PRELIMINARY ORDNANCE PAMPHLET No. 820

40MM ANTIAIRCRAFT GUN

40MM MACHINE GUN MECHANISM
MARK 1 MARK 2 MARK 1, MOD. 1 MARK 2, MOD. 1

40MM GUN BARREL
MARK 1

40MM SIGHT
MARK 3 MARK 4

DESCRIPTION AND OPERATION



OCTOBER 1943

PRELIMINARY

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#1

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DESCRIPTION AND OPERATION



OCTOBER 1943

NAVY DEPARTMENT
BUREAU OF ORDNANCE
WASHINGTON, D. C.

ORDNANCE PAMPHLET No. 820 October 1943
40MM ANTIAIRCRAFT GUN

1. Ordnance Pamphlet No. 820 provides a description of the construction and operation of the 40MM Machine Gun Mechanism, and descriptions of the gun barrel and sight. It also includes operating instructions and instructions for the care and maintenance of the gun.

2. Ordnance Pamphlet No. 820-A may be used where a less detailed pamphlet is desired.

3. This pamphlet supersedes Ordnance Data No. 3781, preliminary manual for the description and operation of the 40MM antiaircraft gun. Ordnance Data No. 3781 should be destroyed. Ballistic Data for 40MM Guns are given in Ordnance Pamphlet No. 867.

4. Ordnance Pamphlet No. 820 is UNCLASSIFIED.

Rear Admiral, U. S. N.
Chief of the Bureau of Ordnance

PREFACE

This Ordnance Pamphlet, No. 820, applies to the following:

40MM MACHINE GUN MECHANISMS, MARK 1 AND MARK 2, MARK 1, MOD. 1 AND MARK 2, MOD. 1

40MM GUN BARREL, MARK 1

40MM SIGHTS, MARK 3 AND MARK 4

Standard Navy nomenclature is used herein, and is considered preferable to that used on drawings and in previous publications relating to these mechanisms.

York Safe and Lock Co.
York, Pennsylvania

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40MM ANTIAIRCRAFT GUNS

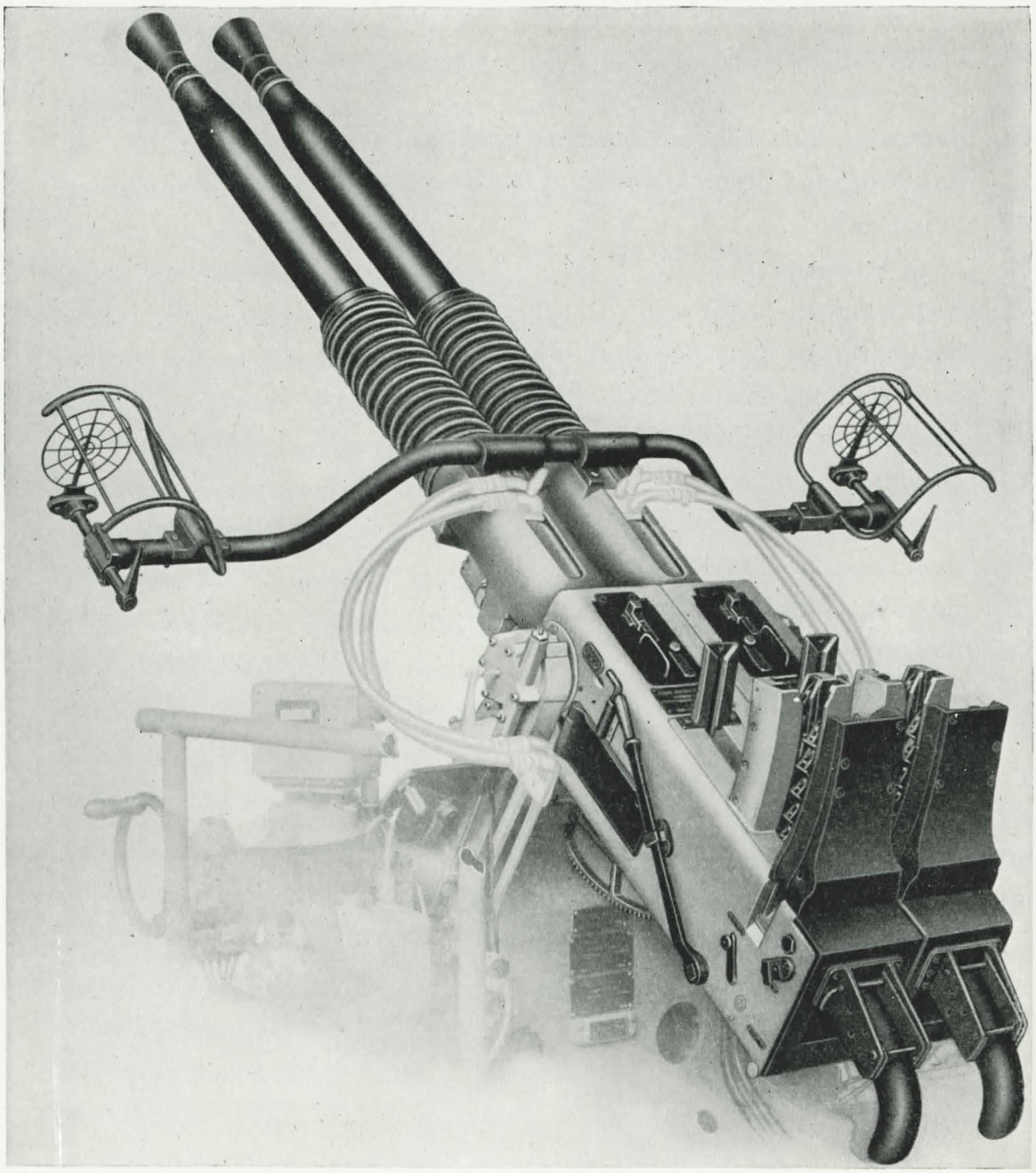


Figure 1

Chapter I

INTRODUCTION

The 40MM Antiaircraft Gun, Figure 1, consists of the machine gun mechanism, the gun barrel, and the sights. **The 40MM Machine Gun Mechanisms** are assembled in pairs. The left mechanism is designated **Mark 1 or Mark 1, Mod. 1,** and the right mechanism is designated **Mark 2 or Mark 2, Mod. 1.** The only differences between the two Marks of mechanisms are those required by the twin assembly. The only difference between the **Mod. 0 and Mod. 1** is that certain parts are not interchangeable between the two. **40MM Gun Barrels, Mark 1,** are used with all mechanisms. The **40MM Sight, Mark 3,** is used on the 40MM Twin Mount; the **40MM Sight, Mark 4,** is used on the 40MM Quadruple Mount.

The design of these mechanisms and barrels is essentially that of the Swedish Bofors 40MM Antiaircraft Gun. The design provides for a rapid fire, recoil operated, automatic mechanism, with a maximum cyclic rate of approximately 160 rounds per minute.

Chapter II

DESCRIPTION **MECHANISM** OPERATION

Part One—Description of Gun Mechanism

The 40MM Machine Gun Mechanism consists of five principal components. They are the **Slide Assembly, Breech Mechanism Assembly, Loader Assembly, Recoil Cylinder Assembly,** and **Barrel Assembly** (excluding barrel).

A. SLIDE ASSEMBLY

The slide, **Figure 2,** is a steel casing which positions and provides working surfaces for other parts of the mechanism. It has a trunnion, trigger

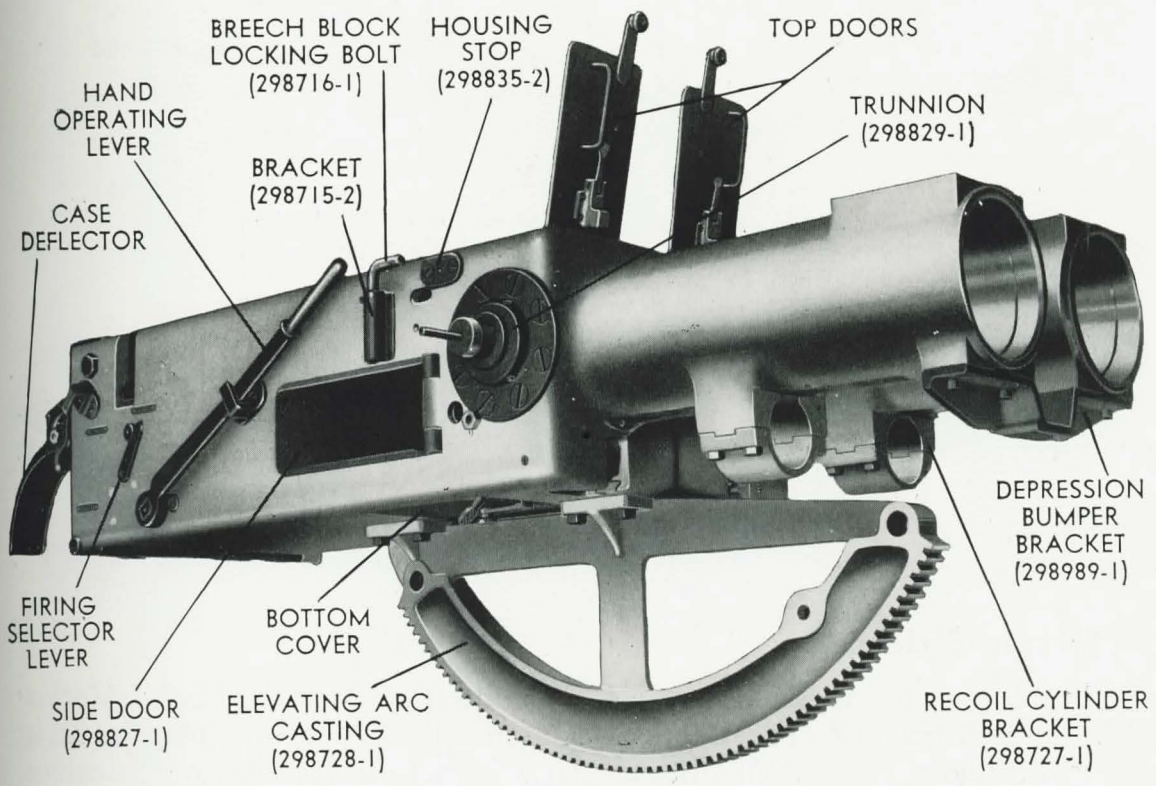


Figure 2

mechanism, hand operating mechanism, top, side, and rear doors, bottom cover and extractor release lever. A Mark 1 and a Mark 2 Mechanism are bolted together and are supported at the trunnions, one on the left side of the Mark 1 Mechanism, and one on the right side of the Mark 2 Mechanism. An elevating arc is attached to the bottom surfaces of the slides.

TRUNNION DIAGRAM

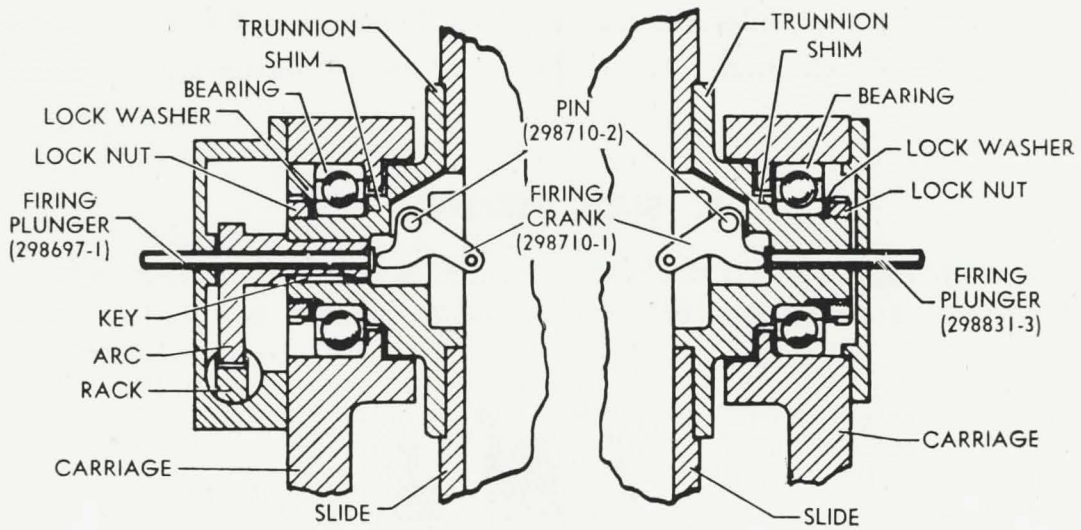


Figure 3

The trunnion on the left is part of the Mark 1 Mechanism, the one on the right is part of the Mark 2 Mechanism.

1. Trunnion

The trunnion, **Figure 3,** contains the firing plunger and crank of the trigger mechanism. The trunnion of the Mark 1 Mechanism is provided with a gear sector to transmit gun elevation to the firing cut-out mechanism of the mount.

2. Trigger Mechanism

The trigger mechanism, **Figure 4,** is on the left side of the Mark 1 Mechanism on the right side of the Mark 2 Mechanism. It is operated by the firing plunger in the trunnion. The trigger is a vertical arm, pivoted near its center, and is located inside and at the rear of the slide, where it contacts and controls the movement of the rammer control spindle arm of the loader. The trigger is operated by a pawl on the firing lever. Motion of the trigger and firing mechanism is limited by the cam on the firing selector lever shaft, as shown in **Figure 5.** When the firing selector lever is at SAFE, motion of the trigger mechanism is prevented by the firing selector cam. When the selector lever is at AUTO FIRE, the trigger can be maintained in the firing

position by the trigger mechanism. When the selector lever is at SINGLE FIRE, motion of the trigger mechanism can be sufficient to permit the pawl to trip and thus release the trigger. The trigger returns to its non-firing position after releasing the trigger catch lever in the loader. Thus in SINGLE FIRE the firing mechanism must be restored to its non-firing position before the trigger can again be operated.

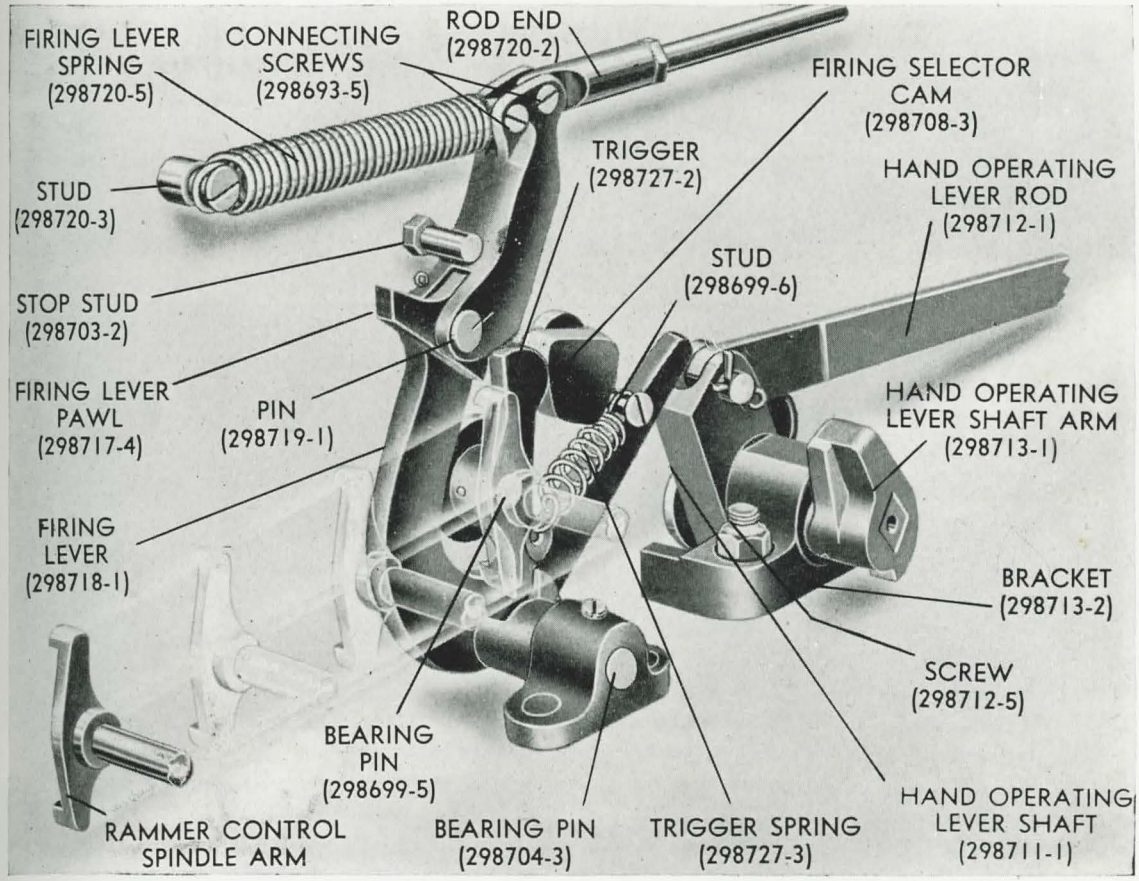


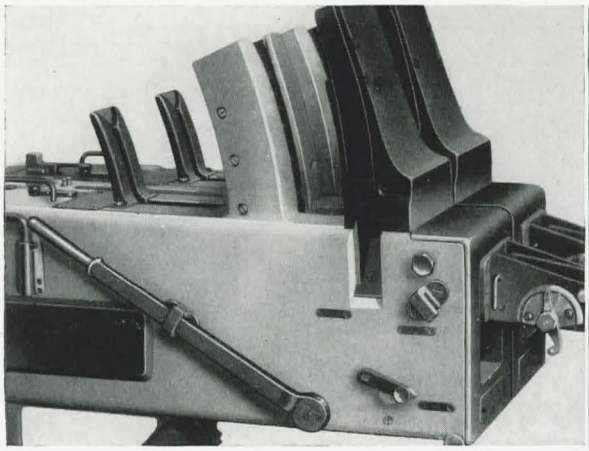
Figure 4

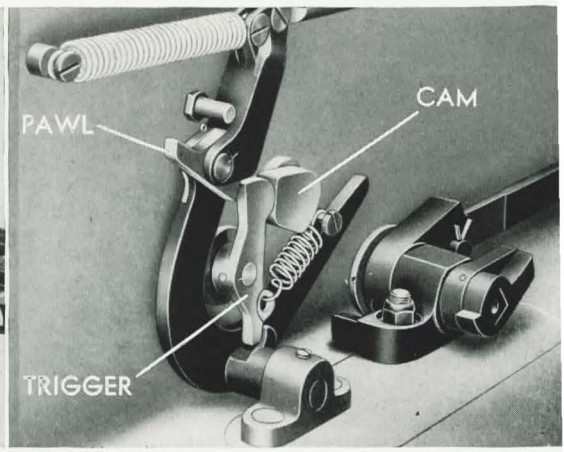
Phantom positions of the rammer control spindle arm show how it contacts the trigger when the loader is placed in the slide. The position of the hand operating lever shaft is shown when the hand operating lever is in the rear catch bracket.

3. Hand Operating Mechanism

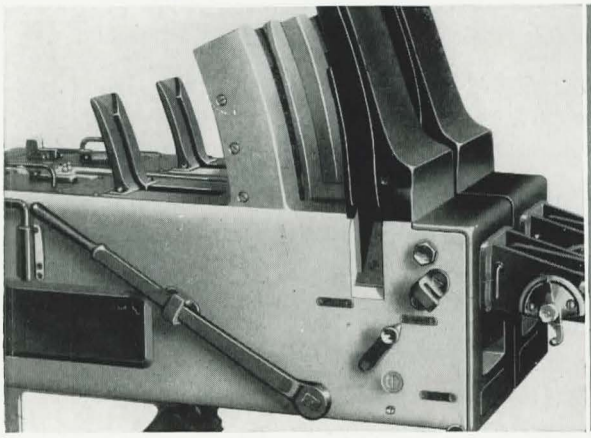
The hand operating mechanism, located on the same side of the slide as the trigger mechanism, provides the means for performing manually the operations required to prepare the gun for firing, operations which are otherwise accomplished automatically during recoil and counterrecoil. It

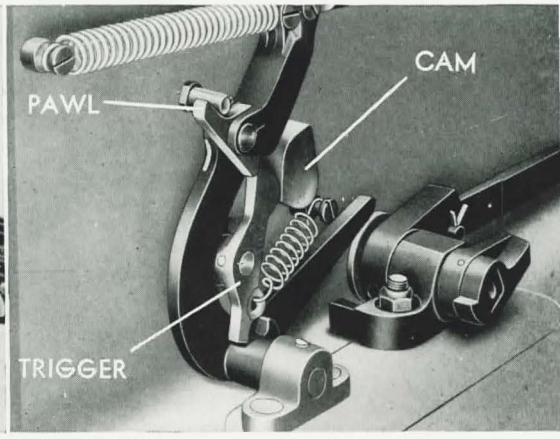
FIRING SELECTOR LEVER POSITIONS



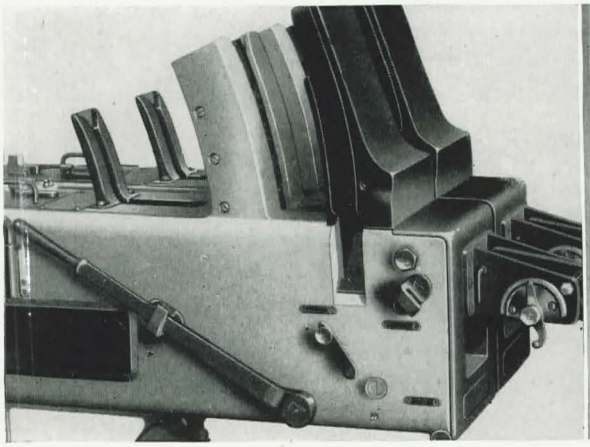


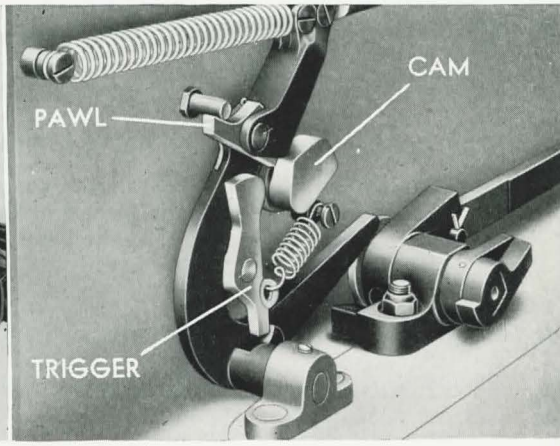
Lever set on SAFE.





Lever set on AUTO FIRE.





Lever set on SINGLE FIRE.

Figure 5

consists of the external hand operating lever and associated internal linkage. The arm on the hand operating lever shaft, **Figure 4,** operates the cocking mechanism of the loader. A projecting lever of the shaft is pinned to the hand operating rod, which engages the toe of the breech mechanism outer crank to cock the breech mechanism. The lever also provides an interlock with the trigger mechanism to prevent firing when the hand operating lever is in the rear catch bracket.

4. Top Door

The top door, **Figure 6,** when open, disengages the barrel lock, **Figure 7,** and rotates the safety catch arm of the housing into position to engage a stop on the slide. This door must be left latched open when the barrel assembly is not in place, to prevent possible rearward movement of the housing.

However, **the top door must always be latched closed before firing,** in order to disengage the safety catch arm from the stop, thus preventing damage to the mechanism.



Figure 6

The top door, when open, disengages the barrel lock.

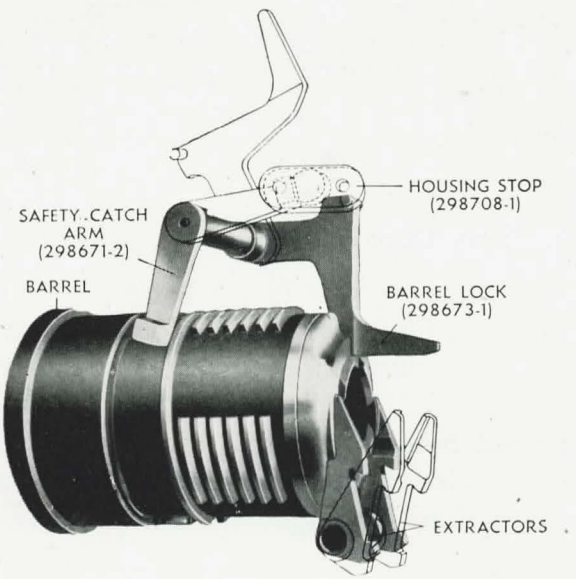


Figure 7

The barrel lock is shown in both open and closed positions.

SIDE DOOR CAM ACTION

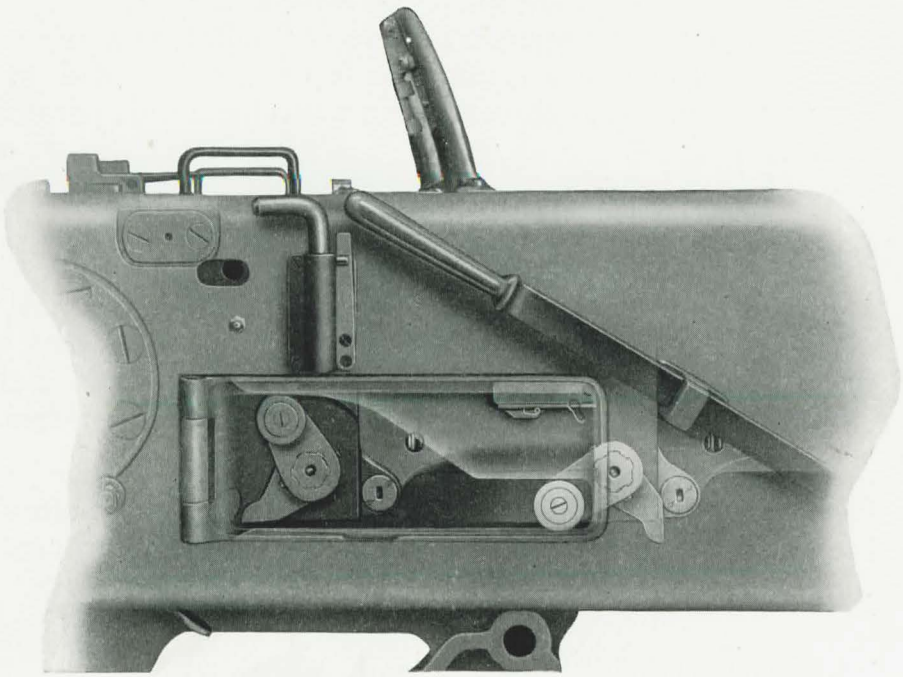


Figure 8

This transparent view shows the action of the cam surface of the side door on the outer crank. The crank is shown at the start and finish of its travel during recoil.

5. Side Door

The side door has a cam surface shown in **Figure 8,** to provide for the rotation of the outer crank of the breech mechanism during recoil.

This door must be opened to remove the breech block, closing spring and cranks from the housing. However, **the side door must always be locked closed before firing,** so that the breech block will be lowered during recoil. Otherwise the breech block will be rammed into the front of the loader causing serious damage.

6. Rear Door

The rear door, **Figure 9,** has an opening to permit the recoil of the rammer tray and ejection of empty cases, and to facilitate removal of live rounds from the tray. It opens to permit removal of the loader and housing assemblies

REAR DOOR

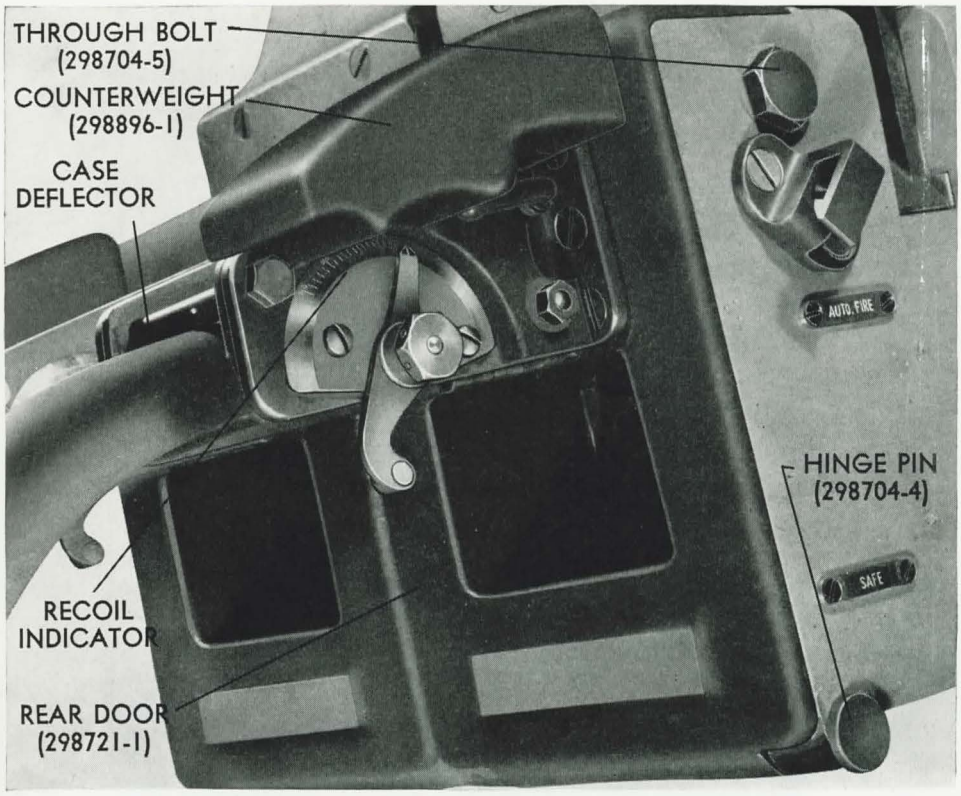


Figure 9

To this door are attached case deflector brackets on which are mounted the case deflector, counterweights, and recoil indicator. This indicator measures the length of recoil, being contacted by the rear of the tray in recoil. It must be reset by hand.

7. Bottom Cover

The bottom cover provides access to the breech mechanism and permits removal of the breech block and associated parts.

8. Extractor Release Lever

The extractor release lever, located in the bottom of the slide, provides for manually releasing the extractors from the breech block.

B. BREECH MECHANISM ASSEMBLY

The breech mechanism assembly consists of a housing assembly, breech block assembly and associated operating parts, and is a recoiling part of the gun mechanism.

1. Housing Assembly

The housing, **Figures 10, 11,** and **12,** is a rectangular steel block with projecting bronze-covered bearing strips which ride in corresponding guides in the slide. The housing is provided with an interrupted thread for attaching the breech end of the barrel. The barrel lock is pivoted in the top of the hous-

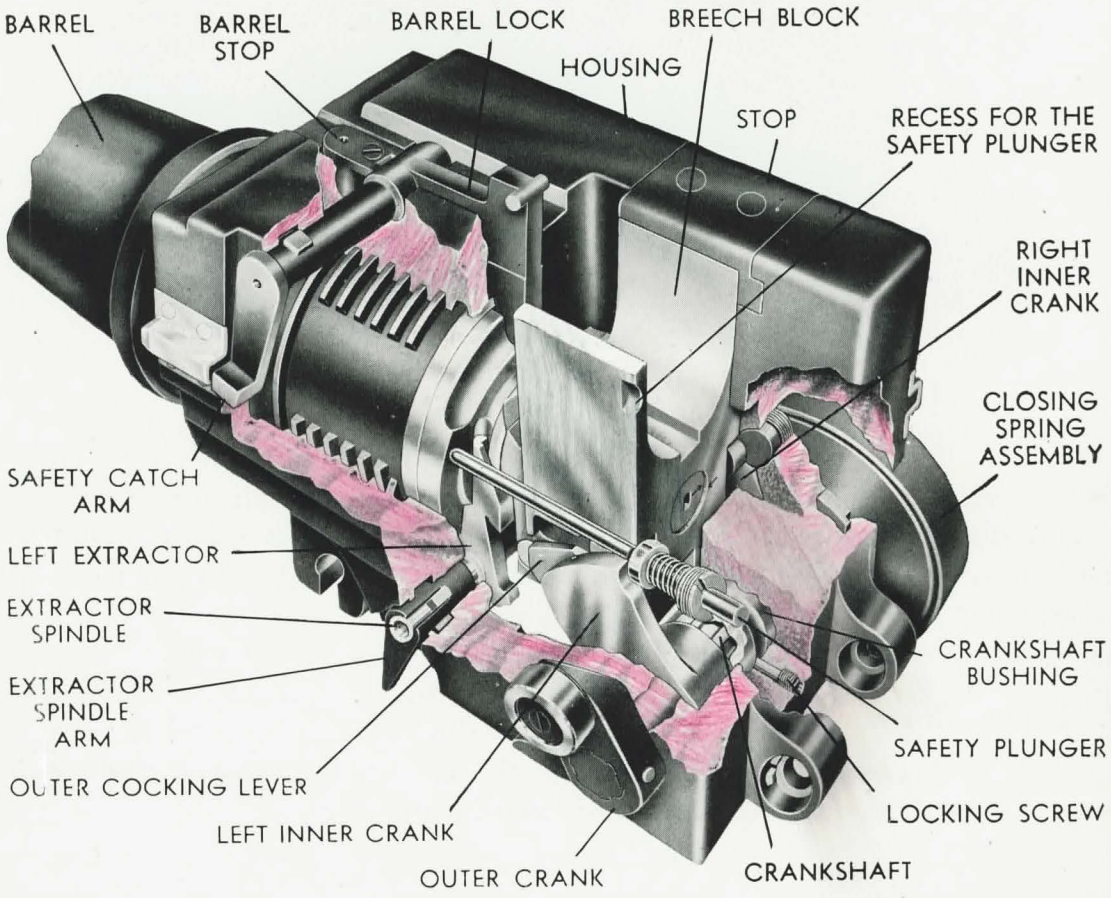


Figure 10

Broken open housing shows the relationship of the parts of this assembly.

HOUSING–FRONT VIEW

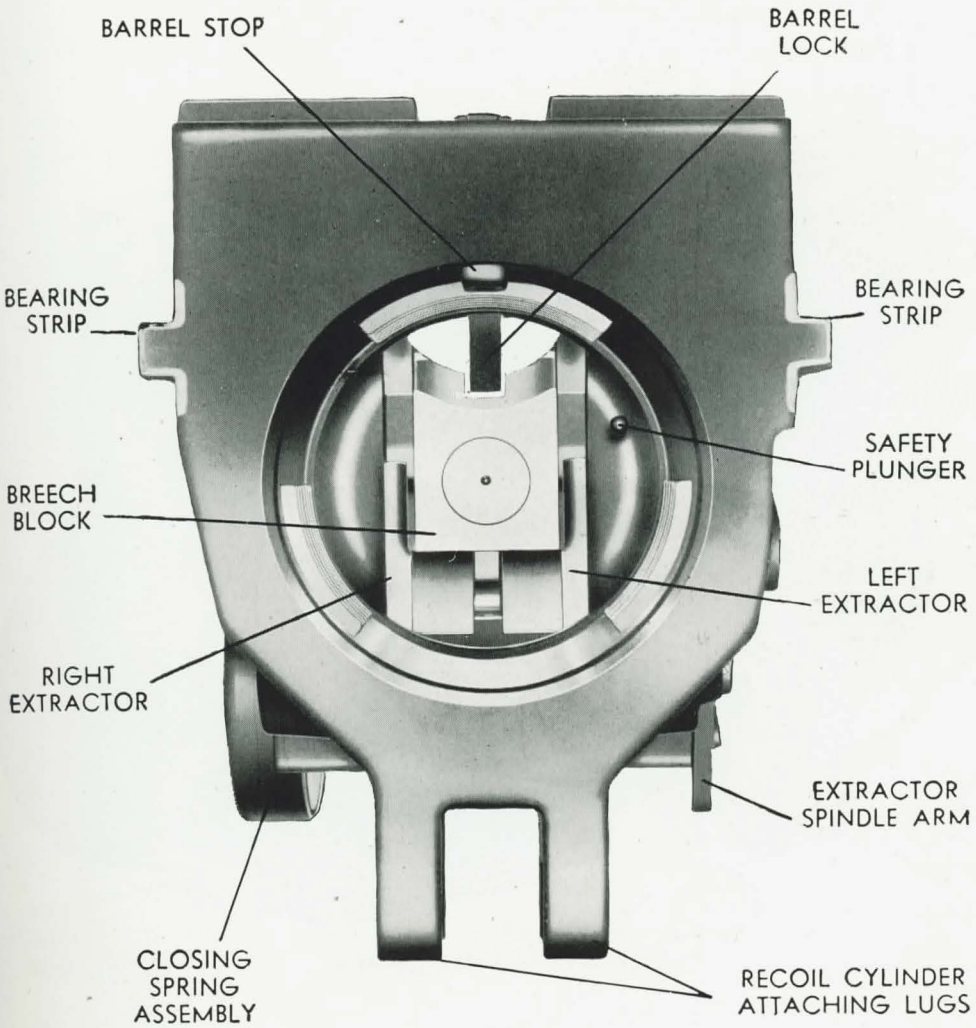


Figure 11

This view of the housing shows the breech block in the closed position.

ing and locks the barrel in the assembled position when the top door is closed. The safety catch arm prevents rearward movement of the housing, when the top door is latched open, by contact against the stop fastened to the slide. A vertical slot is provided for the movement of the breech block. A transverse splined crankshaft keys together the outer crank, two inner

HOUSING–SIDE VIEW

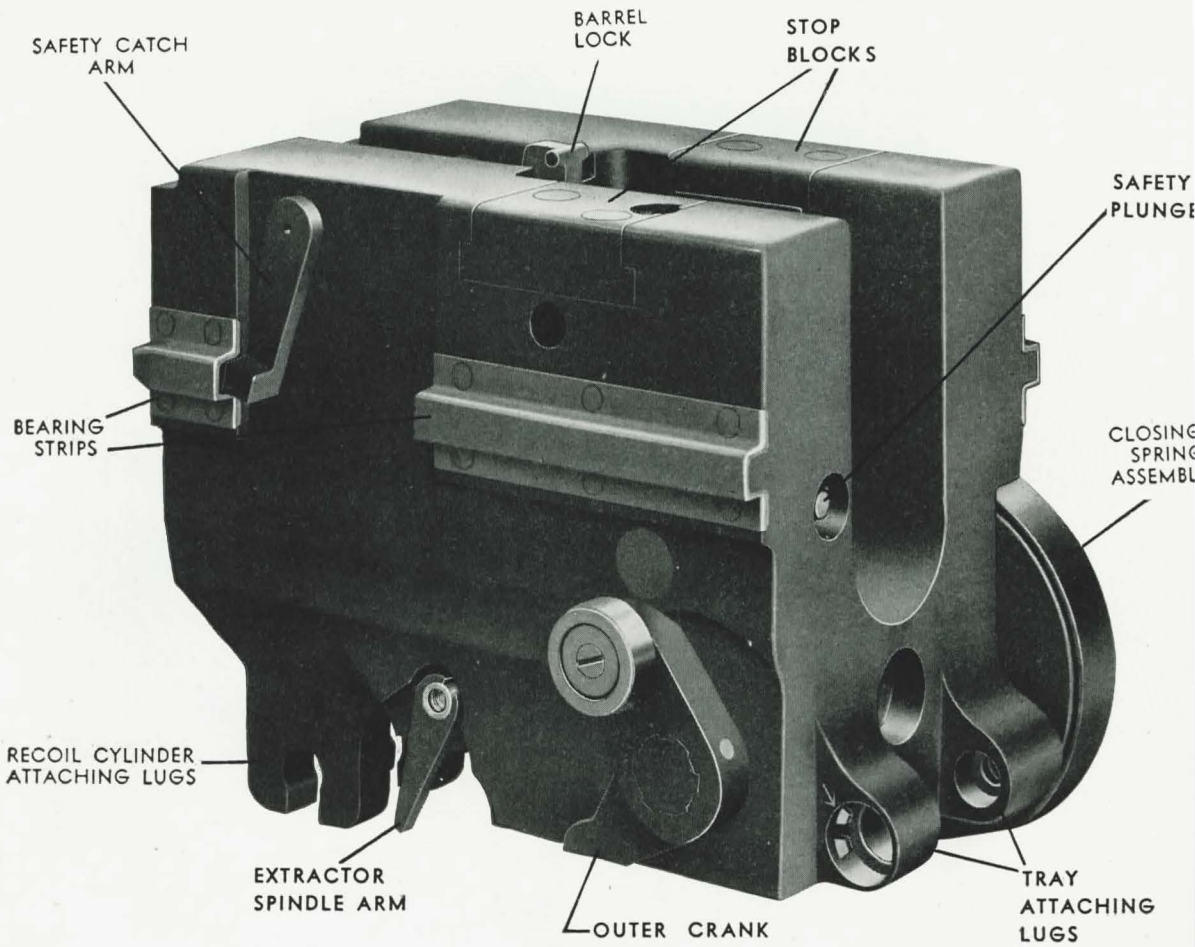


Figure 12

This is the complete assembly for Mark I Mechanism, as it appears from the rear outboard side.

cranks, and the cover of the breech block closing spring. These are shown in **Figure 13.** Cams on the inner cranks operate in slots in the sides of the breech block to open and to close and lock the block in the closed position. Additional cams on the inner cranks operate the outer cocking lever and the sear of the breech block. Extractors, operated by the downward stroke of the

HOUSING DISASSEMBLED

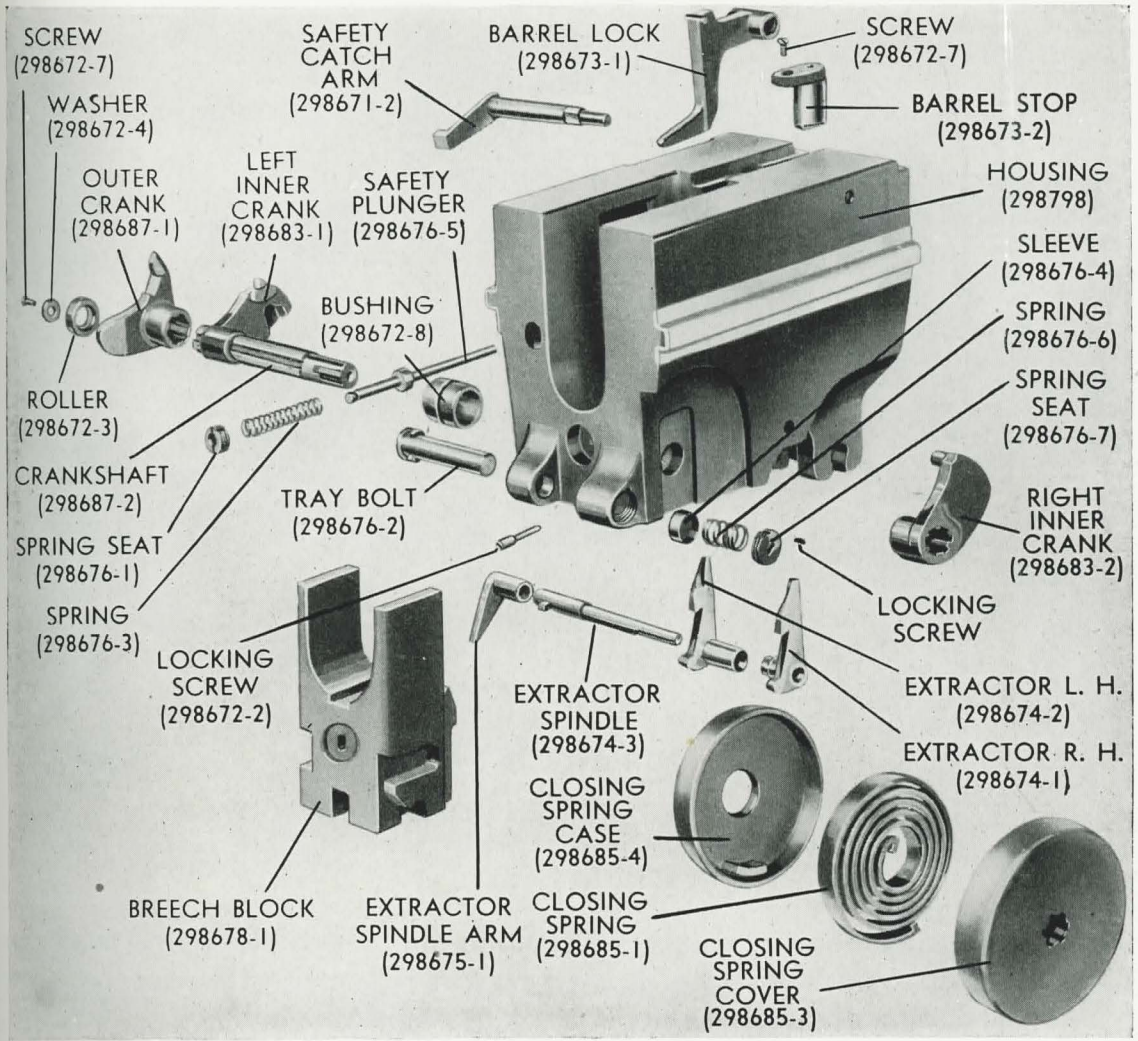


Figure 13

breech block, extract the empty case from the barrel chamber, and lock the block in the open position against the action of the closing spring. The locking is accomplished by the hooks on the extractors engaging abutments on the breech block. The extractors are tripped by a live round catapulted into the chamber, or by manual operation of the extractor release lever. A spring loaded safety plunger, **Figure 14,** moves longitudinally in the housing and contacts a cam on the breech end of the barrel. This plunger moves forward

SAFETY PLUNGER

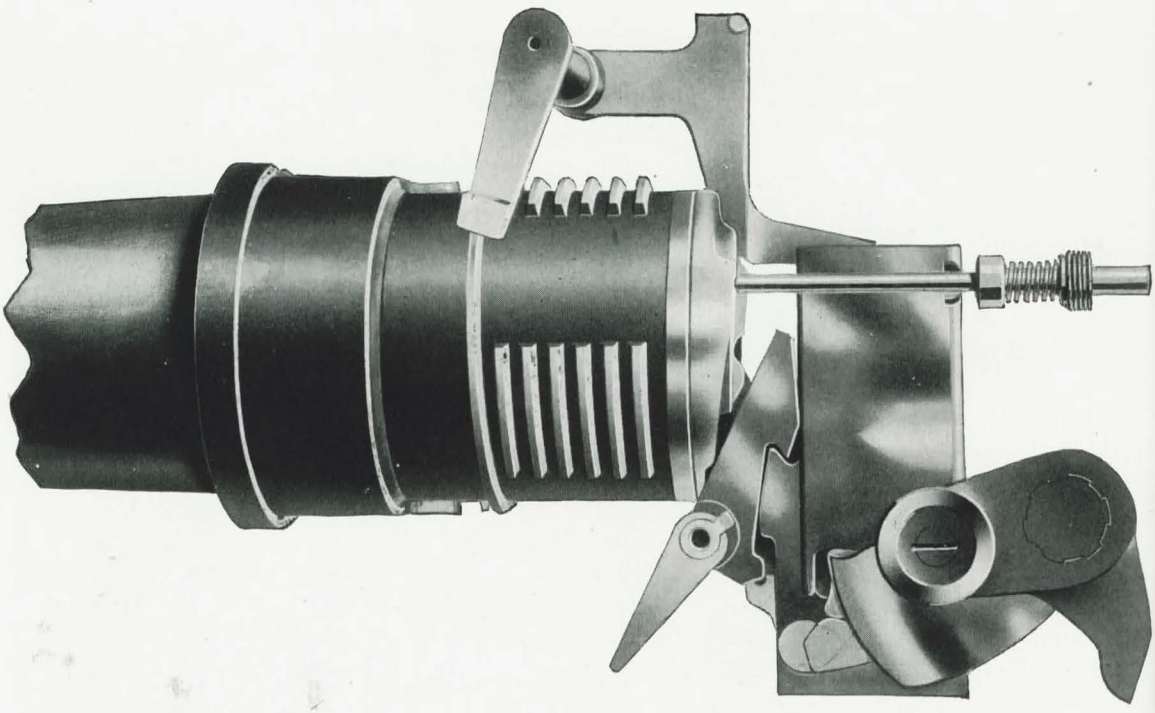


Figure 14

The safety plunger is shown held back by the cam surface on the breech end of the barrel.

when the barrel is removed, enters a notch in the breech block, and locks the block in the open position. The plunger may be retracted to release the block by the use of a special tool inserted in the top of the housing.

2. Breech Block Assembly

The breech block, **Figure 15,** contains the firing pin and spring, inner and outer cocking levers, and the sear and sear spring. The inner cocking lever holds the firing pin in the cocked position or releases it. The outer cocking lever, which is splined to the inner cocking lever, is acted upon by the cam of the left inner crank to cock the firing pin. In the cocked position, the sear is forced outward by its spring, locking the inner cocking lever. In the firing position, the sear is forced inward by the right inner crank, releasing the inner cocking lever and the firing pin.

BREECH BLOCK–DISASSEMBLED

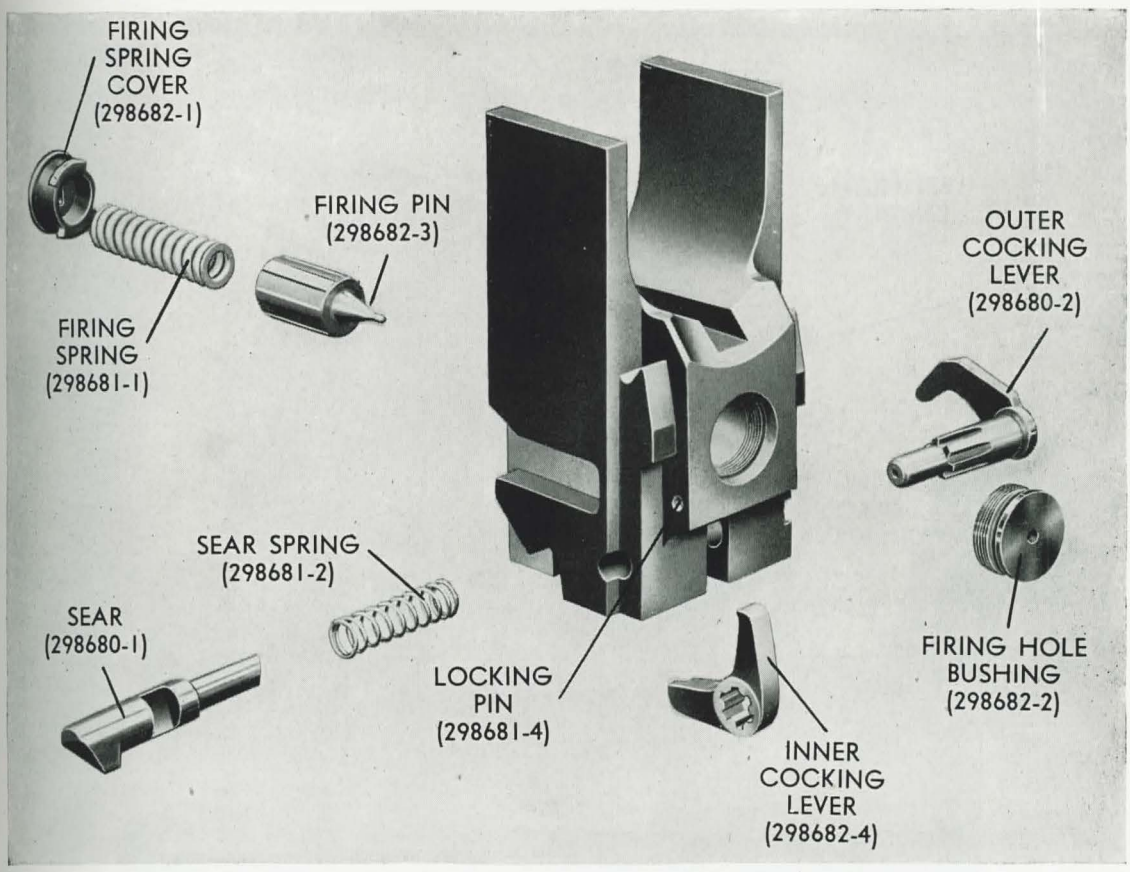


Figure 15

The disassembled breech block shows all parts of this assembly and their identifying piece numbers. The firing hole bushing is not found in all blocks, as some have the firing hole drilled through the solid face of the block.

C. LOADER ASSEMBLY

The loader assembly, **Figure 16,** consists of feeding, ramming and cocking mechanisms and their associated parts. It is located in the rear of the slide, resting on guides for easy removal, and is locked in place by the rear door.

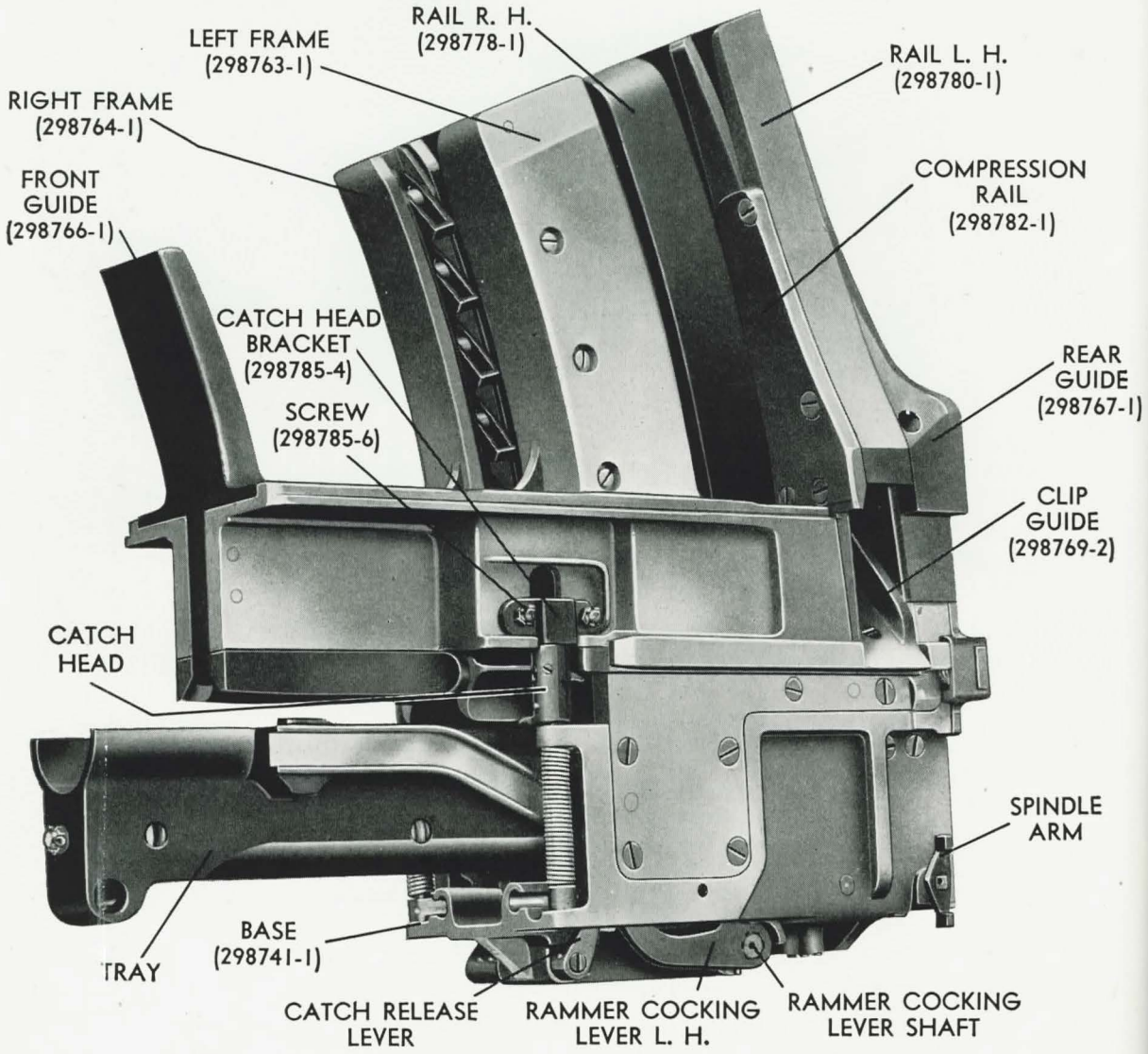
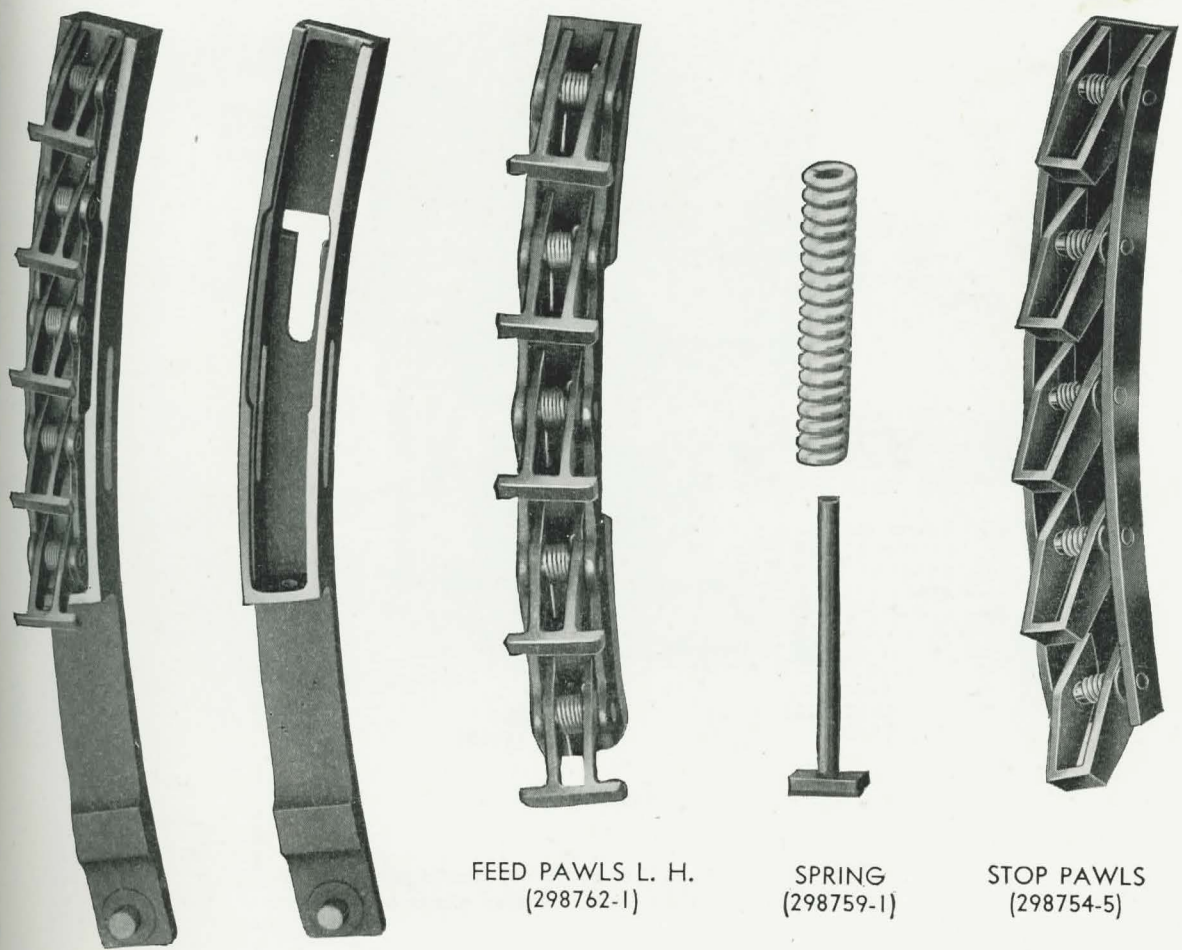


Figure 16

1. Feeding Mechanism

Live rounds are inserted in the loader in clips of four. The clips are automatically removed by the rear guide and ejected through the clip chute. The side frames include guides which contain the feed pawls and stop pawls, **Figure 17,** for automatically feeding single rounds onto the tray, during the counterrecoil stroke. The feed pawls are attached to a movable holder, which is positioned in the feed rod by a spring loaded plunger. In case of overload, as from a jammed round, the plunger will trip and release the feed



FEED ROD ASSEMBLY

FEED ROD L. H. (298757-1)

FEED PAWLS L. H. (298762-1)

FEED PAWL HOLDER L. H. (298757-2)

SPRING (298759-1)

PLUNGER (298759-3)

STOP PAWLS (298754-5)

STOP PAWL HOLDER, L. H (298756-1)

Figure 17

pawl holder as the feed rod completes a stroke. The loader contains two star wheels which are pivoted at the forward ends and positioned at the rear ends by spring loaded plungers, **Figure 18.** The star wheels, **Figure 20,** are locked by catch mechanisms, which are tripped by pawls on the top face of the tray, or released by the hand operating mechanism. When a round is forced through the star wheels by the round above, the case spreads the star wheels sufficiently to pass through as it rotates the star wheels one-quarter turn.

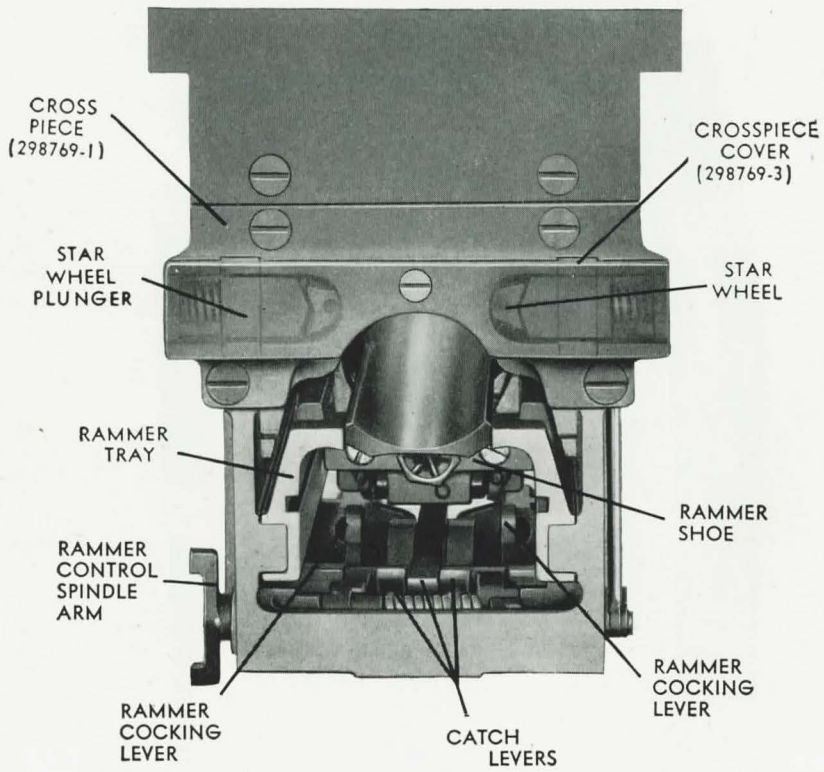


Figure 18

Rear of loader; note transparent treatment of the crosspiece cover to show the star wheel plungers.

2. Rammer Tray

The loader contains the rammer tray, **Figure 19,** which is attached to the rear of the housing and recoils with it. The tray contains the rammer shoe, its levers, and the rammer spring. The rammer shoe, in the cocked position, is so located that the base of the live round, as it is forced through the star

RAMMER TRAY

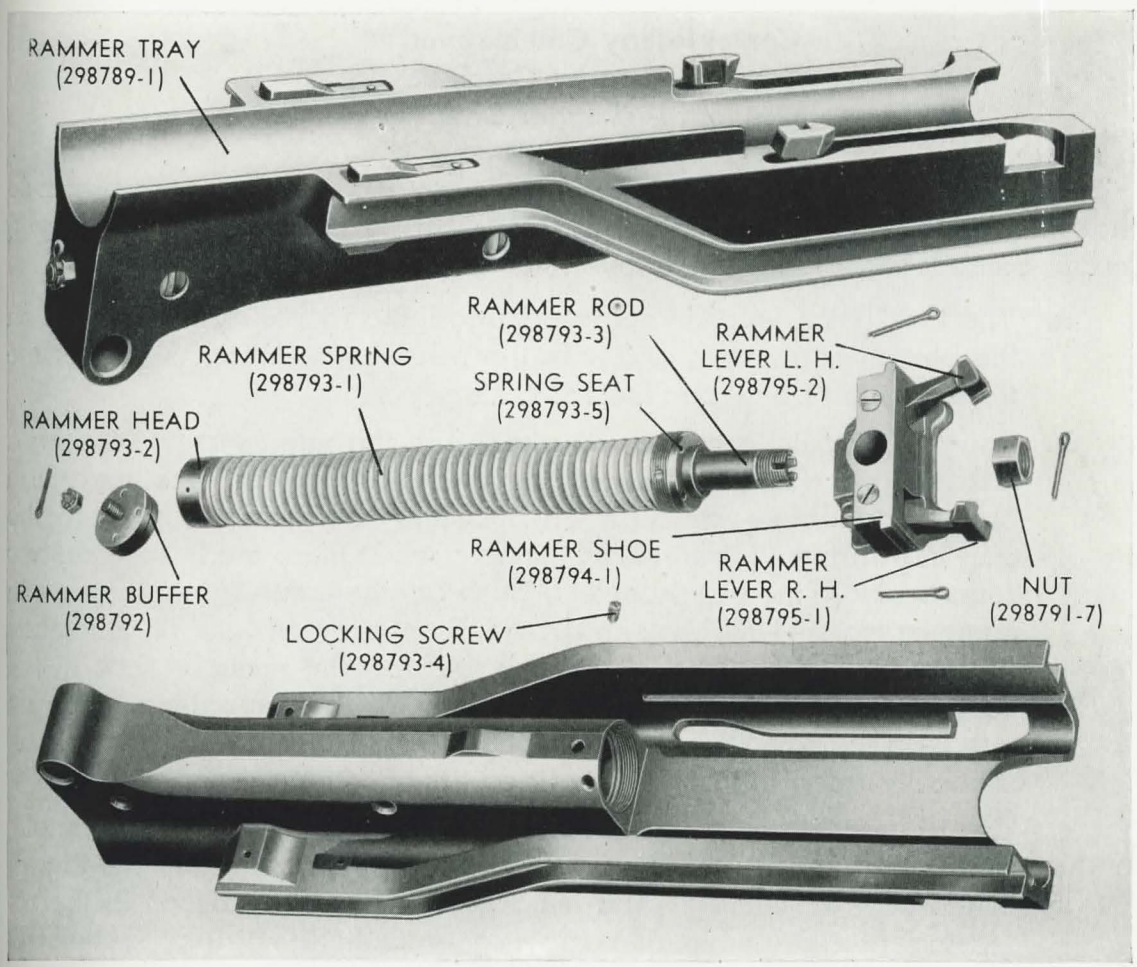


Figure 19

Below the rammer tray assembly, shown at the top of the picture, are the parts of a disassembled tray.

wheels, will fall into the slots of the rammer levers. The tray supports the live round before the round is catapulted, and provides a guide for the ejected case. Guides in the sides of the tray operate the feed rods during recoil and counterrecoil. The pawls on the top face of the tray unlock the star wheel catch mechanisms during counterrecoil at the instant the feed pawls force a live round through the star wheels onto the tray.

3. Catch Levers

The rammer shoe is latched in the cocked position by one of three levers in the base of the loader. The three levers, **Figure 20,** are:

Center—Tray Catch Lever
Inboard—Loader Catch Lever
Outboard—Trigger Catch Lever

These levers are pivoted on a common shaft and are of varying length so that they release the rammer shoe in the following order: Tray catch lever, loader catch lever, trigger catch lever.

a. The tray catch lever is operated, through a rocker arm, by a cam on the bottom of the tray, and is in the releasing position whenever the tray is within about one inch of battery position.

b. The loader catch lever is maintained in the releasing position by a linkage in the rear guide, whenever the loader contains more than one round above the star wheels. Its purpose is to prevent the gun from firing the round on the tray, when there are fewer than two rounds above the star wheels to push another round onto the tray in counterrecoil. This lever is provided to prevent loss of automatic functioning of the mechanism, by latching the rammer shoe in the cocked position, if the loader is supplied with ammunition at a rate less than the rate of fire. This lever releases the rammer shoe automatically upon the insertion of additional clips of ammunition.

c. The trigger catch lever is controlled by the rammer control spindle, and the arm of the spindle is contacted and controlled by the trigger of the slide assembly. The trigger catch lever is placed in the releasing position whenever the trigger is in the firing position.

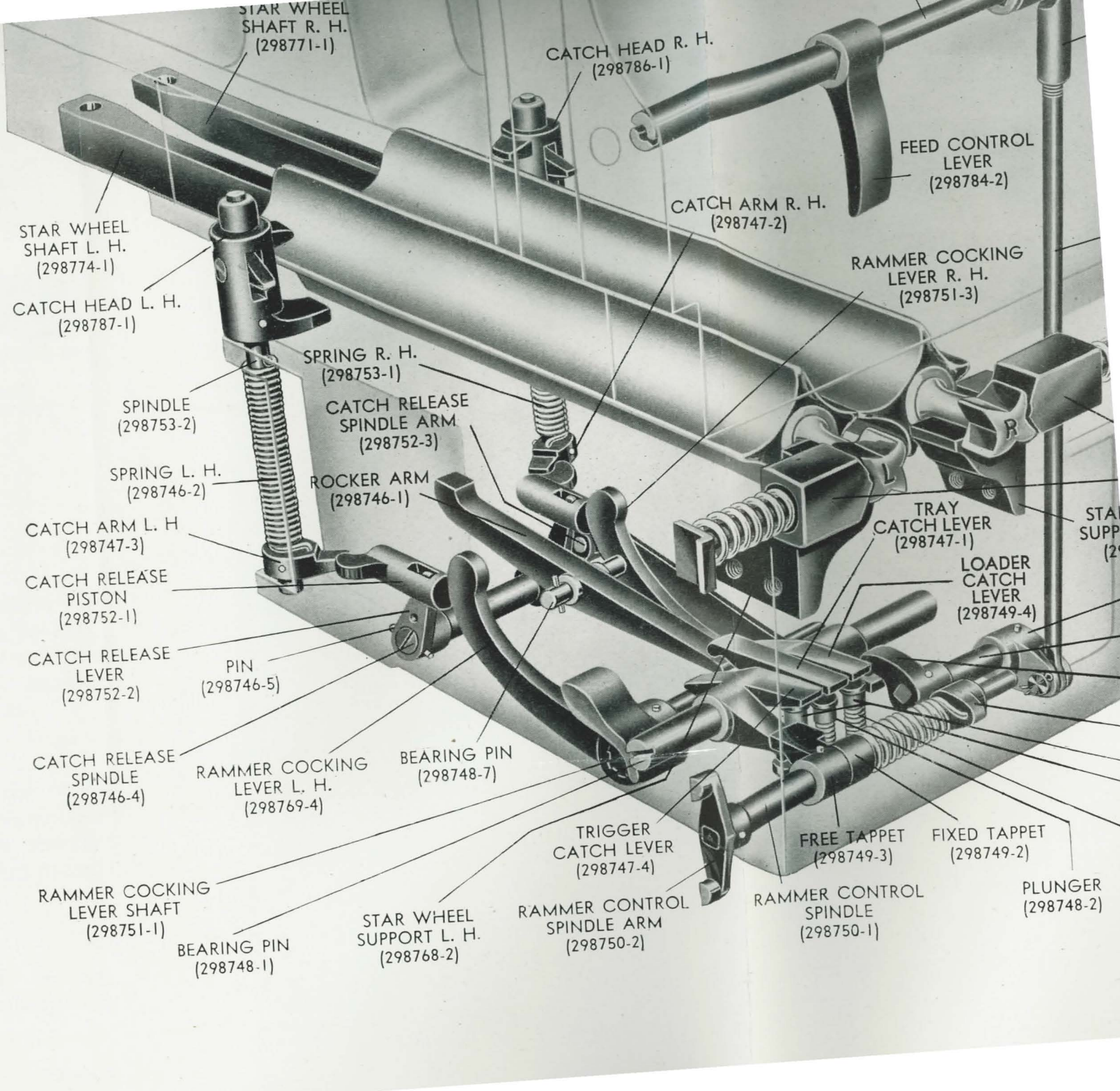
4. Cocking Mechanism

The loader contains the cocking mechanism which is operated by the hand operating mechanism of the slide. The cocking mechanism forces the rammer shoe to the rear and thus compresses the rammer spring. At the same time, the cocking mechanism rotates the catch mechanisms so that a round can be forced through the star wheels. Motion of the hand operating lever, beyond the position necessary to latch the rammer shoe, causes the rammer levers to move to the rear end of the slots in the tray. When the rammer levers are in this position, they are spread by the slots, so that a round can be inserted in or removed from the tray through the opening in the rear door.

NSPARENT IEW OF OADER

Figure 20

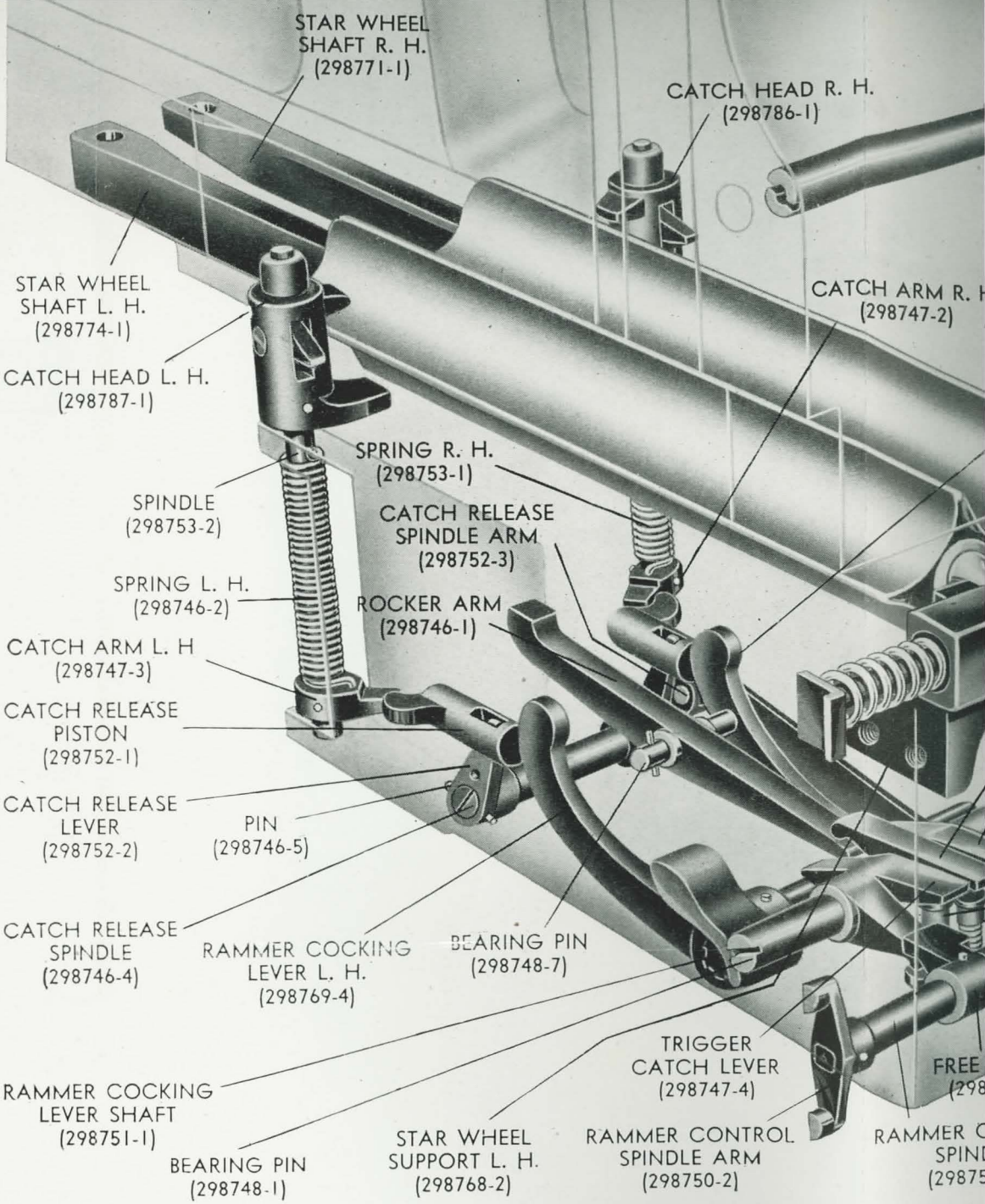
oader mechanism parts are their proper relationship.



TRANSPARENT VIEW OF LOADER

Figure 20

Important loader mechanism parts are shown in their proper relationship.



D. RECOIL CYLINDER ASSEMBLY

The recoil cylinder assembly, **Figure 21,** provides the necessary retarding force during the recoil and counterrecoil strokes to limit the length of recoil and to control the velocity of counterrecoil. The recoil cylinder is attached under the forepart of the slide, and the piston rod is attached to lugs on the housing.

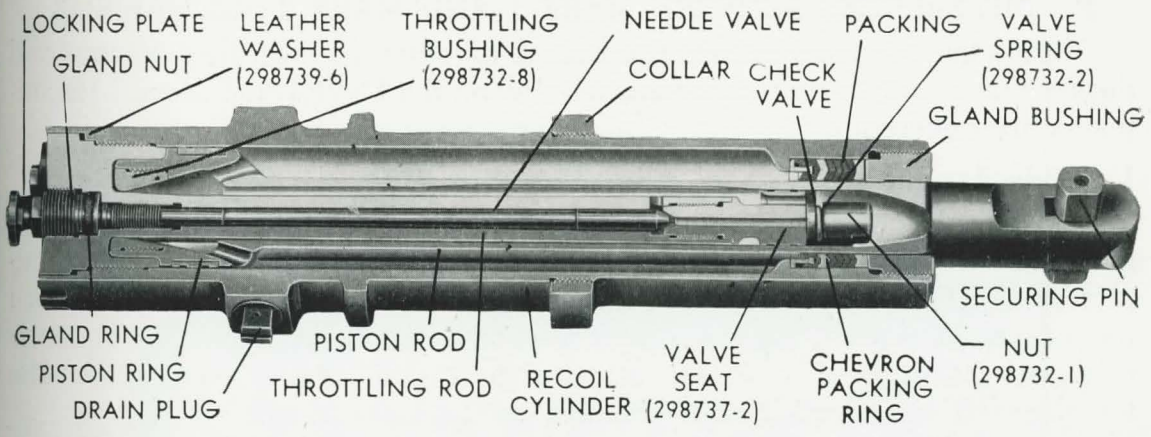


Figure 21

The recoil cylinder shown in the illustration has been cut open to reveal the relationship of its parts.

1. Piston Rod

The piston rod is attached to the housing and moves in recoil with it. The forward end of the rod is enlarged to form a piston, and contains a throttling bushing which provides an orifice for liquid passing between it and the throttling rod. The inside surface of the piston rod has two grooves, tapered at each end, which control the flow of liquid around the valve seat.

2. Throttling Rod

The throttling rod is attached to the body of the recoil cylinder at the front end. It varies in diameter throughout its length, tapering to its smallest diameter near the front end, thus varying the opening between the rod and the bushing. The rear end of the rod carries the check valve which permits flow of recoil fluid through it only during the recoil stroke.

3. Needle Valve

The needle valve fits into a valve seat inside the throttling rod. By varying the setting of this valve, the velocity of counterrecoil, and consequently, the rate of fire of the gun can be controlled.

4. Recoil Fluid

The fluid used in the recoil cylinder is specified by O.S. 1324. This mixture is approximately sixty percent glycerine and forty percent water, with a small percentage of corrosion inhibiting compound added.

E. BARREL ASSEMBLY

For description of barrel assembly see Chapter III.

F. DIFFERENCES BETWEEN MARK 1 AND MARK 2 MECHANISMS

Since the two mechanisms are bolted together so that they elevate and depress as a unit, certain differences between the Mark 1 and Mark 2 Mechanisms are necessary.

1. Slide Assembly

To permit the gun to be loaded, cocked and fired, each mechanism has its hand operating lever, firing selector lever, trigger mechanism, and firing plunger on the outboard side of the slide. To allow access to the breech mechanism assembly, the side doors are on the outboard side. The extractor release levers are also placed near the outboard side of each slide. The top doors differ in having their catches on the inboard side.

2. Breech Mechanism Assembly

The housings in the Mark 1 and Mark 2 Mechanisms differ in having their breech closing spring assemblies mounted on the inboard side, while the outer cranks, the extractor spindle arms, and safety catch arms are on the outboard side. The breech closing springs differ in the direction of their spirals; the closing spring in the Mark 1 Mechanism is wound so that it increases in diameter in a counter-clockwise direction, when viewed from the convex side of the spring; in the Mark 2 Mechanism, the spring is wound in the opposite direction.

Extractors and breech block assemblies are identical for the two Marks of mechanisms, and are, therefore, interchangeable.

3. Loader Assembly

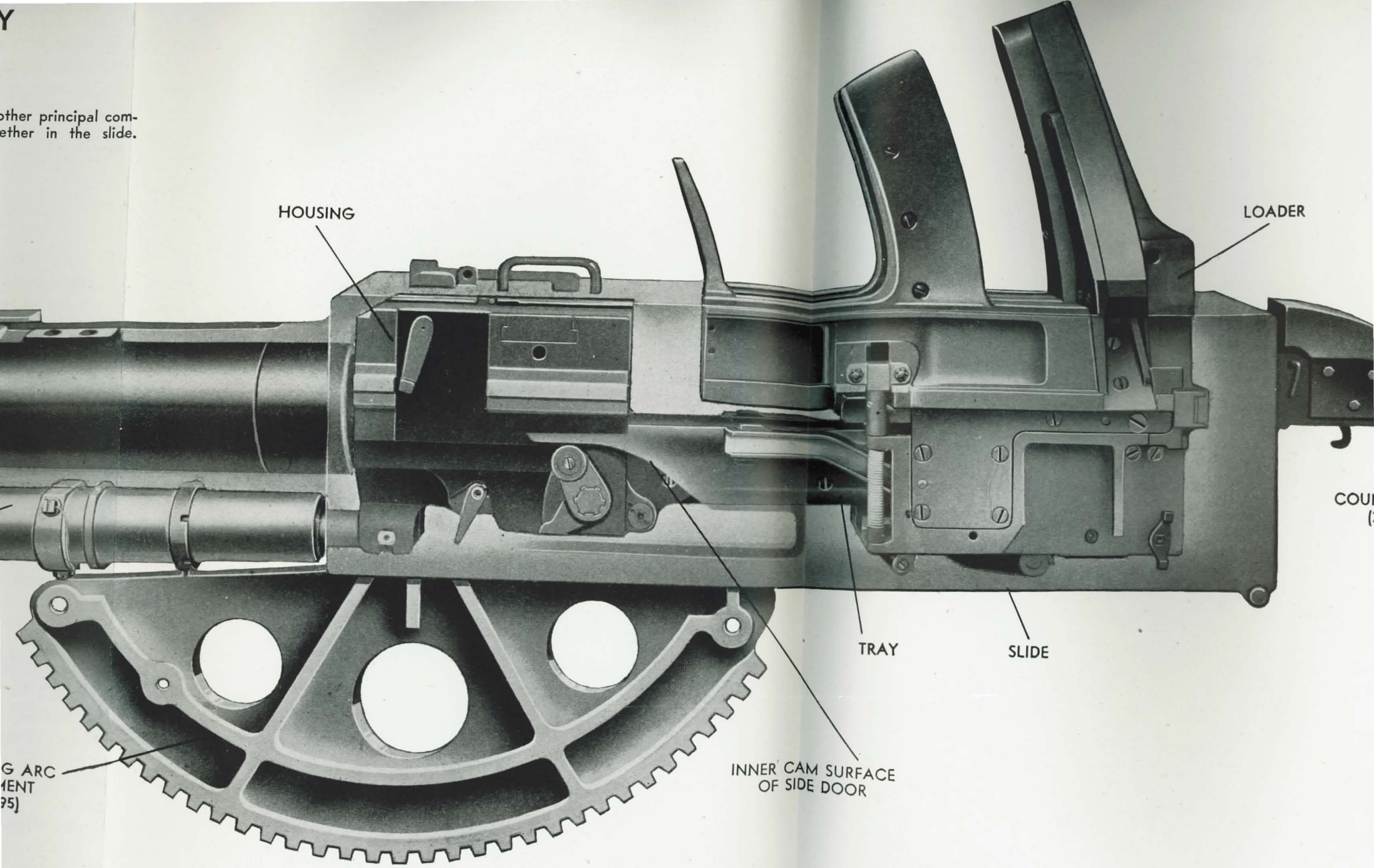
The differences between the loaders in the Mark 1 and Mark 2 Mechanisms are those which are required to permit the cocking of the rammer and release of the catch mechanisms by the hand operating lever, the operation of the rammer control spindle arm by the trigger, and ejection of the ammunition clips through the outboard side of the slide.

4. Recoil Cylinder Assembly

The only difference between the recoil cylinders in the Mark 1 and Mark 2 Mechanisms is that the fill plug of each is positioned on the outboard side for easy access in filling the recoil cylinders.

Y

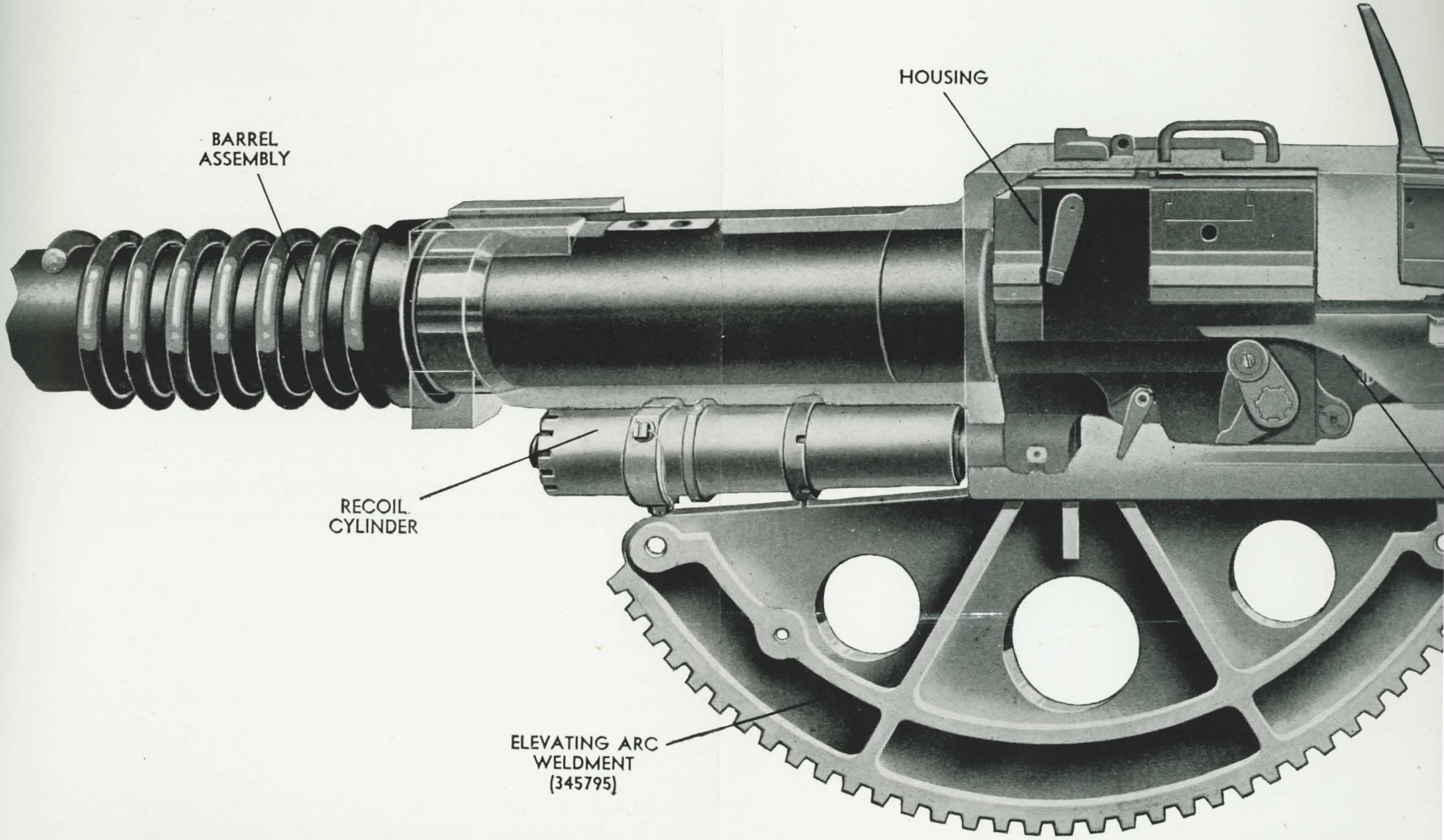
other principal com-
ether in the slide.



GUN MECHANISM ASSEMBLY

Figure 22

The transparent side shows how the other principal components of the mechanism fit together in the slide.



Part Two—Operation of Gun Mechanism

Before automatic operation of the gun mechanism can take place, the gun mechanism must first be cocked and a round fed onto the tray manually. When the trigger catch lever is depressed, the round is rammed into the chamber and fired. The resulting recoil and counterrecoil will now cock the gun mechanism and feed the rounds, thus providing automatic operation.

A. FIRING THE FIRST ROUND

1. Loading

To prepare the mechanism for firing, the hand operating lever is moved to the rear as far as possible and then forward to the rear catch bracket. This movement, **Figure 23,** performs three operations:

It rotates the rammer cocking levers which force the rammer shoe to the cocked position where it is held by the loader catch lever.

It operates the star wheel catch mechanisms, through a linkage and catch release pistons, to permit a quarter turn of the star wheels.

It lowers the breech block, through the hand operating rod, to a position which causes the extractors to lock the block down.

A clip of four rounds is now placed in the loader and pushed smartly home, rotating the star wheels and placing the lowermost round on the rammer tray with its base in the slots of the rammer levers. The clip is automatically detached from the rounds, and ejected through the clip chute of the loader.

These rounds press back the feed control lever, disengaging the loader catch lever from the rammer shoe. The trigger catch lever now holds the rammer shoe until released by the trigger mechanism. The hand operating lever is returned to the forward catch bracket, and the firing selector lever set on AUTO FIRE. The mechanism is now prepared to fire automatically as long as at least two rounds are in the loader above the star wheels.

COCKING MECHANISM

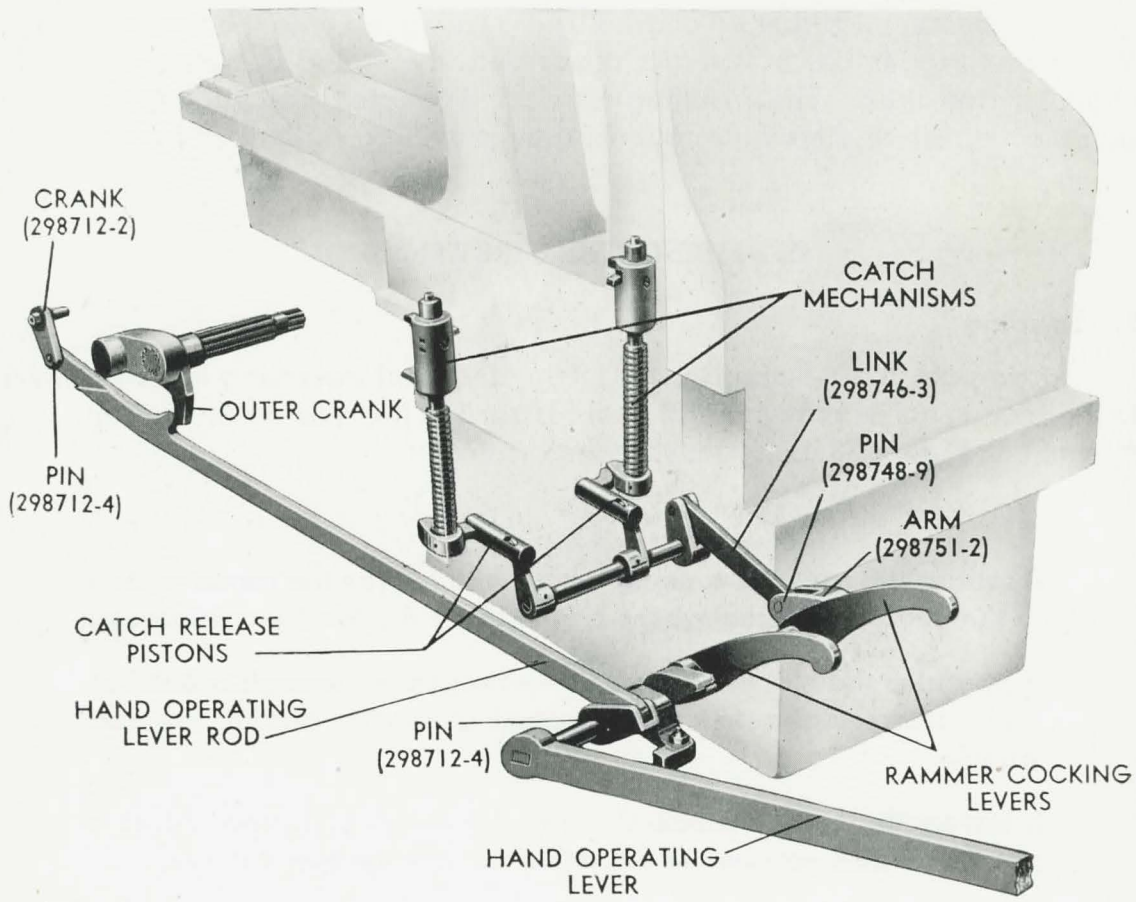


Figure 23

The illustration shows the position of the outer crank, the catch mechanisms, and the rammer cocking levers when the hand operating lever is moved fully to the rear.

2. Ramming

The inward motion of the firing plunger in the trunnion operates the trigger mechanism of the slide and disengages the trigger catch lever from the rammer shoe. The rammer shoe, with the rammer levers and the live round, is forced rapidly forward by the rammer spring. At the end of the rammer stroke, the rammer levers are spread by the slots in the tray, and the live round is released at high velocity and catapulted into the barrel chamber.

BREECH CLOSED

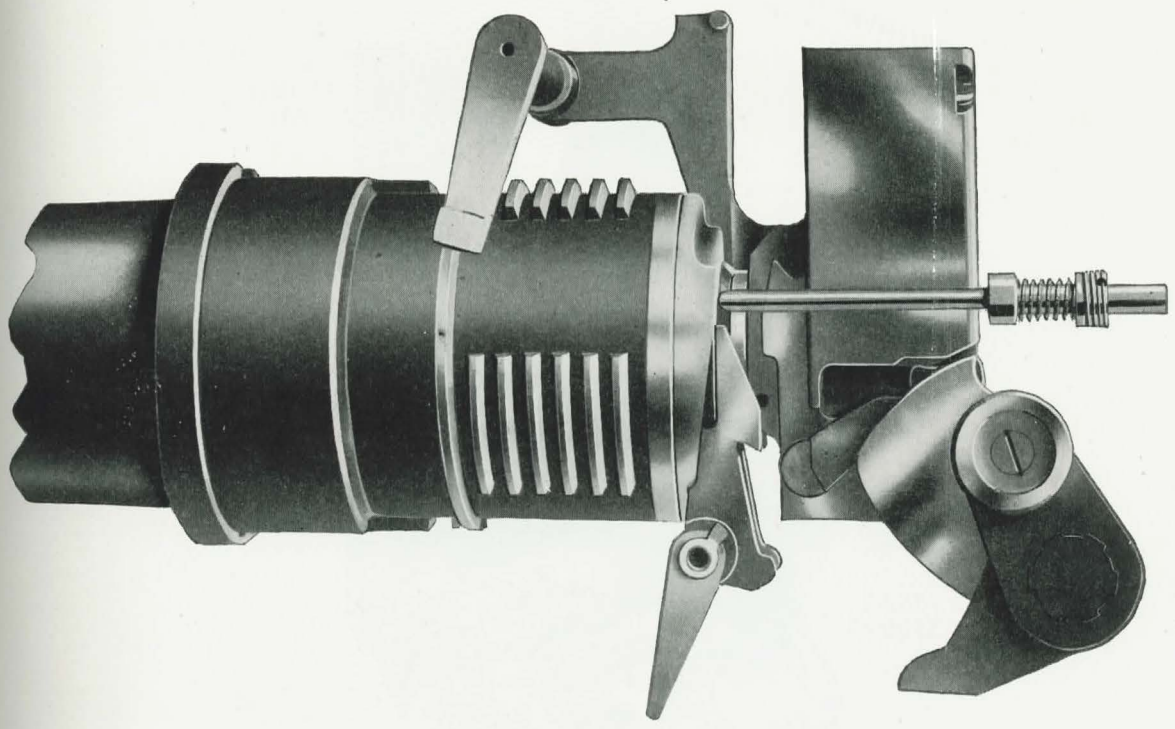


Figure 24

The extractors, caught by the round, have released the breech block, allowing it to be raised to the closed position.

3. Firing the Round

As the round enters the chamber, its base comes into contact with the extractors, pulls them forward, and disengages the extractor hooks from the breech block. The torsion of the breech block closing spring rotates the crankshaft with its attached cranks. The cams on the inner cranks raise the breech block to its closed position, as shown in **Figure 24.** After the breech block is raised, the inner cranks continue to rotate until the cams lock the breech block in its closed position. As the breech block is raised, the pressure of the cam of the left inner crank on the outer cocking lever is released. The inner cocking lever, and thus the firing pin, is now being held by the sear. During the last few degrees of motion of the inner cranks, the lower cam on the right inner crank forces the sear inward, releasing the inner cocking lever, and thus the firing pin. The firing spring then forces the firing pin into

BREECH BLOCK–FIRING

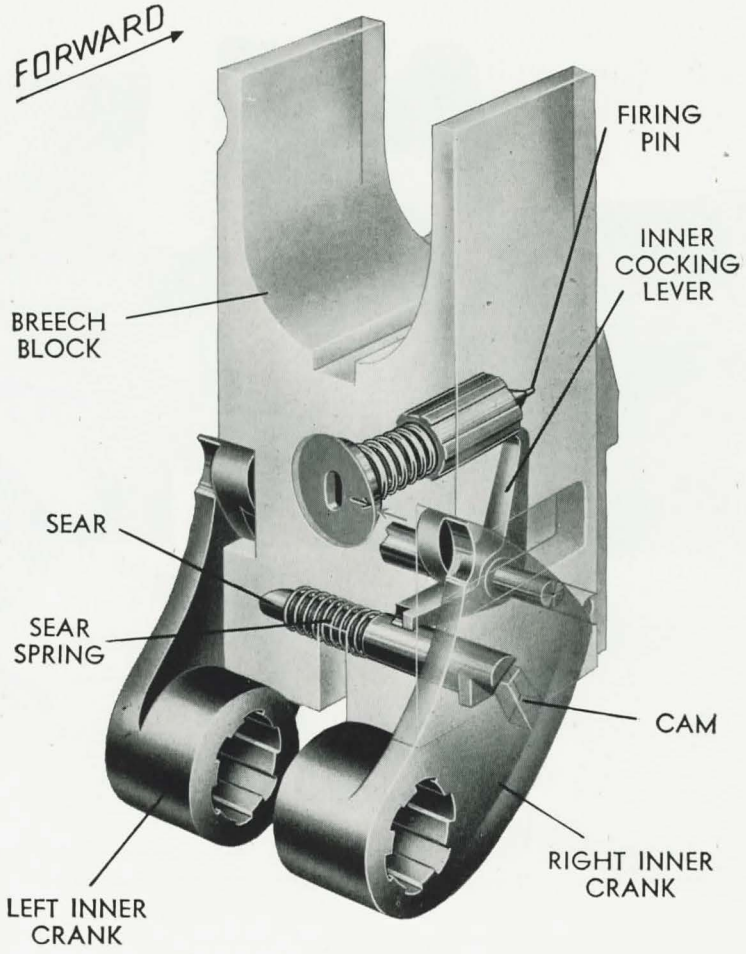


Figure 25

The breech block is shown in the closed position. Transparent treatment of the block shows the relationship of the parts of the assembly.

the primer. This is illustrated in **Figure 25.** The firing pin rotates the freely moving inner and outer cocking levers during its stroke.

B. FIRING AUTOMATICALLY

1. Action of Breech Mechanism and Loader During Recoil

During recoil, the cam on the side door acts on the outer crank to rotate the crankshaft and the inner cranks. The first movement of the inner cranks retracts the firing pin and unlocks the breech block, **Figure 26.** To do this, a

BREECH BLOCK–COCKING

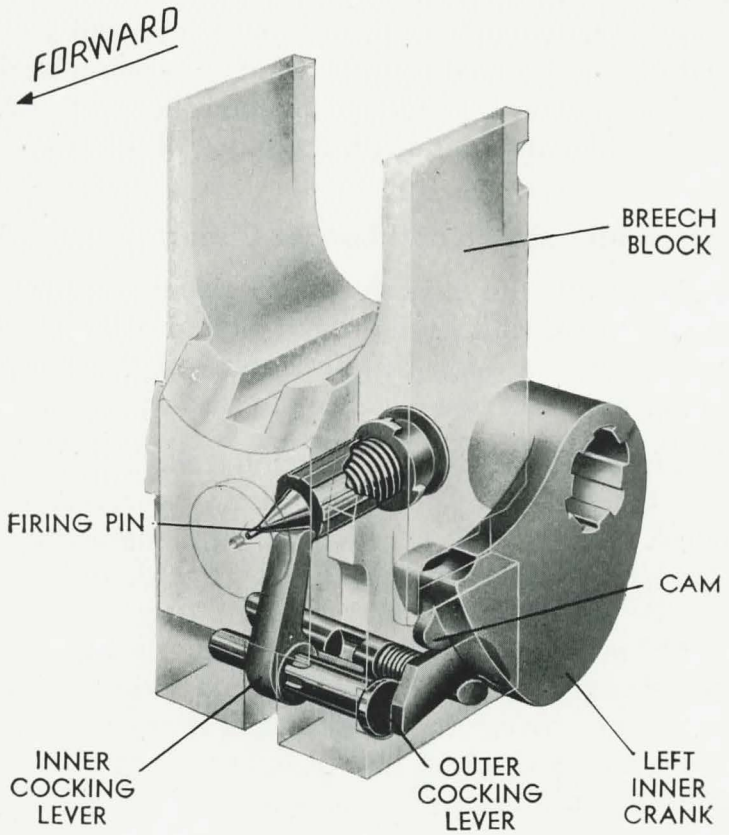


Figure 26

The breech block is cocked during recoil, and the firing pin held back by the inner cocking lever.

cam on the left inner crank depresses the outer cocking lever, and thereby rotates the inner cocking lever, which retracts the firing pin. As the lower arm of the inner cocking lever clears the notch in the sear, the sear spring moves the sear to the right, so that it is held in position to lock the inner cocking lever. In the event of failure of the sear spring, motion of the sear to the right is insured by a cam on the left inner crank. Locking of the inner cocking lever will occur as the breech block is closing, when the outer cocking lever is released by the cam of the left inner crank.

Further rotation of the inner cranks lowers the block into contact with the toes of the extractors, rotating the extractors in the housing. The extractors violently eject the empty case through the housing and loader, between the spread rammer levers, through the rear door, and into the case deflector.

They also lock the breech block in the open position, as shown in **Figure 14,** page 28.

During the recoil movement of the rammer tray, the feed pawls of the loader are raised above the next rounds, which are being held in position by the stop pawls. This motion is produced by the roller on the lower end of the feed rod being moved by the guides on the sides of the tray.

2. Action of Breech Mechanism and Loader During Counterrecoil

During counterrecoil, the breech block closing spring acts to move the breech block to the closed position, but motion of the block is stopped as the breech block is latched open by the hooks on the extractors. Consequently the outer crank is carried clear of the side door cam.

As the tray moves forward during counterrecoil, the pawls on the top surface rotate the catch heads, so that the star wheels can be rotated by the round which is fed between the star wheels and then onto the tray. The rounds in the loader are forced downward by the feed pawls, which in turn are operated by the guides of the tray. As the tray is moving forward, the rammer shoe is latched to the rear by the tray catch lever, in such a position that the base of the next live round above the star wheels will be caught by the slots in the rammer levers as the round is dropped onto the tray. The tray continues forward, and when it is about one inch from battery position, the cam on the bottom of the tray trips the rocker arm, which in turn trips the tray catch lever, releasing the rammer.

The cycle, beginning with the ramming of the live round, will be repeated if the trigger is kept in the firing position, and if the loader contains sufficient rounds, so that the loader catch lever is in the releasing position. If the trigger is kept in the firing position, but the loader contains insufficient rounds for operation of the loader catch lever, firing will cease, but will begin again immediately upon the insertion of additional rounds into the loader.

3. Action of the Recoil System

The recoil system is comprised of the recoil spring and the recoil cylinder. The recoil spring provides in counterrecoil the force necessary to return the gun mechanism to the battery position, cock the rammer, and feed a new round. The recoil cylinder controls the length of recoil and the velocity of counterrecoil.

As the barrel, housing, and tray recoil, the housing carries with it the recoil cylinder piston rod. As the piston rod is drawn to the rear of the recoil

cylinder over the throttling rod, **Figure 27,** liquid is forced from the rear to the front of the piston through the eight holes in the piston and through the throttling bushing. Liquid pressure forces the check valve to the rear, thereby opening the ports in the valve seat. Through these ports liquid now passes to the rear of the valve. Liquid also passes to the rear of the valve around the valve seat and through the tapered grooves inside the piston rod; through the ports in the throttling rod, over the needle valve, and through the seat. These effective flow areas set up a fluid resistance which retards recoil.

Meanwhile, the recoil spring has been placed under greater compression. When recoil ceases, the recoil spring returns the recoiling parts to battery position, and the piston rod moves forward along with the housing.

During counterrecoil, the piston rod moves forward over the throttling rod, and the check valve, under spring action and liquid pressure, masks the ports in the valve seat. Liquid at the rear of the valve seat is forced to the front of the valve seat through the grooves in the piston rod and through the bore in the center of the valve seat. The tapered grooves gradually reduce the flow space as the barrel approaches the battery position until finally no liquid can pass over the valve seat. The flow of liquid from the rear to the front of the seat is now restricted to the bore in the seat, over the needle valve, and through the ports in the throttling rod. Liquid in front of the piston is forced through the throttling bushing and the holes in the piston.

Finally, the front end of the piston enters the recess in the head of the throttling rod. This action forces the liquid between the head and piston through the space between the throttling bushing and the throttling rod. The front taper of the rod reduces the flow space as the barrel approaches the battery position. This action and the tapered grooves inside the piston rod further reduce the speed of counterrecoil.

At the end of counterrecoil, the buffer pad provides a positive stop at battery position for the recoiling parts of the gun mechanism.

The length of recoil is measured by the recoil indicator, attached to the rear door. The indicator is operated by the rear surface of the rammer tray. A length of recoil of approximately 7.2 inches is required to insure automatic operation of the mechanism. Shorter recoil may be insufficient to permit the tray pawls to operate the catch mechanisms of the star wheels, thus preventing feeding. Short recoil may also cause a jam on the tray by causing the star wheels to start to rotate before the ejected case has had time to clear them. The maximum operating length of recoil is about 8.3 inches and is lim-

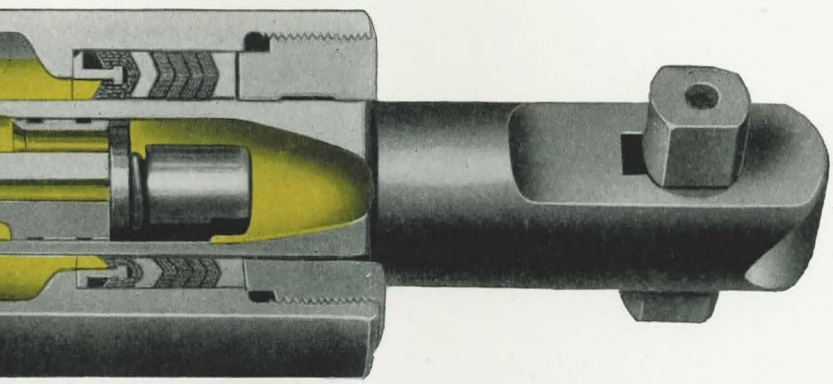
ited by the design of the throttling rod and bushing in the recoil cylinder. Normal recoil should lie within the above mentioned limits, and will vary somewhat with the elevation of the gun, and with the quantity, specific gravity, and temperature of the recoil fluid.

The velocity in counterrecoil, and thus the rate of fire, is determined by the setting of the needle valve of the recoil cylinder. The setting of this valve has no appreciable effect on the length of recoil. The needle valve is adjustable at the forward end of the recoil cylinder.

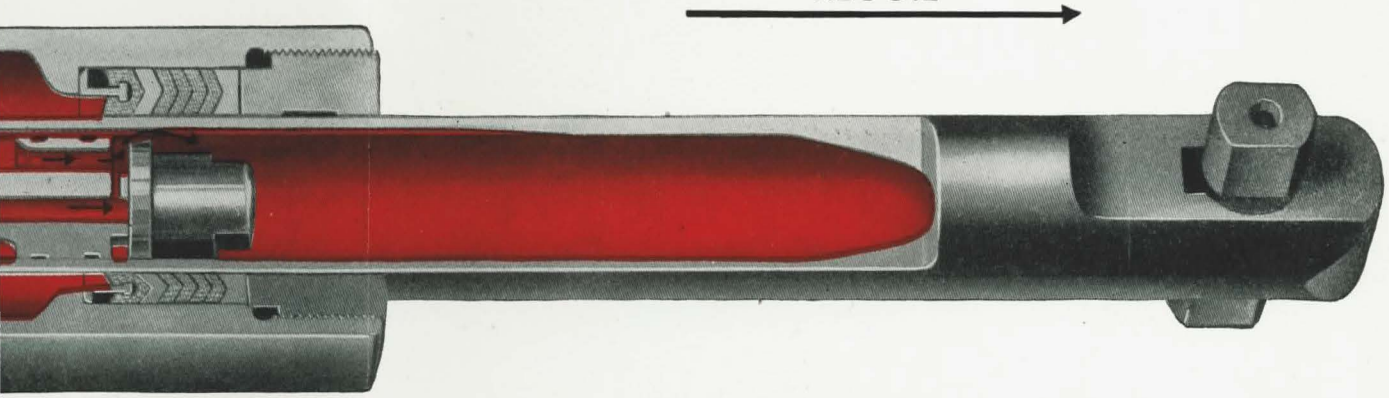
OPERATION OF THE RECOIL CYLINDER ASSEMBLY

Figure 27

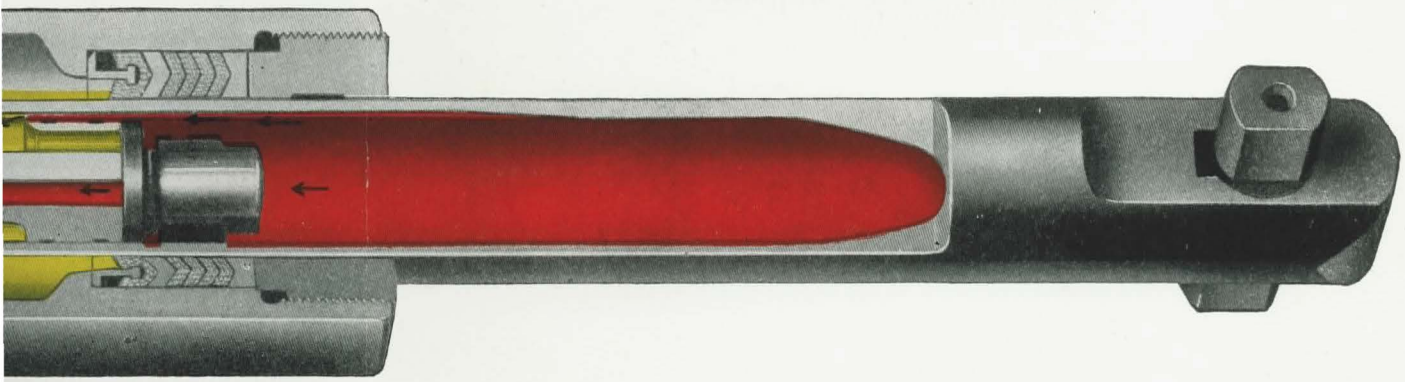
The top sectional view shows the recoil cylinder when the gun is at battery position, and the other two views show the flow of fluid during the recoil and counterrecoil strokes. The red areas represent fluid under high pressure, while the yellow areas represent fluid under low pressure.

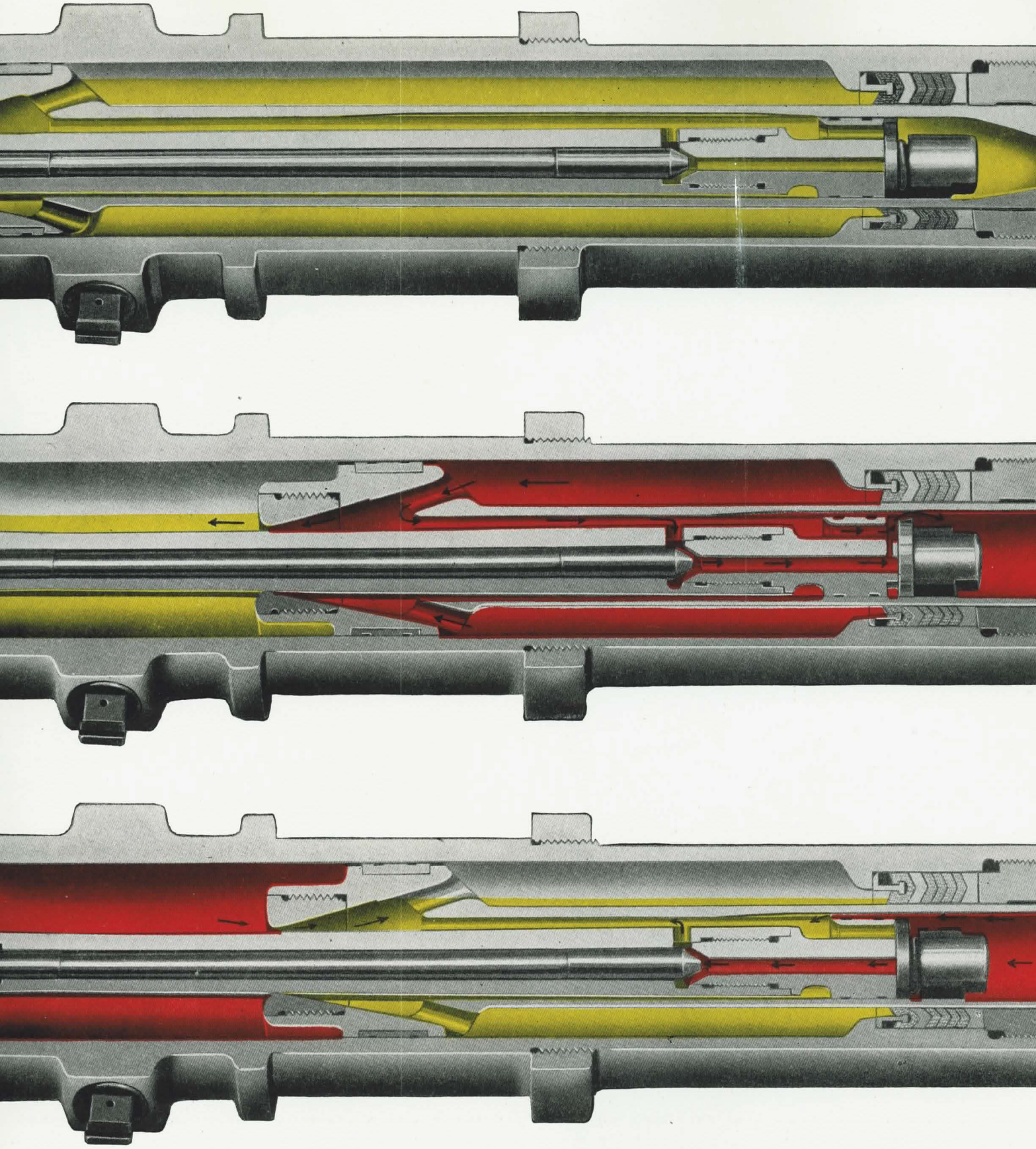


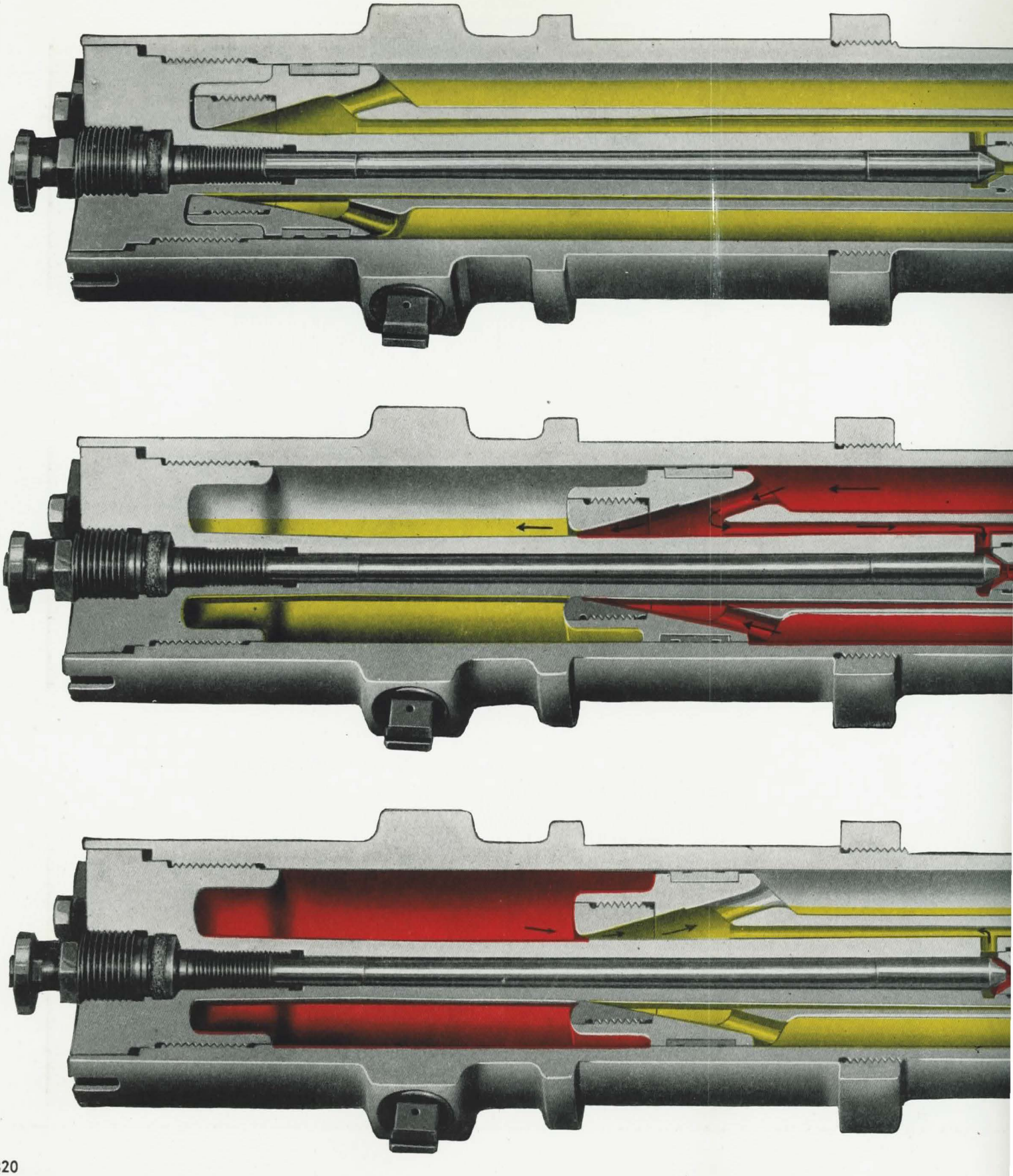
RECOIL



COUNTERRECOIL







Chapter III

BARREL ASSEMBLY

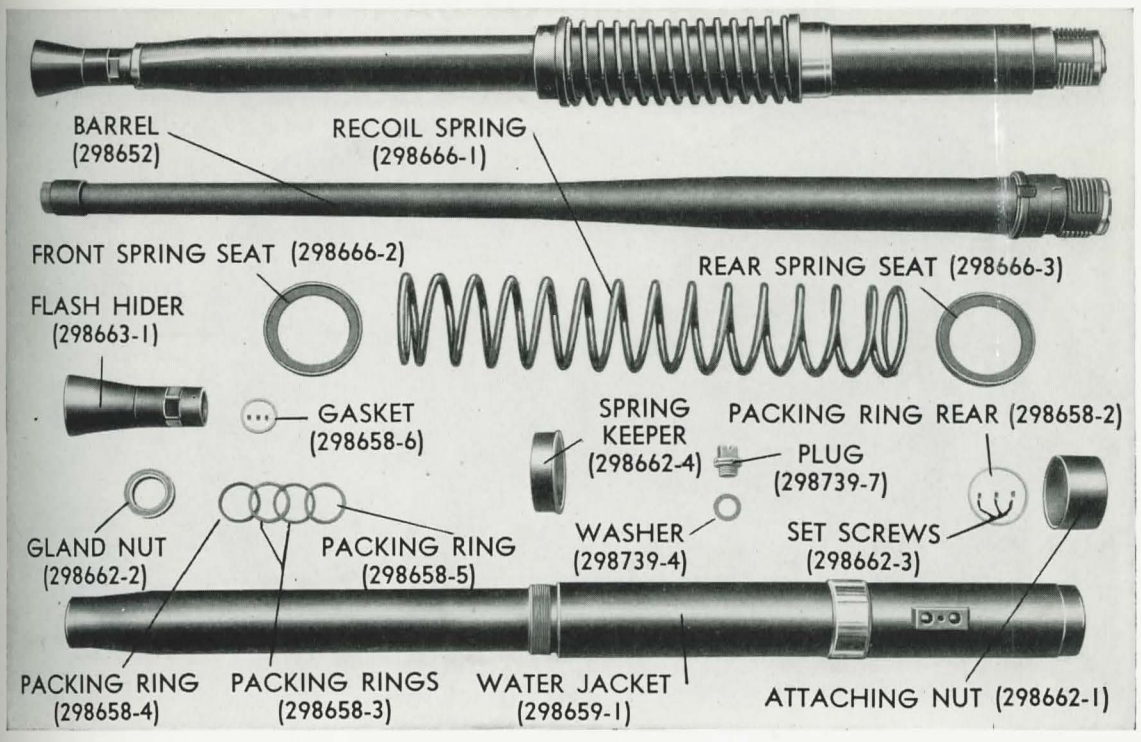


Figure 28

A complete barrel assembly is shown at the top of the illustration; below the assembly are shown its individual parts.

The Barrel Assembly, **Figure 28,** includes a 40MM Barrel, Mark 1, its water jacket, a flash hider, and a recoil spring. The barrel assembly is inserted in the cylindrical fore part of the slide and engaged, by a half turn to the right, with mating interrupted threads in the housing. This half turn brings uppermost the barrel interlock slot in the breech end of the barrel, where it receives the barrel lock upon closure of the top door.

1. 40MM Gun Barrel, Mark 1

The breech face of the barrel, **Figure 29,** is also provided with vertical slots to accommodate the extractors, and a cam surface to actuate the breech block safety plunger which is assembled in the housing. The bore is rifled with sixteen grooves having a right hand twist. The rifling is of increasing twist—one turn in 45 calibers at the origin to one turn in 30 calibers at the muzzle.

BREECH END OF BARREL

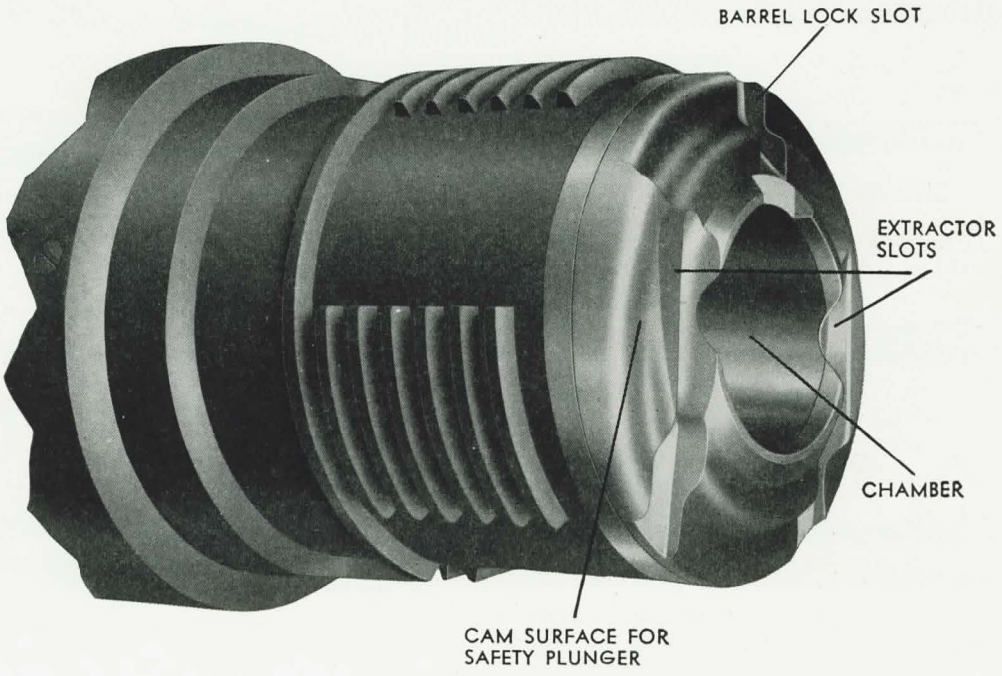


Figure 29

2. Water Jacket

The water jacket covers the barrel; it is installed over the muzzle end and is retained in place by an attaching nut at the rear end of the barrel. A cooling liquid is circulated through the jacket by a motor driven pump located on the mount.

3. Flash Hider

The flash hider is screwed on the end of the barrel, and is held in place by three set screws. Hexagonal surfaces provide a place for application of the two handled wrench used in installing and removing the barrel.

4. Recoil Spring

The recoil spring is assembled over the fore end of the water jacket. The rear spring seat abuts against a sleeve welded to the outside surface of the water jacket. The recoil spring is retained at its forward end by a spring keeper threaded onto the water jacket. The sleeve on the water jacket provides a bearing surface for the assembly within the cylindrical fore part of the slide.

Chapter IV

SIGHTS

A. DESCRIPTION OF SIGHTS

The sights provide a simple means of giving the necessary lead to allow for target motion during the time of flight of the projectile, and also provide for quick changing of the lead, as the position of the target changes. When the gun is controlled by means of the director, these sights are not used.

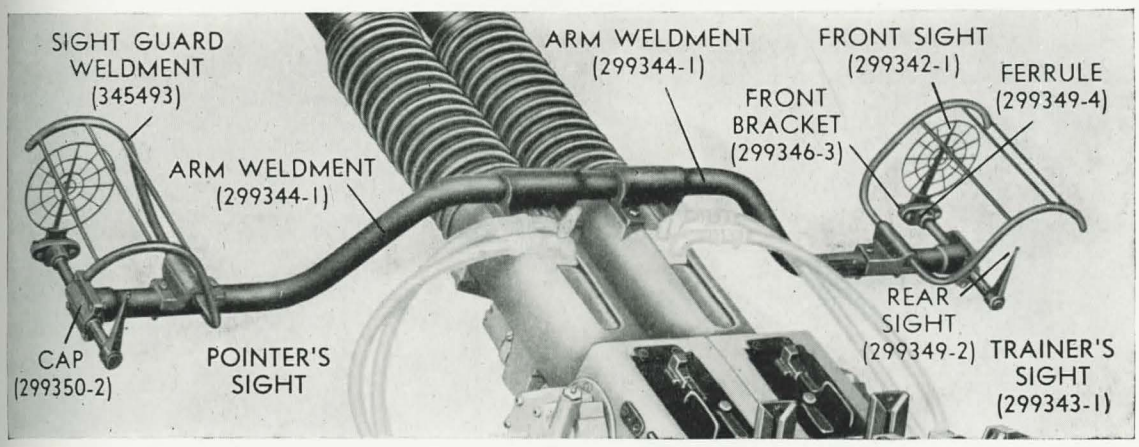


Figure 30

Mark 3 sight shown in position on the gun mechanisms of a twin mount.

1. 40MM Sight, Mark 3

The 40MM Sight, Mark 3, **Figure 30,** is used with a pair of 40MM Machine Gun Mechanisms installed in a 40MM Mount, Mark 1 (Twin). The sight arm weldment is bolted to pads on the front end of each of the slides.

2. 40MM Sight, Mark 4

The 40MM Sight, Mark 4, **Figure 31,** is used with two pairs of 40MM Machine Gun Mechanisms installed in a 40MM Mount, Mark 2 (Quad). It differs from the Mark 3 Sight by having two sight arm weldments, each of which is bolted to pads on the front end of the slides on a pair of mechanisms.

3. Pointer's and Trainer's Sights

Each 40MM Sight, Mark 3 or Mark 4, includes a pointer's sight on the left end and a trainer's sight on the right end of the sight arm weldment. The

rear sight of each consists of a vertical post with a peep sight at its upper end. The front sight is a ring type sight consisting of four concentric rings provided with radial strips. Provision is made for vertical and horizontal adjustment of the front sight.

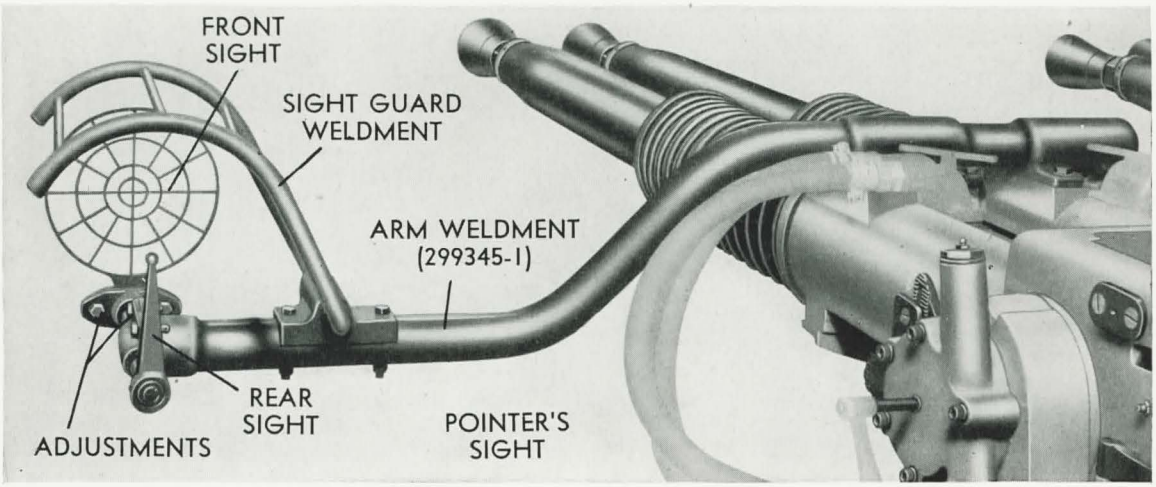


Figure 31

The Mark 4 sight has two separate arm weldments. The pointer's sight of the Mark 4 sight is shown in position on the gun mechanisms of a quad mount.

B. USE OF SIGHTS

The following tables indicate the approximate amounts of lead required at ranges of 1,000 yards and 3,500 yards against targets whose speed components across the line of sight are as listed in the tables.

1,000 Yard Range		3,500 Yard Range	
Sight Ring	**Speed Component**	**Sight Ring**	**Speed Component**
1st (Inner)	75 knots	1st (Inner)	50 knots
2nd	150 knots	2nd	100 knots
3rd	300 knots	3rd	200 knots
4th (Outer)	450 knots	4th (Outer)	300 knots

C. ALIGNMENT OF SIGHTS

For aligning the sights with the gun, a bore sight and a sight testing target are required. The bore sight consists of two parts, a breech end (298879) and a muzzle end (299205). A sight testing target, **Figure 32** for the Mark 3 Sight and **Figure 33** for the Mark 4 Sight, may be constructed and used after the gun has been placed in service. The target is made to the

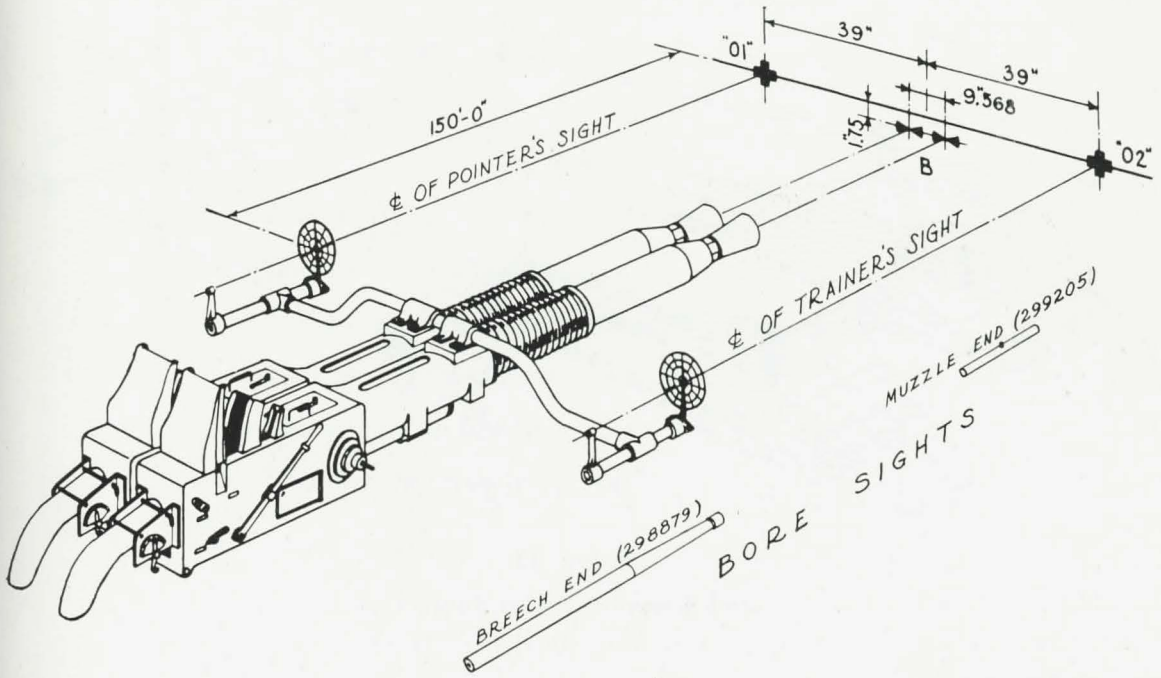


Figure 32

Mark 3 sight alignment diagram.

dimensions shown in the diagram, and placed approximately one hundred fifty feet in front of the gun, at right angles to the gun bore, and with line "01–02" of the target parallel to the center line of the trunnions.

1. Checking the Alignment

To check the alignment of the sights, proceed as follows:

a. Lower the breech block.

b. Remove the case deflector brackets.

c. Insert the two parts of the bore sight.
d. Train and elevate the gun as required until the bore sight is aligned with the corresponding point " B " of the target.

If the sights are properly adjusted, they will be in line with the black crosses. The alignment of the sights should be checked against both gun barrels.

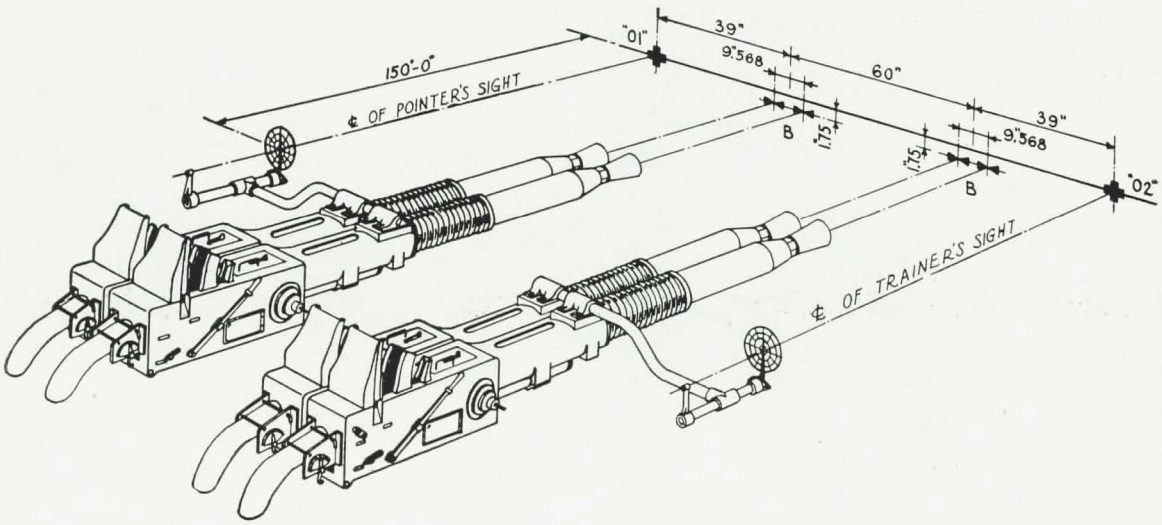


Figure 33
Mark 4 sight alignment diagram.

2. Adjustments

If the sights are not in line, make the following adjustments:

a. Loosen the two lock nuts of the front sight until it can be moved horizontally to a point at which the vertical center line of the sight is in line with the rear sight and the black cross on the target.

b. Tighten the nuts slightly and then turn the adjusting collar until the horizontal center line of the front sight is in line with the rear sight and the black cross on the target.

c. Tighten the lock nuts securely.

Upon completion of the sight check and adjustment, remove the bore sights, and replace the case deflector brackets.

Chapter V

CYCLIC OPERATION

Cyclic Operation of The Gun Mechanism

In automatic fire, one complete cycle of operation occurs approximately every half second. In each cycle the following basic functions are performed:

A live round is fed onto the tray.
The rammer is cocked.
The round is rammed into the barrel chamber.
The breech is closed.
The round is fired.
The empty case is ejected.

These basic functions are shown step by step in the following diagrams, following a round through the complete cycle from feeding to ejection. In these diagrams, the cool colors (green and blue) are used to indicate the parts of the gun mechanism that move in recoil, while the warm colors (red, orange, and yellow) are used to indicate other moving parts.

A. FEEDING THE ROUND

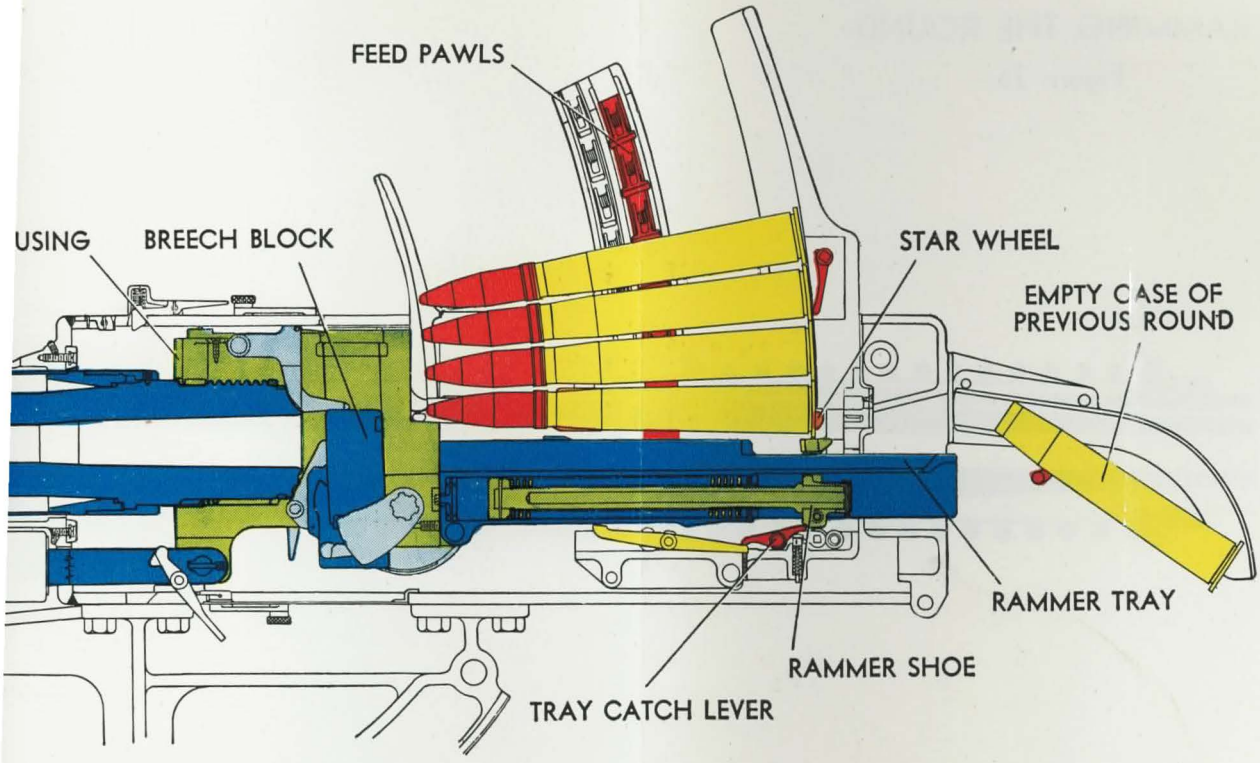
Figure 34

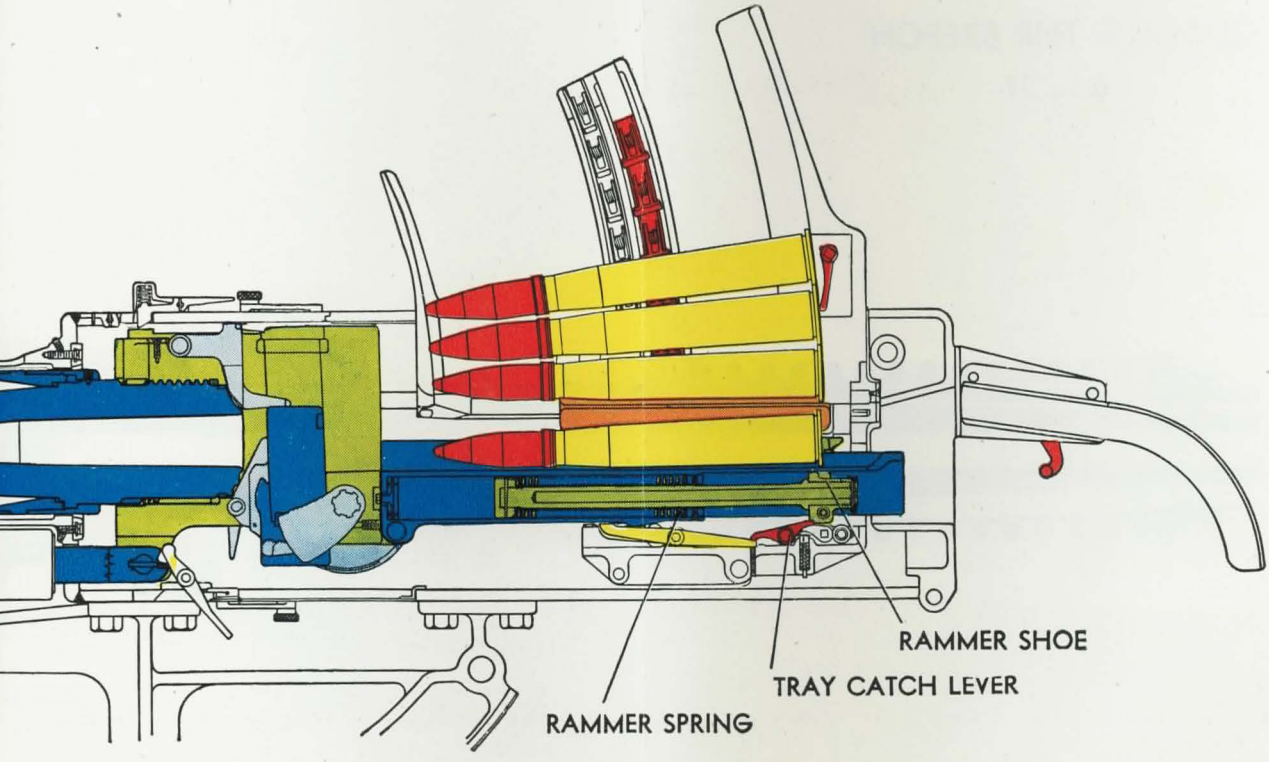
The barrel assembly, breech mechanism, and tray are moving forward in counterrecoil. The breech block is held down by the extractors, and the rammer shoe is held back by the tray catch lever. The star wheels are released, the catch heads of the catch mechanisms having been tripped by the rammer tray pawls. The feed pawls, due to the action of the tray guides, are pressing the rounds down. This forces the bottom round between the star wheels and onto the tray.

B. COCKING THE RAMMER

Figure 35

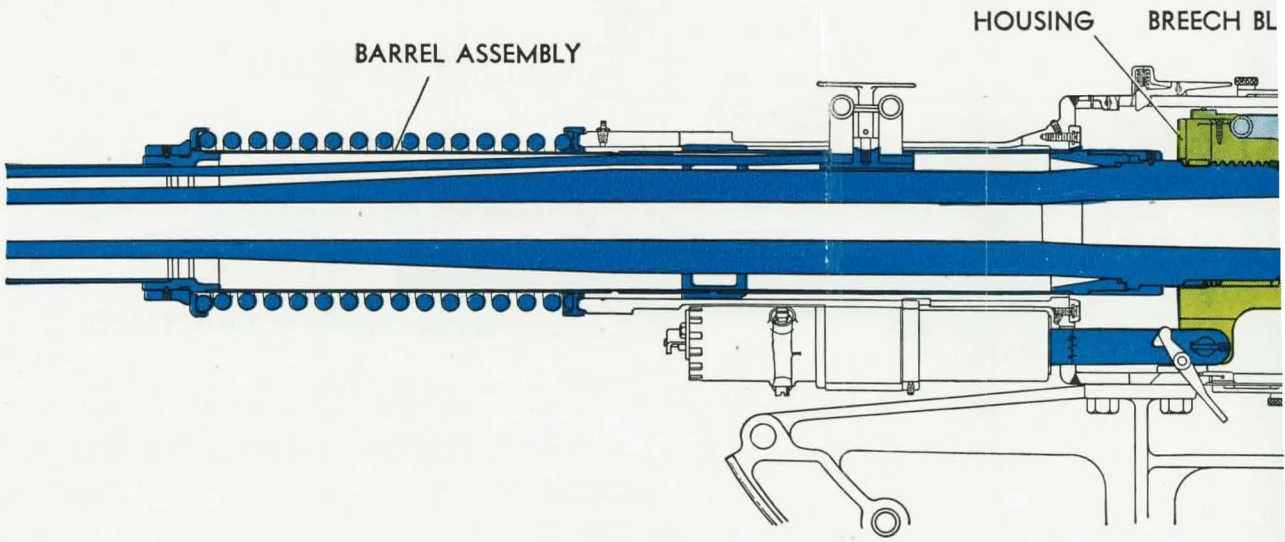
The barrel assembly, breech mechanism, and tray are still moving forward in counterrecoil and have almost reached battery position. The live round is now on the tray with its base in the slots of the rammer levers. The rammer shoe is being held back by the tray catch lever, and as the tray moves forward, the rammer spring is compressed, cocking the rammer. The trigger catch lever is held down by the trigger mechanism, and the loader catch lever is held down by the rounds in the loader. This leaves only the tray catch lever holding the rammer shoe.


FEED PAWLS
USING
BREECH BLOCK
STAR WHEEL
EMPTY CASE OF
PREVIOUS ROUND
RAMMER TRAY
RAMMER SHOE
TRAY CATCH LEVER


RAMMER SHOE
TRAY CATCH LEVER
RAMMER SPRING

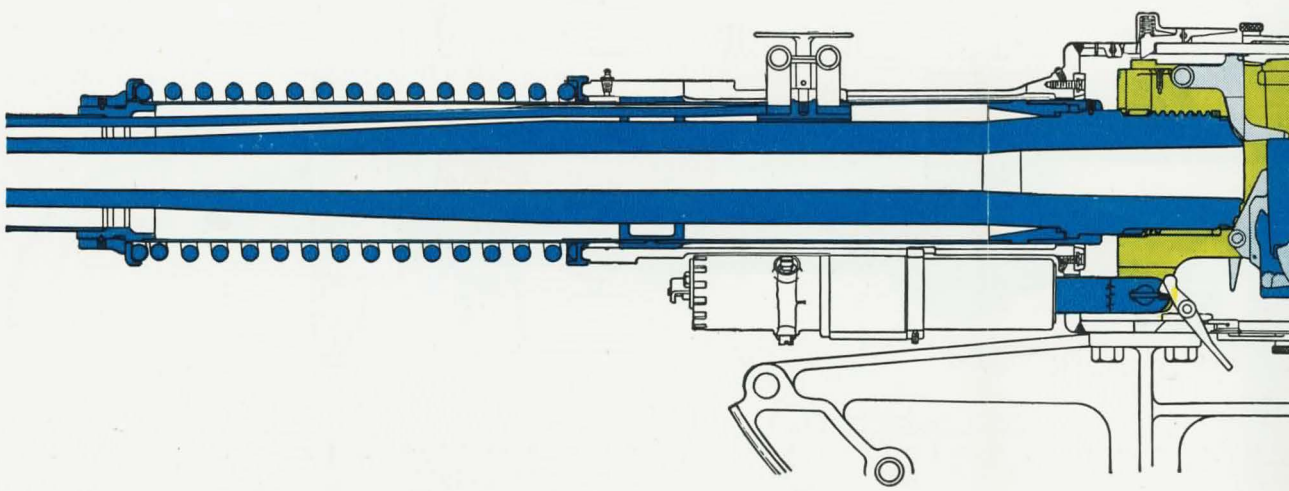
FEEDING THE ROUND

Figure 34



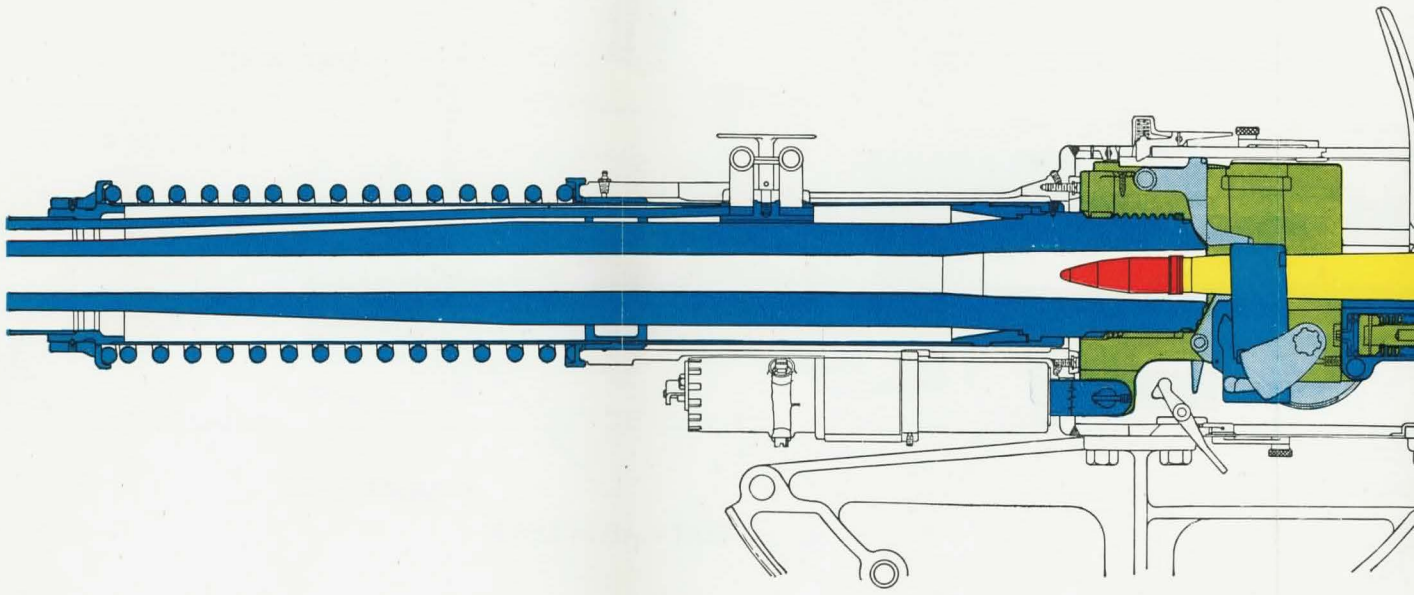
COCKING THE RAMMER

Figure 35



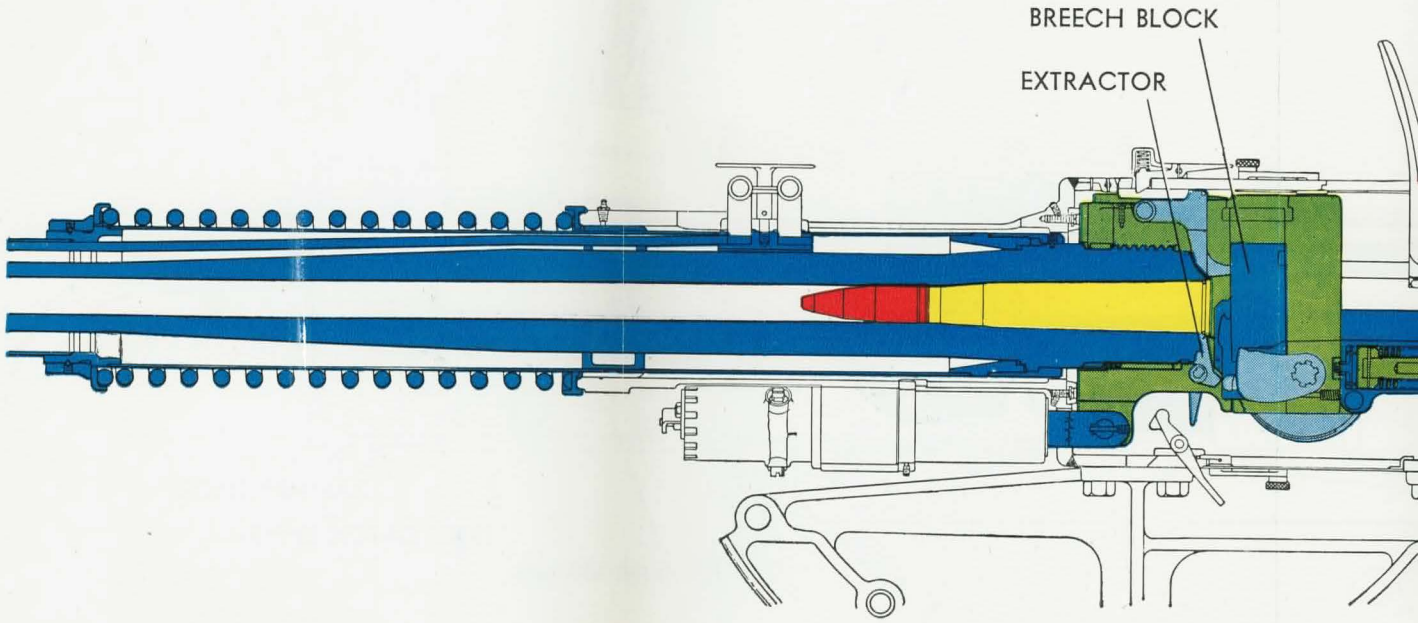
RAMMING THE ROUND

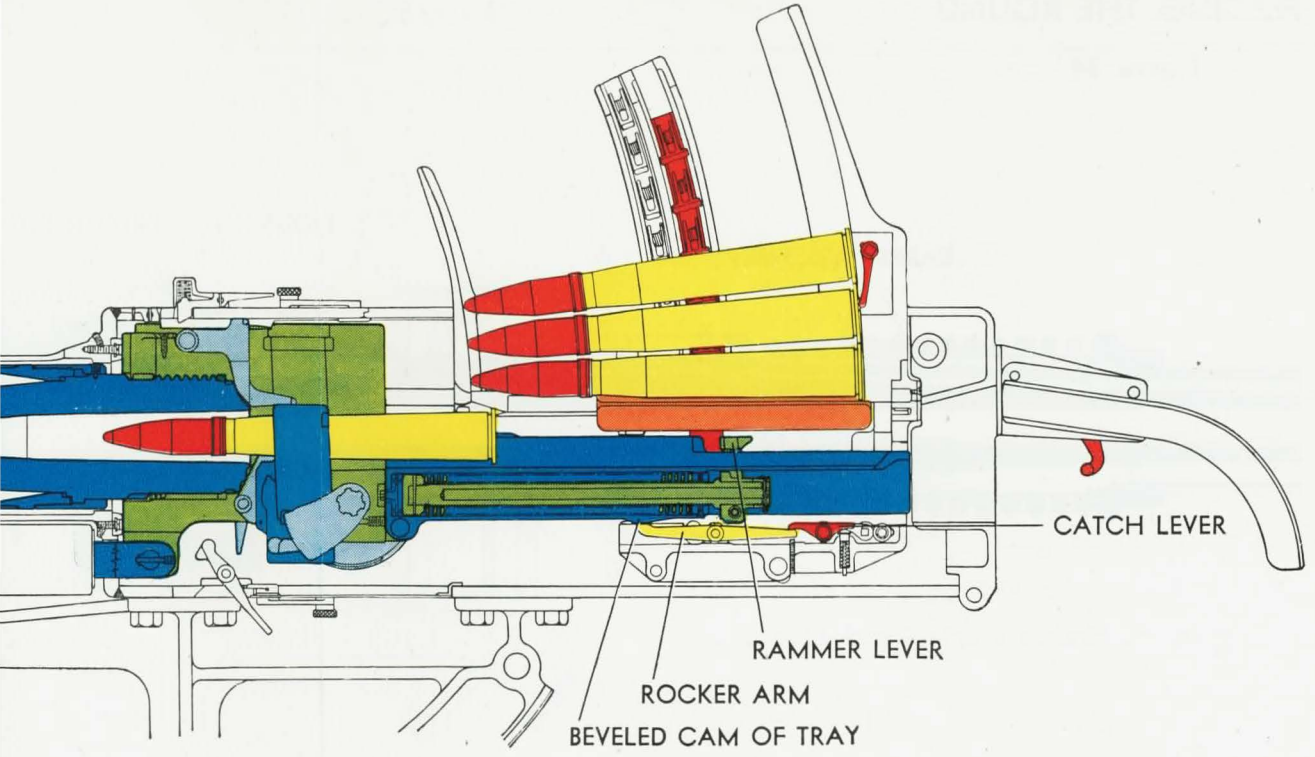
Figure 36

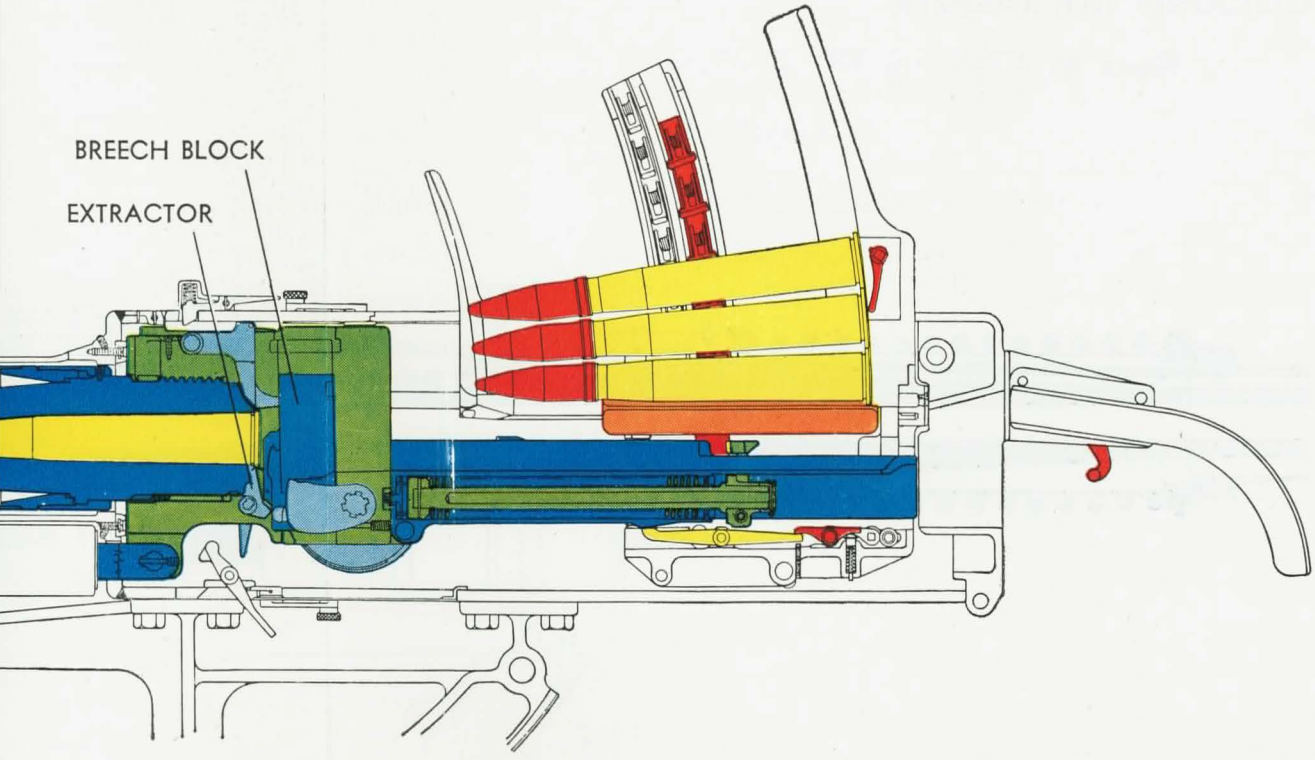


CLOSING THE BREECH

Figure 37




CATCH LEVER
RAMMER LEVER
ROCKER ARM
BEVELED CAM OF TRAY


BREECH BLOCK
EXTRACTOR

C. RAMMING THE ROUND

Figure 36

The parts that were moving forward in counterrecoil have now reached battery position. The beveled cam on the under side of the tray has ridden over the forward end of the rocker arm, tripping the tray catch lever, thus allowing the rammer shoe and levers to be thrown forward by the action of the rammer spring. As the rammer levers neared the forward limit of their travel, they were spread apart by the cam slots of the tray through which they extend. This allows the round to continue its travel and be thrown into the barrel chamber.

D. CLOSING THE BREECH

Figure 37

The round is completely in the chamber and the closing spring is raising the breech block to the closed position. The breech block is free to rise, because the extractors were unhooked from the block by the base of the round as it was thrown into the chamber. As the block rises, pressure of the cam on the left inner crank is removed from the outer cocking lever. The firing pin is being held back only by the inner cocking lever which is prevented from moving by the sear.

E. FIRING THE ROUND

Figure 38

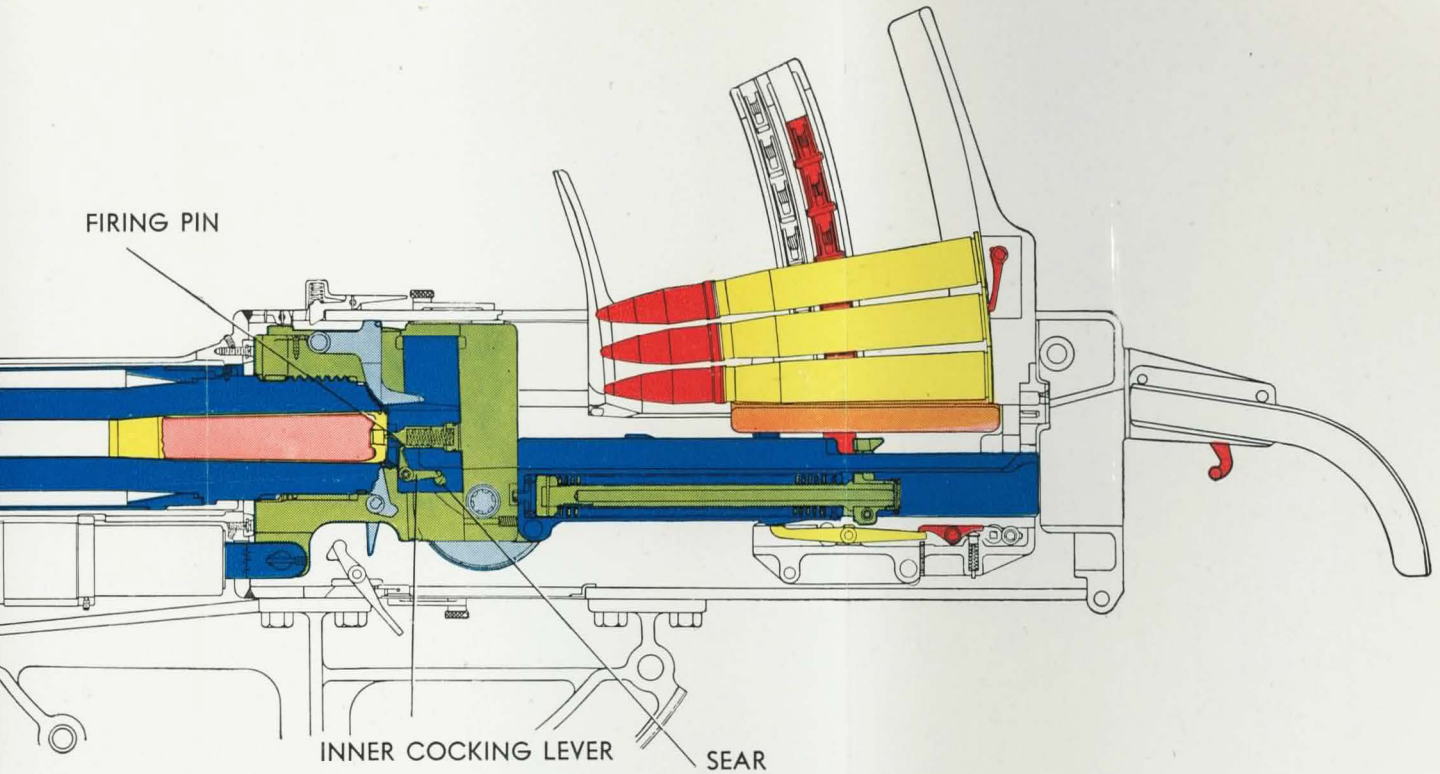
The breech is completely closed and the round is fired. Firing occurs after the breech is closed, by the action of the cam of the right inner crank upon the sear. The cam forces the sear inward, releasing the inner cocking lever and the firing pin. The firing pin strikes the primer, which explodes the propellant charge of the round.

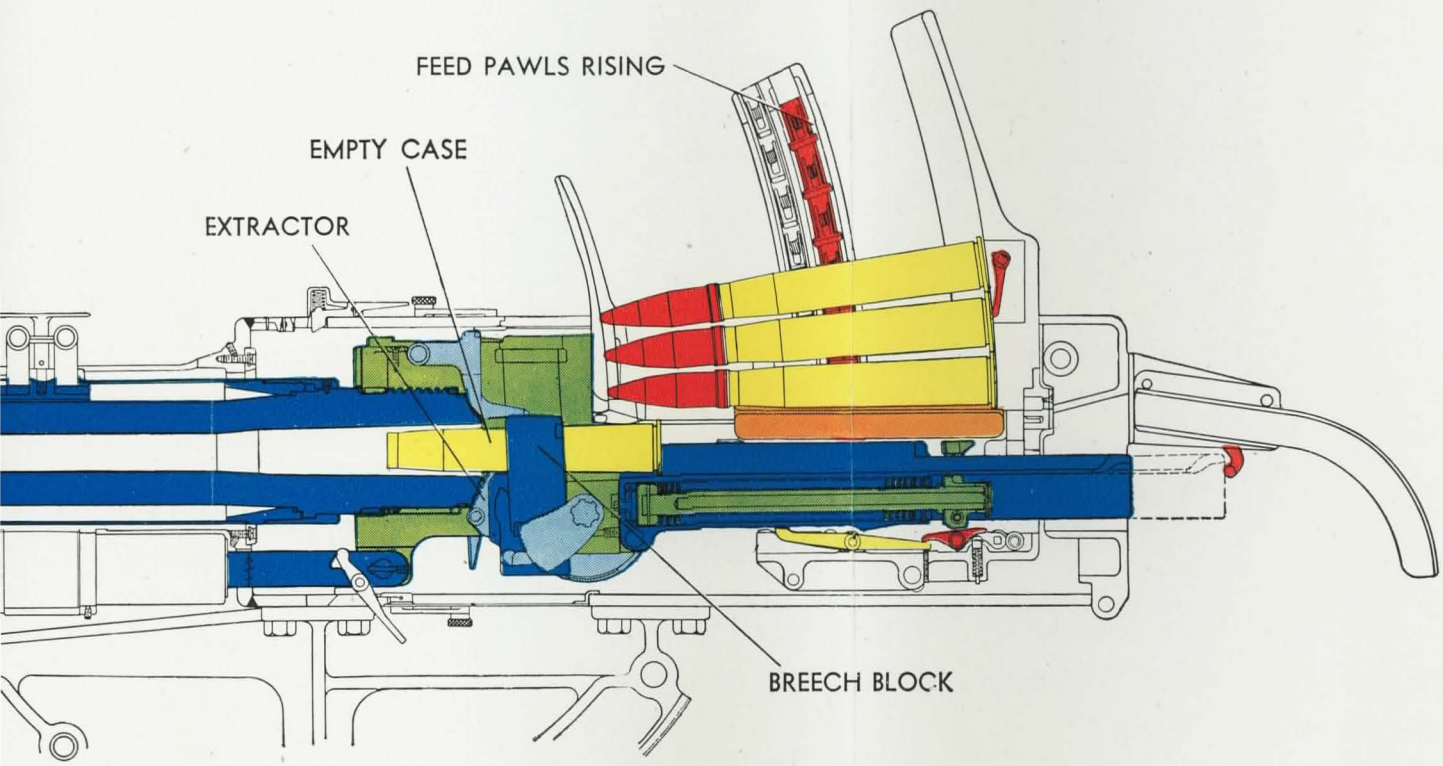
F. EJECTING THE CASE

Figure 39

The barrel assembly, breech mechanism, and tray are moving rearward as a result of the momentum imparted by the powder pressure at the beginning of recoil. The breech block is in the open position, the outer and inner cranks having been rotated by action of the roller, riding against the cam surface of the side door. The firing pin is cocked by action of the cam of the left inner crank depressing the outer cocking lever. As the breech block descended, it struck the toes of the extractors, ejecting the empty case. The feed pawls, due to the action of the tray guides, are rising in order to feed the next round onto the tray.

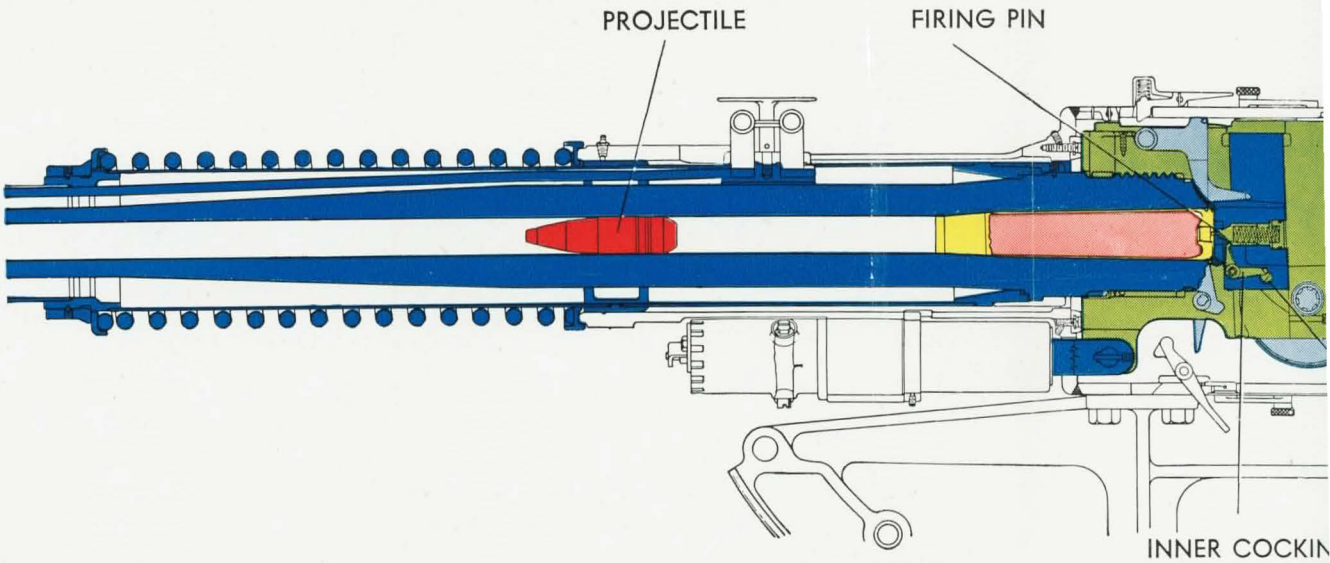
A complete cycle has now taken place, and the action repeats itself in automatic fire as long as the loader is supplied with ammunition and the trigger mechanism is held in the firing position.


FIRING PIN
INNER COCKING LEVER
SEAR


FEED PAWLS RISING
EMPTY CASE
EXTRACTOR
BREECH BLOCK

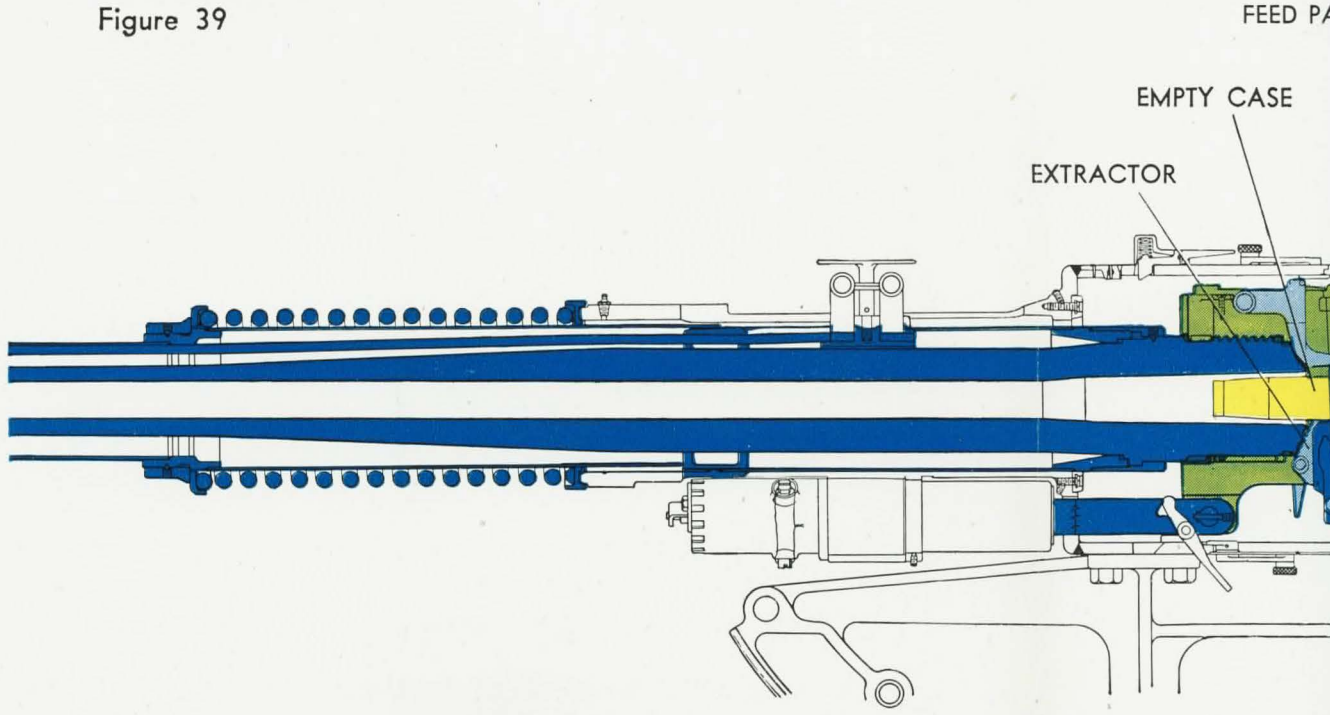
FIRING THE ROUND

Figure 38



EJECTING THE CASE

Figure 39



Chapter VI

LOADING AND UNLOADING

A. INSTRUCTIONS FOR LOADING

1. Put the firing selector lever on SAFE.

2. Move the hand operating lever all the way to the rear, then latch it in the rear catch bracket.

3. Push a full clip into the loader, so that one round drops onto the rammer tray. When the clip is pushed in far enough to accomplish this, the empty clip will be ejected through the clip chute. Place another full clip in the loader.

4. Move the hand operating lever forward and latch it in the forward catch bracket.

5. See that the feed control thumb lever on the loader rear guide, if provided, is in the position indicated by the red arrow.

6. Place the firing selector lever on AUTO FIRE or SINGLE FIRE as desired.

7. **a.** Hold the firing pedal of the mount down for automatic fire.
   b. Press the firing pedal smartly for each shot in single fire.

8. Keep the loader filled.

   The loader catch lever will stop operation, with the rammer shoe cocked, when only two rounds remain, one on the tray and one on the star wheels. The gun mechanism is then in condition to resume automatic fire when the loader is refilled, without further manipulation of the hand operating lever.

B. INSTRUCTIONS FOR UNLOADING

1. Place the firing selector lever on SAFE.

2. Elevate the gun to about 30 degrees.

3. Move the hand operating lever all the way to the rear, making sure an assistant catches the live round thus released from the rammer levers, as the round slides through the opening in the rear door.

4. Place the hand operating lever in the rear catch bracket.

5. Install the round releasing tool (298899) in the side frames, **Figure 40,** compressing the feed and stop pawls.

6. Lift out the rounds which have been released. Remove the round releasing tool.

7. Using the pusher tool (298876), **Figure 41,** force the round on the star wheels down on to the rammer tray. Remove the round.

8. Move the hand operating lever fully forward to release the star wheel catch mechanisms, and then latch it in the rear catch bracket.

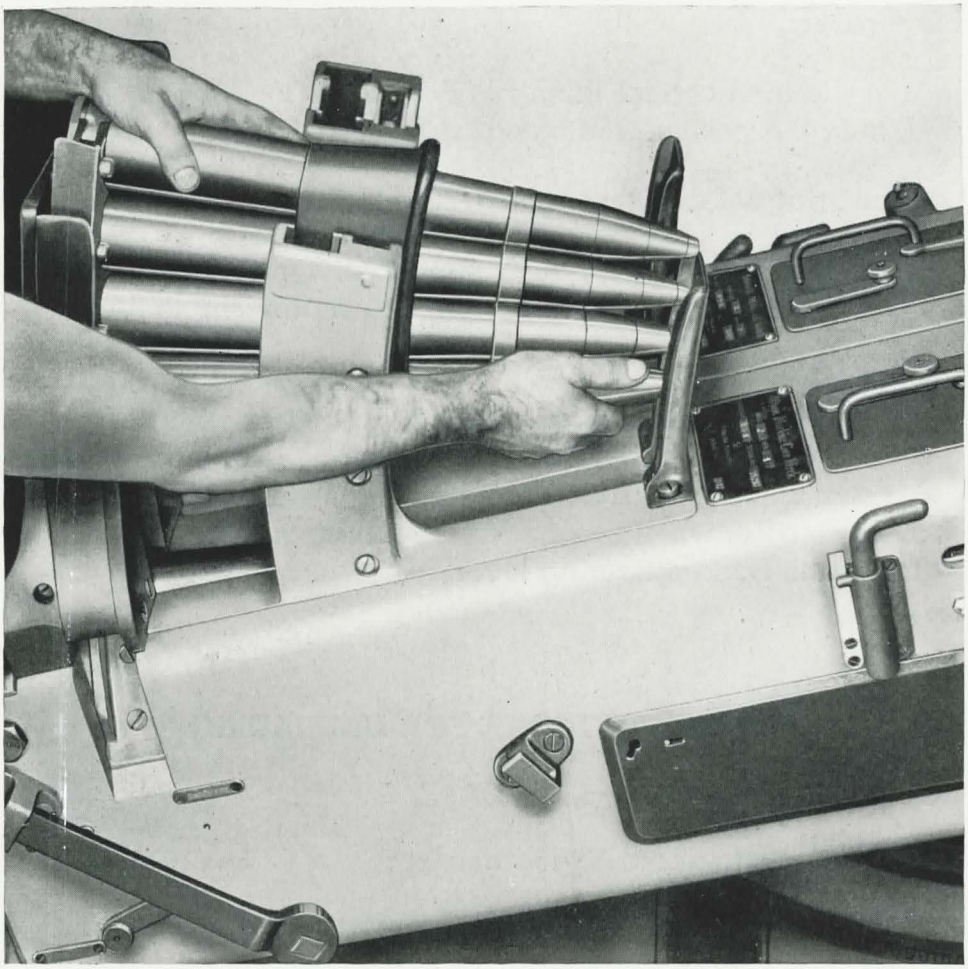


Figure 40

Using the round releasing tool.

9. Use the pusher tool to force the last round through the star wheels on to the tray. Remove the round as before.

10. When the loader is empty, secure the hand operating lever in the forward catch bracket. Trip the extractors with the extractor release lever to close the breech block.

11. Depress the feed control lever in the rear guide and then release it. This operation will release the rammer shoe from the loader catch lever. Place the firing selector lever at either firing position. Press the firing pedal of the mount smartly to release the rammer shoe from the trigger catch lever.

12. Place the firing selector lever on SAFE.

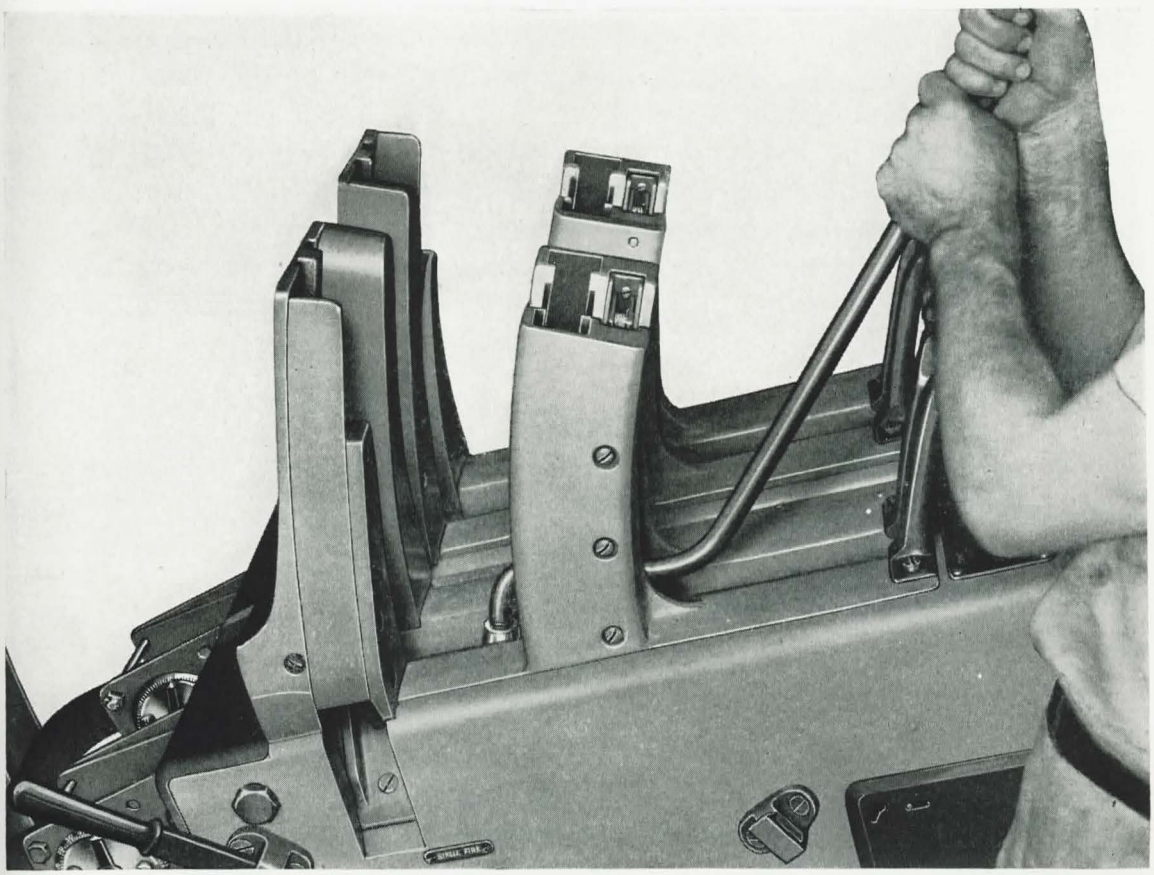


Figure 41

Using the pusher tool.

Chapter VII

CASUALTIES

In the event of a casualty, the greatest care should be exercised to insure that no actions are taken which can result in injury to personnel or material. It is important to understand that a round in the chamber can be fired unexpectedly even with the firing selector lever on SAFE, if for any reason the breech block has failed to close.

A. CASUALTIES WHICH CAN BE CORRECTED QUICKLY AND EASILY

1. Clip Placed in Loader Improperly

The most common loader failure is caused by jammed rounds, resulting from a clip not being passed into the loader properly. To free the rounds thus jammed, insert the round releasing tool (298899) in the loader to hold back the feed and stop pawls. Rounds in the upper part of the loader can then be cleared by hand. Either end of the pusher tool (298876) may be carefully used to pry the jammed rounds loose. Properly loaded rounds should be free enough to be removed by hand. Firing will continue when a new clip is placed in the loader.

2. Firing Pedal Not Fully Depressed

Depress the firing pedal fully. If the gun fires, no further examination is required.

B. OTHER CASUALTIES

1. Live Round Drops Out Into Case Chute

Open the top door.

a. **If the breech block is latched down by the extractors and the empty case has been ejected,** trip the extractor release lever. Closing of the breech block indicates that the breech block closing spring is not broken. Follow the normal loading procedure and continue firing. Casualties of this nature have occurred with no parts damaged and through no fault of the operator.

b. If the breech block is in the closed position, and a round is in the chamber, it is likely that it has failed to extract, but that recoil and counterrecoil were completed, and the ejected live round was rammed against the rear face of the closed breech block. **Examination of the mechanism will probably show that the crankshaft in the housing is twisted or that the extractors are broken.**

2. Live Round In the Gun or On the Rammer Tray

Place the firing selector lever at SAFE. Remove the bottom cover of the slide.

a. If the breech block is down, insert the breech block locking bolt, and then open the top door. Never open the top door when it is possible for the gun to fire. Remove the round through the rear door, and examine the mechanism for damaged parts, such as, broken extractors, twisted crankshaft, broken breech block closing spring, broken rammer rod or spring. Examine the round to determine, if possible, the cause of the trouble. If the gun was at a low angle of elevation when this stoppage occurred, it may have been the same type of casualty as the one described in **1. a.** above, when a live round dropped out into the case chute.

b. If the breech block is closed, and if examination of the tray through the opening in the rear door,—without removing the case deflector,—**discloses a live round on the tray,** the case in the chamber is presumably empty, and the casualty should be treated as in paragraph **1. b.** above, after removal of the live round.

c. If the breech block is closed and a live round is not on the tray or in the case chute, and examination through the bottom opening in the slide shows the base of a case in the gun, a misfire has occurred and the procedure will be governed by the applicable Naval Regulations. If the breech block is not fully closed for any reason, the firing pin will not be released at all. **In such cases, the breech block may slowly close itself and fire the gun after an apparent misfire,** by wedging action of the breech block finally seating a round in a dirty chamber, by slow action of a gummy breech block, etc. A situation of this kind can usually be determined by examination of the sear in the bottom of the breech block.

(1) **If the sear is to the left,** that is, the head of the sear is fully in the mating slot, the firing pin has been released and the casualty is probably a misfire.

(2) **If the sear is to the right,** that is, the head of the sear is not fully in the mating slot and is adjacent to the right inner crank, the firing pin probably has not been released **but the casualty should be treated as a misfire until definite knowledge to the contrary has been determined.** After removal of the round **in accordance with Naval Regulations,** the mechanism should be examined and tested for free operation of all parts.

3. Live Round Still Above Star Wheels

a. If a round is not on the rammer tray, in the chamber or has not dropped out into the case chute, **feeding through the star wheels may have been prevented by a jammed round in the loader.** In such case the feed pawl safety mechanism has operated. Remove the jammed and other rounds, force or hammer the feed pawls down into their normal positions, and follow the normal loading procedure. Failure to feed may also result from short recoil or a twisted crankshaft in the housing. Either condition may cause slow ejection of the empty case, which will not clear the star wheels in time to permit feeding of the next round.

b. **If recoil is too short**—less than about seven inches—feeding will be definitely prevented because the catches will not be released. If short recoil is the result of low temperature operation, firing of several rounds may warm the fluid in the recoil cylinder sufficiently to permit automatic operation. Certain of the mechanisms have throttling rods which may prevent sufficient recoil to allow reliable cold weather automatic operation. With such throttling rods, one or two ounces of the fluid in the recoil cylinder should be removed, such that recoil with service charge at approximately zero degrees elevation produces a length of recoil between 7.4 and 7.5 inches. This fluid should be replaced when warmer temperatures are encountered.

C. STAR WHEELS LOCKED

If it is not possible to push a round through the star wheels during the normal loading routine, the star wheels are probably locked by the catch mechanisms. Such a condition will result from a sheared taper pin in the bottom of the loader, in which case motion of the hand operating lever will not release the catch mechanisms. The remedy is to replace the taper pin. However, the gun may be fired normally and safely, before the taper pin is replaced, by loading the first round as follows:

With the hand operating lever all the way to the rear so that the rammer levers are moved to the rear and spread, carefully place a live round on the tray through the rear door opening. Move the hand operating lever slowly forward, at the same time maintaining the round in such a position that the base of the case will be caught in the slots in the rammer levers. The mechanism may then be operated normally.

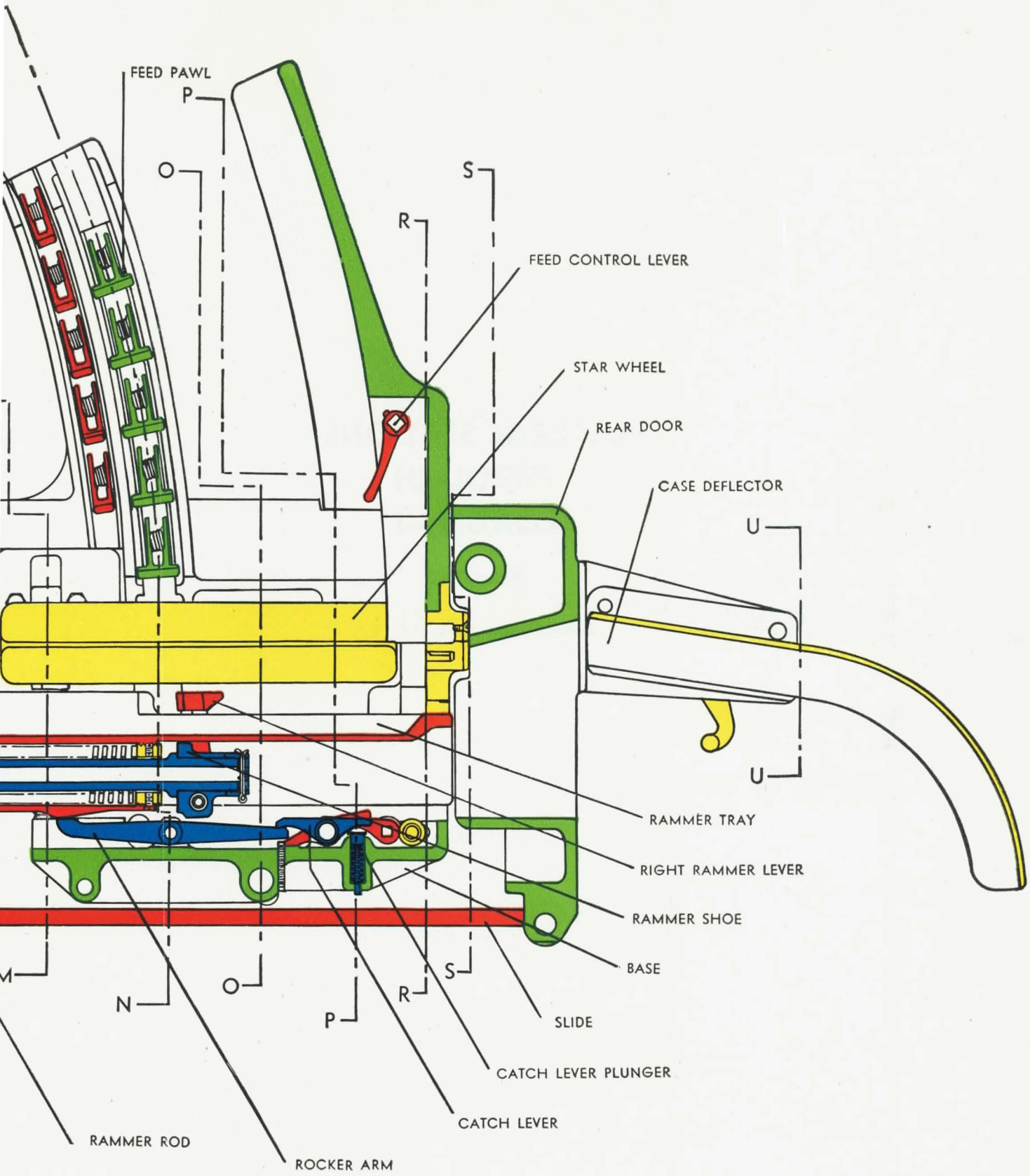
D. LONG RECOIL

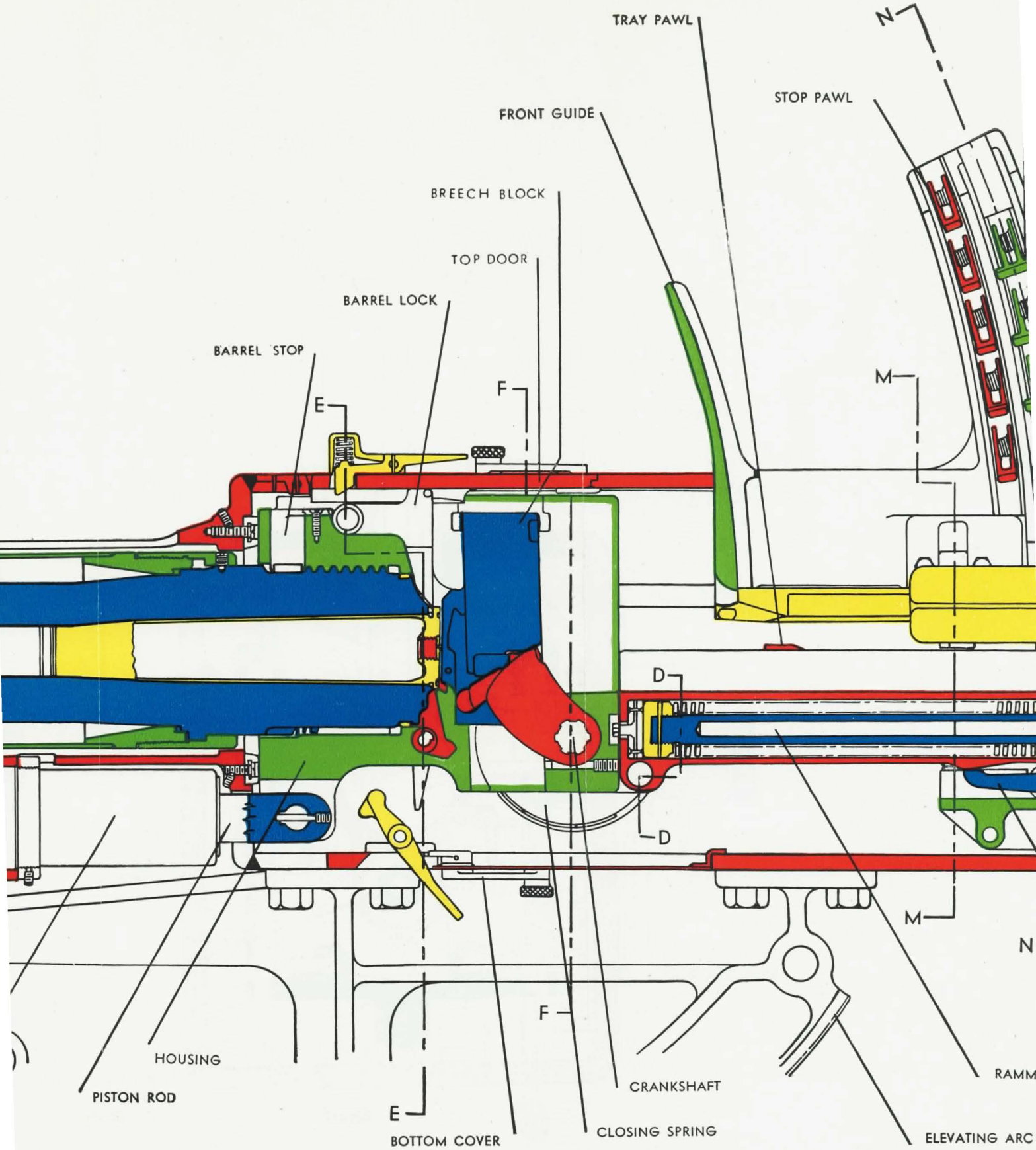
Long recoil will not cause stoppage but may cause excessive stresses in the mechanism. Tests indicate that with the present design of throttling rod and bushing a length of recoil in excess of about 8.3 inches is not practically attainable. However, if this maximum length of recoil is obtained, it is probable that excessive pressures are being developed in the recoil cylinder, and therefore, excessive stresses are being developed elsewhere in the mechanism. **The recoil cylinder should be examined to determine if it has sufficient fluid.**

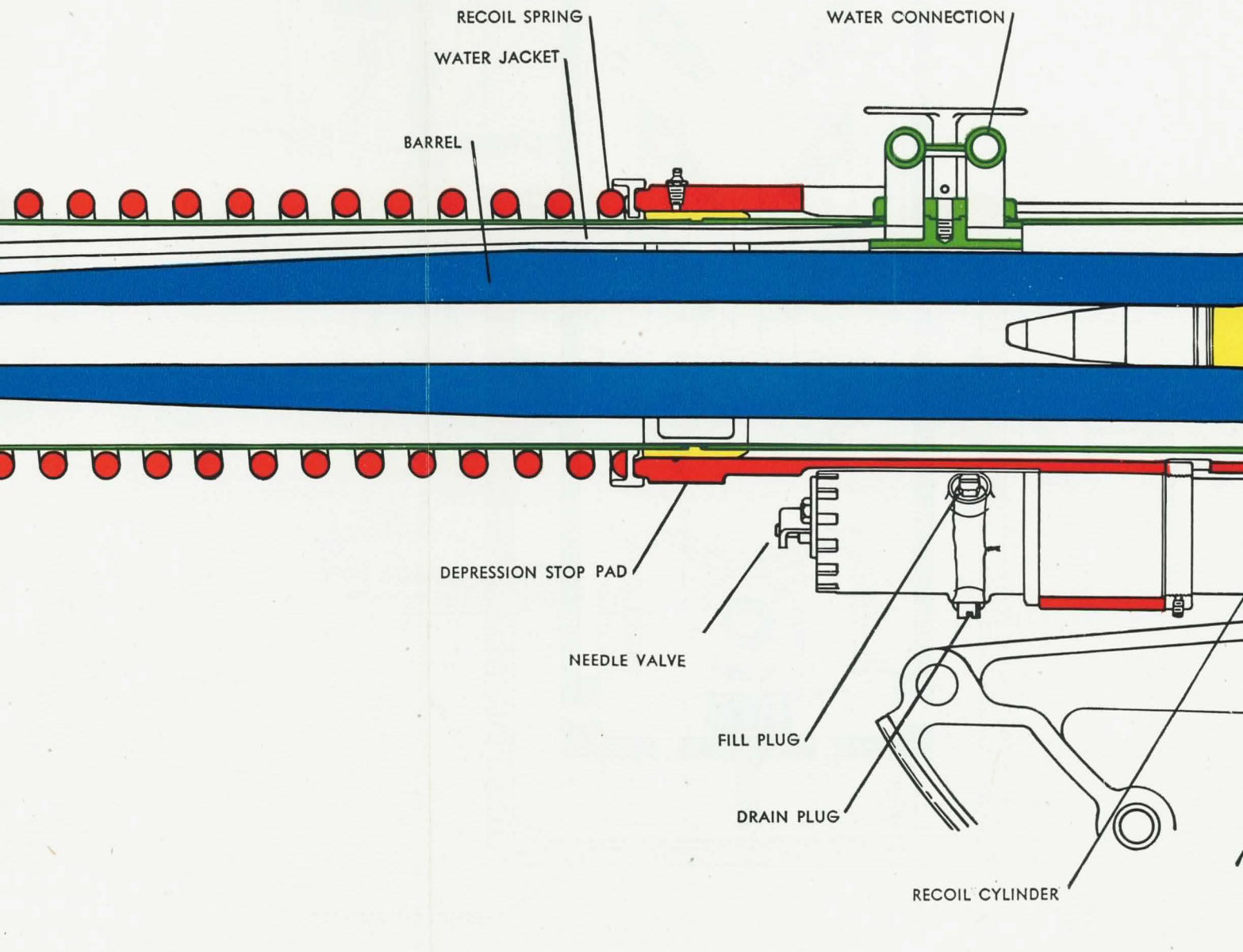
E. TWISTED CRANKSHAFT

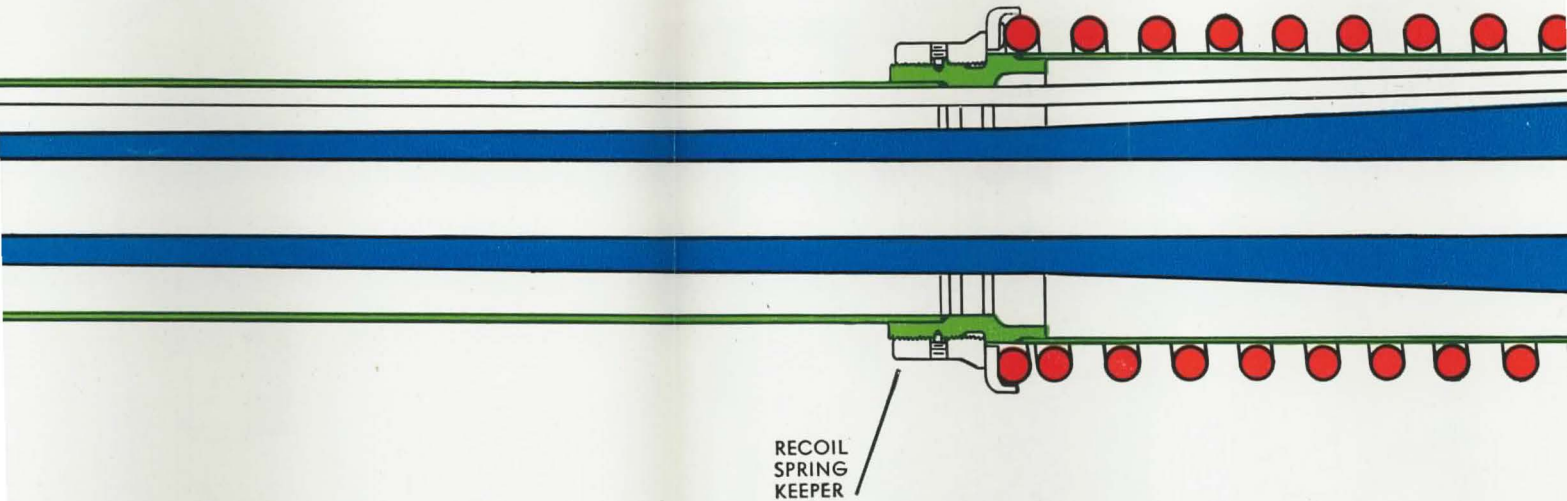
An angular displacement of the housing outer crank of about five degrees, an amount readily detected, from the normal position when the breech block is closed is sufficient to make satisfactory operation doubtful. A twist of approximately eleven degrees will result in no motion of the extractors when the breech block is pulled down. In such case the crankshaft should be replaced. If the extractors are broken, they should be replaced. Even if only one extractor is broken, both should be replaced.

Twisting of the shaft may have developed gradually or may have occurred suddenly during the firing of the last round. If the casualty resulted from a single tight case, it could not have been foreseen. As a precautionary measure, the crankshaft should be examined periodically for this twisted condition. A slow speed of extraction of the empty cartridge case, resulting in a jam on the tray between the ejected case and the next round, is a danger signal that a twisted shaft may be developing. Recoil of less than about 7.2 inches may give the same result.


FEED PAWL
P
O
S
R
FEED CONTROL LEVER
STAR WHEEL
REAR DOOR
CASE DEFLECTOR
U
U
RAMMER TRAY
RIGHT RAMMER LEVER
RAMMER SHOE
BASE
SLIDE
CATCH LEVER PLUNGER
CATCH LEVER
ROCKER ARM
RAMMER ROD
M
N
O
P
R
S
ELEVATING ARC


TRAY PAWL
N
STOP PAWL
FRONT GUIDE
BREECH BLOCK
TOP DOOR
BARREL LOCK
BARREL STOP
E
F
M
D
D
M
N
F
HOUSING
PISTON ROD
E
BOTTOM COVER
CRANKSHAFT
CLOSING SPRING
RAMM
ELEVATING ARC

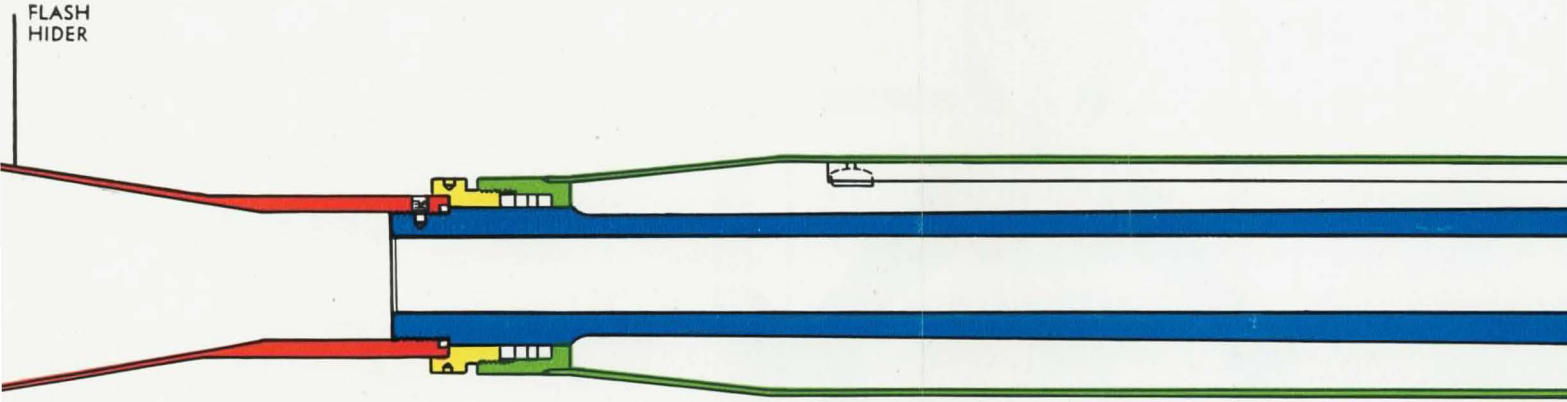

RECOIL SPRING
WATER JACKET
BARREL
WATER CONNECTION
DEPRESSION STOP PAD
NEEDLE VALVE
FILL PLUG
DRAIN PLUG
RECOIL CYLINDER


RECOIL
SPRING
KEEPER

LONGITUDINAL SECTION OF GUN

Figure 42

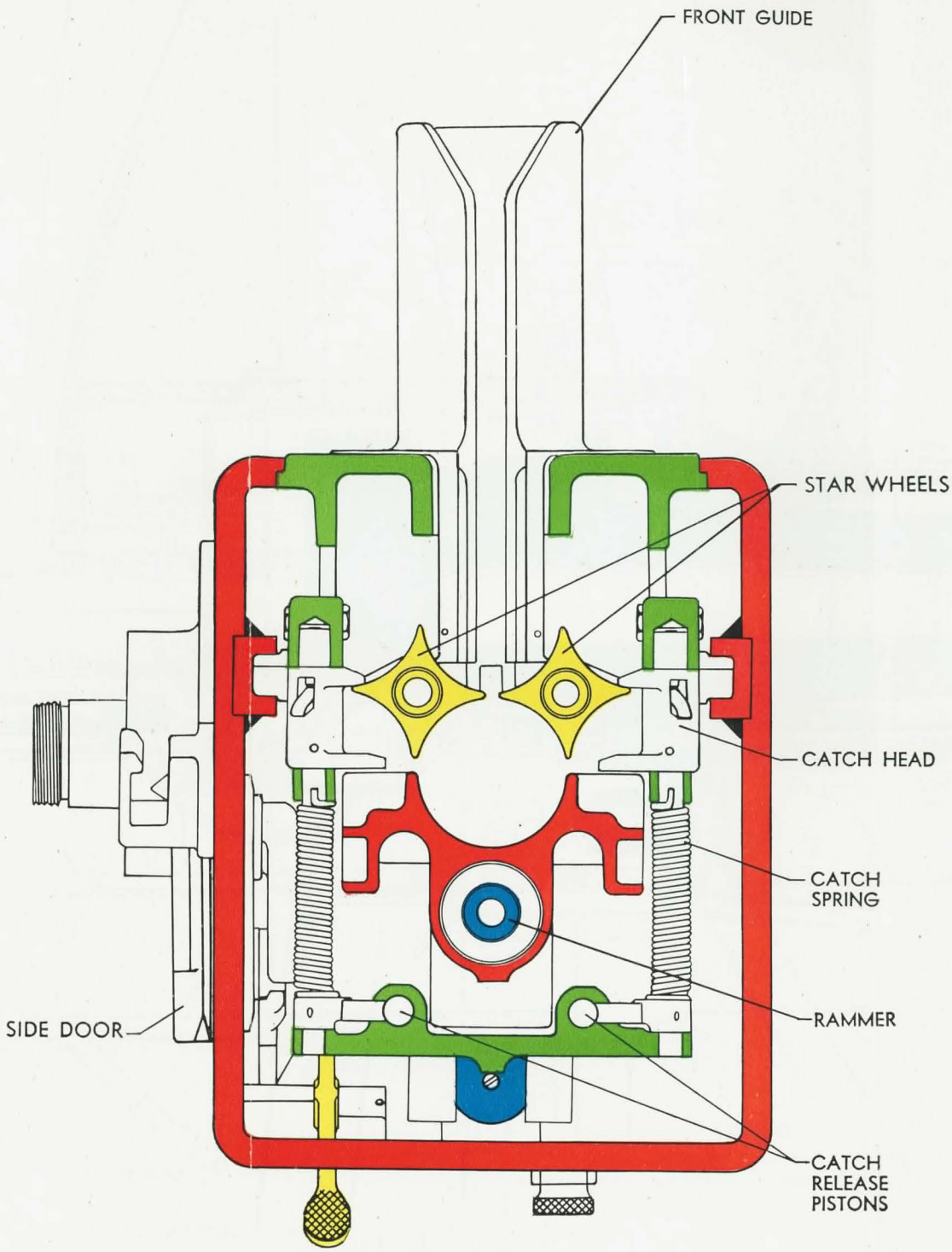
For lateral sections indicated on this drawing, see Figures 43, 44, 45.



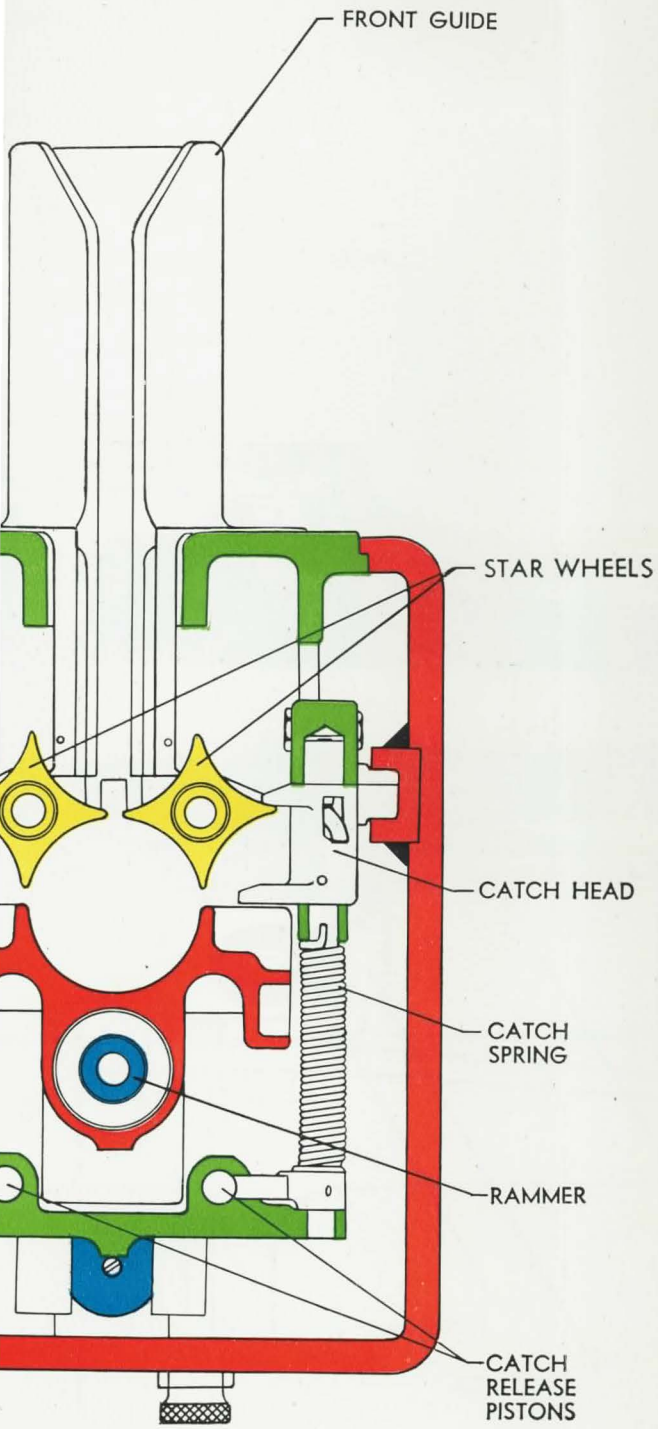
LATERAL SECTIONS THROUGH LOADER–I

Figure 43

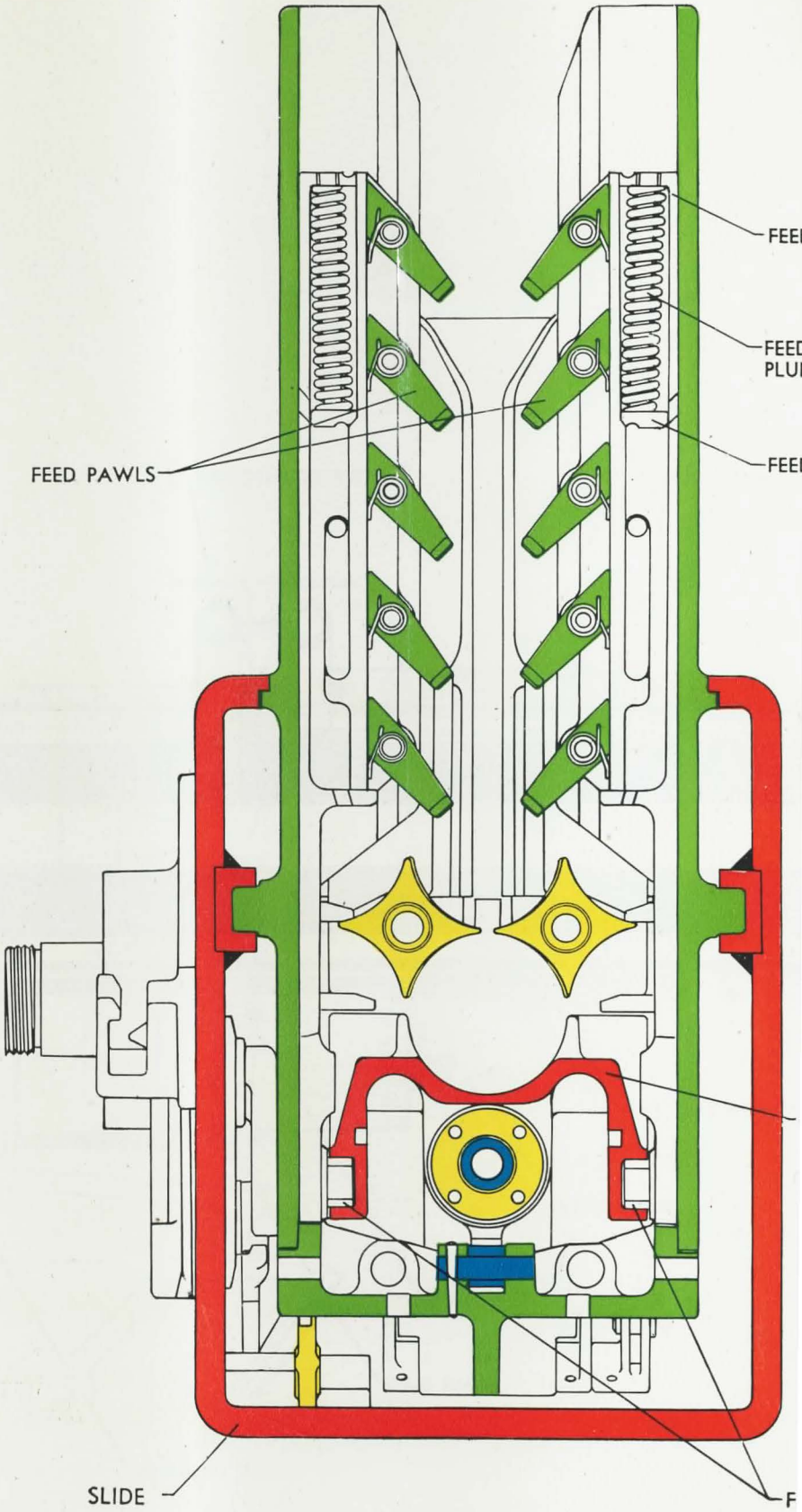
Sections M-M, N-N, O-O, P-P


FRONT GUIDE
STAR WHEELS
CATCH HEAD
CATCH SPRING
RAMMER
SIDE DOOR
CATCH RELEASE PISTONS

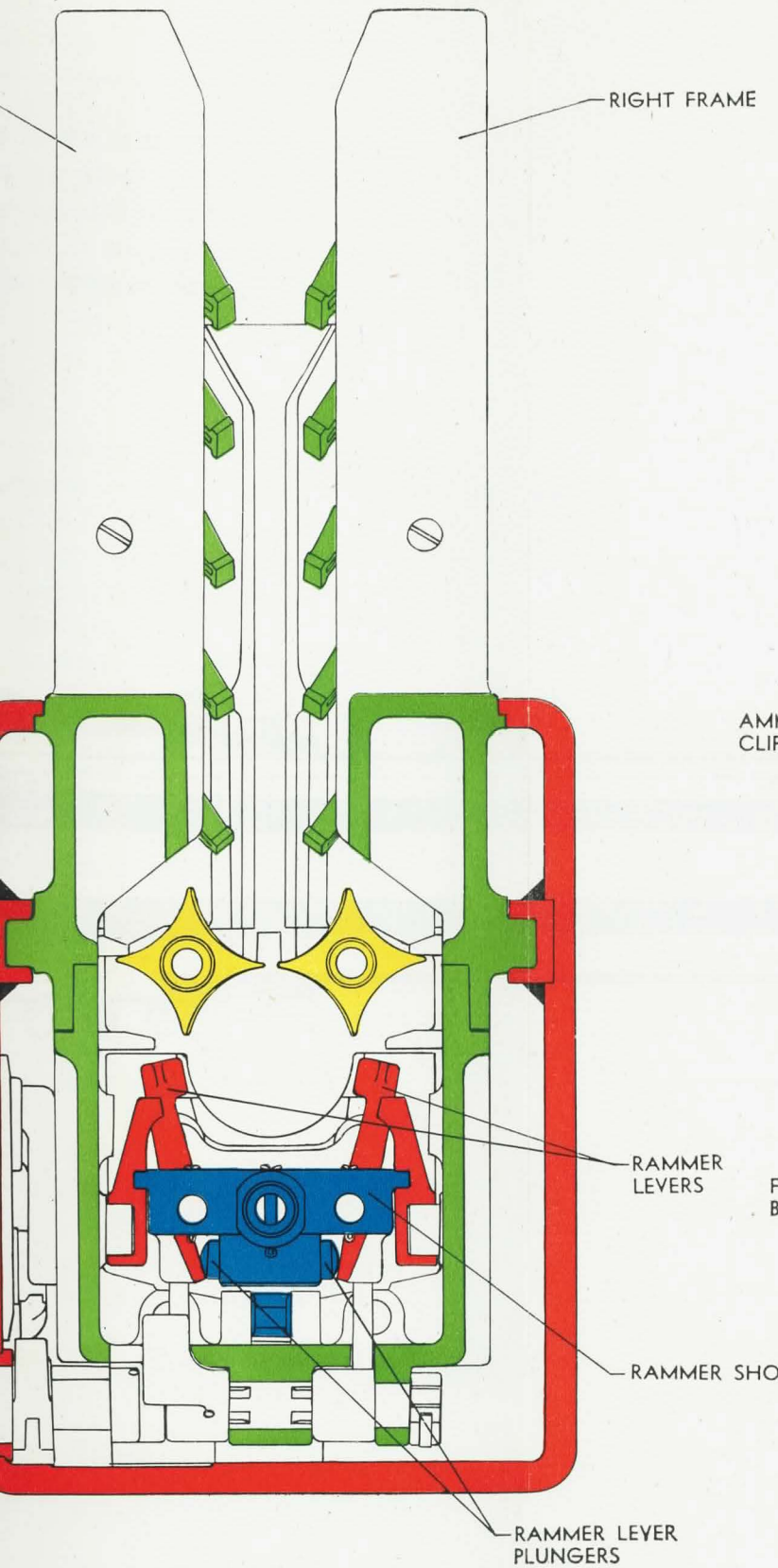
SECTION M-M



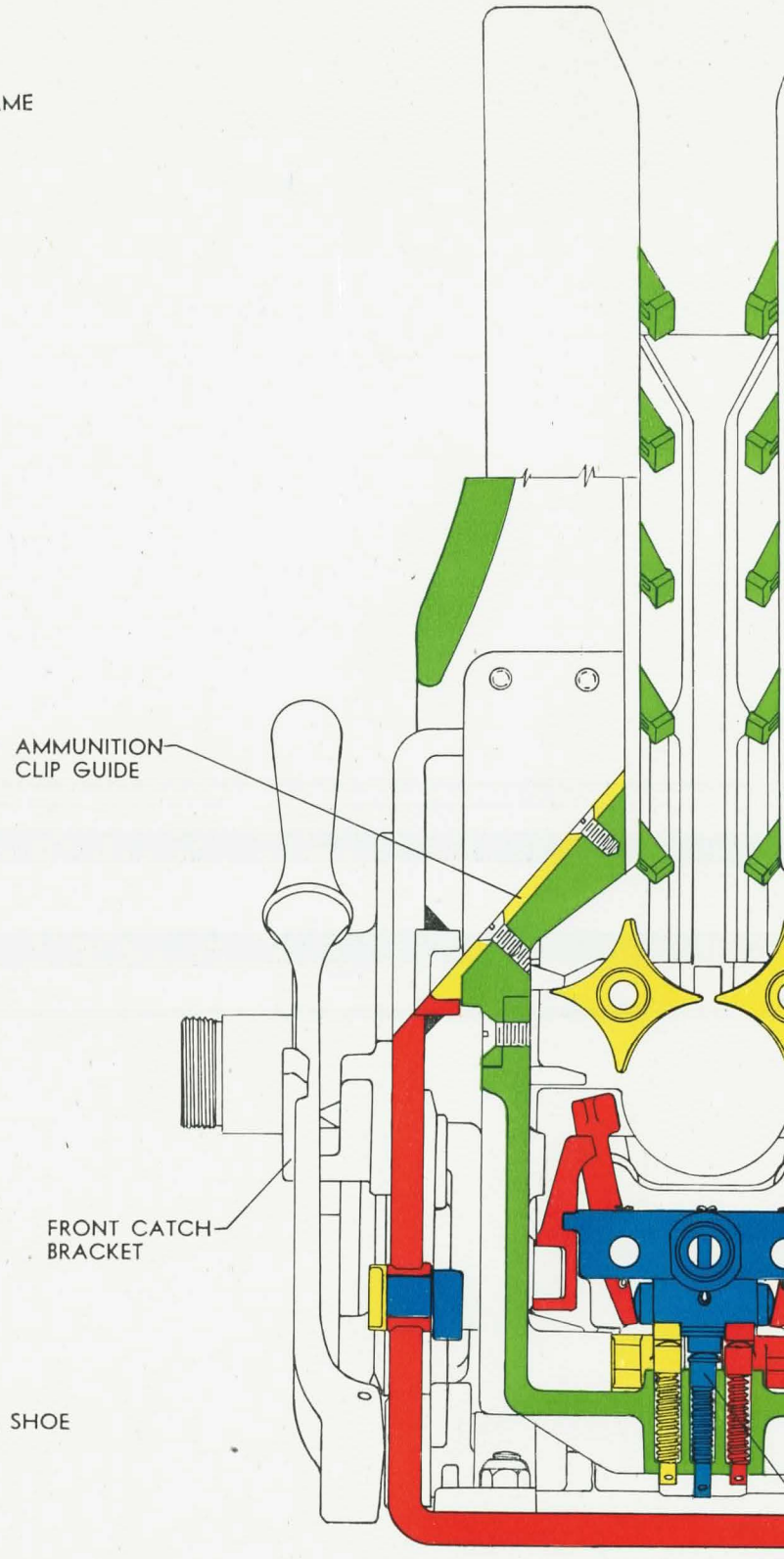
SECTION M-M



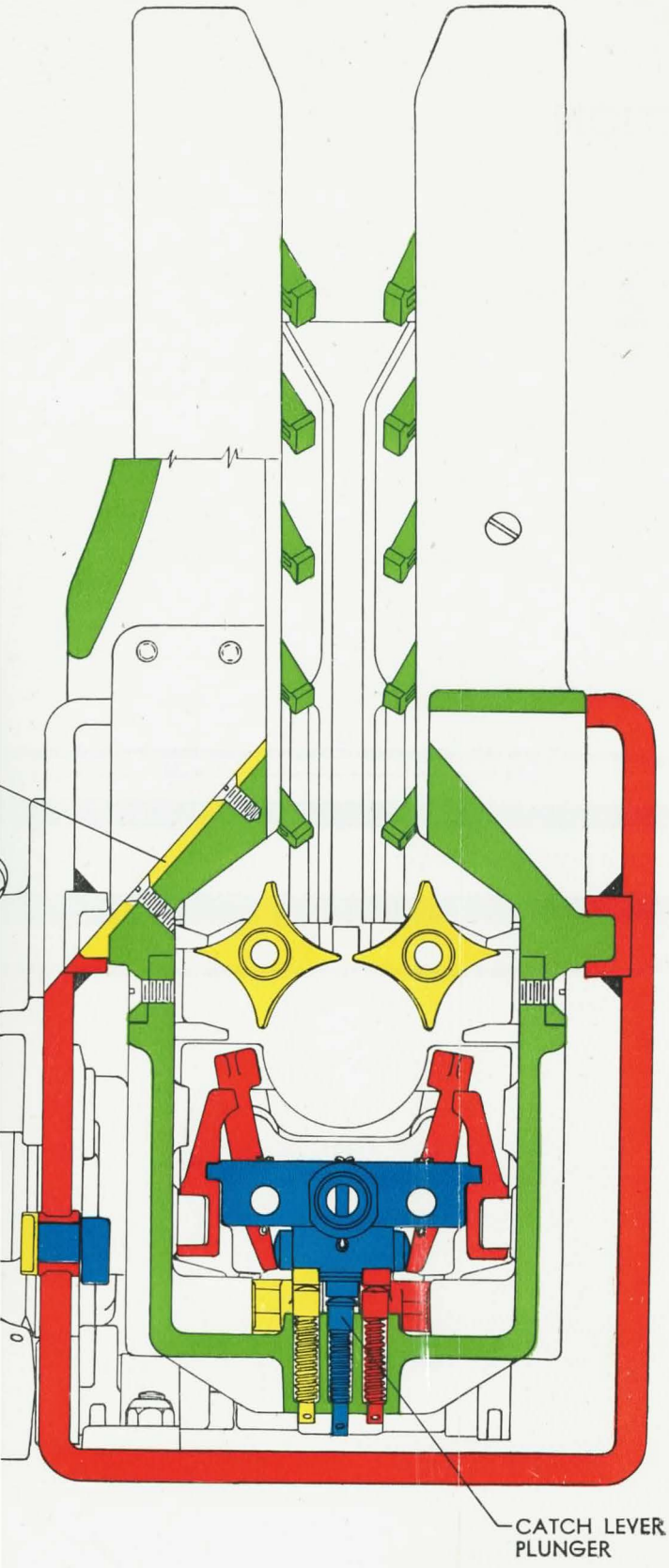
SECTION N-N



SECTION O-O



SECTION P-P

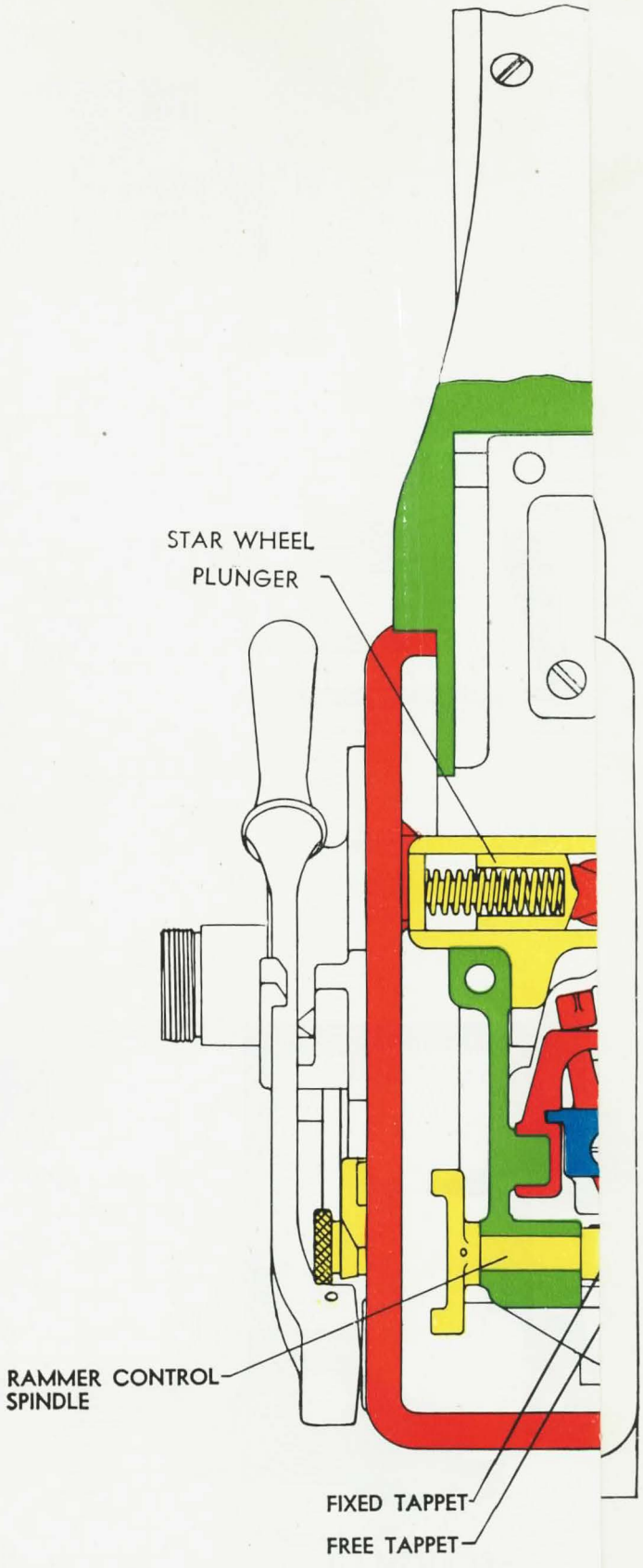


SECTION P-P

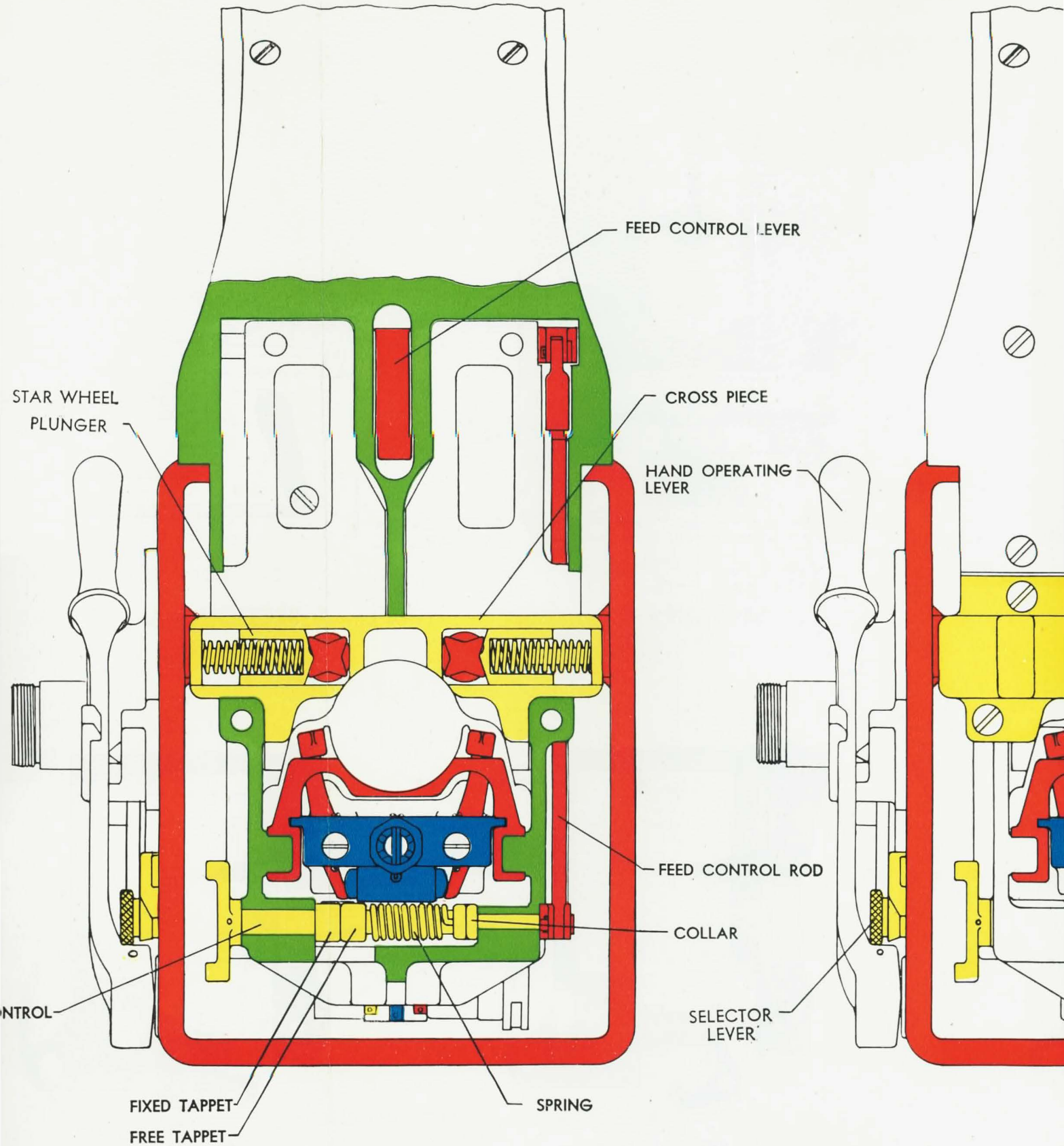
LATERAL SECTIONS THROUGH LOADER–II

Figure 44

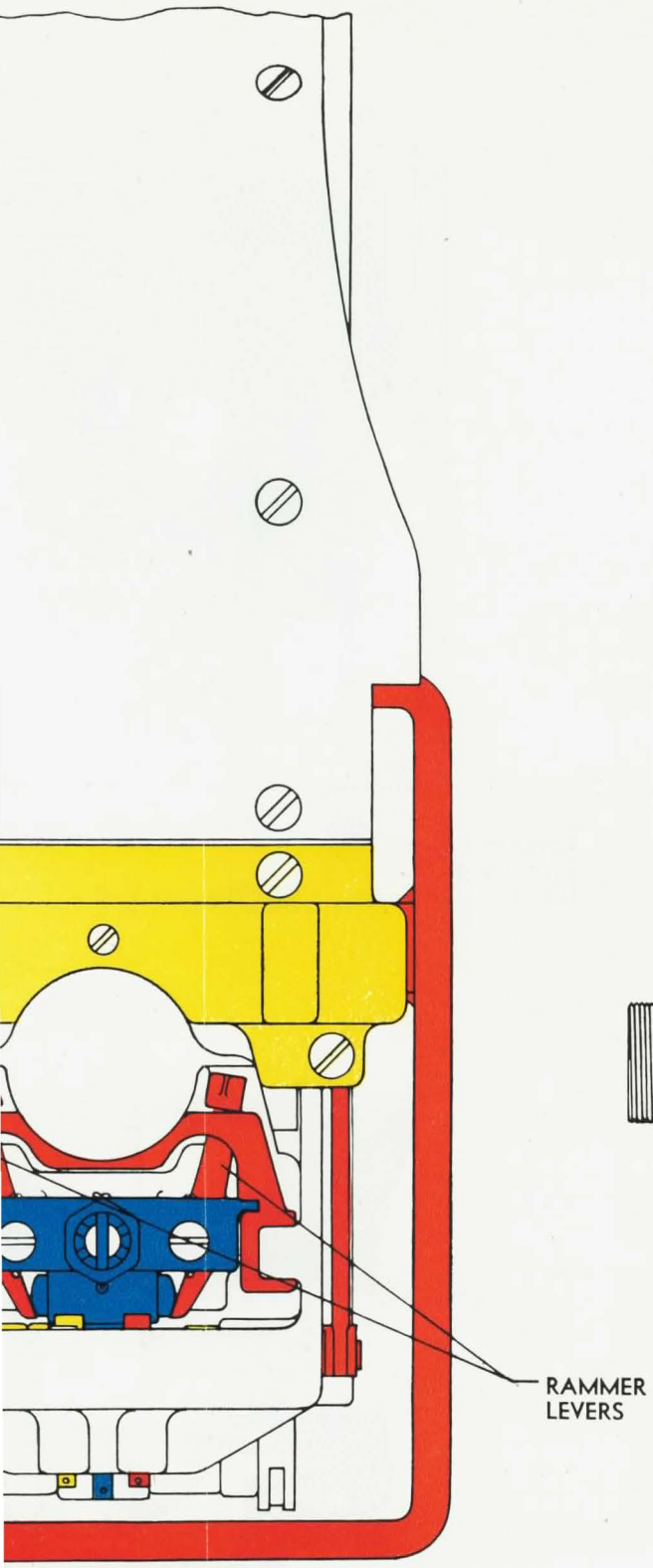
Sections R-R, S-S, U-U



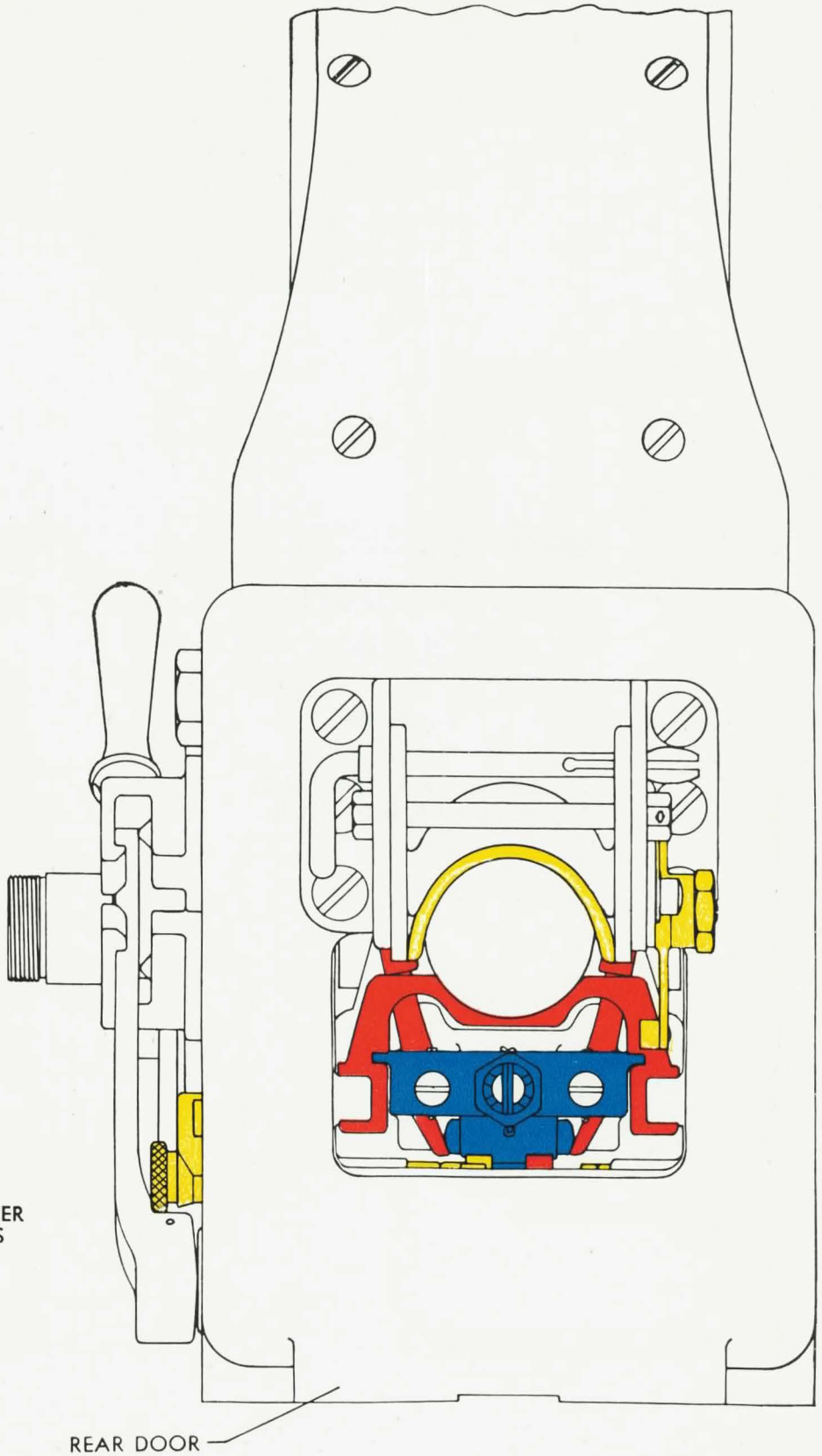
SE


FEED CONTROL LEVER
STAR WHEEL PLUNGER
CROSS PIECE
HAND OPERATING LEVER
FEED CONTROL ROD
COLLAR
SELECTOR LEVER
SPRING
FIXED TAPPET
FREE TAPPET

SECTION R-R



ECTION S-S

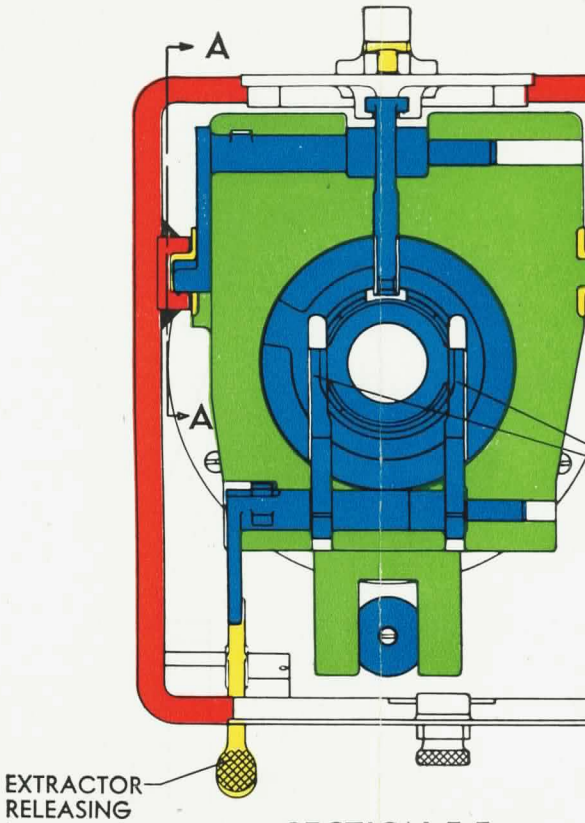


SECTION U-U

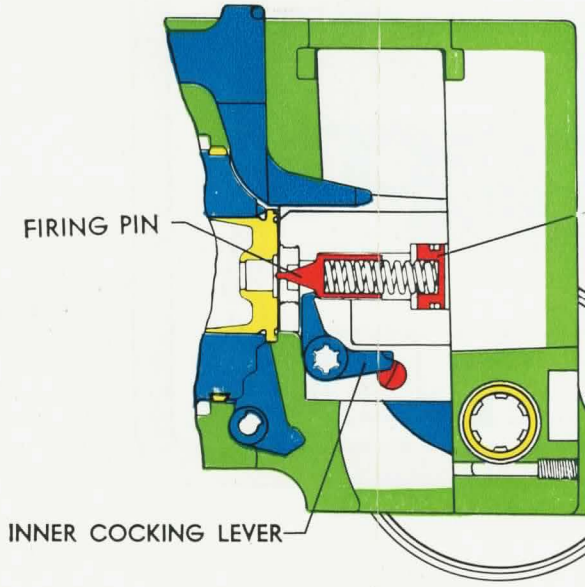
LATERAL SECTIONS THROUGH HOUSING

Figure 45

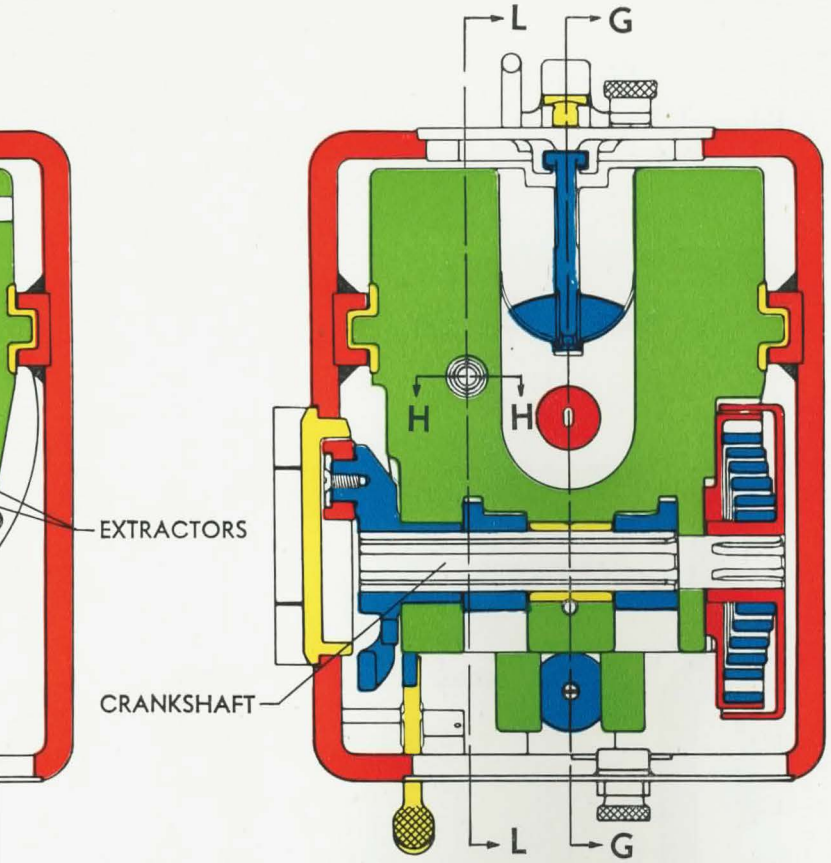
Sections A-A, B-B, C-C, D-D, E-E, F-F, G-G, H-H, L-L



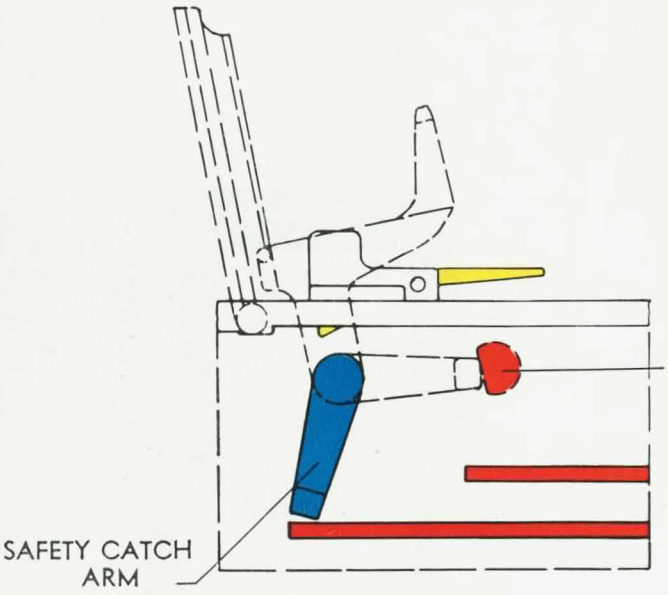
SECTION E-E



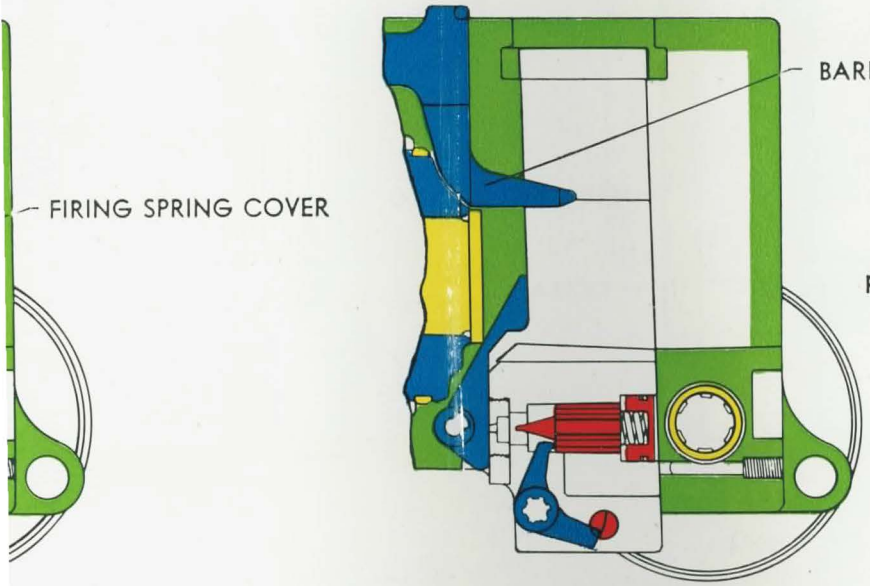
SECTION G-G
FIRED



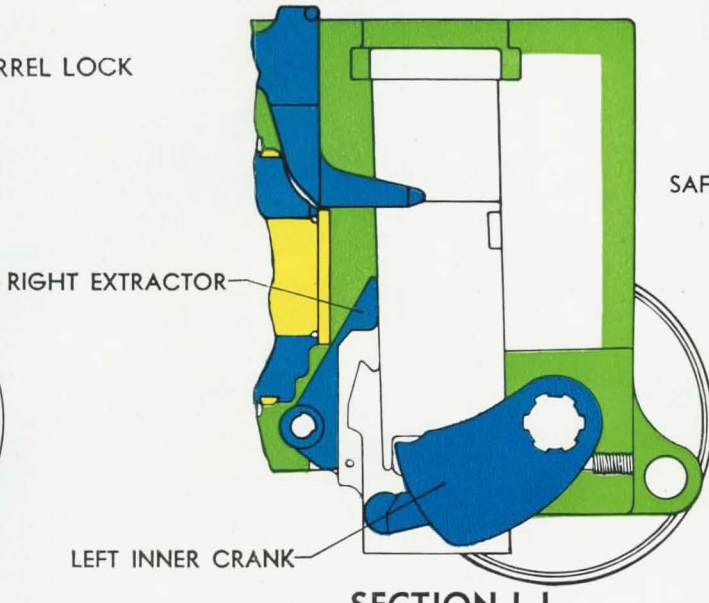
SECTION F-F



SECTION A-A

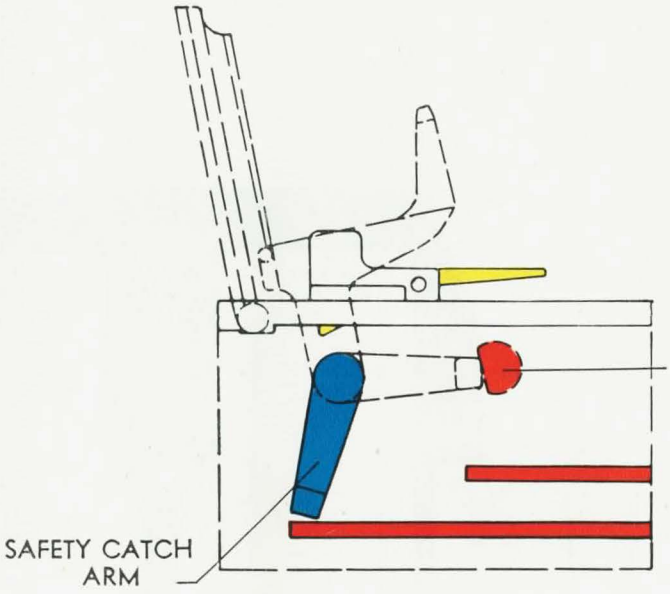


SECTION G-G
COCKED

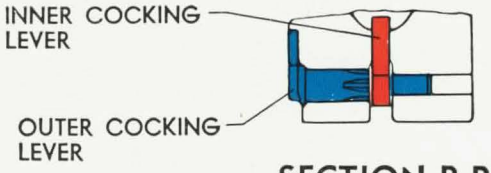


SECTION L-L

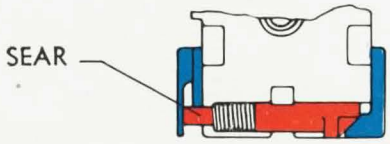




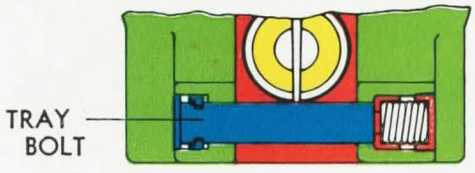
SECTION A-A



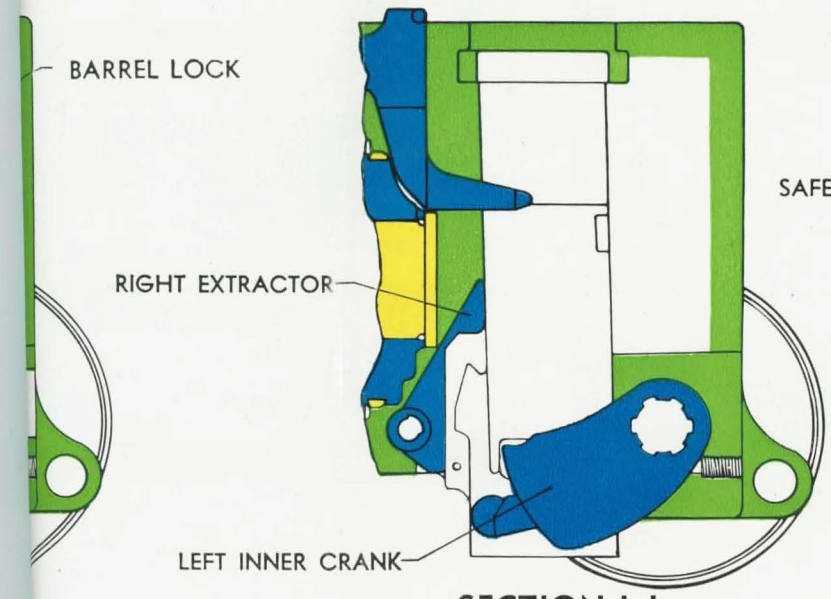
SECTION B-B



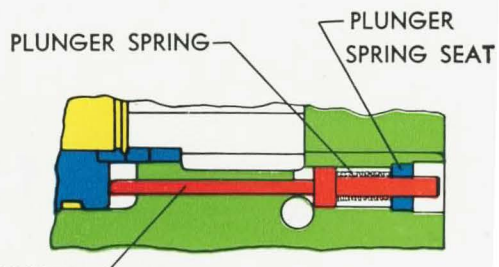
SECTION C-C



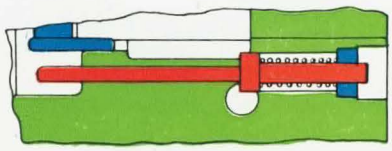
SECTION D-D



SECTION L-L



SECTION H-H
BARREL IN POSITION



SECTION H-H
BARREL REMOVED