the wall of the gun.

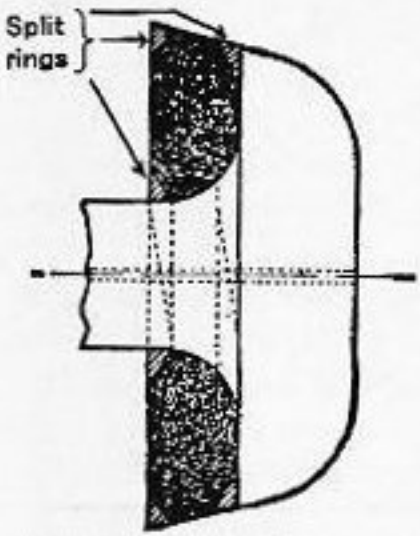


FIG. 703.—THE DE BANGE GAS CHECK—SHOWING SPLIT-RINGS.

713. The De Bange gas check pads used in the Navy, as shown in Figs. 703 and 706, are made of a plastic material with a neat-fitting canvas cover. The edges are protected by split metal rings which expand due to the pressure transmitted by the pad. The chamfered edges where the rings are split, have a tendency to wear or cut the covering of the pad. On guns of 6-inch caliber and above, this is prevented by a thin copper protector formed to the contour of the forward face of the pad. The use of this copper protector will doubtless be extended to all bag guns.

When the pads are to be used in guns where high pressures are developed, the pads are made as above except they are compressed in steel dies under a pressure from 50,000 to 80,000 pounds per square inch. After being subjected to this pressure they are no longer soft but possess a certain amount of elasticity, and may be said to be plastic-elastic. Due to this

initial compression the recoil of the mushroom relative to the breech block is very small.

714. A gas check experimented with in Spain is shown in Fig. 704. It consists of a mushroom, *A*, which bears against a copper ring, *B*, of triangular cross section. The pressure of the powder gas on the mushroom head causes the copper ring to expand and exert a pressure on its seats. It appears that this system should give good results, but there is none of this type in the U. S. Navy.

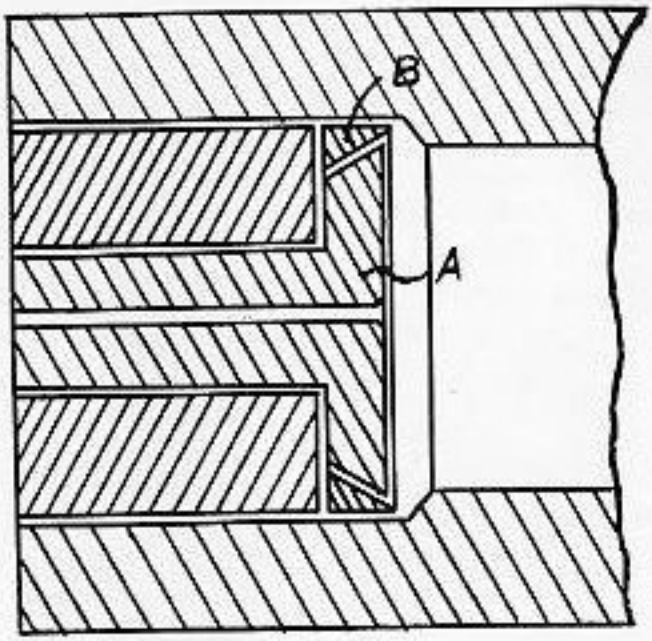


FIG. 704.

715. Mechanism for breaking the seal of gas checks and extracting cartridge cases: When plastic gas checks are used it is necessary that the breech mechanism be designed so as to facilitate the breaking of the seal of the gas checks, which adhere strongly to their seats after the gun has been fired. In the first place it is necessary that the breech block may be rotated independently of the gas check, and secondly, that sufficient force may be exerted to translate the block and gas check to the rear. A thorough description of the action of the breech mechanism and the De Bange gas check pad will be found in the description of the Mark VII—5″ breech mechanism (see Art. 728).

When cartridge cases are used it is necessary to provide a mechanism for extracting the case. This mechanism should be designed, first, to loosen the case by extraction, and second to eject the case when the breech is fully open. In general, it consists of a lever which engages the rim on the base of the cartridge case, the other end being pivoted near the hinge pin of the breech-block carrier. This lever remains sta-

tionary during the first part of the rotation of the block; the portion which engages the case is then moved slowly to the rear as the outboard end of the extractor lever is forced forward by a cam surface on the breech-block carrier. This exerts sufficient force on the case to start it from its seat. The lever then becomes practically stationary until the breech is fully opened. The final movement of opening gives the outboard end of the lever a very quick motion forward with the result that the inner end of the lever ejects the case clear of the gun. With breech mechanisms of the sliding wedge type, the extraction is accomplished upon the same principle, but details of its application vary slightly.

TYPES OF SALVO LATCHES.

716. When a number of guns are fired in salvo, the gun captain sometimes fails to observe whether or not his own gun recoils and counter-recoils. In other words, after a salvo the gun captain sometimes does not know whether or not his own gun has fired. If the gun captain, thinking his gun has fired, should open the breech while a hangfire was in progress, a disaster would result. To prevent the opening of the breech of a gun after loading, the operating mechanism is locked by a salvo latch until the gun has fired and recoiled.

Breech mechanisms in general cannot be opened by a pressure on the front face of the breech block, but there is a tendency for the breech mechanism to rebound from the breech in closing, and to open due to inertia during recoil or counter-recoil, or due to the shock of firing. In addition to performing its primary function, the salvo latch prevents the rebounding of the plug and premature opening during firing or recoil.

The design of these latches varies with the particular mechanism, but usually the lock feature is incorporated in the operating mechanism. As soon as the breech has been closed, the operating handle is latched in a closed position by the salvo latch which unlatches during the recoil of the gun. The salvo latch prevents the mechanism from being opened after the gun has been loaded except when this is done deliberately with full knowledge that the gun is loaded. Most guns are fitted with salvo latches which are unlocked by *inertia*. Breech mechanisms of the sliding-wedge types lend themselves to the attachment of *positive* type salvo latches which are unlocked by the full recoil of the gun past a fixed attachment on the slide. The recoil produced by the firing of reduced charges is sufficient to accomplish the unlocking of the breech. The latest guns developed in the U. S. Navy, 5-inch 25-caliber and 5-inch 38-caliber guns, are of the sliding-wedge type breech mechanism, and these guns as well as the 3-inch

50-caliber anti-aircraft guns are fitted with positive type salvo latches. The positive type is superior to the inertia type salvo latch. Guns now fitted with inertia type salvo latches will gradually be modified by the installation of positive type salvo latches. New guns of all types will be fitted with positive type salvo latches.

3-INCH SEMI-AUTOMATIC BREECH MECHANISM, MARK V.

(Plate III.)

717. This mechanism is of the vertical sliding-wedge type, which has been sometimes designated as the "Driggs-Seabury semi-automatic mechanism." Several modifications have been made to remedy minor defects in the original design.

718. The operation of this mechanism may be readily understood by following the description below and referring to Plate III. If model breech mechanisms or guns are available, as at the Naval Academy, it is recommended, however, that the mechanisms be inspected in conjunction with a study of these pages.

The crank shaft H (Fig. 2) rests in a cradle projection under the gun and is held in place by means of a lock plate L (Figs. 4 and 5), which is dovetailed to the bottom of the breech housing and secured by the lock plate lock bolt. As the crank shaft is rotated the breech block crank (Fig. 2) moves along a sloping cam surface on the under side of the block, raising or lowering it.

Assume that the thrust cam B (Figs. 7 and 8), which is attached to a bracket secured to the slide, is set for semi-automatic operation. Then, when the gun recoils, the tumbler crank on the left end of the crank shaft H (Fig. 2) strikes and passes over the thrust cam B (Figs. 7 and 8), forcing the latter to rotate through 68° to 74°. After the tumbler crank has passed by the thrust cam, the latter is returned to its original position by the thrust cam spring (Fig. 5), so that on counter recoil the tumbler crank again is brought up against the thrust cam (Fig. 9). This time, however, the thrust cam, being locked, forces the crank shaft to rotate, thus causing the breech block to be dropped.

The rotation of the crank shaft also causes the operating spring to be compressed (Fig. 1), the operating spring arm on the right end of the crank shaft being engaged to the spring piston through the operating chain and spring piston rod.

As the block drops, the extractor lugs C (Fig. 5) follow the extractor grooves in the block, forcing the lugs forward and the upper nibs of the extractors aft, accomplishing extraction. The lugs also, by bearing on shoulders M (Fig. 4) in the block at the top of the extractor grooves, hold the breech block down. The extractors are held in this position

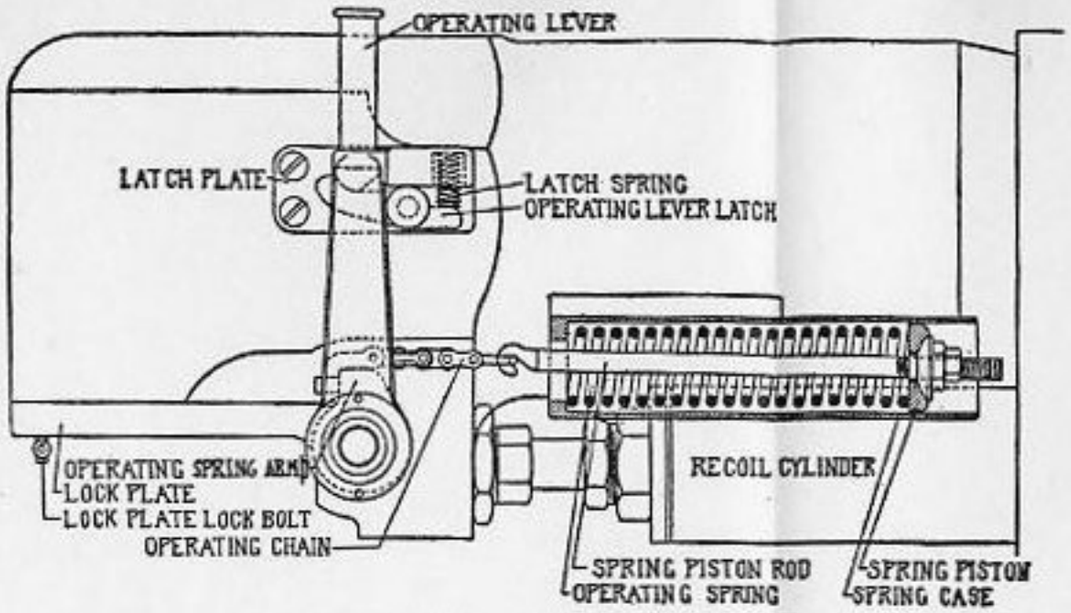


Fig. 1.—Right Side of Gun. (Breech closed.)

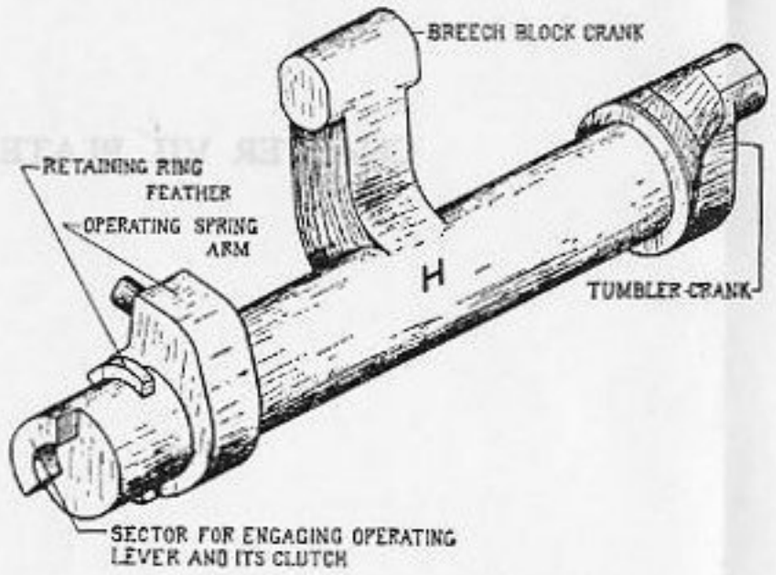


Fig. 2.—Crank-Shaft.

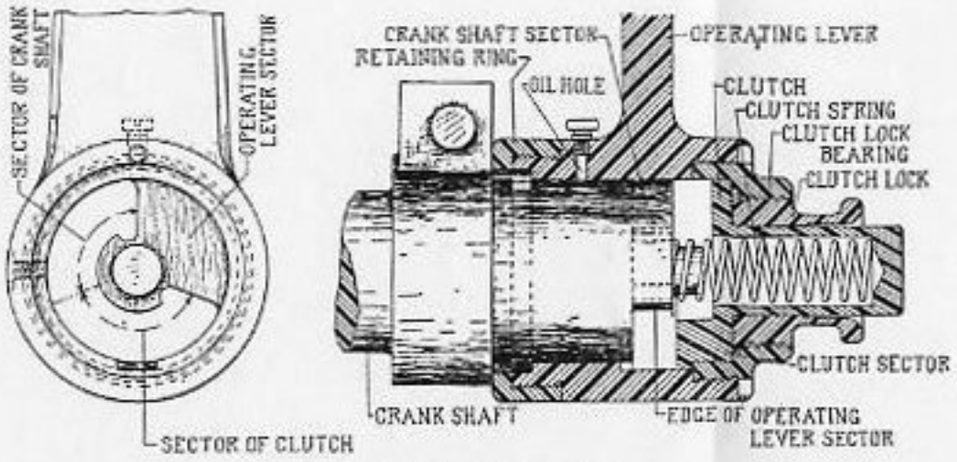


Fig. 3.—Clutch-Mechanism.

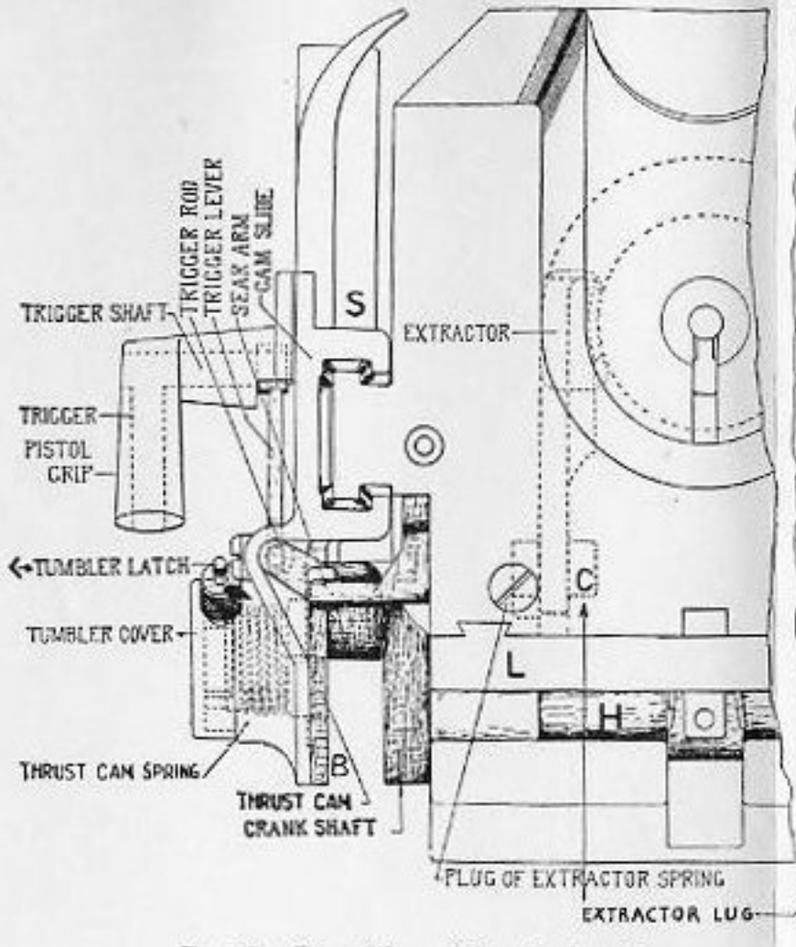


Fig. 5.—Rear View. (Breech closed.)

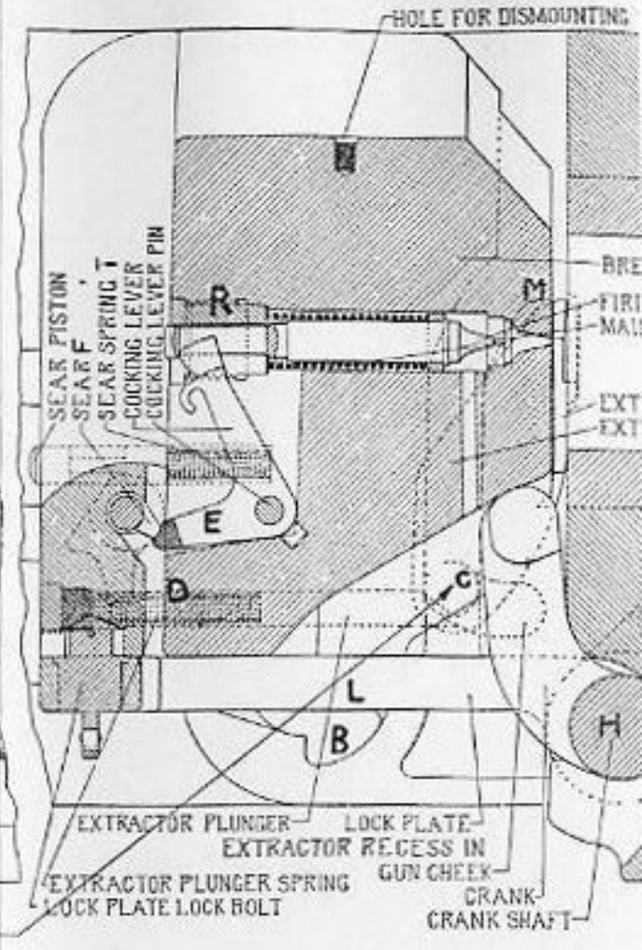


Fig. 4.—Gun Closed. (Breech

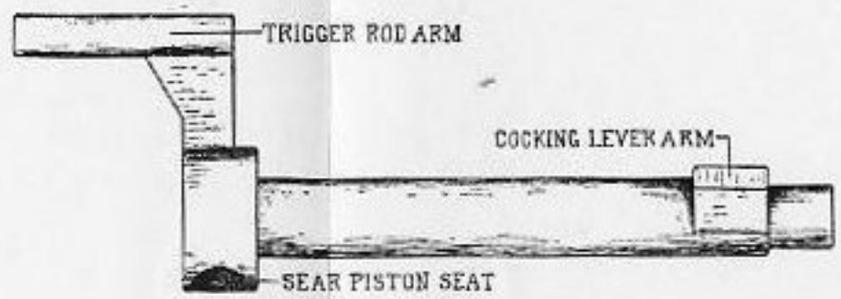


Fig. 6.—Sear.

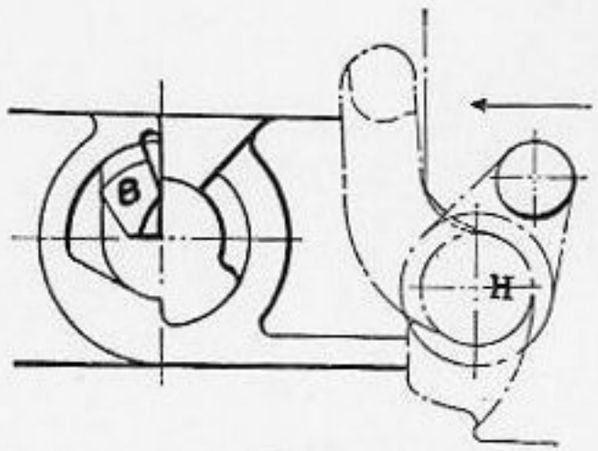


Fig. 7.

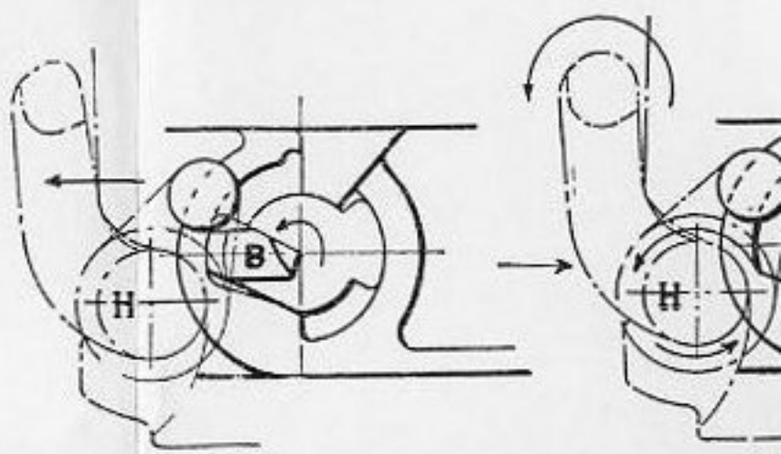


Fig. 8.

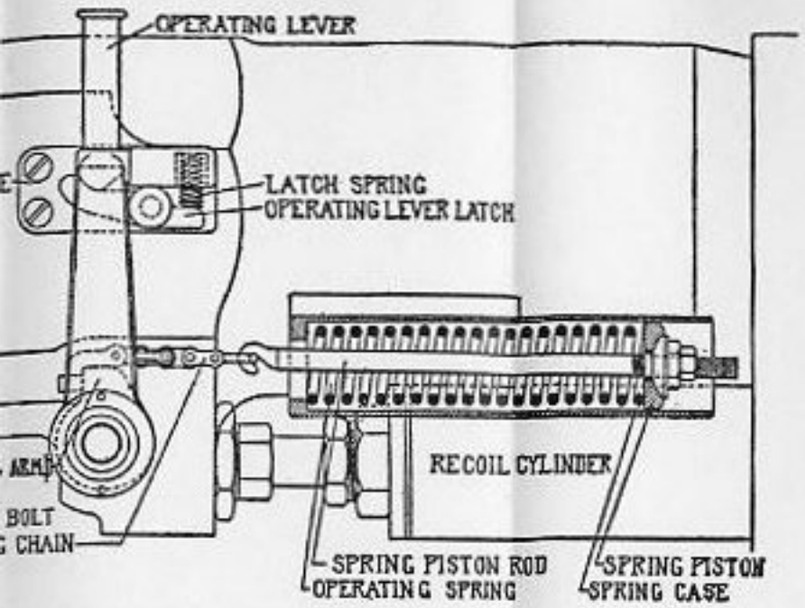


Fig. 1.—Right Side of Gun. (Breech closed.)

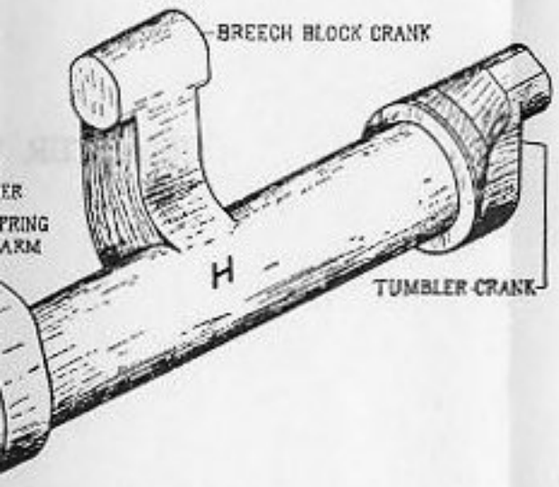


Fig. 2.—Crank-Shaft.

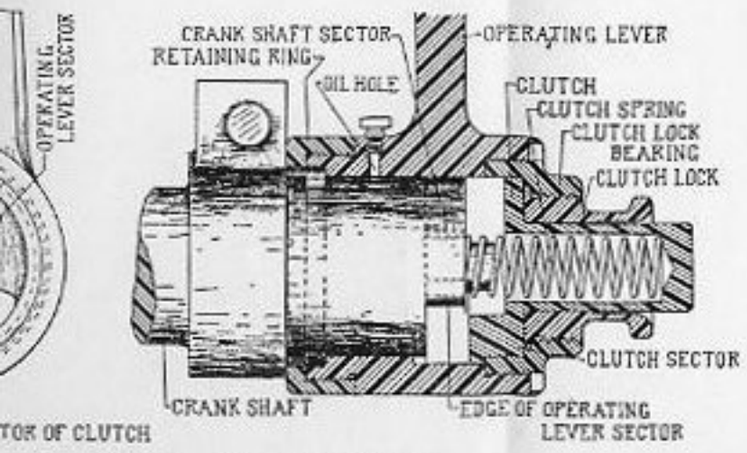


Fig. 3.—Clutch-Mechanism.

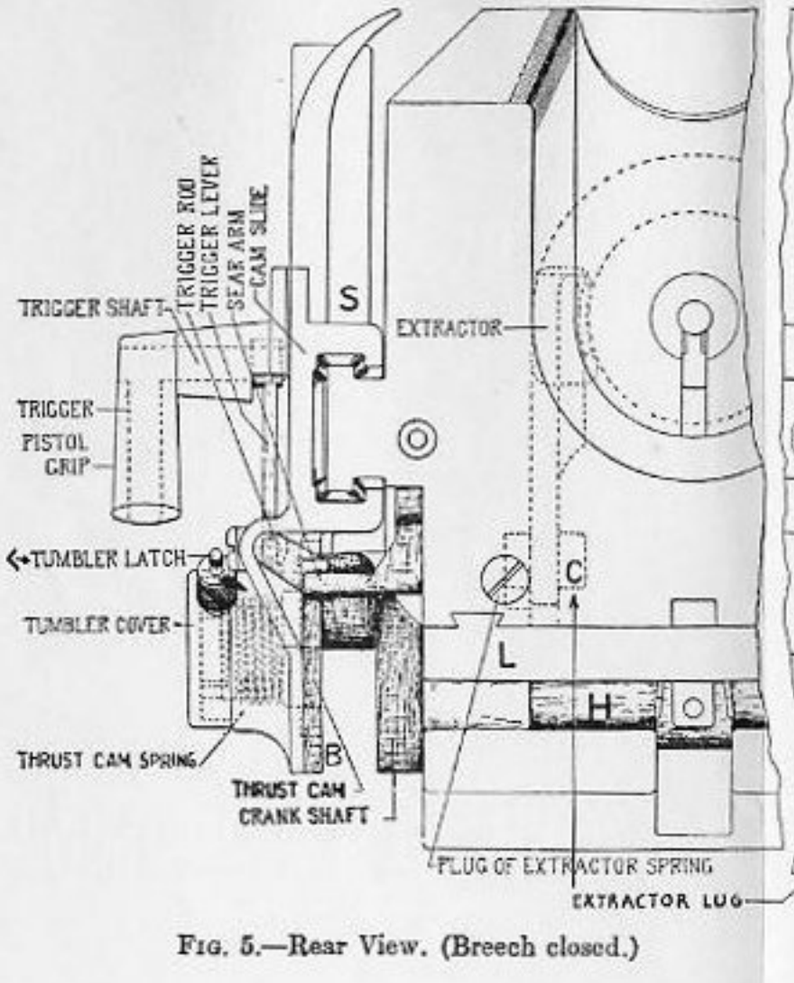


Fig. 5.—Rear View. (Breech closed.)

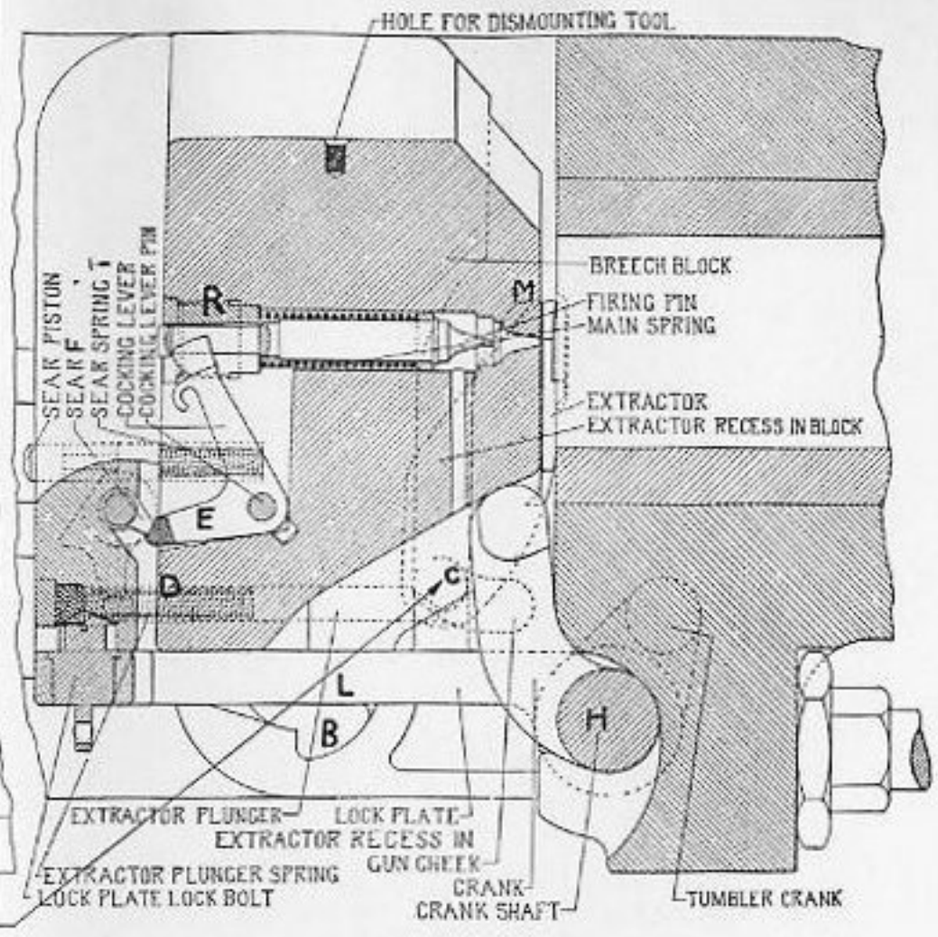


Fig. 4.—Gun Closed. (Breech closed.)

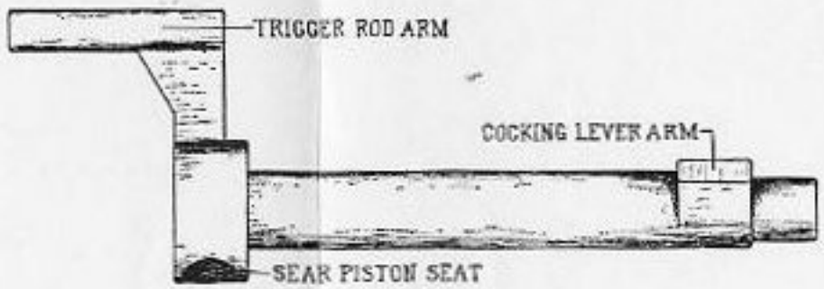


Fig. 6.—Sear.

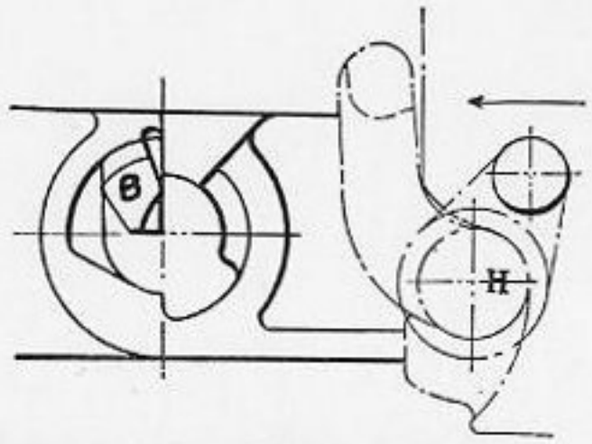


Fig. 7.

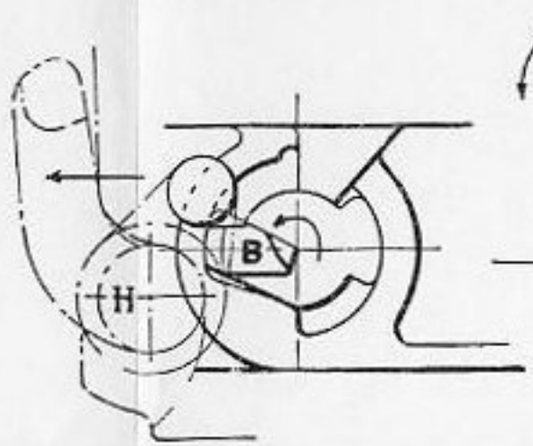


Fig. 8.

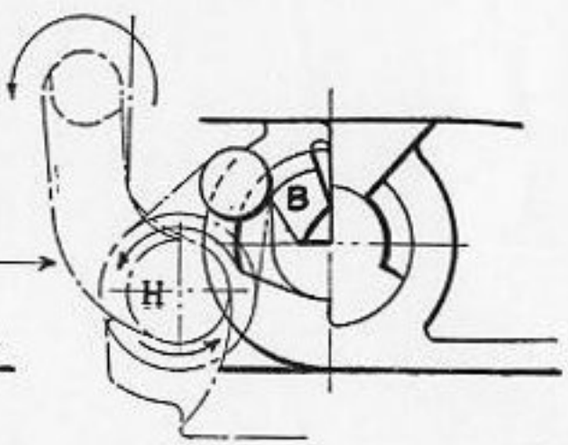


Fig. 9

by the extractor springs D (Fig. 4) and plungers, one to each extractor.

When the cartridge is loaded, the extractor nibs are struck by the flange on the base of the cartridge case and forced forward, and the lugs are disengaged from the shoulders on the block. The operating spring (Fig. 1), which was compressed on counter-recoil, then causes the crank shaft H to rotate, raising the block and closing the breech.

The semi-automatic feature can be eliminated by turning the thrust cam B (Fig. 7) to the rear and down, thus permitting the tumbler crank on the crank shaft to pass above the cam as the gun returns to battery. For this purpose there is a tumbler latch K (Fig. 5) fitted in the tumbler cover which holds the thrust cam down and to the rear.

719. Operating lever clutch mechanism (Fig. 3).—This mechanism is for the purpose of disengaging the operating lever, *i.e.*, preventing its rotation, when the gun is set for semi-automatic operation.

In Figs. 2 and 3 it will be observed that there are three 120° sectors for engaging the operating lever to the crank shaft, one, an integral part of the crank shaft (Fig. 2), one, an integral part of the operating lever (which otherwise is bored out to pass over the crank shaft), and the third, the clutch sector.

When the breech block is closed and the operating lever is in the vertical position, the upper face of the crank shaft sector is also vertical as in Fig. 2, and abuts against a corresponding face of the operating lever sector. If the clutch lock and sector are screwed out, there will be left a blank sector of 120°. Consequently, for semi-automatic operation it is evident that rotation of the shaft will not rotate the operating lever as the shaft sector will move in a blank sector. On the other hand, if necessary, rotation of the operating lever will rotate the crank shaft.

When the gun is not set for semi-automatic operation, the clutch lock is screwed inward, carrying the clutch sector in against the compression of its spring and filling the former blank space. The shaft and operating lever are thus securely locked together.

720. The firing mechanism (see Art. 750) functions as follows (Fig. 4):

When the breech block rises the cocking lever toe E strikes the nib of the sear F, thus drawing back the firing pin and compressing its spring. The sear F fits into the left of the breech housing and is held in position by a plunger and spring. The sear is rotated by the action of pull on the trigger, acting through the trigger lever, trigger rod, and sear arm. When the trigger is pulled the sear is rotated against the force of the sear spring, the cocking lever is released by the sear nib, and the firing pin flies forward. If the trigger were lashed in the

closed position, firing would result automatically as soon as the breech is closed. Firing may also be accomplished by an electrical firing circuit, which includes a pointer's firing key and a solenoid. The plunger of the latter strikes the sear arm, tripping the sear.

721. **The salvo latch,** of the positive type, engages the left end of the plug-operating shaft. This latch unlocks when the gun has recoiled approximately half the amount of its normal recoil. As the plug, when operated automatically, does not start to open until after the beginning of counter-recoil and, if operated by hand, is not opened until after the completion of counter-recoil, it is apparent that the salvo latch unlocks sufficiently in advance to prevent interference with the normal operation of the plug. With the plug closed and locked, the salvo latch may be unlocked by hand.

5-INCH 25-CALIBER ANTI-AIRCRAFT BREECH MECHANISM.

722. The 5-inch 25-caliber breech mechanism is of the semi-automatic sliding-wedge type and is essentially the same as that of the 3-inch, 50-caliber anti-aircraft gun. It may be hand operated by a lever on the right side of the slide. The salvo latch, of the positive type, engages the left end of the plug-operating shaft. The latch unlocks when the gun has recoiled approximately half the amount of its normal recoil. As the plug, when operated automatically, does not start to open until after the beginning of counter-recoil and, if operated by hand, is not opened until after the completion of counter-recoil, it is apparent that the salvo latch unlocks sufficiently in advance to prevent interference with the normal operation of the plug. With the plug closed and locked, the salvo latch may be unlocked by hand.

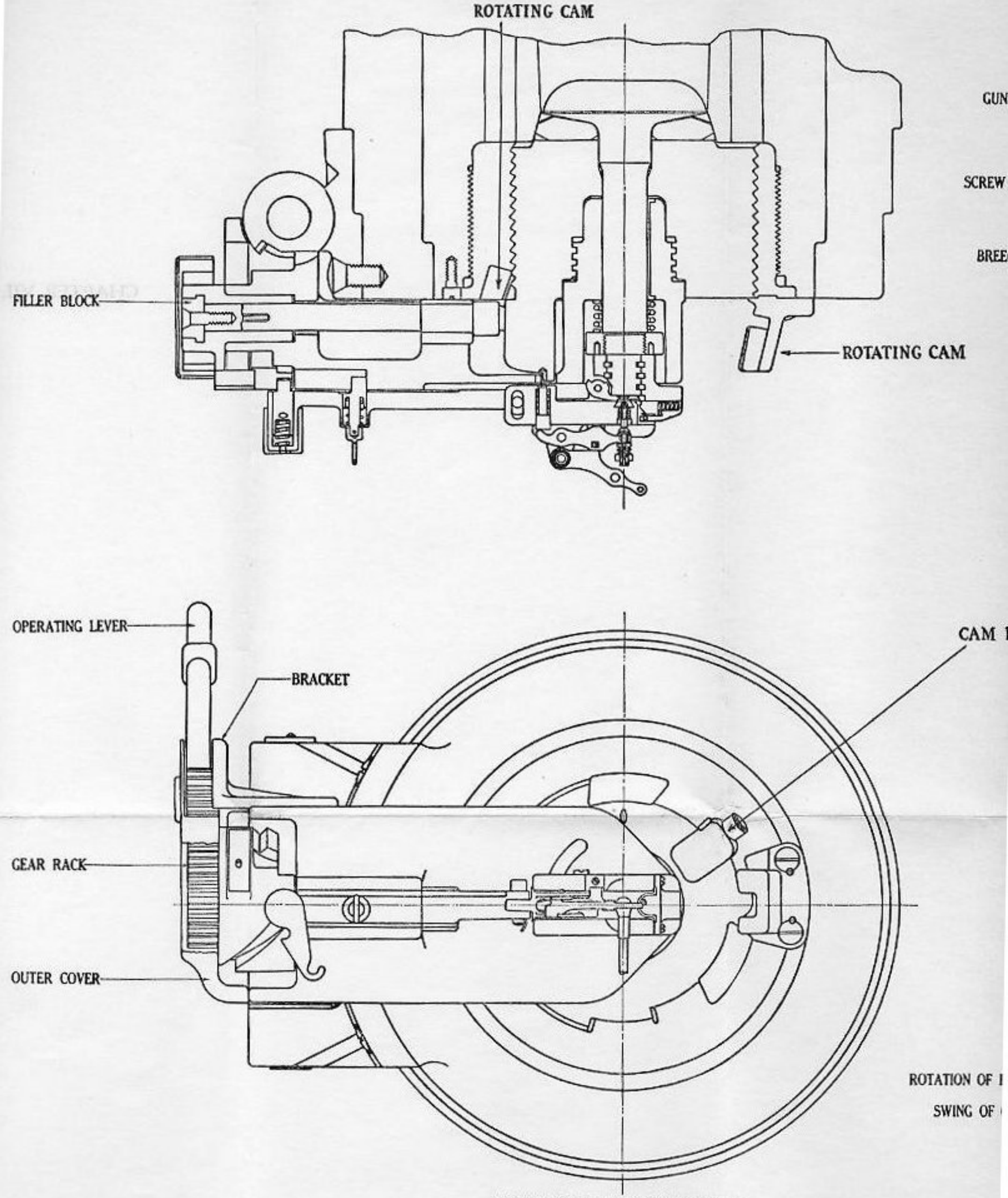
5-INCH BREECH MECHANISM, MARK VII.

(Plates IV and V, Figs. 705 and 706.)

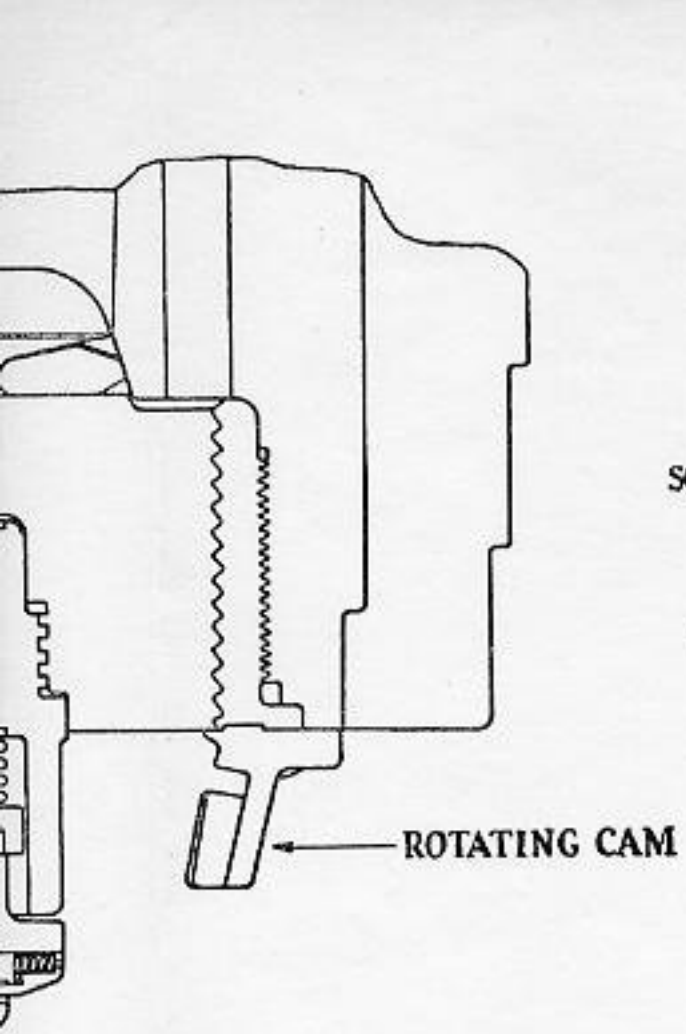
723. **Introductory.**—The description in detail of the 5-inch Mark VII breech mechanism follows. Except for minor details, this description covers also the 6-inch Mark X, 12-inch Mark IX, 14-inch Marks II, III, and IV, and 16-inch Mark I breech mechanisms.

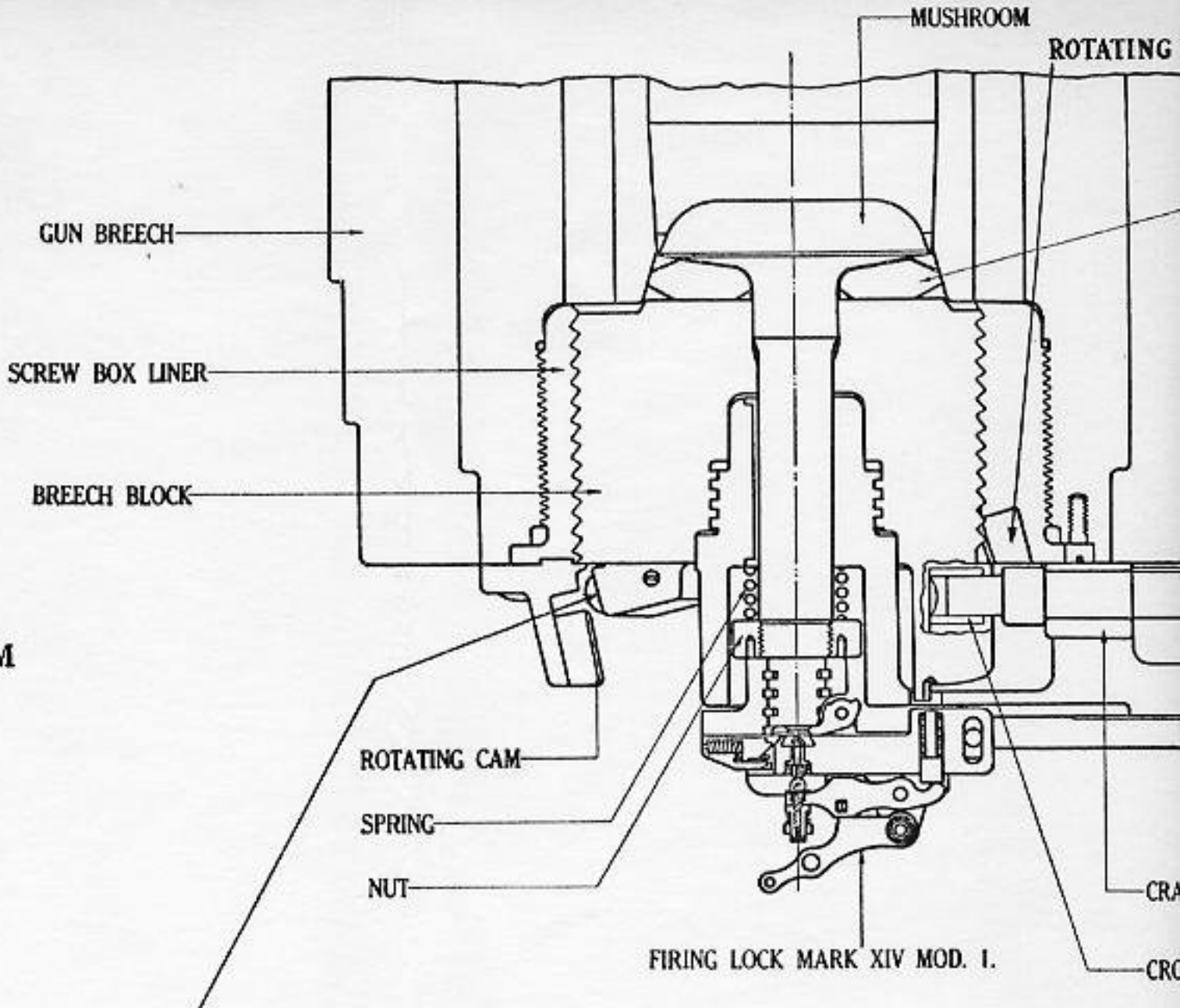
724. **General design.**—This breech mechanism is designed to fit the 5-inch bag gun. The breech mechanism is of the carrier type, with the Welin breech plug, De Bange gas check system, and the Smith-Asbury type of operating mechanism.

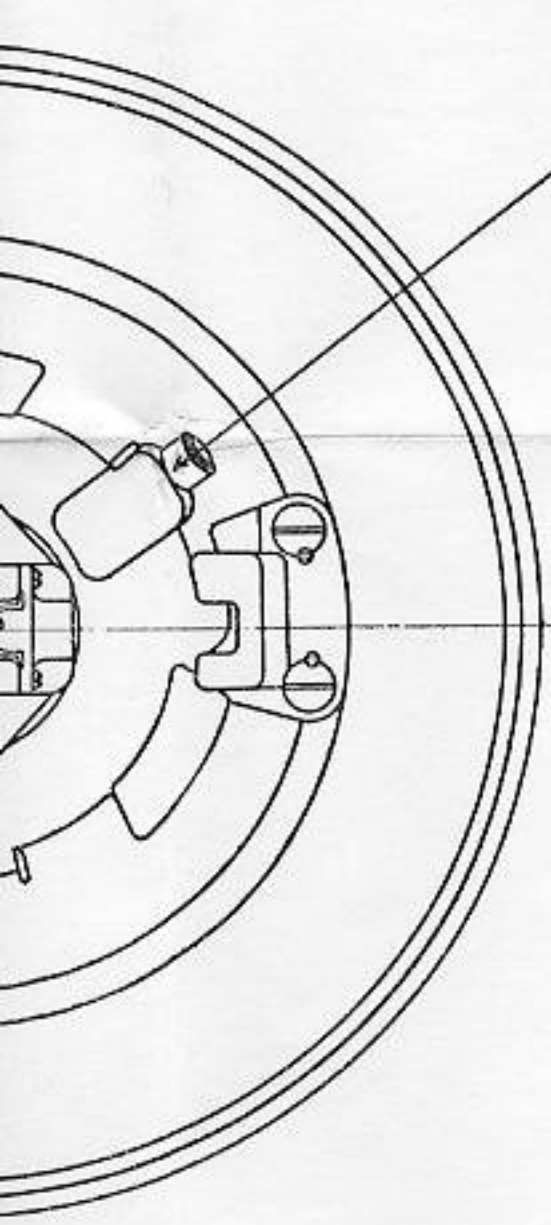
725. **The carrier** (see Plates IV, V, and Figs. 705, 706) is journaled on a vertical hinge pin on the right-hand side of the gun. The carrier extends across the breech face of the gun and has a forward projecting hub on which the breech plug is journaled. The operating lever is

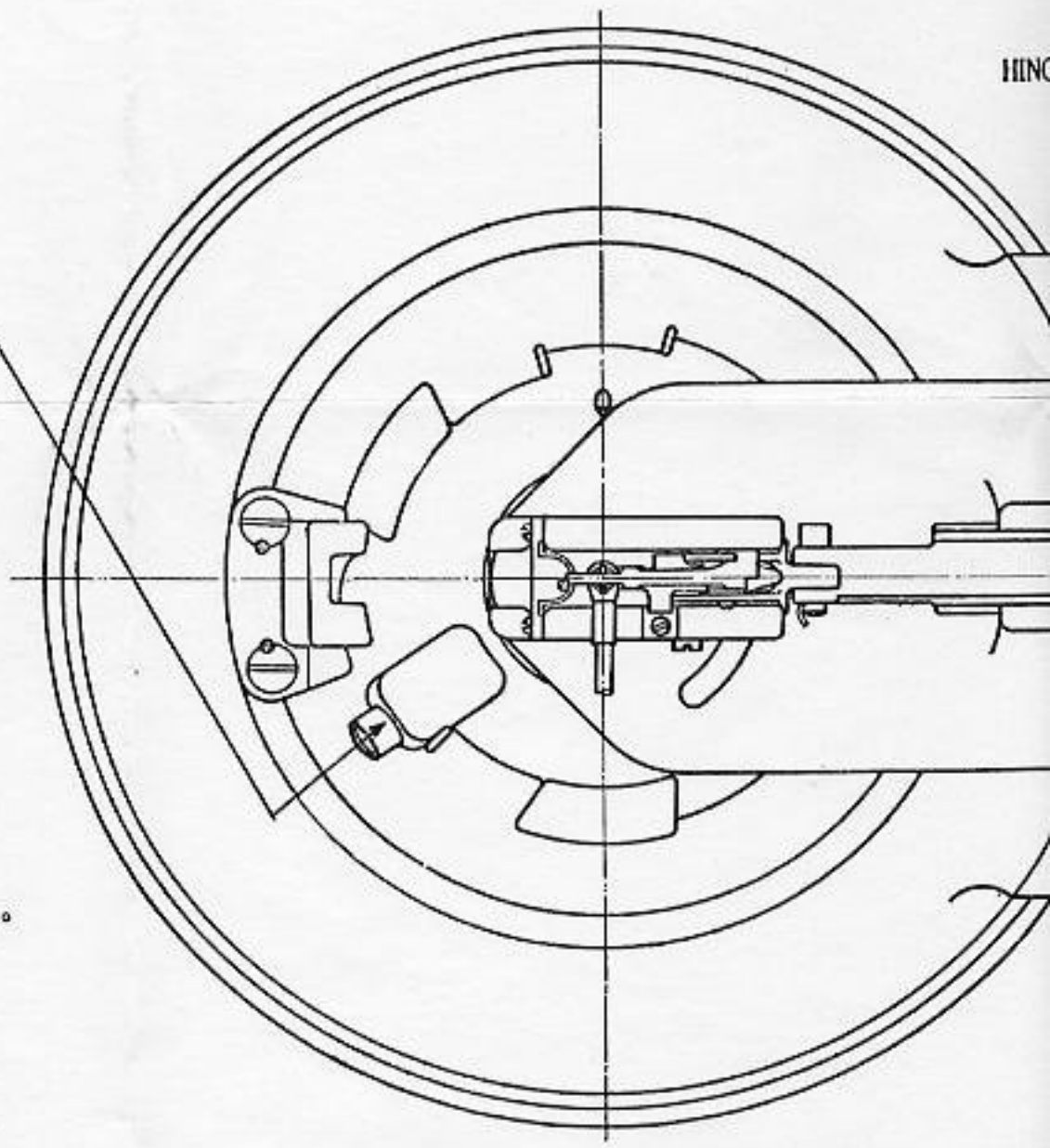


BREECH MECHANISM MARK X MOD. 2









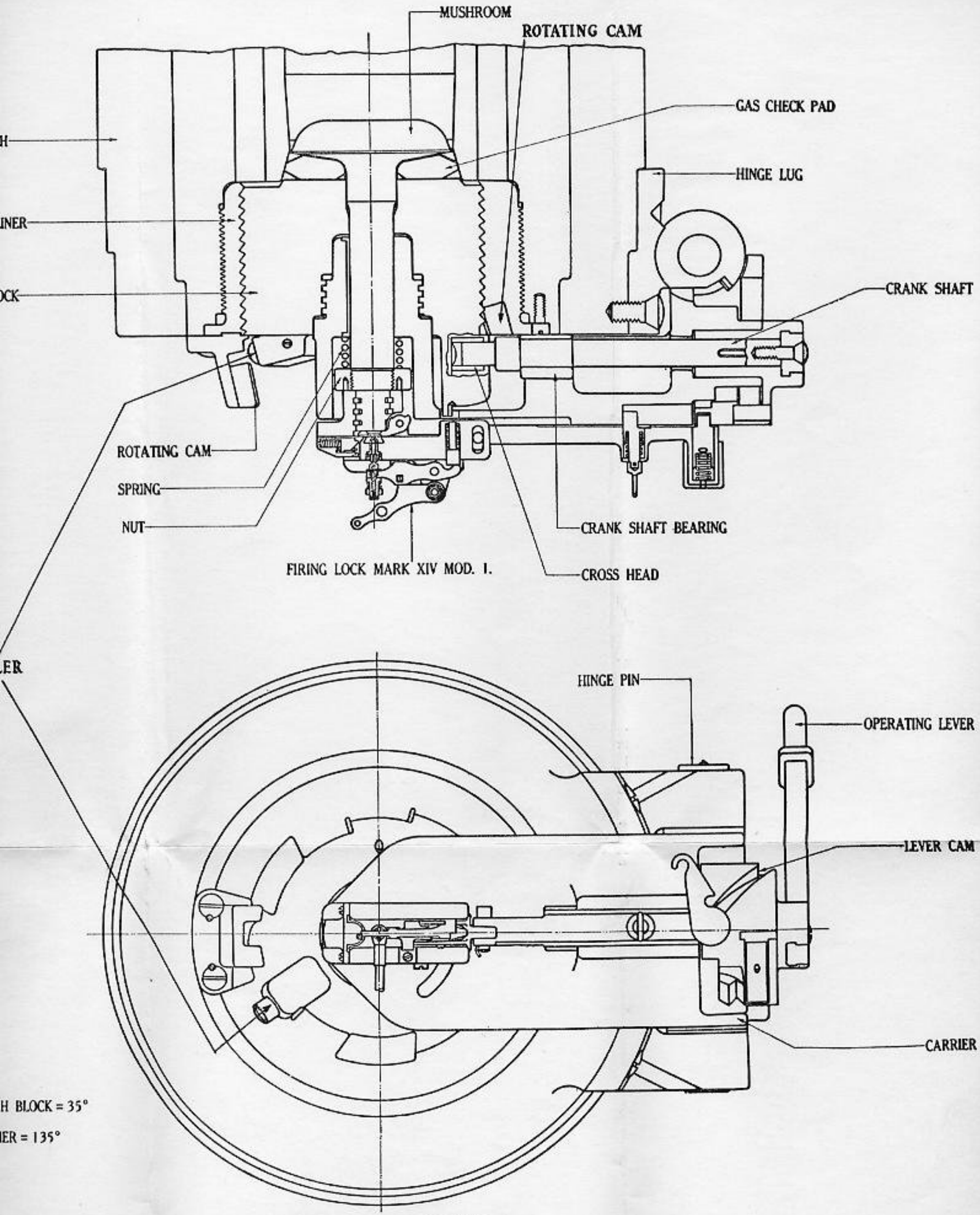
ROTATION OF BREECH BLOCK = 35°

SWING OF CARRIER = 135°

ARK X MOD. 2

BREECH MECHANISM MARK X MOD. 3

Breech Mechanism, Mark X Mods. 2 and 3



BREECH MECHANISM MARK X MOD. 3

H BLOCK = 35°

IER = 135°

k X Mods. 2 and 3

attached to a shaft journaled in the carrier. The other end of this shaft carries an overhung crank, the pin of which engages a crosshead which works in a crosshead bearing set into the rear face of the breech plug.

726. To open the mechanism, the operating lever is swung to the rear in a vertical plane. This rotates the crank shaft, which by means of the crank and crosshead, rotates and unlocks the plug. The operating

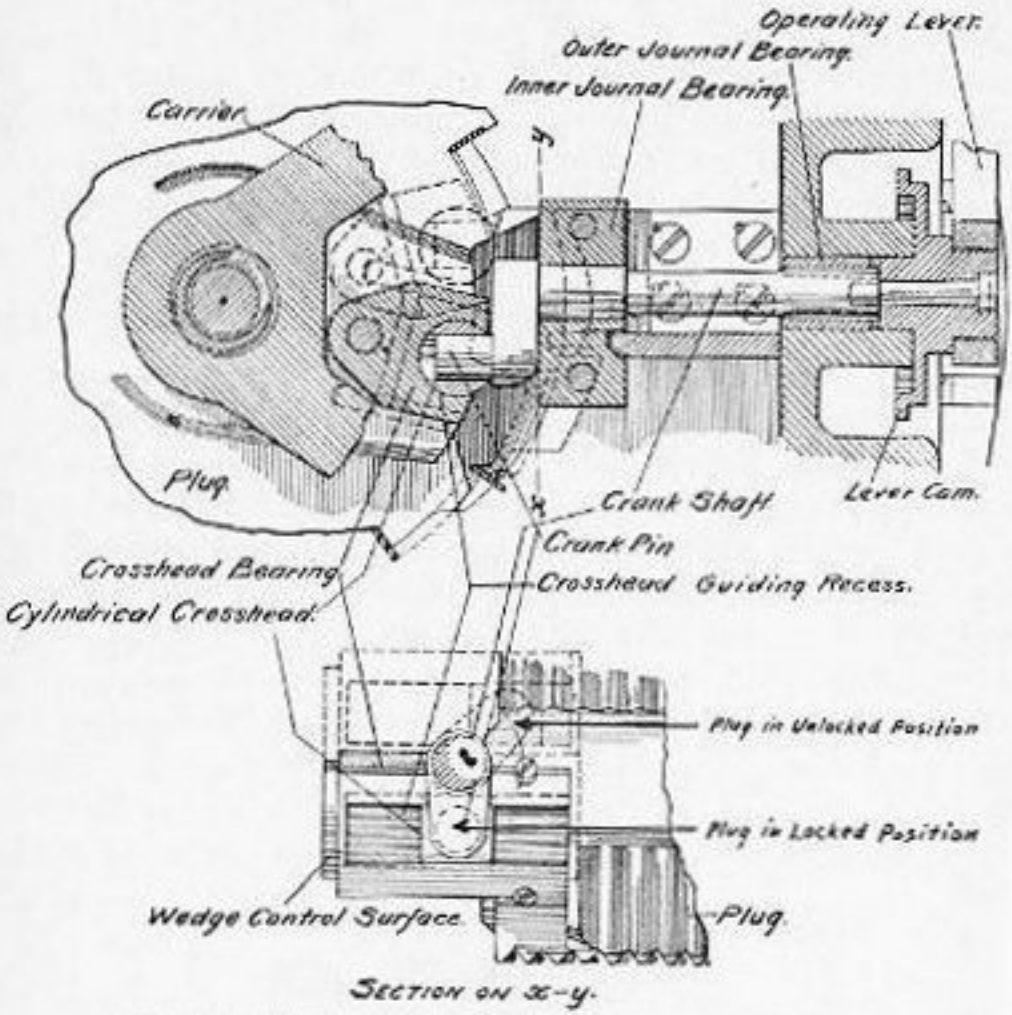


FIG. 705.—OPERATING MECHANISM FOR 5-INCH BREECH MECHANISM, MARK VII.

lever is then swung to the side in a horizontal plane, which swings the carrier and plug about the vertical hinge pin and clear of the breech. Reverse motions close the breech. A salvo latch locks the operating lever in position so that it can only be unlocked by the recoil of the gun or by hand.

727. Screw-box liner and breech plug.—The rear end of the gun jacket is threaded to receive the screw-box liner. The gas-ejector valve is secured to the rear flange of the screw-box liner, and is opened by the rotation of the breech plug in opening the breech. Air from the

valve passes to one or more annular channels turned on the outside of the screw-box liner, and thence through tangential ducts to the inner side of the screw-box liner and to the bore of the gun. The screw-box liner and the breech plug are slotted to form 12 sectors, 4 blanks and 8 threaded steps, in four groups, the blanks being wider than the threaded steps to permit the action of the rotating cam.

The breech plug is of the Welin or stepped-screw type, having abutment threads with the pressure side the steeper. The center of the plug is bored out to provide a bearing for the mushroom stem and to receive the threaded hub of the carrier. This thread has the same pitch as the external thread on the plug.

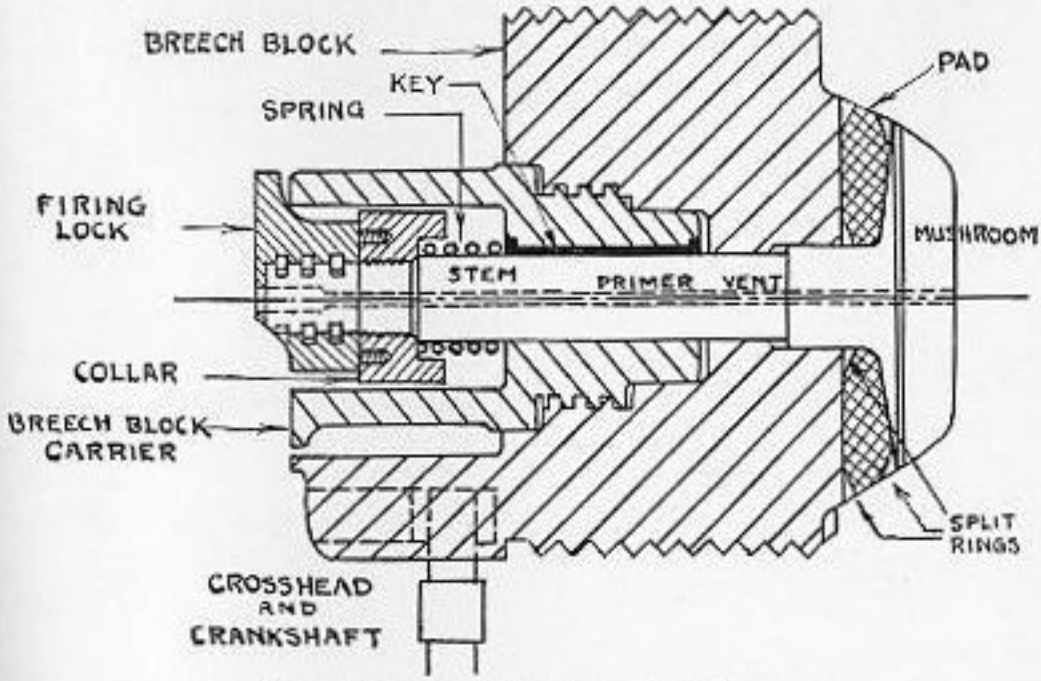


FIG. 706.—THE DE BANGE GAS CHECK.

728. The De Bange gas check system (Fig. 706).—The breech-block carrier has an axial hole through it, through which passes the mushroom stem. The firing lock is secured to the after end of the stem. Just forward of the firing lock is screwed a collar, and between this collar and the carrier is a spiral spring, the compression of which tends at all times to keep the mushroom and gas-check pad pulled aft against the breech block. The mushroom stem is keyed to the carrier so that the mushroom cannot rotate but has free movement in the fore-and-aft direction. The breech block necessarily has to rotate a small amount, but the mushroom cannot rotate and the gas-check pad normally never rotates as it adheres to the mushroom instead of to the breech block. The breech block is screwed on to the forward hub of the carrier, this screw having the same pitch as the screw of the

breech block and screw-box liner, thus the carrier is not translated during the rotation to the breech block while opening or closing the breech.

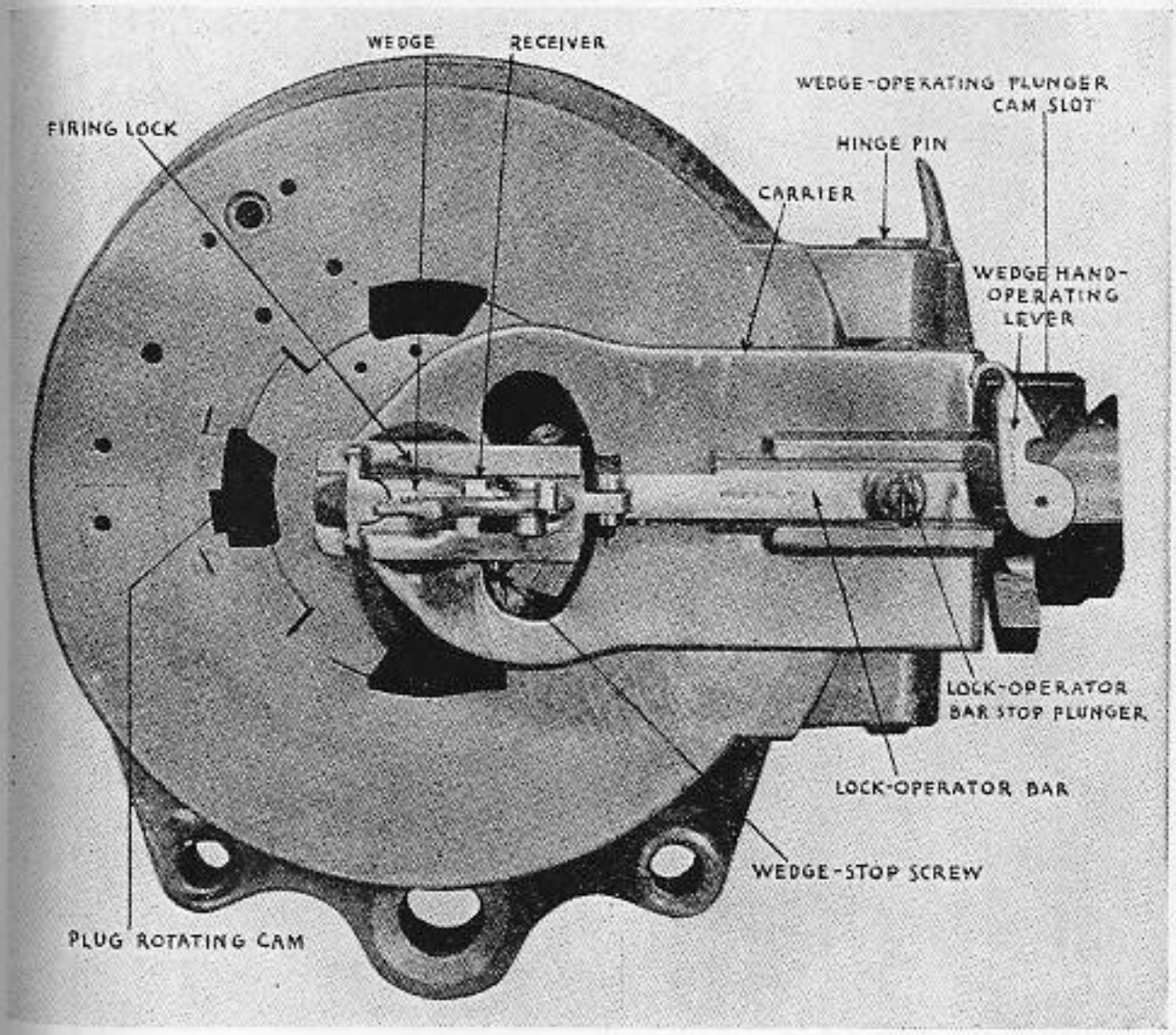
On opening the breech, the action of the mechanism and the gas-check pad is as follows: (a) The breech block is rotated to unlock it. During this rotation the carrier does not move, but the breech block moves aft a small amount due to the pitch of the screw in the screw box and the pitch of the screw on the carrier. When the breech block moves aft this small amount, the spiral spring around the mushroom stem, being under compression, tends to draw the mushroom and gas-check pad aft against the breech block. In some cases this will serve to break the seal and in others it will not accomplish the breaking of the seal. (b) The plug being unlocked, the carrier with the plug is next swung back, opening the breech. If the seal is not broken at the beginning of this movement, the rotation of the carrier through a small arc will put the spiral spring under high compression and thus exert a strong pull on the mushroom stem. In case this fails to break the seal, a slight additional swing of the carrier will compress the spiral spring to its solid length or will bring the collar on the mushroom stem up against the carrier, in which case it is evident that any further movement of the carrier will necessarily break the seal and that the pressure exerted by the spiral spring will force the pad and mushroom back against the breech block.

729. Operating mechanism (Fig. 705).—The crank shaft, which extends through the carrier, is provided with two bearings. The inboard bearing engages the portion of the crank shaft adjacent to the overhung crank.

The outboard bearing for the crank shaft is machined in the shoulder of the carrier casting, which is bored out to fit a steel sleeve keyed to the crank shaft. To this sleeve is attached the operating lever and wedge-operating cam, these parts being keyed to the outer portion of the sleeve and clamped in position against a collar on the sleeve by the circular flange of a nut threaded on the extremity of the crank shaft and seated in a counterbore in the end of the cam.

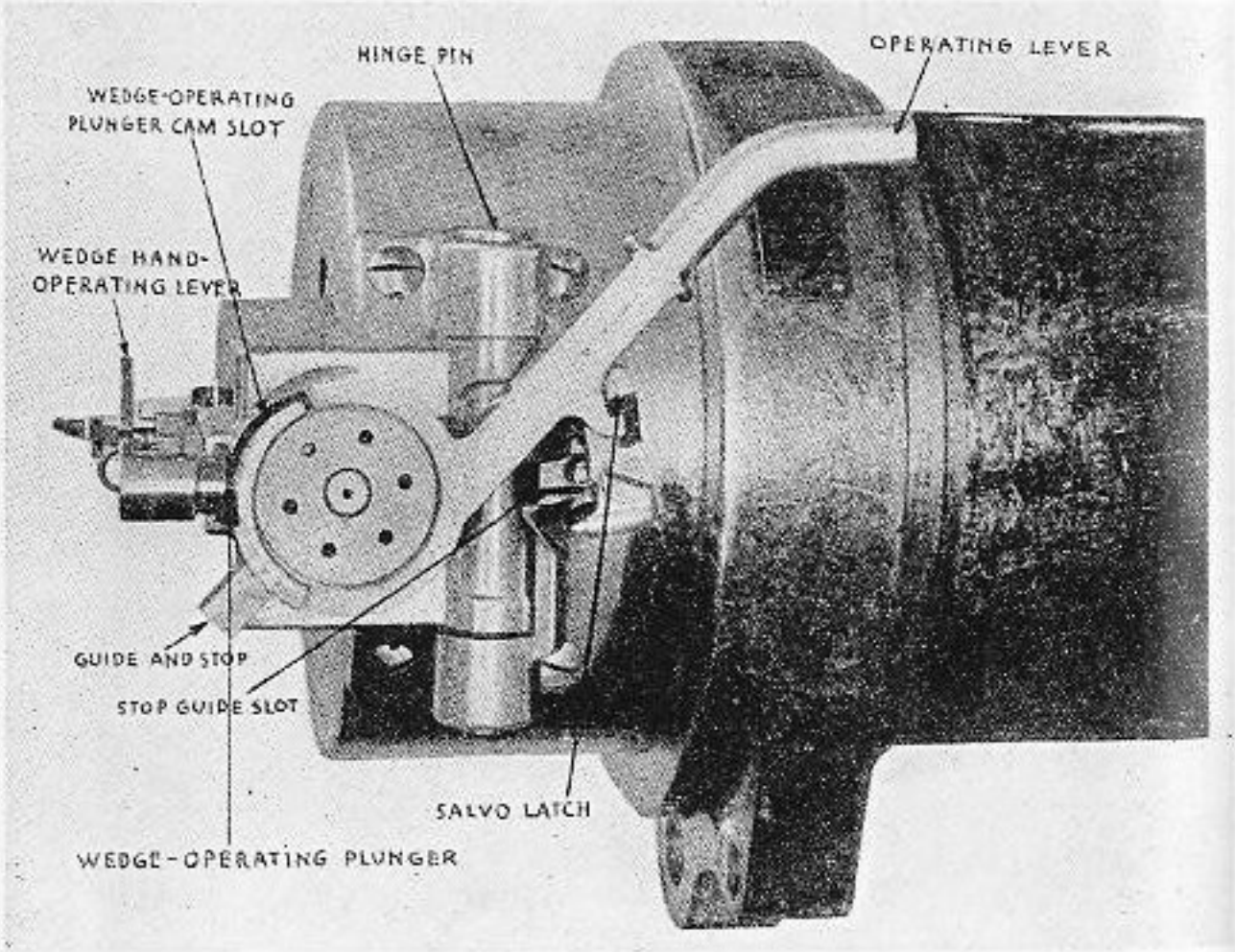
In the rear face of the plug, and located near the right-hand edge, at an angular distance above the horizontal center line (unlocked position) equal to half the angle of rotation, is a counterbore into which is rigidly fitted a hollow, cylindrical crosshead bearing. The crosshead, which is housed in the crosshead bearing, engages the crank pin of the overhung crank, the parts being so arranged that the crosshead is capable of both a rotary and a sliding motion with respect to its bearing and crank pin.

CHAPTER VII, PLATE IV.



5-INCH BREECH MECHANISM—REAR VIEW.

CHAPTER VII, PLATE V.



5-INCH BREECH MECHANISM—SIDE VIEW.

When the plug is closed and locked, as during firing, the operating lever extends upward and toward the muzzle, making an angle of 43° with the vertical. The crosshead and bearing are below the horizontal center line at an angular distance of 16° 42′ 30″ (equal to half the rotation of the plug) and the crank shaft is in the dead center position, with the crank pin directly in line with the center of the shaft when viewed in the plane of rotation of the plug. The plug is thus securely locked against any rotary tendency produced by reason of the chamber pressure and the inclination of the plug threads.

730. To open the breech, the operating lever is moved to the rear until it reaches the horizontal position, turning the crank shaft through an angle of 133°. The corresponding circular motion of the crank pin is resolved by the crosshead within its bearings into an upward movement of this bearing, which, being rigidly attached to the plug, causes a rotation of this member in the direction required to disengage the threaded steps. At the beginning of this motion, as the crank pin leaves the dead center position a large angular movement of the lever and crank shaft will produce but a small rotation of the plug, with a corresponding increase in the force available to unseat the gas-check pad.

731. Plug-rotating cam.—The total angular movement of the plug produced by the rotation of the crank shaft is 33° 25′, of which movement but 26° 42′ 5″ is required to disengage the threads, the remainder of the rotation occurring as the carrier begins to swing away from the gun, thus affording an easy transition from the rotary motion of unlocking the plug to the translatory motion of swinging it out of the breech. The effect is accomplished by the plug-rotating cam, which is fitted in a dovetail in the blank between the threaded sections on the left side of the screw box, and consists of a hardened-steel plate into which is cut a curved cam slot coinciding in its forward portion with the pitch of the screw-box threads, and running out at the breech face in the path of the parts swinging about the hinge pin. This cam slot engages a stud or cam follower projecting from the side of the breech plug, and guides it during the latter part of the motion of unlocking, so that, as soon as the threads of the plug are disengaged, the rearward motion of the plug and carrier, in swinging about the hinge pin, is gradually started without the shock to the mechanism or to the operator which would result were the direction of motion changed suddenly. The advantages derived from the use of the plug-rotating cam are most marked during the act of closing the breech, when, by checking gradually the velocity of the swinging parts, it serves to avoid the objectionable slamming and rebounding of the carrier by utilizing and absorbing the energy of the swinging parts in imparting a

rotary motion to the plug and operating lever. In all except the largest guns, it also does away with the necessity for closing buffers.

Inefficient forms of power transmission, such as gears, racks, and worms, have been eliminated, and bearings with large surfaces have been introduced instead. In major caliber guns fitted with breech mechanisms of this type, ball bearings or roller bearings on the hinge lug carry the dead weight of all swinging parts. The number of pieces has been greatly reduced.

732. Operating-lever guide and stop (see Plate V).—The rearward swing of the carrier about the hinge pin, commenced by the plug-rotating cam, is continued by the operating lever until the mechanism has been swung through 90°, when further swing is limited by recessed stops on either side of the carrier hinge, which come up against corresponding abutments formed upon the hinge lug forging. While the mechanism is open, the plug is prevented from rotating and is maintained in the unlocked position by the operating-lever guide and stop, a projection from the hub of the operating lever, which, as the outward movement of the mechanism about the hinge pin commences, enters a guide slot in the hinge lug forging. This device and the rotating cam prevent the plug from rotating while the threads of the plug and screw box are disengaged.

To guard against the failure of the guide on the operating lever hub to enter the guide slot fairly, which might occur if lost motion should develop in the operating gear, an operating lever stop is provided to limit the rotation of the lever and crank shaft. This stop consists of a pin driven through the hub of the operating lever, and which is provided with a stud projecting inwardly to engage a slot milled in the outboard end of the carrier (not shown).

733. Features of the operating-lever mechanism.—The movement of the lever in a vertical plane around the crank shaft for rotating the plug, and in a horizontal plane around the hinge pin for swinging it, results in several desirable features being obtained, as follows:

(1) It eliminates the use of a carrier latch or a plug latch.

(2) The operator stands entirely clear of the recoil.

(3) When the plug is closed, the lever is in such position as to allow the plugman to catch it as the gun returns to battery and, by holding on to it, to have the forward movement of the gun unlock the mechanism.

(4) It permits of a design of mechanism which does not require right- or left-hand parts.

734. Operating-lever latch (salvo latch) (Plate IV).—The lever latch consists of a latch member journaled on a screw bolt attached

to the forward edge of the hinge lug in line with the operating lever guide slot. A locking plunger is mounted in a recess directly in the rear of the latch boss, and in such a position that the plunger is retained in place by an overlapping portion of the latch. The upper portion of the latch is broad and heavy, and is machined at its upper extremity to engage the hook or catch formed on and projecting from the under side of the operating lever. The lower part of the latch is made as light as possible, and is bored out to provide a bearing for the latch spring and plunger, which, by acting against the hinge lug, throw the latch into proper position to engage the catch on the operating lever.

During recoil, the inertia of the upper and heavier parts of the latch causes it to rotate on its pivot so that the lower portion moves to the rear toward the hinge lug, compressing the latch spring, and the upper portion moves forward and out of engagement with the catch on the operating lever. The latch is held in this released position by the locking plunger, which, under the impulse of the locking plunger spring, moves out and engages a notch in the latch as soon as it is brought into line by the rotation of the latch. When the breech is opened the lug on the operating lever strikes the locking plunger, compressing its spring, and moves the projecting stud out of engagement with the notch in the latch, which thereupon, under the action of the latch spring and plunger, is returned to the "set" position ready to engage the catch on the operating lever when the breech is closed. The bottom part of the latch serves as a stop which comes up against the hinge lug and limits the rotation of the latch.

As the latch does not release automatically except upon the discharge and recoil of the gun, it gives warning of misfires or hangfires which might pass unnoticed when a number of guns are being fired in salvo. In such case, the breech can only be opened after releasing the latch by hand.

6-INCH 53-CALIBER GUN BREECH MECHANISM.

735. Breech mechanism Mark X, Mods. 2 and 3.—This breech mechanism is essentially the same as the 5-inch Mark VII just described, except that each breech mechanism is fitted with two cam rollers diametrically opposite each other to reduce the shock of closing and to assist in changing the motion of translation to one of rotation. These cam rollers perform the same function as the follower pin on the plug of the 5-inch Mark VII breech mechanism. The right-hand mechanism is the standard for the type as far as the operating lever is concerned, but it was found that when the gun and breech mechanism were rotated 180° for the left-hand gun for a 6-inch twin mount

the operation of the lever was not convenient, so a modification of the lever was developed for the left-hand gun consisting of two gear segments and an additional bearing bracket, so as to permit the operating lever to be mounted on the upper part of the carrier and to swing in a manner similar to the right-hand breech mechanism (see Plate VI).

14-INCH BREECH MECHANISMS.

736. Some 14-inch two-gun turrets have Mark II breech mechanisms which are practically identical with the 5-inch Mark VII breech mechanism previously described, except that the carrier trunnions are provided with roller bearings in the hinge lugs because of the greater weights involved.

The 14-inch breech mechanism, Mark III and its modifications is essentially similar to the breech mechanism, 5-inch, Mark VII, and 14-inch, Mark II, except that it has been rotated through 90° to permit the breech plug to swing in the vertical plane in opening and closing. This mechanism is used on the 14-inch 45-caliber guns, mounted in three-gun turrets.

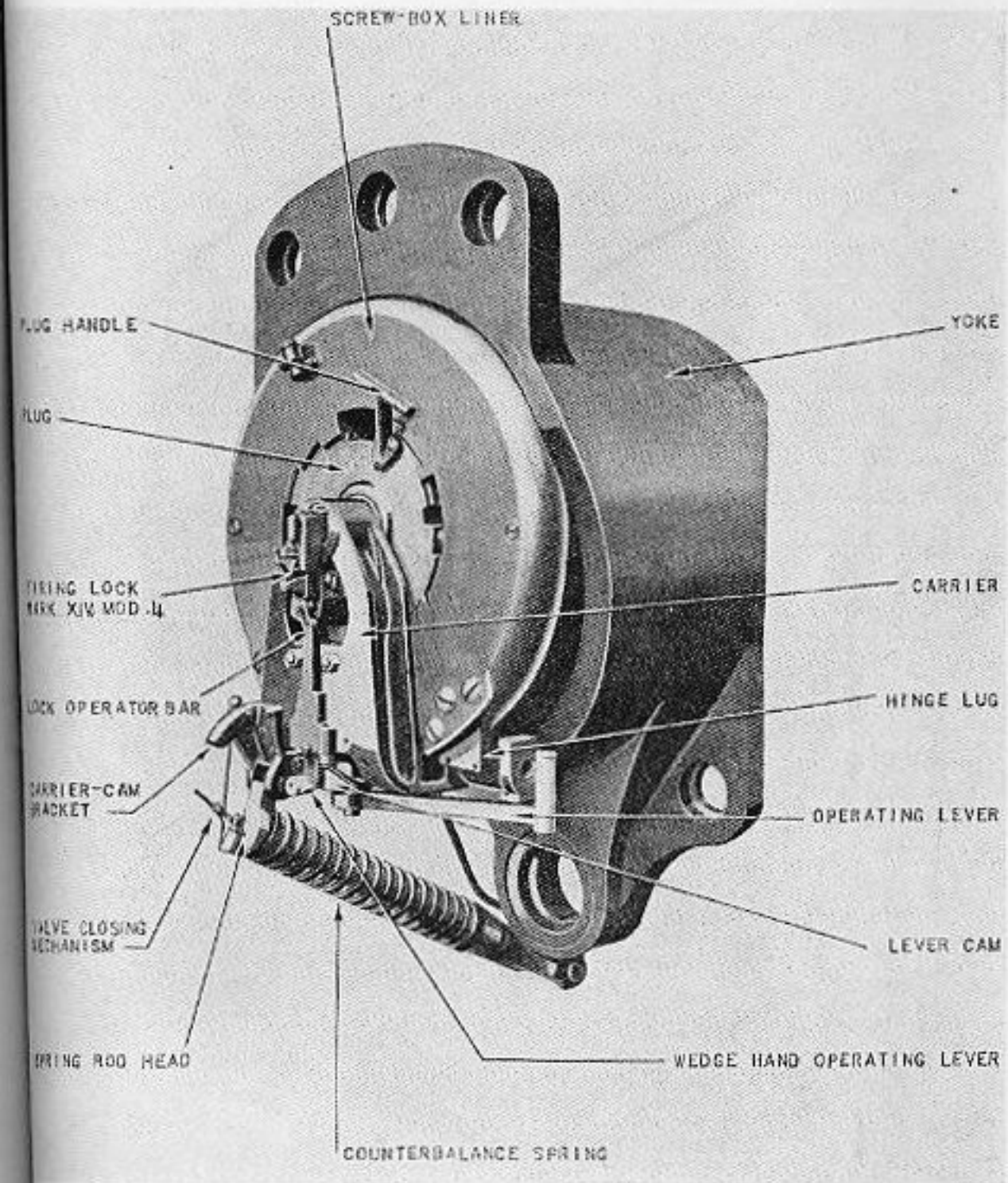
The Mark IV breech mechanism is used on the 14-inch 50-caliber guns, mounted in three-gun turrets. This Mark IV breech mechanism is essentially the same as the Mark III (described below) except that the breech plugs of the right-hand and center guns swing downward at an angle of 16° from the vertical axis, to the right, while the left-hand gun plug swings downward at an angle of 16° to the left of the vertical axis. This arrangement permits more space between the plug and the spanner tray and for handling ammunition.

737. General description of the 14-inch Mark III breech mechanism.—In this description of the 14-inch Mark III breech mechanism and its modifications, the mechanisms and operations which are identical in principle with those of the 5-inch Mark VII are omitted. The breech mechanisms, similar to those of the 5-inch Mark VII, are of the carrier type with the Welin breech plug, De Bange gas-check system, and the Smith-Asbury type of operating mechanism. The operation of opening and closing the breech mechanism is facilitated by using a counterbalance spring and a closing cylinder operated by compressed air (see Plate IX). To reduce friction the two trunnions of the carrier are provided with roller bearings.

738. Breech plug and screw-box liner.—The screw-box liner and the breech plug are slotted to form 16 sections, 4 blanks and 12 threaded steps, in four groups.

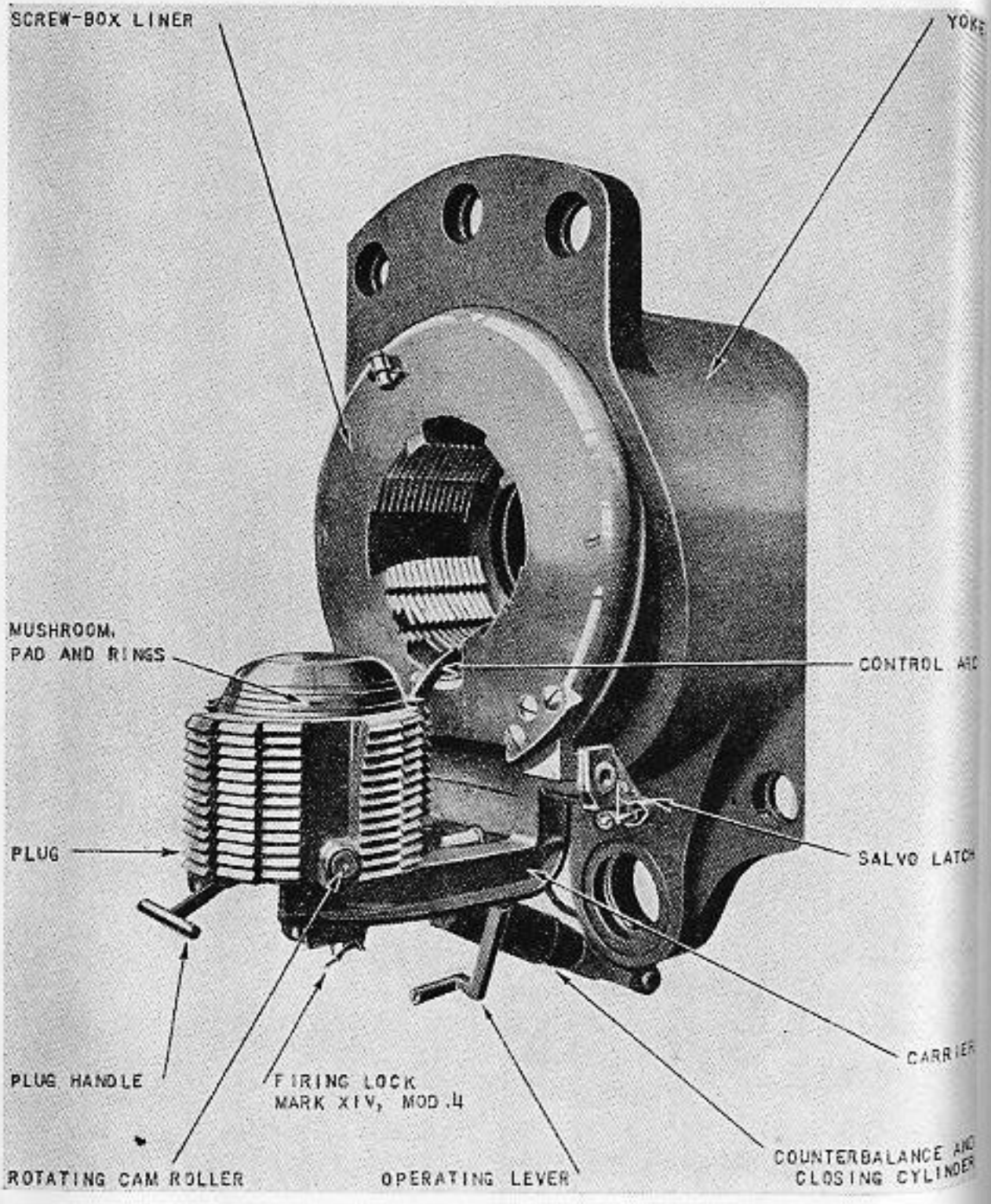
739. Opening the breech.—To open the breech, the operating lever is swung rearward through an angle of 135°. The crank turns through

CHAPTER VII, PLATE VII.



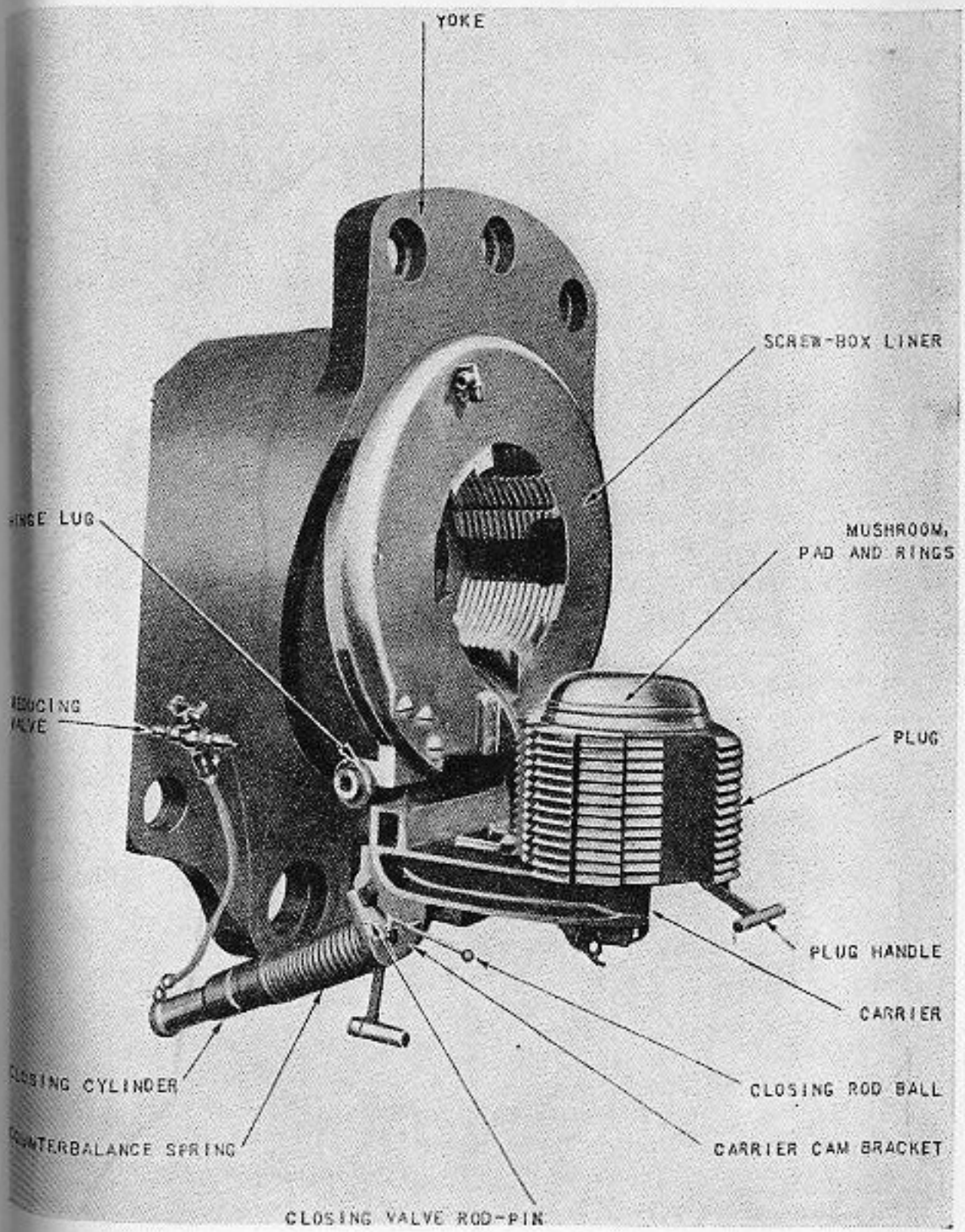
14-INCH BREECH MECHANISM, MARK III, MOD. 1, PLUG CLOSED.

CHAPTER VII, PLATE VIII.



14-INCH BREECH MECHANISM, MARK III, MOD. 1, PLUG OPEN, RIGHT SIDE.

CHAPTER VII, PLATE IX.



14-INCH BREECH MECHANISM, MARK III, MOD. 1, PLUG OPEN, LEFT SIDE.

the same angle. The total angular movement of the plug produced by the rotation of the crank shaft is 27° 30′, 22° 30′ of which is required to disengage the threads. During the remainder of the rotation, a rearward motion is given the plug by means of a rotating cam roller. The rearward swing of the carrier about the hinge pins is continued by means of the plug handle until the plug has swung downward through an angle of 90°, when the energy acquired by the heavy plug and carrier in swinging down is absorbed and checked by the counterbalance spring which also supports the mechanism in the open position.

The Mark III type of breech mechanism should never be opened when the counterbalance spring is not in place, as the plug will drop down, wrecking the carrier and hinge lugs.

740. Control arc.—While the mechanism is open, the plug is prevented from rotating in the closing direction by the control arc engaging the adjacent high section of the plug. The control arc is a circular segment concentric with the hinge and is bolted to the screw-box liner between the hinge lugs.

741. Counterbalance and closing cylinder for 14-inch breech mechanism (Plate X).—This device consists of a pneumatic closing cylinder with its bracket bushing and pin, a counterbalance spring with adjusting nut, a spring rod, a spring-rod piston with packings rings, a carrier-cam bracket with spring rod pin, closing cylinder valve body with valve plug, valve shaft and sleeve, valve handle, and valve-closing rod with pins and joint. The closing cylinder is supported by a bracket pivoted in a journal under the recoil-cylinder lug of the yoke. The spring-rod piston at one end of the spring rod works in the closing cylinder. At its upper end the spring rod terminates in a head with an offset hook which bears on a pin in the carrier-cam bracket. The spring surrounds the spring rod and extends from under the spring-rod head to the adjusting nut which is threaded on the outside of the closing cylinder. The body of the valve for admitting compressed air to the closing cylinder serves as the cylinder head. Compressed air is led to the valve by means of a flexible metallic hose from the reducing valve.

The power of the counterbalance spring and its lever arm is so designed that during the opening of the breech mechanism the weight of the plug is nearly balanced until fully opened, when an extension on the carrier bracket comes in contact with the spring-rod head, increasing the lever arm of the spring, which is thus enabled to take the shock and stop further motion of the breech mechanism.

To close the breech mechanism, care being taken to stand clear of the moving parts, compressed air is admitted to the closing cylinder by operating the closing valve by hand. The air pressure on the piston is

transmitted through the spring rod to the carrier-cam bracket and the carrier and plug are forced upward. When the mechanism is nearly closed, the ball on the closing rod takes up against the valve-closing rod pin, automatically revolving the valve shaft, closing the valve, and at the same time opening a by-pass from the closing cylinder to the atmosphere (see Plate X).

In case of failure of the air pressure, the mechanism can be closed by means of the plug handle bolted to the plug. In closing by hand, care must be taken to stand clear of the path of the operating lever. It is possible for one man to close the plug with the gun elevated to an angle of 20°.

Reducing valve.—The reducing valve is inserted in the air line at the end of rigid piping and fastened to the gun yoke by two pipe clips. It is set to deliver a constant pressure to the inlet valve of the closing cylinder instead of the varying pressure in the air supply lines.

742. Salvo latch.—As the salvo latch is disengaged automatically upon the recoil of the gun, it gives warning of misfires or hangfires which might pass unnoticed when a number of guns are fired in salvo. The salvo-latch bracket and operating-lever buffer are combined in one casting fastened to the hinge lug, so that the catch in the end of the operating lever engages the operating-lever latch when the breech plug is closed (see Plate XI).

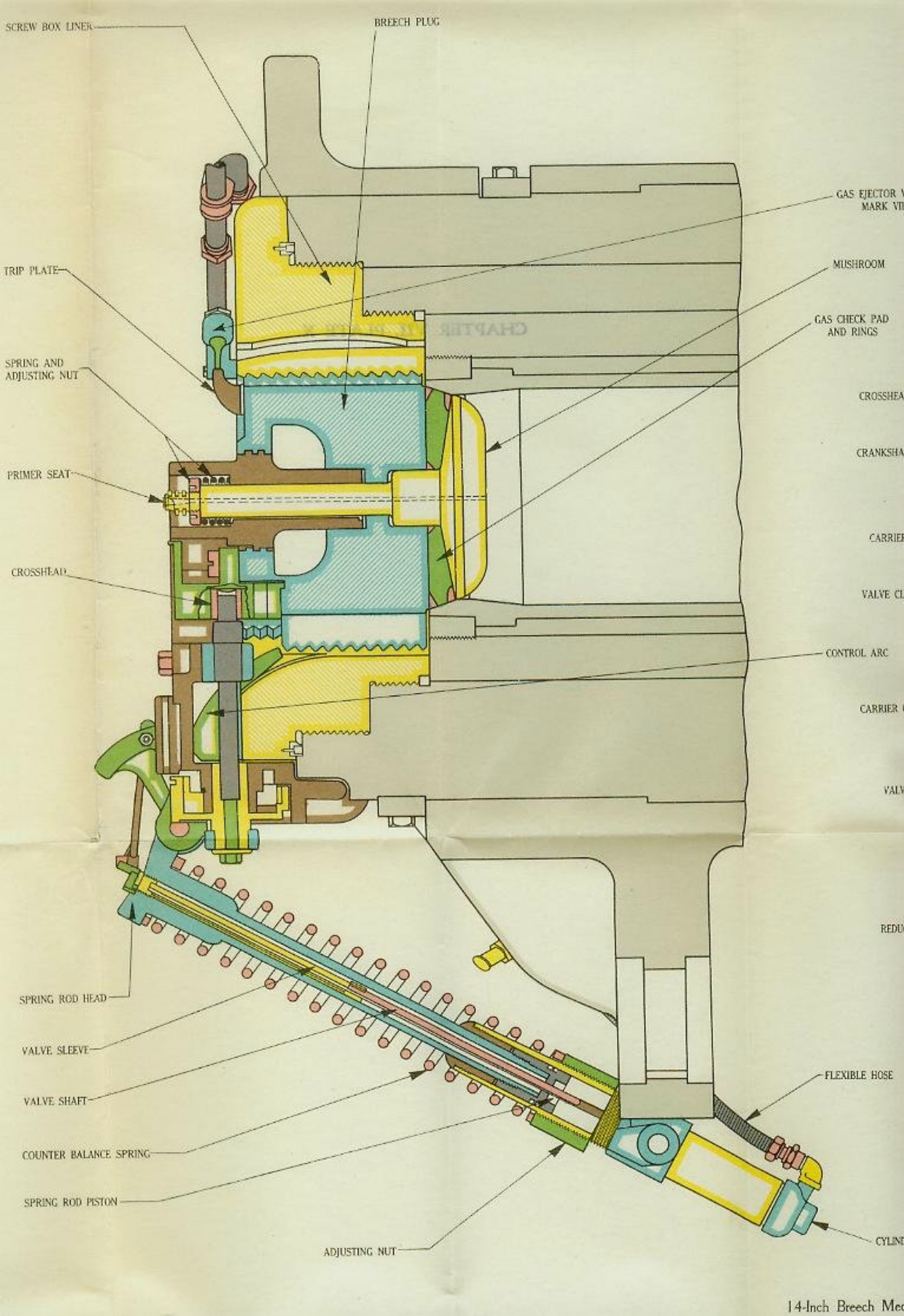
During recoil the inertia forces the salvo latch forward against its spring and the salvo-latch catch is released, thus holding the salvo latch out of the way of the lever latch, which may now be pushed back by the operating-lever catch when opening the mechanism. As the operating-lever latch and catch are no longer engaged, it is possible to swing the operating lever and open the mechanism. For drill purposes the salvo latch is held in its forward position by screwing in a locking pin not shown.

The hydraulic buffer prevents the operating lever from rebounding, thereby permitting the lever latch to engage the lever catch. A rawhide buffer is also inserted in the salvo-latch bracket to cushion the blow of the operating lever when it swings home.

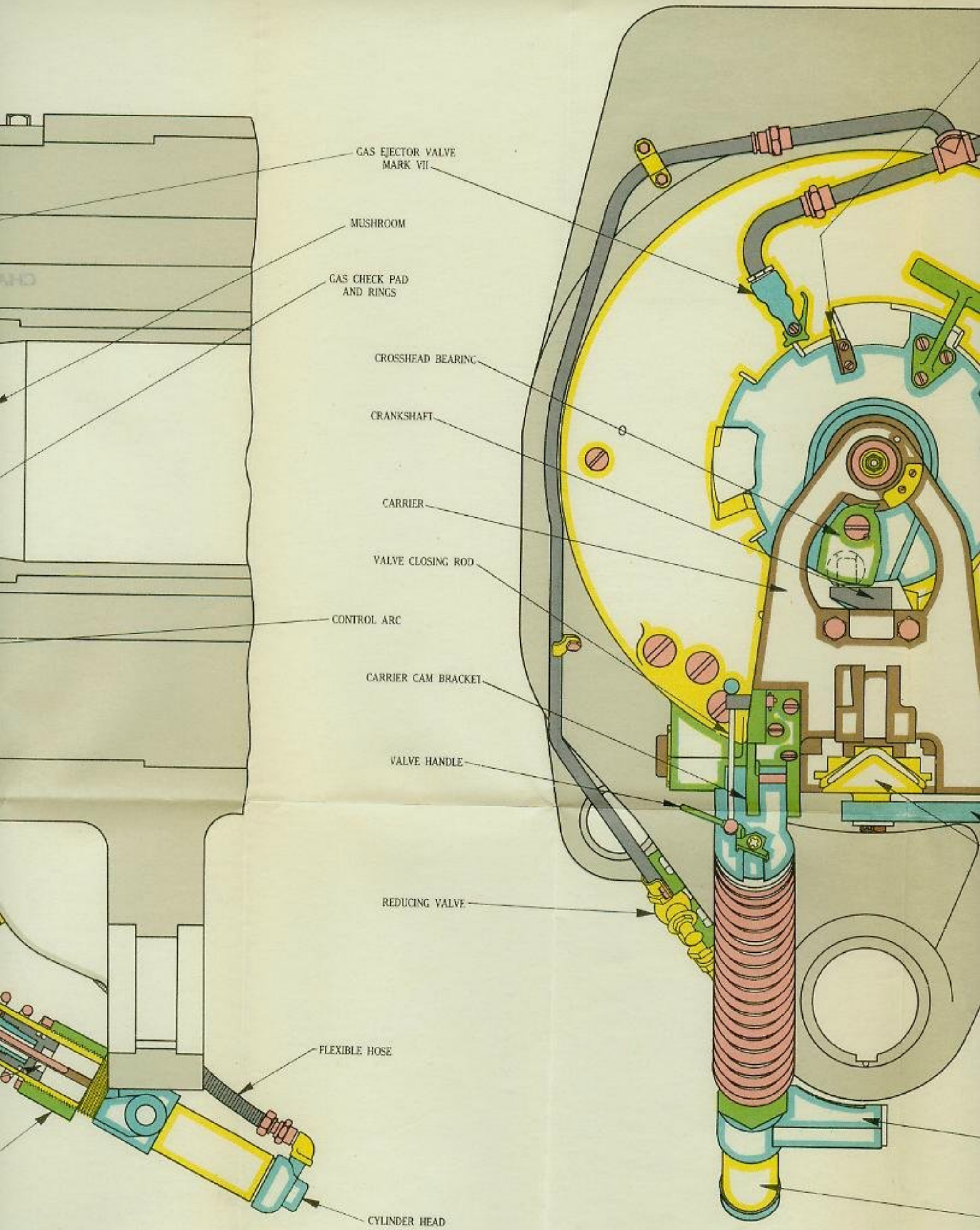
16-INCH BREECH MECHANISMS, MARK I AND MARK I, MOD. 1.

(Plates XII–XX.)

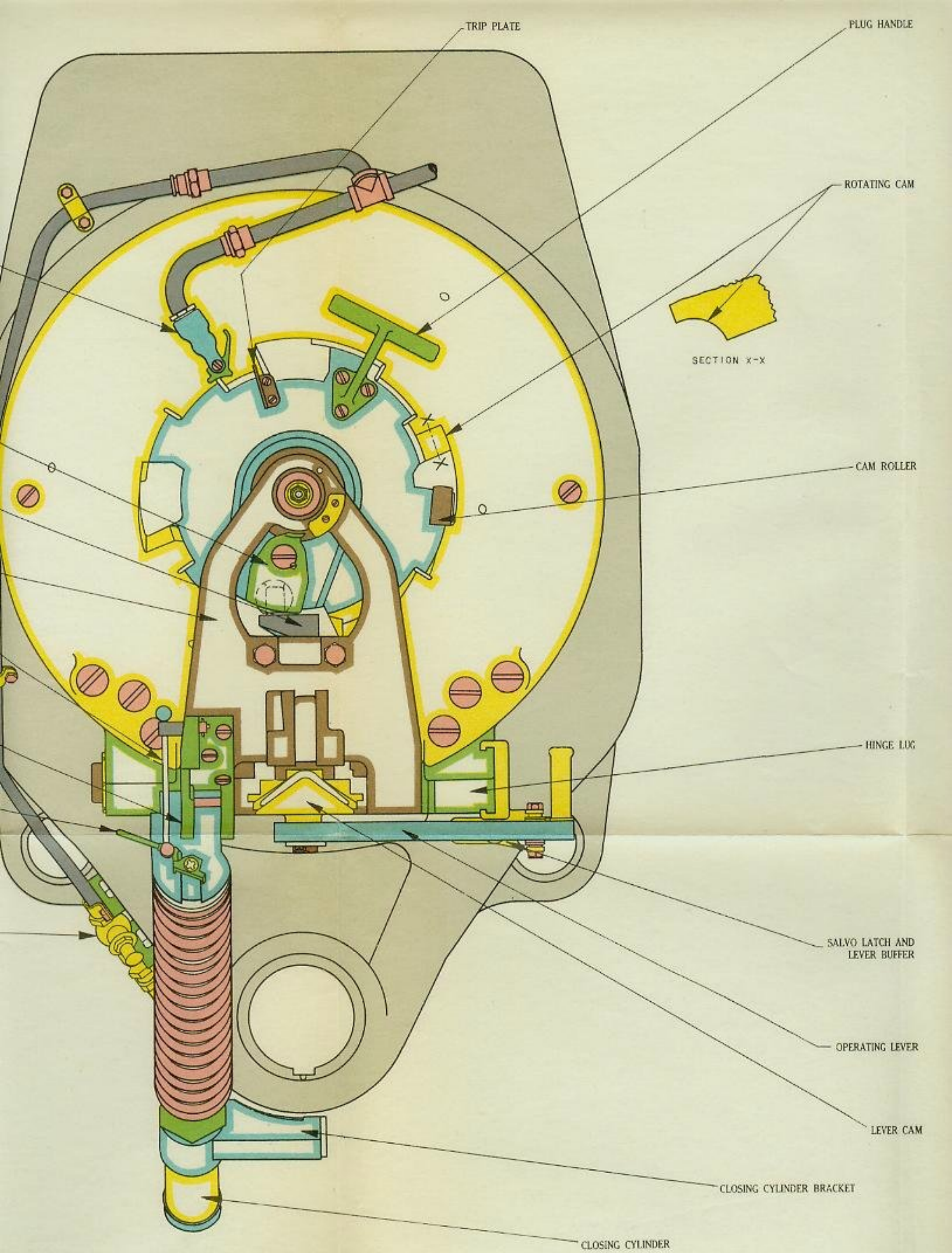
743. The 16-inch Mark I and Mark I, Mod. 1, breech mechanisms were designed for the 16-inch Mark I (45-caliber) and 16-inch Mark II (50-caliber) guns, respectively. These mechanisms are essentially similar to the 5-inch Mark VII and the 14-inch breech mechanisms



14-Inch Breech Mec

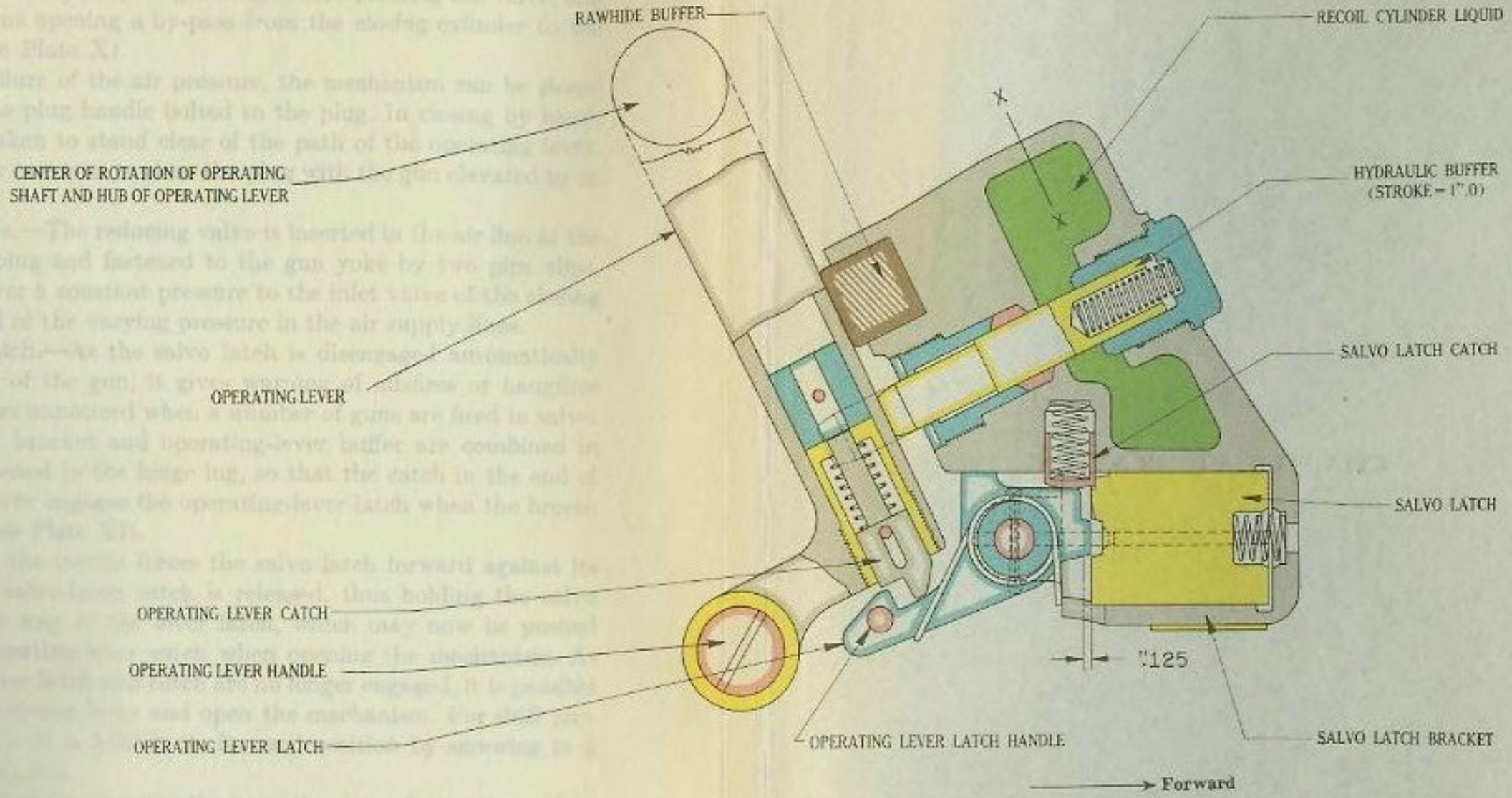


14-Inch Breech Mechanism, Mark III, Mod, 3, General Arrangement



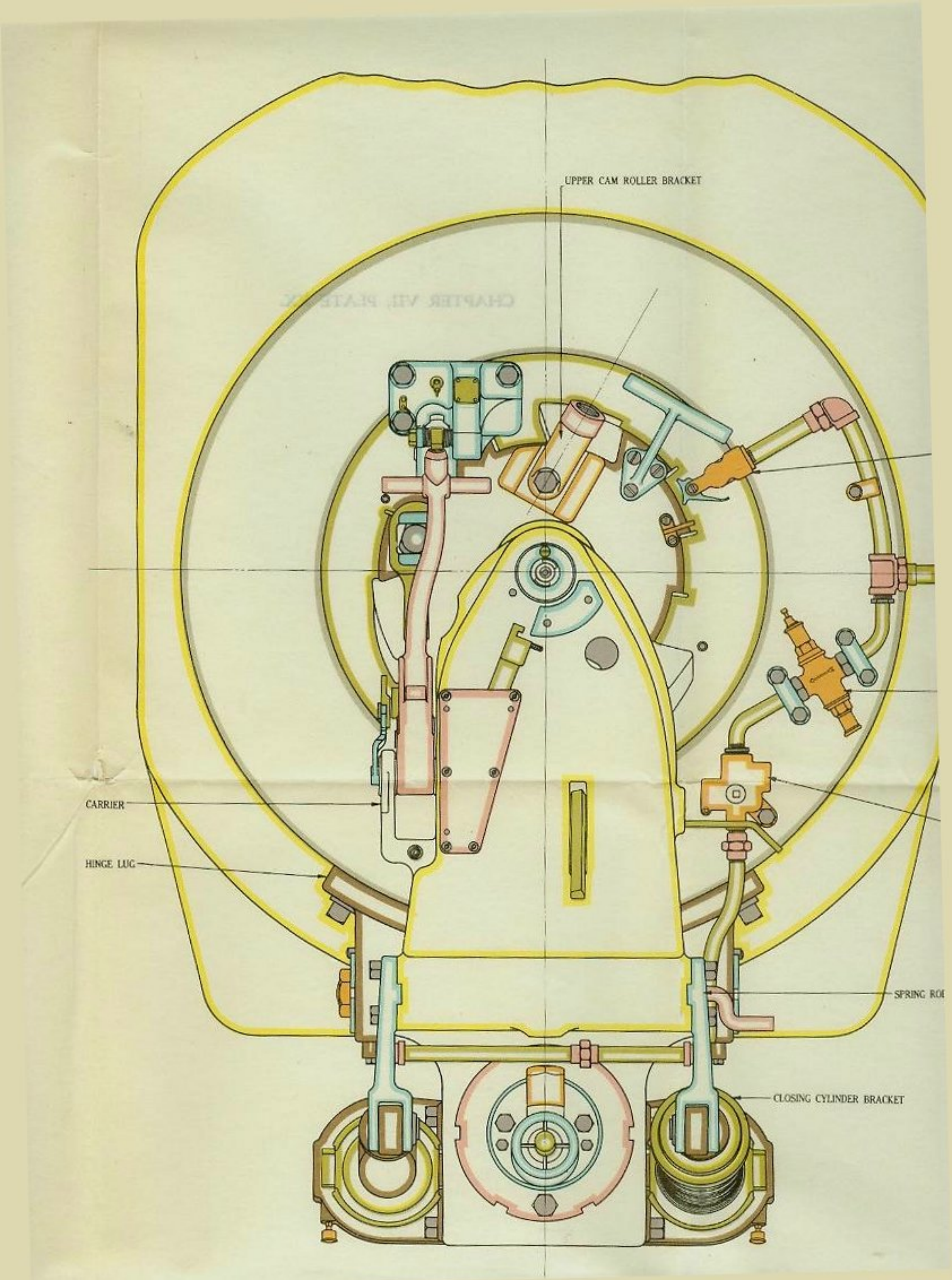
3, General Arrangement

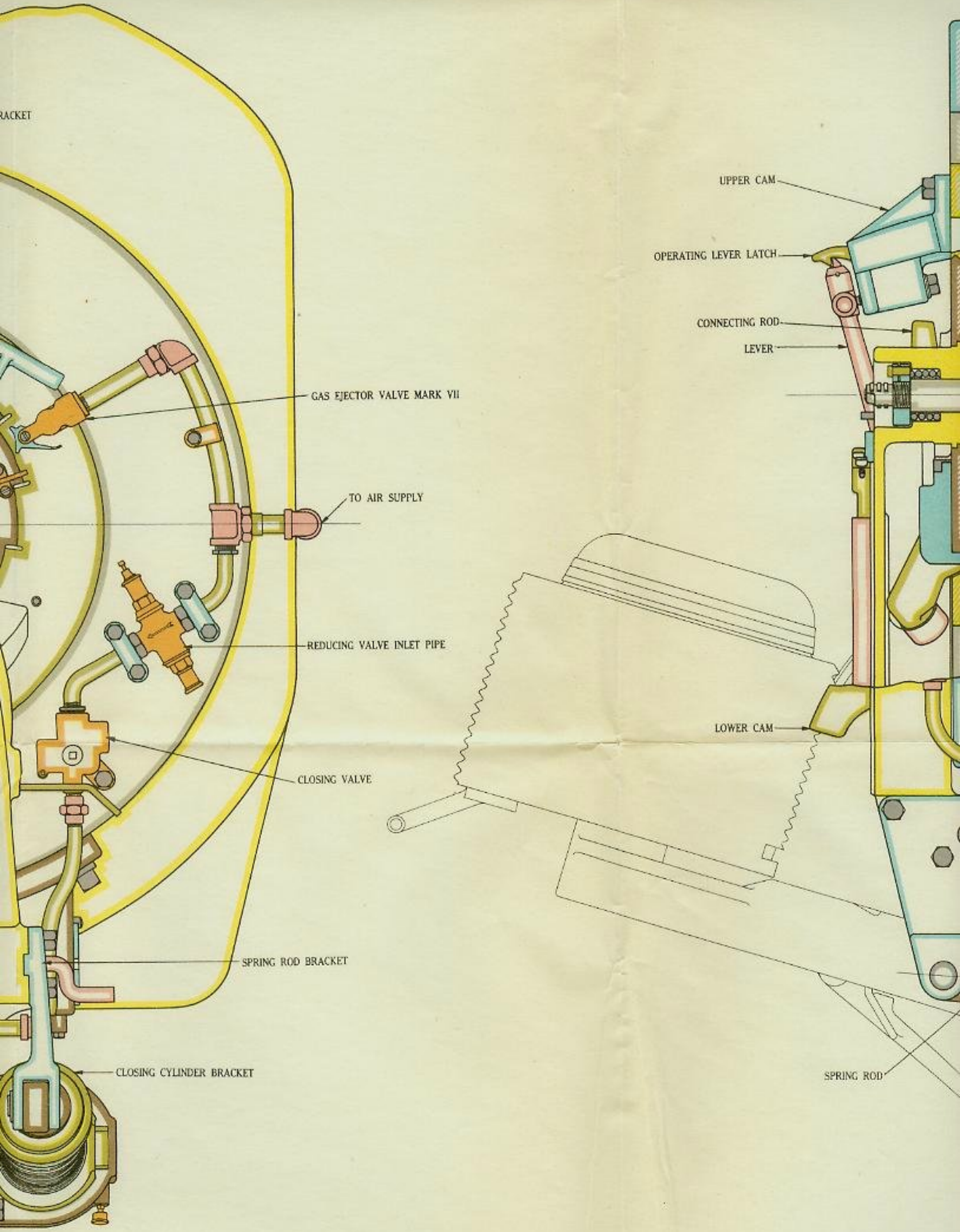
Litho. A. Horn & Co., Inc.



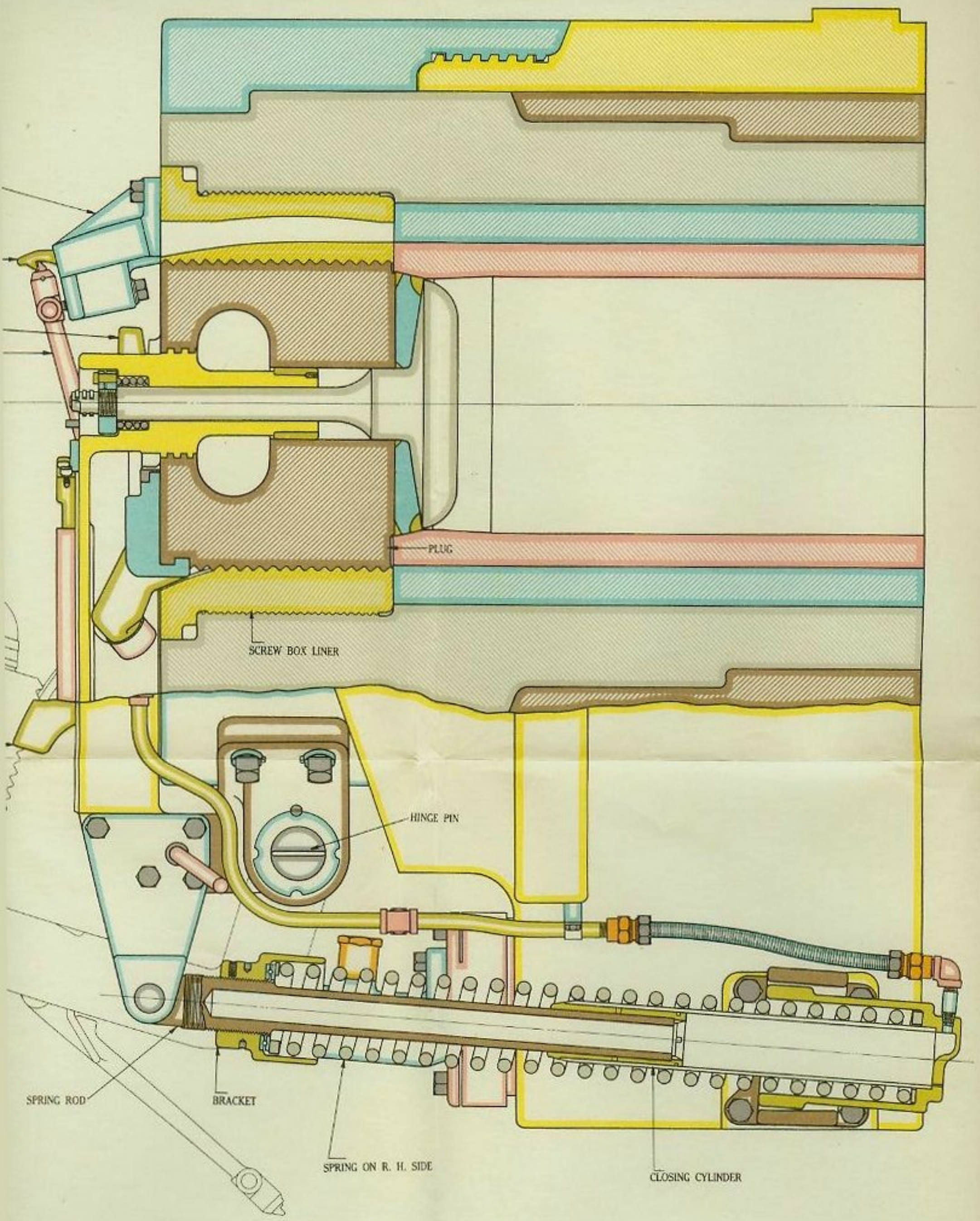
Plan View in Section, Salvo Latch in Recoiled Position.
(14-Inch Breech Mechanism, Mark III and Mods.)

Litho. A. Hoen & Co., Inc.

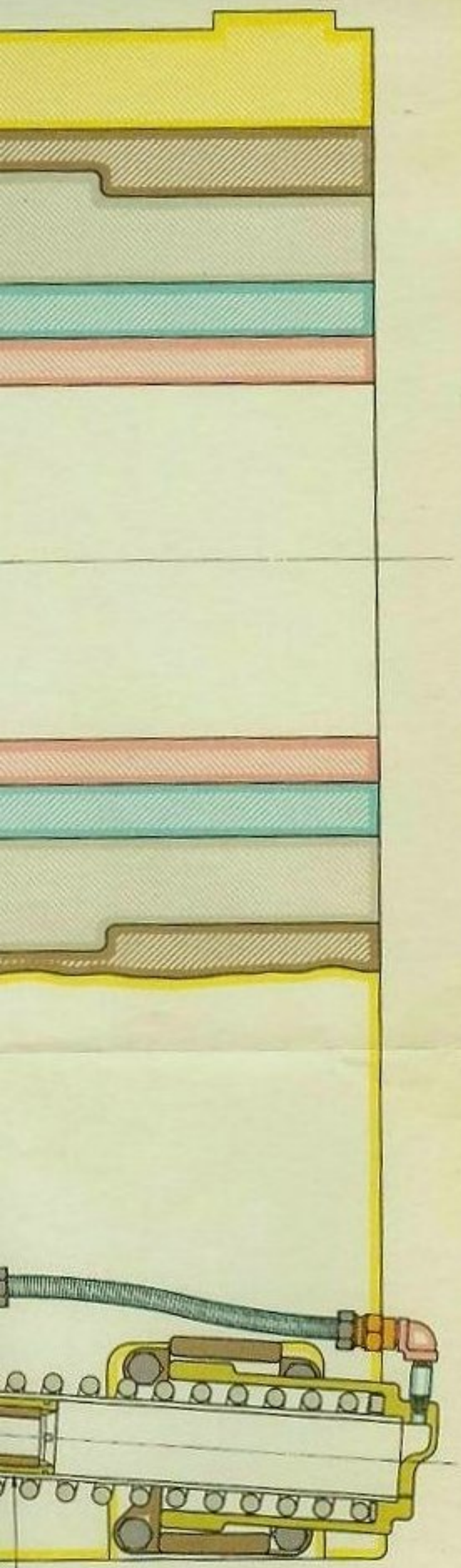

UPPER CAM ROLLER BRACKET
CARRIER
HINGE LUG
SPRING ROI
CLOSING CYLINDER BRACKET



16-Inch Breech Mechanism, Mark I, General Arrangement


PLUG
SCREW BOX LINER
HINGE PIN
SPRING ROD
BRACKET
SPRING ON R. H. SIDE
CLOSING CYLINDER

.rrangement



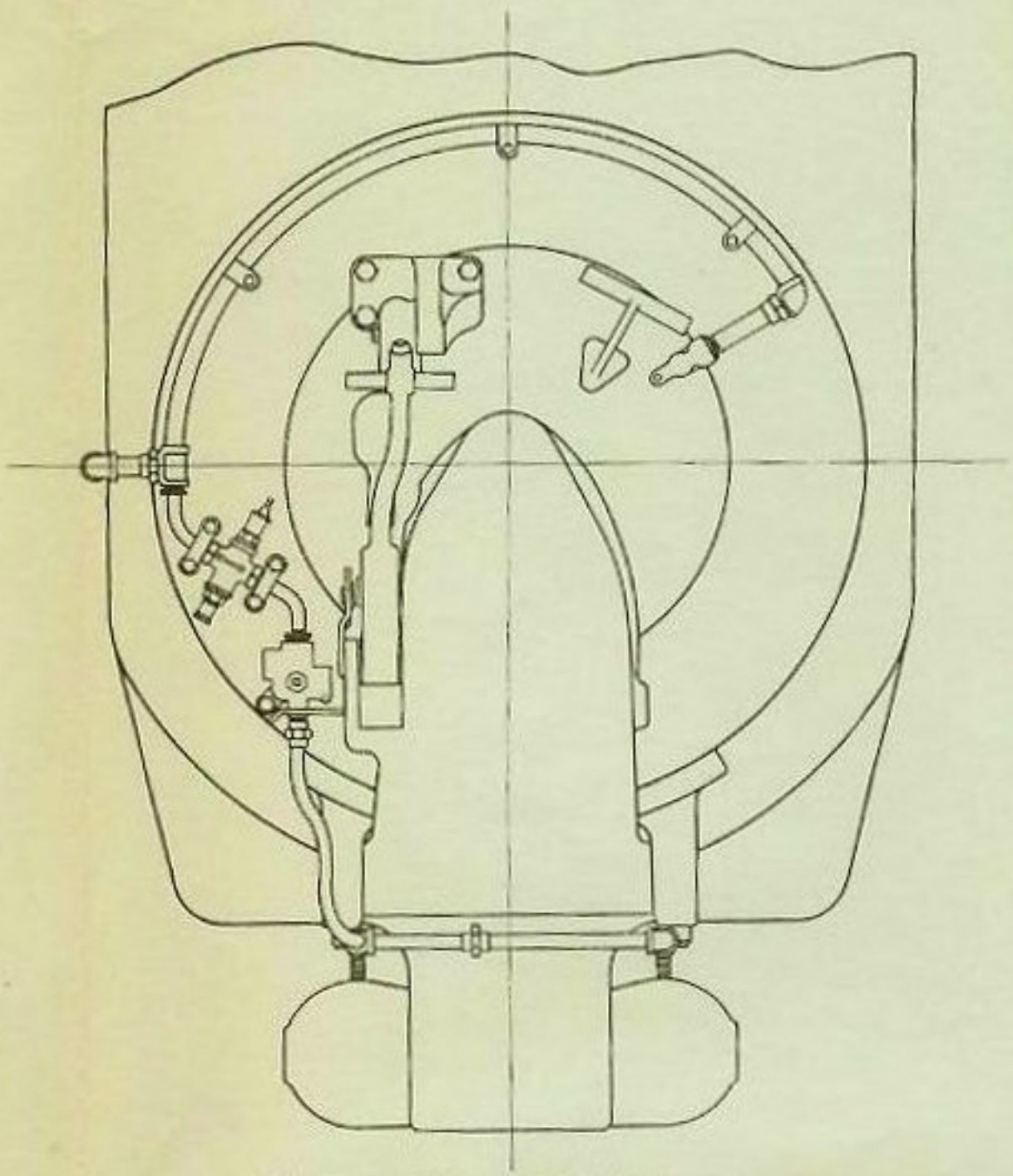
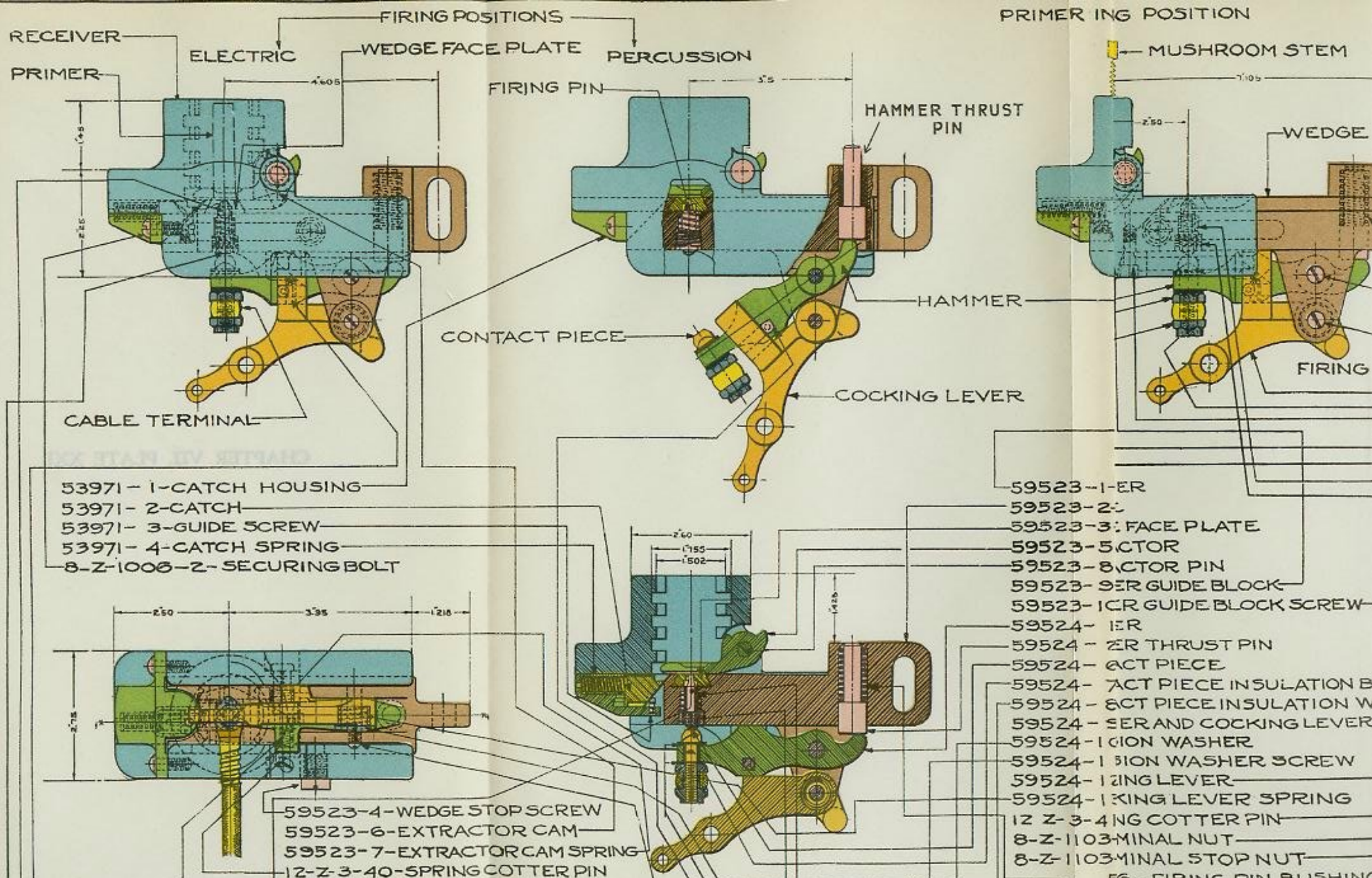
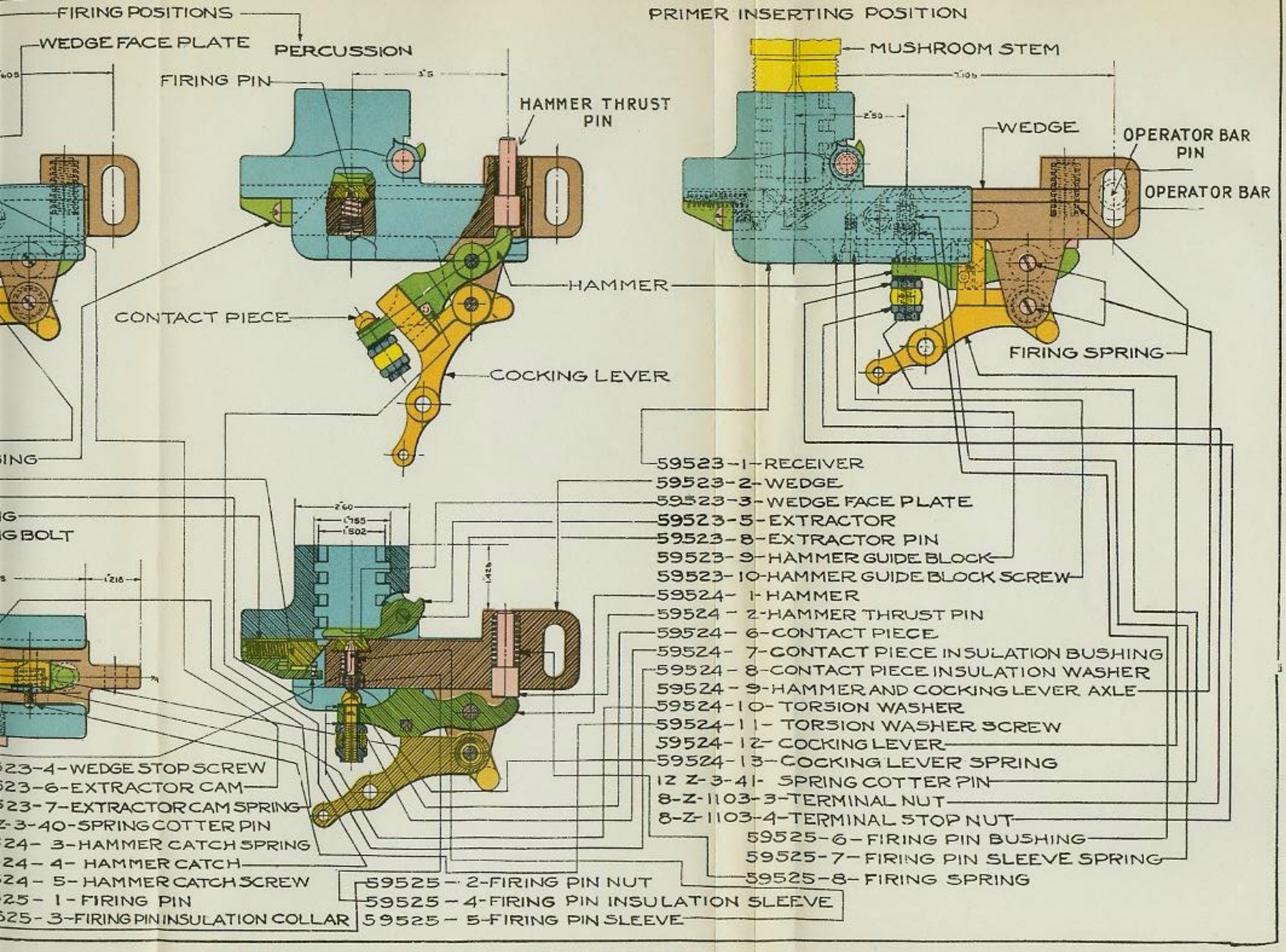


FIGURE 1. LEFT HAND BREECH MECHANISM SHOWING LOCATION OF REDUCING AND CLOSING VALVES



FIRING LOCK, MARK XIV, MOD. I, NOMENCLATURE SHEET.



FIRING LOCK, MARK XIV, MOD. I, NOMENCLATURE SHEET.

previously described. There are, however, some minor variations which will be mentioned.

744. The screw-box liner and breech plug are slotted to form 15 sections, consisting of 3 blanks and 12 threaded.

745. Similarly to the 14-inch, these breech mechanisms are of the down-swing type but with a vertical lever-operating mechanism. The operating lever is on the left of the center line of the carrier and is journaled at its lower end in the carrier. It is offset so as to form a journal for the lower end of the connecting rod (Plate XV), slightly above and to the rear of its own bearing. On the upper end of the connecting rod is provided a universal ball joint, which is set in the rear face of the breech plug and serves to rotate the plug as the operating lever is pulled back.

746. The carrier trunnions are provided with roller bearings mounted in *adjustable eccentric* bushings.

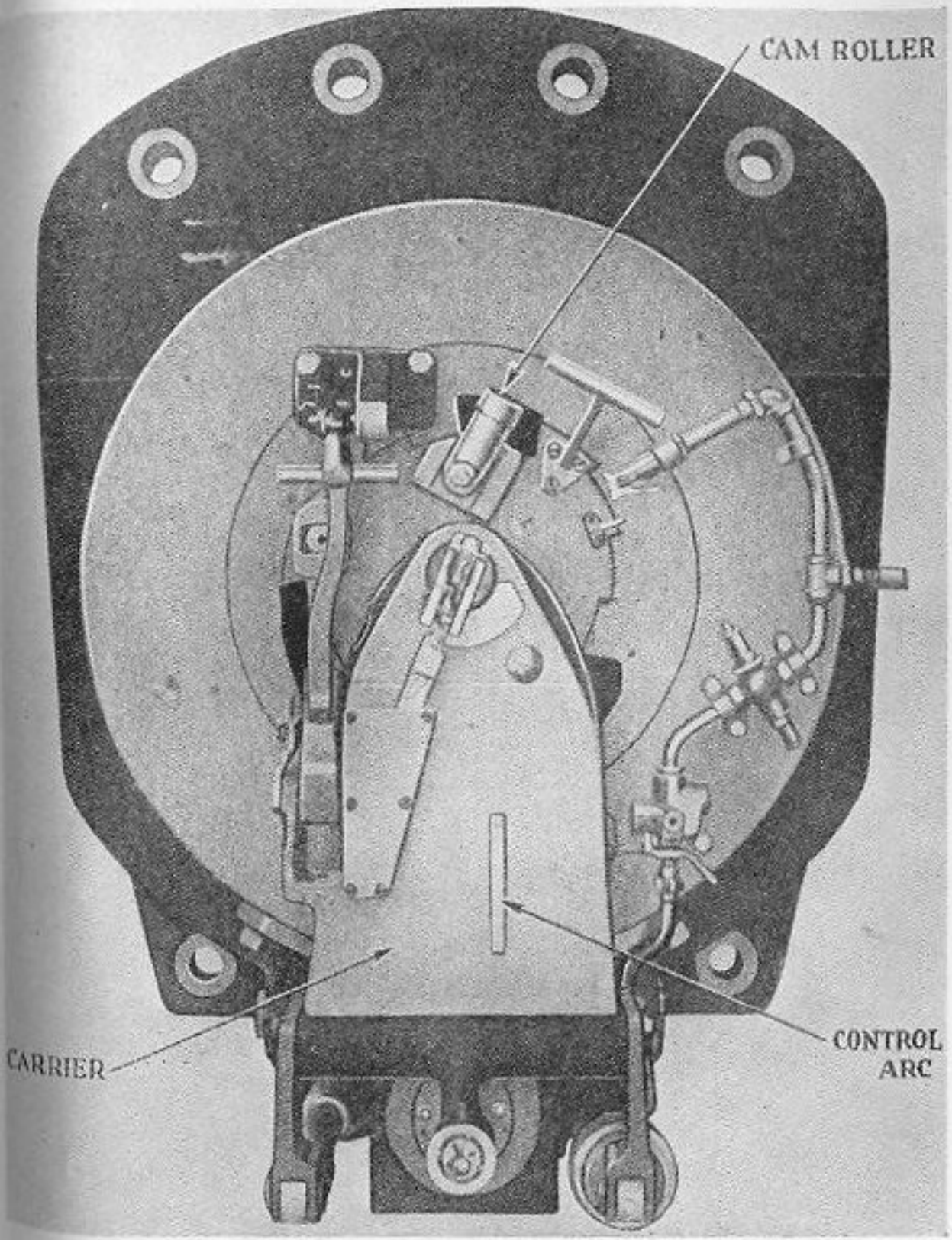
747. Two rotating cams are bolted to the breech end of the gun. They make contact with cam rollers supported in brackets bolted to the plug. These cams are so cut that the upper and lower rollers work in synchronism.

748. Tripping device.—A safety mechanism, known as the holding-down latch, is located in the carrier below the plug. This consists of toggle levers which, when the breech mechanism is open, prevent its being closed without first operating the tripping handle. This mechanism is clearly shown on Plate XVII.

749. Closing mechanism.—The closing mechanism consists chiefly of two pneumatic cylinders fitted with pistons and one counterbalance spring. The pneumatic closing cylinders are secured in the oscillating bearings, which are pivoted in the closing-cylinder brackets. These brackets in turn are bolted to the lower part of the gun yoke. The pistons are secured to the forward ends of the spring rods. The rear ends of these rods are pivoted to the spring-rod brackets, which are bolted to the carrier. Air is led from the reducing valve through the closing valve by means of copper pipe and flexible metallic hose to the forward ends of the closing cylinders. When the closing valve is opened, air is admitted against the spring-rod pistons, forcing them to the rear and thus causing the carrier and plug to swing upward to the closed position. A counterbalance spring surrounds one of the spring rods between the spring-adjusting nut and the oscillating bearing. This spring, which is under its maximum compression while the mechanism is open, assists the spring rods in closing the mechanism and absorbs the energy acquired by the plug and carrier when swinging open.

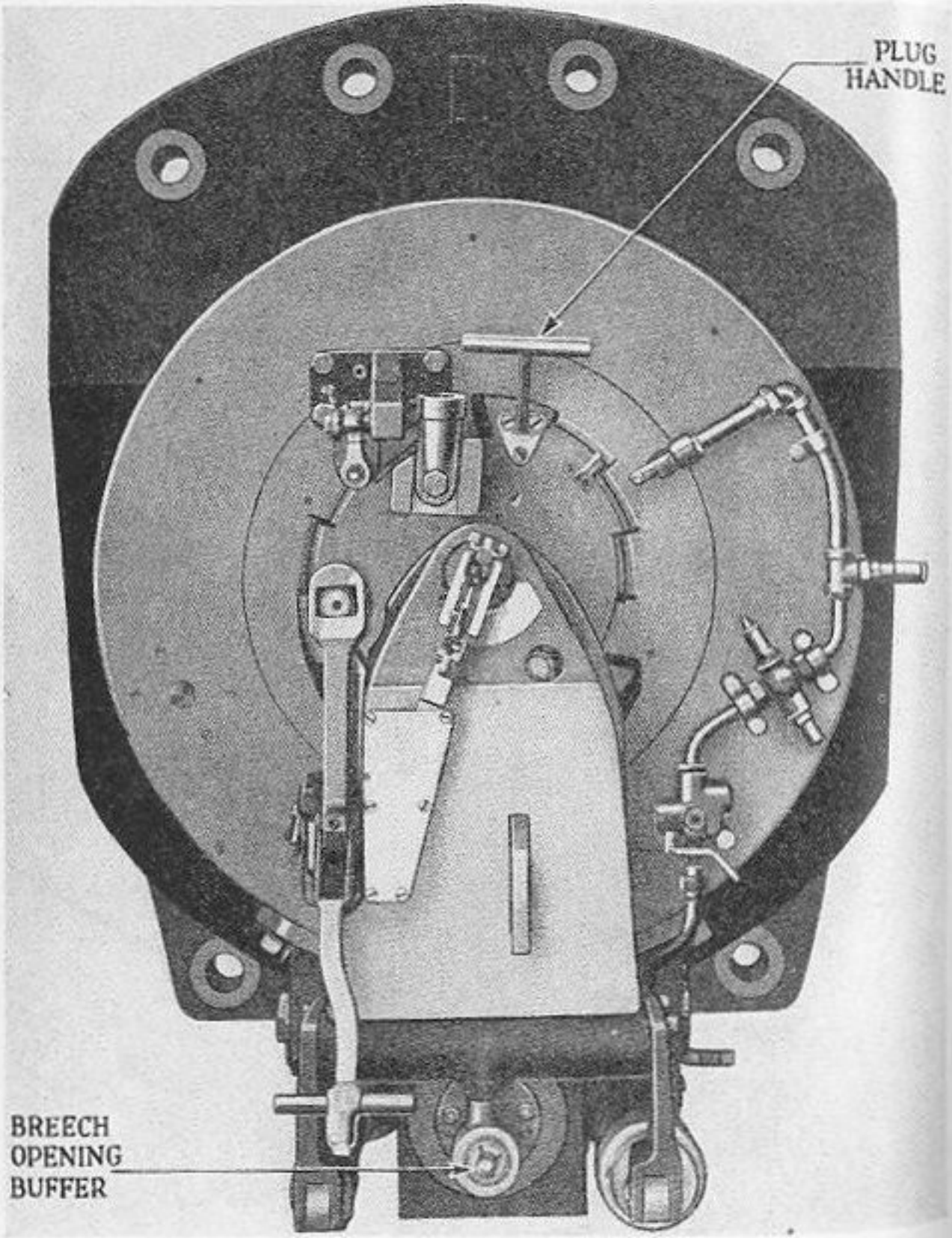
As the carrier reaches the vertical position in swinging home, it

CHAPTER VII, PLATE XII.

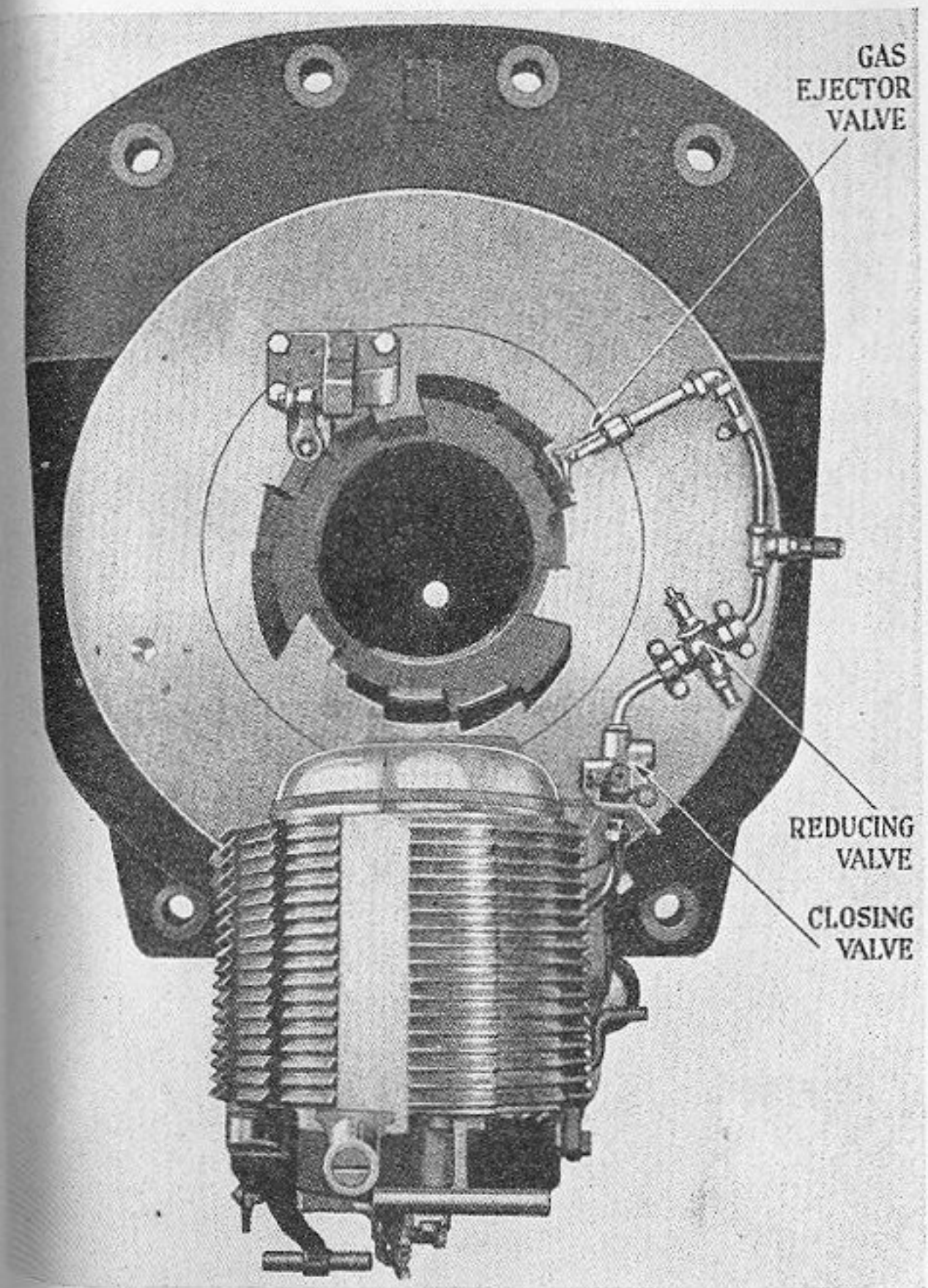


16-INCH BREECH MECHANISM, REAR VIEW, CLOSED.

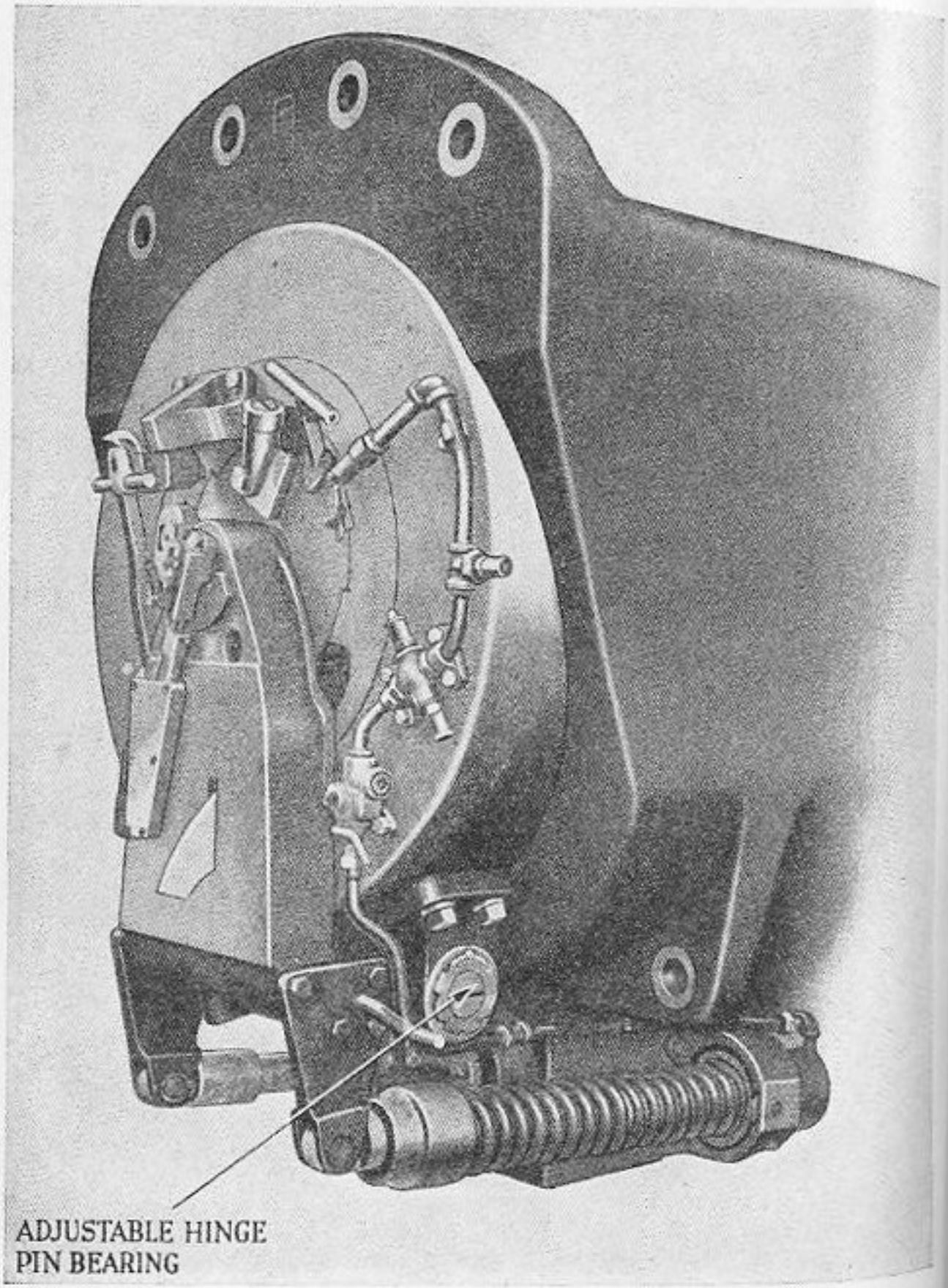
CHAPTER VII. PLATE XIII.



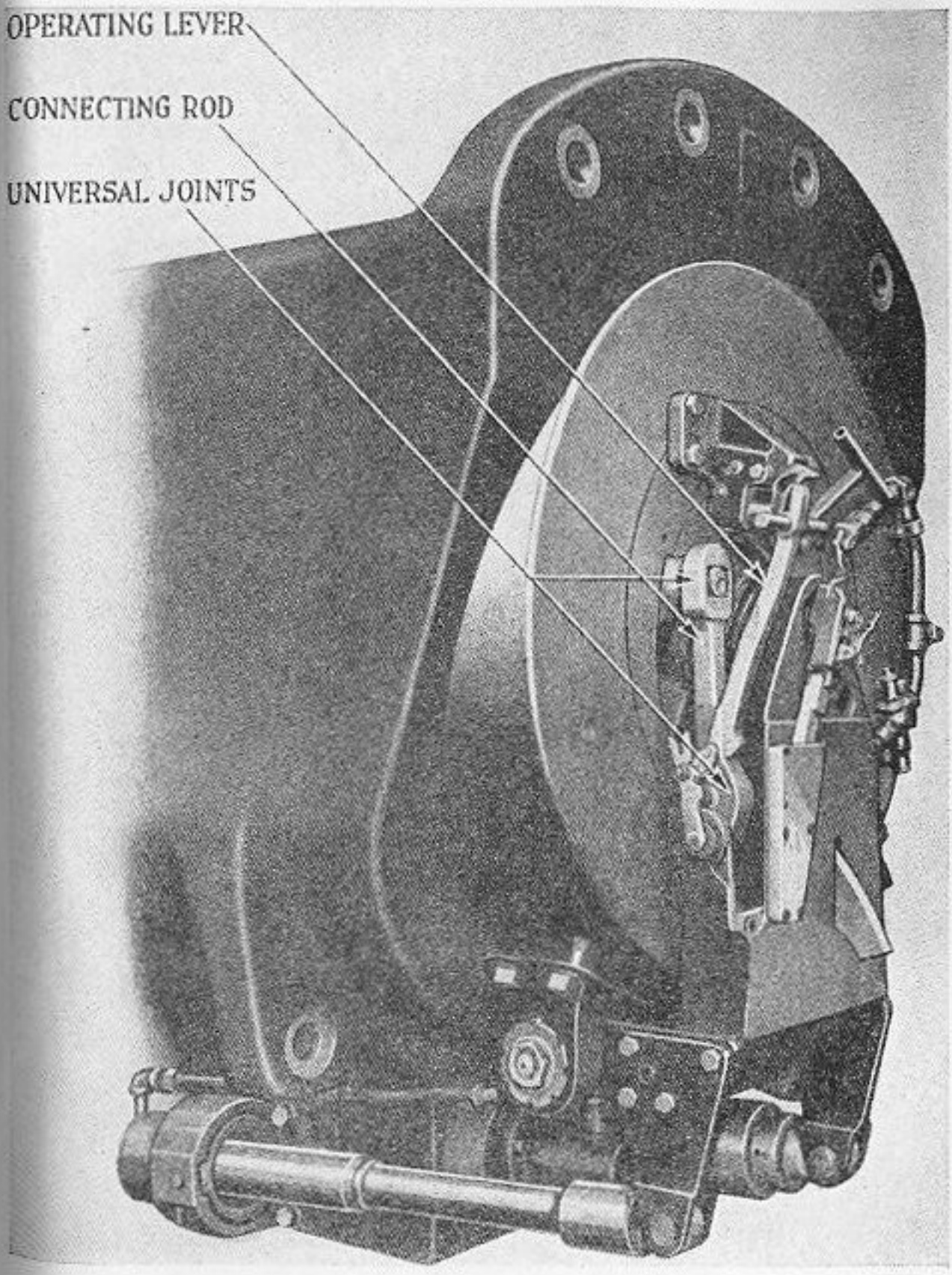
16-INCH BREECH MECHANISM, REAR VIEW, BLOCK ROTATED.



16-INCH BREECH MECHANISM, REAR VIEW, OPEN.

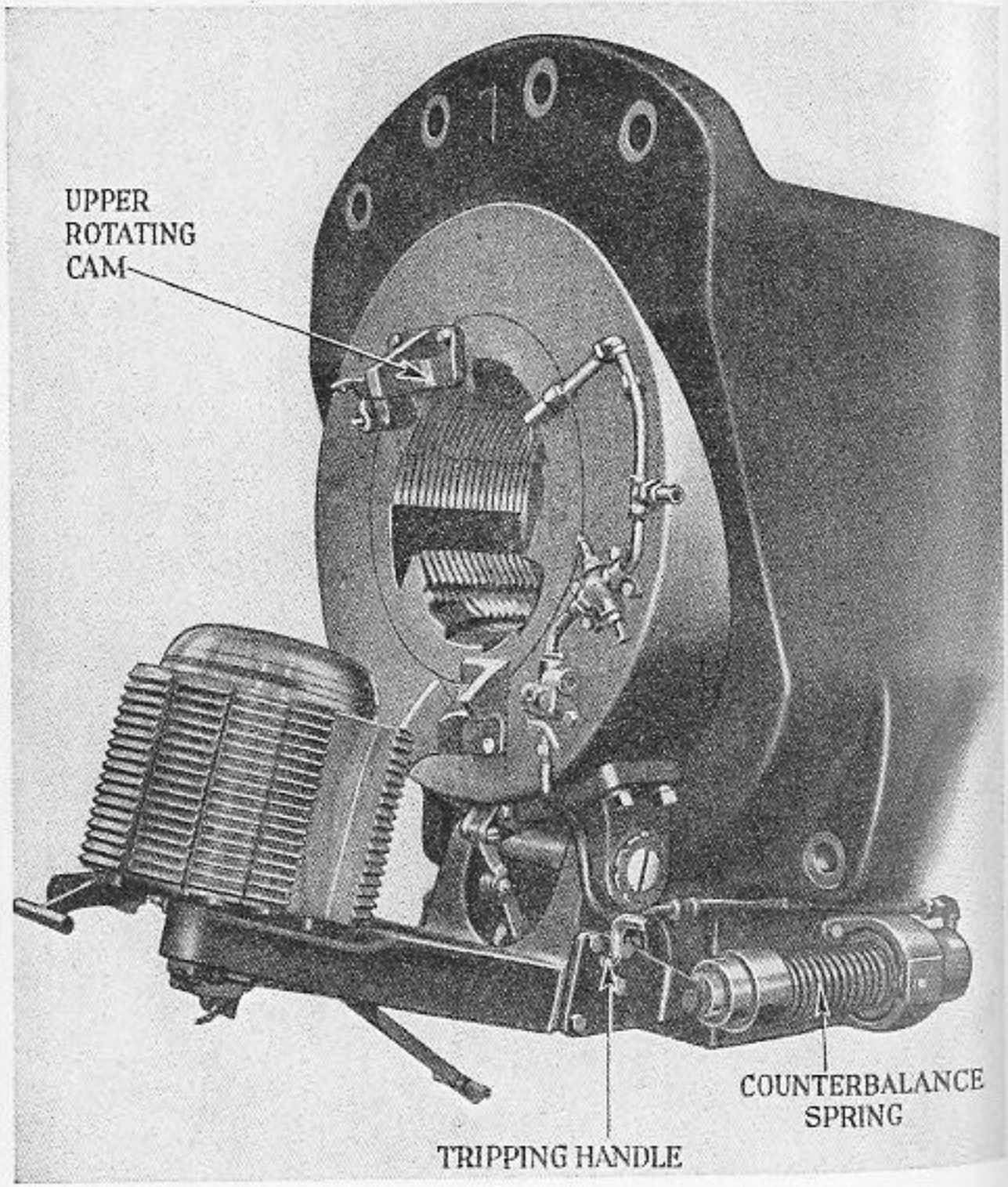


16-INCH BREECH MECHANISM, RIGHT SIDE, REAR VIEW, CLOSED.



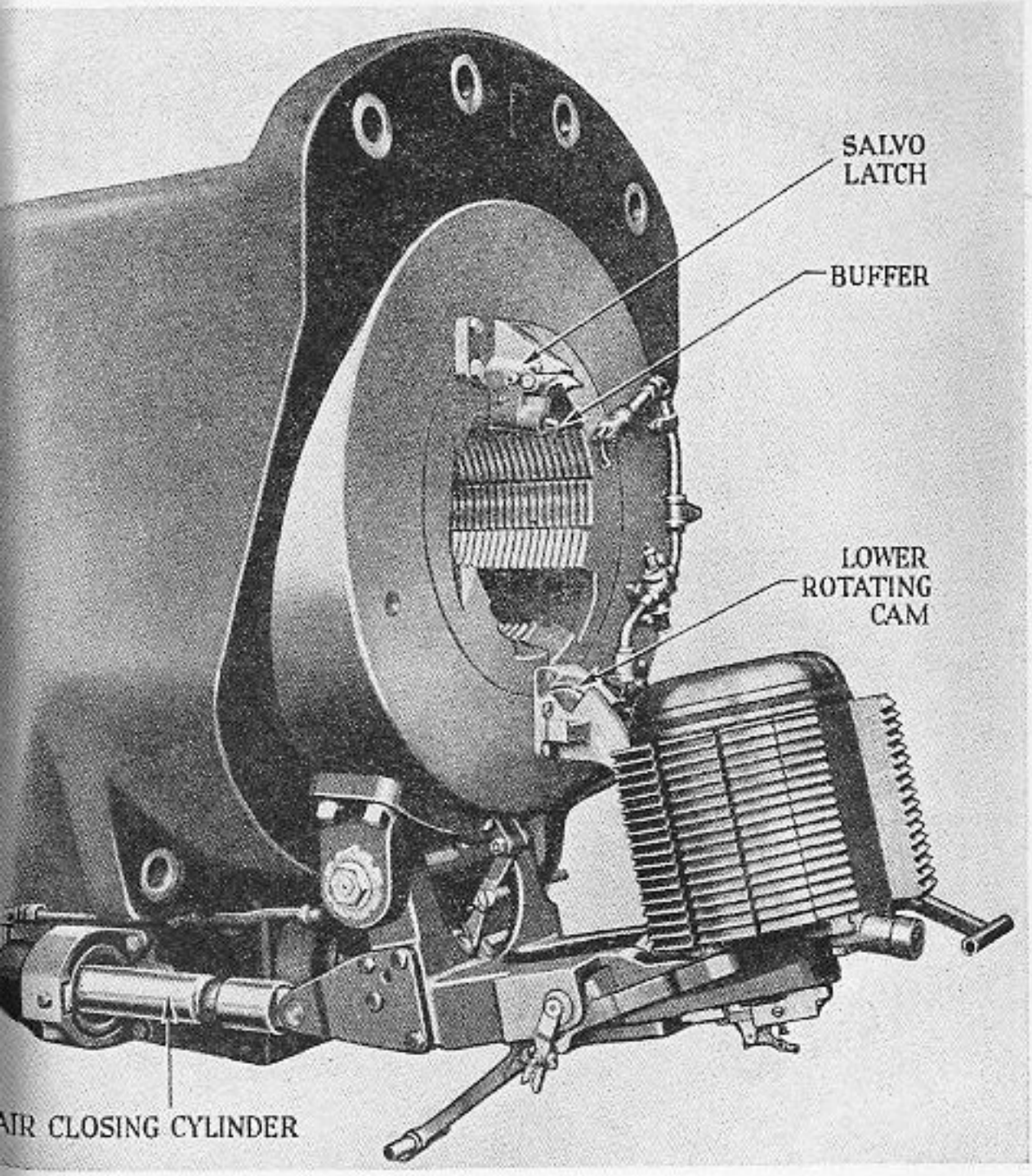
16-INCH BREECH MECHANISM, LEFT SIDE, REAR VIEW, CLOSED.

CHAPTER VII, PLATE XVII.



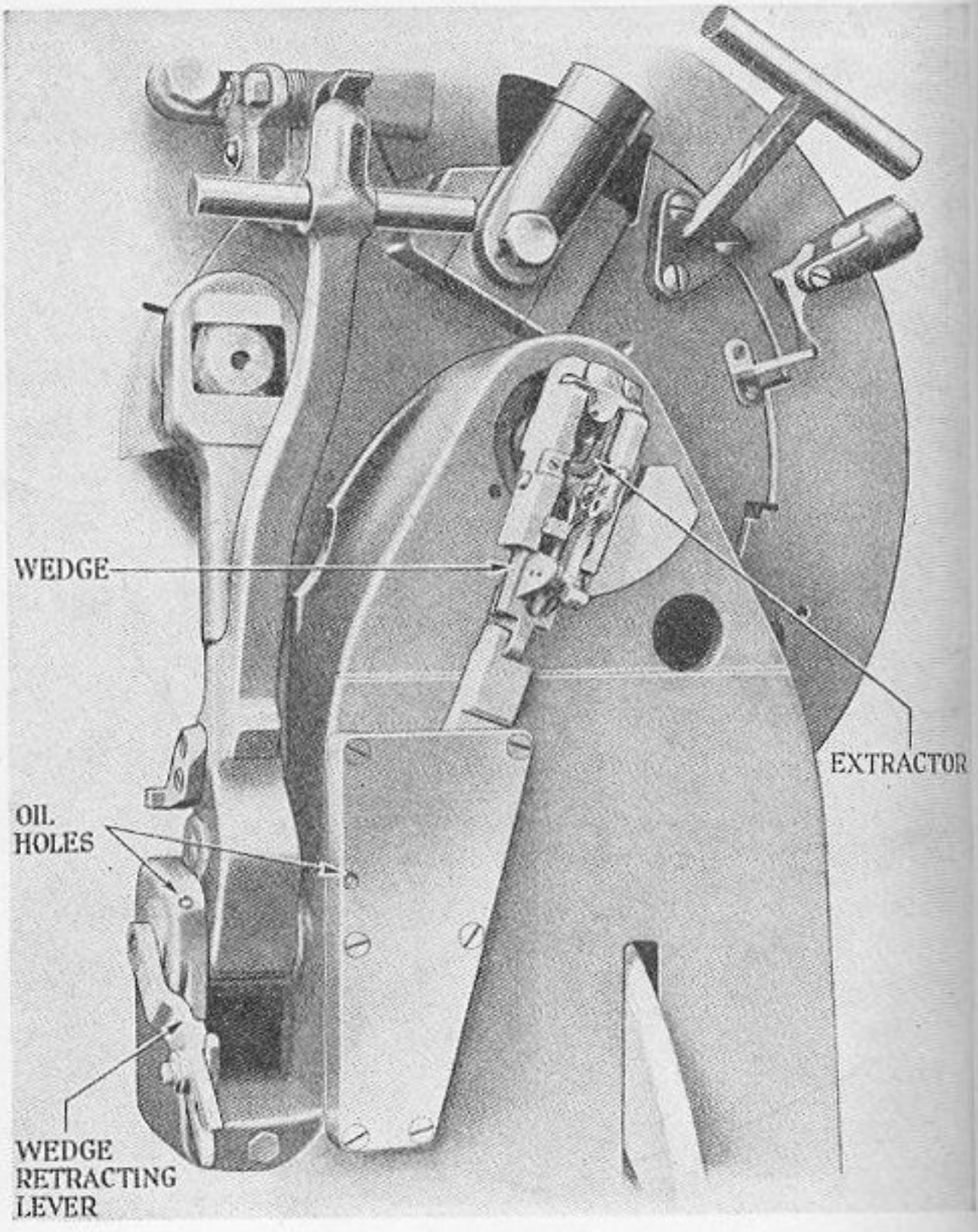
16-INCH BREECH MECHANISM, RIGHT SIDE, REAR VIEW, OPEN.

CHAPTER VII, PLATE XVIII.



16-INCH BREECH MECHANISM, LEFT SIDE, REAR VIEW, OPEN.

CHAPTER VII, PLATE XIX.



REAR VIEW, 16-INCH FIRING MECHANISM, POSITIONED FOR RE-PRIMING.

comes in contact with the closing valve handle and closes the valve. This cuts off the air pressure, which is released by check-valve vents and allows the air pressure to decrease until the valve spring has sufficient force to lift the valve from its seat.

When the plug is unlocked, it falls in a downward arc, forcing the spring rods with their pistons into the cylinders and compresses the counterbalance spring. A boss cast on the carrier comes in contact with the piston rod of the breech-opening buffer, forcing it in against the resistance formed by liquid in the buffer cylinder; this cylinder is provided with ports to by-pass the liquid to the forward side of the piston as it is forced down. The after end of this piston takes up hard against a boss on the inside of the cylinder, which forms a positive stop for the mechanism. The buffer cylinder is bolted to the rear end of the recoil piston and is tilted at an angle of 5° from the horizontal. The counterbalance spring which encircles the right-hand closing cylinder is so designed that it assists in balancing the weight of the plug. Air is admitted to the closing cylinder by opening the closing valve by hand, thus admitting air behind the spring-rod pistons and closing the mechanism. The blow of the operating lever as it nears the closed position is taken up by means of a hydraulic buffer cast integral with the salvo latch, which locks the operating lever in its closed position. The salvo latch is automatically released by the recoil of the gun; it may also be operated by hand. In case of failure of air pressure, it is readily possible for three men to close the mechanism by means of the closing handle bolted to the plug. In closing by hand great care must be exercised to stand clear of the path of the operating handle.

FIRING MECHANISMS.

750. Definition.—The term "firing mechanism" is used to designate that part of the breech mechanism which directly explodes the primer and thus fires the gun.

751. Guns are fired by *percussion* and by *electricity*. Percussion primers are used for guns of 3-inch caliber and below, while guns of larger caliber use combination primers which may be fired either by percussion or by electric current. For large guns electric firing is considered preferable, percussion firing being used only as an alternative.

Current for electric firing is furnished either by batteries or by motor generators, connections being made so that either one may be used.

752. Definition of percussion and electric firing mechanism.—A percussion firing mechanism is one in which the blow of a firing pin explodes the cap in a primer.

An electric firing mechanism is one in which an insulated firing pin, suitably connected to a firing battery, or other source of electricity, transmits an electric current to the primer grounded in the gun. Electric current heats a fine wire or bridge in the primer to a sufficiently high temperature to explode the charge of the primer.

Generally speaking, for the percussion firing mechanism, the firing pin, surrounded by a spiral spring, has a rectilinear axial movement within the plug, the cocking being performed automatically during the opening of the breech mechanism.

The electric firing mechanism has an encased insulated firing pin. The electric contact is not made until the breech block is entirely closed.

753. The firing lock consists essentially of a receiver which screws on the rear of the mushroom stem (see Plates III and IV) and contains a wedge made so that the primer seat may be either closed or unmasked for priming. The receiver has a suitable catch for retaining the primer when priming, and an extractor for ejecting the primer case upon opening the breech after firing. For electric firing, the wedge contains an insulated firing pin which is in contact with the insulated plunger within the primer; the latter is grounded in the gun. For percussion fire, the wedge carries a hammer, firing spring, and cocking lever to deliver the blow to the same firing pin as that used for electric firing.

754. Safety is one of the most important functions of a firing mechanism and special care must be given to it in design. In general, the safety features consist of devices which prevent the firing of the gun until the breech is entirely closed; the details vary with each particular mechanism.

755. Definitions of firing attachments.—These are a part neither of the firing mechanism nor of the breech mechanism, but are certain appliances used to put in operation the firing mechanism. The firing lanyard, electric firing battery, wires, terminals, firing key, etc., are attachments.

The two terms *firing mechanisms* and *firing attachments* should not be confused.

DESCRIPTIONS OF FIRING LOCK, MARK XIV AND MODIFICATIONS.

(Plate XXI.)

756. This firing lock, which is the standard equipment for the latest 5-, 6-, 8-, 12-, 14-, and 16-inch breech mechanisms, consists of a receiver, wedge, operator bar, extractor, and primer-retaining catch. The wedge is actuated by means of a cam attached to the operating

lever of the breech mechanism. This cam withdraws the wedge and ejects the primer as the breech is opened. Priming is accomplished by hand, and in case of misfire, the lock can be reprimed without opening the breech mechanism, by rotating the wedge hand-operating lever, thus lifting the wedge-operating plunger from the cam; the lock-operator bar can then be drawn out, carrying with it the wedge. The wedge actuates the extractor and causes the ejection of the primer. After the new primer has been inserted, the lock-operator bar is pressed in against its stop; the wedge-operating plunger re-enters the cam slot and gun is again ready to be fired. The firing lock is the same for all mechanisms; operator bars of different lengths, however, are necessary for the various breech mechanisms.

757. **The receiver,** approximately rectangular in shape, is milled out to receive the wedge. It is secured to the breech mechanism by means of a bayonet joint on the end of the mushroom stem and is prevented from rotating by the operator bar which is fastened to the wedge. The receiver is drilled for the extractor pin and necessary clearances are milled for the extractor. On one side of the receiver is milled a slot into which a lug on the hammer slides, thus preventing the hammer from being pulled back for percussion firing after the wedge has started to retract. In the front face of the receiver on the side with the milled slot is fitted the hammer guide block. This block is milled so as to align with the slot and allows the hammer to be cocked only when the wedge is fully closed. It also serves to lift the hammer, thus breaking the contact with the firing pin and preventing electric firing except when the wedge is fully closed.

758. **The wedge** slides in the receiver and is operated by means of the operator bar. It is prevented from being withdrawn entirely from the receiver by means of a wedge-stop screw passing through the side of the receiver and fitting into a recess milled in the side of the wedge. The firing pin is mounted in insulating bushings at the inner end of the wedge. A hardened face plate is placed in the wedge next to the mushroom stem to take the thrust of the primer when fired. This wedge face plate has a striking lug for actuating the extractor as the wedge is retracted. The inner end of the wedge has a 45° sloping cut to permit pushing home the extractor, and a circular tapered cut to seat the primer. The wedge is drilled for the hammer thrust pin and the firing spring. The thrust pin, when the hammer is drawn back, protrudes through the wedge into a hole drilled in the crosshead bearing of the breech mechanism. This hole is in alignment with the thrust pin only when the breech plug is fully closed. The thrust pin, due to the action of the firing spring, keeps the hammer in contact with the

firing pin except when the wedge is retracted. The wedge is secured to the lock operator bar by the operator bar pin passing through a hole in the outer end of the wedge. This hole is elongated to provide for any movement of the mushroom stem to rear at time of firing.

759. The hammer has fitted into its right-hand side a spring catch which acts in conjunction with the cocking lever. This catch engages

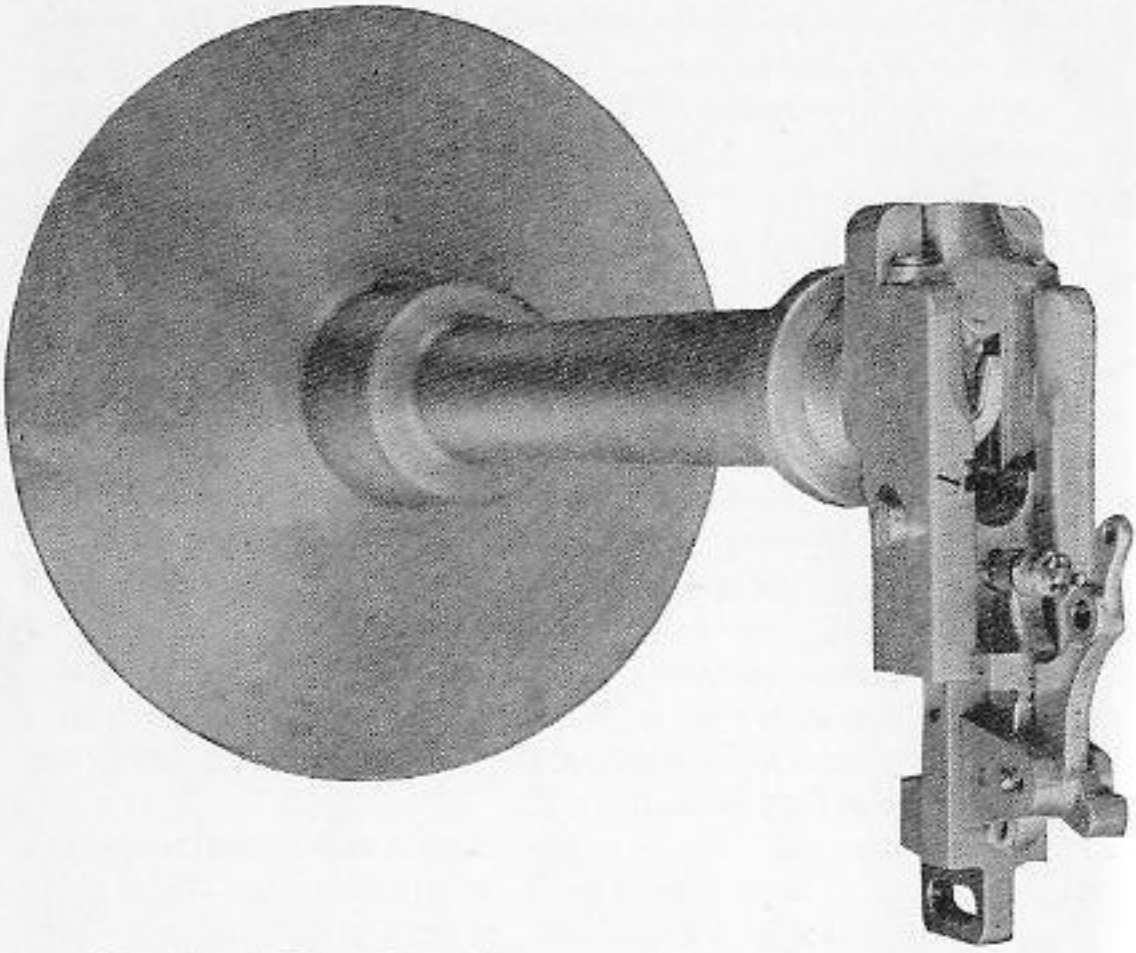


FIG. 707.—A FIRING LOCK MOUNTED ON END OF MUSHROOM STEM.

with the latch as the cocking lever is pulled back by the lanyard for percussion firing until their relative positions are such that the hammer is released. When the lanyard pull is released, the cocking lever spring throws the lever forward into its original position and the latch snaps over the hammer catch. The contact piece is housed in an insulated housing in the forward end of the hammer. The lower end rests upon the firing pin when the lock is closed; the upper end carries a terminal to which one side of the electrical firing circuit is connected.

760. The cocking lever turns on the cocking-lever axle, directly above and in the same vertical plane as the axis of the hammer. Incorporated with the cocking-lever bearing is a cocking-lever spring

which has a torsional action tending to throw the left end of the cocking lever towards the lock. One end of the spring engages a recess in its housing in the cocking lever; the other engages a hole in the torsional washer that serves as cover to the spring housing and also as a bearing for the cocking lever. Adjustment of the spring tension is effected by turning the torsional washer in the direction of the arrow stamped on it until the zero mark is aligned with the index line on the wedge. A lug on the right-hand side of the cocking lever extends toward the face of the wedge and serves as a latch to engage the hammer catch when the hammer is to be pulled back for percussion firing. When the cocking lever is in its normal position, the under edge of the latch lug rests on the face of the wedge and transmits to the wedge, instead of through the hammer and to the primer, any accidental blow upon the cocking lever. This precludes accidental firing which might occur were the cocking lever struck when the lock is closed. The hammer, mounted between the wedge and the cocking lever, is amply protected from exterior blows. The slightest withdrawing of the wedge from the closed position removes the firing pin from the percussion cap of the primer and precludes firing electrically or percussively. The outer end of the wedge is so designed that it may be used in connection with the lock operator bars of any of the standard breech mechanisms. Lanyards are secured to the cocking lever by means of a hook. In addition to lanyard firing, the lock may be fired percussively by hand- or foot-operated firing mechanisms incorporated with the various mounts by an extension which may be attached to the outer end of the cocking lever.

761. The extractor is pivoted in the receiver and fits between the forward face of the wedge and the rear face of the mushroom stem. The extractor arms engage the primer shell on two sides, a clearance cut being provided in the extractor for the primer seat extension on the rear end of the mushroom. The extension is added to the end of the mushroom stem to give better support to the primer. The extractor is actuated by an *extractor cam* which turns on the same pin as the extractor. When the wedge is retracted the lug on the wedge face plate strikes the extractor cam, which, in turn, causes the extractor to swing to the rear, lifting the primer retaining catch out of the way and ejecting the primer. This extractor cam is also provided with a torsional extractor spring which returns it to the original position as soon as the wedge is sufficiently withdrawn. In priming, the primer is inserted between the arms of the extractor into the primer seat. The head of the primer, seating in a recess cut in the rear face of the extractor, pushes the extractor forward until the primer-retaining catch

engages the primer. The extractor and primer are pushed entirely home by the tapered cut on the inner end of the wedge.

762. The primer-retaining catch consists of a catch housing which is secured to the upper end of the receiver by two screws, a catch which slides in and out of the housing, a guide screw which controls the outward movement of the catch, and a catch spring which keeps the catch in the correct retaining position. This catch sits in rear of the primer seat, and when the primer is inserted in the seat the catch is pushed in until the head of the primer is engaged by the forward face of the catch. When the wedge is closed and the primer is pushed home, the end of the wedge pushes the catch into its housing. When the primer is ejected, the arms of the extractor force the catch out of the way of the primer.

763. The lock-operator bar is secured to the carrier by means of a T-slot. The movement of the bar is controlled by a wedge operating plunger. The stop plunger is housed in the operating bar, being held in the housing by means of a stop-plunger key fitted in the forward face of the operator bar, a stop-plunger spring being used to keep the plunger against the key. A stop-plunger pull ring is attached to the end of the plunger to enable the plunger to be lifted over the cam surface when withdrawing the bar from the carrier. This plunger works against a machined surface in the carrier and only allows the bar to be moved the distance necessary to close the wedge and to align the firing pin with the primer.

764. The wedge-operating plunger is housed in the outer end of the operator bar, the end of the plunger entering the slot in the operating cam. This cam being secured to the operating lever of the breech mechanism causes the lock to open and close with the opening and closing of the breech mechanism. The wedge-operating plunger is secured in the housing by means of a wedge-operating plunger pin and plunger pin detent and is kept in the cam slot by means of a wedge-operating plunger spring. Over the housing for the wedge-operating plunger is secured the wedge hand-operating lever. This lever has two helical slots diametrically opposite, through which it is secured to the housing by a plunger pin and by which, when the lever is pushed outward, the wedge-operating plunger is lifted out of the cam slot. The operator bar can then be moved outward, withdrawing the wedge. The wedge hand-operating lever is used only for repriming or in assembling or disassembling the lock. The inner end of the operator bar is secured to the wedge by means of an operator-bar pin with a spring detent.

765. Safety features of the firing lock may be summarized:

(1) Unless the wedge is fully closed, (a) a lug on the hammer, sliding

in a slot on one side of the receiver, prevents the hammer from being pulled back for percussion firing; (b) the hammer lug slot in the receiver causes the hammer to be lifted, thus breaking the electrical firing circuit.

(2) Unless the breech mechanism is in the fully closed position, (a) the hammer cannot be drawn back for percussion firing as the hole in the crosshead bearing of the breech mechanism is not in alignment with the hammer thrust pin; (b) the operator bar and the attached wedge cannot be placed in the firing position, for the surface of the cam on the outer side of the cam slot is cut down to allow the wedge-operating plunger to move over it in withdrawing the operator bar from the slide, but the surface on the inner side of the cam slot is too high to permit the plunger to slide over it; (c) a shoulder on the end of the crosshead bearing of the breech mechanism prevents the wedge from being closed.

(3) Unless the wedge is retracted a pin, which is screwed into the carrier, prevents the rotation of the firing lock to the position for assembly or removal.

(4) When the cocking lever is in its normal position, the under edge of the cocking-lever latch rests on the face of the wedge, and transmits to the wedge, instead of through the hammer and primer, any accidental blow upon the cocking lever.

766. Briefly, the advantages of the Mark XIV firing lock are:

(1) It can be reprimed without opening the breech and without endangering personnel.

(2) By one pull on the cocking lever lanyard it can be cocked and fired by percussion, this eliminates separate cocking and firing operations.

(3) It has a short, well protected, insulated firing pin and a short, strong contact piece on the hammer.

(4) If the primer is inserted past the primer retaining catch, the latter keeps the primer in place and thus prevents the primer from being jammed or sheared by the wedge.

(5) The design of the lock prevents the possibility of firing the primer, either by percussion or by electricity, unless the plug is completedly closed.