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WAR DEPARTMENT TECHNICAL MANUAL

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37-mm AA Gun Materiel

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24 JANUARY 1944

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WAR DEPARTMENT
Washington 25, D. C., 24 January 1944

TM 9-235, 37-mm AA Gun Materiel, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
*Major General,
The Adjutant General.*

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(For explanation of symbols, see FM 21-6.)

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*This Technical Manual supersedes TM 9-235, dated 16 May 1942; TB 235-1, dated 30 January 1942; TB 235-2, dated 1 January 1942; TB 235-5, dated 13 July 1943; TB 235-6, dated 18 October 1943; section III of TM 9-708, dated 9 February 1943; and TC 59, dated 31 August 1942.

37-MM AA GUN MATERIEL

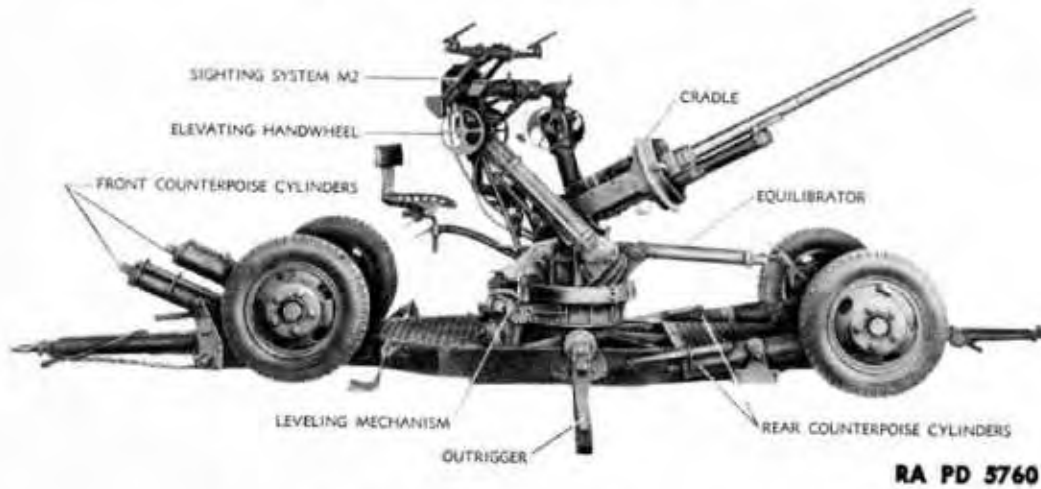


Figure 1 — 37-mm AA Gun Carriage M3



Figure 2 — 37-mm AA Gun Carriage M3E1

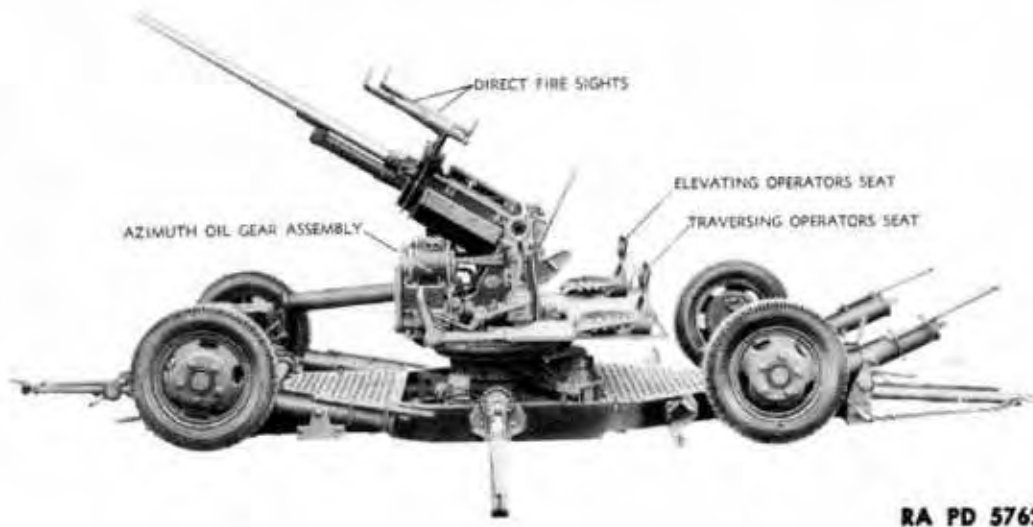


Figure 3 — 37-mm AA Gun Carriage M3A1

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RA PD 45094

**Figure 4 — Combination Gun Mount M42 —
(Sighting Equipment Removed)**

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Section I

INTRODUCTION

1. SCOPE.

a. This manual is published for the information and guidance of the using arms and services.

b. In addition to a description of the 37-mm antiaircraft materiel, this manual contains technical information required for the identification, use, and care of the materiel. It differs from TM 9-235: 37-mm AA Gun Materiel, dated 16 May 1942, as follows:

(1) Addition of information on the Combination Gun Mount M42, with Sighting System M6.

(2) Addition of information on the Direct-fire Sighting System M5, with Telescopes M7 and M64.

(3) Antiaircraft Director M5 and Generating Unit M5 are omitted. They are published in TM 9-659 and TM 9-616, respectively. For other off-carriage equipment not contained in this manual, see section XVII.

c. Disassembly, assembly, and such repairs as may be handled by using arm personnel will be undertaken only under the supervision of an officer or the chief mechanic.

d. In all cases where the nature of the repair, modification, or adjustment is beyond the scope or facilities of the unit, the responsible ordnance service should be informed in order that trained personnel with suitable tools and equipment may be provided, or proper instructions issued.

2. CHARACTERISTICS.

a. The 37-mm Antiaircraft Automatic Gun M1A2 is a high-velocity antiaircraft weapon of the long recoil type. The gun can also be fired manually by changing the setting of a foot firing mechanism which is incorporated in the gun carriage. The carriage is a 4-wheeled trailer carriage capable of being towed 50 miles per hour over good roads. The carriage is lowered to the ground for firing and raised to the wheels for traveling by means of four counterpoise cylinders. Antitank firing as well as antiaircraft firing is possible, as a maximum depression of minus 5 degrees and a maximum elevation of plus 90 degrees can be realized when elevating mechanism is manually operated. A remote control or "off-carriage" system of pointing the gun in firing azimuth and quadrant elevation is possible on the Carriage M3A1 through data furnished by a Director M5 located approximately 13 feet from the gun. Power is furnished by a motor-driven generator, also designated as M5.

b. There are three model designations for the carriages mounting the Gun M1A2, the earliest being the M3, on which the elevating, traversing, and leveling mechanisms are operated by handwheels,

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while the cradle is of open frame construction. Another distinguishing characteristic is the two Telescopic Sights M7 mounted on the gun. The second model, the M3E1, is similar in appearance to the M3 but includes two Browning Machine Guns, cal. .50, M2, watercooled. For description and functioning of these guns, see TM 9-226. Since there are comparatively few of these early units in the field, this text will chiefly concern the third and latest model, the M3A1, using double hand cranks for elevating and traversing instead of handwheels. The two oil gear units and other fire control equipment mounted on the top carriage positively identifies the Carriage M3A1. A detailed comparison of these models will be found in paragraph 3 on carriage data.

c. The Combination Gun Mount M42 permits the 37-mm gun and the two Browning Machine Guns, cal. .50, M2, heavy barrel, with which it is equipped to be traversed 360 degrees. The guns may be elevated to 85 degrees and lowered to a horizontal position. When operating the guns directly to the front, they cannot be placed in a horizontal position because of the driver's compartment. The minimum elevation when firing to the front is approximately 20 degrees. Gun firing is controlled by the Sighting System M6 and is used in direct fire only. The maximum vertical range of the 37-mm gun, using the high-explosive shell, is about 6,200 yards. The maximum horizontal range, using the high-explosive shell, is about 8,875 yards. The maximum range of the cal. .50 gun is approximately 7,200 yards. For description and functioning of the heavy barrel machine gun, see FM 23-60.

3. CARRIAGE DATA.

Item	M3	M3E1	M3A1
Guns.	One 37-mm AA Automatic Gun M1A2.	One 37-mm AA Automatic Gun M1A2 and two Browning Machine Guns, cal. .50, M2, watercooled, flexible.	One 37-mm AA Automatic Gun M1A2.
Carriage chassis.	4-wheeled towed vehicle type.	Same as M3.	Same as M3.
Brakes.	Disk and lever type electric brakes on four wheels, hand brakes on rear wheels.	Same as Carriage M3.	Same as M3.
Leveling mechanism.	Tilts through a range of 10 degrees, operated by two handwheels.	Same as Carriage M3.	Tilts through a range of 10 degrees, operated by two ratchet handles secured to the leveling mechanism.

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Item	M3	M3E1	M3A1
Elevating mechanism.	Two speed ratios available for a 0- to 85-degree limit elevation. Hand-operated only. One turn of handwheel elevated 3.75 degrees in slow ratio and 11.25 degrees in fast ratio.		One speed ratio. Hand- and power-operated. Mechanical stops at minus 5 degrees and plus 90 degrees. Automatic stop switch for power operation at 0 and 85 degrees. One turn of hand crank elevates 4.67 degrees.
Traversing mechanism.	Two speed ratios available for 360-degree traverse. Hand-operated only. One turn of handwheel traverses 3.75 degrees in slow ratio and 11.25 degrees in fast ratio.		One speed ratio. Hand- and power-operated for 360 degree traverse. One turn of hand crank traverses 6 degrees.
Equilibrator.	Equilibrator connected to cradle by means of a rod.	Same as M3.	Equilibrator connected to cradle by means of a rod and a chain.
Firing mechanism.	Cam and lever arrangement operated by a foot pedal.	Same as Carriage M3 for the 37-mm gun. Separate pedal for cal. .50 machine guns.	Lever and cable arrangement operated by two foot pedals. Adjustment provided for single or automatic firing.
Outrigger assembly.	Pivots about a bracket centrally located on each side of the chassis. Stands upright for traveling.	Removed from bracket and carried alongside the chassis for traveling.	Same as M3, or M3E1.
Cradle.	Open frame construction.	Open frame construction. Contains brackets for attachment of two cal. .50 machine guns.	Frame construction with top, bottom, and front, and rear removable covers.
On-carriage fire control equipment.	Sighting System M2 and Telescope M7.	Sighting System M2 and Telescope M7.	Remote Control System M1 and direct fire sights.
Weight, complete pounds.	5,300	5,600	6,100
Rate of fire, rounds per minute.	120	120 for 37-mm gun; 650 for cal. .50 machine gun.	120
Over-all length (traveling position), inches.	241	241	241

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Item	M3	M3E1	M3A1
Over-all width (traveling position), inches.	69.5	69.5	69.5
Tread, inches.	58	58	58
Wheelbase, inches.	120	120	120
Height (traveling position), inches.	80.5	80.5	72
Height of trunnions above ground, inches.	33	33	54.5
Road clearance, inches.	11	11	11
Tire size.	5.50-18	5.50-18	5.50-18
Tire inflation, pounds per square inch.	40	40	40

4. GUN DATA.

Bore, 37-mm	1.457 in.
Weight of gun, complete.....	365 lb
Length of gun, complete.....	104 in.
Weight of tube.....	119 lb
Length of tube.....	78 in.
Length of bore.....	53.53 cal.
Rifling:	
Uniform, twist to right, one turn in 30 calibers	
Number of grooves.....	12
Depth of grooves.....	0.020 in.
Width of grooves.....	0.2314 in.
Width of lands.....	0.150 in.
Number of turns in rifling in tube (approx.).....	1.56
Muzzle velocity	2,600 ft per sec
Rate of fire.....	120 rounds per min
Type of breechblock.....	Vertical sliding
Recoil mechanism	Hydrospring
Length of recoil.....	10 ³ / ₈ -10 ⁵ / ₈ in.
Recoil fluid	OIL, recoil, light
Recoil fluid capacity.....	3 ¹ / ₂ pt
Maximum vertical range (H.E. shell).....	6,200 yd
Maximum horizontal range (H.E. shell).....	8,875 yd
Vertical range, self-destructing (H.E. shell).....	3,960 yd
Horizontal range, self-destructing (H.E. shell).....	4,070 yd
Weight of high-explosive projectile.....	1.34 lb
Weight of armor-piercing projectile.....	1.9 lb

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Maximum number of rounds permitted to be fired before cooling:

Continuous fire	50-60 rounds
In bursts within short period.....	100 rounds
Weight of 1 round, SHELL, H.E., M54.....	2.62 lb
Weight of 1 round, SHOT, AP, M59.....	3.12 lb

Section II**DESCRIPTION AND FUNCTIONING OF GUN****5. GENERAL DESCRIPTION.**

a. The 37-mm Automatic Gun M1A2 is a recoil-operated weapon using an ammunition clip carrying 10 rounds. The cartridges are fed into the left side of the feed box, the empty cases ejected through a longitudinal opening below the trunnion block, and the empty clip ejected through an opening in the right side of the feed box. Sustained fire is possible, since a new clip of ammunition may be fed into the mechanism without interruption of the firing.

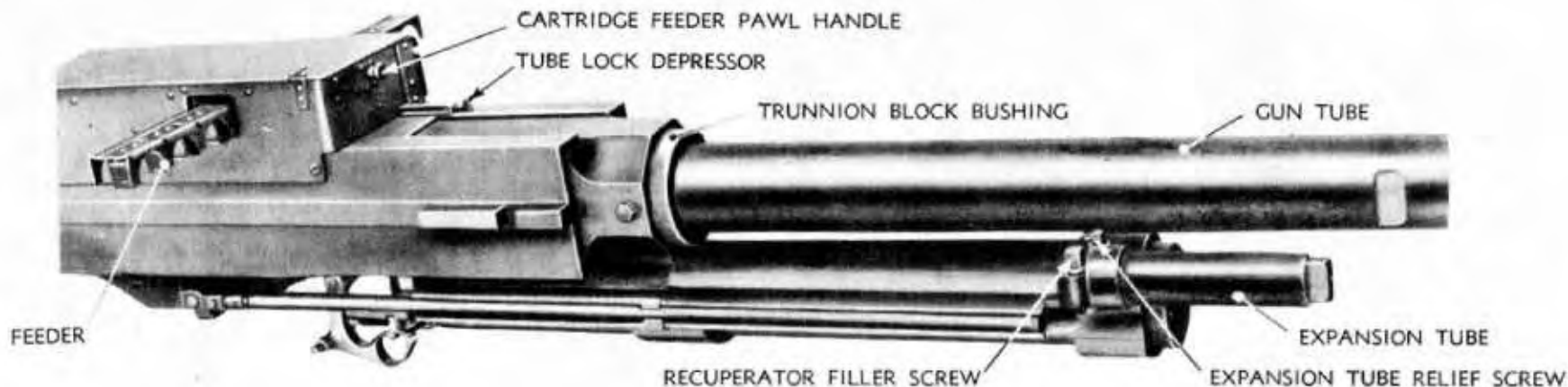
6. MAJOR ASSEMBLIES.

a. The entire gun (figs. 5 and 6) depends for its operation upon the functioning and proper relationships of the following major assemblies:

- (1) Trunnion block.
- (2) Feed box.
- (3) Tube and tube extension.
- (4) Lock frame assembly.
- (5) Driving spring assemblies.
- (6) Back plate assembly.
- (7) Recuperator.

7. TRUNNION BLOCK (fig. 5).

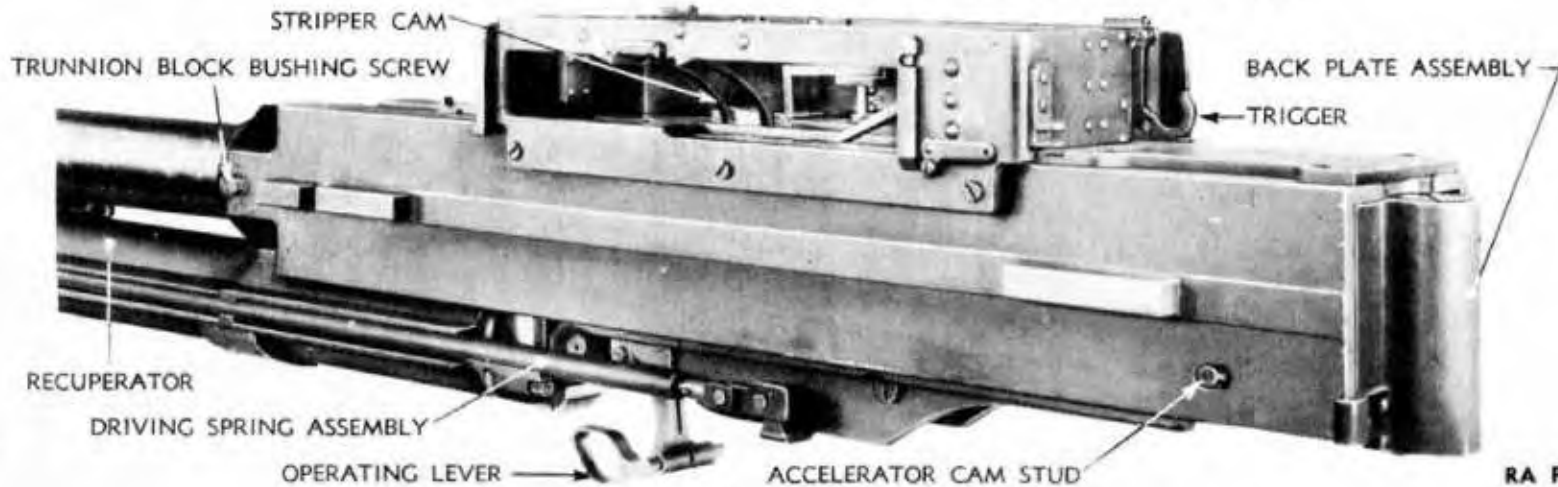
a. This section of the gun mechanism is a rectangular casing, open at the top and front, and partly open at the bottom. The feed box is secured to the top of the trunnion block. The tube extension fits in the center of the block and projects through the front opening, at which point the tube is threaded and locked into the tube extension. The bottom of the trunnion block is flanged inward on each side to support the tube extension and lock frame, but it contains an opening large enough to permit ejection of the empty cartridge cases. The trunnion block assembly may be considered the housing of the gun. In addition to providing for mounting the gun, it supports all of the operating mechanism consisting of the tube and tube extension, recuperator group, lock frame assembly, back plate group, driving spring assemblies, and the feed box group.



RA PD 5805

Figure 5 - Gun With Cartridge Clip in Place - Right Front View

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RA PD 5803

Figure 6 - Gun - Left Rear View

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8. FEED BOX.

a. **Cartridge Clip and Cartridge Tray.** The cartridge tray fastens to the left side of the feed box and supports the loaded cartridge clip as it feeds into the gun. The cartridge clip (fig. 5) is a long, narrow channel-shaped piece to which are riveted 10 spring clips. One round of ammunition is held by each spring clip. The loaded clip is fed into the gun through the opening in the left side of the feed box. The feed box mechanism automatically removes the rounds from the clip and moves the empty clip out of the right side of the feed box.

b. **Feed Box Mechanism.** The feed box, a rectangular box-like structure about half the length of the trunnion block, is fastened to the top of the trunnion block in the approximate center. The feed box has an opening in its left side plate through which the cartridge clip enters, and a smaller opening in the right side plate through which the empty clip is ejected. The top of the box has a hinged cover that may be opened so that it will hang over the right side of the feed box. A set of levers, links, and pawls which are housed in the feed box, controls the motion of the cartridge clip and removes the rounds from it. The important parts of the feed box mechanism function as described below. Figures 7 and 8 show the position of the parts at the beginning and at the end of the feed stroke.

(1) **FEED LEVER** (figs. 9 and 10). This is a long pointed lever which pivots on a pin at the top right rear of the feed box frame, permitting the lower end of the lever to move forward and rearward. It is fastened to the feed crank by means of a swivel stud just below its pivot point. The lower end of the feed lever normally points toward the rear of the gun, but is moved forward during counterrecoil by a stud on the right rear of the tube extension. In this manner the feed lever initiates the action of the feed box linkage which brings the next round of ammunition into the gun. Toward the end of counterrecoil, the stud on the tube extension raises the feed lever and compresses the feed lever spring, front. Further forward movement of the tube extension causes the stud to pass beyond the tip of the feed lever, thus permitting the feed lever to return to its normal position. As the feed lever is moved forward and the feed mechanism is actuated, the feed slide return lever plunger spring is compressed by movement of the feed slide return lever. When the stud on the tube extension disengages the feed lever in counterrecoil, the force of this spring transmitted through the feed linkage moves the feed lever to its rearward position. Near the end of recoil of the tube extension, the feed lever operating stud passes beneath the lower tip of the feed lever, raising it slightly and compressing the rear feed lever spring. The feed lever is then returned to its normal position by the feed lever spring and it is ahead of the feed lever operating stud so that it will be actuated as the tube

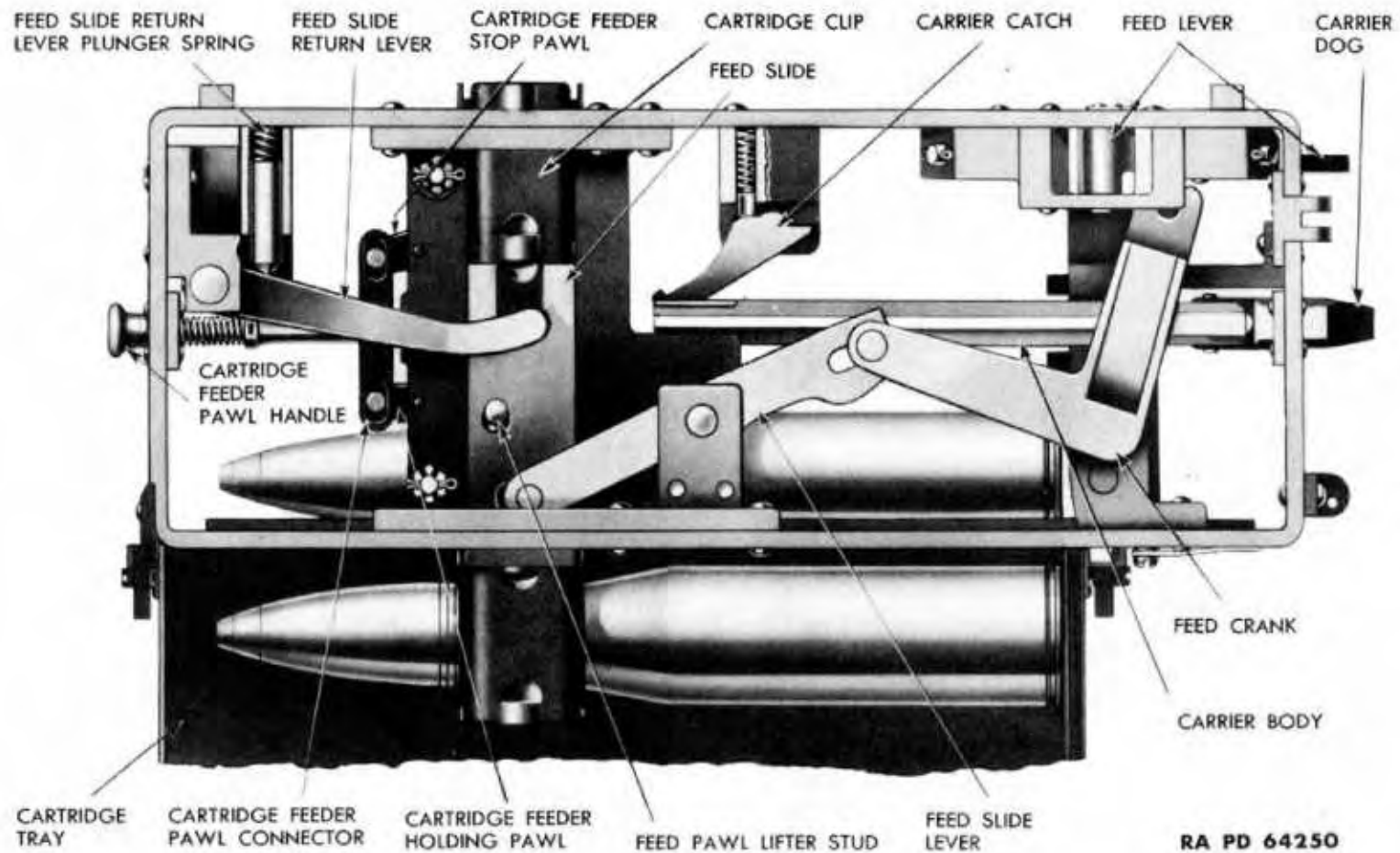


Figure 7 — Position of Feed Box Mechanism at Beginning of Feed Stroke

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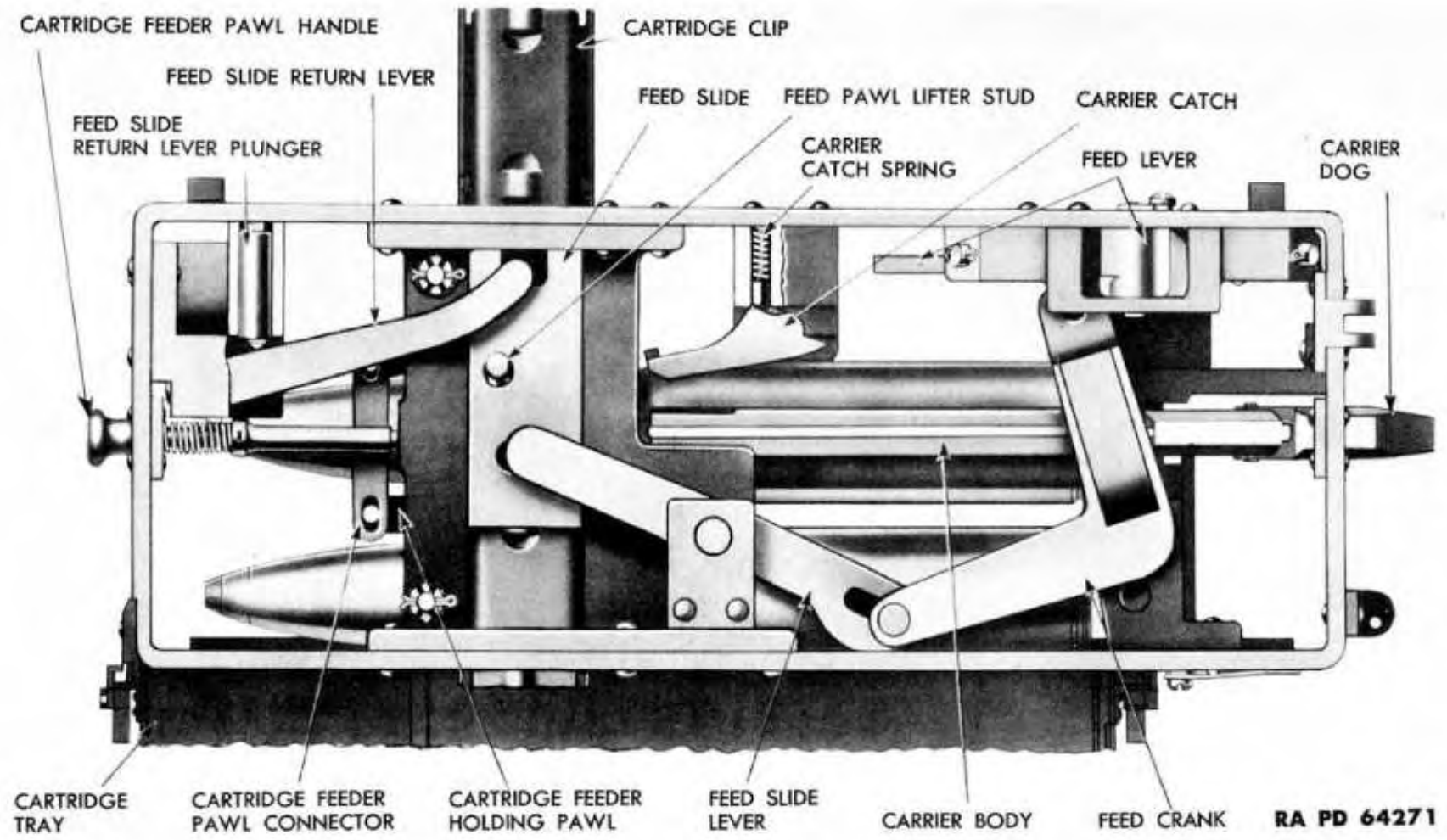


Figure 8 — Position of Feed Box Mechanism at End of Feed Stroke

DESCRIPTION AND FUNCTIONING OF GUN

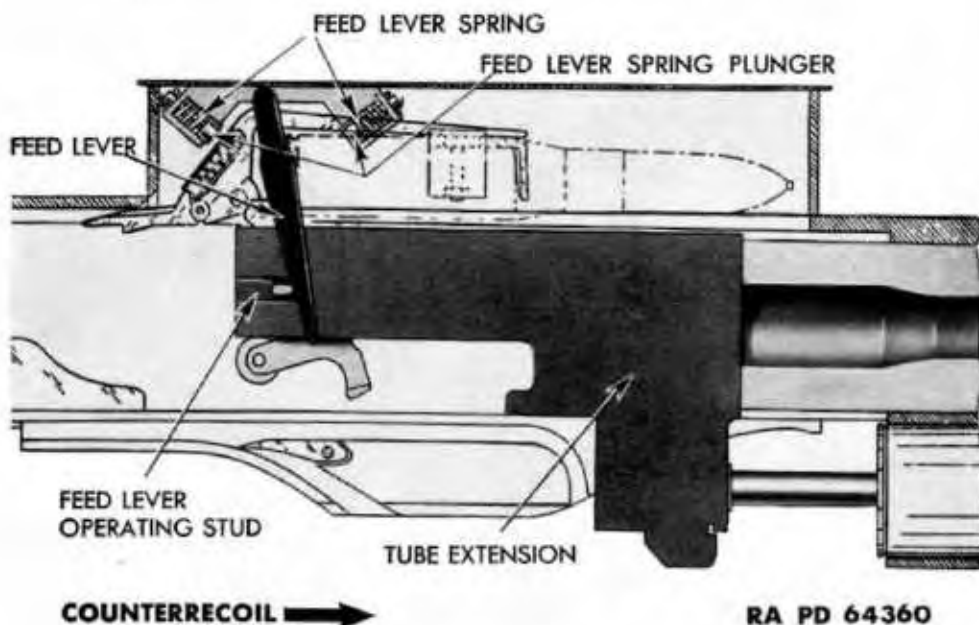


Figure 9 — Feed Lever During Counterrecoil

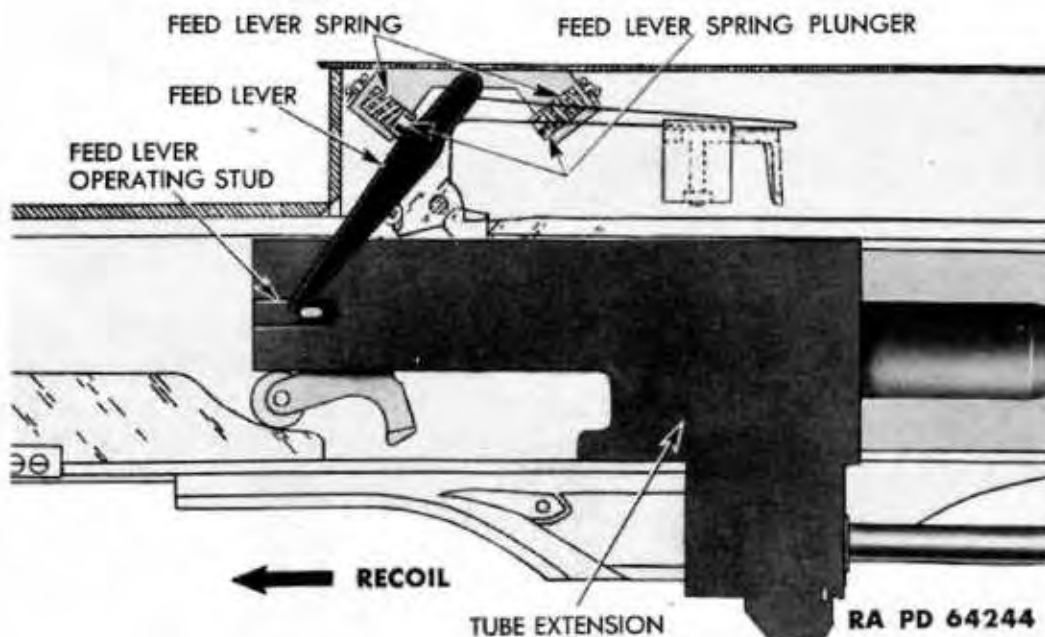


Figure 10 — Feed Lever During Recoil

extension counterrecoils. The function of the feed lever springs, front and rear, is to cause initial movement of the feed lever and thus insure positive action under all conditions.

(2) **FEED CRANK.** This is a large right-angled lever which transmits the motion of the feed lever to the feed slide lever.

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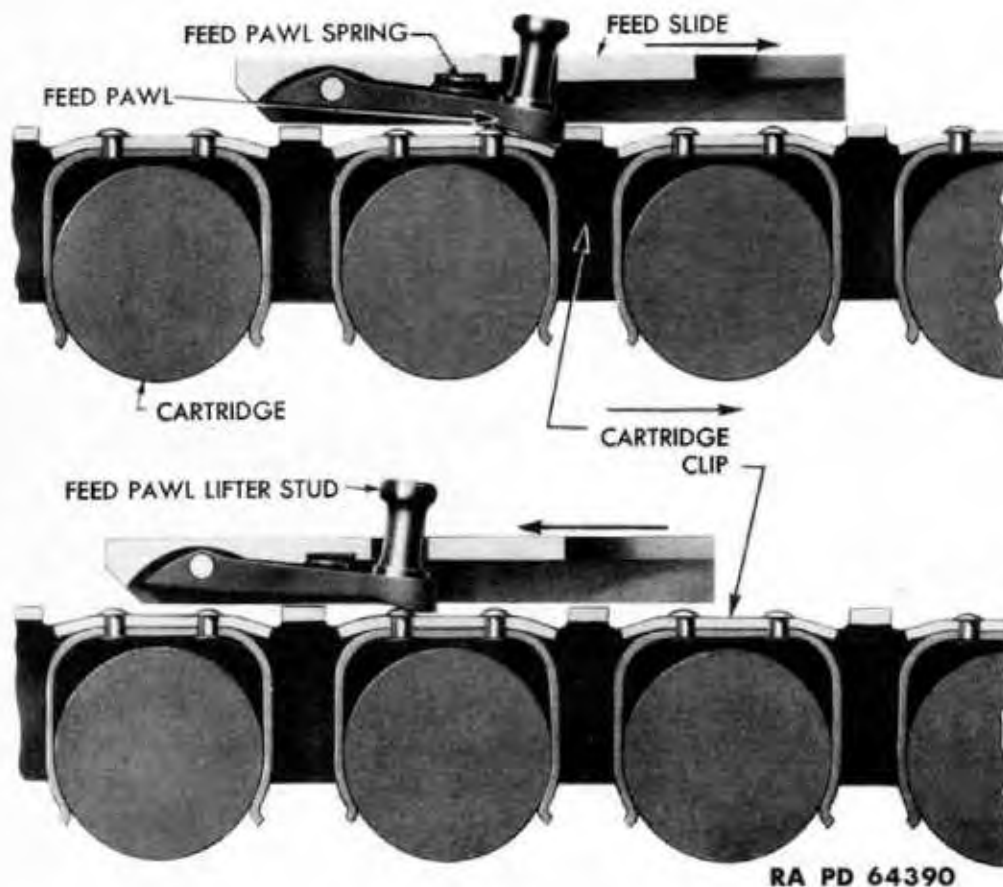


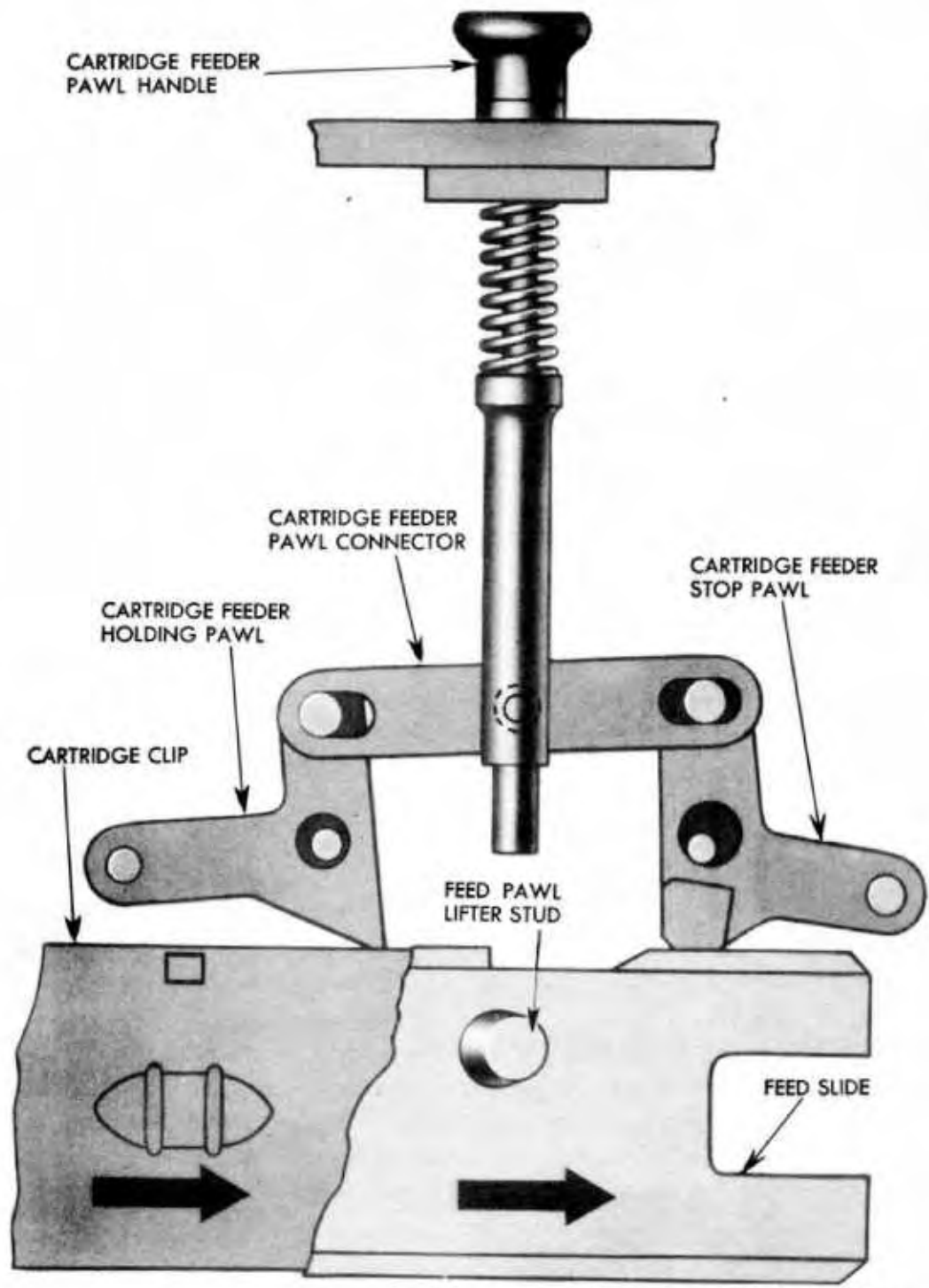
Figure 11 — Feed Slide and Feed Pawl Action

(3) **FEED SLIDE LEVER.** This lever transmits the motion to the feed slide and feed pawl assembly.

(4) **FEED SLIDE AND FEED PAWL ASSEMBLY.** These two parts move together in a slideway just below the upper surface of the feed box. The lower surface of the feed pawl has a projecting edge which engages mating slots in the cartridge clip. As the feed slide and feed pawl are moved to the right by the feed slide lever, the feed pawl pushes the cartridge clip to the right, thus carrying another round into the mechanism. The feed slide and feed pawl then slide back over the clip without moving the clip. The upper portion of figure 11 shows the feed slide and feed pawl moving the cartridge clip to the right, and the lower portion of figure 11 shows the feed slide and feed pawl moving back over the clip without moving the clip.

(5) **FEED SLIDE RETURN LEVER.** This is a long lever which pivots about a point in the upper front right-hand corner of the feed box. This lever is pushed to the right by the motion of the feed slide and feed pawl assembly. The lever compresses a spring and plunger which, at the end of the stroke, cause the lever to move the feed pawl and feed slide assembly back to the left. This in turn causes the feed slide lever,

DESCRIPTION AND FUNCTIONING OF GUN



RA PD 64407

Figure 12 — Cartridge Feeder Stop and Holding Pawls

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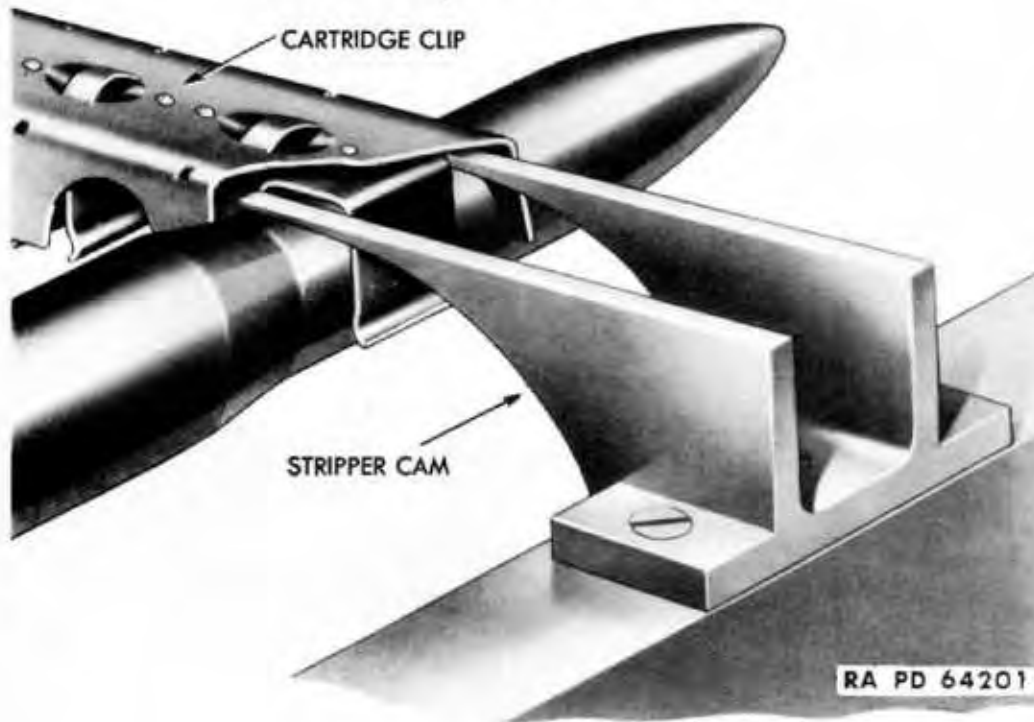


Figure 13 — Start of Stripper Cam Action

feed crank, and feed lever to return to their original positions. This action takes place after the feed lever operating stud has pushed the feed lever to its extreme forward position. In its extreme forward position the feed lever exerts pressure on the front feed lever spring and plunger which gives initial assistance in returning the feed lever to its normal position after the tube and tube extension are in battery position.

(6) **CARTRIDGE FEEDER HOLDING AND STOP PAWL ASSEMBLIES** (fig. 12). These pawls are secured to the slideways in which the feed slide and feed pawl assemblies operate. Toward the end of the motion of the feed slide, in moving the cartridge clip into the gun, the stop pawl engages a slot in the upper edge of the feed slide and prevents the slide from moving the clip farther than is necessary to have a round removed. The holding pawl engages a slot in the clip and prevents the clip from being moved out of the feed box as the feed slide moves back in preparation for bringing in another round.

(7) **CARTRIDGE FEEDER PAWL HANDLE.** This is the small knob that extends through the front plate of the feed box. Under normal operating conditions, the feeder mechanism can move the ammunition clip only from left to right. If it is necessary to withdraw the clip after it has started to enter the mechanism, the feed pawl lifter stud must be raised and the cartridge feeder pawl handle pulled forward before the clip can be removed.

DESCRIPTION AND FUNCTIONING OF GUN

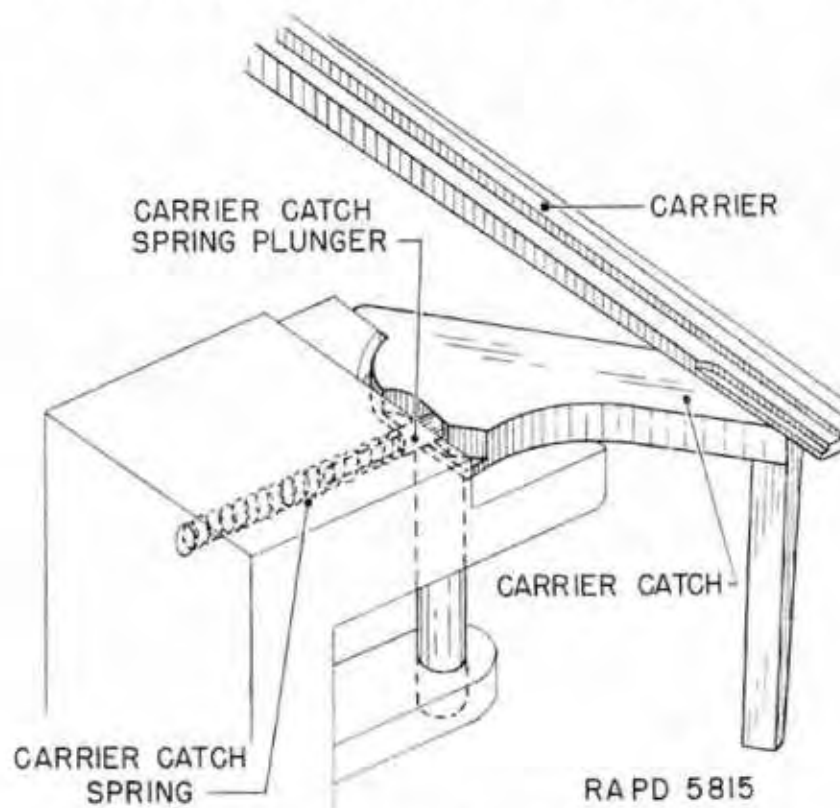


Figure 14 — Carrier Supported by Carrier Catch

(8) **STRIPPER CAM** (fig. 13). This cam is screwed to the right upper part of the trunnion block and lies below the path of the incoming cartridge clip. As the clip moves in, the cam forces the cartridge out of the clip and down into the gun mechanism. Figure 13 shows the cartridge clip and cartridge moving toward the stripper cam.

(9) **CARRIER ASSEMBLY AND CARRIER CATCH** (figs. 14 and 15). The carrier is a long flat lever which pivots vertically about an axis in the back part of the feed box. The carrier dog is a short flat-edged piece that pivots about the lower back portion of the carrier and is positioned by a spring and plunger located in the carrier body. During recoil, the lock frame presses the carrier dog up against the spring and plunger and then the dog holds the lock frame in the recoiled position. In this position, the compressed carrier spring causes the carrier to exert a downward force on the carrier catch. The carrier catch is so positioned that it holds the carrier in a horizontal plane just above the incoming cartridge. As the incoming cartridge is stripped from the clip, it pushes the carrier catch against a spring and plunger (fig. 15), thus freeing the carrier to push the cartridge down into the gun mechanism. When the carrier reaches its lowest limit, it relieves the pressure on the carrier dog and the dog releases from the notch in the lock frame. The lock frame then is carried forward by the driving spring assemblies and the cartridge is moved into the firing chamber

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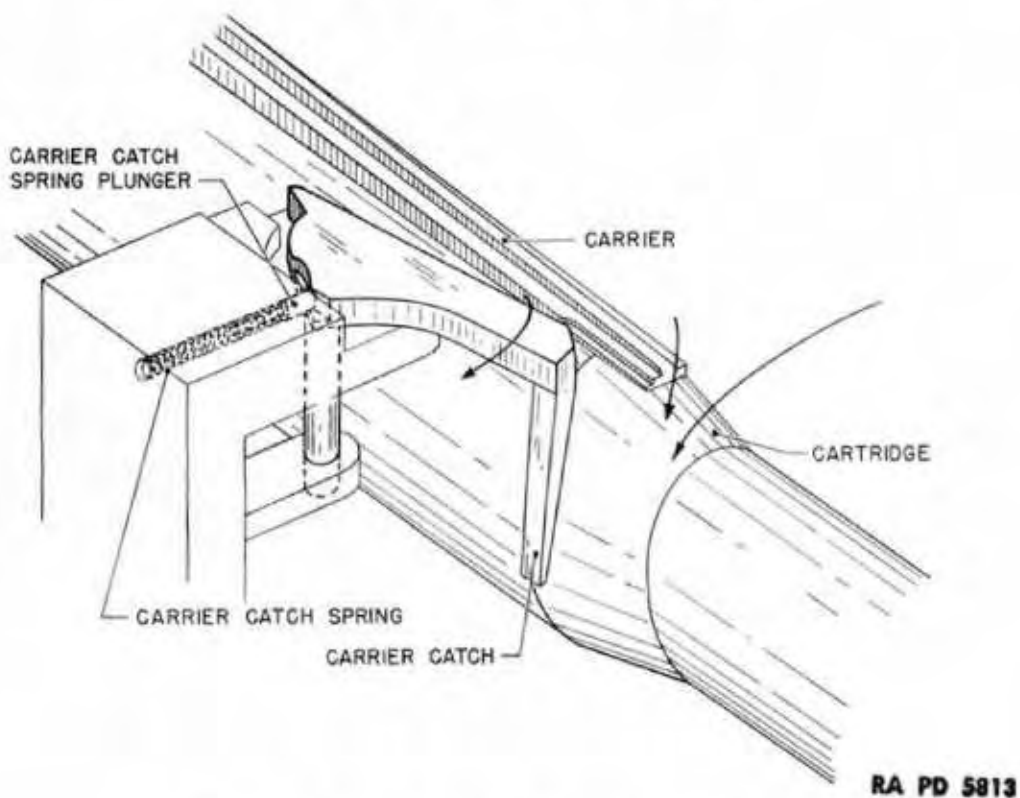


Figure 15 - Carrier Pushing Cartridge Down

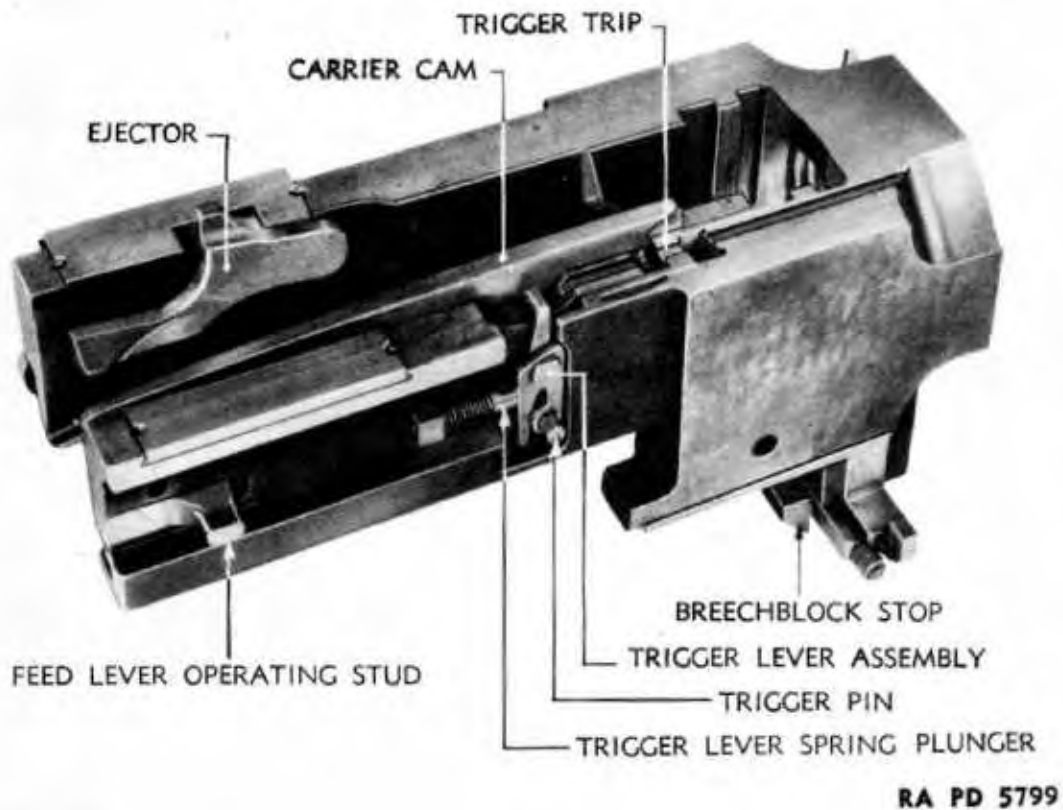
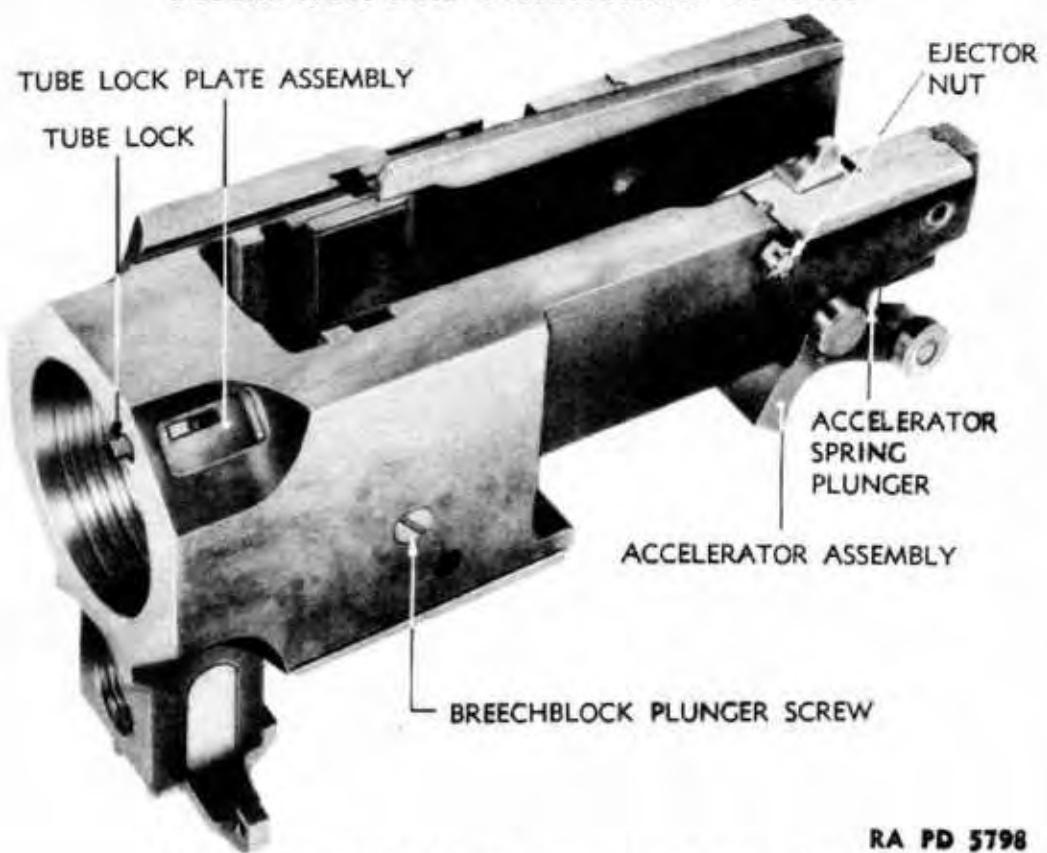


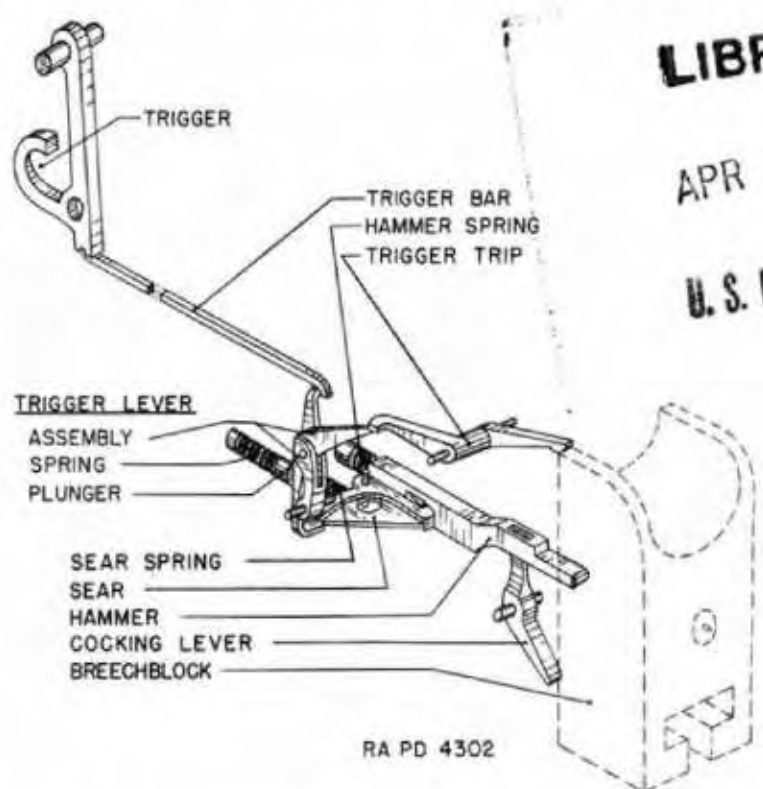
Figure 16 - Tube Extension - Right Rear View

DESCRIPTION AND FUNCTIONING OF GUN



RA PD 5798

Figure 17 - Tube Extension - Left Front View



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Figure 18 - Elements of Firing Mechanism in Position

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by the charger and extractor of the lock frame. The carrier is brought up over the carrier catch by carrier cam on the recoiling tube extension.

9. TUBE AND TUBE EXTENSION (figs. 16 and 17).

a. The gun tube is threaded into and locked to the front of the tube extension. Tubes for the 37-mm AA Gun M1A2 are interchangeable in their breechings. These tubes may be replaced by using troops. The entire assembly recoils about $10\frac{5}{8}$ inches in the trunnion block. The front portion contains the tube receptacle, tube lock, recuperator piston rod receptacle, driving spring front bracket, breechblock plunger, and the breechblock stop. The tube lock is a snap lock which engages a notch in the gun tube and prevents it from turning loose during operation. A vertical opening directly back of the tube socket acts as the guide for the breechblock as the latter moves up and down during the operation of the gun. The breechblock plunger steadies the motion of the breechblock in its slideway. Two vertical side plates extend rearward on the tube extension. These plates act as the receptacle for the incoming cartridge and contain the accelerator, trigger levers, carrier cam, ejector, and the feed lever operating stud, the functions of which are as follows:

(1) **ACCELERATOR ASSEMBLY** (fig. 17). This is a lever which accelerates the lock frame to the back plate buffer mechanism when revolved about its axis by a cam on the lower rear part of the left side plate of the trunnion block.

(2) **TRIGGER LEVER AND FIRING MECHANISM.**

(a) Figure 18 shows all parts of the firing mechanism removed from the gun and in their proper relationship to each other. The trigger lever assembly is located on the right side plate of the tube extension and the trigger trip is located on top of the tube extension. The sear and cocking lever are part of the lock frame. The trigger bar lies under the top flange on the right trunnion block side plate and transmits the motion of the trigger to the trigger levers. The trigger mechanism is so arranged that the trigger can be pulled manually or operated through the foot firing mechanism to fire a single round. Automatic fire is possible as long as the trigger is held in a "pulled" position, either through the foot firing mechanism or manually.

(b) Firing of a single round by pulling the trigger for each round or automatic firing as soon as the breechblock raises is accomplished in the following manner: Upon recoil, the cocking lever is actuated by a lug on the operating lever retracting the hammer and compressing the hammer spring. When the lock frame counterrecoils, the sear engages a notch in the right side of the hammer and holds it in the cocked position. See figure 19, showing the arrangement of the trigger at rest, trigger trip in contact with top of breechblock which is in battery position, and trigger connector in position in front of sear which

DESCRIPTION AND FUNCTIONING OF GUN

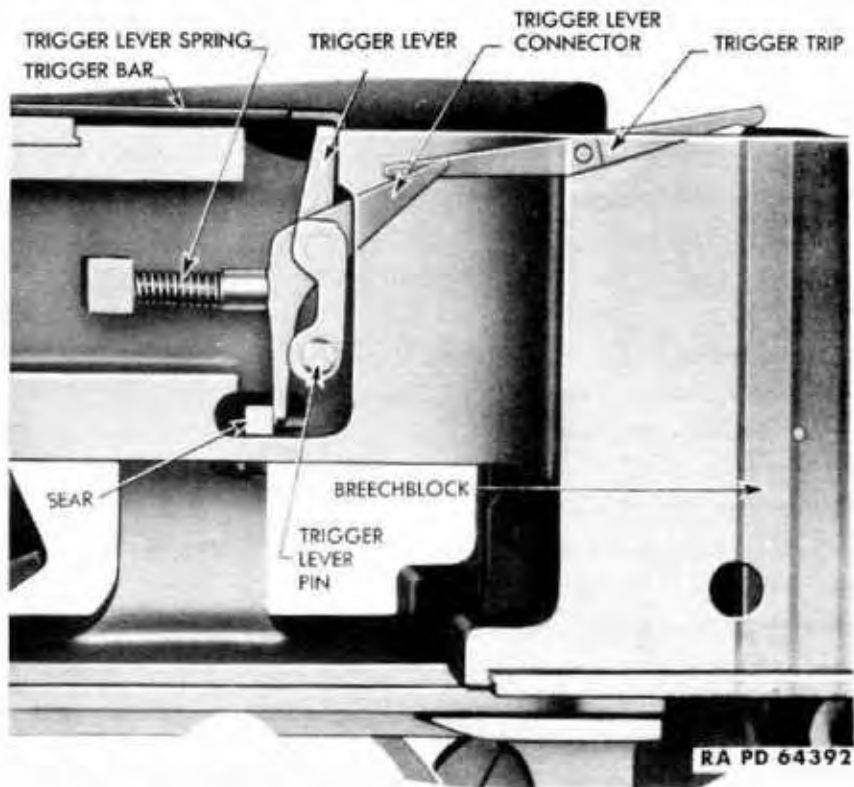


Figure 19 — Trigger at Rest — Gun Cocked

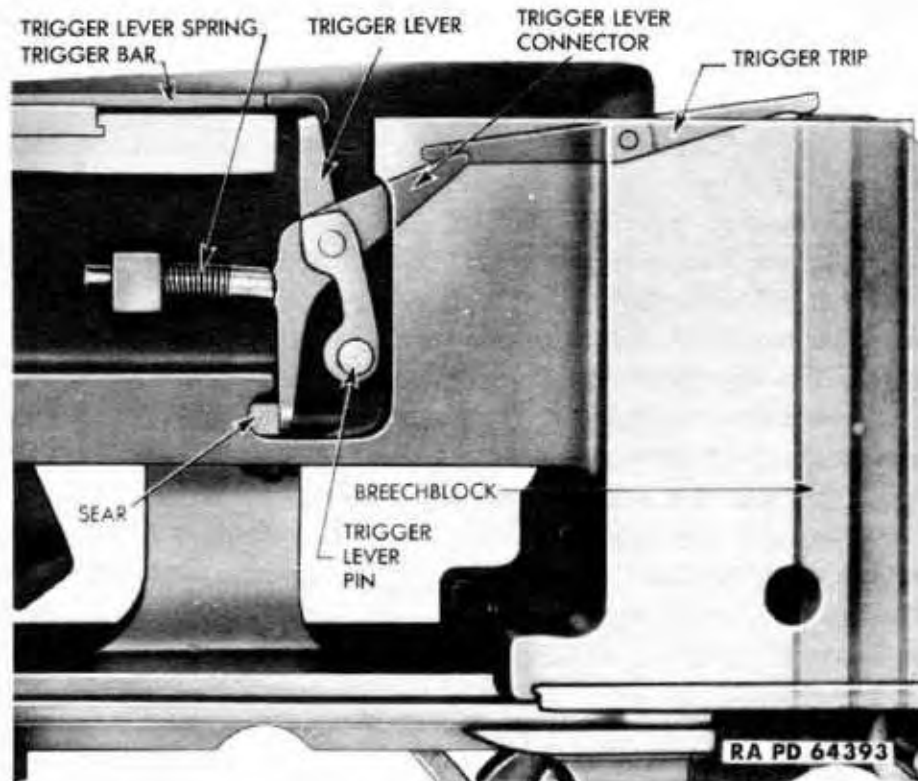


Figure 20 — Trigger Pulled — Gun Firing

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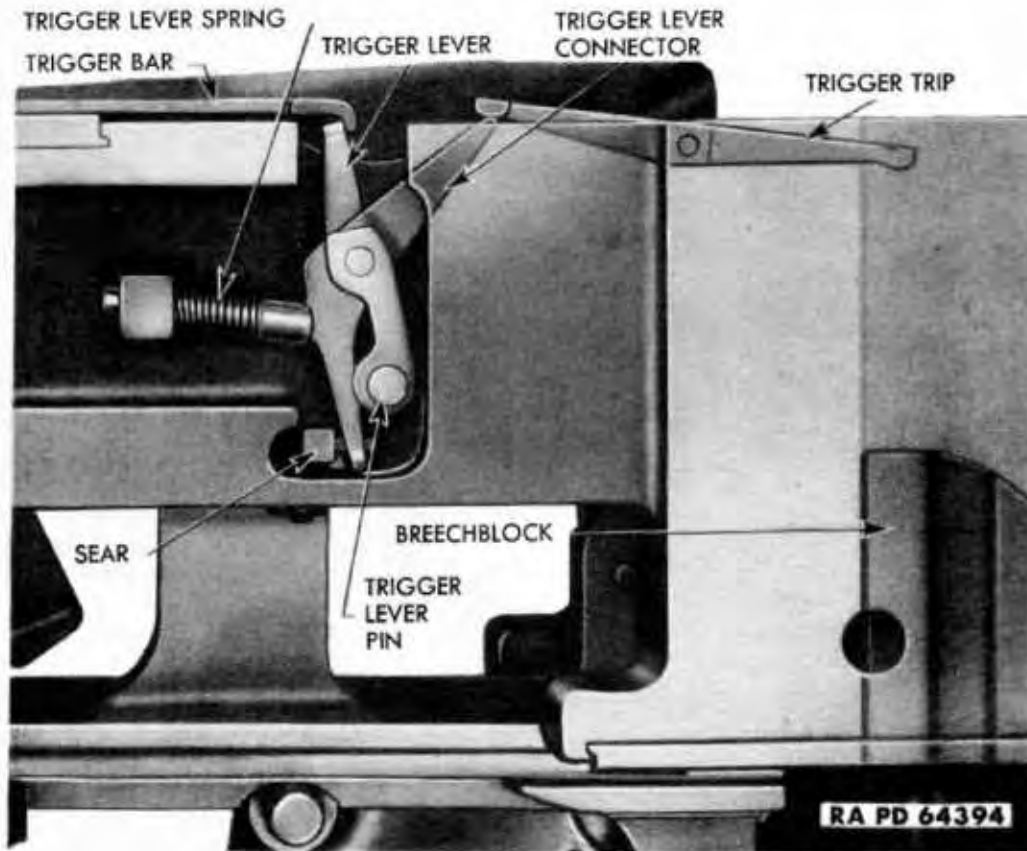


Figure 21 — Trigger Pulled — Gun Will Fire When Breechblock Raises to Battery Position

is in cocked position. See figure 20, which shows the trigger mechanism with the trigger pulled. The top of the trigger lever has been moved to the rear by the trigger bar, and has pivoted on the trigger lever pin. The forward end of the trigger trip is resting on the top of the breechblock and the rear end holds the upper end of the trigger connector from moving upward. Since the trigger lever connector is pinned to the trigger lever, the assembly moves to the rear as a unit and the lower end of the connector moves the sear rearward disengaging it from the hammer which moves forward under spring pressure and fires the round. See figure 21 which shows the trigger bar still "pulled" and holding the trigger lever to the rear. The trigger lever spring has forced the lower portion of the trigger lever connector forward, since it is free to pivot on the trigger lever pin. This is because the breechblock is lowered in recoil and allows the forward end of the trigger trip to pivot downward. Automatic firing will occur when the breechblock reaches battery position and lifts the forward end of the trigger trip, which in turn causes the trigger lever connector to pivot, actuating the sear and releasing the hammer.

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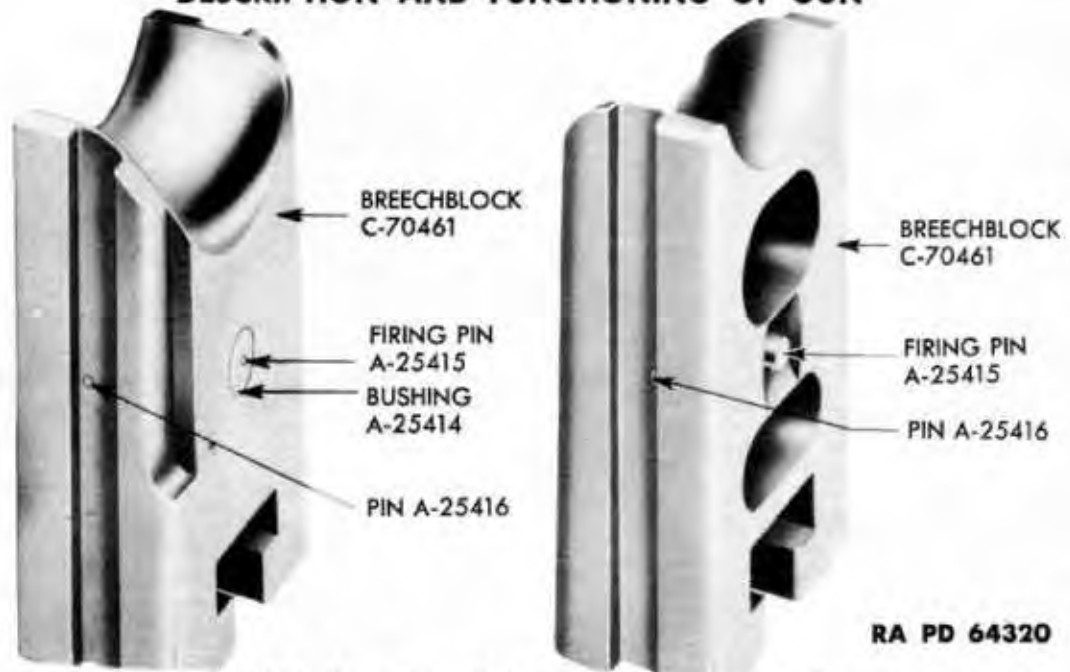


Figure 22 — Breechblock — (Front View) and Breechblock — (Rear View)

(3) **CARRIER CAM** (fig. 16). This is a long narrow cam fixed to the top of the right side of the tube extension. During recoil, the carrier cam raises the carrier so that it is caught by the carrier catch.

(4) **EJECTOR**. The ejector rotates about a pin on the inside of the left side of the tube extension. As the cartridge case is extracted from the firing chamber, a cam located in the left top flange of the trunnion block operates the ejector so that the ejector pushes the empty case out of the gun through the bottom of the trunnion block.

(5) **FEED LEVER OPERATING STUD** (fig. 16). As the tube extension recoils, the feed lever operating stud, projecting from the right side of the tube extension, passes to the rear of the feed lever. On counterrecoil the stud, being attached to the tube extension, pushes the feed lever forward, thus actuating the entire feed mechanism and feeding a new round into the tube extension.

(6) **BREECHBLOCK STOP**. This is a hinged stop provided in the tube extension to position the breechblock assembly properly when out of battery. The stop may be released to swing forward for removal of the breechblock by pulling outward on the stop retaining pin knob.

(7) **BREECHBLOCK PLUNGER**. This is a spring-loaded plunger provided in the left side of the tube extension to steady the motion of the breechblock.

10. BREECHBLOCK ASSEMBLY (fig. 22).

a. The breechblock assembly is actuated by the operating lever that moves in slideways in the tube extension. These slideways, and the mating grooves in the breechblock, are inclined forward 1 degree

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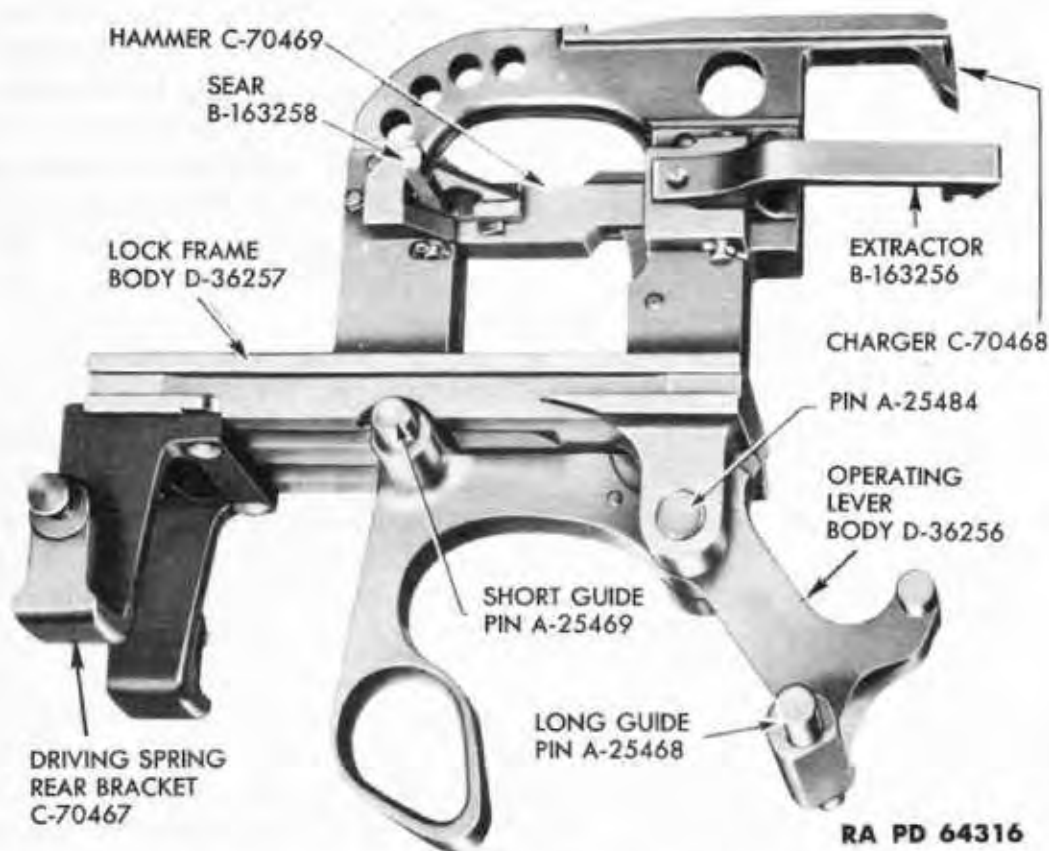


Figure 23 — Lock Frame — Hammer in Cocked Position

30 minutes from vertical to provide a wedging effect as the breechblock raises to the battery position. This wedging action, in conjunction with a beveled radius on the front upper face of the breechblock acts to chamber the cartridge completely before it is fired. The breechblock carries the firing pin, spring, and stop pin.

11. LOCK FRAME ASSEMBLY (fig. 23).

a. The lock frame is a separate recoiling unit that fits between the sides of the tube extension. These two units recoil together until the lock frame is struck by the accelerator. The lock frame is accelerated rearward until it strikes the back plate buffer while the tube extension comes to the end of its recoil. The carrier dog engages the notch in the charger and holds the lock frame to the rear. At the time of acceleration of the lock frame, the extractor, located on the front of the lock frame, draws the cartridge case from the firing chamber, and extraction is completed as the tube extension moves forward during counter-recoil. The lock frame, during counterrecoil, charges a new round into the firing chamber and raises the breechblock to battery position. The operating lever is pivoted to the lower part of the lock frame, and rides in cam grooves secured to the lower surfaces of the trunnion block side

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plates. The motion of the operating lever cocks the firing hammer at the beginning of recoil by means of the cocking lever. The hammer is held in the cocked position by the sear as the operating lever pivots in raising the breechblock. The operating lever strut pivots about a pin in the operating lever and enters an opening in the under center portion of the lock frame. During recoil, the motion of the operating lever causes the strut to compress the operating lever spring. At the end of counterrecoil, this compressed spring causes the operating lever to raise the breechblock into firing position.

12. DRIVING SPRING ASSEMBLIES (fig. 6).

a. **Description.** Two driving spring assemblies run lengthwise outside the lower right- and left-hand sides of the gun assembly. These springs are used to drive the lock frame forward to firing position after recoil. Each assembly consists of a long cylindrical tube, a piston rod, piston, and two springs. A small bracket, secured to the outside of the driving spring tube near its rear end, is connected to the bracket located on the lower front part of the tube extension. The end of the piston rod extends out of the rear of the driving spring assembly and terminates in a hook that connects to the lower rear projecting stud of the lock frame. Thus the driving spring tube is connected to the tube extension and the driving spring piston rod is connected to the lock frame.

b. **Function.** As recoil starts, the tube, tube extension, and lock frame recoil together, carrying with them the driving spring assemblies. The tube and tube extension start to counterrecoil shortly after the lock frame is accelerated rearward. The tube of each spring assembly moves forward with the tube extension while the piston rod and piston move rearward with the lock frame, thus compressing the driving springs. When the lock frame is released, these compressed springs bring the lock frame back to firing position.

13. BACK PLATE ASSEMBLY (fig. 6).

a. The back plate assembly of the gun contains the gun buffer mechanism. This consists of two springs, two buffer pieces, and a buffer plunger (fig. 71). One spring is located inside the other and all parts are assembled in a small vertical cylinder machined in the back plate. The shock of the recoiling lock frame is taken up by the buffer plunger and transmitted to the springs by the two buffer pieces. The buffer mechanism is adjusted by means of the buffer adjusting screw located at the top of the cylinder.

14. RECUPERATOR (figs. 5 and 6).

a. **Recuperator Cylinder.** The recuperator cylinder fits into the lower front opening of the trunnion block and houses the recoil piston

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rod, piston, recuperator springs, and the recoil oil. The piston rod is fastened to the lower part of the front section of the tube extension by means of the recuperator piston rod nut. As the tube and tube extension recoil, the piston is drawn rearward, compressing the recuperator springs and forcing the recoil oil through the openings of the recuperator bushing. The expansion of the compressed recuperator springs returns the piston, piston rod, and recoil oil to their initial positions, thereby causing counterrecoil since the tube and tube extension are secured to the piston rod by the recuperator piston rod nut.

b. **Expansion Tube** (fig. 5). This is the small cylinder screwed to the upper front end of the recuperator. This cylinder is a hollow body used to compensate for expansion and contraction of the recoil oil in the recuperator.

15. FUNCTIONING OF GUN.

a. **General.** The series of operations and motions of the various parts of the gun occur in a definite and interrelated manner. Each part receives its motion from some other part, and each functions at a definite moment of the entire cycle. To describe the action and function of the various parts of the gun during one complete cycle of operation, the entire cycle will be broken down into the following motions and each will be discussed in detail, in the order in which they normally occur:

- (1) Loading initial round.
- (2) Firing initial round.
- (3) Recoil.
- (4) Counterrecoil of the tube and tube extension.
- (5) Counterrecoil of lock frame.
- (6) Function of feed mechanism.
- (7) Function of recuperator.

NOTE: Photographs of working models, figures 26, 27, 28, 29, and 30 are used to illustrate functioning of assemblies. Details of construction vary or are omitted in some cases.

b. **Loading Initial Round.** Initial cocking is accomplished by manually lifting the carrier until caught by carrier catch and pulling the lock frame to the rear until it is caught by carrier dog (figs. 24 and 25). The loaded cartridge clip is then manually pushed into the feed box and against the stripper cam until the first cartridge is stripped from the clip. As the cartridge is stripped from the clip it strikes the carrier catch which releases the carrier so that the front end snaps down, pushing the cartridge downward, while the carrier dog pivots upward releasing the lock frame. As the lock frame is driven forward, the charger contacts the base of the cartridge; the downward movement

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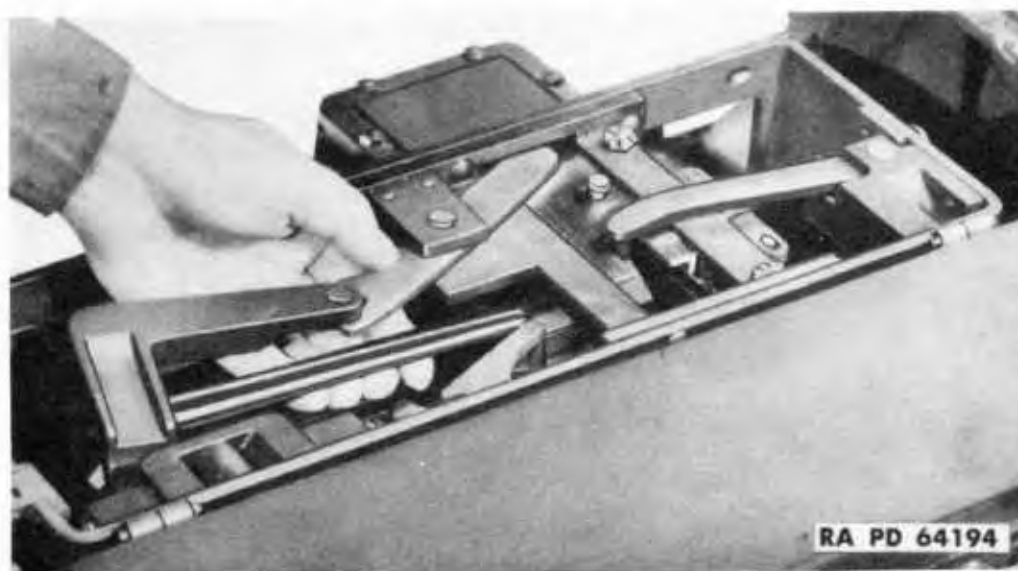


Figure 24 — Raising the Carrier

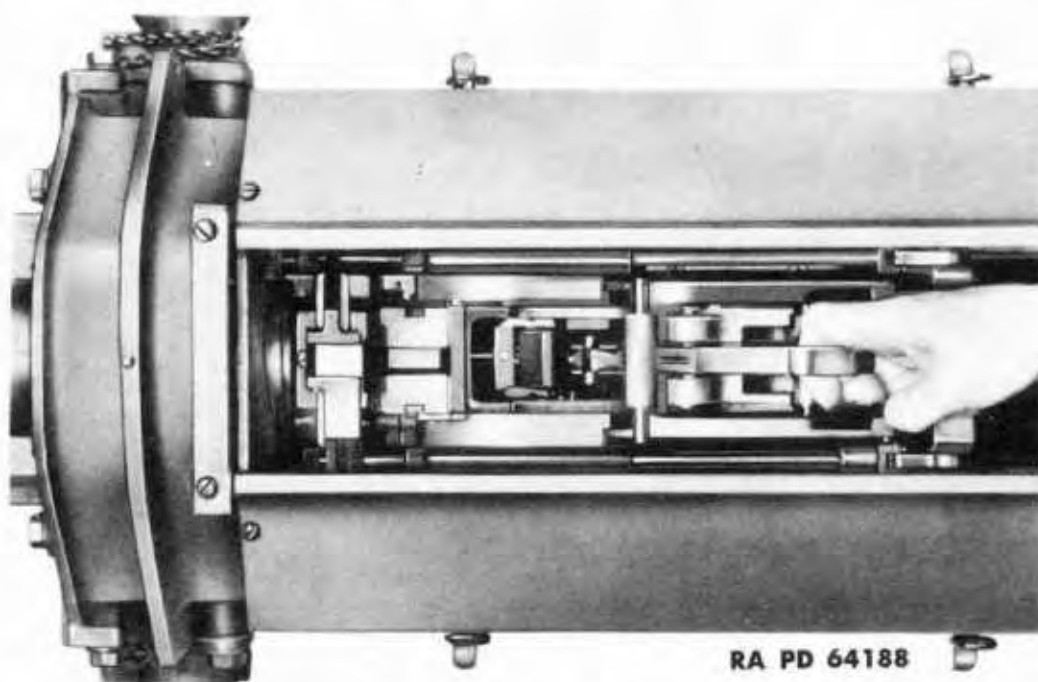


Figure 25 — Pulling Lock Frame Back

of the carrier forces the cartridge into the notch of the extractor and the cartridge is carried into the firing chamber. The short guide pins of the operating lever ride the upper groove of each rear operating cam. When the lock frame reaches a point where the T-lug on the front end of the operating lever is about to enter the T-slot of the breechblock, the contour of the cams causes the operating lever to pivot sharply, forcing the breechblock upward. Pressure applied by the

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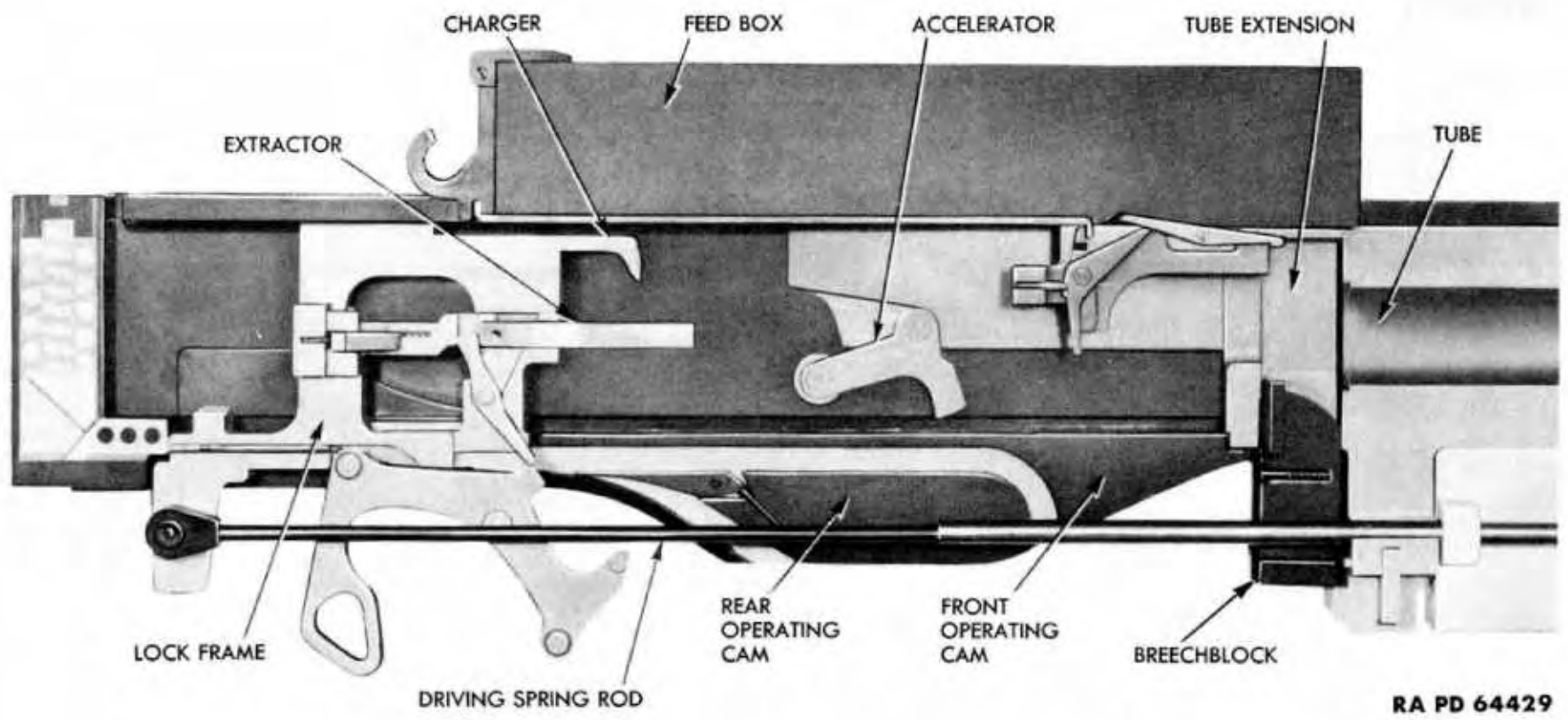


Figure 26 — Hand Cocking of Gun — Lock Frame Held to Rear

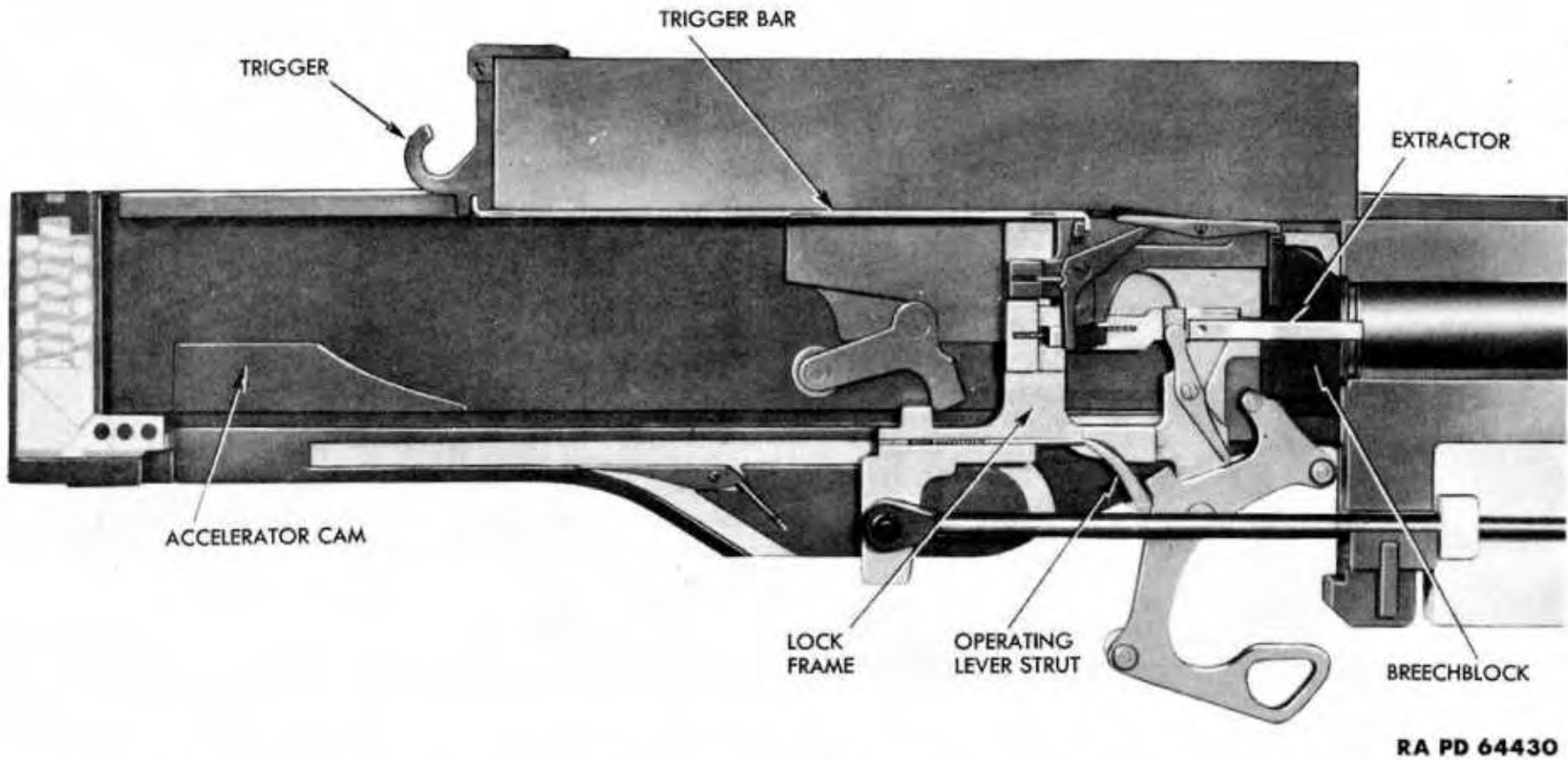
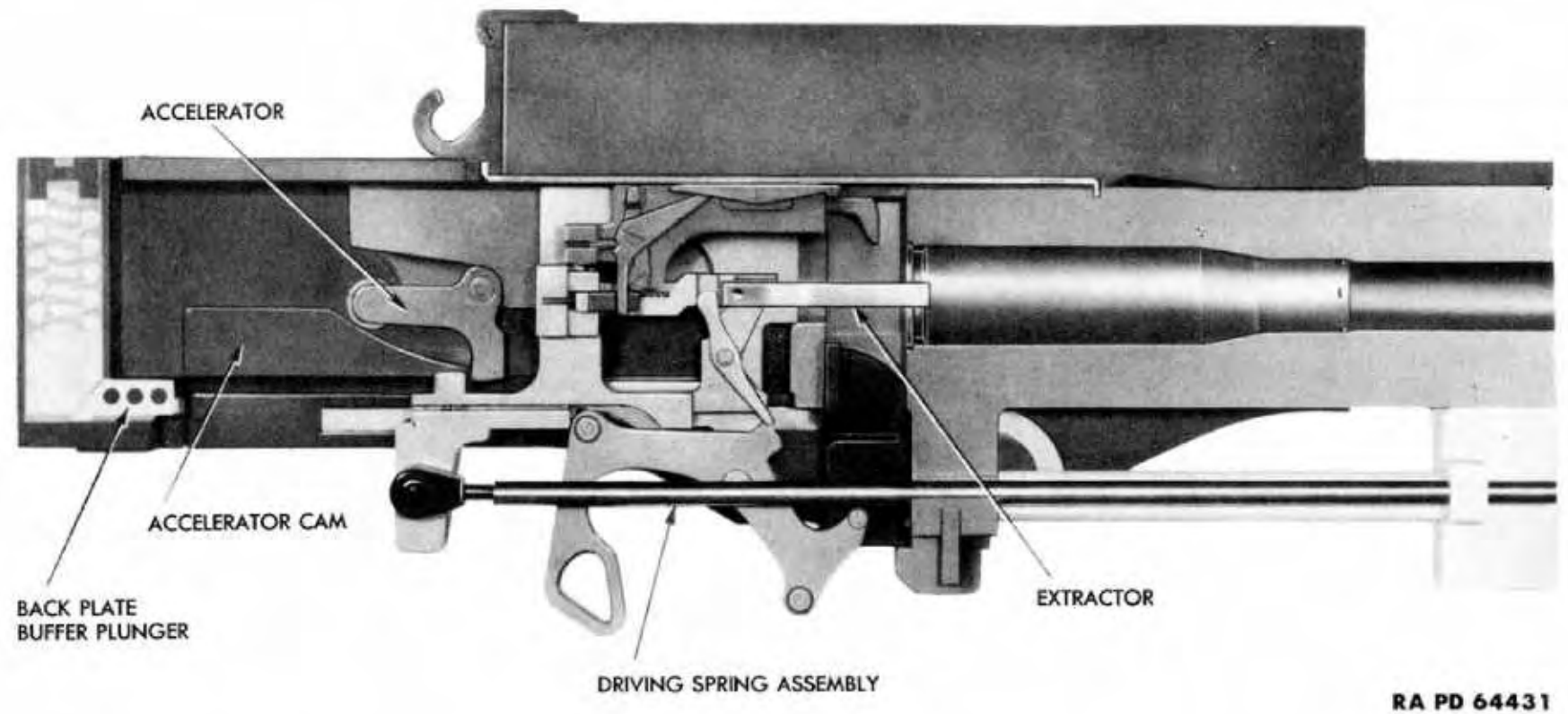


Figure 27 — Lock Frame Released — Cartridge in Firing Chamber, Breechblock Raised to Battery Position

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Figure 28 — Gun in Full Recoil — Lock Frame Accelerating Toward Back Plate Buffer

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operating lever spring through the strut assures positive action of the operating lever and final positioning of the breechblock.

c. Firing Initial Round. The final movement of the breechblock into position raises the front end of the trigger trip and lowers the rear end which bears against the trigger lever connector, so that when the trigger is pulled the trigger bar moves the trigger lever and trigger lever connector rearward as an assembly. Rearward pressure of trigger lever and connector assembly against the sear disengages it from the hammer which springs forward striking the firing pin in the breechblock, and the round is fired.

d. Recoil.

(1) Immediately after the detonation, the tube, tube extension, and lock frame start to recoil together. The carrier cam on top of the tube extension engages the projecting stud of the carrier, which is then pushed up by the cam. The carrier rises until caught in its uppermost position by the carrier catch. As the lock frame recoils, the operating lever starts to revolve due to the action of the operating cams below the right and left side plates of the trunnion block. The operating lever, which is engaged to the breechblock, pulls the latter down until the breechblock rests on its stop at the bottom of the tube extension. Coincident with this motion is that of the cocking of the firing hammer. This is accomplished when a projection of the operating lever forces one end of the cocking lever forward, causing the other end to move the firing hammer rearward until caught by the sear. The rotation of the operating lever also forces the strut back against the action of the follower and spring located in the base of the lock frame.

(2) Toward the end of the recoil of the tube and tube extension, the accelerator starts to ride up on the accelerator cam. The motion given the accelerator by its cam causes the accelerator to kick the lock frame to the back plate buffer plunger. The tube and tube extension come to the end of recoil and the recuperator spring will immediately draw them back to firing position.

e. Counterrecoil of the Tube and Tube Extension. The extractor, located at the front center position of the lock frame, curves around the breechblock and is hooked into the extractor groove of the cartridge case. The extractor remains in this position from the moment of charging the round into the firing chamber until ejection of the empty cartridge case. As the tube extension counterrecoils and the lock frame accelerates rearward, the cartridge case is withdrawn from the chamber by the extractor. A cam then rotates the ejector, which deflects the empty case down through the opening of the trunnion block. As this is taking place, the driving spring piston rod is carried rearward by the lock frame and the driving spring tube carried forward by the tube extension. This causes the driving springs to be com-

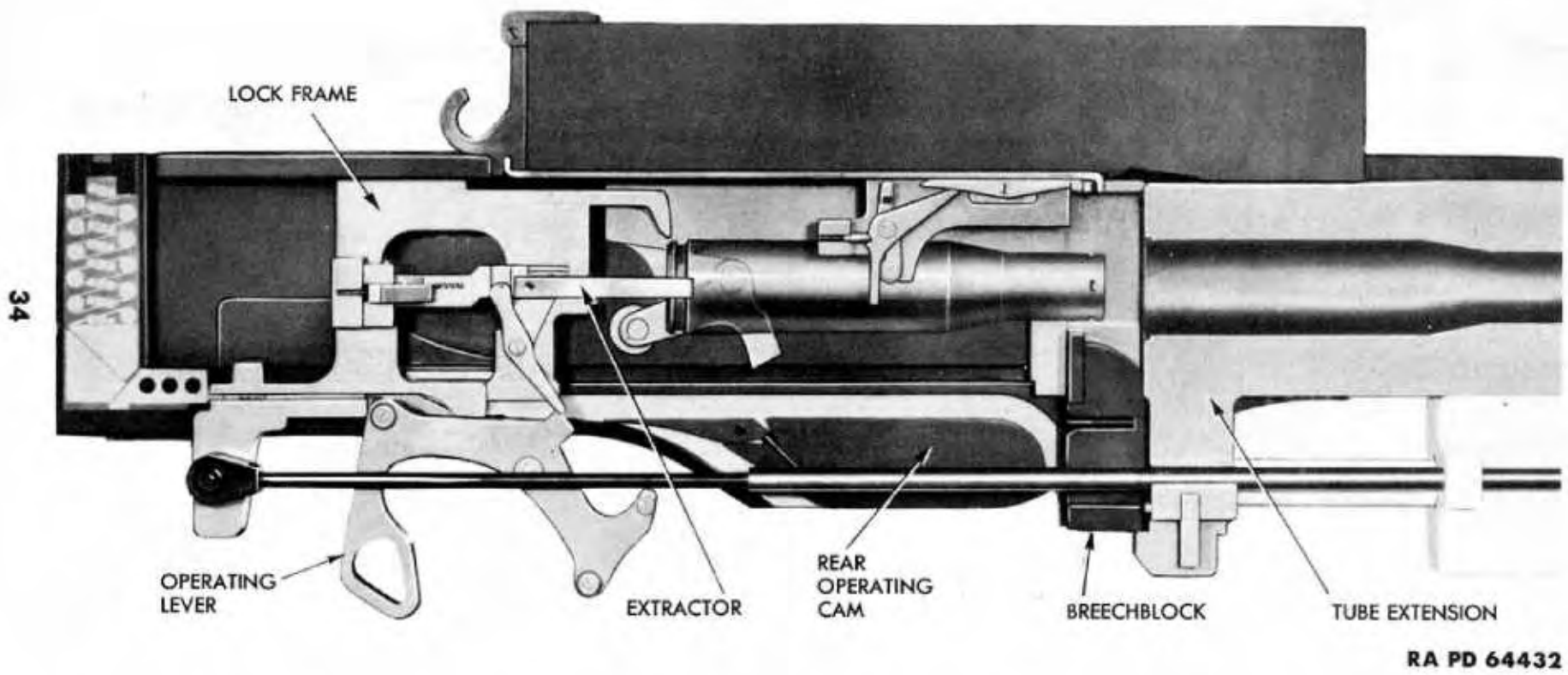
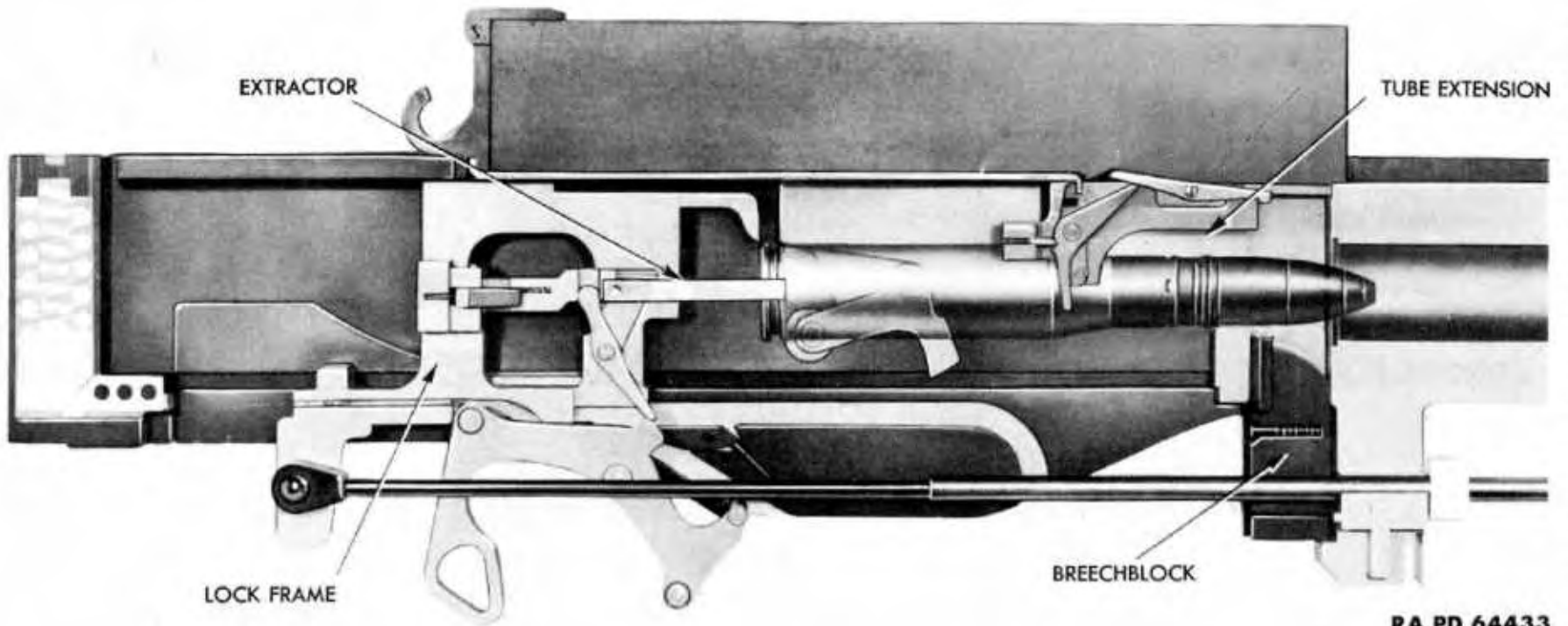


Figure 29 — Cartridge Case Extracted as Tube and Tube Extension Counterrecoils — Lock Frame Held to Rear



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Figure 30 — Lock Frame Counterrecoiling — Cartridge Entering Firing Chamber

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pressed. On counterrecoil, the feed lever operating stud pushes the feed lever forward, causing this lever to actuate the system of levers and links that carries the next cartridge into the feed box, strips the round from the clip, and feeds the round into the tube extension. The feed lever is then forced back to its initial position by the action of the feed slide return lever, located in the front of the feed box.

f. **Counterrecoil of the Lock Frame** (fig. 30). Further action of the feed lever and feed slide strips a round of ammunition from the cartridge clip and as the cartridge moves to the right it moves the carrier catch which releases the carrier. The carrier forces the cartridge down and causes the carrier dog to pivot, thus releasing the lock frame which is pulled forward by the driving springs, and the loading of the gun is completed as described in subparagraph b, above. The round is fired by pulling the trigger, for the trigger lever connector will move against the sear and release the hammer. When the trigger is held in firing position, the gun will continue to fire automatically as long as ammunition is fed into the gun.

g. **Function of Feed Mechanism** (figs. 7 and 8). Movement imparted to the feed lever by the feed lever operating stud as the tube extension counterrecoils, is transmitted through the feed crank and feed slide lever to the feed slide, moving it to the right. The spring-loaded feed pawl attached to the under side of the feed slide engages a projection on the top surface of the cartridge clip. Near the end of the feed slide movement to the right, the cartridge feeder stop pawl drops into a recess in the front edge of the slide and a notch in the side of the cartridge clip. This stops the clip and prevents it from being moved farther to the right than necessary. The holding pawl engages a notch in the cartridge clip body and prevents the clip from being moved to the left as the feed slide moves to the left in preparation for bringing in another round. As the tube extension nears battery position, the feed slide return lever causes the feed slide to move to the left. This movement of the feed slide disengages the stop pawl from the notch in the cartridge clip and the recess in the feed slide. Since the holding pawl engages only the notch in the cartridge clip, it will prevent the clip from moving to the left during the return of the feed slide, but it will become disengaged from the notch in the cartridge clip as the clip is moved to the right. Both pawls are pressed into engagement by the cartridge feeder pawl spring.

h. **Function of Recuperator** (fig. 31). The recuperator cylinder fits in the lower front opening of the trunnion block and houses the recoil piston rod, piston, recuperator springs, and the recoil oil. The piston rod is fastened to the lower part of the front section of the tube extension by means of the recuperator piston rod nut. As the tube and tube extension recoil, the piston moves backward, compressing the

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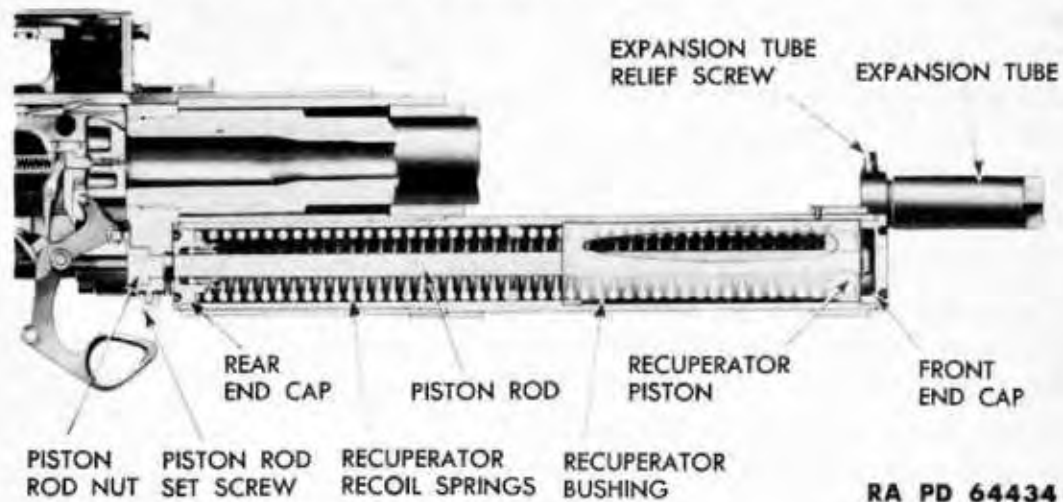


Figure 31 — Recuperator Assembly — Cutaway View

recuperator spring and forcing the recoil oil through the openings of the recuperator bushing. The expansion of the compressed recuperator spring returns the piston, piston rod, and recoil oil to their initial positions, thereby causing counterrecoil. The tube and tube extension are carried back to battery by the recuperator piston rod. The expansion tube is the small cylinder screwed to the upper front end of the recuperator. This cylinder is a hollow body used to compensate for expansion and contraction of the recoil oil in the recuperator.

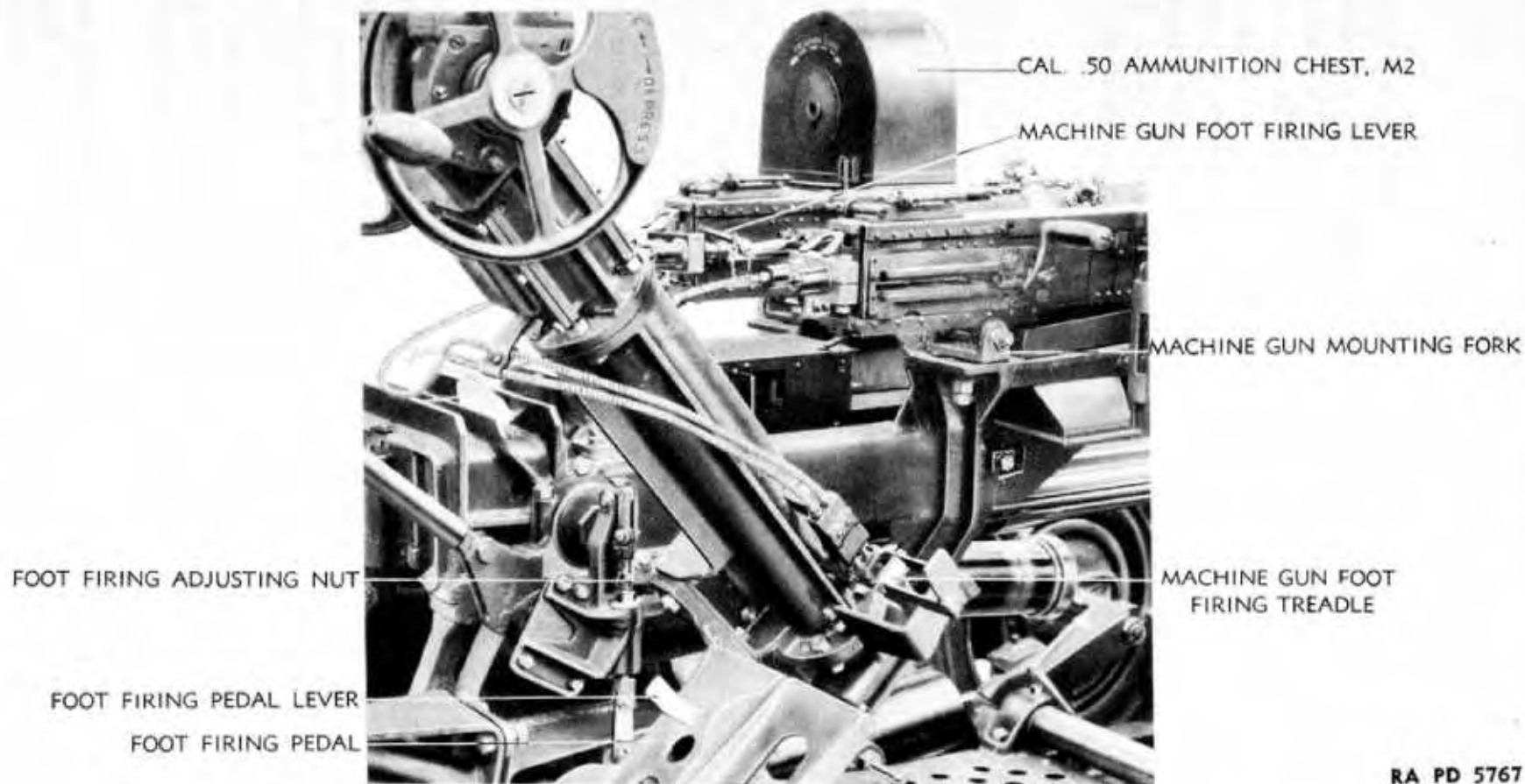
Section III

DESCRIPTION AND FUNCTIONING OF GUN CARRIAGE AND MOUNT

16. GENERAL DESCRIPTION.

a. The 37-mm Automatic Gun M1A2 is mounted on Carriage M3, M3E1, or M3A1 (figs. 1, 2, and 3). At the present time the Carriage M3A1 is a standard model, M3 substitute standard, and M3E1 is classified as limited procurement type. These carriages are of 2-axle, 4-wheel trailer type and are equipped with pneumatic tires and electric brakes on all wheels. There is a manually operated brake on each of rear wheels. A drawbar and lunette connect the carriage to the prime mover.

b. The carriage consists mainly of the chassis and the top carriage. The chassis supports the top carriage and contains all mechanisms necessary for maneuvering and emplacing the carriage. The top carriage is the rotating part, and contains all mechanisms necessary for laying, setting, and firing the gun.



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Figure 32 — Foot Firing Mechanism for 37-mm Gun and Two Cal. .50 Machine Guns

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c. A detailed description and the function of each major assembly is given in the following paragraphs.

17. TOP CARRIAGE.

a. The top carriage consists of welded steel sections which form a circular base and two upright sections. It is supported by a large circular bearing resting on top of the leveling mechanism. Through the medium of the traversing rack bolted to the leveling mechanism and connecting gearing to the traversing mechanism, the top carriage can be turned or traversed through 360 degrees. The platform is bolted to and swings with the top carriage. Mounted on the top carriage are all operating mechanisms essential to the functioning of the gun. The upright members support the cradle in which the gun is mounted.

18. CRADLE.

a. The cradle is secured to the top carriage by means of trunnion blocks. The elevating rack used for elevating the cradle is bolted to the bottom of the cradle and meshes with the elevating pinion at the base of the elevating mechanism. The equilibrator is attached to the back end of the cradle by means of a rod on the Carriages M3 and M3E1, and by a chain for the Carriage M3A1. A horizontal slideway in each side plate of the cradle is used for locating and securing the gun. Two gun mounting keys bolted to the front of the cradle, lock the gun in position. The Cradle M3E1 contains brackets on the right and left side for mounting the cal. .50 machine guns and is of open frame construction. The Cradle M3A1 is provided with a set of cover plates and removable covers that totally enclose the gun when not in use.

19. FIRING MECHANISM.

a. **Carriage M3** (fig. 32). The elevation setter or operator is provided with two foot pedals, the left one acting as a control for firing the gun. This foot pedal has a latch lever which is located on the left side of the pedal. The operator fires the gun by disengaging the latch. This is done by pressing the lever to the left and then pushing the pedal down. The gun trigger remains pulled as long as the foot pedal is depressed. When pressure on the pedal is released, the pedal rises and the latch automatically locks the pedal. A mechanical system of levers and links carries the motion of the foot pedal through the right trunnion bearing to the trigger connector bracket lever, which passes through the hole of the trigger.

b. **Carriage M3E1** (fig. 32). The firing mechanism for the 37-mm gun on the M3E1 is the same as that on the Carriage M3. The firing mechanism for the two cal. .50 machine guns consists of a foot treadle

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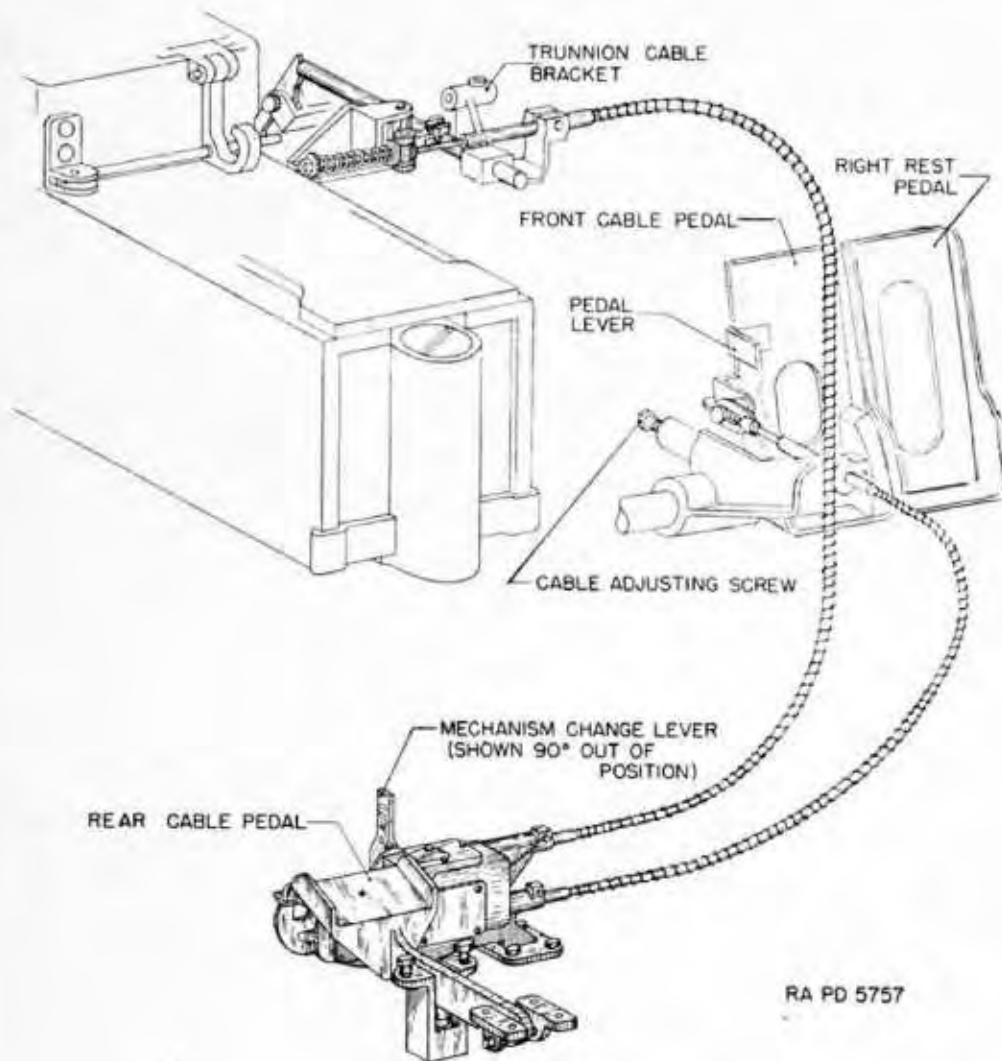


Figure 33 — Firing Mechanism of Carriage M3A1

assembly, bolted to the lower portion of the elevating mechanism gear case. This foot treadle is operated by the right foot of the elevation setter. Two cables run from this treadle, one to each of the two cal. .50 machine guns mounted on the sides of the cradle. Either one of the cables can be disconnected from the machine gun by means of the machine gun foot firing lever found at the point where the cables are connected to the trigger mechanism (fig. 32).

c. **Carriage M3A1.** A foot pedal similar to that on the Carriages M3 and M3E1 is provided on the Carriage M3A1. In addition, the rear cable pedal (figs. 33, 34, and 35), which is located on the firing platform directly behind the cradle, can also be used to fire the gun. This pedal has no latch. The foot firing mechanism change lever (figs. 34 and 35) is provided to change the type of firing. When this lever points

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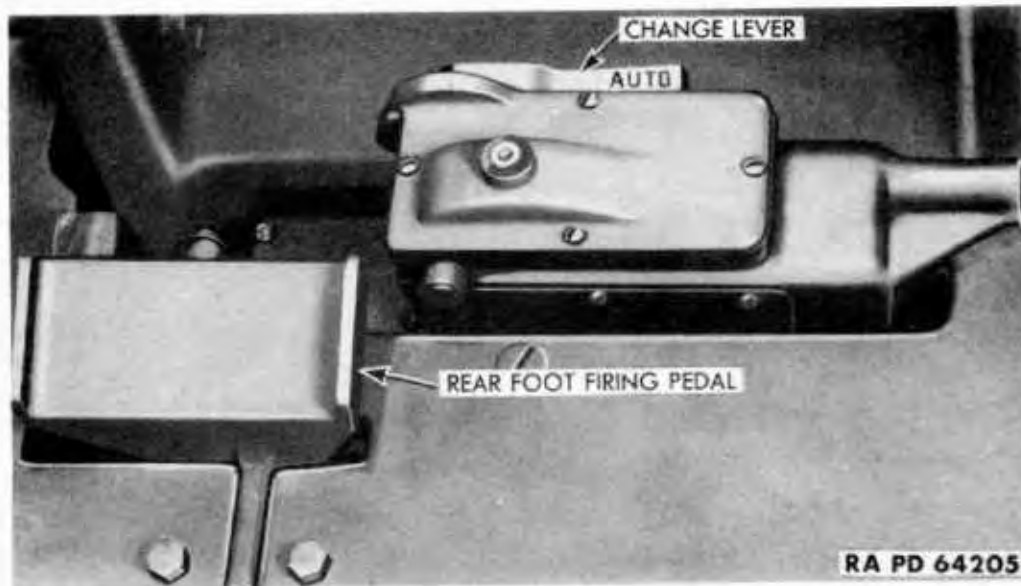


Figure 34 — Change Lever Set for Automatic Firing

to the right, the word "AUTO" is shown. Operation of each pedal will provide full automatic firing of the gun. When this lever is pointed to the left the word "FOOT" is shown. Firing will be semiautomatic when operating with either foot pedal. A mechanical system of levers, links, and cables carries the motion of the front and rear cable pedals to the trigger of the gun. The trunnion cable bracket is used for mounting the subcaliber equipment.

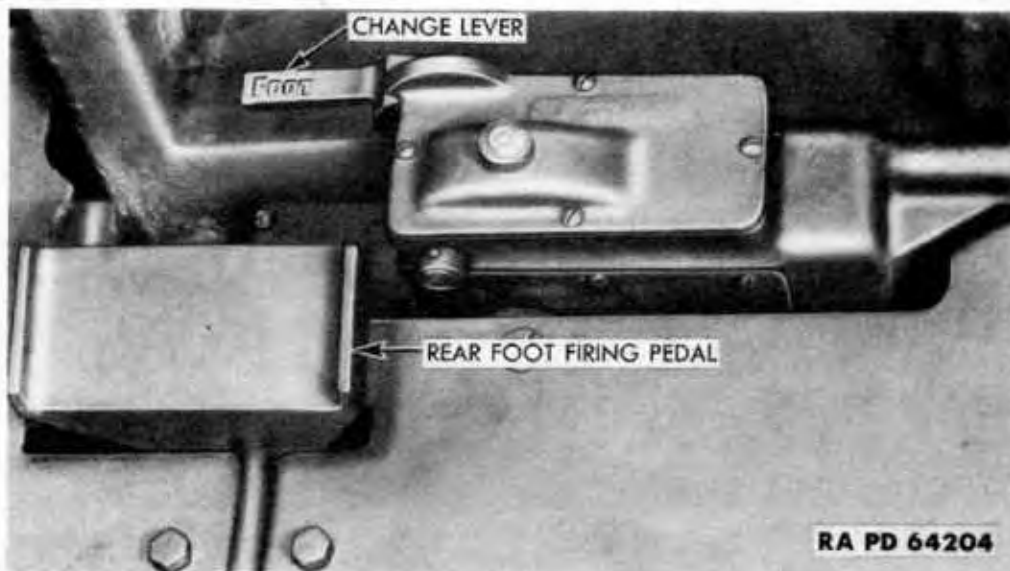


Figure 35 — Change Lever Set for Semiautomatic Firing

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20. EQUILIBRATOR MECHANISM.

a. The equilibrator counterbalances the effort required to depress or elevate the gun and cradle. The equilibrators of these carriages are spring-operated. When the gun is lowered, the equilibrator spring is compressed, and when elevated, the spring is extended. Adjustment of the equilibrator mechanism is possible by means of two adjusting nuts made available by removing the front cap of the equilibrator.

21. ELEVATING MECHANISM.

a. Carriages M3 and M3E1. The elevating mechanism of these carriages is an upright post mounted to the right of the cradle. Two handwheels (fig. 32) are provided for elevating or depressing the gun and cradle. By sliding the handwheels laterally along their axes, either a fast or slow motion can be obtained. The limits of elevation are from 0 degrees to 85 degrees, at which point the cradle will automatically stop. Slow motion of the handwheel will elevate the gun 3.75 degrees for one turn of the handwheel, and the fast motion will elevate the gun 11.25 degrees for one turn of the handwheel.

b. Carriage M3A1. The elevating mechanism of this carriage is to the right of the cradle. There is one speed obtainable by the elevating crank. The gun and cradle are elevated 4.67 degrees for each turn of the crank. The limits of elevation are from minus 5 degrees to 90 degrees when using the hand crank, and from 0 degree to 85 degrees when using the remote control system.

22. TRAVERSING MECHANISM.

a. Carriages M3 and M3E1. The traversing mechanism of these carriages is an upright post to the left of the cradle. Two handwheels are provided for traversing the gun and cradle. By sliding the handwheels laterally along their axis, either a fast or slow motion can be obtained. Complete traverse of 360 degrees is obtainable. Slow motion of the handwheel will traverse the gun 3.75 degrees for one turn of the handwheel and the fast motion will traverse the gun 11.25 degrees for one turn of the handwheel.

b. Carriage M3A1. The traversing mechanism of this carriage is to the left of the cradle. Only one speed is obtainable by the hand crank of the traversing mechanism and complete traverse of 360 degrees is obtainable.

23. OIL GEARS.

a. The oil gear assemblies, one for the elevating mechanism and one for the traversing mechanism, are mounted on the top carriage and form a part of the remote control firing system. Through electrical

DESCRIPTION AND FUNCTIONING OF GUN CARRIAGE AND MOUNT

connection (Cable System M8, with safety switch) with the remote control sighting and fire control equipment, these oil gears operate the elevating or traversing mechanisms. These oil gears are provided only on the Carriage M3A1.

24. LOWER CARRIAGE.

a. The chassis of all three carriages are very much alike in construction. They consist of frames carrying the gun mount in traveling and supporting it during firing. Attached to the chassis are the wheels, steering mechanism, counterpoise cylinders, buffer spring suspensions, a gun support, outriggers, top carriage, and all maneuvering mechanisms. The carriage is towed by a prime mover. When ready for firing, it is detached from the prime mover and, by means of proper assemblies, the chassis is lowered to the ground and the wheels are raised so that the entire weight is supported by the chassis.

25. LEVELING MECHANISM.

a. The leveling mechanism is provided for placing the top carriage in a horizontal plane for firing. Two handwheels are provided for making this adjustment and two leveling vials for noting the level position of the top carriage. The motion of the leveling mechanism operates through a range of 10 degrees.

26. CARRIAGE BUFFER MECHANISM.

a. The buffer cylinders are pivoted to the side members of the chassis behind each of the four wheels. The front buffer cylinders are connected by a shaft as well as the rear buffer cylinders. A buffer lever and lock are provided to rotate each set of buffers into or out of position by rotating the shafts to which they are connected. The buffer shafts rotate in bearings on the chassis. Locks are provided for the buffer levers to prevent accidental movement. The front buffer lever is also arranged to lock the drawbar and steering mechanism in the straight forward position when the carriage is lowered. The buffer dog, which is welded to the right tie rod, fits into a socket on the buffer mechanism when the carriage is lowered and the drawbar is in a straight forward position. This prevents the drawbar from being moved while the carriage is emplaced.

27. COUNTERPOISE ASSEMBLIES (fig. 36).

a. The counterpoise cylinders are pivoted to the side members of the chassis in front of each of the four wheels. The counterpoise rods are pinned in brackets on the rotating axle arms. Together with the buffer assemblies, they provide the spring suspension for road travel. The counterpoise springs also provide the counterbalance for the

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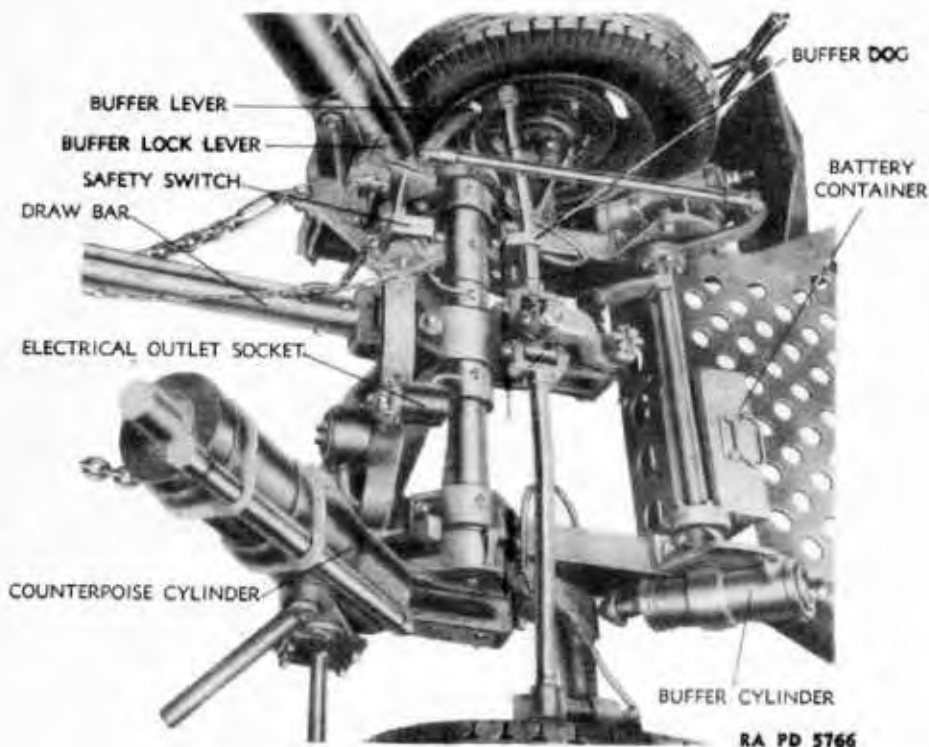


Figure 36 – Counterpoise Cylinder and Buffer Mechanism

weight of the carriage, allowing the carriage to be lowered to the ground and lifted therefrom by man power. Long handles on the counterpoise cylinders give added leverage for rotating the axle arms. The ends of the counterpoise rods are so arranged in the axle arms that when forcing the counterpoise cylinders down, the counterpoise rods raise the wheels, allowing the chassis to drop, and the counterpoise springs are compressed and hold the wheels off the ground. The reverse action occurs when manually lifting the chassis and rotating the buffer cylinder levers up. Adjustment of the counterpoise cylinders is possible by means of two adjusting nuts made available by removing the upper cap of the counterpoise cylinder.

28. BRAKES.

a. **Service Brakes.** Electric brakes are provided on all wheels of the carriage. The two rear wheels are supplied with hand brakes which are to be used when maneuvering the carriage by man power and when the carriage is not connected to the prime mover. A jumper cable carries current from the prime mover to the carriage for the operation of brakes and lights. One end of the cable is attached to a junction box on the carriage and the other end has a connection which plugs into a socket on the prime mover. When the carriage is detached from the prime mover, a safety switch chain and the jumper cable

DESCRIPTION AND FUNCTIONING OF GUN CARRIAGE AND MOUNT

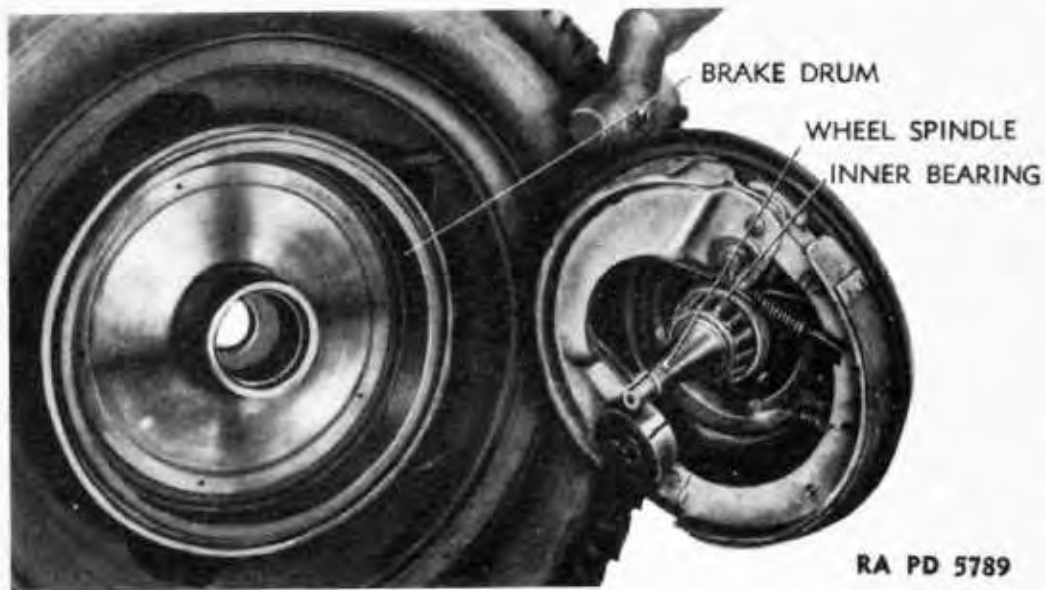


Figure 37 – Wheel and Brake Drum Removed From Assembly

must be separated from the prime mover. When detached from the prime mover, the connection on the loose end of the cable may be plugged into the electrical outlet socket on the carriage (fig. 36).

b. Types of Brakes. There are two different kinds of electric brakes on all three carriages. The lever type of brakes (Magdraulic electric) are on carriages having the letters "K.H." stamped on the backing plate of each brake. When the wheel and brake drums are removed, the brake will be seen to consist, in part, of a circular disk attached to the end of a long curved lever (fig. 37). The other type of brake is the disk brake (Warner electric) which is identified by a flat movable ring located concentrically around the wheel spindle.

c. Safety Switch. A safety switch ("break-away" switch) (fig. 36) is provided to insure that the brakes on the carriage are applied if the carriage breaks away from the prime mover. The switch is mounted on the front cross member of the carriage and is connected to the rear of the prime mover by a light chain. Current which is supplied to the brakes by the safety switch comes from a 6-volt dry cell battery mounted on the carriage (fig. 36). In case of an accidental separation between the carriage and prime mover, the chain attached to the prime mover pulls the switch, and the brakes on the carriage set instantly. After a breakaway, the switch must be placed in the "OFF" position so as not to exhaust the battery.

d. Prime Mover. The driver of the prime mover operates the brakes by means of an electric brake controller. The position of the hand lever of the controller determines the amount of current flowing

37-MM AA GUN MATERIEL

from the battery of the prime mover to the brakes, and governs the intensity of the braking force. A load controller is also installed in the prime mover and is set by the driver. This adjustment allows the driver to regulate the braking power, thereby holding skidding to a minimum, regardless of load or road conditions.

e. **Hand Brakes.** The brakes on the rear wheels of the carriage may be applied by pulling the hand brake levers forward. These are to be used only when the carriage is not connected to the prime mover.

29. WHEELS AND HUBS.

a. Wheels are of pressed steel type and tires are mounted directly on the wheel, the inner side of which is formed into a rim. The tire is held in place by a locking ring which fits into a groove in the wheel and forms the outer rim. Wheels are mounted to wheel hubs by studs fastened to the hubs. Wheel mounting studs and nuts have left-hand threads on the left side of the carriage and right-hand threads on the right side of the carriage to prevent loosening of wheel nut when carriage is in motion. The hub and drum are mounted on the wheel spindles on tapered roller bearings.

30. FRONT AND REAR AXLES.

a. Both front and rear axles are of the same general construction. The left axle arm is welded to a shaft and the right axle arm is welded to a tube. When assembled, the end of the shaft, which is a part of the left axle arm, extends through the tube which is part of the right front axle arm. A nut fastens the assembly together, allowing the right and left wheel to move up and down independently of each other.

31. STEERING MECHANISM.

a. The carriage is steered by moving of the right and left steering knuckles, which are mounted with pins to the axle arms. Movement of the steering knuckles is initiated by swinging of the drawbar to the right or left. This movement is transmitted through linkage, connectors, and tie rods to the steering knuckles. The steering mechanism is secured to the chassis by a bracket which is keyed to the front outer axle shaft and rotates with this bracket as the wheels are raised or lowered. A lug is welded to the right steering tie rod and when the wheels are in the straight ahead position, this lug is in line with the notch in the steering mechanism lock. The lug on the tie rod should engage this notch when the carriage is lowered to firing position to keep front wheels in alignment, as otherwise, binding of counterpoise mechanisms would result making it necessary to raise the carriage with a jack.

DESCRIPTION AND FUNCTIONING OF GUN CARRIAGE AND MOUNT

32. OUTRIGGER ASSEMBLIES.

a. Two outriggers attached to the side members of the chassis, when lowered, bear against the ground and give stability to the carriage in firing position. When in traveling position, these outriggers are raised and secured so that they stand upright on each side of the chassis. The Carriage M3E1 has provisions for carrying the outriggers alongside the chassis rather than in an upright position. The Carriage M3A1 is now made so that the outriggers stand upright for traveling; however, if these carriages are made by converting Carriage M3E1, the outriggers will be carried as on the present Carriage M3E1. Side plates which are part of the firing platforms of the Carriage M3A1, must be folded back when raising the outriggers of these carriages.

33. GUN SUPPORT.

a. The gun support is of welded tubular construction, pivoting on a shaft at the rear of the lower carriage frame. Its purpose is to support the gun tube in traveling position. A clamp is provided at the top of the support to lock the gun tube securely in place. The gun support should be lowered when the gun is in firing position.

34. COMBINATION GUN MOUNT M42.

a. This mount provides a means for laying, setting, and firing the 37-mm gun and the two cal. .50 machine guns.

b. **Cradle** (fig. 38). The cradle is designed to accommodate the 37-mm gun and the two cal. .50 machine guns. The elevating rack, provided for elevating the cradle, is bolted to the bottom of the cradle and meshes with the elevating pinion of the elevating mechanism. The equilibrator is attached to the back end of the cradle by means of a rod.

c. **Elevating Mechanism** (figs. 4 and 38). The elevating mechanism is contained in the upright post to the right of the cradle. Two handwheels are provided for elevating or depressing the guns and cradle. By sliding the handwheels laterally along their axes, either a fast or slow motion can be obtained. The limits of elevation are 0 degree and 85 degrees. Slow motion of the handwheel will elevate the gun 3.75 degrees for one turn of the handwheel, and fast motion will elevate the gun 11.25 degrees for one turn of the handwheel.

d. **Traversing Mechanism** (fig. 38). The traversing mechanism is contained in the upright post to the left of the cradle. Two handwheels are provided for traversing the gun and cradle. By sliding the handwheels laterally along their axis, either a fast or slow motion can be obtained. Complete 360-degree traverse is obtainable. Slow

37-MM AA GUN MATERIEL

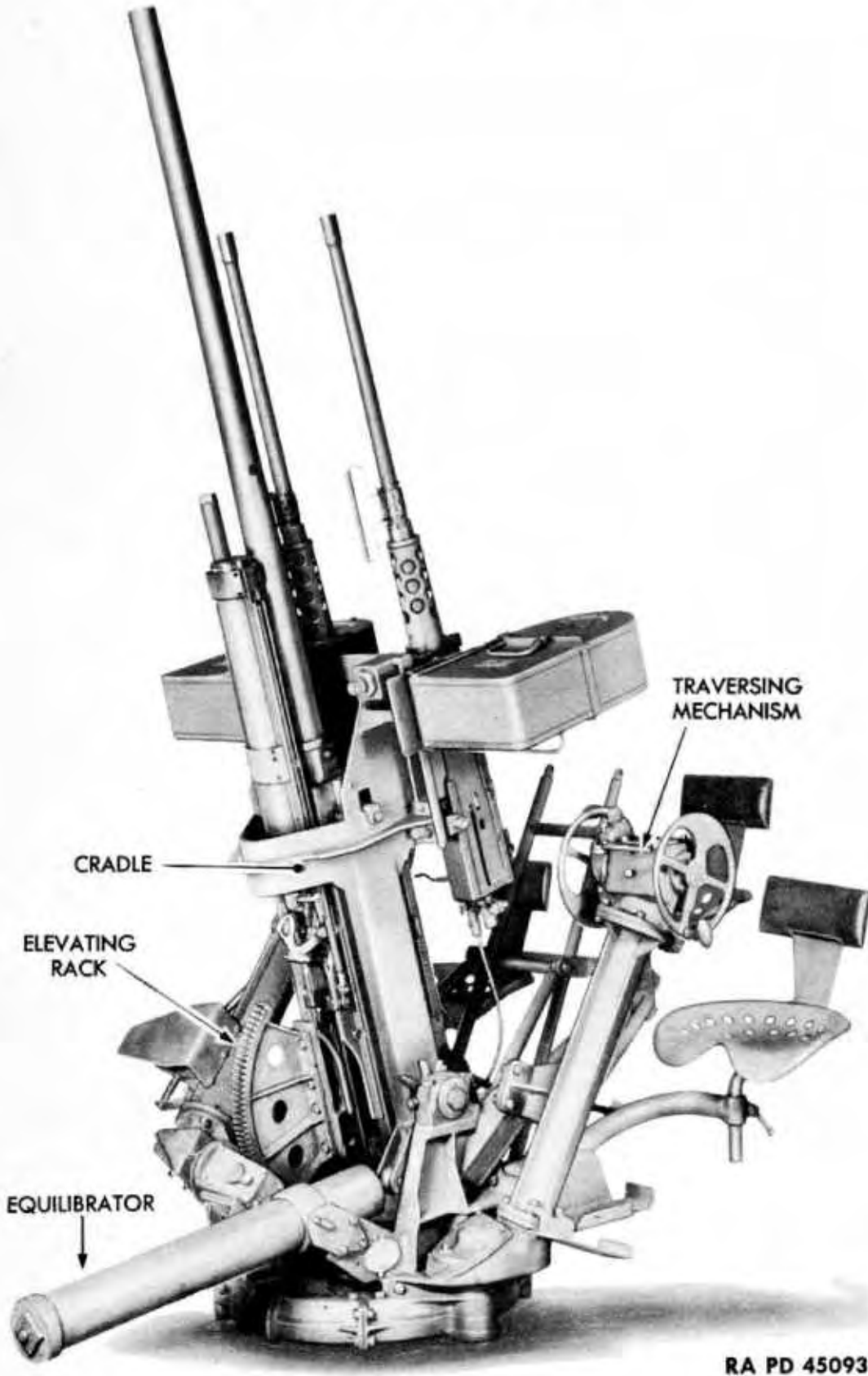


Figure 38 — Combination Gun Mount M42 — Guns Elevated 85 Degrees

DESCRIPTION AND FUNCTIONING OF GUN CARRIAGE AND MOUNT

motion of the handwheel will traverse the gun 3.75 degrees for one turn of the handwheel, and the fast motion will traverse the gun 11.25 degrees for one turn of the handwheel.

e. Firing Mechanism.

(1) 37-MM GUN. The elevating operator is provided with two foot pedals, the left one acting as a control for firing the gun. This foot pedal is provided with a latch lever which is located to the left of the pedal. The operator fires the gun by disengaging the latch. This is done by pressing the lever to the left and then pushing the pedal down. The gun trigger remains pulled as long as the foot pedal is depressed. When pressure on the pedal is released the pedal rises and the latch automatically locks the pedal. A mechanical system of levers and links carries the motion of the foot pedal through the right trunnion bearing to the trigger connector bracket which passes through the hole of the trigger.

(2) CAL. .50 MACHINE GUNS. The firing mechanism for the two cal. .50 machine guns consists of a foot treadle assembly bolted to the lower portion of the elevating mechanism gear case. This foot treadle is operated by the right foot of the elevating operator. Two cables run from this treadle, one to each of the two cal. .50 machine guns mounted on the sides of the treadle. Either one of the cables can be disconnected from the machine gun by means of the machine gun foot firing lever found at the point where the cables are connected to the trigger mechanism.

f. Equilibrator. The equilibrator counterbalances the handwheel load when elevating or depressing the guns and cradle. The equilibrator is spring-operated and is connected to the rear of the cradle. When the gun is lowered, the equilibrator spring is compressed; and when elevated, the spring is extended. Adjustment of the equilibrator mechanism is possible by means of two adjusting nuts made available by removing the head of the equilibrator.

35. PEDESTAL.

a. The pedestal is provided for mounting the gun mount, guns, and armor shields on the half-track vehicle. The pedestal consists of the upper pedestal and lower pedestal and two heavy castings bolted together by 8 bolts, nuts, and lock washers. The lower pedestal is secured to the vehicle by means of 12 bolts, nuts, and lock washers.

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Section IV

OPERATION

36. TO PLACE WEAPON IN FIRING POSITION ON CARRIAGE.

a. **Terrain.** These carriages should be emplaced on smooth, level ground. If the terrain has a slope greater than 5 degrees, the top carriage can not be properly leveled.

b. **Brakes.** Safety switch should be in "OFF" position. Use hand brakes for braking power whenever the carriage is disconnected from prime mover. Hand brakes must be in "OFF" position when raising or lowering the carriage.

c. **Lowering Carriage to Ground.**

(1) Swing the drawbar so that the front wheels are parallel to the carriage side frames. A check of this can be had by noting if the lug which is welded to the steering tie rod, right, is in alinement with the notch in the steering mechanism lock.

(2) While standing in front of the carriage, pull the buffer lock lever (fig. 39) to the right and pull the buffer lever forward as far as it will go. Let the buffer lock re-engage the buffer lever in this position. Operate the rear buffer mechanism in the same manner (fig. 40).



RA PD 39501

Figure 39 — Lowering Front of Carriage to Firing Position

OPERATION

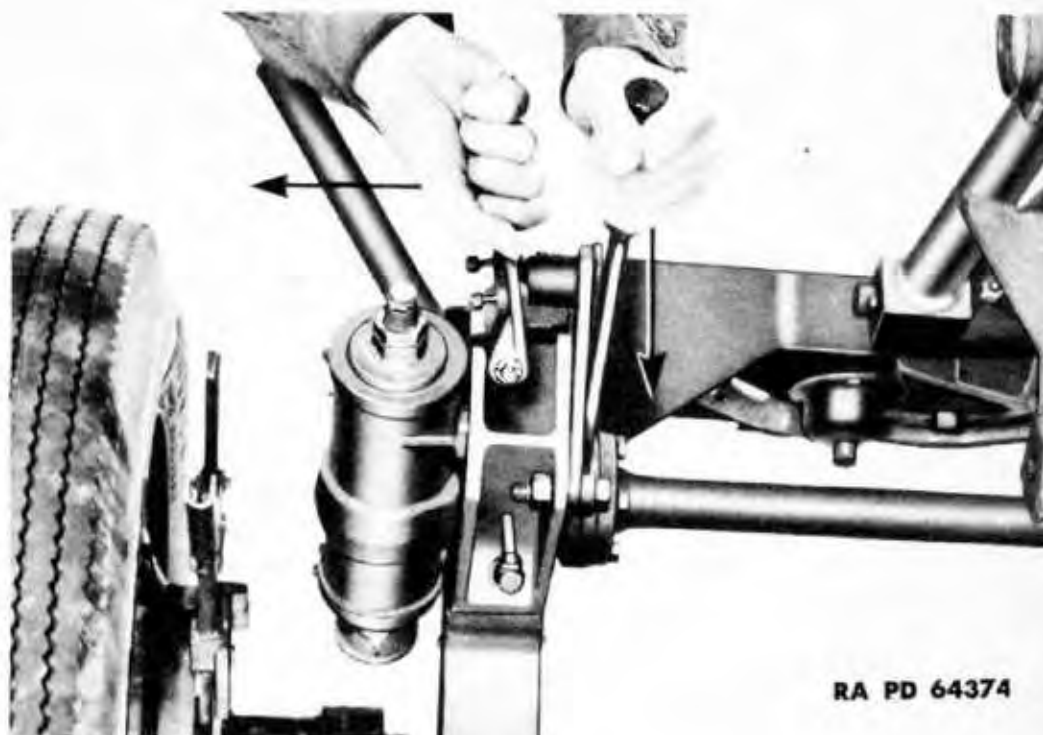


Figure 40 — Moving Rear Buffers Away From Axle Arms

(3) Force the carriage to the firing position by pressing down on the handholds located at the four corners of the chassis. If necessary, a man can stand on each handhold.

(4) Extend the counterpoise levers and force them down until the counterpoise cylinders have rotated the full amount (fig. 41). The wheels should now be off the ground, if not, pull them up.

(5) If it is difficult to lower the carriage, an appropriate number of men should get on the platform so that their weight will help in lowering it. If it is difficult to rotate the counterpoise cylinders, it may be necessary to use a pry or jack on the axle in order to force the wheels to the raised position while rotating the counterpoise cylinders. Incorrect adjustment of the counterpoise cylinders may be the cause of difficult operation. **CAUTION:** This method is to be used only in emergency when advance maintenance personnel are not available since additional weight may result in damage to the materiel. For adjustment of counterpoise cylinders, notify ordnance personnel.

(6) When emplacing the carriage in sand or soft ground, a small plank about two feet long and at least six inches wide should be placed under each wheel so that the axles will be rotated sufficiently to raise the wheels above the ground.

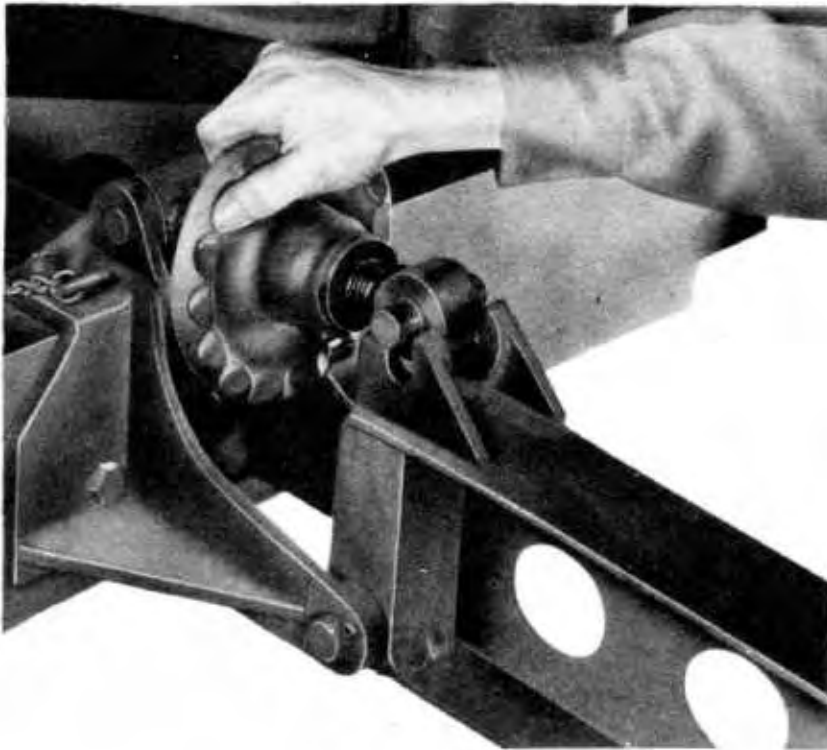
(7) Under no circumstances should undue force be applied to

37-MM AA GUN MATERIEL



RA PD 39500

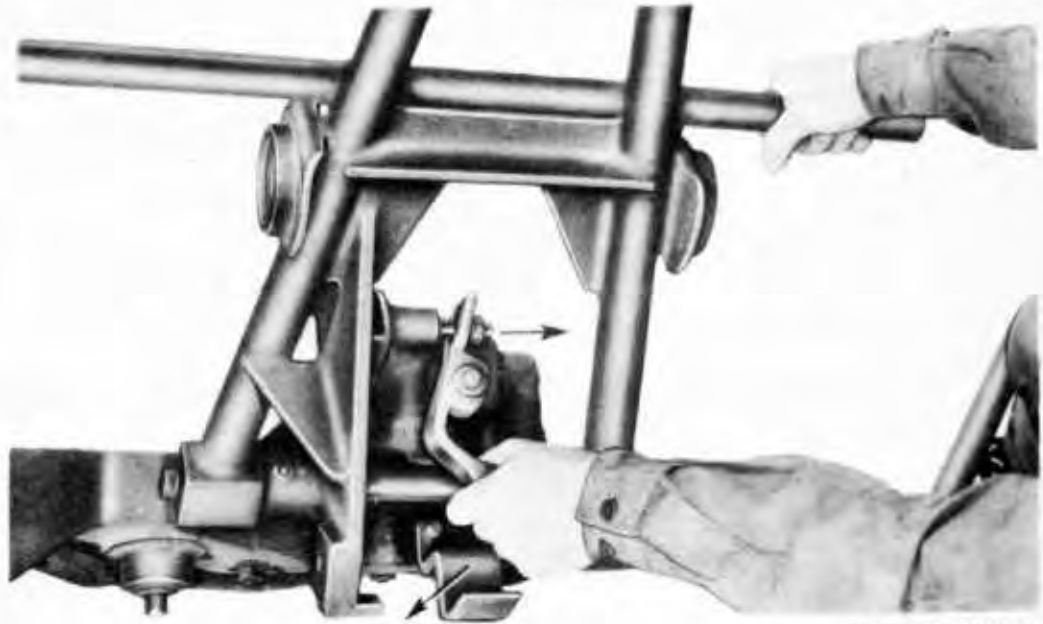
Figure 41 — Lowering Rear of Carriage to Firing Position



RA PD 5775

Figure 42 — Locking Outrigger in Firing Position

OPERATION



RA PD 64375

Figure 43 – Operating the Gun Support Lever

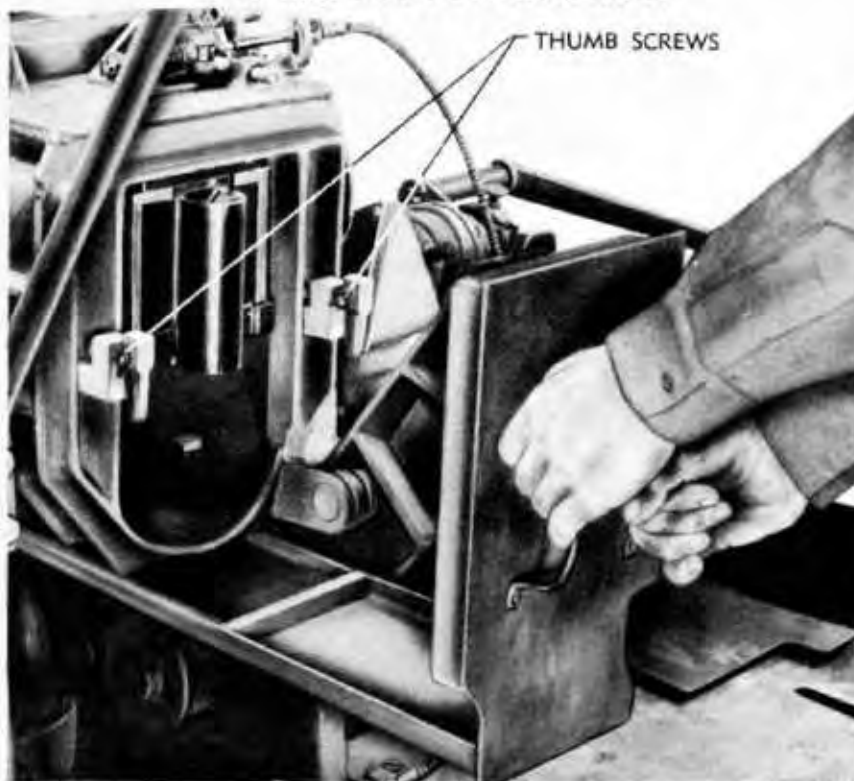
the counterpoise levers in pivoting the counterpoise and moving the lower end of the rod to a new position in the axle bracket. Neither should force be applied to these levers in an attempt to lower the carriage down to firing position or to raise it into traveling position. This will result in bending the counterpoise rods. Avoid excessive force on counterpoise levers and cylinders.

d. Lowering Outriggers when Carried in Upright Position.

- (1) Turn turnbuckle nut counterclockwise until the turnbuckle screw pin is disengaged from its socket on the outrigger.
- (2) Lower the outrigger and force it into contact with the ground.
- (3) Insert the turnbuckle screw pin into its other socket in the outrigger (fig. 42). Turn the turnbuckle nut counterclockwise until it is tight and holds the outrigger firmly against the ground.
- (4) The other outrigger is treated in the same manner.
- (5) The firing platform of the Carriage M3A1 contains two hinged plates that lead from the platform to the foot pedals. These plates must be extended when the outriggers are lowered.

e. Positioning Outriggers when Carried Alongside the Chassis Frame.

- (1) Loosen outrigger from traveling position by turning the turnbuckle nut counterclockwise.
- (2) Elevate the free end of the outrigger about 15 degrees until the pivoted end can be lifted from the supporting pin, and lift the outrigger free from the carriage.

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RA PD 5777

Figure 44 – Removing Cradle Shield Slide From Carriage M3A1

(3) Place the outrigger over the pin below the turnbuckle and force the outrigger against the ground.

(4) Insert the turnbuckle screw pin into its socket in the outrigger. Turn the turnbuckle nut counterclockwise until it is tight and holds the outrigger firmly against the ground.

(5) The other outrigger is treated in the same manner.

f. Lowering Gun Support.

(1) Loosen the nut holding the clamp around the gun tube, swing nut down, and swing the clamp in the opposite direction.

(2) Push the gun support lever (fig. 43) toward the center of the carriage and lower the gun support.

g. Removing Cradle Shields from Carriage M3A1.

(1) Turn the thumbscrews of the cradle shield slide to a vertical position and withdraw the slide (fig. 44).

(2) Unlatch both sides of the cradle shield cover. Lift the cover from the cradle (fig. 45).

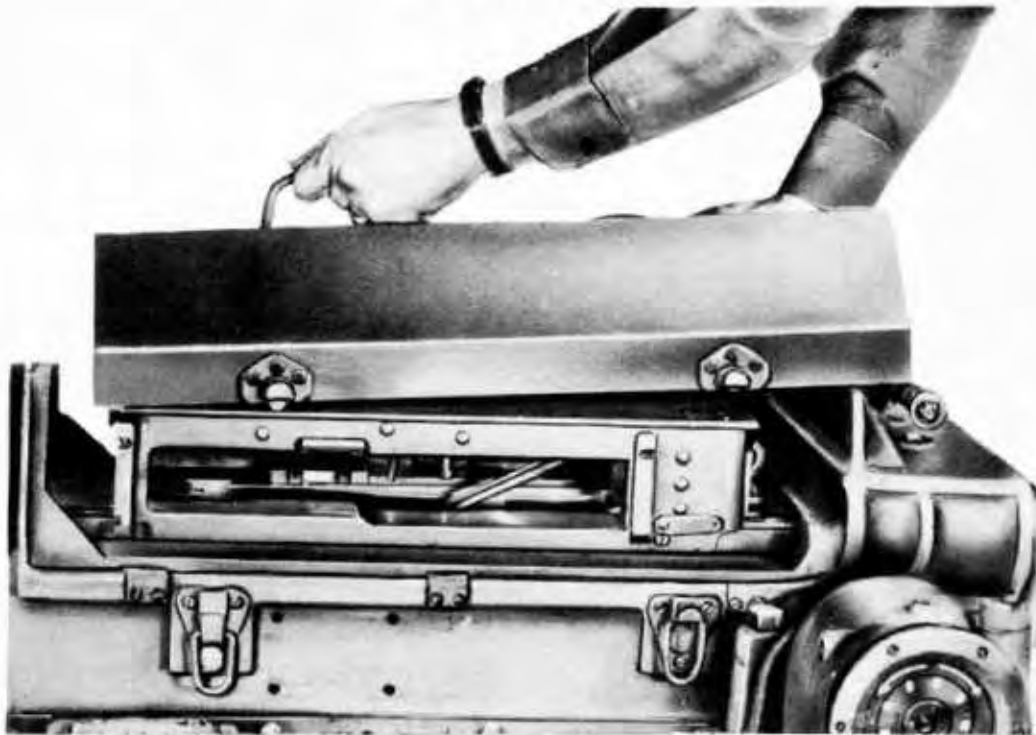
h. Assembly of Cartridge Tray to Gun.

(1) Depress the levers on each side of the cartridge tray.

(2) Push in the feed slide.

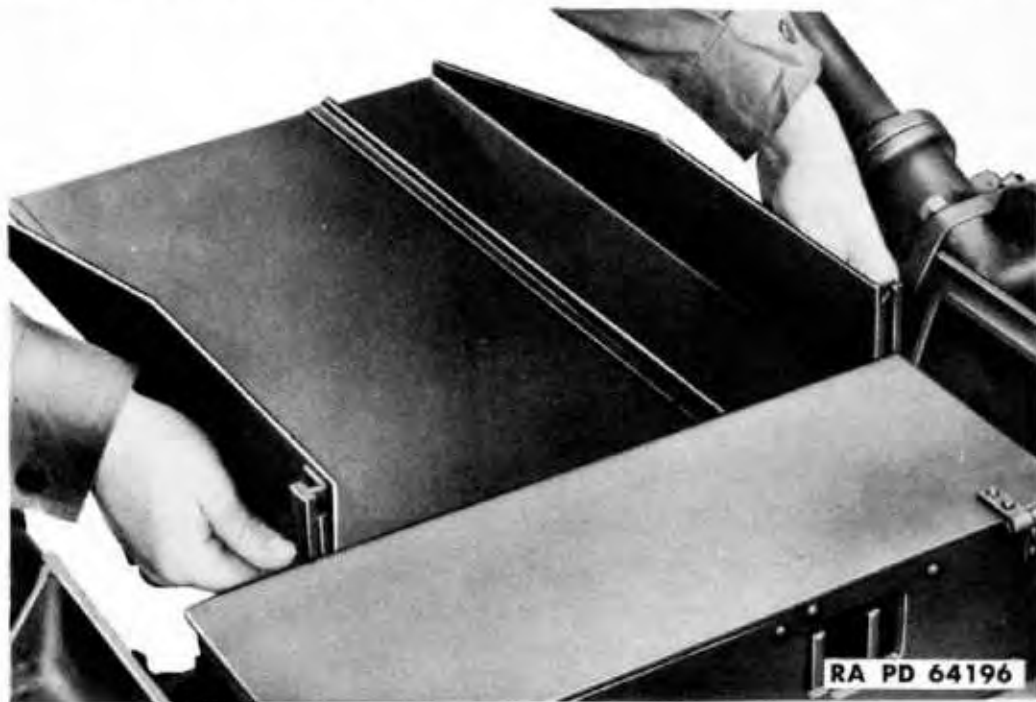
(3) Slide the tray down over its brackets on the left side of the

OPERATION



RA PD 5776

Figure 45 — Removing Cradle Shield Cover From Carriage M3A1



RA PD 64196

Figure 46 — Installing Cartridge Tray

gun far enough to let the latches snap into the holes of the brackets (fig. 46).

i. **Leveling Top Carriage.** Uncover the two leveling vials and level the top carriage by means of the two leveling handwheels on

37-MM AA GUN MATERIEL

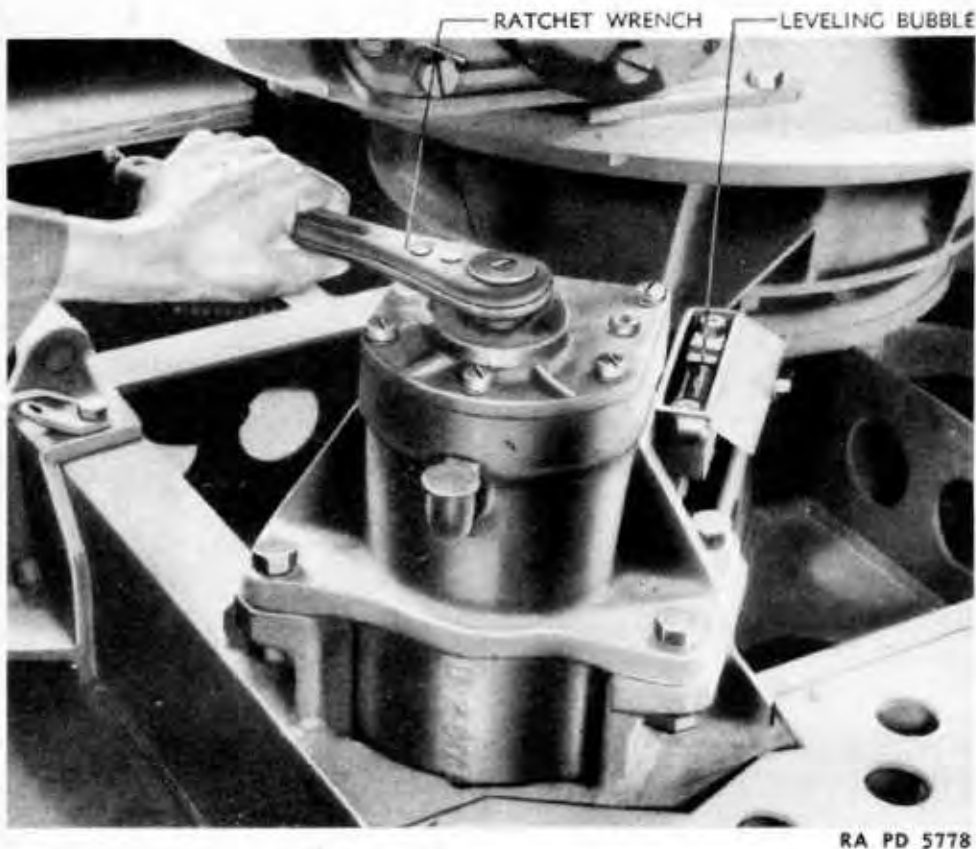


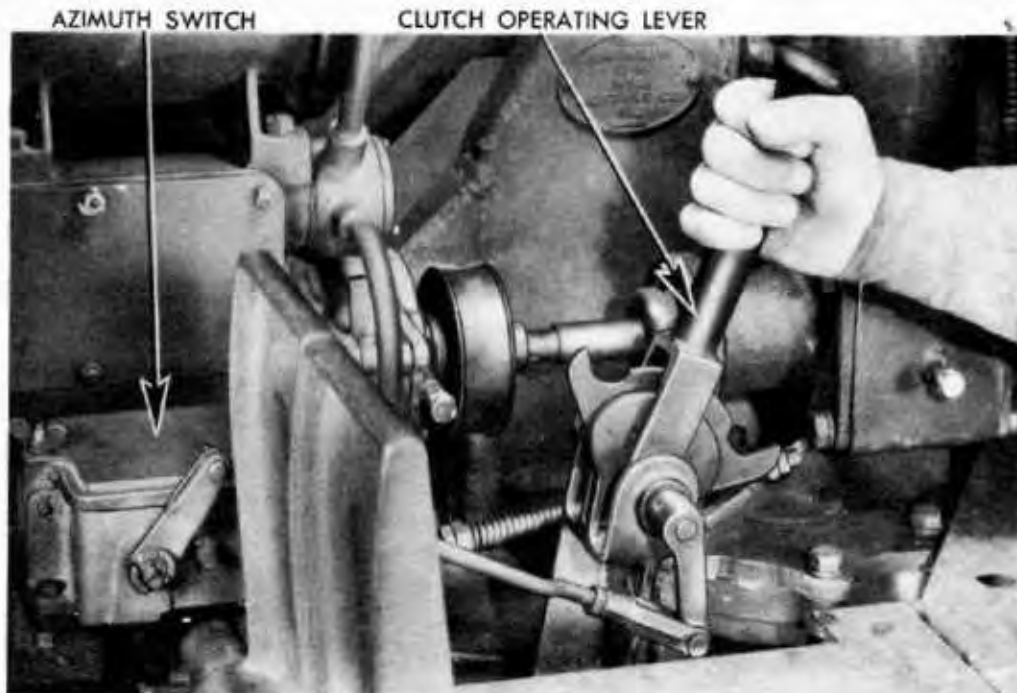
Figure 47 – Leveling Top Carriage of Carriage M3A1

the Carriages M3 and M3E1 or the two ratchet wrenches on the Carriage M3A1 (fig. 47). During firing, care should be taken not to move the leveling mechanisms and disturb the level condition of the top carriage. This is important, since no locking devices are on the leveling mechanisms.

37. TO PLACE WEAPON IN FIRING POSITION ON COMBINATION GUN MOUNT M42.

- a. **Terrain.** If possible, place the mount on level terrain.
- b. **Covers.** Remove gun covers and store them out of the way in the place assigned for them; likewise, store other equipment not required for operating the gun.
- c. **Gun Support.** Unlock the gun support so that the gun can be elevated and traversed.
- d. **Cartridge Tray.** Depress the levers on each side of the cartridge tray; push in the feed slide; then slide tray down over its brackets on the left side of the gun far enough to let the latches snap into the holes of the brackets.

OPERATION



RA PD 39499

Figure 48 — Disengaging Hydraulic Gear Switch

38. TO CHECK RECOIL OIL IN RECUPERATOR.

- a. Elevate the gun to 5 degrees.
- b. Remove the recuperator filler screw and the expansion tube relief screw (fig. 31).
- c. Note whether oil is just visible in the bottom of the recess in the bottom of the filling hole.
- d. If not to this level, add oil as described in paragraph 59 c.
- e. If too much oil is present remove the excess quantity as described in paragraph 59 c.

39. TO TRAVERSE TOP CARRIAGE.

a. **Carriages M3 and M3E1.** The traversing gear ratio is changed by sliding the handwheels laterally along their axes. On these models, the top carriage is traversed only by operation of handwheels.

b. **Carriage M3A1.**

(1) To traverse the top carriage by hand, disengage the azimuth clutch and switch by moving the clutch operating lever rearward (fig. 48). Engage the traversing hand crankshaft assembly by pushing the hand crank and sleeve $\frac{1}{2}$ inch toward the traversing mechanism and operate the hand crank. The hand crank is removed or replaced on the mechanism by pulling out on the spring-loaded plunger which holds it to the squared sleeve and then sliding it off or on the sleeve (fig. 49).

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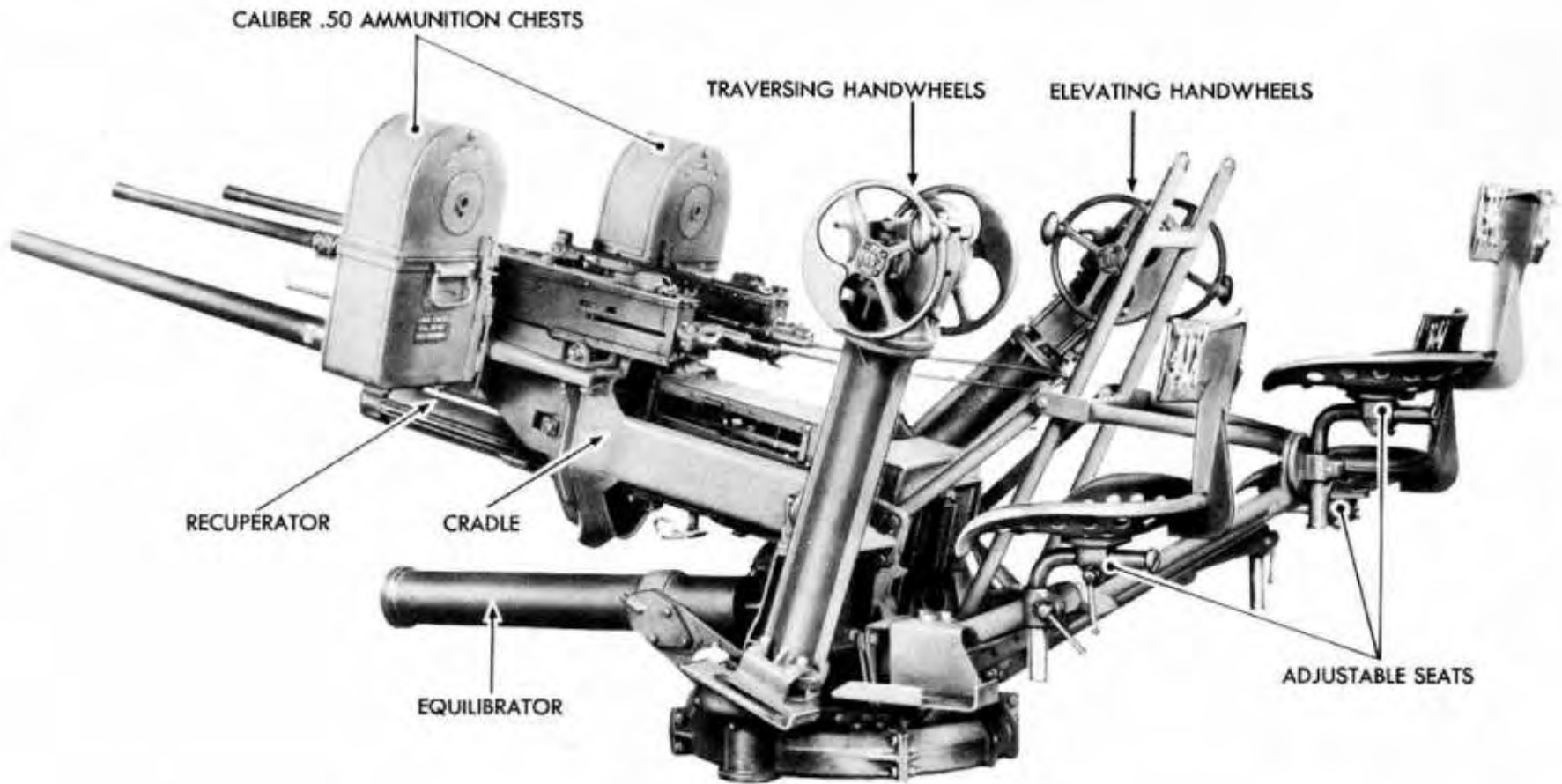


Figure 49 — Removing Hand Crank

(2) To make the top carriage ready to traverse by power, move the azimuth clutch operating lever to its forward position, which will engage the clutch and place the switch in the "ON" position. Disengage the hand crank and sleeve from the hand crankshaft by pulling hand crank away from traversing mechanism about $\frac{1}{2}$ inch.

40. TO TRAVERSE COMBINATION GUN MOUNT M42.

a. The gun mount, guns, crew, and shields are traversed by the two handwheels to the left of the cradle (fig. 50). Complete 360-degree traverse is obtainable. By sliding the handwheels along their axes, either a fast or slow traverse can be obtained.

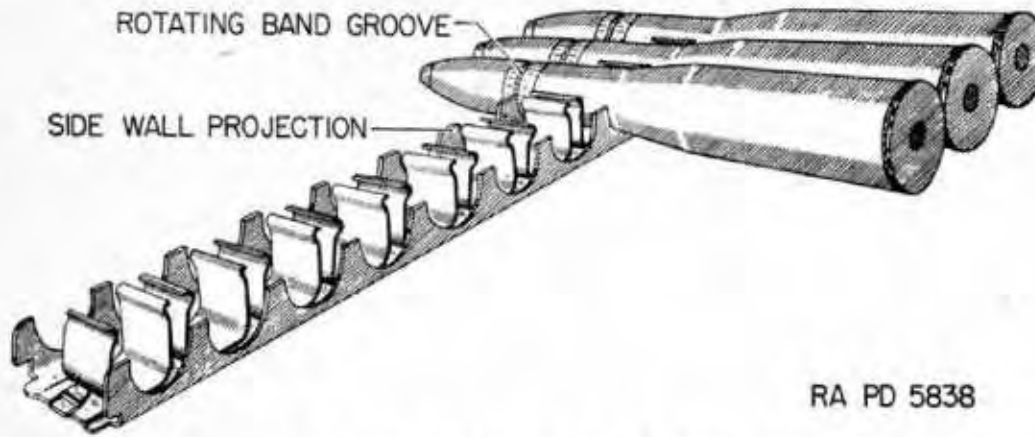


OPERATION

RA PD 45128

Figure 50 — Gun Mount M42 — Guns Elevated 25 Degrees

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RA PD 5838

Figure 51 — Cartridge Clip Partially Loaded

41. TO ELEVATE GUN.**a. Carriages M3 and M3E1.**

(1) On these carriages, the gun is elevated only by operation of the handwheels. The gear ratio may be changed by sliding the handwheels laterally along their axes.

(2) Force should not be exerted on the handwheels when the elevation limiting stops are reached.

b. Carriage M3A1.

(1) To elevate the gun by hand, disengage the elevation oil gear clutch by moving the clutch lever away from the oil gear. Engage the elevating hand crankshaft by sliding the squared sleeve about $\frac{1}{2}$ inch on its axis toward the gun. Mount the hand crank by pulling out on the spring loader plunger and sliding the crank on the squared sleeve. Force should not be exerted on the crank when the elevation limiting stops are reached.

(2) **TO PREPARE THE GUN FOR ELEVATION BY POWER.** Engage the elevation oil gear clutch by moving the clutch lever toward the oil gear. Move the lever controlling the elevation limit switch against its stop in the direction marked "ON" (fig. 152). Pull the squared sleeve about $\frac{1}{2}$ inch along its axis away from the gun disengaging the hand operating crank.

c. Combination Gun Mount M42. The gun is elevated by the two handwheels to the right of the cradle. The limits of elevation are 0 degree and 85 degrees. When firing over the top of the driver's compartment, the minimum elevation obtainable is approximately 20 degrees. By sliding the handwheels along their axes, either a fast or slow elevation action can be obtained.

OPERATION

42. TO LOAD.

a. Loading Cartridge Clip (fig. 51).

- (1) Place the clip, prongs up, on a flat surface.
- (2) Place one round at a time on the clip so that the groove in the rotating band is in line with side wall projections.
- (3) With one hand on the projectile and the other hand on the case, press the round straight down into place.
- (4) Inspect loaded clip to see that the bases of all rounds are even.

b. Loading Gun.

- (1) Inspect the bore and gun to see that no ammunition or foreign material is present, and that trigger is not in pulled position.
- (2) Open the feed box cover.
- (3) Raise the carrier until caught by the carrier catch.
- (4) Pull the lock frame to the rear until caught by the carrier dog. The priming rod is used to pull the lock frame rearward by hooking the rod into the operating lever.
- (5) Place loaded cartridge clip on cartridge tray, cartridge side down.
- (6) Close the feed box cover.
- (7) Push the cartridge clip into the feed box, using enough force to strip the first cartridge from the clip. The cartridge should trip the lock frame and be charged into the firing chamber without being fired.

c. Continuous Loading.

- (1) Succeeding rounds will be fed from the clip by automatic action of the feed mechanism; however, other clips must be loaded and fed in as described below.
- (2) A second clip is pushed lightly into contact with the first clip just before the last round of the first clip enters the feed box opening. Contact should be maintained until the feed pawl, located in the feed slide, grasps the second clip.
- (3) During certain periods of recoil and counterrecoil, the cartridge clip is free to move through the feed box if pushed by the loader. **CAUTION:** If this occurs, more than one round will be fed into the feed box and gun will jam. To prevent this, the loader should not exert too much pressure on the clip in the gun when following it up with a second clip.
- (4) If the new clip is not caught by the feed mechanism and carried into the gun, then the clip will have to be pushed in hard enough to strip the first cartridge as described in subparagraph b, above.
- (5) The empty clips should be caught as they come out of the right side of feed box.

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43. TO FIRE.

a. **Carriage M3** (fig. 32). The gun is fired by the elevation setter as follows:

(1) Push the foot firing pedal latch lever to the left in order to unlatch the foot firing pedal.

(2) Depress the foot pedal to fire the gun. The trigger will remain pulled as long as the pedal is depressed. When the pedal is released, the trigger returns to normal position and the pedal latch lever locks the pedal in place.

(3) If the pedal is depressed while loading the gun, the cartridge will be fired as soon as it is charged into the chamber. If the cartridge is fed in first, it will remain unfired until the pedal is depressed.

b. **Carriage M3E1** (fig. 32).

(1) The 37-mm gun is fired the same as when mounted on the Carriage M3.

(2) The two cal. .50 machine guns are fired by depressing the machine gun foot firing treadle. There is no latching device on this treadle.

(3) Either one of the machine guns can be detached from the firing mechanism cables as follows (fig. 32):

(a) Lift the snaplock and rotate the machine gun foot firing lever forward.

(b) Pull out the pin which is secured by a chain.

c. **Carriage M3A1** ((fig. 33).

(1) For full automatic fire, move the mechanism change lever to the right so that the word "AUTO" is up (fig. 34).

(2) For semiautomatic fire, move the mechanism change lever to the left so that the word "FOOT" is up (fig. 35).

(3) The elevation setter can fire the gun in the same manner as described for the Carriage M3.

(4) The rear cable pedal will also fire the gun. No latching device is provided for this pedal.

d. **Combination Gun Mount M42** (fig. 52).

(1) The 37-mm gun is fired by the elevation operator as follows: Push the foot firing pedal lever to the left in order to unlatch the foot firing mechanism.

(2) Depress the foot pedal to fire the gun. The trigger will remain pulled as long as the pedal is depressed. When the pedal is released, the trigger returns to normal position and the pedal lever locks the pedal in place.

OPERATION

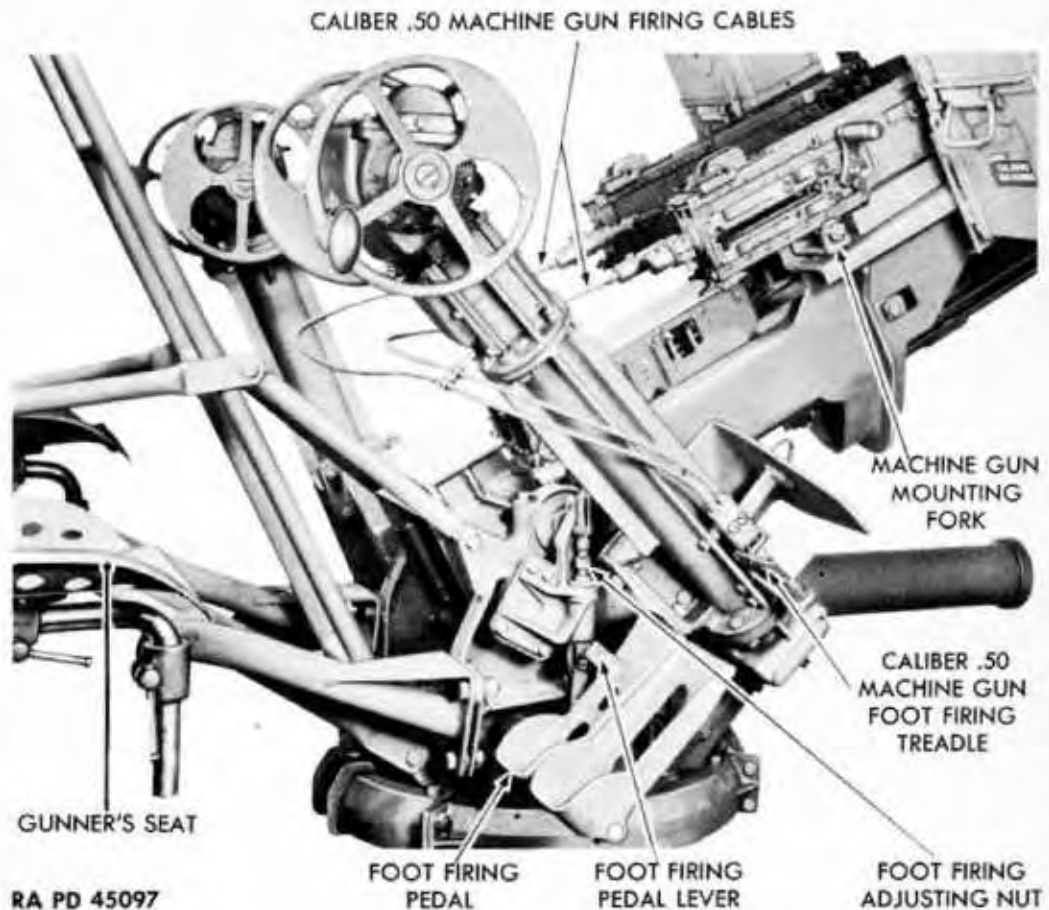


Figure 52 — Foot-firing Mechanism for 37-mm Gun and Two Cal. .50 Machine Guns

(3) If the pedal is depressed while loading the gun, the cartridge will be fired as soon as it is charged into the chamber. If the cartridge is fed in first, it will remain unfired until the pedal is depressed.

(4) The two cal. .50 machine guns are fired by depressing the machine gun foot firing treadle. There is no latching device on this treadle. Either one of the machine guns can be detached from the firing mechanism cables as follows:

(a) Lift the snaplock and rotate the machine gun foot firing lever forward.

(b) Pull out the pin which is secured by a chain.

(5) To recock the 37-mm gun, proceed as follows:

(a) Pull the lock frame back by means of the priming rod until the breechblock is lowered.

(b) Let the lock frame go forward.

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44. TO COOL GUN TUBE.

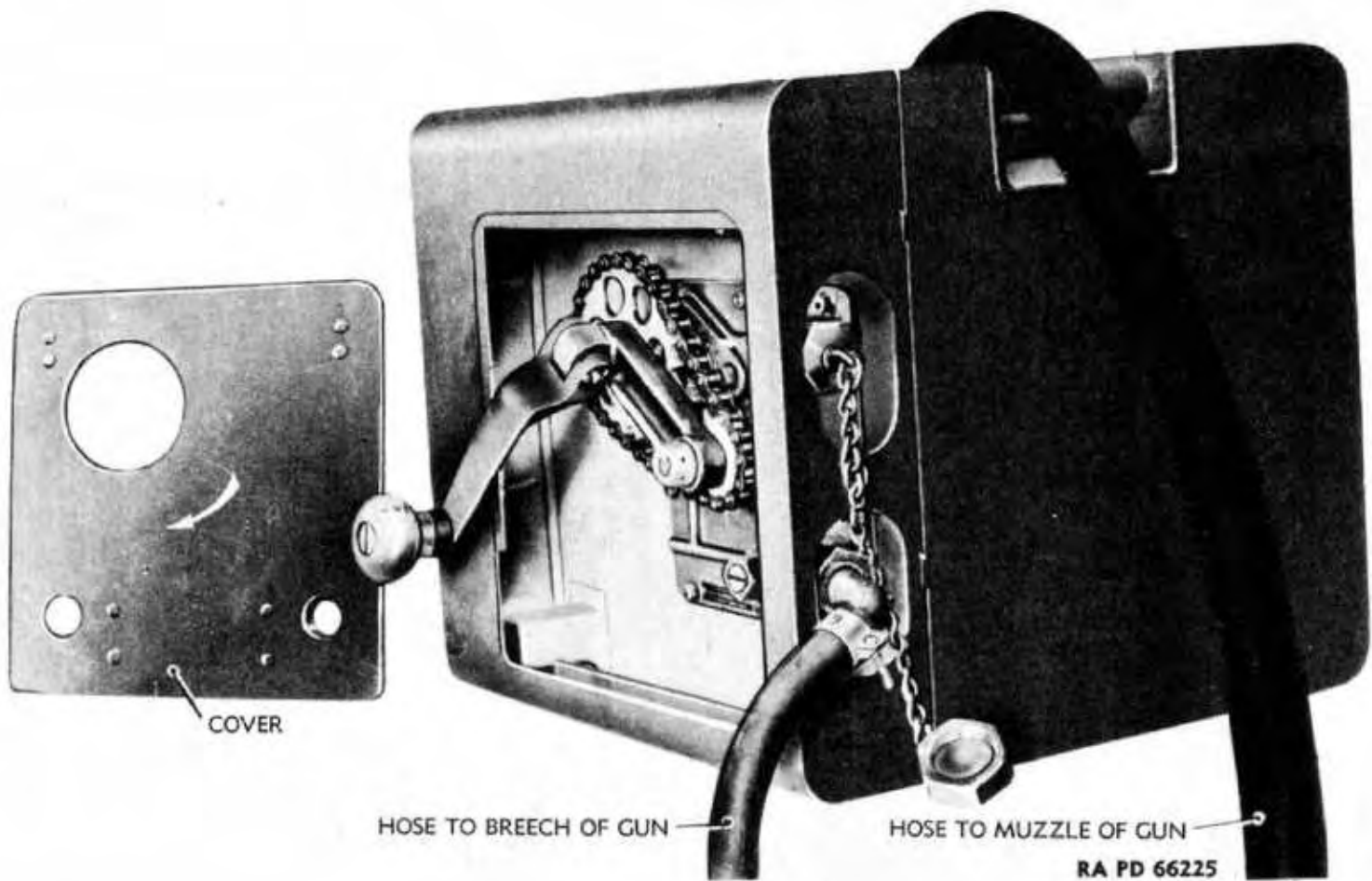
a. **General.** The tube of the 37-mm gun should be water-cooled after about 50 rounds of sustained fire at maximum rate. When single shots or bursts of less than 30 rounds are fired, the gun should be cooled after about 100 rounds. Never fire more than 80 rounds continuously before cooling. If the trunnion block bushing grips the tube so that recoil is prevented, the tube is not being cooled often enough, the gripping being caused by excessive expansion of the tube from the heat of firing.

b. **To Cool Gun Tube.** Fill water chest with clean water. Remove the cap from outlet connection of water chest. Connect the hose attached to the long curved brass pipe (the breech connection) to the outlet connection of the water chest (fig. 53). Remove the filler cap (fig. 53). Insert the hose attached to the muzzle cap into the filler cap opening of the water chest, but do not connect to the muzzle at this time. Raise the carrier; then pull the lock frame to the rear until caught by the carrier dog, and elevate the gun to about 30 degrees. Lift the breech connection up through the bottom of the gun and insert it into the breech opening through the tube extension as far as it will go. Ease the lock frame forward slowly so that the operating lever will hold the breech connection in place (fig. 54). Remove the hand-hole cover from the water chest, place the pumping handle into position, and pump water up into the gun tube so that the tube is filled with water. The pump handle should be turned clockwise as indicated by the arrow on the water chest cover. When steam stops coming out of the tube, connect the muzzle cap to the tube. The cap should be placed over the muzzle and the handle turned clockwise to tighten the cap in place (fig. 55). Pump water through the gun tube for 2 or 3 minutes or until a man can place his bare hand lightly on the gun tube without being burned. When the tube has been cooled, disconnect the muzzle connection from the gun and allow the water to drain back into the chest. Turn the pump handle counterclockwise until the water in the gun tube is pumped into the chest. Pull the lock frame to the rear and remove the breech connection. Allow the gun tube to drain and thoroughly dry it. Coat the bore with OIL, engine, SAE 10, below 32 F or OIL, engine, SAE 30, above 32 F.

45. TO UNLOAD.

a. **To Remove Cartridge Clip.**

- (1) Fold back feed box cover.
- (2) Pull out on the cartridge feeder pawl handle and upward on the feed pawl lifter stud at the same time.
- (3) Draw the cartridge clip out of the left side of the feed box.



COVER

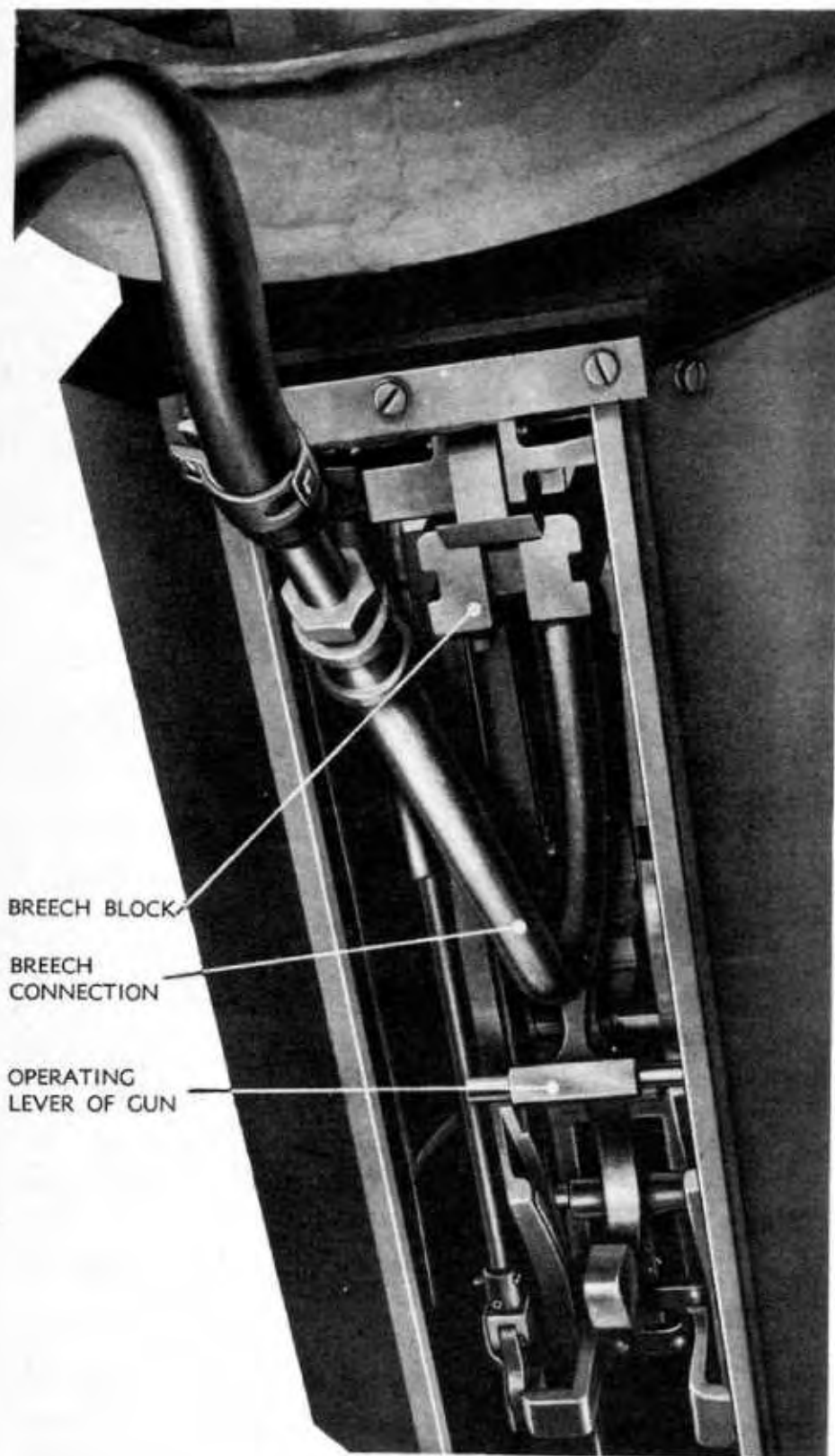
HOSE TO BREECH OF GUN

HOSE TO MUZZLE OF GUN

RA PD 66225

Figure 53 — Connections to Water Chest

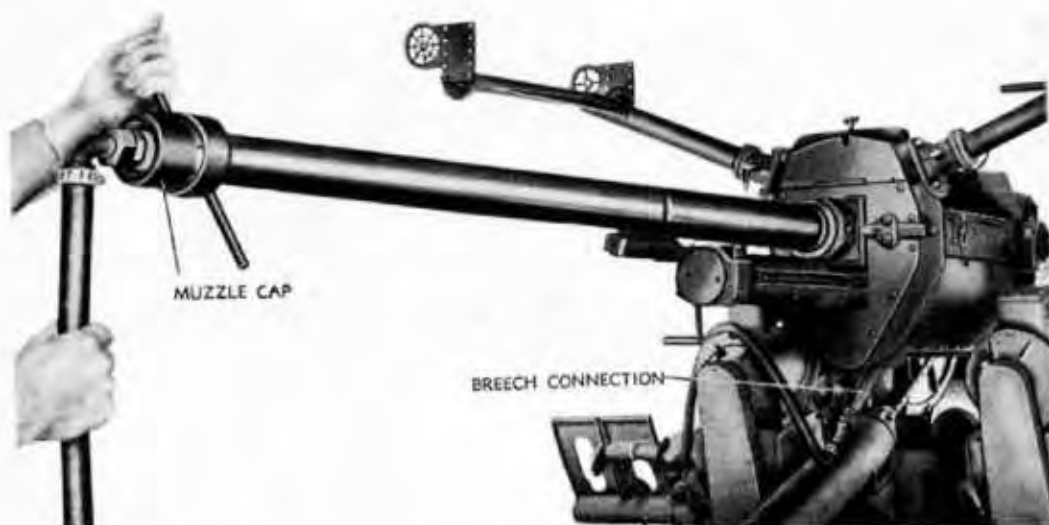
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RA PD 5786

Figure 54 — Installation of Breech Connection of Cooling System

OPERATION



RA PD 5785

Figure 55 — Securing Muzzle Cap of Cooling System

h. To Remove Cartridge From Chamber.

- (1) Raise the carrier until caught by the carrier catch.
- (2) Retract the lock frame until caught by the carrier dog. The extractor will withdraw the round, and it will fall out through the bottom of the gun.
- (3) Examine the chamber to see that it is empty.
- (4) Push the carrier catch to the right to allow the lock frame to go forward and pull trigger to release hammer.

c. To Empty Cartridge Clip.

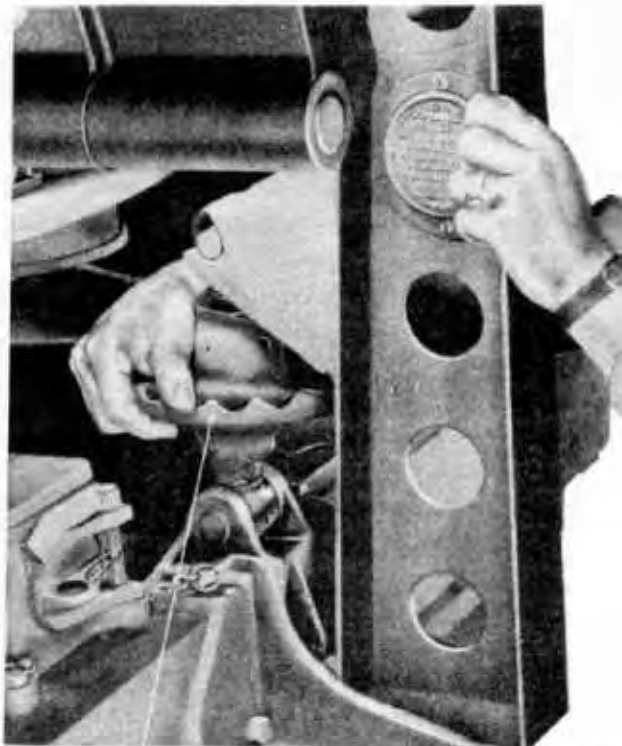
- (1) Place the clip on a flat surface with the rounds up.
- (2) Grasp a projectile with one hand and its case with the other, and with the thumbs pressing downward against the clip or adjacent cartridges, pull straight up.

46. TO PLACE WEAPON IN TRAVELING POSITION ON CARRIAGE.

a. Secure gun tube to gun support, raise outriggers, and lock in position (fig. 56).

b. When the carriage is lowered, the wheels are set parallel to the side frames of the carriage which brings the welded lug on the right tie rod into such position that, as the carriage drops into firing position, the dog engages the slot in the steering mechanism lock. Before raising the carriage to traveling position, see that the buffer lever is locked in the disengaged position so that the steering mechanism lock may not be rotated out of engagement with the lug on the tie rod. If the

37-MM AA GUN MATERIEL



OUTRIGGER TURNBUCKLE NUT RA PD 5774

Figure 56 — Locking Outrigger in Traveling Position

lug does not follow the slot until the carriage is raised, the carriage will jam badly.

c. The end of the carriage which is at the lower elevation should be raised first. It will normally take four men, two at either side to grasp the handholds and raise one end of the carriage.

d. When the carriage is emplaced, the slot in the axle bracket which holds the lower end of the counterpoise rod, assumes a vertical position and the compression of the counterpoise spring holds the wheel off the ground. When raising the carriage to the firing position, the counterpoise must be pivoted by lifting on the extended counterpoise levers so that the lower end of the counterpoise rods are moved to the lower ends of the slot in the axle brackets. The counterpoise spring compression will then assist in lowering the wheels. Then lift up on the handholds, raising one end of the carriage at a time.

e. If the carriage has sunk into the ground the full length of the spade beneath the chassis, difficulty may be encountered in pushing the wheels down far enough to allow the counterpoise cylinders to be rotated. Remove enough earth from under the wheels to allow them to be sufficiently depressed.

f. When the carriage has been raised to a point where the buffers will pass over the axle arms, operate the buffer levers and lock them in position.

MALFUNCTIONS AND CORRECTIONS

g. The buffer locking levers must be fully engaged whenever the carriage is in traveling position. Failure of the locking lever pin to engage fully in its seat may result in that end of the carriage dropping to firing position while being towed. This may cause a serious accident. If this fault develops, either the locking pin seat should be cleaned out, or the pin worked down with fine CLOTH, abrasive, aluminum-oxide, until engagement is easy and positive; also inspect the pin and locking lever to see that the threads of the pin fully engage the threads in the locking lever, as otherwise, the pin may work out of the locking lever and allow disengagement of the operating lever.

47. TO PLACE WEAPON IN TRAVELING POSITION ON COMBINATION GUN MOUNT M42.

a. **Cartridge Tray.** Push feed slide in. Release the latches from the brackets on the left side of the guns, and slide the tray up over the brackets. Pull up on the levers at each side of the tray.

b. **Gun Support.** Lock the gun to the gun support.

c. **Covers.** Place covers on gun.

48. TO TOW GUN.

a. The lock frame should be in the forward position and hammer in the fired position while gun is being towed. Cradle shield slide and cradle shield cover should be placed on the gun and the muzzle should be protected with a muzzle cover.

b. Check the fastening of the water chest and give the gun and carriage a general inspection to make sure that all parts are securely fastened in place. Hand brake levers should be in the "OFF" position, safety switch should be in the "OFF" position, and breakaway (safety) chain attached to lever on the safety switch and to the prime mover.

Section V

MALFUNCTIONS AND CORRECTIONS

49. GENERAL.

a. A malfunction is an improper action of some part of the gun, resulting in a stoppage; for example, failure to extract the empty cartridge case.

b. Any accidental cessation of fire is a stoppage. It may be a faulty cartridge or a malfunction of some part of the gun.

c. Immediate action is the term applied to that operation required to clear a temporary stoppage or malfunction.

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d. Proper care of the gun and attention to the points before, during, and after firing will greatly reduce the liability to stoppages, particularly if the gunner has an intelligent understanding of the reason stoppages generally occur. Prevention is the best remedy for all stoppages. See paragraphs 71 and 72 for proper inspection procedures.

CAUTION: After any stoppage, make sure that the bore is clear before continuing firing. For example, it is possible that a stoppage caused by incomplete ignition of the powder charge may result in the projectile lodging in the bore, and in case this happens and another round is fired before the bore is cleared, serious damage to the gun is certain to result.

e. **Types of Stoppage.** Stoppages may be classed under two main headings:

- (1) **TEMPORARY STOPPAGES.** Temporary stoppages are caused by:
 - (a) Failure of some part, duplicate of which is carried with gun.
 - (b) Faulty ammunition.
 - (c) Neglect of points before or during firing.

(2) **PROLONGED STOPPAGE.** Prolonged stoppages are caused by a failure of some part that, as a rule, cannot be replaced by the gun squad under fire or without skilled assistance. These necessarily put the gun out of action for a more or less prolonged period.

50. MISFIRES.

a. Immediately after occurrence of a misfire, the gun should be recocked and refired. If the round does not function upon the second attempt, wait 30 seconds from the time of occurrence of the original misfire; then remove the round.

51. GUN, MALFUNCTIONS AND CORRECTIONS.

a. Failure to Fire; No Percussion on Primer.

Cause	Correction
Broken firing pin.	Install new firing pin.
Broken hammer or hammer spring.	Replace.
b. Lock Frame Fails to Drive Forward.	
Weak driving springs.	Replace driving spring assemblies.
Driving spring assembly not attached or broken.	Attach, or replace spring assembly.
Dirty or broken carrier assembly.	Clean or replace.

MALFUNCTIONS AND CORRECTIONS

Cause	Correction
Burred or bent driving spring rod.	Remove burs. Replace driving spring assembly.
Dented driving spring housings.	Replace spring assemblies.
Gummy or excessively heavy lubricant in driving spring assemblies.	Clean with SOLVENT, dry-cleaning, and lubricate as described in paragraph 72 c.

c. Lock Frame Fails to Function.

Accelerator fails to function due to broken or damaged cam.	Replace accelerator spring or cam.
Carrier dog fails to function.	Replace carrier assembly.
Broken switch assembly in rear operating cam.	Replace.
Operating lever fails to function through broken or weak operating lever spring.	Replace.
Ejected cartridge case striking the mount and rebounding to wedge between lock frame and tube extension.	Draw lock frame to rear and remove cartridge case.
Dirt or foreign matter in moving parts or operating cams.	Clean with SOLVENT, dry-cleaning, and lubricate.

d. Tube Extension Fails to Return to Full Battery Position.

Weak or broken recuperator recoil springs.	Notify ordnance personnel.
Oil in recuperator mechanism too heavy due to cold weather or other conditions.	Drain and refill with OIL, recoil, light.
Excessive amount of oil in recuperator.	Adjust to proper level as described in paragraph 59 c.
Scored recuperator piston or bushing.	Notify ordnance personnel.
Improper installation of feed box screws.	Check the three screws on right side of feed box. They are shorter than those on left side. If improperly installed, replace them with proper length screws.

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e. Breechblock Does not Move Completely into Battery.

Cause	Correction
Breechblock contacting recuperator piston rod nut.	Tighten recuperator piston rod nut.
Bent or jammed firing pin protruding.	Replace with new firing pin.
Excessive friction due to dirt, gummy lubricant, metal pick-up on breechlock or lock frame slide ways.	Remove parts and clean with SOLVENT, dry-cleaning. Hone rough spots. Lubricate lightly at assembly.
Bent or broken operating lever guide pin. Weak or broken operating lever spring.	Remove lock frame and install new operating lever. Replace with new spring.
Broken strut.	Replace.

f. Fails to Feed (Carry Cartridge into Position to Load).

Worn or broken feed pawl; weak or broken feed pawl spring.	Replace with new parts.
Cartridge feeder stop, or holding pawl binding; pawls worn or broken; feed pawl spring weak or broken.	Replace with new part.
Weak or broken feed slide return lever plunger spring.	Install new spring.
Warped or broken stripper cam.	Install new cam.
Broken or bent feed lever; broken or binding feed lever swivel stud.	Replace with new feed lever assembly.
Weak or broken feed lever spring.	Replace with new spring.
Weak carrier spring failing to force the round into the gun.	Replace carrier spring.

g. Fails to Load (Carry Cartridge into Chamber).

Lock frame not held to rear by carrier dog. Lock frame fails to move forward.	Refer to subparagraphs b and c above.
Broken charger.	Replace lock frame.
Broken extractor or extractor spring.	Replace part.

MALFUNCTIONS AND CORRECTIONS

h. Fails to Extract (Remove Empty Case from Chamber).

Cause	Correction
Weak or broken extractor spring.	Replace with new spring.
Bent or damaged extractor.	Replace with new extractor.
Scored cartridge chamber.	Replace with new tube.
Binding ejector or broken ejector spring, allowing ejector to remain in path of extracted shell.	Free ejector; replace weak spring.

i. Fails to Eject.

Insufficient oil in recuperator, permitting recoil at such high speed that case is torn or extractor broken.	Check recuperator oil and fill to proper level.
Weak or broken ejector spring.	Replace with new spring.
Broken ejector.	Replace with new ejector.
Damaged ejector cam.	Notify ordnance personnel.

j. Gun Fires When Loaded, Firing Pedal not Depressed.

Binding or broken trigger.	Replace with new trigger.
Bent or jammed trigger bar; dirt, grit, heavy or gummed lubricant around trigger bar.	Disassemble gun, clean and lubricate trigger bar. Replace bar if not serviceable.
Lower end of trigger positioned ahead of hook on trigger bar.	Remove trigger and engage notch at lower end with hook on bar.

k. Slow Firing Gun.

Excessive friction due to dirt, grease, gummy or heavy lubricant, or scored bearing surfaces.	Disassemble gun and clean all parts with SOLVENT, dry-cleaning. Hone scored bearing surfaces. Oil lightly at assembly.
Slow recoil caused by low-pressure ammunition or recuperator oil too heavy.	Change ammunition. Drain and refill recuperator with OIL, recoil, light.
Slow counterrecoil caused by weak recuperator spring.	Notify ordnance personnel.
Slow counterrecoil caused by bind in feeding mechanism.	Disassemble feeding mechanism and check for scored or worn parts or improper lubrication, and make necessary corrections.

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I. Gun Jams During Sustained Firing.

Cause	Correction
Excessive pressure exerted on ammunition clip by loader.	The loader should not exert a pressure on the clip during firing, and should be particularly careful to avoid such pressure in following one clip with another during sustained firing.
Two cartridge clips locked in feed box, due to a worn feed pawl or broken feed pawl spring.	Replace parts.
m. Oil Leak from Rear Stuffing Box of Recuperator.	
Wear of stuffing box.	If leak is slight, the gun should be kept in service and the leakage overcome by frequent fillings of the recoil cylinder. If leak becomes serious, or if time permits, the gun must be turned over to ordnance maintenance personnel for repair.

52. CARRIAGE, MALFUNCTIONS AND CORRECTIONS.

a. Road Shock Too Severe.

Improper adjustment of counterpoise springs.	Adjust as described in paragraph 73 h.
Weak buffer springs.	Notify ordnance personnel.

b. Front or Rear of Carriage Drops While Carriage Is Being Towed.

Loose buffer lock lever stem due to worn threads or broken buffer lock lever spring.	Notify ordnance personnel.
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c. Carriage Difficult to Emplace in Firing Position.

Improper adjustment of counterpoise springs.	Adjust as described in paragraph 73 h.
Bent counterpoise rod.	Notify ordnance personnel.
Dented counterpoise cylinder.	Notify ordnance personnel.
Dirt and foreign material in cylinder.	Notify ordnance personnel.
Dirt and binding of the counterpoise rod pin and bearings in the axle bracket.	Notify ordnance personnel.

MALFUNCTIONS AND CORRECTIONS**d. Top Carriage Cannot Be Leveled.**

Cause	Correction
Leveling mechanism binds.	Notify ordnance personnel.
Improper engagement of buffer lock lever stem with the operating lever.	Inspect and make certain buffer operating lever is locked before towing gun.

e. Excessive Effort to Elevate or Depress Gun.

Equilibrator spring broken or improperly adjusted.	Adjust spring. If adjustment does not correct, notify ordnance personnel.
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53. BRAKES, MALFUNCTIONS AND CORRECTIONS.**a. No Braking, or Intermittent Braking.**

Broken wire in circuit.	Check entire wiring for broken wires. Repair or replace.
Broken wire in magnet.	If broken wire is on outside of magnet, repair if possible. If no current flows through magnet, notify ordnance personnel.
Controller defective.	Short out controller by connecting both wires to one terminal and see whether brakes are effective. If they are, replace controller.
Poor connections at brake, controller, or plug and socket.	Clean and tighten all connections.
Defective plug or socket.	Check plug and socket for loose connections, dirty or corroded blades, or broken socket. Repair or replace with new socket.

b. Very Weak Brakes.

Worn out.	Notify ordnance personnel.
Glazed magnet facing.	Roughen face of magnet with CLOTH , abrasive, aluminum-oxide, coarse.
Foot control out of adjustment on prime mover when using foot pedal type of controller.	When carriage brakes are adjusted, pedal travel is shortened. This throws controller out of adjustment. Reset controller to new pedal travel to cover full range of controller.

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Cause	Correction
Insulation of wire broken. Loose connection.	Tape exposed portions of wire or replace wire. Tighten loose connections.
Insufficient current.	Clean and tighten all connections, check plug and socket for corroded or dirty blades or broken socket. Replace broken parts.
Poor ground connection at brakes.	Clean and make good connections at brake and frame.
c. Brakes Grab.	
Loose or worn wheel bearings.	Adjust or replace bearings.
Sticky or grease-coated lining.	Notify ordnance personnel.
Drums out of round.	Notify ordnance personnel.
Controller burned out.	Replace with new controller.
Controller arm in controller pitted.	Smooth contractor arm with CLOTH, abrasive, aluminum-oxide, fine.
Broken magnet spring.	Replace spring.
Bushing in magnet worn out.	Notify ordnance personnel.
d. Brakes Drag.	
Drums out of round.	Notify ordnance personnel.
Broken spring in controller.	Replace with new spring.
Brake shoe distorted, unequal clearance.	Notify ordnance personnel.
Insufficient lining clearance.	Notify ordnance personnel.
Loose or damaged wheel bearings.	Adjust bearings. If bearings are worn or damaged, notify ordnance personnel.
e. Battery Runs Down.	
Safety switch left in "ON" position.	Keep safety switch lever in "OFF" position.
Short circuit in brake electrical system.	Check for bare wire, and tape or replace damaged cable.

Section VI

CARE AND PRESERVATION**54. GENERAL.**

a. It is of vital importance that all parts of the materiel be kept in proper operating condition in order that the weapon be ready for immediate service. The proper use of tools and accessories, and lubricating, cleaning, and preserving materials provided with the gun and carriage will enable personnel to keep the materiel in proper working condition.

b. Proper lubrication with lubricants at intervals prescribed in this section is essential to the care and preservation of the weapon. Examinations should be made periodically to insure that lubricants are reaching the parts for which they are intended.

c. The gun, carriage, and sighting equipment covers should be used when traveling or when the gun is not in service. When inactive for temporary periods, the materiel should be prepared for storage as described in section XV.

d. In disassembly, assembly, and inspection, extreme care must be exercised to prevent dust, dirt, and other foreign matter from entering mechanism of the gun and carriage.

e. All organizational spare parts, tools, and accessories should be kept in an orderly manner in the chests and containers provided, so that they can be quickly located when required. Items which are susceptible to rust or corrosion must be cleaned thoroughly after use and coated with a film of oil. Organizational spare parts and accessories for the gun and carriage should be maintained as complete as possible at all times. They should also be checked with lists in standard nomenclature lists, and all items used for replacement, or which are missing should be replaced immediately.

f. Should an enemy shell burst near the weapon or after the gun has been under fire, it must be determined that the weapon has not been damaged to a dangerous degree before further use of the gun. Damage of a serious nature should be reported to the ordnance officer.

g. When the gun is used in hot or cold climates or under extreme conditions of sand, dust or water, refer to section XVI.

h. The trunnion block should be kept covered to prevent dust and grit from getting into the mechanism, causing wear and impeding smooth operation. The breechblock assembly should be removed and disassembled before every firing period and the parts washed with SOLVENT, dry-cleaning. Wipe dry and coat with the prescribed lubricating oil. If the lock frame and tube extension do not operate smoothly, they should be removed and the cause determined.

37-MM AA GUN MATERIEL

In assembling and disassembling any part of the gun, do not use a steel hammer directly on any part. A copper hammer or a wood block should be used to transmit the blow to prevent deforming the part. Special care must be taken to insure that any sand, grit, or other foreign matter is removed from the threads of the tube as well as from the threads of the tube extension before assembling the tube to the tube extension. Failure to observe this instruction will result in the threads being badly burred or torn. The motion of the lock frame should be smooth and free. There should be no sign or evidence of dirt or grit in the slideways or operating cams of the lock frame. Likewise, the slideways of the tube extension should be kept clean and smooth. Before firing, the bore should be thoroughly wiped out to insure that it is clean and dry. At the end of each period of firing, the bore should be thoroughly washed out and the gun depressed to the horizontal position. It should then be dried and well oiled when cool. When not actually in use, guns should have their covers in position.

55. LUBRICATION GUIDES.

a. War Department Lubrication Guides Nos. 1, 60, and 131 (figs. 57a, 57b, and 58) prescribe first and second echelon lubrication maintenance.

b. A lubrication guide is placed on or is issued with each item of materiel and is to be carried with it at all times. In the event the materiel is received without a guide, the using arm shall immediately requisition a replacement from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Mich.

c. Lubrication instructions on the guide are binding on all echelons of maintenance and there shall be no deviations from these instructions.

d. Lubricants are prescribed in the "Key" in accordance with three temperature ranges, "above -32°F ," "from -32°F to 0°F ," and "below 0°F ." When to change to lubricants prescribed for a different range is determined by maintaining a close check of the performance of the materiel during the approach of anticipated prolonged periods of lower or higher temperatures. Because of the time element involved in preparing for operation at lower prevailing temperatures, a change to lubricants prescribed for the next lower range will be undertaken the moment movement becomes sluggish. Ordinarily it will be necessary to change lubricants *only when expected air temperatures will be consistently in the next higher or lower range*, unless malfunctioning occurs sooner due to lubricants being of improper consistency.

CARE AND PRESERVATION**e. Lubrication Equipment.**

(1) Each piece of materiel is supplied with lubricating equipment adequate to maintain the materiel. Be sure to clean this equipment both before and after use. Operate lubricating guns carefully and in such manner as to insure a proper distribution of the lubricant. If lubricating fitting valves stick and prevent the entrance of lubricant, remove the fitting and determine cause. Replace broken or damaged lubricators. If lubricator cannot be replaced immediately, cover hole as a temporary expedient with tape to prevent the entrance of dirt. If oil lines become clogged, disassemble the line and remove the obstruction.

(2) Lubricating fittings, grease cups, oilers, oilholes, and plugs are readily identifiable by a $\frac{3}{4}$ -inch red circle.

(3) Wipe lubricators and surrounding surface clean before applying lubricant. Where relief valves are provided, apply new lubricant until the old lubricant is forced from the vent. Exceptions are specified in notes or on the lubrication guide. Metal surfaces on which a film of lubricant must be maintained by manual application, will always be wiped clean before the film is renewed.

f. Service intervals specified on the guide are for normal operating conditions and continuous use of the materiel with frequent firing. Reduce these intervals under extreme conditions such as excessively high or low temperatures, prolonged periods of travelling or firing, continued operation in sand or dust, immersion in water or exposure to moisture, any one of which may quickly destroy the protective qualities of the lubricant and require servicing in order to prevent malfunctioning or damage to the materiel.

g. Cleaning.

(1) Unless otherwise specified, use SOLVENT, dry-cleaning, or OIL, fuel, Diesel, to clean or wash all metal parts, whenever partial or total disassembly is undertaken or when renewing the protective lubricant film on exposed metal surfaces. Flushing of gear cases and bearing housings will not be undertaken unless inclosed mechanism is first disassembled in order to insure complete removal of the solvent prior to application of lubricants. Use of gasoline for this purpose is prohibited. Dry all parts thoroughly before lubricating.

(2) Care must be taken when cleaning oil and grease compartments to insure the complete removal of all residue or sediment. Dirt or other foreign matter should not be allowed to drop into any of the lubricating compartments.

(3) Operating personnel are cautioned when cleaning the gun to refrain from playing water from the high-pressure hose directly

No. 1
WAR DEPARTMENT LUBRICATION GUIDE
ORDNANCE DEPARTMENT

**GUN, AUTOMATIC, 37-mm, M1A2
CARRIAGE, GUN, 37-mm, M3 and M3E1**



SNL A-29.

For detailed instructions, refer to TM 9-235.

Clean fittings before lubricating. Lubricate after washing.

Reduce intervals under severe operating conditions.

Lubricate dotted arrow points on both sides. Opposite points are shown by short arrows.

Requisition replacement Guide from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Michigan.

NOTE—See Reverse Side for lubrication of LOWER CARRIAGE

To clean parts, use SOLVENT, dry-cleaning, or OIL, fuel, Diesel. Dry before lubricating. Swab gun bore with a solution of 1/2 pound of SODA, ash, to each gallon of warm water, or with a thick suds of issue soap and warm water. Rinse with clear water and dry thoroughly before oiling. Clean machine gun bore with CLEANER, rifle bore. Dry thoroughly before oiling.

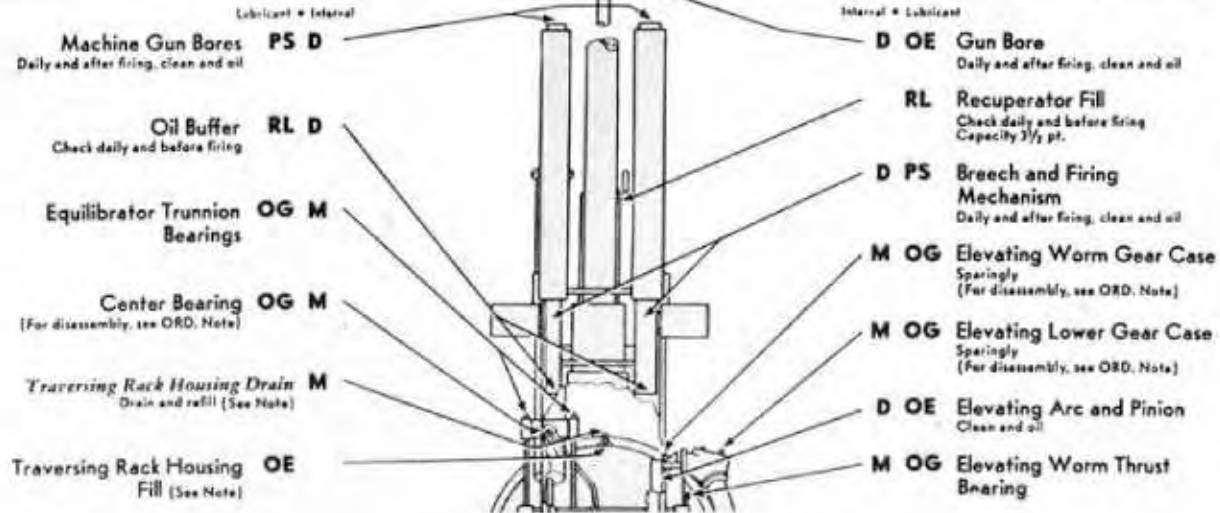
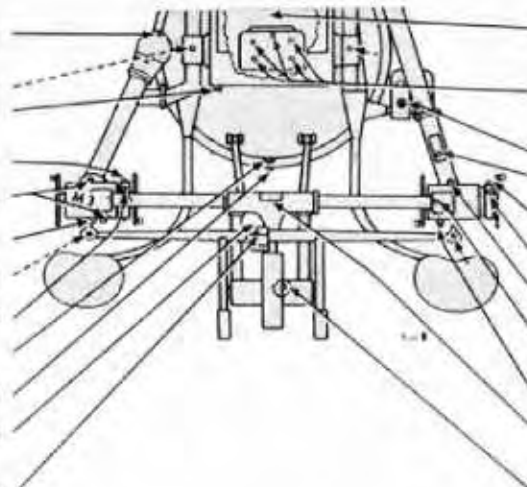


Figure 57a — Lubrication Guide of Gun

- Traversing Lower Gear Case **OG M**
Springly
(For disassembly, see ORD. Note)
- Cradle Trunnion Bearing **OG M**
- Equilibrator Piston Rod End Bearing **OG M**
- Traversing 2-Speed Gear Box Level
Remove while lubricating 2-speed gear box
- Traversing Upper Gear Case **OG M**
(For disassembly, see ORD. Note)
- Traversing Upper Gear Case Level
Remove while lubricating upper gear case
- Lateral Adjusting Worm **MO M**
Springly (Remove screw)
- Traversing 2-Speed Gear Box **OG M**
(For disassembly, see ORD. Note)
- Traversing Rack Housing Fill **OE**
(See Note)
- Traversing Rack Housing Drain **M**
Drain and refill (See Note)
- Lateral Deflection Drive Worm **MO M**
Springly (Remove screw)
- Lateral Deflection Counter Drive Gears **MO M**
Springly (Remove plate)



- D OE** Breech and Firing Mechanism
Daily and after firing, clean and oil
- M MO** 360° Drive Mechanism Gear Case
Springly
- M OG** Foot Firing Pedal
- M OG** Elevating Stop Mechanism
(For disassembly, see ORD. Note)
- Elevating 2-Speed Gear Box Level
Remove while lubricating 2-speed gear box
- M OG** Elevating 2-Speed Gear Box
(For disassembly, see ORD. Note)
- M OG** Elevating Upper Gear Case
(For disassembly, see ORD. Note)
- M MO** Elevating Vertical Deflection Drive Gears
Springly (Remove screw)
- Elevating Upper Gear Case Level
Remove while lubricating upper gear case
- M MO** Vertical Deflection Counter Drive Gears
Springly (Remove cover)
- M MO** Vertical Deflection Drive Worm Gear
Springly (Remove bolt)

NOTES

TRAVERSING RACK HOUSING—Traverse gun through 360° while lubricating.
OIL CAN POINTS—Weekly, lubricate External Linkages and Pins of Foot Firing Mechanism.
DO NOT LUBRICATE—Sighting Mechanism Drive Cables.
LUBRICATED BY ORDNANCE PERSONNEL—Elevating

2-Speed Gear Box, Elevating Upper and Lower Gear Cases, Elevating Worm Gear Case, Elevating Stop Mechanism, Traversing 2-Speed Gear Box, Traversing Upper and Lower Gear Cases, Traversing Thrust Bearing, Center Bearing, Back Plate Assembly, Driving Spring Assemblies, Equilibrator, Tube Extension Assembly. (Refer to TM 9-1235, also TM 9-1606 for Sighting System M2.)

Copy of this Guide will be kept with the material at all times. These lubrication instructions are binding on all echelons of maintenance.
By Order of the Secretary of War:
G. C. Marshall, Chief of Staff.

KEY

LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE			ALL TEMPERATURES	INTERVALS
	above +32°F.	+32°F. to 0°F.	below 0°F.		
OE—OIL, engine	OE SAE 30	OE SAE 10	PS	RL—OIL, recoil, light	D—Daily M—Monthly
OG—GREASE, O.D.	OG No. 0	OG No. 00	OG No. 00	MO—OIL, lubricating, for aircraft instruments and machine guns	
				PS—OIL, lubricating, preservative, special	

COLD WEATHER: For Lubrication and Service below 0°F., refer to OFSB 4-5.

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15 Feb 44
Supersedes all previous issues.

No. 1

WAR DEPARTMENT LUBRICATION GUIDE

ORDNANCE DEPARTMENT



SNL A-29.

GUN, AUTOMATIC, 37-mm, M1A2 CARRIAGE, GUN, 37-mm, M3 and M3E1



For detailed instructions, refer to TM 9-235.

Clean fittings before lubricating. Lubricate after washing.

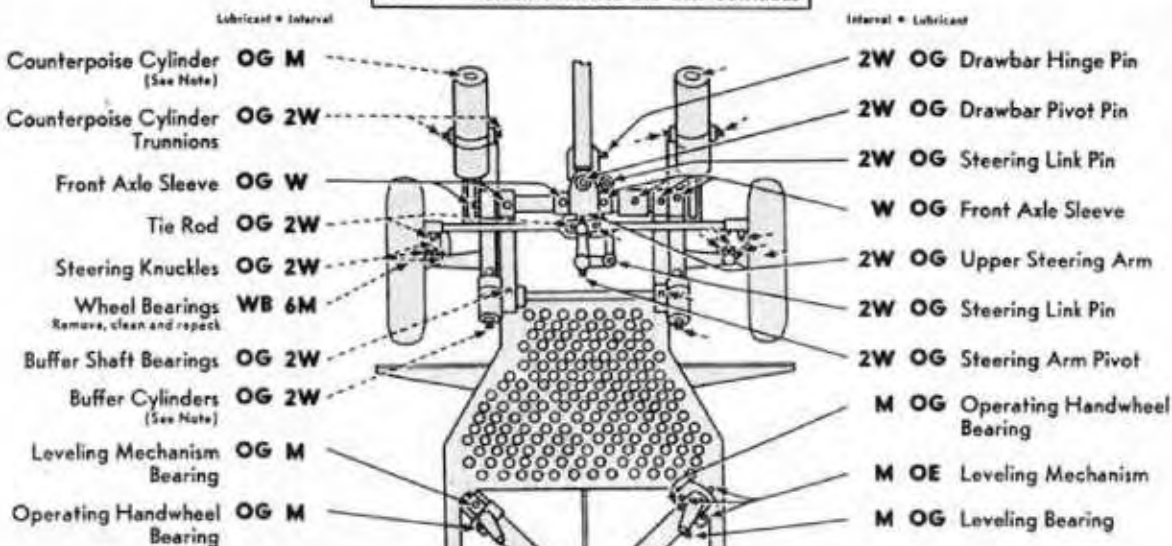
Clean parts with SOLVENT, dry-cleaning or OIL, fuel, Diesel. Dry before lubricating.

Requisition replacement Guide from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Michigan.

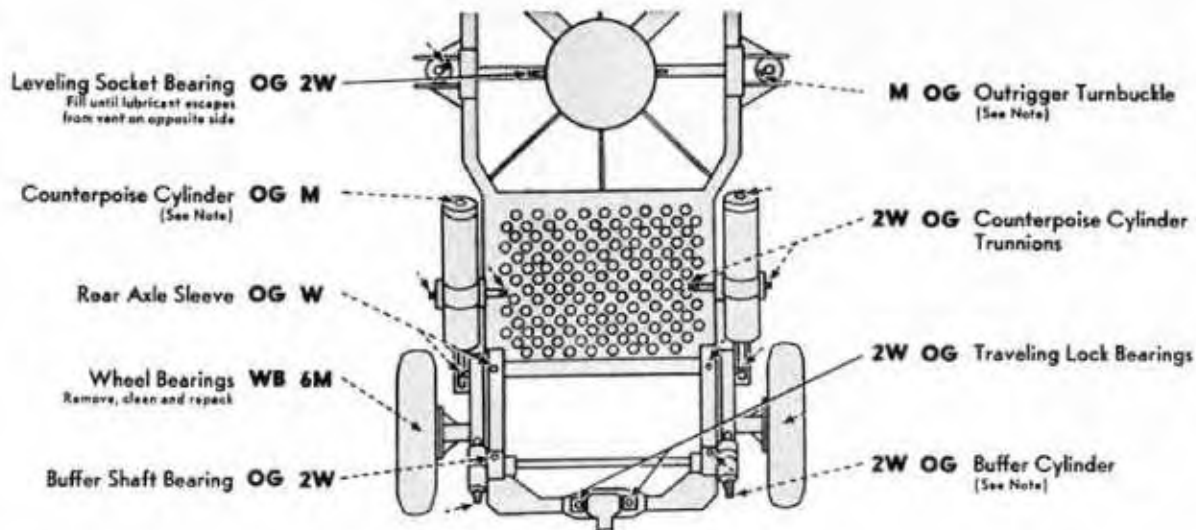
Reduce intervals under severe operating conditions.

Lubricate dotted arrow points on both sides. Opposite points are shown by short arrows.

NOTE— See Reverse Side for lubrication of UPPER CARRIAGE and GUN CONTROLS



82 Figure 57a — Lubrication Guide of Gun



NOTES

BUFFER CYLINDERS AND OUTRIGGER TURNBUCKLES—CAUTION: Excess lubricant in units will cause malfunction. If overfilled, remove fitting and operate parts to force out excess lubricant.

COUNTERPOISE CYLINDERS—Remove cap

on outer end of cylinder and coat surface above piston.

OIL CAN POINTS—Weekly, lubricate Buffer Adjustment Linkage, Buffer Rod, Counterpoise Cam Bracket, Outrigger Hinge Pins, Hand Levers, Water Chest Pump Drive Chain with OE.

Copy of this Guide will be kept with the material at all times. These lubrication instructions are binding on all echelons of maintenance.

*By Order of the Secretary of War:
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KEY

LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE			ALL TEMPERATURES	INTERVALS
	above +32°F.	+32°F. to 0°F.	below 0°F.		
OE—OIL, engine	OE SAE 30	OE SAE 10	PS	WB—GREASE, general purpose, No. 2 PS—OIL, lubricating, preservative, special	W—Weekly 2W—2 weeks M—Monthly 6M—6 months
OG—GREASE, O.D.	OG No. 0	OG No. 00	OG No. 00		

COLD WEATHER: For Lubrication and Service below 0°F., refer to OFSB 4-5 and OFSB 4-11.

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WAR DEPARTMENT LUBRICATION GUIDE
ORDNANCE DEPARTMENT

**GUN, AUTOMATIC, 37-mm, M1A2
CARRIAGE, GUN, 37-mm, M3A1**

SNL A-29.

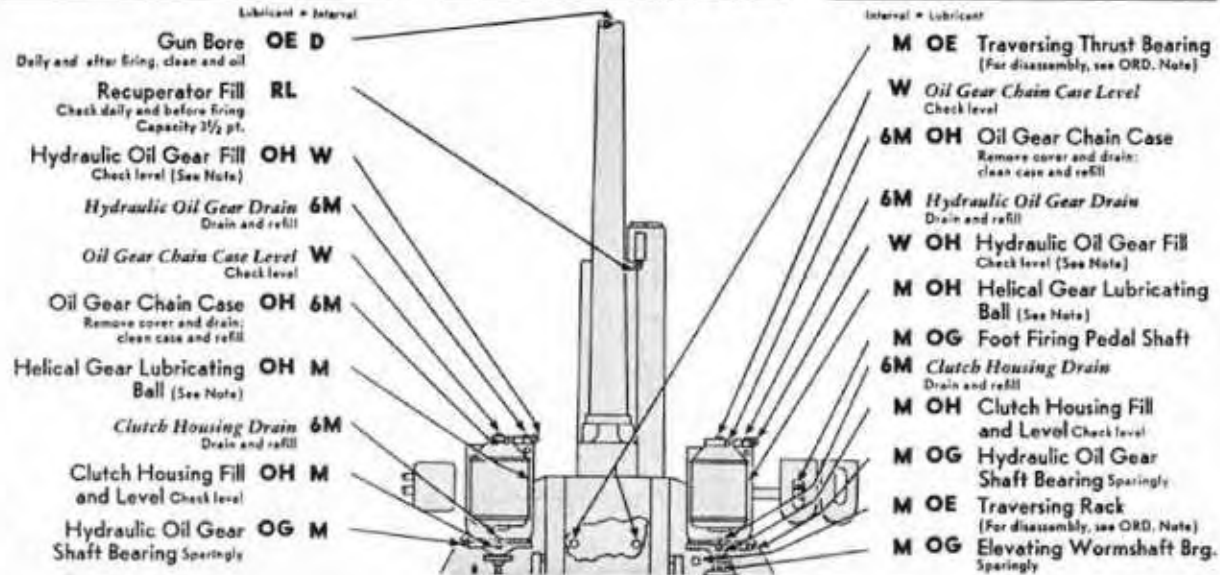
For detailed instructions, refer to TM 9-235.

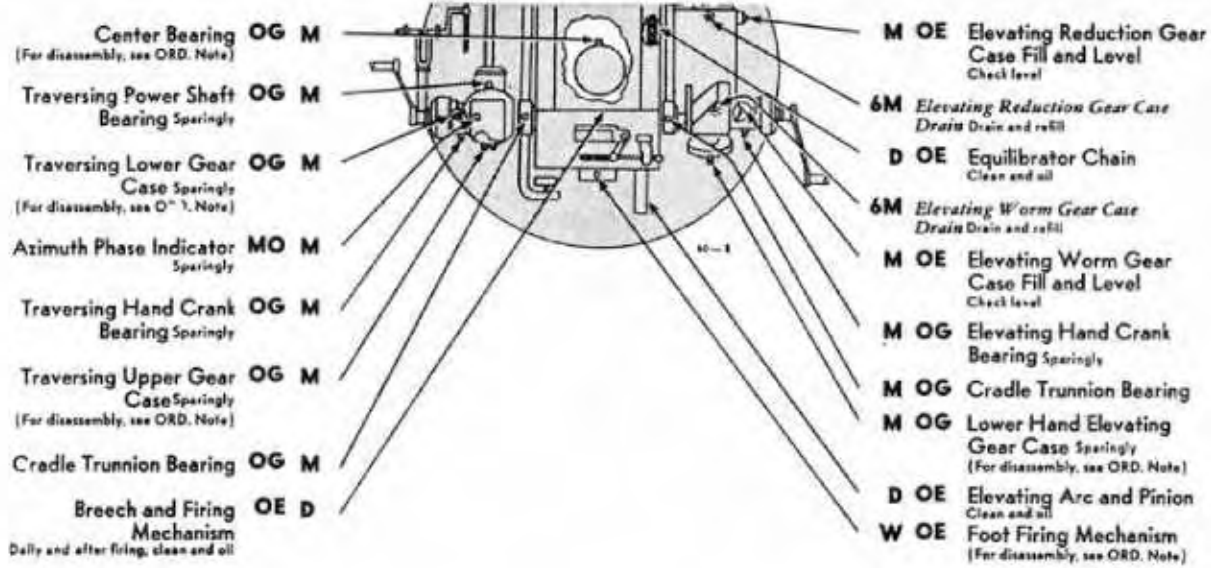
Clean fittings before lubricating. Lubricate after washing.
Reduce intervals under severe operating conditions.

Requisition replacement Guide from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Michigan.

NOTE— See Reverse Side for lubrication of LOWER CARRIAGE

To clean parts, use SOLVENT, dry-cleaning, or OIL, fuel, Diesel. Dry before lubricating. Swab gun bore with a solution of 1/2 pound of SODA, ash, to each gallon of warm water, or with a thick suds of issue soap and warm water. Rinse with clear water and dry thoroughly before oiling.





— KEY —

LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE		
	above +32°F.	+32°F. to 0°F.	below 0°F.
OE —OIL, engine Other points	OE SAE 30	OE SAE 10	PS
OG —GREASE, O.D.	OG No. 0	OG No. 00	OG No. 00
RL —OIL, recoil, light—All temperatures			
MO —OIL, lubricating, for aircraft instruments and machine guns—All temperatures			
OH —OIL, hydraulic—All temperatures			
PS —OIL, lubricating, preservative, special			
	INTERVALS		
	D —Daily		
	W —Weekly		
	M —Monthly		
	6M —6 months		

COLD WEATHER: For Lubrication and Service below -18°F., refer to OPSB 4-5.

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— NOTES —

HELICAL GEAR LUBRICATING BALL—Remove cover, fill recess around ball and add enough oil to fill recess. **CAUTION:** Do not allow moisture, dirt or grit to enter open mechanism. Every 6 months, remove oil, clean recess and refill.

HYDRAULIC OIL GEARS—Remove cap from filter and fill through center hole, using gun provided, until oil escapes from vent at side of filter. Whenever system is drained, remove filter, wash and replace before refilling.

OIL CAN POINTS—Weekly, lubricate External Linkage and Pins of Foot Firing Mechanism, Traversing and Elevating Crank Handles, Buffer Adjustment Linkage, with OE.

LUBRICATED BY ORDNANCE PERSONNEL—Traversing Upper and Lower Gear Cases, Traversing Thrust Bearing, Traversing Hand Lower Hand Elevating Gear Case, Center Bearing, Equilibrator Tube Extension Assembly, Back Plate Assembly, Driving Spring Assemblies, Foot Firing Mechanism. (Refer to TM 9-1235.)

15 Feb 44
Supersedes all previous issues.

No. 60

WAR DEPARTMENT LUBRICATION GUIDE

ORDNANCE DEPARTMENT

GUN, AUTOMATIC, 37-mm, M1A2 CARRIAGE, GUN, 37-mm, M3A1

SNL A-29.

For detailed instructions, refer to TM 9-235.

Clean fittings before lubricating.
To clean parts, use SOLVENT, dry-cleaning, or OIL, fuel, Diesel. Dry before lubricating.

Requisition replacement Guide from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Michigan.

Reduce intervals under severe operating conditions.
Lubricate dotted arrow points on both sides. Opposite points are shown by short arrows.

NOTE— See Reverse Side for lubrication of UPPER CARRIAGE and GUN CONTROLS

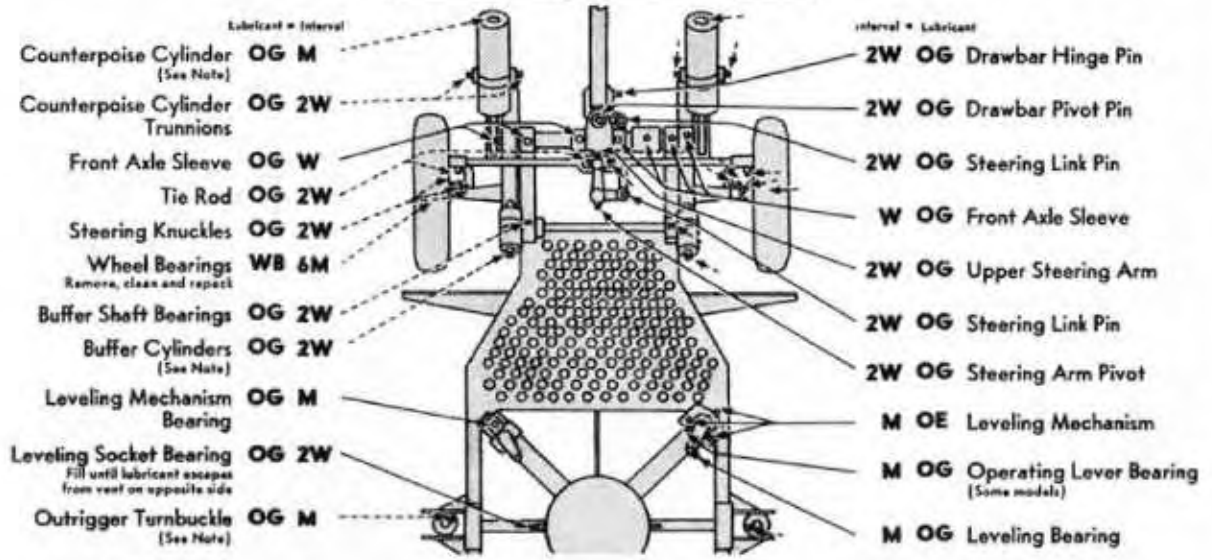
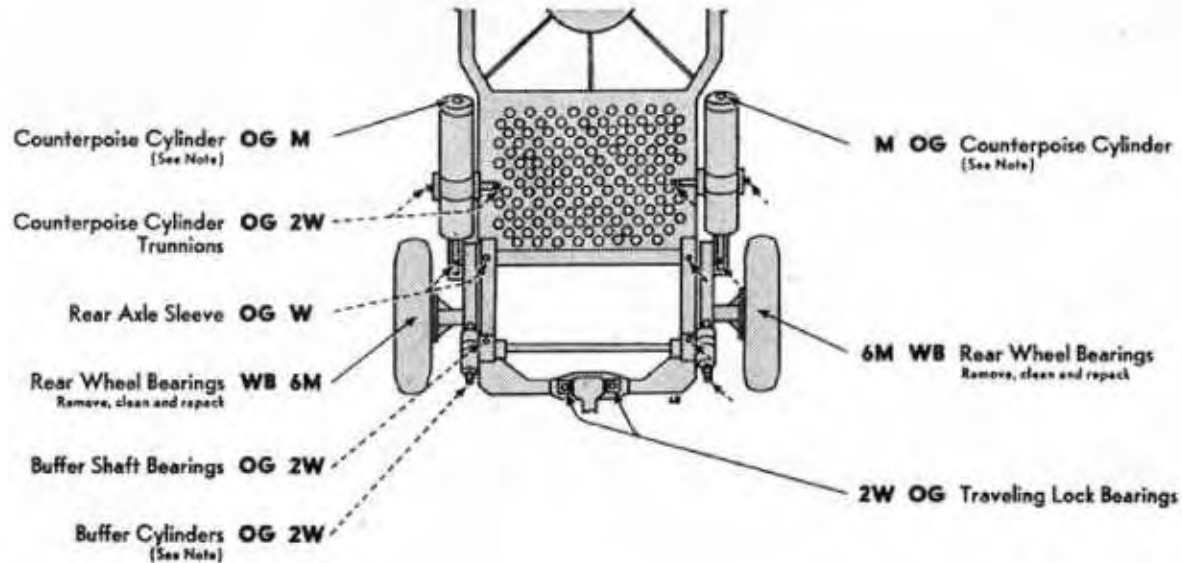


Figure 57b — Lubrication Guide of Gun



— KEY —

LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE		
	above +32°F.	+32°F. to 0°F.	below 0°F.
OE—OIL, engine	OE SAE 30	OE SAE 10	PS
Other Points	OG No. 0	OG No. 00	OG No. 00
OG—GREASE, O.D.			
WB—GREASE, general purpose, No. 2—All temperatures	INTERVALS W—Weekly 2W—2 weeks M—Monthly 6M—6 months		
PS—OIL, lubricating, preservative, special			

COLD WEATHER: For Lubrication and Service below -10°F., refer to OP58 4-5.

No. 60 [NOT TO BE REPRODUCED in whole or in part without permission of the Office of the Chief of Ordnance.] CHECK-CHART

— NOTES —

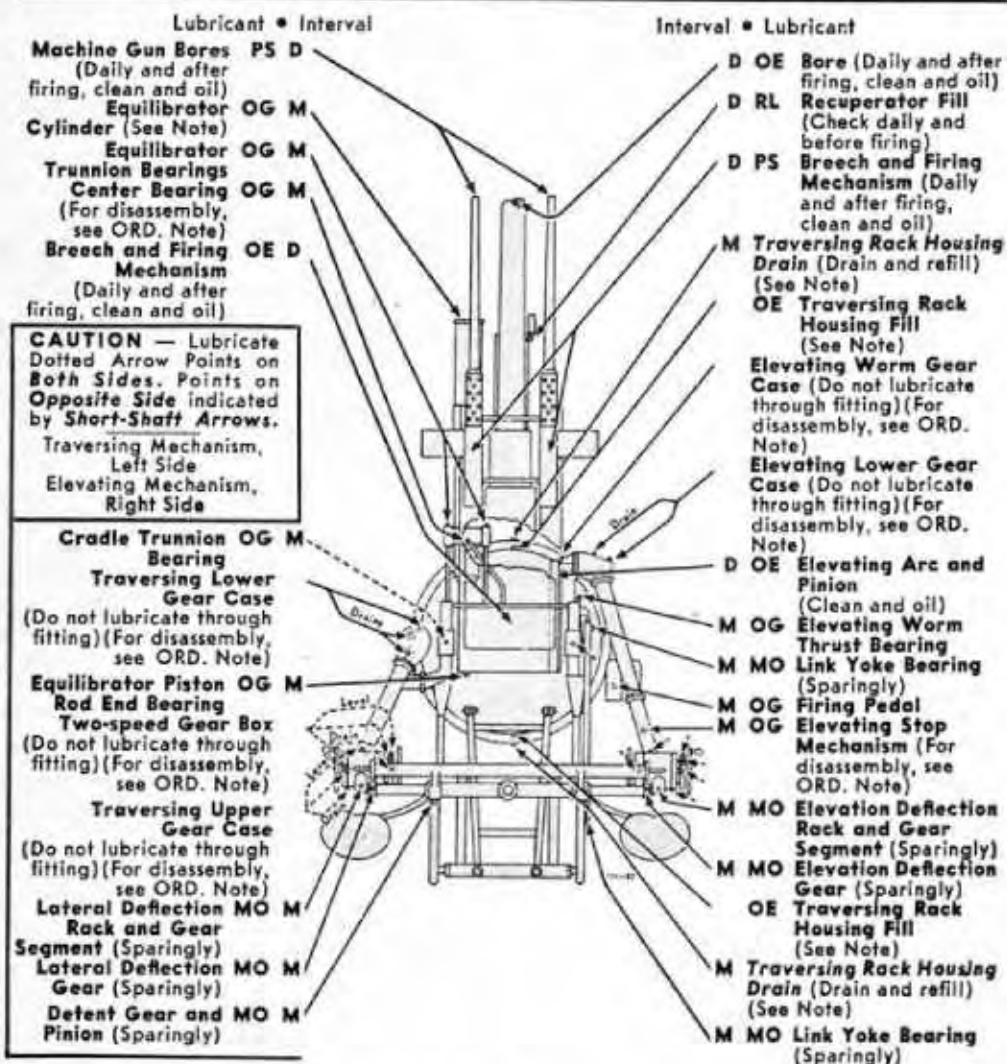
BUFFER CYLINDERS AND OUTRIGGER TURNBUCKLES—CAUTION: Excess lubricant in units will cause malfunction. If overfilled, remove fitting and operate parts to force out excess lubricant.
COUNTERPOISE CYLINDERS—Remove cap on outer end of cylinder and coat the surface above piston.
OIL CAN POINTS—Weekly, lubricate Clevises and Linkage, Buffer Rod, Counterpoise Cam Bracket, Outrigger Hinge Pin, Hand Levers, Water Chest Pump Drive Chain, with OE.
LUBRICATED BY ORDNANCE PERSONNEL—Ratchet Type Operating Lever (some models). [Refer to TM 9-1235.]
 Copy of this Guide will be kept with the material at all times. These lubrication instructions are binding on all echelons of maintenance.
 By Order of the Secretary of War:
 G. C. Marshall, Chief of Staff.

15 Feb 44
 Supersedes all previous issues.

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WAR DEPARTMENT LUBRICATION GUIDE
ORDNANCE DEPARTMENT

GUN, 37-mm, M1A2
MOUNT, COMBINATION GUN, M42



KEY

LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE			INTERVALS
	above +32°F.	+32°F. to 0°F.	below 0°F.	
OE—OIL, engine	OE SAE 30	OE SAE 10	PS	D—Daily M—Monthly
OG—GREASE, O.D.	OG No. 0	OG No. 00	OG No. 00	
RL—OIL, recoil, light. All temperatures.				
MO—OIL, lubricating, for aircraft instruments and machine guns. All temperatures.				
PS—OIL, lubricating, preservative, special. All temperatures.				

COLD WEATHER: For lubrication and Service below 0°F., refer to OFSB 6-5.

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RA PD 22628

Figure 58 — Lubrication Guide of Gun and Combination Mount M42

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against the trunnion bearings, since this will result in water entering into the bearings, causing nonfunction of the operating parts.

(4) Swab the gun bore immediately after firing, while the tube is still hot and daily thereafter on the following three days with a solution of $\frac{1}{2}$ pound of SODA ASH to each gallon of warm water. Rinse thoroughly with clean water and dry thoroughly before oiling. Clean the bore of the machine gun immediately after firing and daily thereafter on the following three days with CLEANER, rifle bore. Dry thoroughly before oiling.

h. Lubrication of Individual Units and Assemblies of Gun and M3 and M3E1 Carriages. The following instructions supplement those notes on the lubrication guide which pertain to lubrication and service of individual units and assemblies.

(1) **BREECH AND FIRING MECHANISM.** Daily and after firing, clean and oil all moving parts and exposed metal surfaces with OIL, engine, SAE 30, above $+32^{\circ}$ F; OIL, engine, SAE 10, from $+32^{\circ}$ F to 0° F; and OIL, lubricating, preservative, special, below 0° F. Use OIL, lubricating, preservative, special, for machine guns. **CAUTION:** To insure easy breech operation and to avoid misfiring in cold weather, clean with SOLVENT, dry-cleaning; dry, and lubricate with OIL, lubricating, preservative, special. To clean firing mechanism, remove and operate pin in SOLVENT, dry-cleaning.

(2) **BUFFER CYLINDERS AND OUTRIGGER TURNBUCKLES.** Excess lubricant in units will cause malfunction. If overfilled, remove fitting and operate parts to force out excess lubricant.

(3) **COUNTERPOISE CYLINDERS.** Remove cap on outer end of cylinder and coat surface above piston.

(4) **TRAVERSING RACK HOUSING.** Traverse gun through 360 degrees while lubricating.

(5) **WHEEL BEARINGS.** Remove bearing cone assemblies from hub. Wash bearings, cones, spindle, and inside of hub, and dry thoroughly. Do not use compressed air. Inspect bearing races and replace if damaged. Wet the spindle and inside of hub and hub cap with GREASE, general purpose, No. 2, to a maximum thickness of $\frac{1}{16}$ inch only, to retard rust. Lubricate bearings with GREASE, general purpose, No. 2, with a packer, or by hand, kneading lubricant into all spaces in the bearing. Use extreme care to protect the bearings from dirt, and immediately reassemble and replace wheel. Do not fill hub or hub cap. The lubricant in the bearing is sufficient to provide lubrication until the next service period. Any excess might result in leakage into the drum. Adjust bearings in accordance with instructions in paragraph 62.

(6) **OILCAN POINTS.** Weekly, lubricate external linkages and pins of foot firing mechanism, buffer adjustment linkage, buffer rod,

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counterpoise cam bracket, outrigger hinge pins, hand levers and water chest pump drive chain with OIL, engine, SAE 30, above +32° F; OIL, engine, SAE 10, from +32° F to 0° F; and OIL, lubricating, preservative, special, below 0° F.

(7) POINTS REQUIRING NO LUBRICATION SERVICE. Sighting mechanism drive cables.

(8) POINTS TO BE LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL.

(a) *Elevating 2-speed Gear Box, Elevating Upper and Lower Gear Cases, Elevating Worm Gear Case, Elevating Stop Mechanism, Traversing 2-speed Gear Box, Traversing Upper and Lower Gear Cases.* Every 6 months, completely disassemble and remove lubricant from inclosed parts and inside of housing. Repack bearings and coat gear teeth with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F. Pack housing where lever plug is provided to level of level plug opening before reassembling. Where level plug is not provided, fill housing approximately two-thirds full.

(b) *Traversing Thrust Bearing and Center Bearing.* Every 6 months, the traversing thrust bearing will be removed from recess in the leveling socket, cleaned and repacked with GREASE, O.D., No. 0, above +32° F or GREASE, O.D., No. 00, below +32° F. With the traversing thrust bearing removed, thoroughly clean the traversing rack and housing. At the same time, clean all recesses in the center bearing housing and coat bearing surfaces with the prescribed lubricant. Upon reassembly, lubricate the traversing rack, center bearing, and leveling socket bearing as prescribed by the lubrication guide.

(c) *Back Plate Assembly.* Every 6 months, remove the back plate assembly, disassemble, and clean inclosed parts and inside of housing. Coat plunger, upper and lower friction pieces, springs and inside of housing with GREASE, O.D., No. 0, above +32° F or GREASE, O.D., No. 00, below +32° F, and reassemble.

(d) *Driving Spring Assemblies.* Every 6 months, disassemble, clean, and oil the driving spring rod, driving springs, spacer, and inside of housing with OIL, engine, SAE 30, above +32° F; OIL, engine, SAE 10, from +32° F to 0° F; and OIL, lubricating, preservative, special, below 0° F.

(e) *Equilibrator.* Every 6 months, disassemble, clean, and coat springs and inside of housing with GREASE, O.D., No. 0, above +32° F or GREASE, O.D., No. 00, below +32° F.

(f) *Tube Extension.* Every 6 months, or whenever the gun tube is disassembled from the tube extension, clean trunnion block bushing, threaded end of the tube extension, and inside of trunnion block. Coat the threaded end of the gun tube as well as that portion which

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recoils in the trunnion block bushing with GREASE, graphited, light, and apply a light film of OIL, engine, SAE 30, above +32° F; OIL, engine, SAE 10, from +32° F to 0° F; and OIL, lubricating, preservative, special, below 0° F, to the trunnion block bushing and inside of trunnion block before reassembly.

i. Lubrication of Individual Units and Assemblies of Gun and Carriage M3A1. The following instructions supplement those notes on the lubrication guide which pertain to lubrication and service of individual units and assemblies.

(1) **BUFFER CYLINDERS AND OUTRIGGER TURNBUCKLES.** CAUTION: Excess lubricants in units will cause malfunction. If overfilled, remove fitting and operate parts to force out excess lubricant.

(2) **COUNTERPOISE CYLINDERS.** Remove cap on outer end of cylinder and coat the surface above piston.

(3) **HELICAL GEAR LUBRICATING BALL.** Remove cover, fill recess around ball, and add enough oil to fill recess. CAUTION: Do not allow moisture, dirt, or grit to enter open mechanism. Every 6 months, remove oil, clean recess, and refill.

(4) **HYDRAULIC OIL GEARS.** Remove cap from filter and fill through center hole, using gun provided, until oil escapes from vent at side of filter. Whenever system is drained, remove filter, wash and replace before refilling.

(5) **WHEEL BEARINGS.** Remove bearing cone assemblies from hub. Wash bearings, cones, spindle, and inside of hub, and dry thoroughly. Do not use compressed air. Inspect bearing races and replace if damaged. Wet the spindle and inside of hub and hub cap with GREASE, general purpose, No. 2, to a maximum thickness of 1/16 inch only, to retard rust. Lubricate bearings with GREASE, general purpose, No. 2, with a packer, or by hand, kneading lubricant into all spaces in the bearing. Use extreme care to protect the bearings from dirt, and immediately reassemble and replace wheel. Do not fill hub or hub cap. The lubricant in the bearing is sufficient to provide lubrication until the next service period. Any excess might result in leakage into the drum. Adjust bearings in accordance with instructions in paragraph 62.

(6) **OILCAN POINTS.** Weekly, lubricate external linkage and pins of foot firing mechanism, traversing and elevating crank handles, clevises and linkage, buffer rod, counterpoise cam bracket, outrigger hinge pins, hand levers and water chest pump drive chain, with OIL, engine, SAE 30, above +32° F; OIL, engine, SAE 10, from +32° F to 0° F; and OIL, lubricating, preservative, special, below 0° F.

(7) **POINTS TO BE LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL.**

(a) *Traversing Lower and Upper Gear Cases, Lower Hand Eleva-*

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ting Gear Case. Every 6 months, completely disassemble and remove lubricant from inclosed parts and from inside housing. Repack bearings and coat gear teeth with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F. Upon reassembly, lubricate as prescribed by the lubrication guide.

(b) *Traversing Rack and Traversing Thrust Bearing.* Every 6 months, the traversing rack and thrust bearing will be removed from recess in the leveling socket and all parts thoroughly cleaned. Oil the thrust bearing and rack with OIL, engine, SAE 30, above +32° F; OIL, engine, SAE 10, from +32° F to 0° F; and OIL, lubricating, preservative, special, below 0° F before assembly.

(c) *Center Bearing.* Every 6 months or whenever the traversing thrust bearing has been removed, disassemble and clean all recesses in the center bearing housing. Coat bearing surfaces with the prescribed lubricant and reassemble.

(d) *Foot Firing Mechanism.* Every 6 months, the foot firing mechanism will be disassembled and the inclosed operating mechanism cleaned and recoated with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F.

(e) *Leveling Mechanism Worm (Left Unit).* Every 6 months, disassemble, clean and repack bearings and coat worm with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F.

(f) *Equilibrator.* Every 6 months, disassemble, clean, and coat springs, chain rod thrust bearing, and inside of housing with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F.

(g) *Tube Extension Assembly.* Every 6 months, or whenever the gun tube is disassembled from the tube extension, clean trunnion block bushing, threaded end of the tube extension, and inside of trunnion block. Coat the threaded end of the gun tube as well as that portion which recoils in the trunnion block bushing with GREASE, graphited, light, and apply a light film of OIL, engine, SAE 30, above +32° F; OIL, engine, SAE 10, from +32° F to 0° F; and OIL, lubricating, preservative, special, below 0° F to the trunnion block bushing and inside of trunnion block before reassembly.

(h) *Back Plate Assembly.* Every 6 months, remove the back plate assembly, disassemble, and clean inclosed parts and inside of housing. Coat plunger, upper and lower friction pieces, springs, and inside of housing with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F and reassemble.

(i) *Driving Spring Assemblies.* Every 6 months, disassemble, clean, and oil the driving spring rod, driving springs, spaces, and inside of housing with OIL, engine, SAE 30 above +32° F; OIL, engine, SAE 10, from +32° F to 0° F; and OIL, lubricating, preservative, special, below 0° F.

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(j) *Ratchet Type Operating Levers (Some Models)*. Every 6 months, disassemble, clean and repack bearing with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F.

j. **Lubrication of Individual Units and Assemblies of Gun and Combination Mount M42.** The following instructions supplement those notes on the lubrication guide which pertain to lubrication and service of individual units and assemblies.

(1) **EQUILIBRATOR CYLINDER.** Remove cap, clean, and coat inner surface above piston.

(2) **TRAVERSING RACK HOUSING.** Traverse through 360 degrees while refilling.

(3) **POINTS TO BE LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL.**

(a) *Elevating 2-speed Gear Box, Elevating Upper and Lower Gear Cases, Elevating Worm Gear Case, Elevating Stop Mechanism, Traversing 2-speed Gear Box, Traversing Upper and Lower Gear Cases.* Every 6 months, completely disassemble and remove lubricant from inclosed parts and inside of housing. Repack bearings and coat gear teeth with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F. Pack housing where level plug is provided to level of level plug opening before reassembling. Where level plug is not provided, fill housing approximately two-thirds full.

(b) *Traversing Thrust Bearing and Socket Level Gearing.* Every 6 months, the traversing thrust bearing will be removed from recess in the leveling socket, cleaned and repacked with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F. With the traversing thrust bearing removed, thoroughly clean the traversing rack and housing. At the same time, clean all recesses in the center bearing housing and coat bearing surfaces with the prescribed lubricant. Upon reassembly, lubricate the traversing rack and center bearing as prescribed by the lubrication guide.

(c) *Back Plate Assembly.* Every 6 months, remove the back plate assembly, disassemble, and clean inclosed parts and inside of housing. Coat plunger, upper and lower friction pieces, springs, and inside of housing with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F, and reassemble.

(d) *Driving Spring Assemblies.* Every 6 months, disassemble, clean, and oil the driving spring rod, driving springs, spaces, and inside of housing with OIL, engine, SAE 30, above +32° F; OIL, engine, SAE 10, from +32° F to 0° F; and OIL, lubricating, preservative, special, below 0° F.

(e) *Equilibrator.* Every 6 months, disassemble, clean, and coat

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springs and inside of housing with GREASE, O.D., No. 0, above +32° F, or GREASE, O.D., No. 00, below +32° F.

(f) *Tube Extension Assembly.* Every 6 months, or whenever the gun tube is disassembled from the tube extension, clean trunnion block bushing, threaded end of the tube extension, and inside of trunnion block. Coat the threaded end of the gun tube as well as that portion which recoils in the trunnion block bushing with GREASE, graphited, light, and apply a light film of OIL, engine, SAE 30, above +32° F; OIL, engine, SAE 10, from +32° F to 0° F; and OIL, lubricating, preservative, special, below 0° F to the trunnion block bushing and inside of trunnion block before reassembly.

56. REPORTS AND RECORDS.

a. Report unsatisfactory performance of materiel to the ordnance officer responsible for maintenance.

b. Maintain a record of changes in lubricants and recoil oils in the artillery gun book for the materiel.

57. CARE OF GUN BORE.

a. *General.* Wear and erosion of the gun tube do not depend entirely upon the number of rounds fired but also on the care given in cleaning, lubricating and cooling between rounds.

b. *Cleaning Before Firing.* Before firing, wipe out the bore to insure that it is clean and dry.

c. *Cleaning During Firing.* During firing, whenever the rate of fire permits, examine the bore for powder fouling; clean with bore brush if necessary.

d. *Cleaning After Firing.* Artillery gun bore will be cleaned immediately after firing while the tube is still hot. Under no circumstances should a gun be allowed to set without cleaning after it has been fired. Clean the bore with a cleaning solution of ½ pound of SODA ASH to each gallon of warm water each day for 3 days after firing. After cleaning, wipe the bore dry, using the cleaning rod, bore brush, and burlap. Using clean dry burlap and oil the bore as prescribed. Only the regular issue bronze bore brush should be used.

(1) The SODA ASH solution is preferable. This solution will do the most efficient cleaning of gun bores, and should be used at all times.

(2) Alternatives listed below are only to be used when SODA ASH is not available. It is to be understood that the alternative cleaning solutions suggested will not do as efficient cleaning as will the soda ash solution. As first alternative, a solution of 1 pound of soap in 4 gallons of hot water can be used. Castile soap is preferred. If the issue soap is used, extreme caution must be taken to rinse the bore

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thoroughly with clean water. If issue soap solution is not thoroughly rinsed from the parts of the gun with clean water, there is danger of corrosion from possible free caustic in the soap or of gumming of the soap solution. Lacking any of the above solutions, cleaning, brushing, and wiping with plenty of hot water can be used as an emergency cleaning method.

(3) The cleaning process must be repeated on successive days until there is no longer evidence of sweating. The purpose of cleaning after firing is to remove all traces of residue and primer salts. The latter causes corrosion. A clean bore is indicated by uniform gray appearance. No attempt should be made to obtain a bright, polished appearance because the use of abrasives damages the bore.

e. *Routine Cleaning.* Thereafter the gun bore should be inspected daily and at the first sign of rust, cleaned with SOLVENT, dry-cleaning, dried and reoiled; otherwise, wipe the bore with clean dry burlap every 5 days and reoil.

58. CARE OF BREECH MECHANISM.

a. Keep the breach mechanism, including the firing lock, clean and well lubricated at all times. Immediately after firing and for daily cleaning, the breach and firing mechanism should be cleaned in SOLVENT, dry-cleaning, thoroughly dried and coated with OIL, engine, (seasonal grade). The operating mechanisms and moving parts are lubricated with a thin film of oil applied with an oil can, if holes are provided, otherwise, with a clean cloth.

b. Fouling of the firing pin or the use of thicker oil than authorized will cause absorption of the energy of the hammer spring and firing hammer and may result in misfires. This is especially true in cold weather.

59. CARE OF RECUPERATOR MECHANISM.

a. *Recuperator Piston Rod Nut.* This nut should be screwed on the recuperator piston rod so that the nut seats solidly on the shoulder of the tube extension and the flat of the nut is in line with the top surface of the breechblock stop. This is necessary to prevent the nut from shaking loose on the piston rod.

b. *Recuperator Springs.*

(1) At high elevations, the recuperator springs must lift the combined weight of the tube, the tube extension, and the piston and piston rod, in addition to forcing the oil past the piston. They have very little power in excess of that required for these functions. The use of recoil oil of improper viscosity or the development of undue friction, due to dirt, oil grease, or improper lubricants, may cause the gun to fail to return completely into battery. If this failure does not exceed $\frac{1}{8}$ inch,

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the gun will fire safely. When the lock frame is more than $\frac{1}{8}$ inch out of battery, the breechblock cannot close and the gun will not fire.

(2) Great care should be exercised in maintaining the correct amount of oil in the mechanism. With too little oil, it is possible to have excessive recoil to the extent that the recuperator piston will completely compress the recuperator spring and damage the piston.

(3) There is no adjustment provided for the packing in the rear end of the cylinder. Excess leakage should be reported to ordnance personnel.

c. Addition of Recoil Oil.

(1) Use only OIL, recoil, light, from sealed containers.

(2) Elevate the gun to 5 degrees.

(3) Remove the recuperator filler screw and the expansion tube relief screw (fig. 30).

(4) Add OIL, recoil, light, until just visible in the bottom of the recess in the bottom of the filling hole. Slap the outside walls of the recuperator cylinder with the bare hands while adding the oil. This action will force the escape of any air trapped in the cylinder. Continue adding oil and jarring the cylinder until all air is removed and the oil remains stationary at the bottom of the filling hole when the cylinder is slapped.

(5) Replace the recuperator filler screw and then the expansion tube relief screw.

(6) Excess oil must be removed from the recuperator mechanism. Remove the recuperator filler screw and expansion tube relief screw. Elevate the gun to its maximum elevation. Remove the excess oil with an eyedropper or by blowing through the air hole of the expansion chamber. Depress the gun to 5 degrees and recheck quantity of oil. Replace the screws if the oil level is correct.

60. CARE OF DRIVING SPRING ASSEMBLIES.

a. Care.

(1) No adjustments are provided for the driving spring. Dents in the cylinders or bent rods may cause the gun to fail. Also, failure may result from accidental sealing of the vents in the forward ends of the cylinders with heavy grease or mud. See paragraph 72 c for inspection, cleaning, and oiling of driving springs.

(2) A critical point in the operation occurs when the forward movement of the lock frame ceases and the breechblock is forced into firing position. At this point the driving springs cease to function and give over to the small operating lever spring in the lock frame itself. Dirt in the cam slots, burs on the breechblock, dirt or grit on the lock

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frame or its track, weak driving springs, or a weak operating lever spring may result in a failure of the breechblock to close.

b. Fastening. It is important that the fastenings of the driving spring assemblies to the tube extension and lock frame be secure at all times.

61. CARE OF FEED BOX MECHANISM.

a. The many parts of the feed box assembly must be kept clean and free from dirt, grit, and moisture. If any one of these parts should bind, the entire mechanism will jam. All studs, pivoting parts, holes, and plungers must be kept clean, properly lubricated, and free from dents and burs. Cotter pins should always be bent close to their pins or nuts so that no projecting ends will interfere with the movement of the mechanism.

62. CARE OF CARRIAGE.

a. The carriage cannot be kept in serviceable condition unless proper attention is given to cleaning, lubrication, and to loose or broken parts. Bearing surfaces, revolving parts, springs, screw threads, gear teeth, and exterior parts must be clean and free from dirt. Special attention should be given to exposed teeth and bearing surfaces. In disassembling and assembling, precautions must be taken to prevent the entrance of foreign matter. A general inspection is required before and after use. If the carriage is to be unused for a considerable length of time, bright unpainted surfaces should be cleaned with SOLVENT, dry-cleaning, and coated with a rust-preventive compound. All lubricating fittings should be kept clean and, if necessary, a piece of wire may be used in cleaning out passages. Every precaution should be taken by the using service to make certain that the battery used to actuate the electric brakes when the carriage breaks away from the prime mover, is in place, properly up to charge, and that all wiring and switches are functioning correctly. The breakaway (safety) switch is to be left habitually in the "OFF" position, except when the brakes are tested by authorized personnel. Brakes are to be tested for proper functioning before each trip. Switch terminals should be well wrapped and the safety chain to the safety switch should under no circumstances be wrapped around the switch. To obtain maximum mileage, the tires should be checked at least every week to see that they contain 40 pounds air pressure. The wheels should not be washed with the tires deflated. Remove any foreign substances from the rubber. It is recommended that the carriage should not be towed at rapid speeds over rough terrain.

b. The leveling mechanism (on left unit) is to be lubricated by ordnance maintenance personnel at time of ordnance inspection.

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c. Bearings.

(1) Remove bearing cone assemblies from hub and wash spindle and inside of hub. Inspect bearing races and replace if necessary. Wet the spindle and inside of hub and hub cap with GREASE, general purpose, No. 2, to a maximum thickness of $\frac{1}{16}$ inch only, to retard rust. Wash bearing cones and grease seals. Inspect and replace if necessary. Lubricate bearings with GREASE, general purpose, No. 2, with a packer or by hand, kneading lubricant into all spaces in the bearing races. Use extreme care to protect bearings from dirt and immediately reassemble and replace wheel. The lubricant in the bearings is sufficient to provide lubrication until the next service period. Do not fill hub or hub cap. Any excess might result in leakage into the brake drum.

(2) Reinstall bearings, mount wheel on spindle, and tighten nut until there is a slight drag when wheel is rotated.

(3) Back off nut until wheel turns freely without side play and insert cotter pin.

(4) Clean and install hub cap.

(5) Weekly, on buffer adjustment and operation linkage, axle bracket and counterpoise rod, pin, outrigger hinge pins and crank handles, apply OIL, engine, SAE 30, above $+32^{\circ}$ F, OIL, engine, SAE 10, for $+32^{\circ}$ F to 0° F, or OIL, lubricating, preservative, light, below 0° F.

63. CARE OF COMBINATION GUN MOUNT M42.

a. Points to be Lubricated by Using Arms.

(1) The gun mount can be kept in serviceable condition only if constant attention is given to cleaning, lubricating, and adjusting the several parts and assemblies.

(2) Bearing surfaces, revolving parts, springs, screw threads, gear teeth, and exterior parts must be clean and free from dirt.

(3) When disassembling and assembling, precautions must be taken to prevent foreign matter from coming in contact with bright surfaces.

(4) If the gun mount is to be unused for a period of more than 1 month, bright surfaces must be cleaned with SOLVENT, dry-cleaning and coated with COMPOUND, rust-preventive.

64. CARE OF COUNTERPOISE CYLINDERS.

a. The spring mechanisms of these cylinders should allow the carriage to descend to the ground freely and slowly without having to use much force on the carriage or the counterpoise cylinder levers. Excessive force should not be exerted on the counterpoise levers, as

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damage is likely to occur to the mechanism. It should be possible to raise the carriage from the ground without excessive effort. Adjust tension of counterpoise cylinder springs, as described in paragraph 73 h.

65. CARE OF SIGHTING AND FIRE CONTROL EQUIPMENT.

a. General.

(1) The instructions given hereunder supplement instructions pertaining to individual instruments included in the sections on sighting and fire control equipment.

(2) The policy in regard to disassembly, repair, maintenance, and adjustment for all sighting and fire control instruments is as described below.

(a) Except as authorized in step (b) below, disassembly and assembly of instruments by the using arm personnel are, in general, not permitted beyond the extent authorized in the paragraphs dealing with the individual instruments.

(b) In general, battery operating personnel are limited to adjustments, repairs, and maintenance which can be performed with the facilities available to them and which do not require access to the interior of the instrument through the removal of the cover plates. Adjustments, repairs, and maintenance, which can be performed with the facilities available and which require access to the interior of the instrument through the removal of the cover plates, may be performed by local personnel, either of the using arms or of the Ordnance Department, who have been qualified for the work either through the successful completion of a recognized course of instruction in director maintenance or through adequate experience in the type of operation to be undertaken. A recognized course of instruction is one that has the approval of the Chief of Ordnance and the Chief of Coast Artillery. Determination of adequate experience in each case will be made by the responsible ordnance officer. The responsible ordnance officer will take the necessary action where maintenance requires facilities beyond those available locally.

(3) The maintenance duties described are those for which tools and parts have been provided the using arm personnel. Other replacements and repairs are the responsibility of maintenance personnel, but may be performed by the using arm personnel, when circumstances permit, within the discretion of the responsible ordnance officer.

b. Care In Handling.

(1) Fire control and sighting instruments are, in general, rugged and suited for the purpose for which they have been designed. They will not, however, stand rough handling or abuse. Inaccuracy or malfunctioning will result from such treatment.

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(2) Unnecessary turning of screws or other parts not incident to the use of the instrument is forbidden.

(3) When placing instruments in or removing them from their carrying cases, avoid the use of undue force.

(4) When the instruments are not in use, keep them in the carrying cases provided or in the condition indicated for traveling.

(5) Keep instruments as dry as possible. If the instrument becomes wet, dry it before placing it in its carrying case.

(6) Instruments which indicate incorrectly or fail to function properly after the authorized tests and adjustments have been made are to be turned in for repair by ordnance personnel.

(7) Painting of fire control or sighting equipment by the using arm personnel is not permitted; however, porter bars for the director and generating unit are exceptions to this rule. The porter bars should be kept painted to prevent rusting.

(8) Fire control mechanisms move freely and smoothly throughout the range of the instruments. The mechanisms must not be forced against the stops provided at the extremes of the range.

c. Lubrication.

(1) Where lubrication with oil is indicated, use **OIL**, lubricating, for aircraft instruments and machine guns; where lubrication with grease is indicated, use **GREASE**, lubricating, special.

(2) Lubricants must be applied carefully and diligently. Excessive lubrication must be avoided.

(3) The exterior of instruments must be kept free of dirt, dust, and seeping oil. Remove excess oil from metal or painted surfaces with a cloth slightly moistened with **SOLVENT**, dry-cleaning, and wipe the surface with a clean cloth.

d. Optical Parts.

(1) To obtain satisfactory vision, exposed surface of lenses and other optical parts must be kept clean and dry. Corrosion and etching of the surface of the glass can be prevented or greatly retarded by keeping the glass clean and dry.

(2) For wiping optical parts use only **PAPER**, lens, tissue. The use of cleaning cloths for wiping optical parts is not permitted. Do not wipe lenses or windows with the fingers. To remove dust, brush the glass lightly with a clean camel's-hair brush. Rap the brush against a hard body to knock out the small particles of dust that cling to the hairs. Repeat this process until all dust is removed from the glass surface. An additional brush with coarse bristles is provided with some instruments for cleaning mechanical parts. Each brush should be used only for the purpose for which it is intended.

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(3) Exercise particular care to keep optical parts free from grease and oil. To remove grease or oil from optical surfaces, apply SOAP, liquid, lens cleaning, with a tuft of lens paper. Wipe the surface gently with clean lens paper. If SOAP, liquid, lens cleaning, is not available, breathe heavily on the surface and wipe it off with clean lens paper. Repeat this process until the surface is clean.

(4) Moisture may condense on the optical parts of the instruments when the temperature of the parts is lower than that of the surrounding air. The moisture, if not excessive, can be removed by placing the instrument in a warm place. Heat from strongly concentrated sources should not be applied directly as it may cause unequal expansion of parts, thereby resulting in breakage of optical parts or inaccuracies in observation.

(5) Serious damage to ordnance materiel, requiring in many cases repair and replacement of component parts of sighting equipment and fire control instruments, has frequently resulted from the use of water, steam or air from a high-pressure hose for cleaning purposes. For this reason, extreme care will be taken to prevent dirt and grit from being forced into the bearing surfaces and gear cases when using water, steam, or air under pressure for cleaning. Under no circumstances will a hose, either normal-pressure or high-pressure, be used in cleaning any sighting equipment or any fire control instruments. Before washing, removable sighting equipment should be taken off the materiel to be cleaned. In cases where it is not removable, care will be taken to cover the parts properly.

66. CARE OF BRAKES AND TIRES.

a. **Brakes.** If brakes have been submerged in mud or water, remove the wheels and hubs as described in paragraph 91. Inspect the brake linings for grease. If grease is present, clean with SOLVENT, dry-cleaning. If linings have absorbed grease, it may be necessary to replace them as SOLVENT, dry-cleaning, will remove only the surface grease. Report to ordnance personnel. Repack wheel bearings with grease as prescribed in paragraph 62 c.

b. **Tires.**

(1) Whenever practicable, the tires should be kept covered from the direct rays of the sun.

(2) The air pressure should be maintained at 65 pounds. Check the pressure, before towing the mount, at normal atmospheric temperature. Do not release air after the mount has been towed and the tires are warm. Pressures will return to normal as the tires cool, when the mount is stopped.

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(3) Grease and oil will deteriorate the rubber tires. Keep them clean at all times by washing with soap and warm water.

(4) Cuts, abrasions, nail holes, etc., should be repaired as soon as possible. A cut through the tread or side wall rubber to the plies will allow water and dirt to enter, which will rot the cords and result in tire failure.

(5) Combat tires, when punctured, are to be repaired as soon as possible. The amount of travel that can be placed on a punctured tire is limited.

(6) Tires may be rotated to different positions on the mount to allow them to wear evenly. Uneven tire wear may indicate bent spindles or bogie axles; report to ordnance maintenance personnel.

67. CARE OF GUN COVERS.

a. To prevent formation of damaging mildew during periods of storage, shake out and air the canvas cover for several hours at frequent intervals. Repair without delay any loose grommets or rips in the canvas. Failure to make immediate repairs may allow a minor defect to develop into a major damage. Mildewed canvas is best cleaned by scrubbing with a dry brush. If water is necessary to remove dirt, it must not be used until mildew has been removed. If mildew has been present, examine fabric carefully by stretching and pulling for evidence of rotting or weakening of fabric where mildew had been. If fabric shows indication of loss of tensile strength, it is probably not worth retreatment. Oil and grease can be removed by scrubbing with issue soap and warm water. Rinse well with clear water and dry. CAUTION: At no time is gasoline or solvent to be used to remove oil or grease spots.

68. EXERCISE OF ARTILLERY MATERIEL.

a. It is necessary to exercise the equipment frequently. This means while in storage, the recoil mechanism should be exercised at least once every 3 months. To exercise the recoil mechanism, drain the oil from the replenisher. Disconnect the oil hose from top of upper recoil cylinder and remove T-fitting from recoil cylinder and replace it with union A311479. Connect oil hose assembly B269301 less coupling A236062 to Oil Pump M3 and to the union in recoil cylinder. Pump oil into recoil cylinder forcing the gun out of battery about 1 foot. Open valve in pump, allowing oil to flow back into pump and gun to return to battery. Repeat this operation several times. Remove union from recoil cylinder and replace T-fitting. Connect oil hose to T-fitting and fill replenisher. At the time of the exercising, inspect all visible parts for corrosion.

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69. CLEANING AND PRESERVING MATERIALS.

a. Equipment.

PAPER, lens, tissue (for wiping lenses and windows)

SOAP, liquid, lens cleaning (for cleaning lenses and windows)

BRUSH, artist, camel's-hair, rd. (for removing dust and lint from lenses and windows)

SOLVENT, dry-cleaning (for cleaning metal surfaces)

b. For complete list of cleaning and preserving materials, see TM 9-850.

70. PAINTING.

a. General.

(1) Ordnance materiel is painted before issue to the using arms and one maintenance coat per year will ordinarily be ample for protection. With but few exceptions, this materiel will be painted with ENAMEL, synthetic, olive-drab, lusterless. The enamel may be applied over old coats of long oil enamel and oil paint previously issued by the Ordnance Department if the old coat is in satisfactory condition for repainting.

(2) Paints and enamels are usually issued ready for use and are applied by brush or spray. They may be brushed on satisfactorily when used unthinned or thinned. No more than 5 percent by volume of THINNER should be used. The enamel will spray satisfactorily when thinned with 15 percent by volume of thinner for synthetic enamels. (Linseed oil must not be used as a thinner since it will impart a luster not desired in this enamel.) If sprayed, it dries hard enough for repainting within ½ hour and dries hard in 16 hours.

(3) Certain exceptions to the regulations concerning painting exist. Fire control instruments, sighting equipment, and other associated items will not be painted.

(4) Complete information on painting is contained in TM 9-850.

b. Preparing for Painting.

(1) If the base coat on the materiel is in poor condition, it is more desirable to strip the old paint from the surface than to use sanding and touch-up methods. After stripping, it will then be necessary to apply a primer coat.

(2) PRIMER, synthetic, refinishing, should be used on wood as a base coat for synthetic enamel. It may be applied either by brushing or spraying. It will brush satisfactorily as received or after the addition of not more than 5 percent by volume of THINNER. It will be dry enough to touch in 30 minutes, and hard in 5 to 7 hours.

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For spraying, it may be thinned with not more than 15 percent by volume of THINNER. A period of 48 hours must elapse before lacquers are applied to the PRIMER, synthetic, refinishing.

(3) PRIMER, synthetic, rust inhibiting, for bare metal, should be used on metal as a base coat. Its use and application are similar to that outlined in step (2), above.

(4) The success of a job of painting depends partly on the selection of a suitable paint, but also upon the care used in preparing the surface prior to painting. All parts to be painted should be free from rust, dirt, grease, kerosene, oil, and alkali, and must be dry.

c. Painting Metal Surfaces. If metal parts are in need of cleaning, they should be washed in a liquid solution consisting of $\frac{1}{2}$ pound of SODA ASH, type I, in 8 quarts of warm water, or an equivalent solution, then rinsed in clear water and wiped thoroughly dry. Wood parts in need of cleaning should be treated in the same manner, but the alkaline solution must not be left on for more than a few minutes, and the surfaces should be wiped dry as soon as they are washed clean. When gun materiel is in fair condition and marred only in spots, the affected places should be touched up with ENAMEL, synthetic, olive-drab, lusterless, and permitted to dry. The whole surface will then be sandpapered with PAPER, flint, class B, No. 1, and a finish coat of ENAMEL, synthetic, olive-drab, lusterless, applied and allowed to dry thoroughly before the materiel is used. If the equipment is in bad condition, all parts should be thoroughly sanded with PAPER, flint, class B, No. 2, or equivalent, given a coat of PRIMER, synthetic, refinishing, and permitted to dry for at least 16 hours. They will then be sandpapered with PAPER, flint, No. 00, class B, wiped free from dust and dirt, and a final coat of ENAMEL, synthetic, olive-drab, lusterless, applied and allowed to dry thoroughly before the materiel is used.

d. Paint as a Camouflage.

(1) Camouflage is now a major consideration in painting ordnance vehicles, with rust prevention secondary. The camouflage plan employed at present utilizes three factors: color, gloss, and stenciling.

(a) *Color.* Materiel is painted with ENAMEL, synthetic, olive-drab, lusterless, which will blend reasonably well with the average landscape.

(b) *Gloss.* The new lusterless enamel makes a gun and carriage difficult to see from the air or from relatively great distances over land. A gun and carriage painted with ordinary glossy paint can be detected more easily and at greater distances.

(c) *Stenciling.* White stencil numbers on guns and carriages have been eliminated because they can be photographed from the air. A

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blue-drab stencil enamel is now used which cannot be so photographed. It is illegible to the eye at distances exceeding 75 feet.

(2) PRESERVING CAMOUFLAGE.

(a) Continued friction or rubbing must be avoided, as it will smooth the surface and produce a gloss. The gun and carriage should not be washed more than once a week. Care should be taken to see that the washing is done entirely with a sponge or a soft rag. The surface should never be polished, rubbed, or wiped, except while wet, or a gloss will develop.

(b) It is not desirable that gun and carriages, painted with lusterless enamel, be kept as clean as materiel has been kept when glossy paint was used. A small amount of dust and dirt increases the camouflage value. Grease spots should be removed with SOLVENT, dry-cleaning. Whatever portion of the spot cannot be so removed should be allowed to remain.

(c) Continued friction of wax-treated tarpaulins on the sides of a vehicle will also produce a gloss, which should be removed with SOLVENT, dry-cleaning.

(d) Tests indicate that repainting with olive-drab paint will be necessary once yearly, with blue-drab paint twice yearly.

e. **Removing Paint.** After repeated paintings, the paint may become so thick as to crack and scale off in places, presenting an unsightly appearance. If such is the case, remove the old paint by use of a lime-and-lye solution for metal (see TM 9-850 for details) or REMOVER, paint and varnish, for wood. It is important that every trace of lye or other paint remover is completely rinsed off and that the equipment be perfectly dry before repainting is attempted. It is preferable that the use of lye solutions is limited to iron or steel parts. If used on wood, the lye solution must not be allowed to remain on the surface for more than a minute before being thoroughly rinsed off and the surface wiped dry with rags. Crevices or cracks in wood should be filled with putty and the wood sandpapered before refinishing. The surfaces thus prepared should be painted according to directions given above.

f. **Painting Lubricating Devices.** A circle $\frac{3}{4}$ inch in diameter will be painted around oil cups, grease fittings, oilholes, and similar lubricating devices, with ENAMEL, synthetic gloss-red, in order that they may be readily located. Do not paint the oil cup or fitting.

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Section VII

INSPECTION AND ADJUSTMENT

71. GENERAL.

a. Inspection of your weapon is vital. Thorough, systematic inspection at regular intervals is the best insurance against an unexpected breakdown at the critical moment when maximum performance is absolutely necessary. Never let your materiel run down. Keep it in first class fighting condition by vigilant inspection and prompt maintenance.

b. Inspection is for the purpose of determining by critical examination the condition of the materiel, whether repairs or adjustments are required, and to insure serviceability and proper functioning. Its immediate aim is trouble prevention, which includes the steps given below:

(1) Inspection of the gun and carriage normally should be carried out during all procedures necessary for operating the gun and carriages. Each time the carriage is emplaced the operators should carefully observe all of the mechanism, together with the levers and handles which are necessary for their operation. If mechanisms gradually become more difficult to operate, thereby showing signs of wear or gradual deformation of parts, this should be noted for a thorough inspection and possible disassembly as soon as practicable. Inspection of the gun should be carried on at all times that the gun is being handled, either under actual firing conditions or during cleaning and lubricating procedures. When firing, the action of the gun should be noted. When disassembling, for the purpose of cleaning and lubrication, each and every part should be checked for burs, rough surfaces, or any other signs of wear that will disturb the true motion of the mechanisms. These deformations should be removed immediately with a fine abrasive. After lubrication and cleaning, these parts should be checked for their proper action. Normally the gun should be disassembled for cleaning, lubrication, and inspection immediately after firing. Reassemble, check for proper operation, and keep in this condition and ready for firing unless put away for storage and then proper methods for storage will be used. Before firing it will be necessary for the operators to ascertain that the gun and carriage are in perfect working condition.

(2) Discovering evidence of improper treatment received by the materiel before delivery into your hands.

c. A record will be kept in Artillery Gun Book (O.O. Form 5825) of all inspection and maintenance, number of rounds fired, seasonal changes of lubrication, and the completed Field Service Modification Work Orders.

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d. The following paragraphs are to be used as an outline for inspection and correction during daily cleaning and firing operations.

72. GUN.

a. **General.** Check general appearance for cleanliness. No accumulations of grease, dirt, or grit should be present and the parts should have neither burrs, scratches, dents, nor any imperfection which might change dimensions or in any way interfere with smooth operation. Make certain that all sliding, moving, and pivoting parts operate smoothly and freely. Cotter pins must be spread so that no projecting ends will interfere with the mechanism. Check mounting of gun in cradle. There should be no looseness. Examine for loose or missing parts.

b. Gun Tube.

Inspection	Correction
<p>Note general appearance and check smoothness of threads by screwing the tube into the tube extension. Examine the bore for evidence of powder fouling. Do not confuse coppering of bore with powder fouling. Present regulations prohibit removal of copper fouling. Erosion at origin of rifling, and wear of the firing chamber. Examine the outer portion of the gun tube for erosion at the point of entry into the trunnion block. Note condition of the tube threads. A clean bore is not necessarily a shiny bore. It might have a dull gray appearance.</p>	<p>Smooth down all burrs and abrasions with a fine abrasive such as CLOTH, crocus. Smooth damages on the thread of the gun tube or tube extension. Copper deposits should not be removed. If the gun tube does not seat firmly in its socket, the trunnion block bushing or the tube threads might be excessively worn. If these parts cannot be smoothed down to fit properly, one or the other or all the parts must be replaced.</p>

c. Back Plate.

<p>Remove the back plate assembly and see that the latch functions properly. The buffer plunger stop screw should be securely tightened so that the parts will not vibrate loose during firing.</p>	<p>Replace back plate latch body if worn, or replace the spring if the latch is loose.</p>
<p>Disassemble and inspect buffer, plunger, and friction pieces for rough surfaces or burrs.</p>	<p>Smooth the rough portions of the internal parts with a fine abrasive.</p>

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Inspection	Correction
Note that the internal parts are properly lubricated.	Lubricate before assembly.
Note back plate assembly for excessive shock during firing.	Buffer adjusting screw is either too tight or too loose. If too loose, the lock frame will cause the buffer plunger to strike the rear wall. If too tight, the lock frame will strike the plunger without the shock being absorbed. Adjust the buffer adjusting screw to give smoother action.
 d. Driving Spring Assembly.	
Raise the carrier until caught by the carrier catch and retract the lock frame until it is caught by the carrier dog. Release the carrier catch, thereby allowing the lock frame to charge forward. The driving spring assemblies should pull the lock frame forward with sufficient force to load a round into the firing chamber and to close the breech completely.	If the driving springs appear to be weak, remove the driving spring assemblies for thorough cleaning as follows: Place the forward end in a quantity of SOLVENT, dry-cleaning, and using the rod as a pump plunger draw solvent through the small hole in the forward end of the cover. Try to remove all possible gummy or heavy lubricant in this manner. Do not clog the hole nor bend the rod. After cleaning, flush with engine oil.
Ascertain that the lock frame moves freely in the trunnion block without any sign of binding.	Clean lock frame and slideways, remove burs, and lubricate. If this cleaning does not improve action of driving spring assemblies, they should be replaced.
 e. Breechblock.	
Remove the breechblock and note whether there are scores or roughness on any of the surfaces. Breechblock must open and close without binding.	Smooth all rough sliding surfaces of the breechblock.
Depress firing pin to check the action of the firing pin spring. The firing pin and bushing	Remove firing pin and firing pin spring, lubricate, and reassemble. Replace the spring if it

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Inspection

should not extend beyond the face of the breechblock when pressure is released. Inspect firing pin for burs or deformation on rear stopping surface where firing pin stop strikes.

f. Tube Extension Assembly.

Check motion of tube extension by pushing the tube back and forth in the trunnion block after removing the recuperator piston rod nut and driving spring assemblies. The tube extension should move freely and easily.

NOTE: While operating the tube extension in this manner, care should be taken to avoid damaging the threads on the recuperator piston rod. Also make certain the gun is in horizontal position before removing recuperator piston rod nut.

Check action of the carrier cam on the carrier, the ejector in the ejector cam, and the feed lever operating stud on the feed lever, before installing recuperator piston rod nut.

g. Feed Box.

Open the feed box cover and note that all parts of the mechanism are in place, properly secured, and properly lubricated, and that they operate freely. All parts should be clean and free from burs, grit, or signs of wear. Be sure that no parts are missing.

h. Recuperator Mechanism.

Elevate the gun to 5 degrees. Remove the recuperator filler screw and the expansion tube relief screw and note whether the recoil oil is at the proper level.

Correction

does not return the firing pin to position as soon as pressure is released.

Remove all burs and smooth all rough portions.

If action is not free and positive, ascertain cause of binding and repair or replace parts.

Replace missing or badly damaged parts. Smooth all rough portions.

Adjust recoil oil to proper level as described in paragraph 59 c.

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Inspection	Correction
<p>Measure the length of recoil as follows:</p> <p>Spread grease on tube from trunnion block bushing forward for a distance of 12 inches.</p> <p>Fire one or more rounds.</p> <p>Measure the distance that the grease has been pushed forward by the bushing.</p> <p>This distance is the length of recoil. When the recuperator is warmed up, this length should be between $10\frac{3}{8}$ and $10\frac{5}{8}$ inches and should never be allowed to exceed $10\frac{3}{4}$ inches.</p> <p>Examine the back portion of the recuperator cylinder for signs of excessive leakage. Examine all other portions of the recuperator cylinder for leakage. Note the action of the recuperator when firing the gun, taking special note of action when the gun is elevated to a high position.</p>	<p>If length of recoil is too great, elevate the muzzle to 10 degrees and add a few drops of oil. If length of recoil is less than required, elevate the gun to maximum elevation and remove several drops of oil.</p> <p>Excessive leakage of the recuperator mechanism or improper action of the mechanism when every other part of the gun is in proper working condition should be reported to ordnance maintenance personnel.</p>

73. CARRIAGE.

a. Check for general appearance. If the paint has deteriorated or become damaged, leaving exposed portions of bare metal, the carriage should be cleaned and repainted. Lubrication fittings should be identified with a $\frac{3}{4}$ -inch red circle painted around each fitting. Examine the carriage for bent, damaged, or broken plates and cracked welds. Broken or malformed parts must be repaired or replaced by ordnance maintenance personnel. No paint is to be applied to top of lubrication fittings. If lubrication fitting top is painted, remove paint before lubricating.

b. Foot Firing Mechanism.

Check the foot firing pedal of Carriages M3 and M3E1 for operation of the latch lever. This should engage the pedal when pressure on the pedal is released.

Clean out the socket of the foot pedal latch or smooth down the latch plunger to provide a positive engagement of the plunger in the socket. Lubricate parts.

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Cock the firing hammer by pulling the lock frame to the rear several inches and then allow to spring forward so that the breechblock is completely closed. Depress the foot pedal and note that the trigger is tripped. This should be evidenced by a sharp click in the gun.	If the hammer is not tripped, examine the linkage system for binding parts. Lubricate freely with engine oil. The motion of the foot pedal can be adjusted by means of the foot firing adjusting nut (fig. 32).
Inspect the action of the front and rear cable pedals of the Carriage M3A1 in the same manner.	Motion of the front cable pedal can be adjusted by means of the cable adjusting screw (fig. 33). Motion of the rear cable pedal is adjusted by means of a screw and lock nut which are secured to the under side of the firing platform directly below the rear cable pedal.
Check the operation of the mechanism change lever of the Carriage M3A1. When this lever is turned to the far right, the gun trigger should remain pulled when the pedals are depressed. When the mechanism change lever is turned to the far left, the trigger should actuate the firing mechanism and then snap back to its original position each time the pedal is depressed.	Notify ordnance maintenance personnel if the mechanism change lever does not cause the firing mechanism to operate properly.
Ascertain that there is no binding of the foot firing cables of the Carriage M3A1.	Lubricate and see that there are no kinks in the cables. Cables that are badly kinked or that bind must be replaced.
c. Cradle.	
Inspect the elevating rack for broken or worn teeth.	Report wear or broken teeth to ordnance maintenance personnel.
Inspect the mounting of the gun in the cradle. There should be no looseness.	Tighten gun mounting keys. If the slideways of trunnion block and cradle are worn, report to ordnance maintenance personnel.

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Inspection	Correction
Inspect mounting of cradle to top carriage.	There must be no looseness of the cradle trunnions or evidence of binding of the trunnion bearings. Report any such malfunctions to ordnance personnel.
Check the mounting of the cal. .50 machine gun on the cradle of the Carriage M3E1. These guns should be held securely in place.	Tighten mounting screws.
Check the cradle shield cover and cradle shield slide of the Carriage M3A1 to see that they can be readily removed or installed.	Straighten bent portions. Replace if badly damaged.
d. Equilibrator.	
Observe effort required to elevate and lower the gun as an indication of adjustment of the equilibrator.	Adjust spring to secure proper counterbalancing of gun and cradle.
Check condition of equilibrator chain and position of pin holding chain to cradle on the M3A1.	Damaged or weak chain links should be reported to the ordnance maintenance personnel. Reinstall pin and insert cotter pin if found out of position.
e. Elevating Mechanisms M3 and M3E1.	
Check for binding or excessive backlash.	If handwheel play is greater than one-fourth turn, notify ordnance maintenance personnel.
Elevate and depress the gun on the Carriages M3 and M3E1 manually through complete movement and note smoothness of operation. Elevating and traversing rack should be free from dirt and grit, and properly lubricated. Gear teeth should be in good condition.	If load on the handwheel is excessive, adjustment of the equilibrator is necessary as follows: Set the gun to maximum elevation. Remove the front cap of the equilibrator. Place the larger equilibrator

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cylinder wrench over the larger nut and the smaller equilibrator cylinder wrench in the larger one and over the smaller nut.

Loosen the smaller nut.

If the gun is hard to elevate turn larger nut clockwise. If the gun is hard to depress, turn the larger nut counterclockwise.

Tighten the smaller nut after the adjustment.

Test the mechanism for improved action.

Replace the front cap. If above adjustment cannot rectify the elevating handwheel load, notify ordnance maintenance personnel.

f. Elevating Mechanism M3A1

Elevate and depress the gun by hand crank and also by remote control system. There should be neither binding nor backlash with either type of operation.

Apply same corrections as above. (The effort required to elevate or depress the gun must not exceed 10 pounds or the remote control system will fail to operate properly.)

g. Traversing Mechanism.

Check for excessive backlash or binding. Traverse top carriage 360 degrees manually and note smoothness of action.

If handwheel play on the Carriages M3 and M3E1 is greater than one-fourth turn, notify ordnance maintenance personnel.

Traverse the top carriage of the Carriage M3A1 by hand crank and also by remote control system. There should be no binding or backlash by either type of operation.

If binding or backlash exists on the Carriage M3A1, notify ordnance maintenance personnel.

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h. Leveling Mechanism.**Inspection**

Revolve the handwheels or operate ratchet wrenches of the leveling mechanism. Note the effect on the leveling vials. The leveling mechanism should rotate through its entire range without binding or backlash.

Correction

Report any malfunction to ordnance maintenance personnel.

i. Carriage Buffer Mechanisms.

While traveling, note whether the buffer mechanisms are taking up the road shock. The buffer rods should bear against the axle arms.

If the axle arms are worn at the point of contact with the buffer rods, report to ordnance maintenance personnel. While a small adjustment of the buffer rods is possible by turning the locking nut and retaining nut on the top of the buffer rod, proper engagement of the buffer rod with the axle arm is largely dependent upon correct adjustment of the counterpoise springs.

Ascertain that the buffer mechanism locks function properly and will not shake out of place.

If the lock does not function properly and cannot be repaired readily, report to ordnance maintenance personnel.

Give particular attention to the threads of the lock lever stem and see that the stem is fully threaded into the lock lever.

The lock lever stem may be tightened with a screwdriver.

j. Counterpoise Cylinders.

Lower and raise the chassis as described in paragraph 36. No excessive force should be necessary in carrying out these instructions. One man should be able to raise and lower each corner of the carriage.

If it is difficult to raise or lower the carriage, adjustment of the counterpoise cylinder springs will be necessary. Adjust only the cylinder whose wheel is difficult to operate. Adjustment is as follows:

Raise the carriage to traveling position.

Remove the dust cap of the counterpoise cylinder.

INSPECTION AND ADJUSTMENT

Inspection

Correction

Place the larger counterpoise cylinder wrench over the larger nut. Place the smaller counterpoise cylinder wrench in the larger wrench and over the smaller nut.

Loosen the smaller nut.

If the carriage is hard to lower, loosen the larger nut by turning it counterclockwise. If the carriage is hard to raise, turn the larger nut clockwise.

Tighten lock nut and install dust cap after proper adjustment of spring is secured.

k. Outrigger Assemblies.

Ascertain that the outrigger turnbuckles will hold the outriggers in position without any possibility of looseness or damage to the parts. The outriggers should remain firm and secure in traveling and in firing positions.

Report any malfunction to ordnance maintenance personnel.

l. Wheels and Tires.

Check for loose wheel nuts.

Tighten wheel nuts.

Check for proper wheel bearing adjustment. Check rim bolt for tightness. The wheel should spin freely when jacked free of ground, but there should be no perceptible looseness when an attempt is made to shake the wheel.

Notify ordnance personnel.

Inspect tires for cuts or foreign material embedded in the casing.

Report serious tire damage to ordnance maintenance personnel. Remove foreign material from surface of tires.

Check inflation pressure.

Inflate tires to 40 pounds air pressure.

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Inspection	Correction
Observe wear of front tires. If wear is greater than on rear tires, or if wear of tire on one side is greater than on the other side, incorrect toe-in may be the cause.	Report to ordnance maintenance personnel.
m. Brakes.	
Measurement of current to each brake (to be carried out monthly):	In case of failure to get this agreement perform the following:
Connect jumper cable to socket on prime mover or connect a 6-volt battery to No. 1 and No. 4 terminals in the junction box on the left front of the chassis.	Follow electric system to the coupling on the carriage for bare wires or loose connections.
Disconnect one lead wire of a brake cable from a brake connector and connect the ammeter (for electric brake) in series between the wire and brake terminal.	Test the amperage which should be 2.2 on the lever type brakes with the controller fully on. The amperage should be 2.5 on the disk-type brakes.
Variations in the amperage of the brakes on any one carriage should not exceed 0.1 ampere for disk-type brakes and 0.5 ampere for lever type brakes.	If unable to correct cause of excessive variation in amperage, notify ordnance maintenance personnel.
Measurement of current to each controller (to be carried out monthly):	Change controller if the difference in reading is greater than 0.2 ampere.
Disconnect battery lead-in wire at the controller and place the ammeter between the lead-in wire and the controller.	
Set the controller to full on position and read the ammeter.	
Remove the ammeter, reconnect the lead-in wire, and connect the ammeter in a similar	

INSPECTION AND ADJUSTMENT

Inspection	Correction
<p>manner to the other terminal of the controller. Set the controller to full on position and read the ammeter.</p> <p>Inspection of brake linings and drums (to be carried out when lubricating wheel bearings):</p> <p>Remove the wheel as described in paragraph 91. Inspect the brake lining for wear.</p> <p>Inspect the brake lining for presence of oil and grease.</p> <p>Inspect the brake drum for scores, abrasion, rust, or noticeable irregularities in roundness.</p> <p>Check condition of safety (breakaway) switch.</p>	<p>If the lining is worn down to the brass rivets, the lining must be replaced by ordnance maintenance personnel.</p> <p>Report to ordnance maintenance personnel for replacement.</p> <p>Report such faults to ordnance maintenance personnel.</p>

n. Electrical System, Light Circuit.

Check lights and blackout light switch as follows:

Remove cover from the rear of the electrical outlet socket and connect a 6-volt storage battery in the lighting circuit by attaching one wire from the battery post to the terminal marked "TL" on back of electrical outlet socket.

Connect the other battery lead to the terminal marked "GR," or ground it to some part of the carriage. Plug jumper cable in socket to complete the circuit.

Now remove the battery lead from the terminal marked "TL" and connect it to the terminal marked "SL."

The most frequent cause of "no lights" is a burned out light filament or broken bulb. Check wiring thoroughly and tape all bare portions or places where wires may be grounded through poor insulation. Replace lamp bulbs or sealed beam units.

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Inspection

Correction

Turn the blackout light switch so the slot in the end of the shaft lines up with the letter "S" on the switch. The service stop light (left light) should now light up.

Turn the blackout light switch so the slot in the end of the switch shaft lines up with the letters "BO" on the switch. A dim light should now be visible at the top of the right taillight.

74. COMBINATION GUN MOUNT M42.

a. General.

(1) **PAINT.** Check for general appearance. Clean and repaint, if necessary, making sure that lubrication fittings have a red circle painted around them.

(2) **BROKEN PARTS AND CRACKED WELDS.** Examine entire mount and top carriage, including firing platform and braces. If broken parts or cracked welds are found, inform ordnance maintenance personnel.

b. Elevating Mechanism.

(1) Examine for binding or noticeable backlash. If handwheel backlash is greater than one-fourth turn, inform ordnance maintenance personnel.

(2) **CHECK EQUILIBRATOR TENSION.** With both cal. .50 ammunition chests half full of ammunition and installed on mount, proceed as follows:

(a) Elevate and depress the guns several times. Use both the slow and fast speeds in making the test.

(b) As mechanism is operated, determine whether elevation or depression is more difficult.

(c) If it is found that equilibrator springs require adjusting, elevate guns to 50 degrees and remove equilibrator head. Now elevate guns to 85 degrees so that adjusting nut and lock nut will be accessible from end of cylinder.

(d) Use $\frac{1}{4}$ -inch equilibrator cylinder wrench to remove the lock nut.

(e) Use $1\frac{1}{2}$ -inch equilibrator cylinder wrench to adjust the adjusting nut. If gun is hard to elevate, turn adjusting nut clockwise. If gun is hard to depress, turn nut counterclockwise.

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(f) When proper adjustment is obtained, install lock nut and equilibrator head.

(g) If this procedure does not rectify the handwheel load, notify ordnance maintenance personnel.

c. Traversing Mechanism.

(1) **CHECK HANDWHEELS FOR BINDING AND BACKLASH.** If backlash is greater than one-fourth turn of handwheel, notify ordnance maintenance personnel.

(2) **CHECK TRAVERSING OPERATION.** Traverse mount 360 degrees and note smoothness of action. If rough action is detected, notify ordnance maintenance personnel.

d. Cradle.

(1) **ELEVATING RACK.** Examine teeth for uniformity and wear. Report broken or worn teeth to ordnance maintenance personnel.

(2) **GUN MOUNTING KEYS.** Examine gun mounting keys and tighten them if found loose. If slideways or lugs are worn so that keys cannot be tightened, notify ordnance maintenance personnel.

(3) **EXAMINE MOUNTING OF CRADLE TO TOP CARRIAGE.** Report looseness or evidence of binding to ordnance maintenance personnel.

e. Foot Firing Mechanism.

(1) **TRIGGER ACTION.**

(a) Cock firing hammer by pulling lock frame to rear several inches.

(b) Allow lock frame to spring forward so that the breechblock is completely closed.

(c) Depress foot pedal and note whether the trigger is tripped. This should be evidenced by a sharp click in gun.

(d) If trigger is not tripped, examine linkage system for binding parts. Lubricate freely with engine oil.

(e) Adjust foot pedal by means of foot firing adjusting nut.

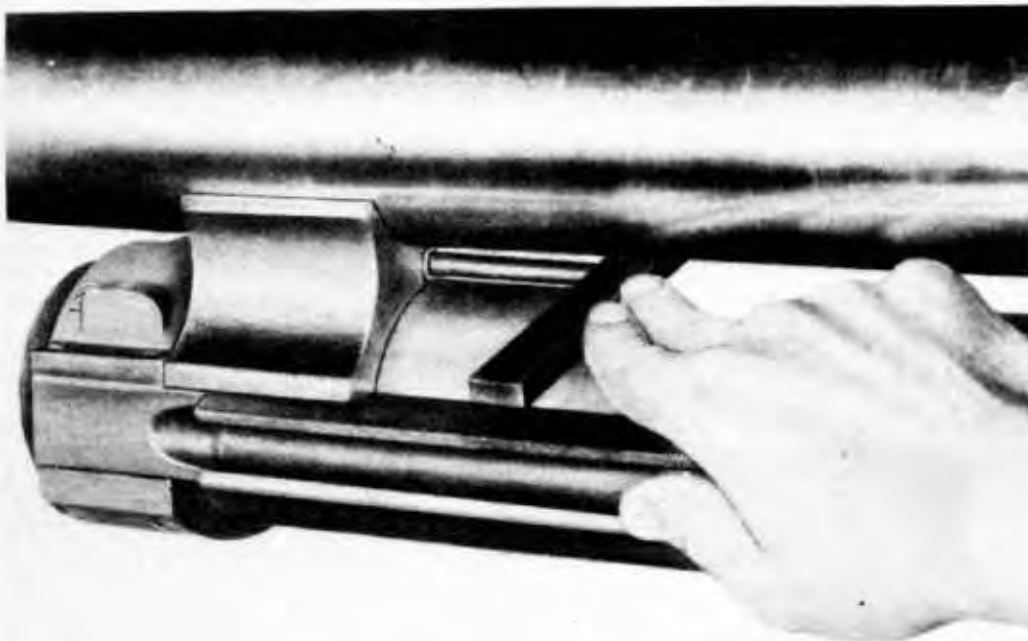
Section VIII

**DISASSEMBLY AND ASSEMBLY OF 37-MM AA GUN
M1A2 AND CARRIAGES**

75. GENERAL.

a. Wear, breakage, cleaning, and inspecting make necessary the occasional disassembly and assembly of various parts of the gun and carriage. This work comes under two headings; the part that can be performed by battery personnel, and the part that must be performed by ordnance maintenance personnel. The battery personnel will not

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Figure 59 — Placing Gun Tube Support for Removal of Gun Tube

attempt to disassemble any part of the recuperator mechanism, the equilibrator, counterpoise, the elevating and traversing mechanism, or the oil gears. Any difficulty which cannot be overcome by battery personnel should be reported to ordnance maintenance personnel.

76. GUN TUBE.

a. Removal.

- (1) Set gun tube to a horizontal position.
- (2) Raise the carrier until caught by the carrier catch.
- (3) Pull lock frame to the rear with the priming rod until caught by the carrier dog. It is important that this be done in order to prevent the extractor and breech end of the tube from being damaged while the gun tube is being unscrewed.

NOTE: A bronze gun tube support is provided to support the gun tube during removal and installation to prevent damage to threads.

- (4) Place the gun tube support in position between the recuperator and the gun tube by placing the hinge of each half of the support on either side of the gun tube near the front end of recuperator and inserting the rod through the hole from the rear to lock both hinges together (fig. 59).

- (5) Remove the trunnion block bushing retaining screws (fig. 60).
- (6) Depress the tube lock depressor (fig. 61) and with tube wrench turn the gun tube in a counterclockwise direction approximately one-

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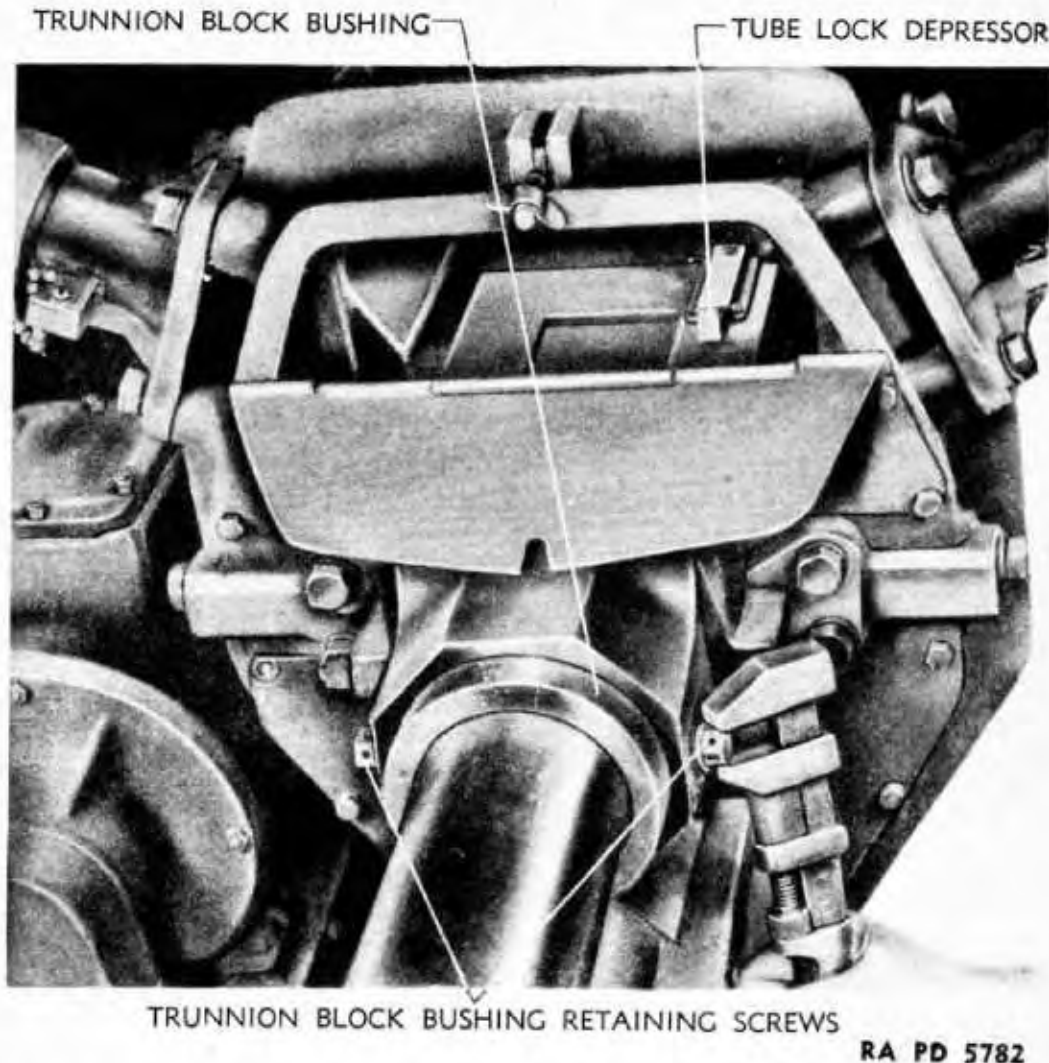


Figure 60 — Removing Trunnion Block Bushing Retaining Screws

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quarter turn; then release tube lock depressor and continue unscrewing the gun tube by hand. (If tube lock does not move back at least $\frac{3}{4}$ inch, tap lightly.)

(7) Remove trunnion block bushing from gun tube (fig. 62).

(8) Release lock frame, using a small piece of wood to move carrier catch (fig. 63). This is a safety precaution to prevent personal injury should the lock frame be accidentally released while someone's finger or hand is in feed box. The lock frame should never be in rear position except for removal of gun tube or first loading.

NOTE: Great care should be taken in removing and replacing the gun tube so that the threads on the breech end of the tube and the threads in the tube receptacle of the tube extension are not burred or injured in any way. Raising or lowering the muzzle of the tube or any lateral movement of the muzzle during this process, may result in bur-

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RA PD 5780

Figure 61 – Loosening Gun Tube

ring the threads. In the case where the tube is removed and replaced without the use of a tube support, care should be taken to see that there is no movement of the muzzle except that of rotation. The following alternate method of tube removal may be necessary if the end of the tube or threads are damaged to the extent that it is impossible to turn the tube counterclockwise after retracting the lock frame and releasing the tube lock. Remove the backplate, lock frame, driving spring assemblies, breechblock, accelerator cam, feed lever, and recuperator piston rod lock nut; then remove the tube and tube extension through the breech end of the gun, unscrewing the tube from the tube extension after both have been removed from the gun. If, after removal of the tube, the recuperator piston rod nut A25527 is loosened, the procedure below is to be followed to avoid difficulty in assembly of the tube to the gun.

(a) The tube and trunnion block bushing should be assembled to the gun before the piston rod nut is tightened.

(b) If this cannot be done with the tube extension mounted in the gun, it will be necessary to remove the tube extension before assembling it to the tube. Then mount the tube and tube extension in the trunnion

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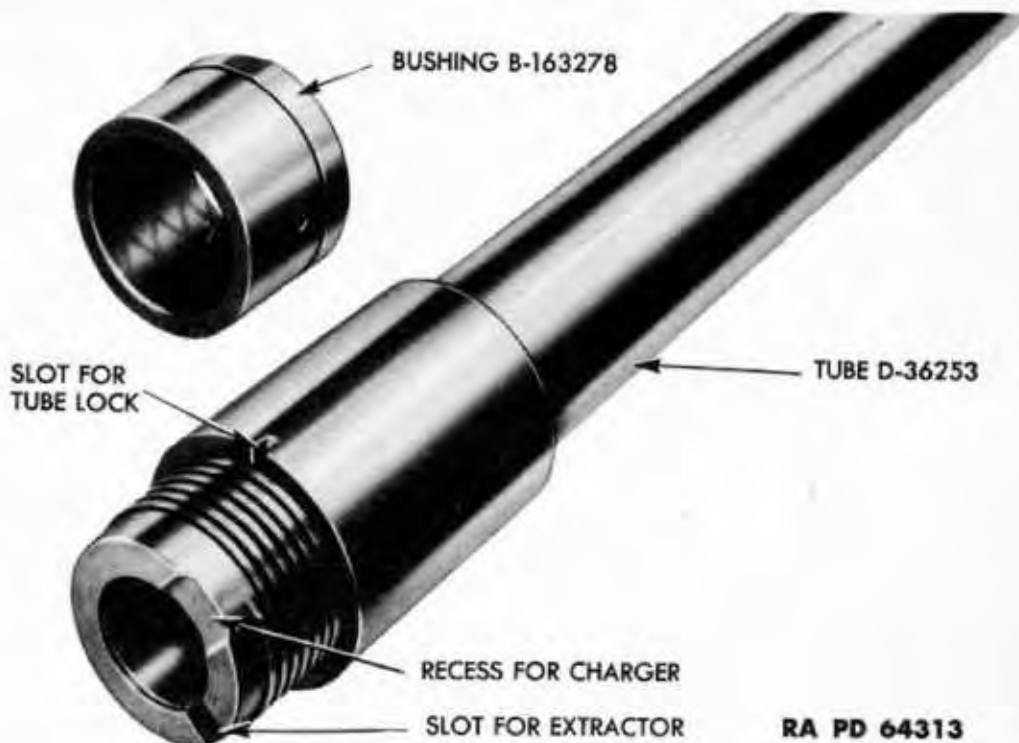


Figure 62 — Gun Tube and Trunnion Block Bushing

block from the rear, assemble the trunnion block bushing, and tighten the recuperator piston rod nut.

b. Inspection.

(1) Clean parts thoroughly with SOLVENT, dry-cleaning, and inspect the bore for rust, corrosion, worn lands and grooves, and for erosion at the forcing cone.

(2) Examine the firing chamber for scored surfaces.

(3) Inspect the mounting of the tube for proper action of the tube lock. There should be no looseness between the tube threads and the tube extension socket.

(4) Check the portion of the gun tube that recoils into trunnion block bushing for signs of wear or abrasion.

(5) Coat this portion of tube with GREASE, graphited, light, when installing in gun.

c. Installation.

(1) Set the gun approximately horizontal.

(2) Install trunnion block bushing on gun tube. Lubricate with OIL, lubricating, preservative, light.

(3) Raise the carrier until caught by carrier catch.

(4) Pull back lock frame until it is caught by the carrier dog.

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Figure 63 – Releasing Lock Frame

- (5) Place tube support in position on the recuperator.
- (6) Coat the threaded end of the gun tube with **GREASE**, graphited, light. **NOTE:** Excessive amount of grease will cause trouble in locking.
- (7) Guide the threaded end of the gun tube into the trunnion block until it presses lightly against the threads of the tube extension and press the trunnion block bushing into place. Replace trunnion block bushing retaining screws.
- (8) Maintain this pressure and rotate the gun tube counterclockwise until a distinct click is heard, indicating that the end of the thread on the tube has passed the end of the thread in the tube extension.
- (9) Screw the gun tube in clockwise, by hand, until seated. When the tube is properly seated, the tube lock will automatically engage its slot in the tube.

CAUTION: Check to make sure that the gun is properly locked by the tube lock by attempting to unscrew the tube. As an added check, a line or arrow should be painted on the gun tube to indicate when it is screwed home and locked. If the tube does not screw in easily, lift muzzle end of the tube slightly; then screw in.

DISASSEMBLY AND ASSEMBLY OF 37-MM AA GUN M1A2
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Figure 64 — Removing Foot-firing Trunnion Arm

77. GUN.

a. Removal.

(1) Remove cartridge tray by depressing the catch at either side and lifting upward. When the gun is mounted on the Carriage M3E1, the cartridge tray should remain in place during travel, as its removal disturbs the bore sight. The paulin employed permits this.

NOTE: If cartridge tray is not in place, the cradle shield cover will be.

(2) Remove cradle shield cover by releasing fasteners.

(3) Disconnect the firing mechanism by removing the foot firing trunnion arm from foot firing trunnion bracket on right top flange of cradle at rear. This is done by removing the cotter pin and pin (fig. 64).

NOTE: An alternate method of disconnecting the firing mechanism is to remove cotter pin securing trigger connector bracket lever, and slide lever out through hole in foot firing trunnion bracket.

(4) Remove the cradle shield slide from rear of cradle (Carriage M3A1) by releasing the two thumbscrews and pulling slide rearward.

(5) Remove the gun tube as described in paragraph 76.

(6) Remove the two gun mounting keys by removing the three cap screws on each side (fig. 65).

(7) Remove the cradle shield cover plate by removing the four cap screws (Carriage M3A1).

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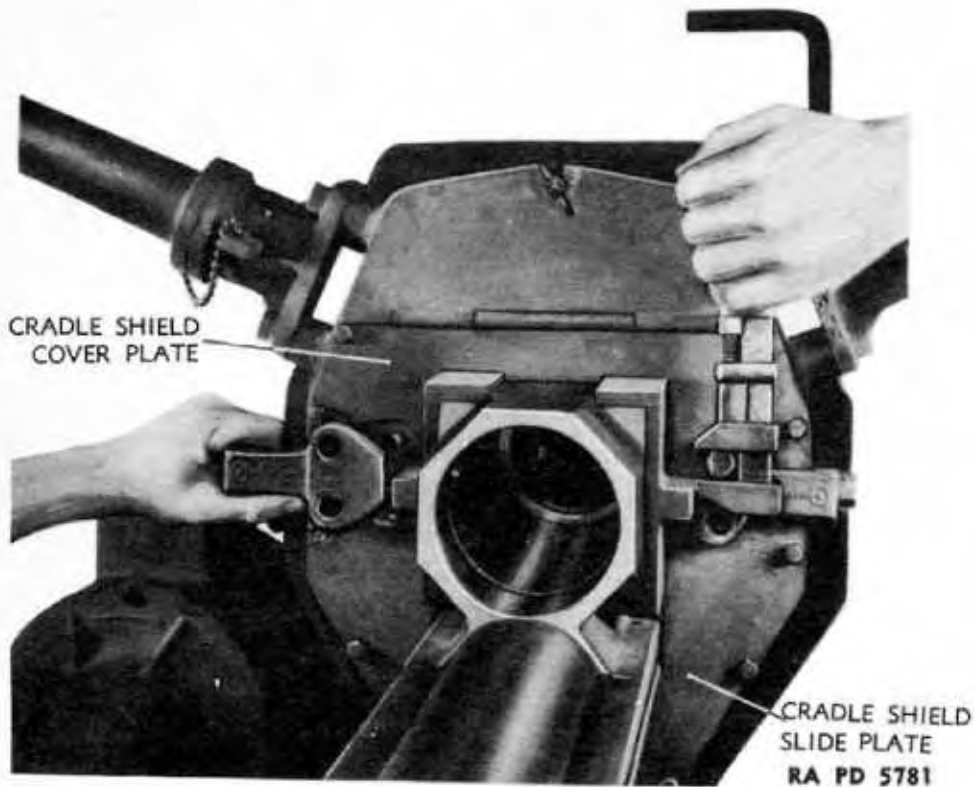


Figure 65 — Removing Gun Mounting Keys

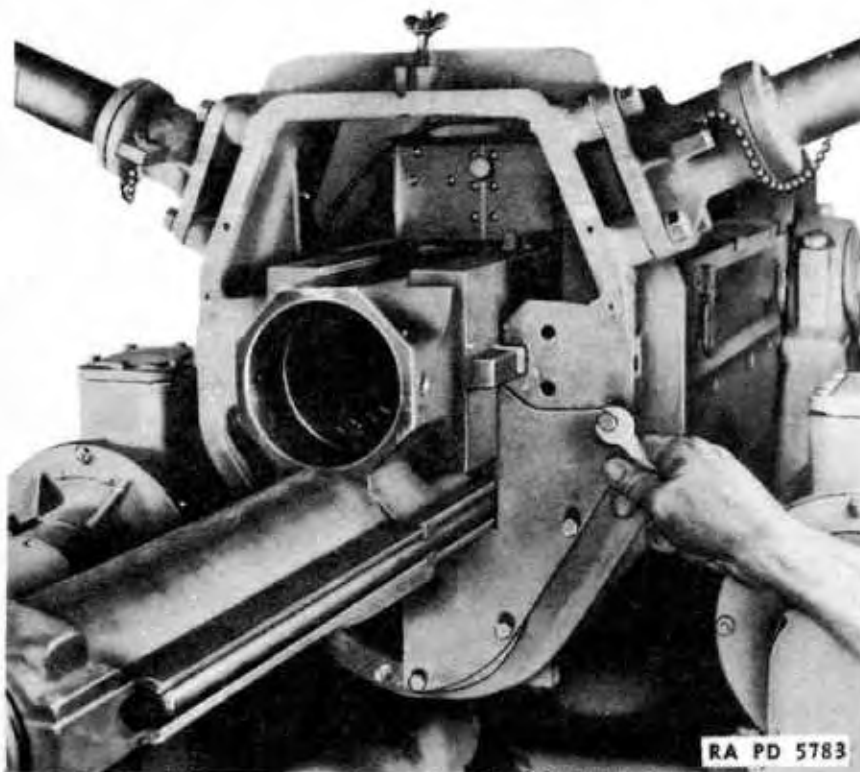


Figure 66 — Removing Cradle Shield Side Plates

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Figure 67 – Sliding Gun From Cradle

(8) Remove the two cradle shield side plates by removing the four cap screws by which each is held (fig. 66).

(9) Slide the gun out of cradle (fig. 67). Three or four men will be required to carry the gun to a suitable resting place.

CAUTION: Do not use recuperator expansion tube as a handhold in removing gun from cradle.

b. Installation.

(1) Slide the gun back in cradle.

(2) Install the two cradle shield slide plates and insert and tighten the four cap screws in each plate.

(3) Install the cradle shield cover plate and insert and tighten the four cap screws.

(4) Install the two gun mounting keys and insert and tighten the three cap screws in each side.

(5) Install the gun tube as described in paragraph 76 c.

(6) Replace the cradle shield slide and secure with the two thumb-screws.

(7) Connect the firing mechanism by installing the foot firing trunnion arm in foot firing trunnion bracket, making sure that the arm is in front of trigger connector bracket lever. Install the pin and secure with cotter pin.

(8) Install the cartridge tray by depressing the catches and sliding the tray down on the guides of the feed box or replace the cradle shield cover and secure with the four fasteners.

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Figure 68 – Unhooking Driving Spring Assemblies

78. GUN DISASSEMBLY AND ASSEMBLY BY GROUPS.

a. The following sequence of disassembly and assembly may be used as a guide when a complete disassembly of the 37-mm Gun M1A2 is desired, or it may be used as a reference before attempting removal of any component group or assembly.

b. **Order of Disassembly.** Unhook left and right driving spring assemblies with lock frame in battery position and disconnect driving spring tube connection from the tube extension assembly (fig. 68). Remove the following assemblies in order:

- (1) Back plate assembly.
- (2) Accelerator cam assembly.
- (3) Lock frame assembly.
- (4) Driving spring assemblies.
- (5) Gun tube.
- (6) Feed box mechanism.
- (7) Tube extension.
- (8) Trigger bar.
- (9) Back plate latch assembly.

c. **Order of Assembly.** Install the following assemblies in order:

- (1) Back plate latch assembly.
- (2) Trigger bar.
- (3) Tube extension.

DISASSEMBLY AND ASSEMBLY OF 37-MM AA GUN M1A2 AND CARRIAGES

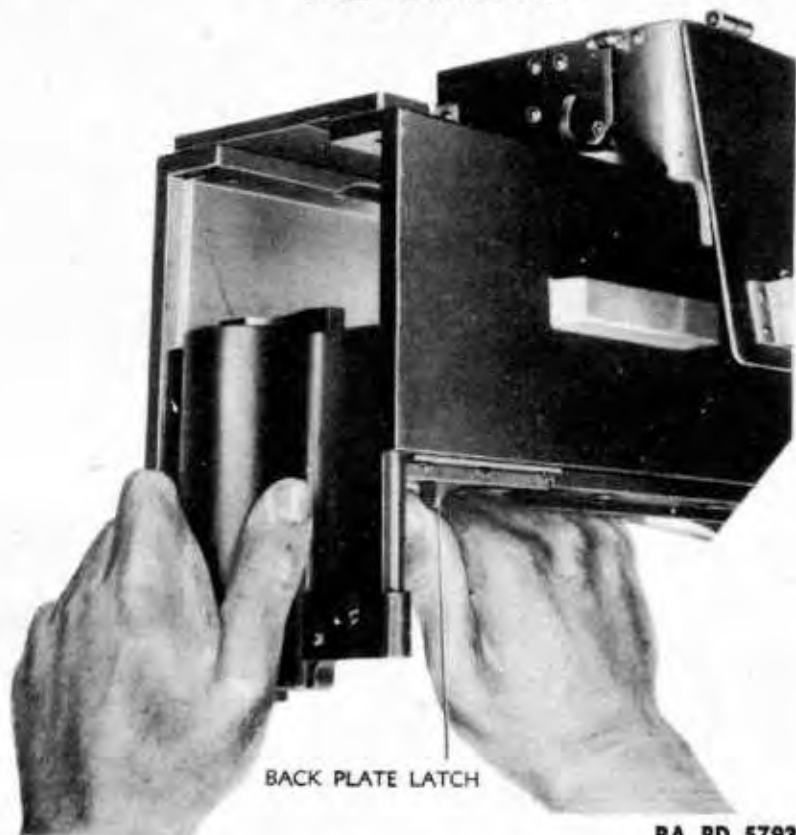


Figure 69 — Removing Back Plate Assembly

- (4) Feed box mechanism.
- (5) Gun tube.
- (6) Driving spring assemblies.
- (7) Lock frame assembly.
- (8) Accelerator cam assembly.
- (9) Back plate assembly.
- (10) Connect left and right driving spring assemblies to lock frame and tube extension.

79. BACK PLATE ASSEMBLY.

a. **Removal.** Depress the back plate latch and slide the back plate assembly down and out of slides (fig. 69).

b. Disassembly.

- (1) Remove the buffer adjusting screw (fig. 70).
- (2) Invert, and shake the buffer springs and buffer friction pieces out of back plate body assembly.
- (3) Remove buffer plunger stop screw.
- (4) Lift buffer plunger out of opening in the back plate assembly.

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Figure 70 – Removing Buffer Adjusting Screw

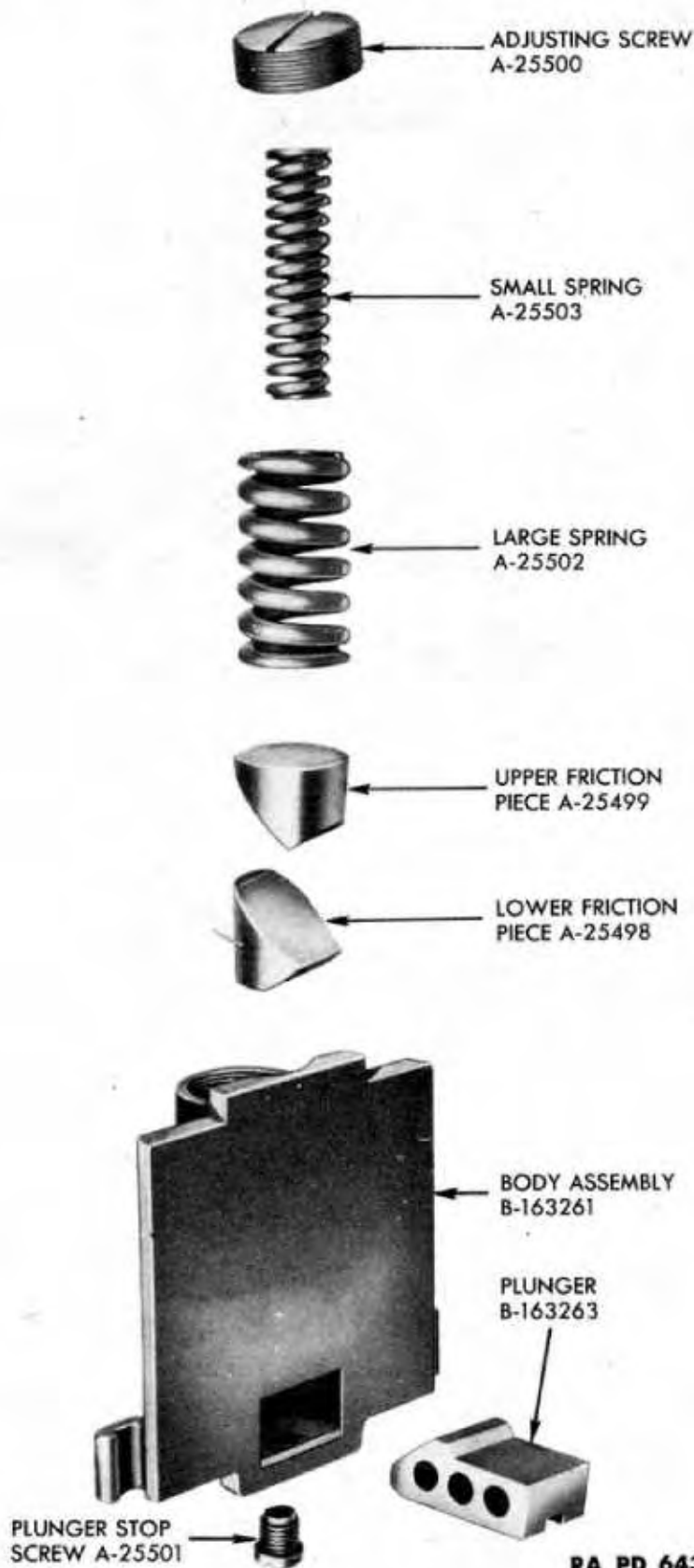
c. Inspection.

- (1) Inspect the buffer plunger and friction pieces for rough surfaces or burs, and remove with CLOTH, crocus, or fine abrasive.
- (2) Lubricate before assembly with GREASE, O.D., No. 0, if above +32 F and GREASE, O.D., No. 00, if below +32 F.

d. Assembly (fig. 71).

- (1) Place buffer plunger in the opening of the back plate assembly and install plunger stop screw, with end of screw in groove of plunger.
- (2) Place lower buffer friction piece in housing, matching taper of buffer plunger.
- (3) Insert upper buffer friction piece with the taper matching the taper of the lower friction piece.
- (4) Place large and small buffer springs on top of upper friction piece.
- (5) Start buffer adjusting screw into opening, turning screw inward until at least four or five threads are engaged.
- (6) Place back plate assembly in vise.
CAUTION: Use vise equipped with soft jaws to avoid marring plunger.
- (7) Press plunger completely inward until solid against inner wall of body assembly.

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Figure 71 — Back Plate Assembly — Exploded View

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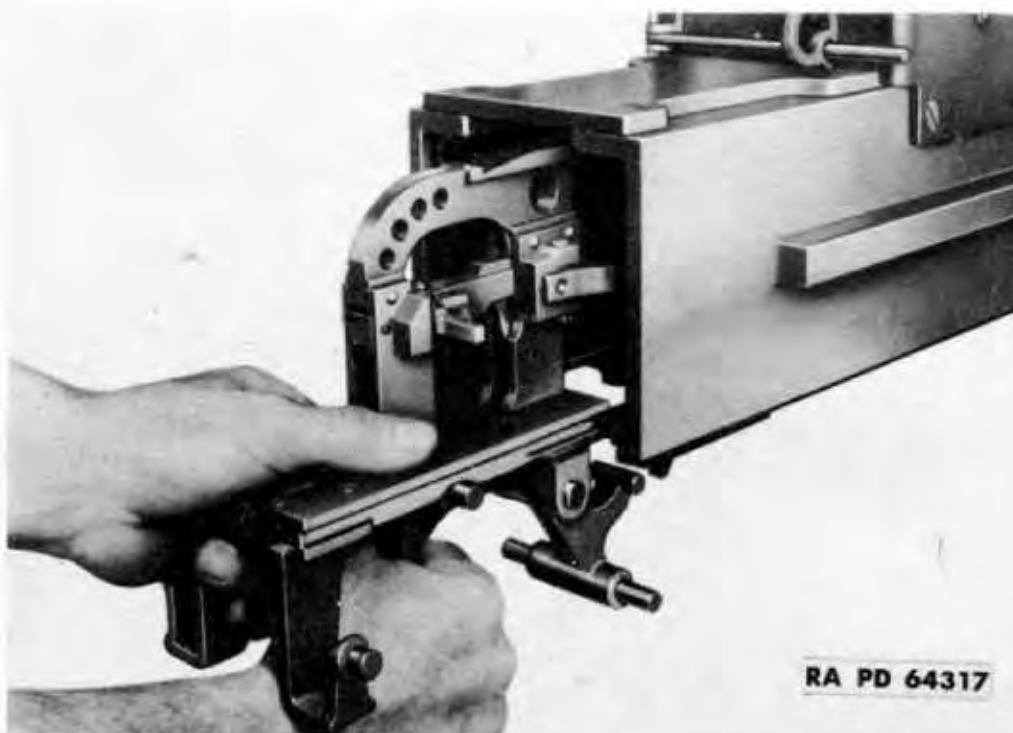


Figure 72 — Removing Lock Frame

(8) Turn adjusting screw downward until the spring is solid; then back off one-half turn.

NOTE: This is the usual adjustment, but if lock frame strikes the back plate with too great a jolt during recoil, turn adjusting screw in a clockwise direction to compress the buffer spring further and increase the effect of the buffer action. To reduce the buffer action, turn adjusting screw in a counterclockwise direction.

(9) Stake plunger stop screw to back plate body.

e. **Installation.** Depress the back plate latch and slide the back plate assembly up into the groove in rear end of side plates. Release the latch and make certain that it will secure the back plate assembly in place.

80. LOCK FRAME ASSEMBLY.

a. Removal.

- (1) The lock frame must be in the forward, or battery position.
- (2) Remove the back plate assembly.
- (3) Disconnect the left and right driving spring assemblies from the lock frame by releasing each driving spring rod hook safety by pulling outward and downward on the rear end.

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Figure 73 – Easing Operating Lever Forward

(4) Press downward on the driving spring rod hooks to release them from the driving spring rear bracket.

(5) Release the carrier, if it is up, by pushing the carrier catch to the right.

(6) Grasp the operating lever and pull lock frame rearward and remove (fig. 72).

CAUTION: Keep a firm grip on top of lock frame and operating lever to prevent operating lever from springing forward and injuring hands.

(7) Pull the sear rearward to release hammer and ease operating lever to forward position for safety in further handling (fig. 73).

b. Disassembly.

(1) Remove operating lever spring lock assembly, spring, and follower, by engaging a screwdriver in the slotted end of lock, forcing it in and turning counterclockwise as far as it will go (fig. 74). Lock assembly, spring assembly, and follower can then be removed as a unit.

(2) Remove cotter pin, operating lever pivot pin, and operating lever.

(3) Remove operating lever strut by drifting out strut pin.

(4) Remove cotter pin and compress sear spring. Remove pin and sear (fig. 75). Remove sear spring.



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Figure 74 — Removing Operating Lever Spring Lock Assembly

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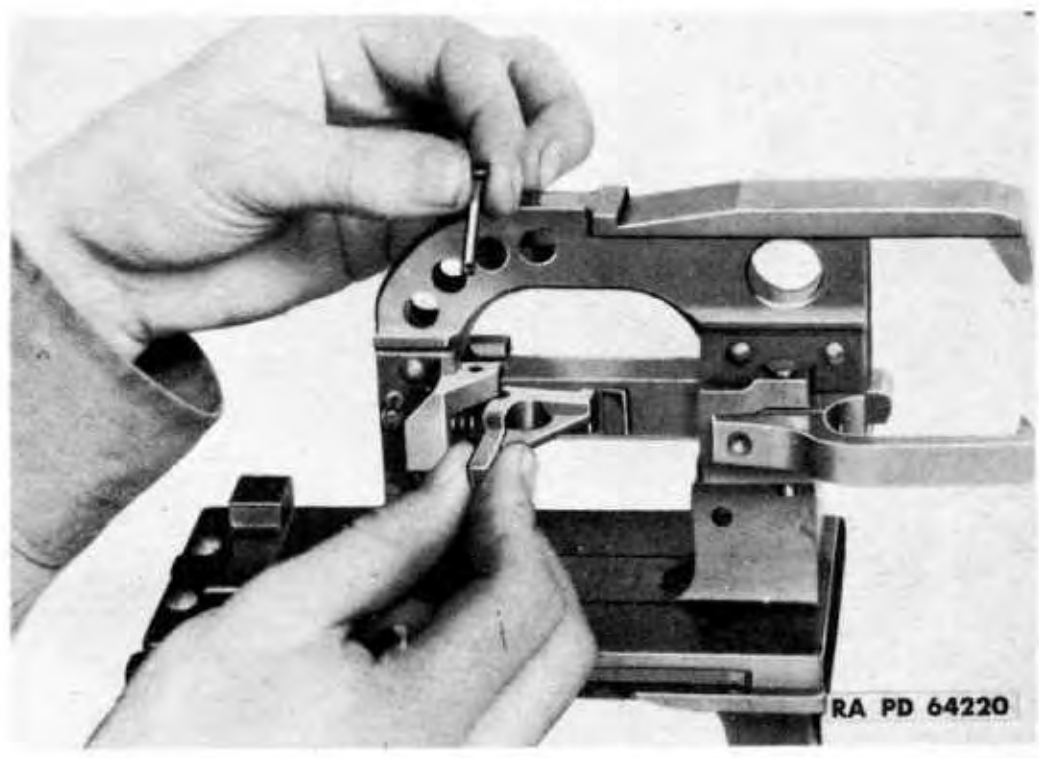


Figure 75 – Removing Sear

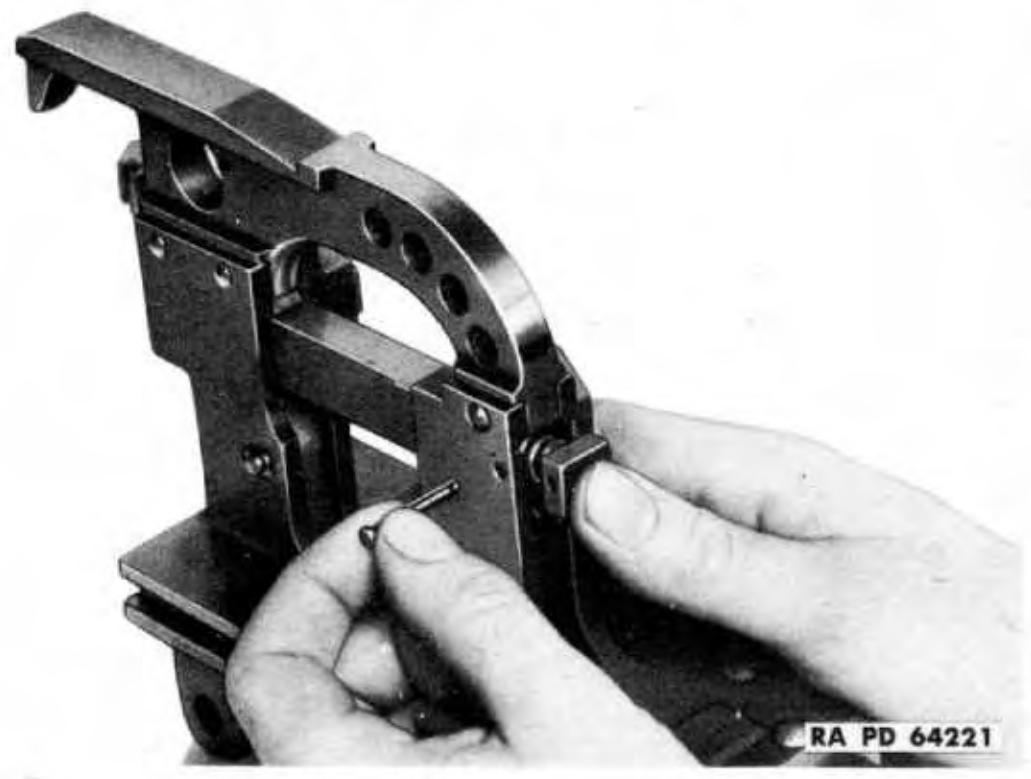


Figure 76 – Removing Hammer Spring Guide Pin

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Figure 77 — Removing Cocking Lever

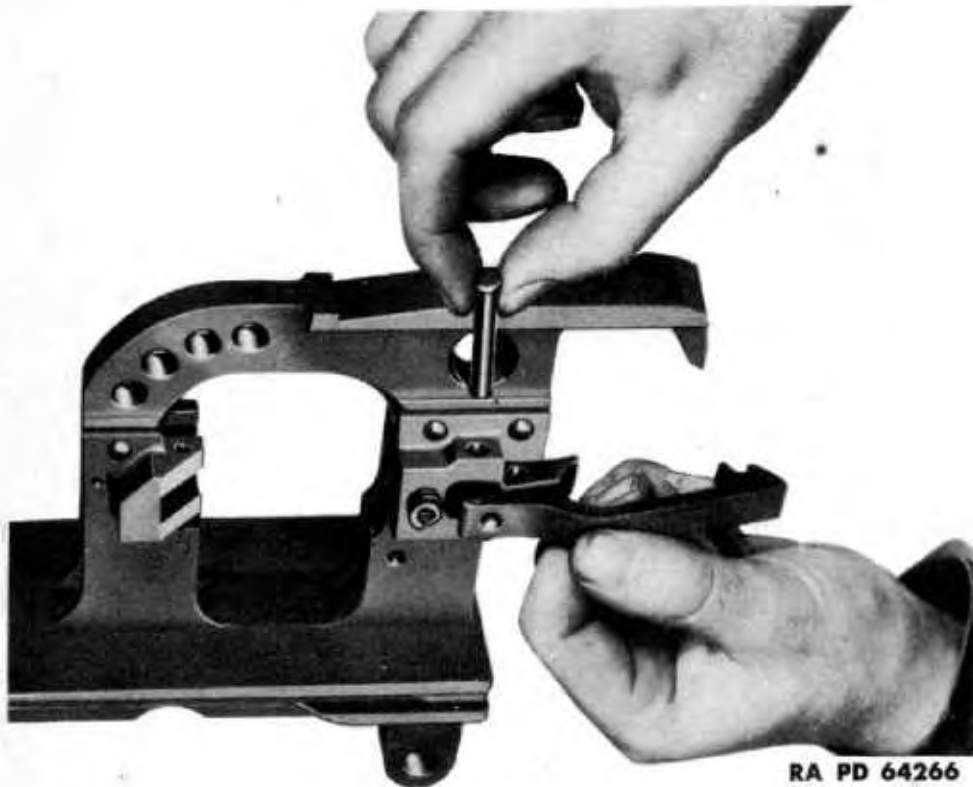


Figure 78 — Removing Extractor

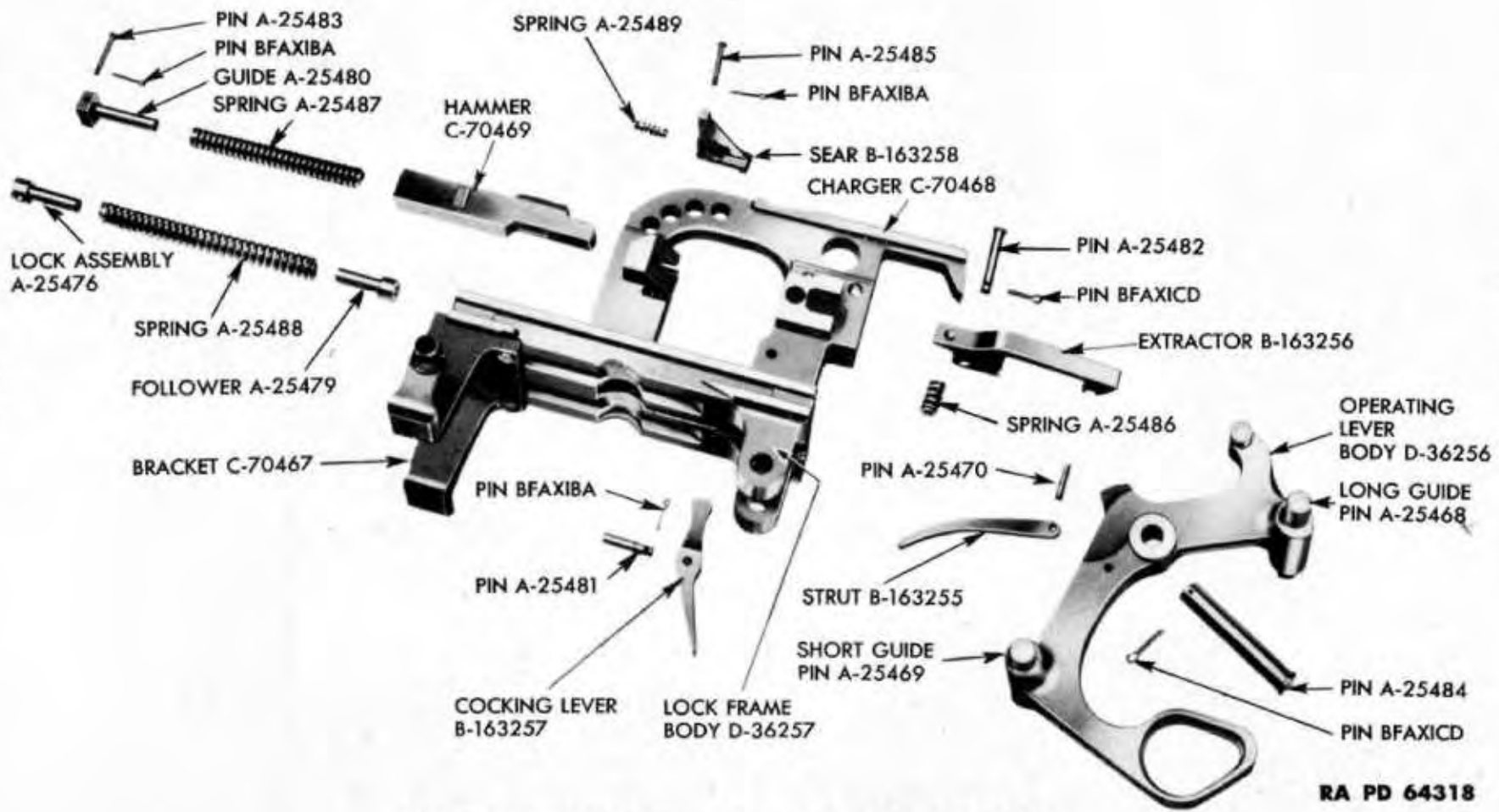


Figure 79 – Lock Frame Assembly – Exploded View

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Figure 80 – Installing Extractor

(5) Remove cotter pin from hammer spring guide pin. Compress hammer spring firmly with thumb and remove the hammer spring guide pin (fig. 76); then remove hammer spring guide and spring.

(6) Remove cotter pin, cocking lever pin, and cocking lever (fig. 77).

(7) Remove hammer.

(8) Remove cotter pin; then compress extractor spring in recess of extractor with screwdriver blade, while removing extractor pin. Remove extractor and spring (fig. 78).

(9) Lock frame parts are shown in figure 79.

c. Inspection. Inspect all parts for excessive wear and polish rough surfaces with CLOTH, crocus. Replace all worn parts.

d. Assembly.

(1) Place extractor spring in hole in right side of lock frame. Place extractor in position and compress spring, using a screwdriver in the recess on side face of extractor to obtain sufficient pressure to compress extractor spring, and insert extractor pin with head up (fig. 80). Secure with a 1/16- by 5/8-inch cotter pin.

(2) Place hammer in lock frame in forward position.

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Figure 81 – Disconnecting Driving Spring Tube

(3) Place cocking lever in lock frame, with concave side forward and rounded end engaged in rectangular hole in hammer. Install cocking lever pin from the right side and secure with cotter pin.

(4) Place hammer spring and guide in hammer. Compress spring firmly and insert hammer spring guide pin through hole in lock frame body and spring guide from the right side. Secure guide pin with a $\frac{1}{16}$ - by $\frac{5}{16}$ -inch cotter pin.

(5) Place sear spring in hole in lock frame, press inward on sear and insert sear pin. Secure sear pin with a $\frac{1}{16}$ - by $\frac{5}{16}$ -inch cotter pin.

(6) Install operating lever strut in operating lever with concave side towards rear. Install strut pin and stake in place.

(7) Place operating lever in lock frame, with cocking lever actuating lug on rear side of cocking lever. Install pivot pin from the right side and secure with a $\frac{3}{32}$ - by $\frac{5}{8}$ -inch cotter pin.

(8) Swing end of strut into slot in lock frame. Place operating lever spring follower, spring, and lock assembly in lock frame, with the follower engaging end of strut.

(9) Engage blade of screwdriver with slot of operation lever lock and push in, making certain lock pin of lock assembly enters groove in bottom of opening in rear of lock frame. Secure lock assembly by turning one-quarter turn clockwise.

e. Installation.

(1) Release carrier so that the front end is down.

(2) Place operating lever in rear (cocked) position and insert lock frame assembly into rear end of gun, engaging flanges of side plate in

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Figure 82 — Removing Driving Spring Tube Connection Pin Knob

the grooves in lock frame body. Oil groove in lock frame and lower flanges of side plates with OIL, engine, SAE 10 above plus 32 F, OIL, engine, SAE 10 from 32 F to zero degree F, or OIL, lubricating, preservative, light, below zero degree F. Slide assembly forward to battery position by pushing on operating lever.

(3) While holding carrier catch to the right, work lock frame assembly back and forth by means of the operating lever to make sure all parts are working without binding or interference.

81. DRIVING SPRING ASSEMBLIES.

a. Removal.

(1) Disconnect left and right driving spring assemblies; then remove lock frame (par. 80 a).

(2) Disconnect driving spring tube connection from the driving spring front bracket by pulling rearward on the connection pin knob, turning the connection outward, and remove driving spring assembly from the gun (fig. 81).

b. Disassembly.

(1) Unscrew driving spring tube connection pin knob by first removing lock pin, thus releasing connection pin and spring (fig. 82).

(2) Remove cotter pin and pin from driving spring rod connection, thus releasing the safety, rod hook, plunger, and spring.

c. **Assembly.** Place spring on driving spring tube connection pin; then install pin and spring in tube connection. Compress spring and screw knob on the pin until hole for lock pin is visible. Insert tube connection pin lock pin, bending ends around connection pin. Back off knob until it is tight against lock pin.

d. Installation.

(1) Slide driving spring assemblies into the bearings in the tube guards from the rear.

DISASSEMBLY AND ASSEMBLY OF 37-MM AA GUN M1A2
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Figure 83 — Removing Breechblock

NOTE: Driving spring assemblies are not interchangeable from one side of the gun to the other because of the driving spring rod hook and hook safety, left and right.

(2) Connect each spring assembly to the driving spring front bracket (on tube extension) by pulling rearward on the tube connection pin knob while engaging notch in tube connection with end of bracket.

(3) Install lock frame assembly as described in paragraph 80 e.

(4) Turn hooks of driving spring assemblies to point upward and engage with rear bracket of lock frame. If spring assemblies are correctly in place, the safety will be on the outside of each hook. Swing hook safety up into position to lock hook in position.

82. BREECHBLOCK.

a. Removal.

(1) Raise the carrier until caught by carrier catch.

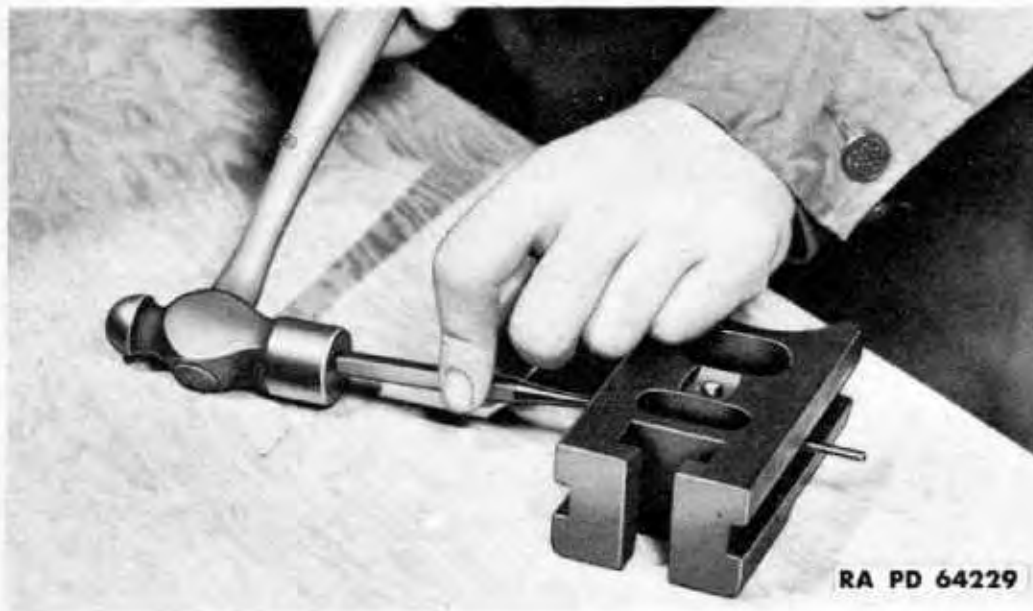
(2) Pull the lock frame back until caught by the carrier dog.

(3) Pull outward on the breechblock stop retaining pin knob. Lower the breechblock stop and remove breechblock assembly (fig. 83).

CAUTION: Unhook driving springs from lock frame before removing breechblock.

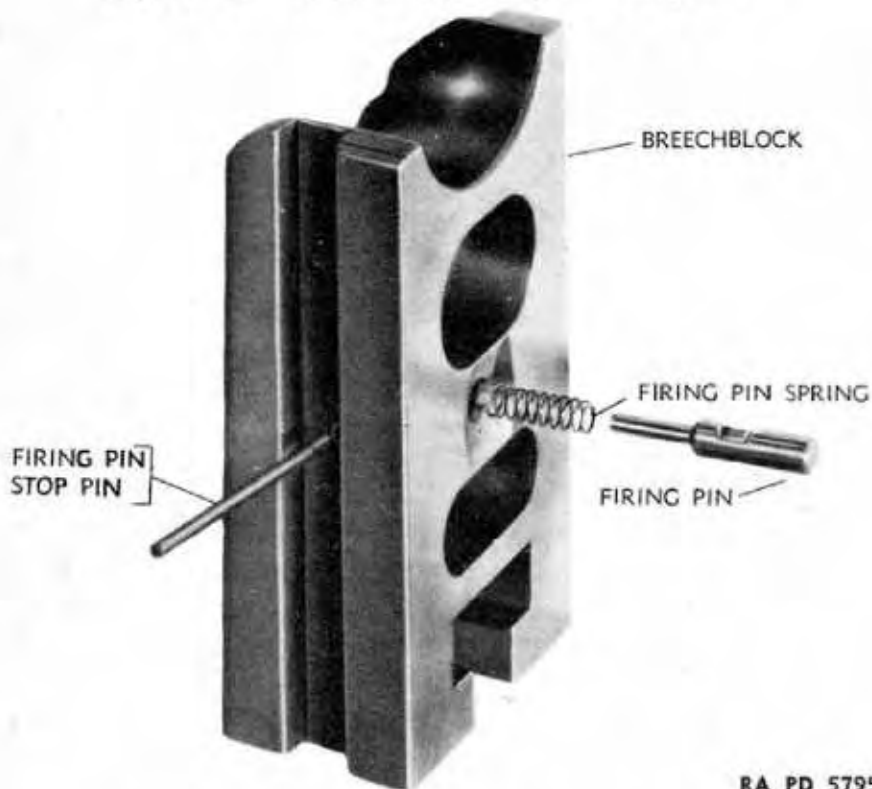
b. Disassembly. Drift out firing pin stop pin and remove firing pin and spring (fig. 84). Stop pin is lightly staked in place.

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RA PD 64229

Figure 84 — Removing Firing Pin Stop Pin



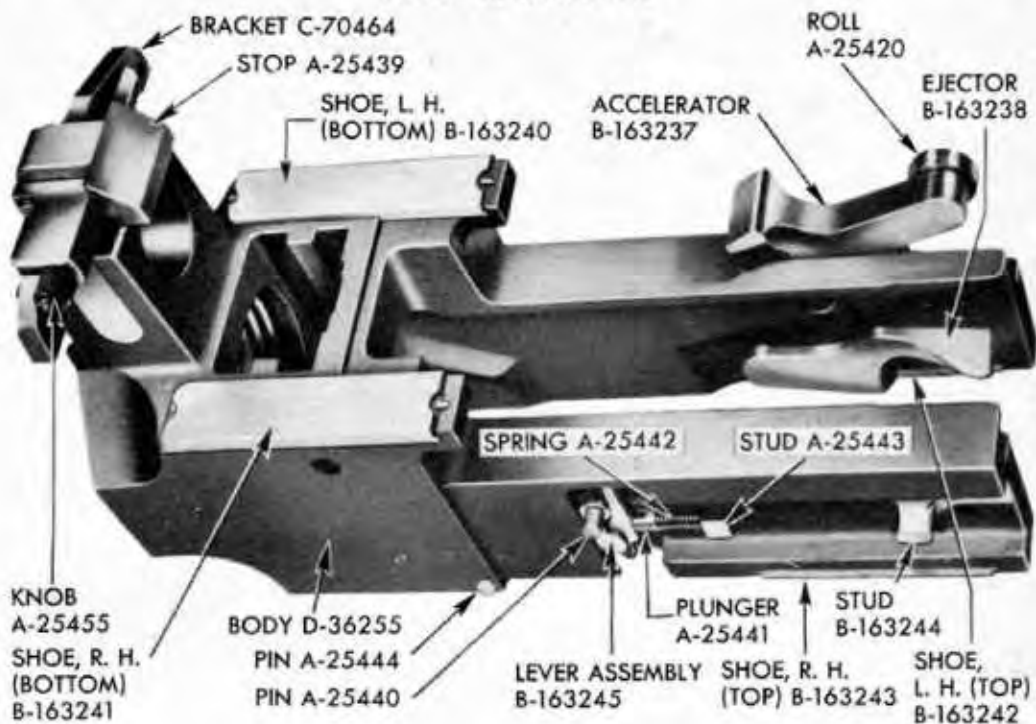
RA PD 5795

Figure 85 — Breechblock — Exploded View

c. Inspection.

(1) Inspect firing pin and spring and clear firing pin hole. Replace the firing pin if it is worn or bent. Replace the spring if it does not return the firing pin into the breechblock body as soon as pressure is released.

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Figure 86 — Tube Extension

(2) Smooth all rough sliding surfaces of the breechblock.

d. Assembly. Install firing pin spring and firing pin, making certain that recess in firing pin is in position to engage firing pin stop pin (fig. 85). Install firing pin stop pin and stake in place.

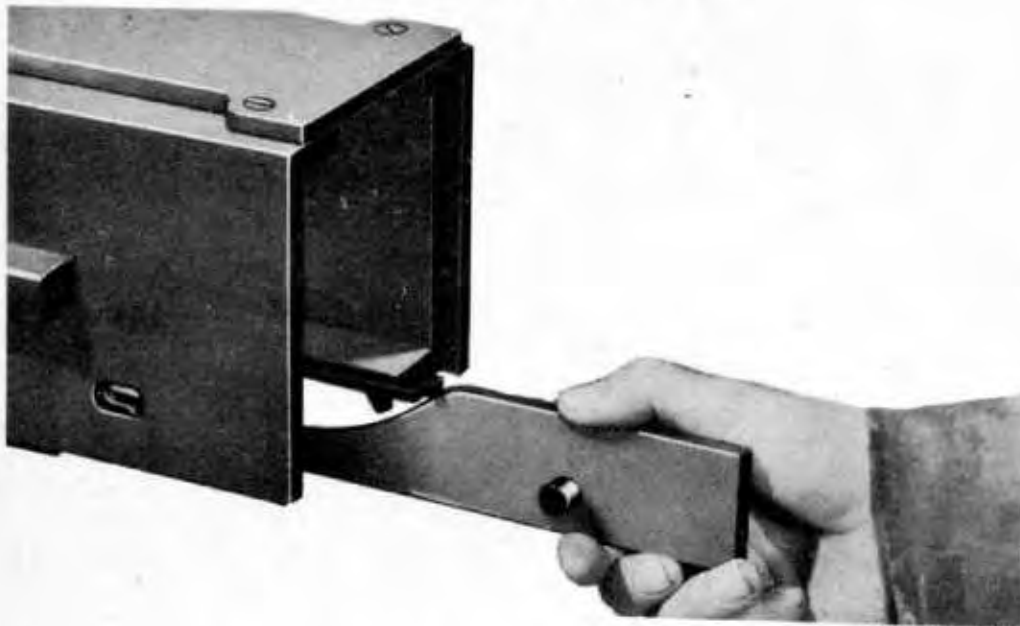
e. Installation. Slide breechblock up into tube extension and swing breechblock stop into position. Pull outward on breechblock stop retaining pin knob to engage retaining pin in the stop. Make sure breechblock is resting on breechblock stop after installation.

83. TUBE EXTENSION ASSEMBLY (fig. 86).

a. Removal.

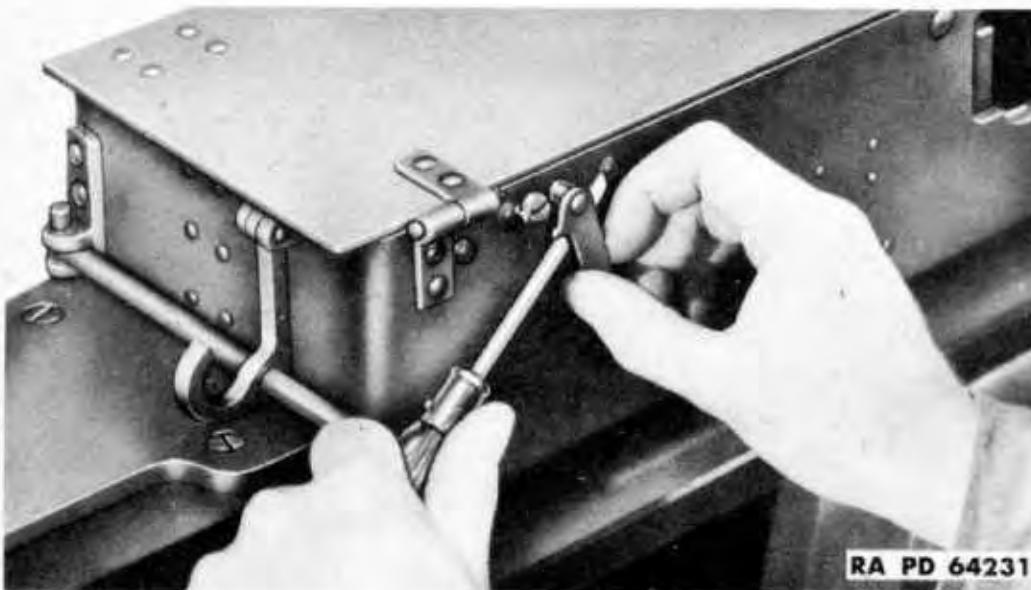
- (1) Remove gun as described in paragraph 77 a.
- (2) Remove back plate assembly as described in paragraph 79 a.
- (3) Remove driving spring assemblies as described in paragraph 81 a.
- (4) Remove lock frame assembly as described in paragraph 80 a.
- (5) Remove breechblock as described in paragraph 82 a.
- (6) Remove accelerator cam assembly by sliding to the rear and pressing inward on the head of the accelerator cam stud; then withdraw cam (fig. 87).

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RA PD 64230

Figure 87 — Removing Accelerator Cam



RA PD 64231

Figure 88 — Removing Feed Lever Pin Assembly

- (7) Unlock and remove feed lever pin assembly (fig. 88).
- (8) Raise feed box cover assembly and lift out feed lever (fig. 89).
- (9) Unlock carrier pin assembly and remove carrier assembly by swinging it down and out between the side plates (fig. 90).
- (10) Make sure gun is in a horizontal position and remove recuperator piston rod nut, using recuperator and piston rod nut wrench (fig. 91).

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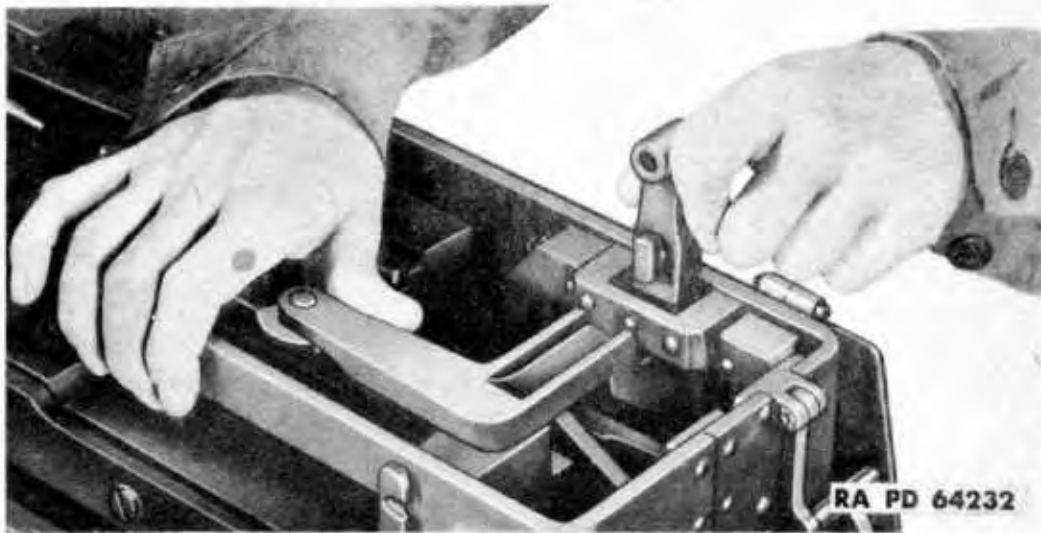


Figure 89 — Removing Feed Lever

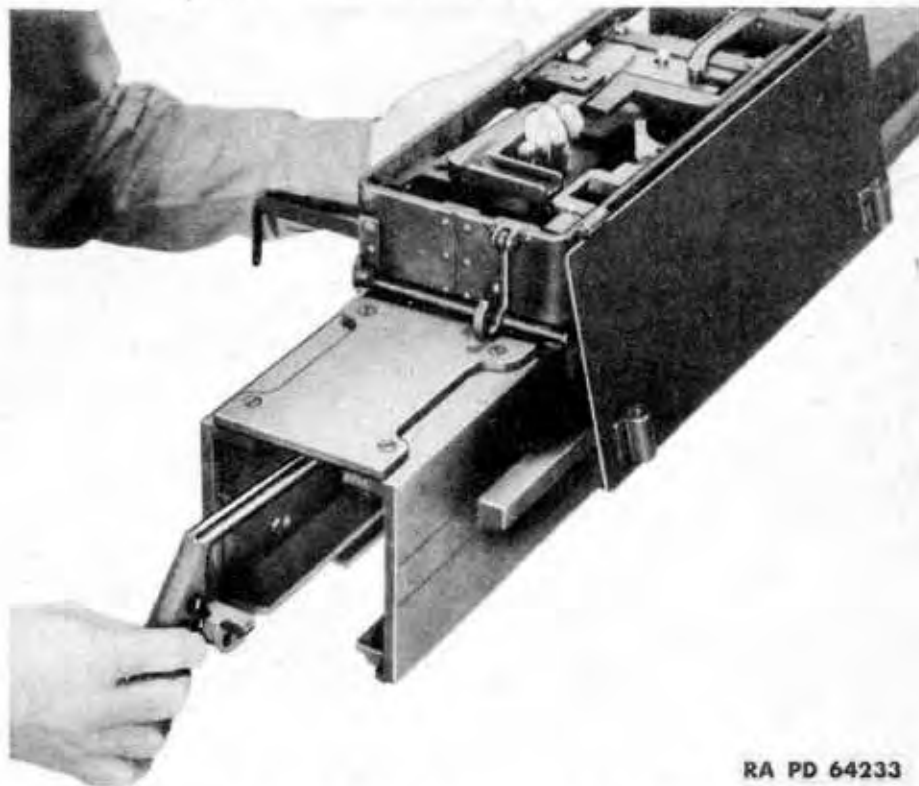


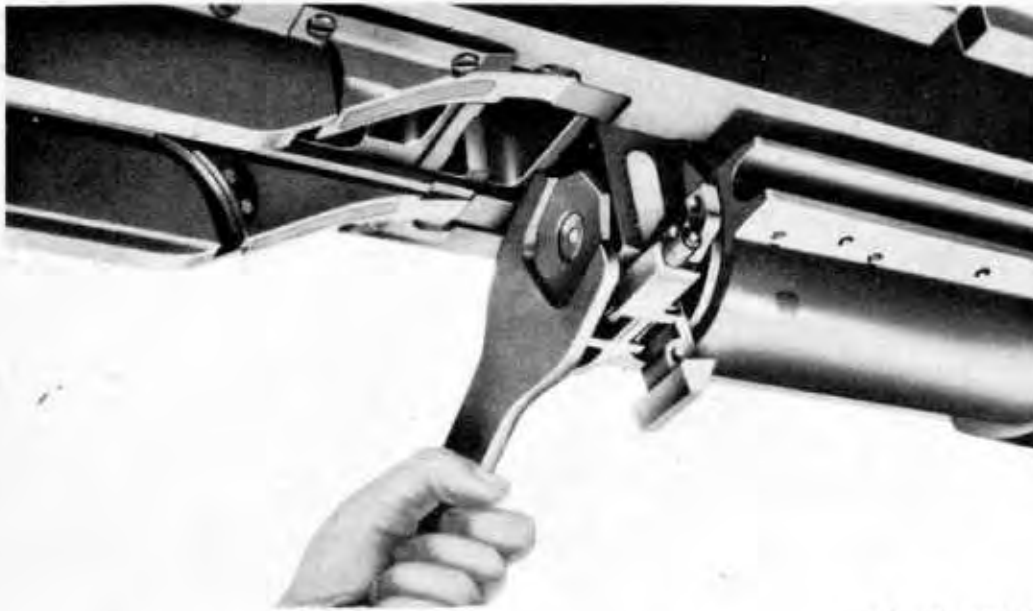
Figure 90 — Removing Carrier

(11) Slide tube extension out through rear end of trunnion block and remove, lifting it during removal to clear the hooked front end of the trigger bar (fig. 92).

b. Disassembly.

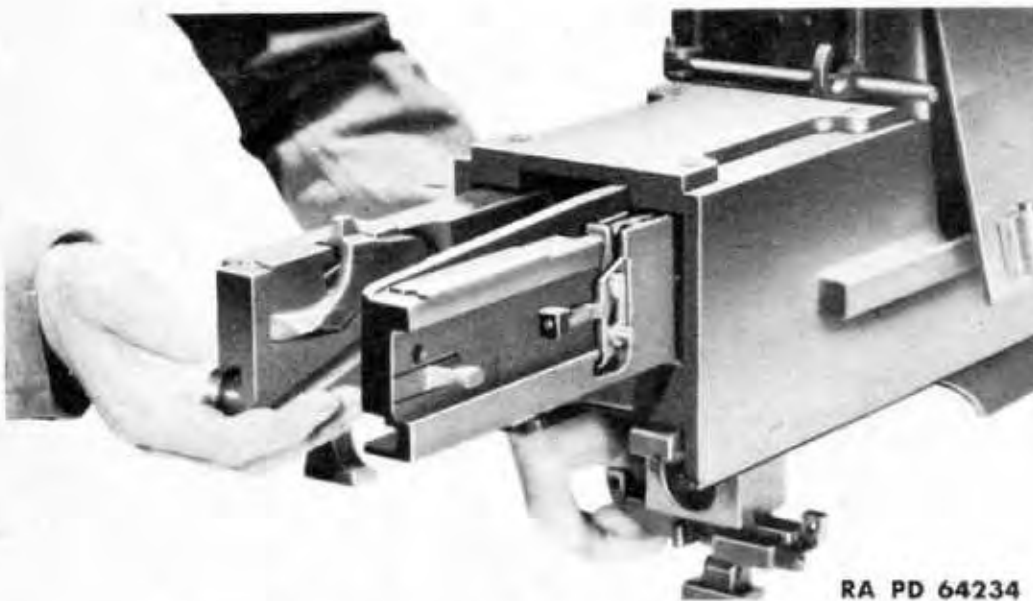
(1) Remove cotter pin; then remove breechblock stop pin and breechblock stop (fig. 93).

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RA PD 64416

Figure 91 – Removing Recuperator Piston Rod Nut



RA PD 64234

Figure 92 – Sliding Tube Extension to the Rear

- (2) Remove recuperator piston rod screw (fig. 94).
- (3) Remove the lock pin, securing the breechblock stop retaining pin and unscrew the knob. Remove breechblock retaining pin and spring (fig. 95).
- (4) Release the tube lock plate assembly (fig. 96) by depressing tube lock plate plunger through the small hole in the front face of tube extension.
- (5) Lift out tube lock plate assembly (fig. 97); then remove the tube lock and tube lock spring.

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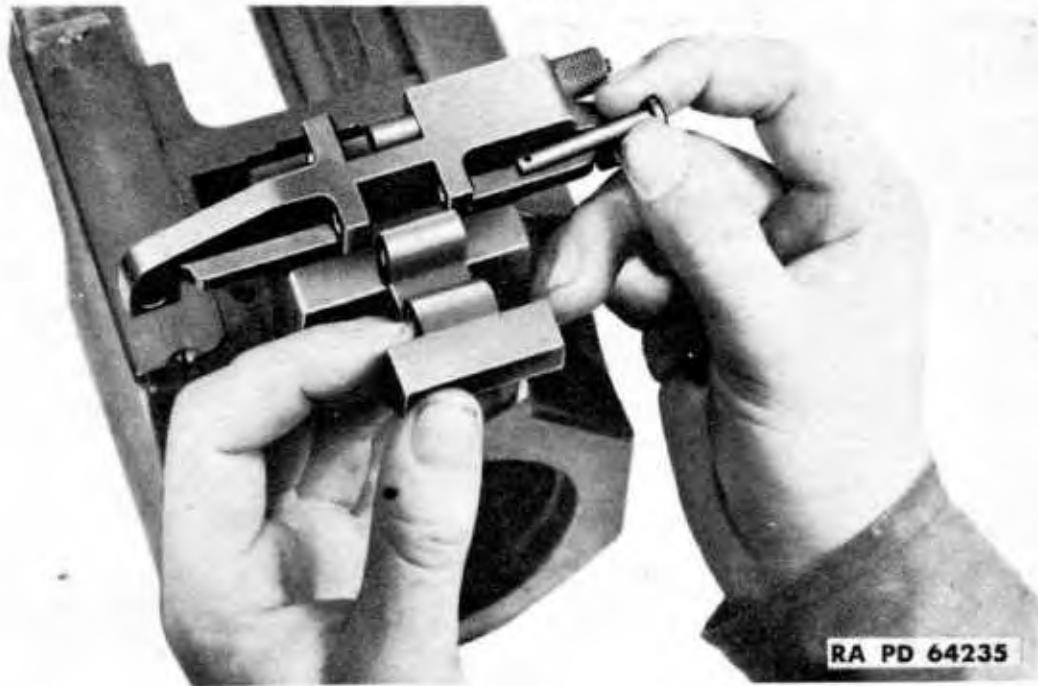
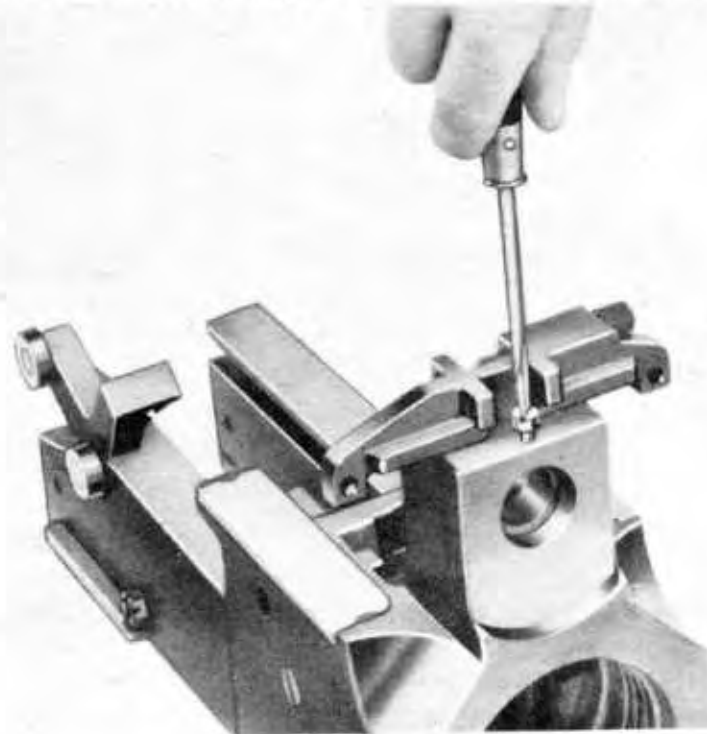


Figure 93 — Removing Breechblock Stop Pin and Stop



RA PD 64261

Figure 94 — Removing Recuperator Piston Rod Screw

- (6) Remove trigger trip pin and lift out trigger trip (fig. 98).
- (7) Remove trigger lever assembly by looping a piece of wire around the front portion of the trigger lever spring plunger. Grip the

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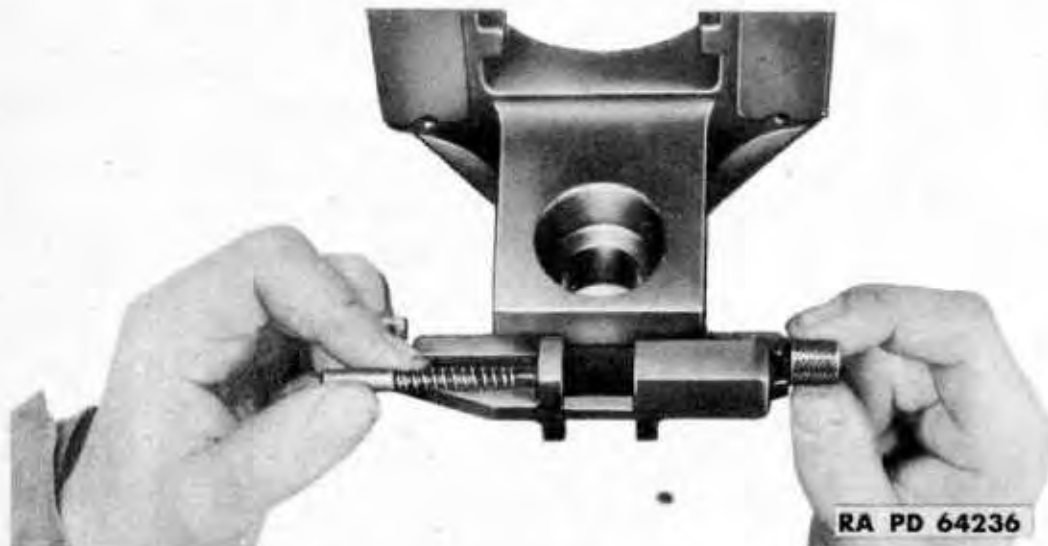


Figure 95 — Removing Breechblock Stop Retaining Spring and Plunger



Figure 96 — Releasing Tube Lock Plate Plunger

wire firmly with pliers and pull the trigger lever spring plunger rearward. Remove trigger lever pin and trigger lever assembly (fig. 99).

NOTE: If wire is not available, the trigger lever plunger may be compressed with the fingers and held fully to the rear with pliers.

(8) Ease out trigger lever spring plunger and spring.

(9) Remove cotter pin and castellated nut from ejector stud and press ejector down; then slide it out toward the center of the tube extension (fig. 100). Be careful not to let ejector spring jump out when removing ejector. Remove ejector spring.

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Figure 97 — Removing Tube Lock Plate Assembly



Figure 98 — Removing Trigger Trip

(10) Use a screwdriver and depress the accelerator spring plunger into tube extension body (fig. 101). Remove accelerator and ease out accelerator spring and plunger.

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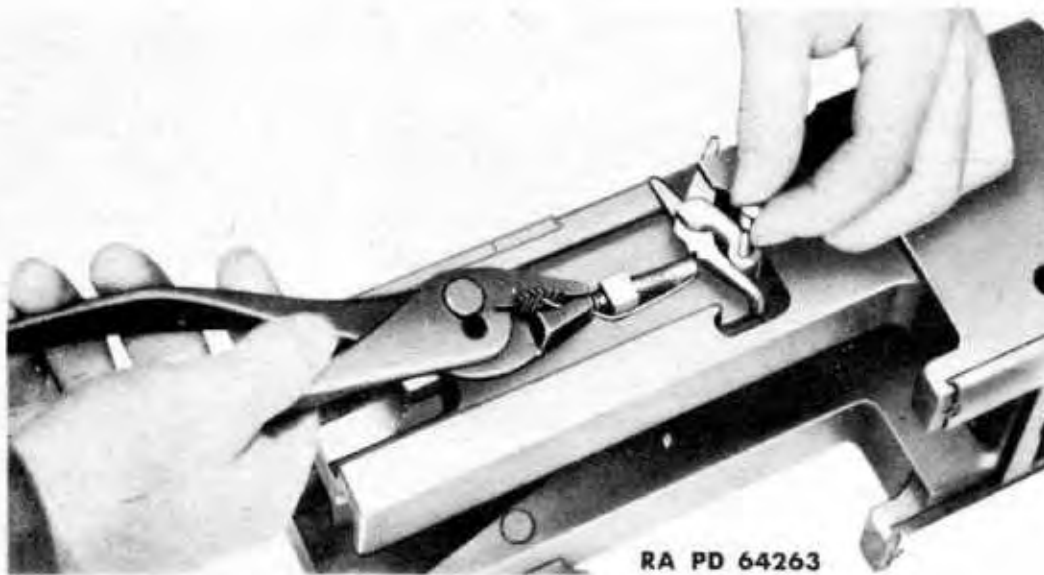


Figure 99 – Removing Trigger Lever Assembly

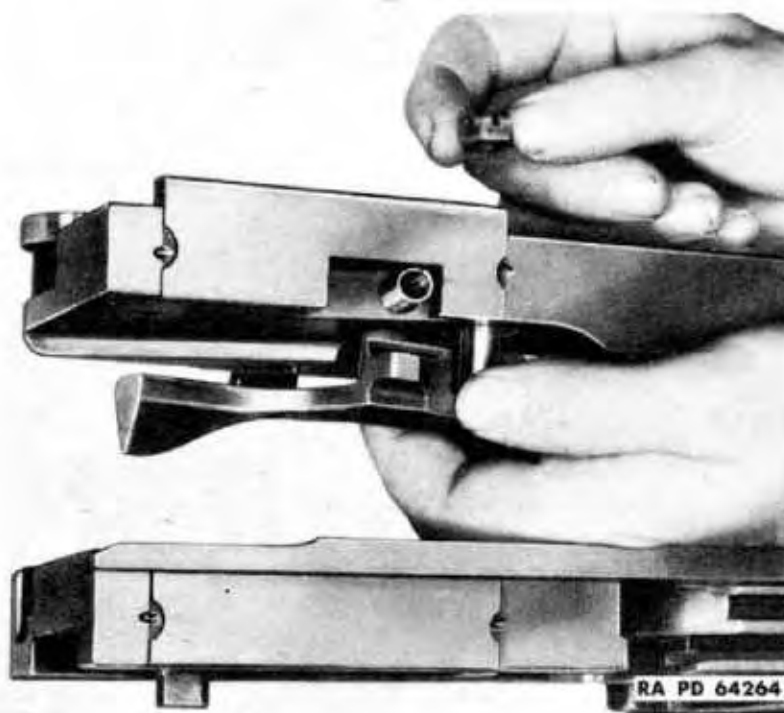


Figure 100 – Removing Ejector Assembly

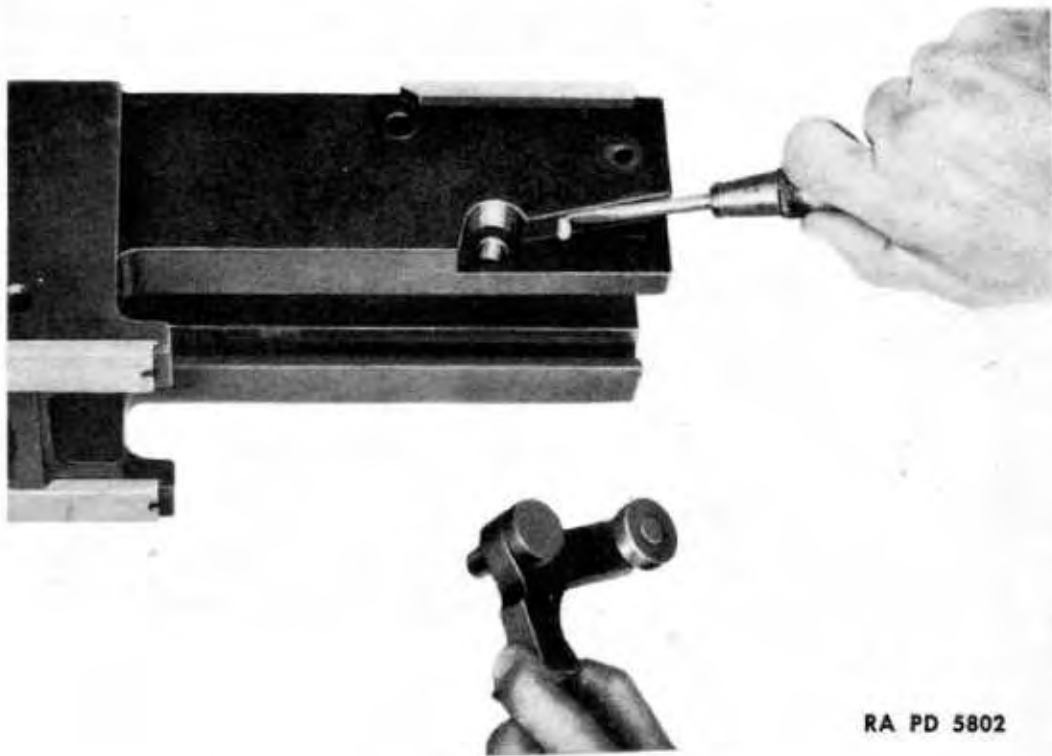
(11) Unscrew breechblock plunger screw and remove breechblock plunger and spring (fig. 102). The screw is staked in place.

(12) Tube extension parts are shown in figure 103.

c. Inspection.

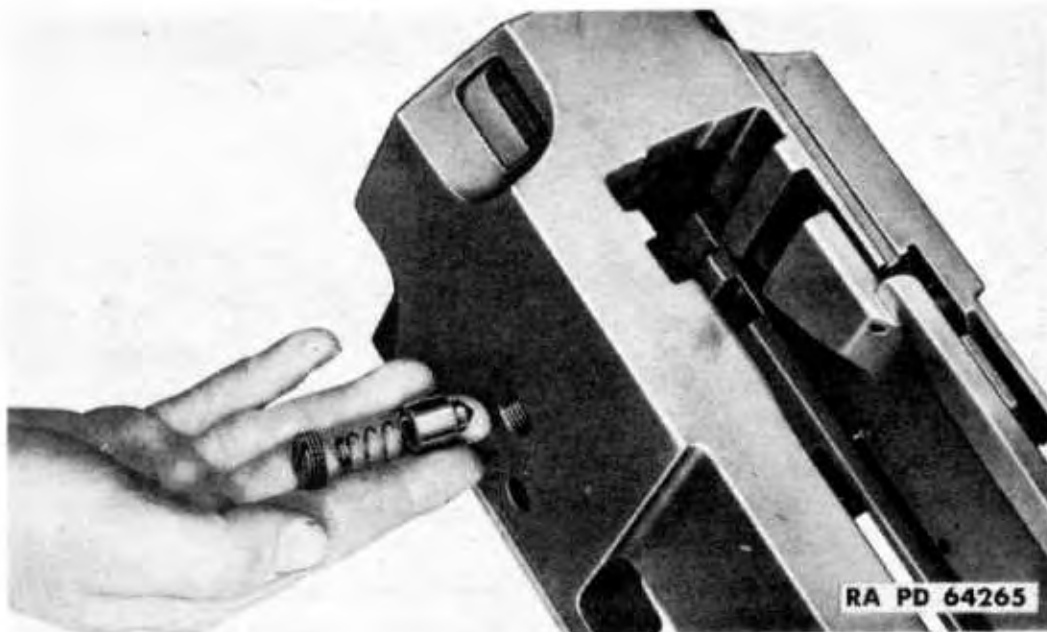
(1) Examine the trigger lever assembly and trigger trip. These

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RA PD 5802

Figure 101 – Removing Accelerator Assembly



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Figure 102 – Removing Breechblock Plunger

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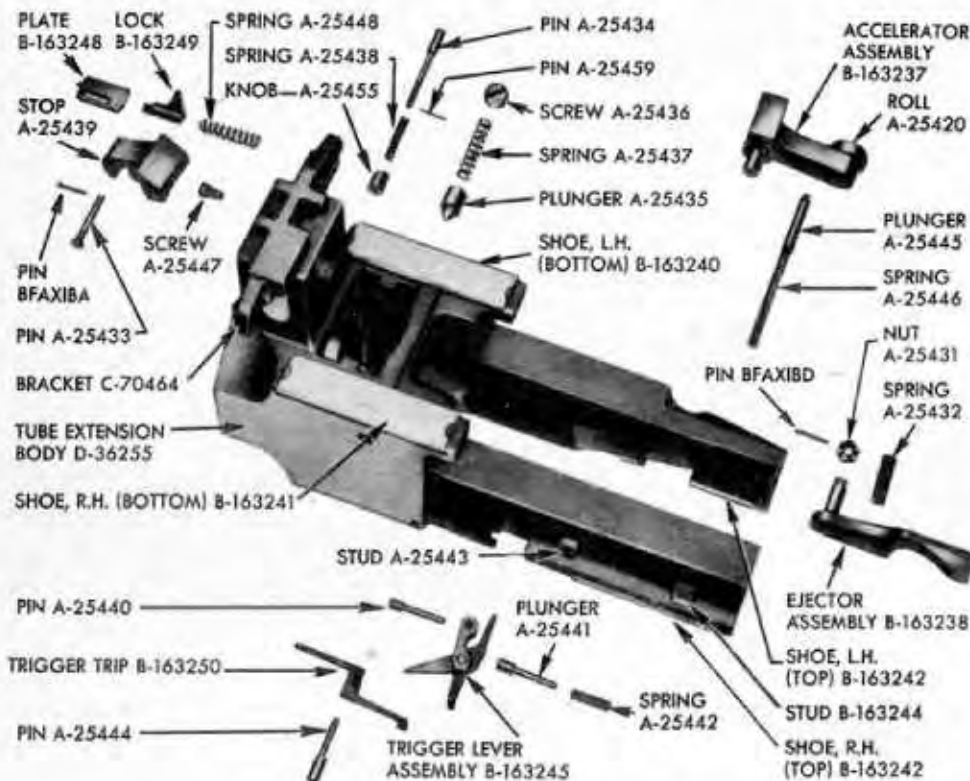


Figure 103 — Tube Extension Parts

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parts should work smoothly with no binding, and should be free from dents and burrs.

(2) Check condition of accelerator and ejector springs. The free length of a new accelerator spring is approximately 3 inches. The free length of a new ejector spring is approximately $1\frac{3}{8}$ inches.

(3) Inspect all bearing surfaces for roughness or burrs and smooth down such imperfections with CLOTH, crocus, or a fine file.

(4) Clean all plunger and spring holes.

d. Assembly.

(1) Install breechblock plunger, spring, and screw, in left side of tube extension until screw is slightly below the surface of the tube extension.

NOTE: Do not turn screw in far enough to bottom the spring, for it will bind the breechblock. Stake screw in place.

(2) Install accelerator spring and plunger and hold compressed while installing the accelerator assembly. The small end of the plunger must engage in the groove in the accelerator body.

(3) Install the ejector spring and the ejector, with the flanged edge of ejector engaged under the bronze shoe. Install the castellated nut and secure with $\frac{1}{16}$ - by $\frac{5}{8}$ -inch cotter pin.

DISASSEMBLY AND ASSEMBLY OF 37-MM AA GUN M1A2 AND CARRIAGES

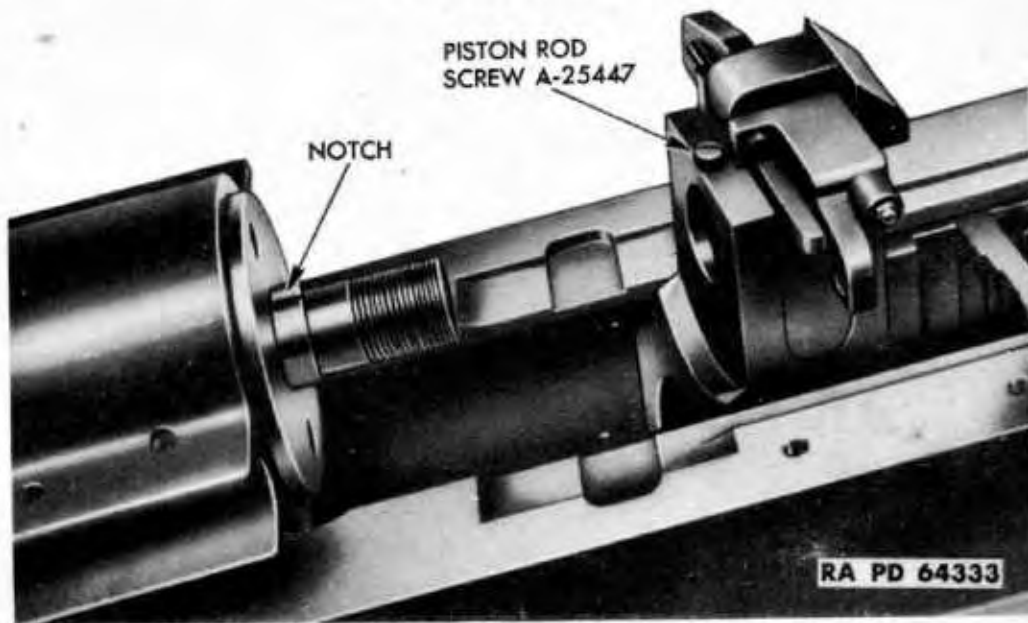


Figure 104 — Installing Tube Extension on Recuperator Piston Rod

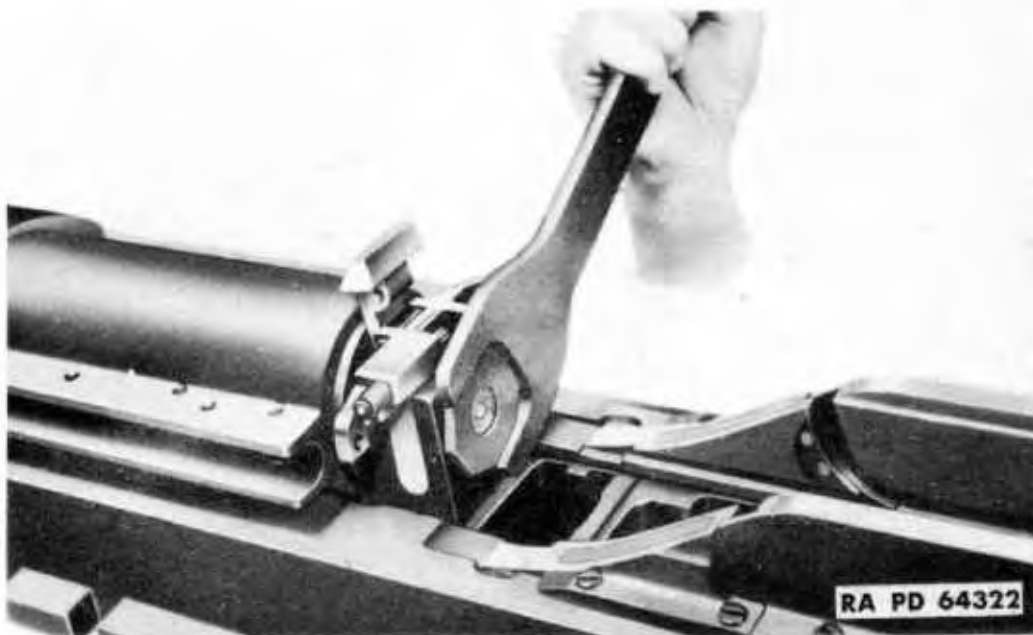


Figure 105 — Tightening Recuperator Piston Rod Nut

(4) Place trigger lever spring and plunger in trigger lever stud on tube extension. Loop a piece of wire around the front portion of the plunger and using pliers, fully compress the plunger spring while installing the trigger lever assembly. Insert the trigger lever pin.

(5) Install trigger trip and pin with offset end of trigger trip to the rear.

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(6) Install tube lock and spring. Install tube lock plate assembly with tongue on the rear end downward, to engage groove in tube extension body.

(7) Install breechblock stop retaining pin spring and pin; then screw knob on pin until hole for lock pin will permit lock pin to be installed. Insert breechblock stop lock pin and bend ends flat against retaining pin; then unscrew knob until tight against lock pin.

(8) Install recuperator piston rod screw.

(9) Install breechblock stop and pin. Secure with a $\frac{1}{16}$ - by $\frac{5}{16}$ -inch cotter pin.

e. Installation.

(1) Slide tube extension assembly into position between side plates of trunnion block and push it forward, lifting it to clear the hooked front end of the trigger bar.

(2) Turn recuperator piston rod to align the notch in the collar of the rod with the piston rod screw in the tube extension (fig. 104).

NOTE: The recuperator piston rod nut should not be tightened before gun tube is seated in tube extension.

(3) Install gun tube as described in paragraph 76 e.

(4) Screw recuperator piston rod nut on rear end of rod and tighten securely with wrench, making certain piston rod screw enters notch in collar of piston rod (figs. 104 and 105).

NOTE: A flat of the hexagonal portion of the nut must be parallel with the breechblock stop when the nut is tight, so that the stop can be locked in place. If it is not, remove the nut and lightly dress off the front face of nut.

(5) Install breechblock as described in paragraph 82 e.

(6) Install driving spring assemblies as described in paragraph 81 d.

(7) Install lock frame assembly as described in paragraph 80 e.

(8) Install accelerator cam assembly in rear end of left side plate of trunnion block by engaging head of accelerator cam stud in key hole slot in side plate and pushing the cam forward.

NOTE: The accelerator cam must be selected for the muzzle velocity at which the gun is to be fired, dependent upon the ammunition used. Each cam is marked to indicate the muzzle velocity for which it is designed; "2600 FS CAM" indicates 2,600 feet per second, "2800 FS CAM" indicates 2,800 feet per second.

(9) Install carrier assembly as described in paragraph 84 d (9).

(10) Install back plate assembly.

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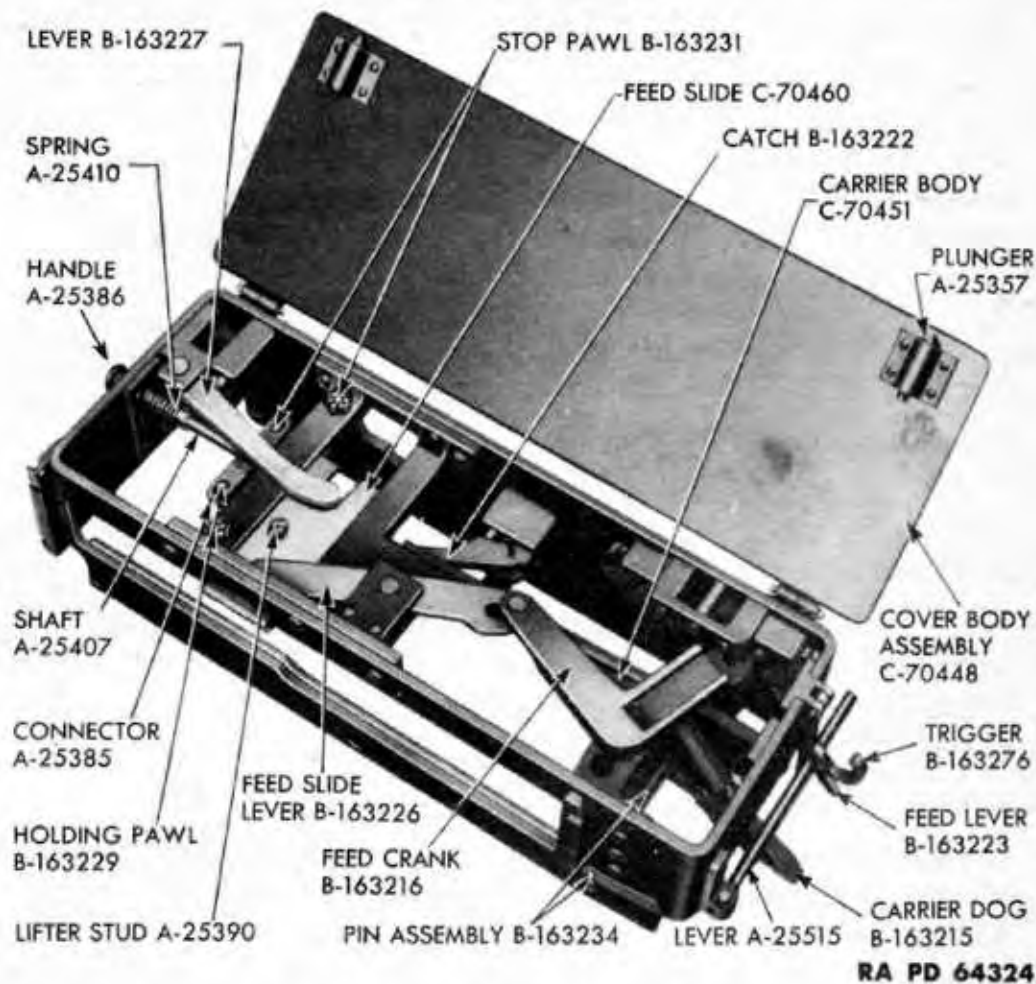


Figure 106 — Feed Box Mechanism

84. FEED BOX MECHANISM (fig. 106).

a. **Removal.** The feed box mechanism may be removed as a unit by removing the three screws on both sides that secure the feed box frame assembly to the trunnion block. It is not necessary that the feed box mechanism be removed in order to permit disassembly.

b. Disassembly.

(1) Raise feed box cover by pushing upward on the front and rear corners of the left side.

NOTE: Cover assembly may be removed from the feed box by removing the two cover hinge pins secured by cotter pins on the right side. The two cover detent plungers and springs may be disassembled by removing the cotter pins; however, removal of these parts is not necessary for disassembly of the feed box.

(2) Remove the feed slide return lever pin and feed slide return lever, while depressing the spring and plunger (fig. 107).

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Figure 107 — Removing Feed Slide Return Lever



Figure 108 — Removing Feed Slide Lever

(3) Push the feed slide to the right side of the feed box and remove the feed slide lever pin and feed slide lever (fig. 108).

(4) Unlock and remove feed lever pin assembly (fig. 88) by pushing lower end of lock counterclockwise until short end is clear of lock screw.

(5) Lift out feed lever (fig. 89).

(6) Swing feed crank assembly clockwise to clear the feed lever bracket, and lift it out of feed box (fig. 109).

(7) Depress feed lever spring plungers and springs, remove cotter pins, and carefully remove the springs and plungers (fig. 110).

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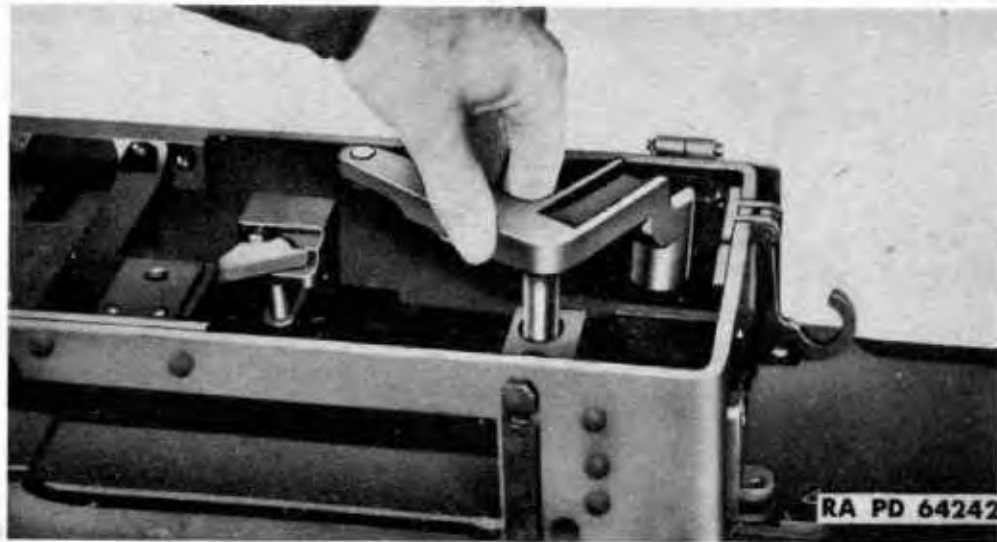


Figure 109 — Removing Feed Crank Assembly



Figure 110 — Removing Feed Lever Spring Plunger and Springs

(8) Pull feed slide to the left and drift out the feed pawl pin (fig. 111). Hand pressure will usually be sufficient.

(9) Lower the feed pawl assembly out of the slide and remove slide and feed pawl spring (fig. 112).

(10) Pry out slightly on the carrier pin lock and push it counter-clockwise until short end is clear of lock screw; then remove the pin and lock assembly. Lower the carrier assembly between the side plates of the trunnion block and remove (fig. 90).

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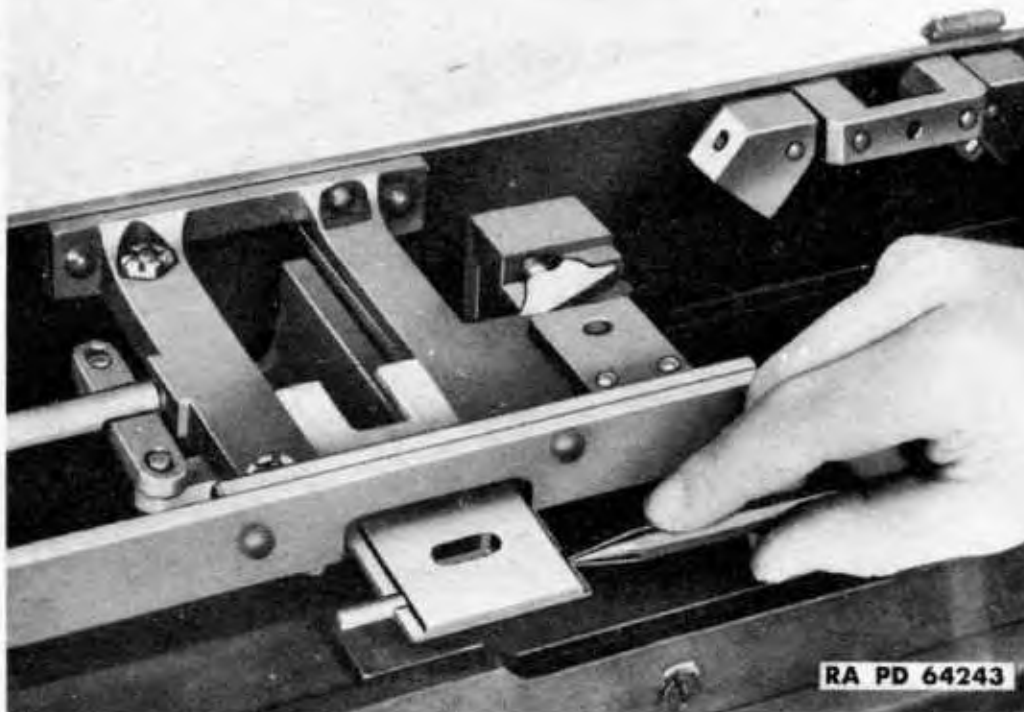


Figure 111 – Removing Feed Pawl Pin

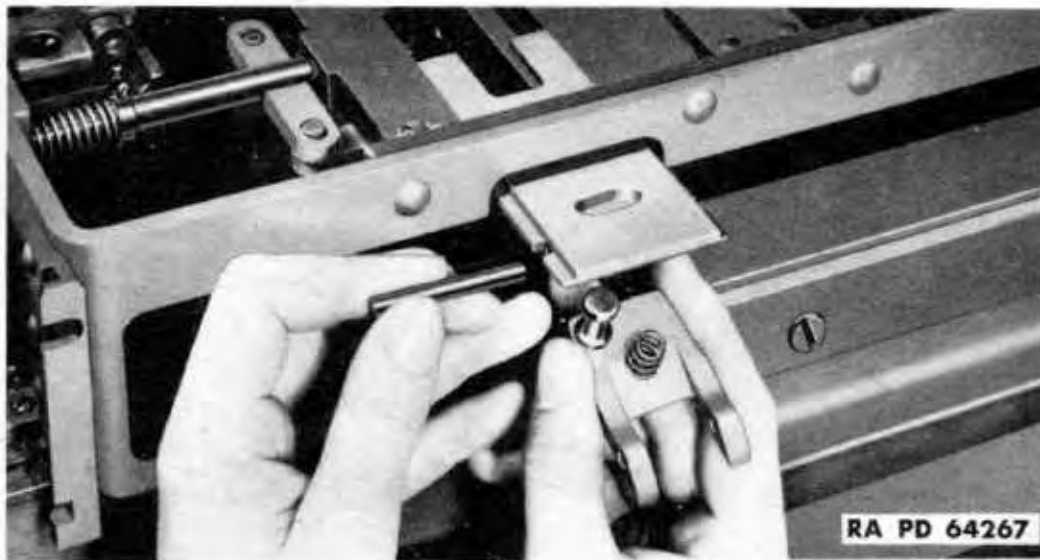


Figure 112 – Removing Feed Pawl Assembly

(11) Depress carrier catch spring plunger with screwdriver and lift out carrier catch (fig. 113).

CAUTION: Release carrier catch spring plunger carefully, covering parts with hand to prevent their jumping out of place and becoming lost. Lift out plunger and spring.

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Figure 113 — Removing Carrier Catch

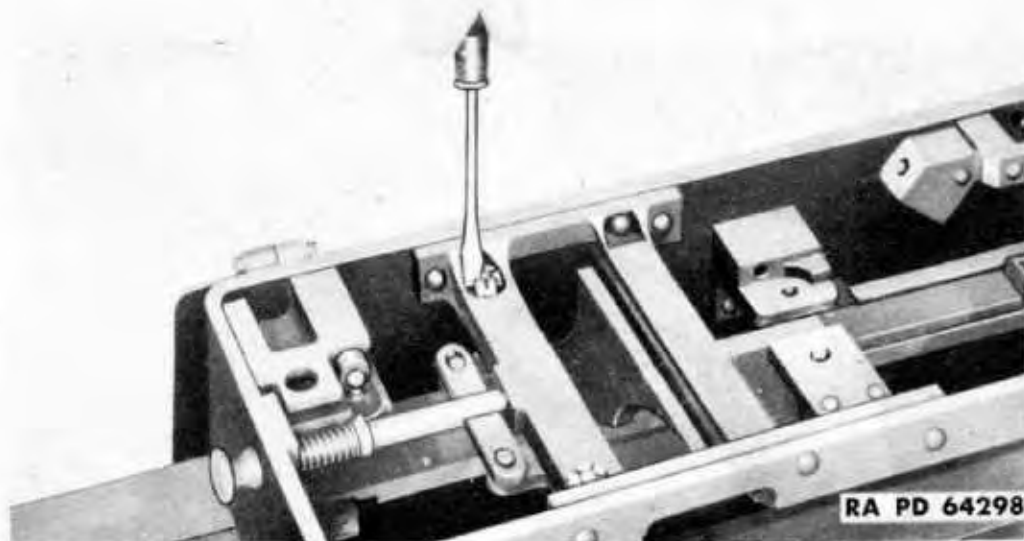


Figure 114 — Removing Cartridge Feeder Stop Pawl

(12) Remove cotter pin and castellated nut from the cartridge feeder stop pawl (right) and remove pawl and cartridge feeder pawl connector (fig. 114).

NOTE: The castellated nut is not tightly set, so nut may be turned by inserting the blade of a screwdriver between castellations.

(13) Remove cotter pin and castellated nut from cartridge feeder holding pawl (left) and remove the pawl (fig. 115).

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Figure 115 — Removing Cartridge Feeder Pawl Handle, Spring, and Connector Shaft

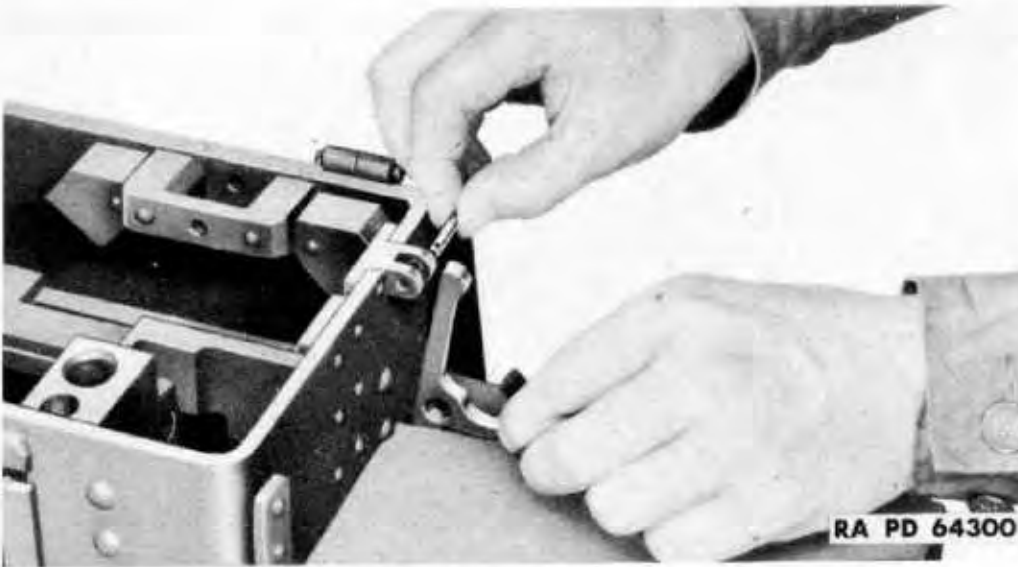


Figure 116 — Removing Trigger

(14) Remove cotter pin, and unscrew cartridge feeder pawl handle from the cartridge feeder pawl connector shaft.

(15) Remove trigger connector bracket lever and trigger by removing cotter pins and pins (fig. 116).

(16) Depress the feed slide return lever plunger with a screwdriver and push out feed slide return lever plunger pin (fig. 117). Release screwdriver slowly and ease out the feed slide return lever plunger and spring.

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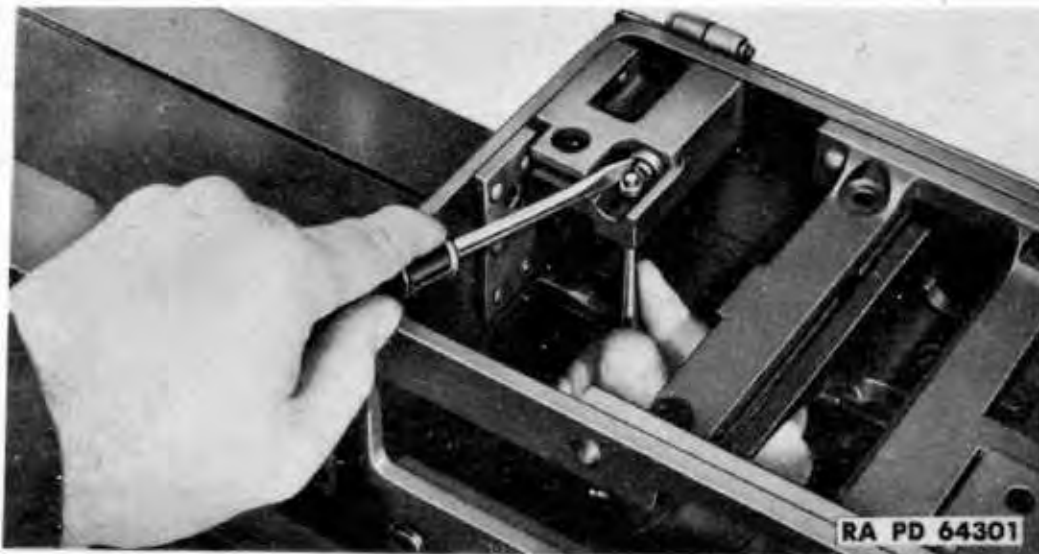


Figure 117 – Removing Feed Slide Return Lever Plunger and Spring

(17) Remove the six attaching screws and remove the feed box frame assembly from the side plates of the trunnion block.

NOTE: The screws on the left side of feed box frame assembly are longer than the screws on the right side. If any of these screws are interchanged, a serious malfunction will result, preventing tube extension from counterrecoiling and causing damage to the mechanism.

(18) Feed box parts are shown in figure 118.

c. Inspection.

(1) Check all parts of mechanism for burs, grit, foreign matter, or wear.

(2) Clean and smooth all rough surfaces. When assembled, the feed slide return lever should easily move all parts back to their original position. The action of the feed pawl assembly, cartridge feeder holding pawl, and cartridge feeder stop pawl is such that the cartridge clip is moved to the right, one section at a time.

(3) Make certain the feed lever spring plungers and springs operate freely, or feed lever may fail to function properly.

(4) Lubricate all moving parts with OIL, engine, SAE 30, above plus 32 F; OIL, engine, SAE 10, from plus 35 F to 0 F, or OIL, lubricating, preservative, light, below 0 F.

(5) Make certain that yoke end of feed crank engages swivel of feed lever. Incorrect assembly will result in failure to feed and bend the feed lever.

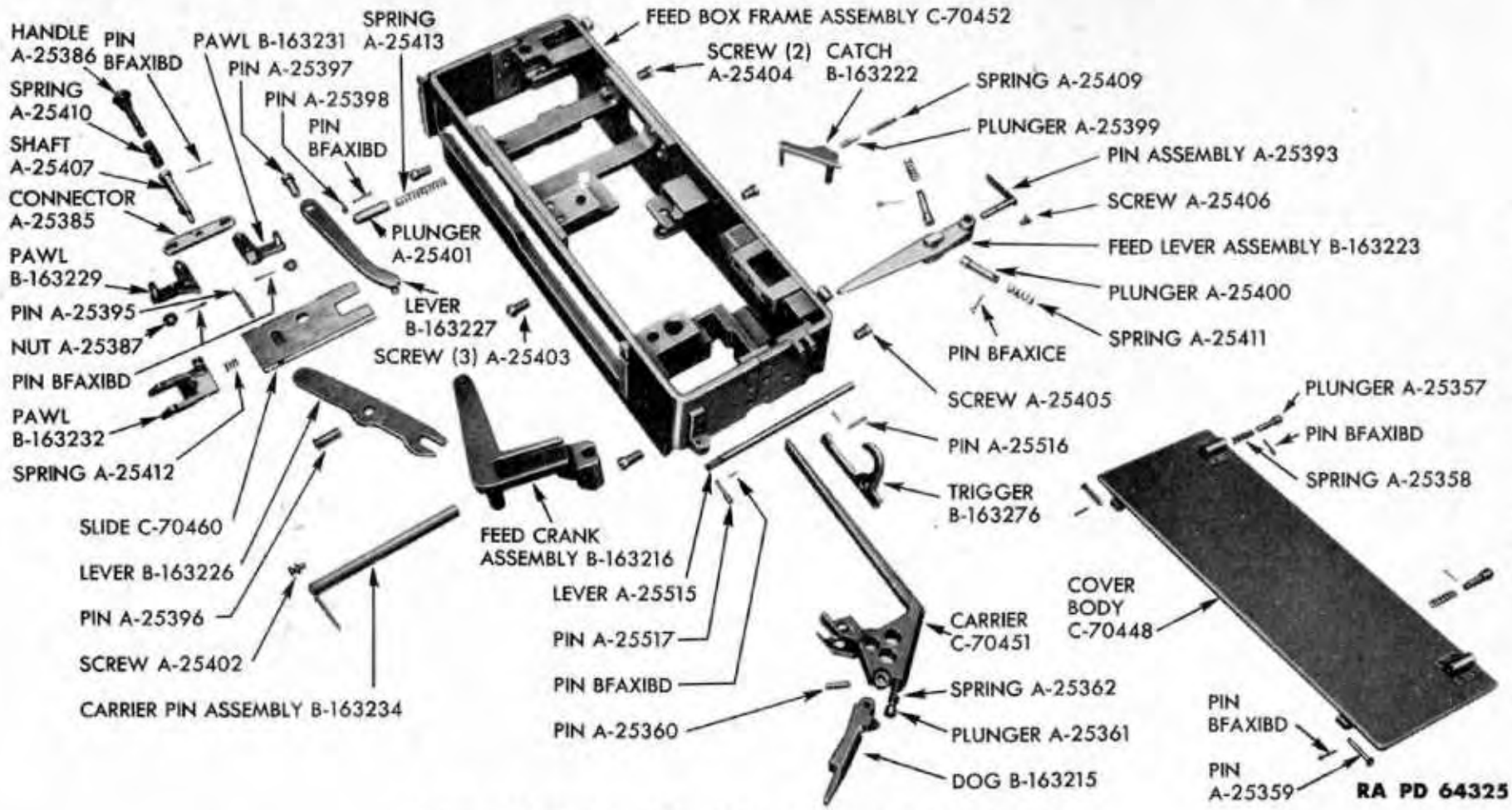


Figure 118 — Feed Box Mechanism — Exploded View

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d. Installation and Assembly.

(1) Place feed box frame assembly on side plates of trunnion block and align screw holes. Install two short screws in the front and center holes in right side. Install the third, or right rear screw which has a thin head, in position; then install the three long screws in the left side.

(2) Place feed slide return lever spring and plunger in bracket at right front corner of feed box. Compress spring and plunger and install plunger pin. Secure with $\frac{1}{16}$ -by $\frac{5}{8}$ -inch cotter pin.

(3) Place trigger in position, making certain notch in lower end of trigger engages hooked rear end of trigger bar. Install trigger pin and secure with a $\frac{1}{16}$ -by $\frac{5}{8}$ -inch cotter pin.

CAUTION: If trigger is incorrectly installed with lower end in front of hooked end of trigger bar, the gun will fire without a pull on the trigger, when the first cartridge is fed into gun. If lower end of trigger is behind the hooked end of trigger bar, the trigger will not actuate sear and hammer.

(4) Install trigger connector bracket lever and pin with lever through the hole in the trigger. Secure with a $\frac{1}{16}$ -by $\frac{5}{8}$ -inch cotter pin.

(5) Place rear end of cartridge feeder pawl connector shaft assembly in hole in feed slide guide. Place spring between the front end of shaft and feed box. Insert feeder pawl handle through hole in rear of feed box and through the spring. Screw into the feeder pawl connector shaft until the cotter pin holes are aligned. Secure with a $\frac{1}{16}$ -by $\frac{5}{8}$ -inch cotter pin.

(6) Install stop pawl in right end of feed slide guide, with the stop on under side of guide engaged in hole in pawl. Install castellated nut so that pawl swings freely, but eliminate all up and down motion, then secure with $\frac{1}{16}$ -by $\frac{5}{8}$ -inch cotter pin.

(7) Hold cartridge feeder pawl connector in position to engage pins on stop pawl and connector shaft while installing holding pawl on left end of feed slide guide. Make certain the stop on under side of guide enters hole in pawl; then install castellated nut and secure with $\frac{1}{16}$ -by $\frac{5}{8}$ -inch cotter pin. Be sure that pawl swing freely. If pawl does not move freely, back off nut to next notch, and insert cotter pin.

(8) Place carrier catch spring and plunger in carrier catch bracket and depress the plunger with blade of screwdriver. Install carrier catch and be sure carrier catch moves freely.

(9) Insert carrier through rear opening between side plates with carrier dog towards rear. Install carrier pin assembly through feed box and carrier assembly from the left side. Press pin in and turn clockwise until short end is engaged under head of the carrier pin lock screw. Make certain carrier will move freely.

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Figure 119 – Removing Trigger Bar

(10) Enter forked end of feed slide into grooves in feed slide guide from the left side, until lifter stud hole is inside, and feed pawl pin hole is outside feed box.

(11) Place large end of feed pawl spring in recess in under side of feed slide. Install feed pawl assembly from below, with lifter stud through the hole in the slide. Install feed pawl pin.

(12) Install feed lever springs and spring plungers in feed lever bracket located at the right rear corner of feed box and secure the plungers with $\frac{3}{32}$ -1-inch cotter pins.

(13) Place feed crank assembly in position with yoke end to rear of feed lever bracket.

(14) Place feed lever assembly in bracket from above, engaging swivel stud in the yoke end of the feed crank. Insert feed lever pin assembly through feed box and upper end of feed lever, from the right side. Press inward on feed lever pin and turn lock clockwise until short end is engaged under head of lock screw on feed box.

(15) Push feed slide to the right side of feed box. Install feed slide lever and pin with forked rear end engaging stud on feed crank, and stud on front end engaged in recess in top of feed slide.

(16) If feed box cover detent plungers and springs were removed from cover on disassembly, install these parts and lock detent plungers with $\frac{1}{16}$ -by $\frac{5}{8}$ -inch cotter pins.

(17) If feed box cover assembly was removed, install this assembly with cover hinge pins. Lock the hinge pins with $\frac{1}{16}$ -by $\frac{5}{8}$ -inch cotter pins.

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Figure 120 — Trunnion Block Subassemblies

85. TRIGGER BAR.

a. Removal.

- (1) Remove back plate assembly as described in paragraph 79 a.
- (2) Remove lock frame assembly as described in paragraph 80 a.
- (3) Remove tube extension assembly as described in paragraph 83 a.
- (4) Remove trigger connector bracket lever and trigger.
- (5) Remove trigger bar from the groove in the under side of the top flange of the right side plate, by sliding it rearward to disengage it from the two trigger bar guides (fig. 119).

b. Installation.

- (1) Place the trigger bar all the way to the rear in the groove on the under side of the top flange of right side plate of the trunnion block, so that the notch which is closer to one end of the bar lies toward the front of the gun.
- (2) Make certain that hooked end at rear of trigger bar points upward; then slide trigger bar forward. This will keep bar in position until trigger is installed.
- (3) Install trigger and trigger bracket connector lever, secure with $\frac{1}{16}$ - by $\frac{5}{8}$ -inch cotter pins.

CAUTION: Notch in trigger must engage hooked rear end of trigger bar; otherwise the gun will not fire, or will fire without a pull on the trigger.

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- (4) Install tube extension assembly as described in paragraph 83 e.
- (5) Install lock frame assembly as described in paragraph 80 e.
- (6) Install back plate assembly.

86. TRUNNION BLOCK SUBASSEMBLIES (fig. 120).

NOTE: The following units are attached to the trunnion block and can be removed or installed should a complete disassembly be required or a unit replacement be necessary.

a. Tube Lock Depressor Assembly.

(1) **REMOVAL.** Remove tube lock depressor, spring, and body which are secured to the top flange of the left side plate by removing one long and two short fillister-head screws.

(2) **INSTALLATION.** Place tube lock depressor spring in body and fasten body to left top flange of trunnion block side plate with the three fillister-head screws.

NOTE: The long screw is installed in the rear hole.

b. Cartridge Support Block.

(1) **REMOVAL.** Remove the two screws securing cartridge support block to trunnion block, and remove.

(2) **INSTALLATION.** Place cartridge support block on top flange of left side plate of trunnion block and install the two retaining screws.

c. Stripper Cam.

(1) **REMOVAL.** Remove the three screws securing stripper cam to trunnion block and remove cam.

(2) **INSTALLATION.** Place the stripper cam on top flange of right side plate of trunnion block and install the three retaining screws. Tighten screws firmly.

d. Carrier Bearing Brace.

(1) **REMOVAL.** Remove the two screws securing the carrier bearing brace to trunnion block and remove brace.

(2) **INSTALLATION.** Place carrier bearing brace on top flange of right side plate of trunnion block and install two retaining screws firmly.

e. Back Plate Latch Assembly.

(1) **REMOVAL** (fig. 121).

NOTE: Gun should be in inverted position.

(a) Remove the six screws securing back plate latch to bottom flange of trunnion block side plate. Be careful not to lose the back plate latch spring. Lift off back plate latch assembly.

DISASSEMBLY AND ASSEMBLY OF 37-MM AA GUN M1A2
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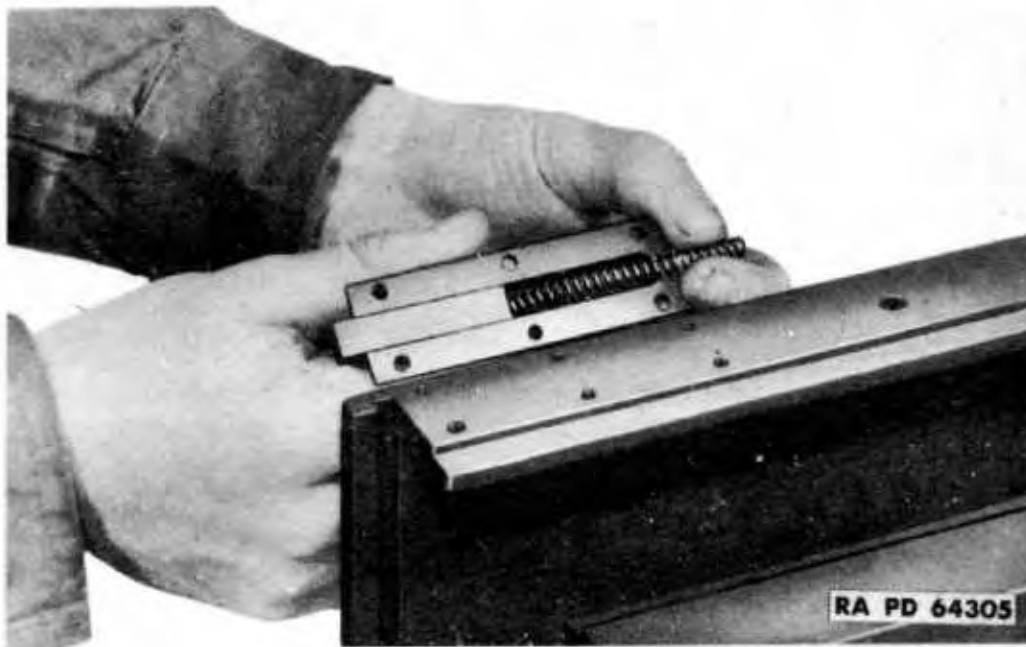


Figure 121 — Removing Back Plate Latch Assembly

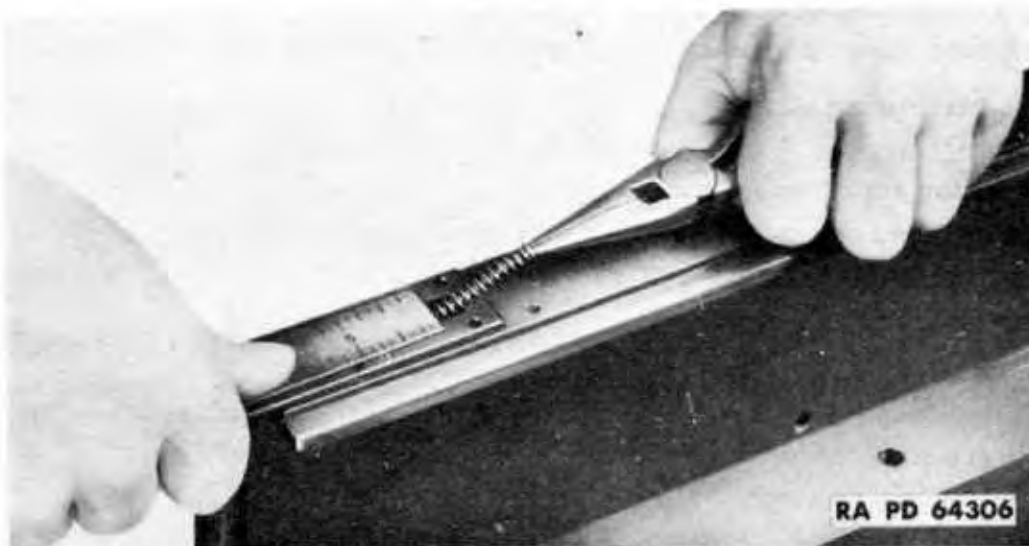


Figure 122 — Assembling Back Plate Latch Spring

(2) INSTALLATION.

(a) Turn back plate latch body upside down on bottom flange of side plate and install back plate latch slide in body; then start back plate latch spring in body assembly and guide with a steel scale or similar object (fig. 122).

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Figure 123 – Installing Back Plate Latch Assembly

(b) Force spring into body with a pointed object, similar to the needle nose pliers shown in figure 122. Slide steel scale over spring to keep it in place.

(c) Turn scale and back plate latch assembly over and place it in position. Carefully remove steel scale and install the six retaining screws (fig. 123).

87. DIRECT FIRE SIGHTS (fig. 124).

NOTE: The direct fire sights are ruggedly constructed, but because of their exposed position must be protected against damage by bending. The sights should not be used as handholds or supports, and should be removed and stored on carriage platform when traveling.

a. Removal.

(1) Remove the two sight keys (fig. 125) from both sides of the cradle assembly and lift off the traversing sight assembly and the elevating sight assembly.

(2) Remove both front and rear traversing sight plate assemblies by removing the nuts, lock washers, and sight plate screws.

(3) Remove both front and rear elevating sight plate assemblies by removing the nuts, lock washers, and sight plate screws.

b. Inspection.

(1) Examine front and rear sight plates for loose or broken cross wires, and solder if necessary.

(2) Replace any damaged or bent sight plates. If either of the welded sight brackets are bent, they should be replaced.

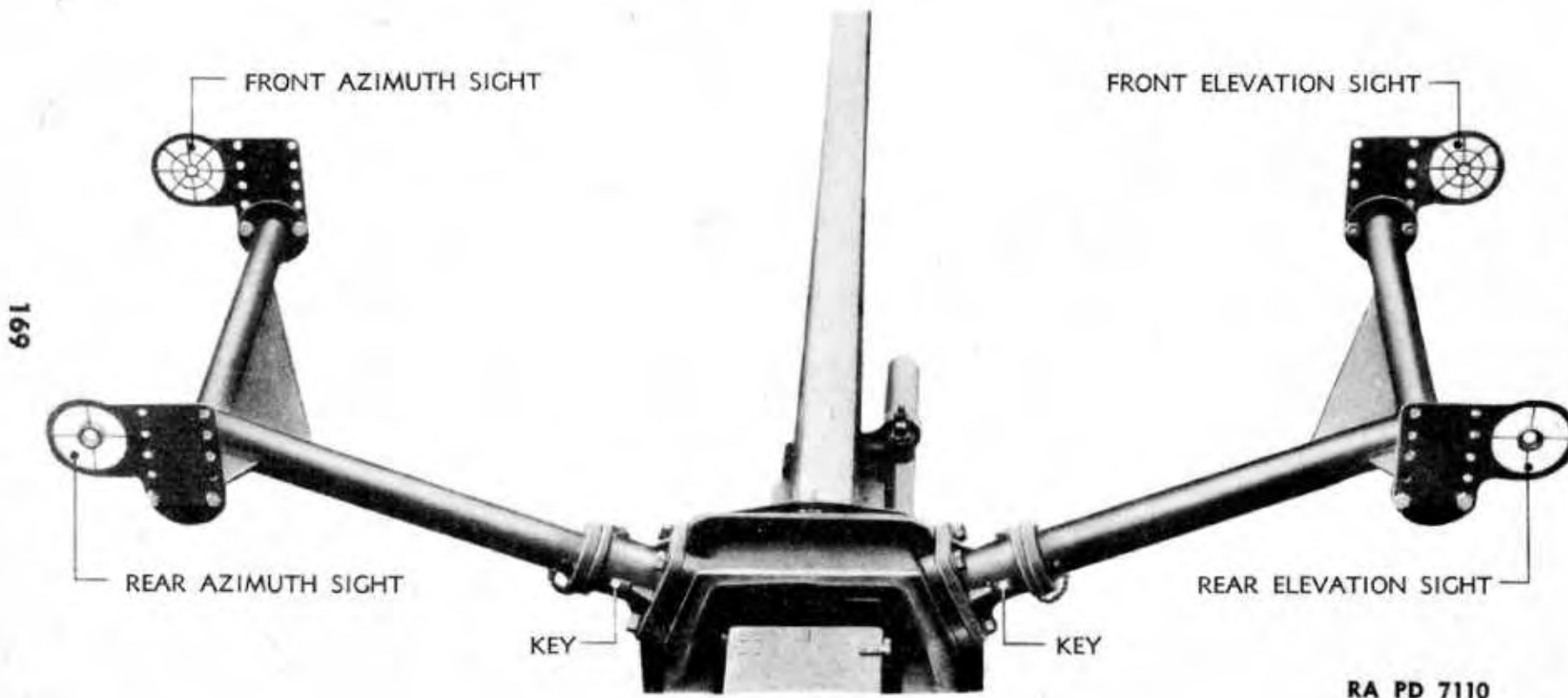


Figure 124 — Direct Fire Sights

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Figure 125 — Removing Sight Key

(3) After repairing the direct fire sights they should be checked for alinement by bore sighting the gun as described in subparagraph **d**, below.

c. Assembly and Installation.

(1) Install the front and rear elevating sight plate assemblies on the elevating sight bracket and secure with sight plate screws, lock washers, and nuts.

(2) Install the front and rear traversing sight plate assemblies on the traversing sight bracket and secure with sight plate screws, lock washers, and nuts.

(3) Place the elevating sight assembly in position on the right side of cradle assembly and install the sight key, tapping securely in place.

(4) Place the traversing sight assembly in position on the left side of cradle assembly and install the sight key, tapping securely in place.

d. Bore Sighting and Adjustment.

(1) Adjust the sight plates to the proper eye level of the operator by removing the sight plate screws, moving the plates, and then re-installing the screws.

NOTE: Since this is the only adjustment possible on these sights, the assembly should be replaced if proper alinement cannot be obtained after gun is bore-sighted.

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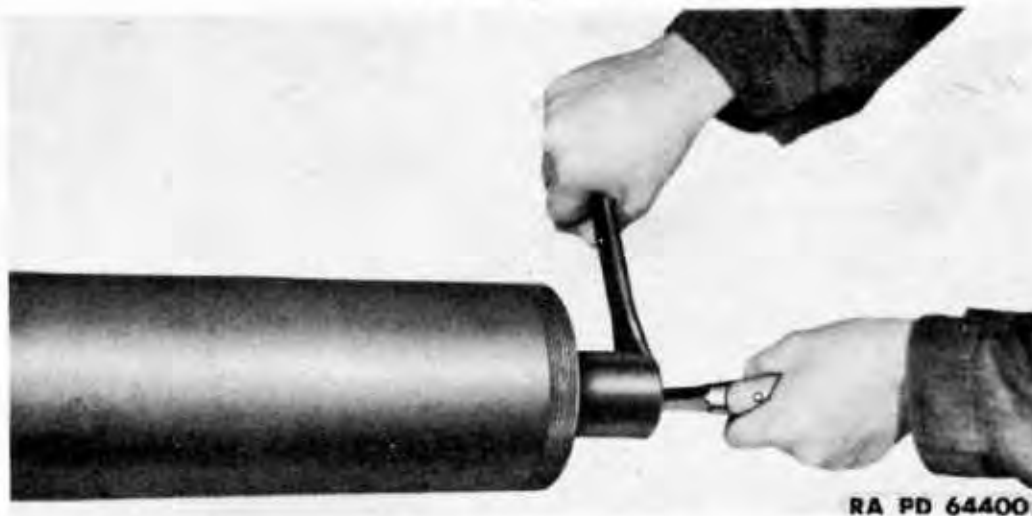


Figure 126 — Adjusting Equilibrator Spring

(2) Place carriage in firing position and level top carriage; then make sure the breech and tube are thoroughly clean and insert the breech bore sight, a disk which fits in the breech chamber of the gun.

NOTE: In the event that a manufactured breech bore sight is not available, an empty 37-mm cartridge case may be substituted after removing the primer from the case.

(3) Stretch a small cord or string tightly across the muzzle, vertically and horizontally in the score marks thereon, and secure with a web belt, or a small quantity of grease may be placed in the score marks to retain the cord.

(4) Look through the aperture in the breech bore sight and sight the gun on an object at least 1,500 yards away. If both elevating and traversing sight assemblies are in alinement, the axis of the bore will be parallel with the line of sight.

88. EQUILIBRATOR, ADJUSTMENT.

a. Carriage M3.

(1) Elevate and lower the cradle and gun several times. Note the force required on the handwheel and the motion of the cradle. The cradle should rotate smoothly in its bearings and the handwheel force should not be excessive.

(2) The two nuts on the end of the piston rod can be adjusted to vary the compression of the equilibrator spring or springs. As the nuts are turned further on the rod, it will be easier to elevate the cradle and harder to depress it.

(3) Equilibrator cylinder wrenches are used to make the adjustment on the equilibrator spring.

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RA PD 64401

Figure 127 – Tightening Lock Nut Against Adjusting Nut

(4) If adjustment cannot be secured to balance the gun and cradle properly, the spring or springs will have to be replaced.

b. **Carriage M3E1.** Adjustment of equilibrator is the same as that for the Carriage M3.

c. **Carriage M3A1.**

(1) Elevate gun to 90 degrees.

(2) Using wrenches, fit large wrench over equilibrator chain rod nut and insert small wrench, fitting it over lock nut. Screw both nuts to approximately original position on shaft. Use a hooked spring scale on end of handcrank and measure effort required to elevate and depress gun. It can be no more than 10 pounds, or gun will not perform by remote control. If greater effort is required to lower the gun than to raise the gun, adjust by turning chain rod nut in a counterclockwise direction. If effort is greater to raise the gun, turn chain rod nut in a clockwise direction. Hold chain rod securely with machinist's screwdriver while chain rod nut is being loosened or tightened (fig. 126). The lock nut must, of course, be backed off slightly from the chain rod nut when the latter is being loosened.

CAUTION: Be sure to keep lock nut on chain rod at all times during adjustment of equilibrator spring, to avoid spring pressure being accidentally released. Tighten lock nut securely against chain rod nut when adjustment of spring is completed (fig. 127).

(3) Replace equilibrator cap and tighten securely.

89. COUNTERPOISE ASSEMBLIES.

a. **Replacement of Counterpoise Spring.**

CAUTION: Do not stand in front of the counterpoise cylinder assembly during or after removal of cover to avoid personal injury should the pressure of the counterpoise springs be accidentally released.

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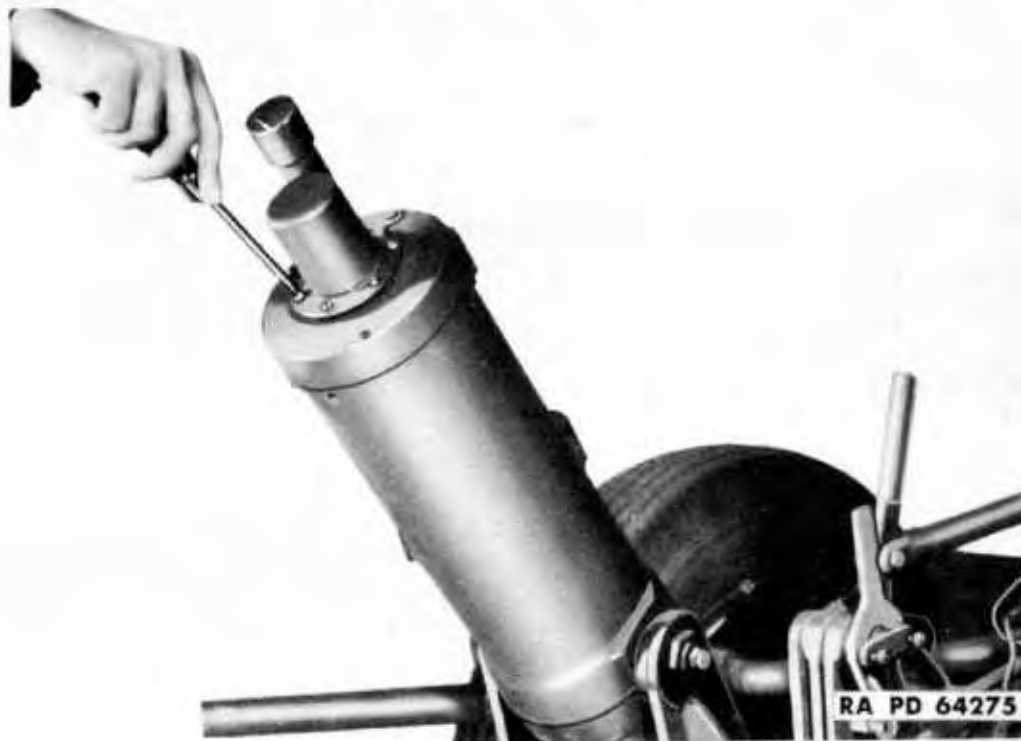


Figure 128 — Removing Dust Guard

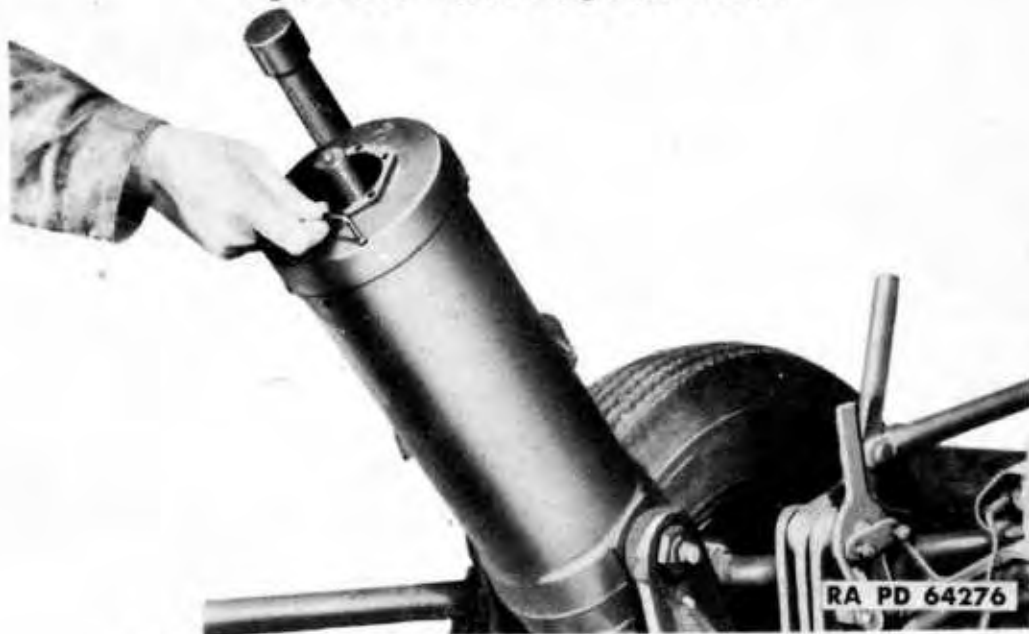


Figure 129 — Loosening Set Screw in Cylinder Cover

(1) Jack up chassis and place support under frame. Remove the six screws which secure counterpoise dust guard and remove dust guard (fig. 128).

NOTE: Count the number of exposed threads on rod, extending from lock nut, so same adjustment can be obtained upon reassembly.

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Figure 130 — Placing Spring Compressor Spacing Collar in Cylinder



Figure 131 — Removing Counterpoise Rod Nuts

(2) Turn counterpoise rod nut, compressing springs until there is a space of approximately $2\frac{3}{4}$ inches between counterpoise piston and cylinder cover.

(3) Remove cylinder cover by first loosening the $\frac{1}{4}$ -20 socket-head set screw which locks cover to end of cylinder (fig. 129), then use an 18-inch adjustable wrench and unscrew cover.

(4) Place spacing collar of spring compressor tool in end of cylinder and replace cover (fig. 130). Tighten cover and secure with $\frac{1}{4}$ -20 socket-head set screw.

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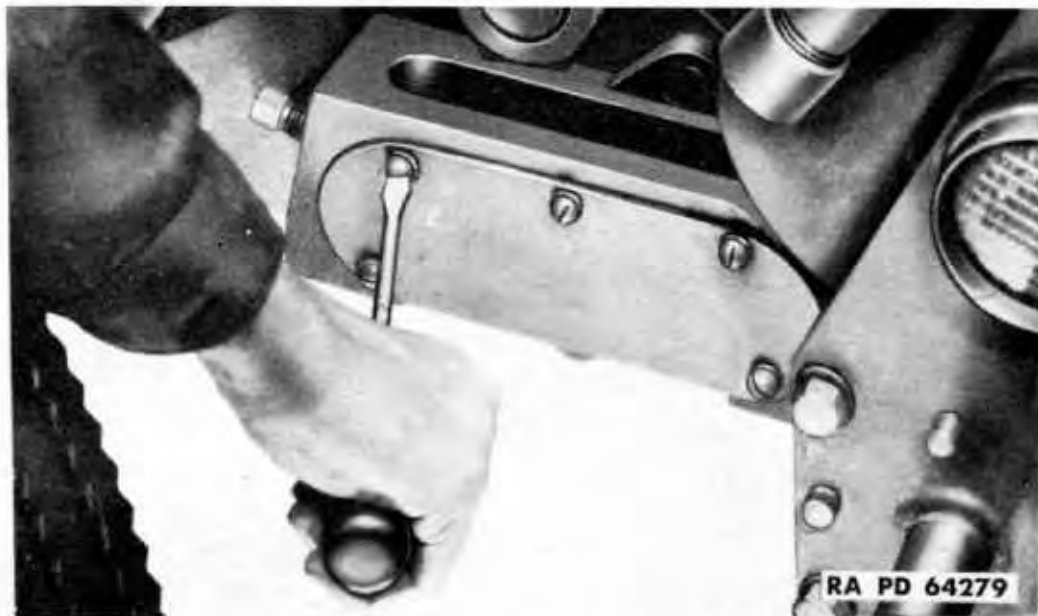


Figure 132 — Removing Axle Bracket Cover

(5) Remove counterpoise rod nut and lock nut (fig. 131). The pressure of the compressed spring will now be against the spacing collar and cover, so counterpoise rod may be disconnected from axle bracket.

(6) Remove the five screws and lock washers securing axle bracket cover and lift off cover (fig. 132).

(7) Disconnect counterpoise rod from axle bracket by removing the counterpoise rod pin (fig. 133). Use a $\frac{3}{8}$ -16 NC-2 cap screw in

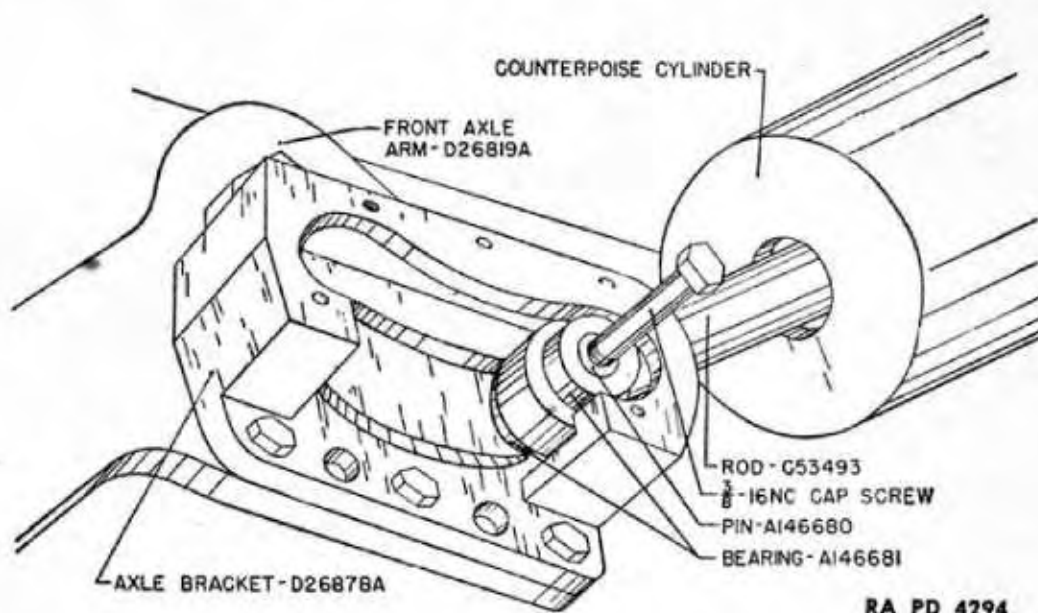


Figure 133 — Removing Counterpoise Rod Pin

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Figure 134 — Removing Counterpoise Rod

threaded hole in end of pin, to withdraw pin from rod bearings and eye of counterpoise rod.

CAUTION: Support upper end of cylinder while removing pin to prevent the cylinder from swinging down and injuring personnel.

(8) Lower front end of cylinder disengaging rod from the two rod bearings and axle bracket. Withdraw the rod from cylinder (fig. 134).

(9) Insert the spring compressor rod (fig. 135) in cylinder so threaded end extends through lower end of cylinder. Place ball bearing on rod so the flat side of bearing is toward bottom of cylinder and install nut on rod so it seats in recess in bearing.

(10) Use equilibrator wrench on the nut which is pinned to upper end of rod, to prevent compressor from turning, and tighten nut on lower end of rod against thrust bearing until spring pressure is relieved from spacing collar. Remove cover and spacing collar.

(11) Unscrew the nut on lower end of compressor rod, releasing both counterpoise springs until fully extended. Remove nut and bearing and withdraw compressor rod.

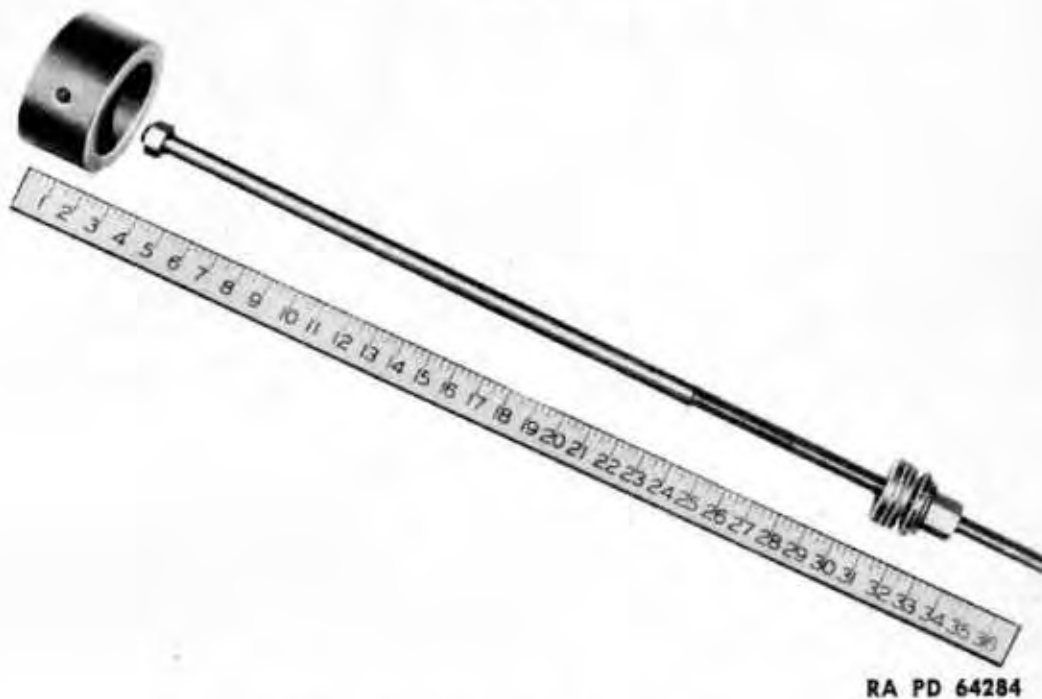
(12) Lower front end of cylinder and remove counterpoise spring assemblies; then remove the rod guide from bottom of cylinder.

(13) Counterpoise springs and rod parts are shown in figure 136.

b. Inspection.

(1) Clean all parts thoroughly and examine springs for cracks;

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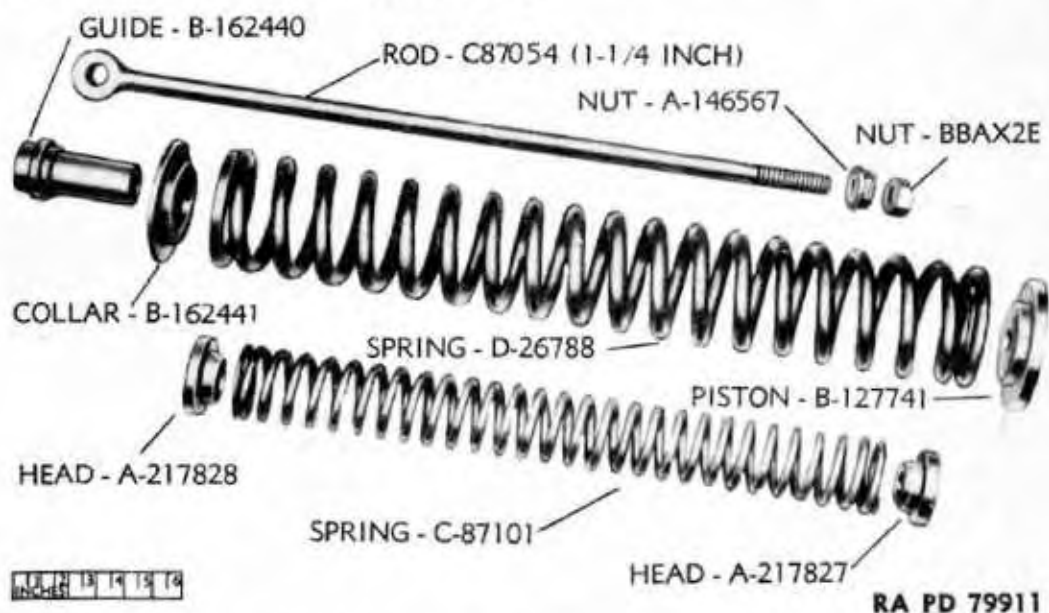


RA PD 64284

Figure 135 — Counterpoise Spring Compressor

also check springs for having taken a permanent "set" by comparing measurements with those of new springs. A new outer spring measures approximately $28\frac{3}{4}$ inches and a new inner spring measures approximately $24\frac{3}{4}$ inches.

(2) Check piston, rod guide collar, rod guide, and spring heads for excessive wear and remove all burrs.



RA PD 79911

Figure 136 — Counterpoise Springs and Rod — Exploded View

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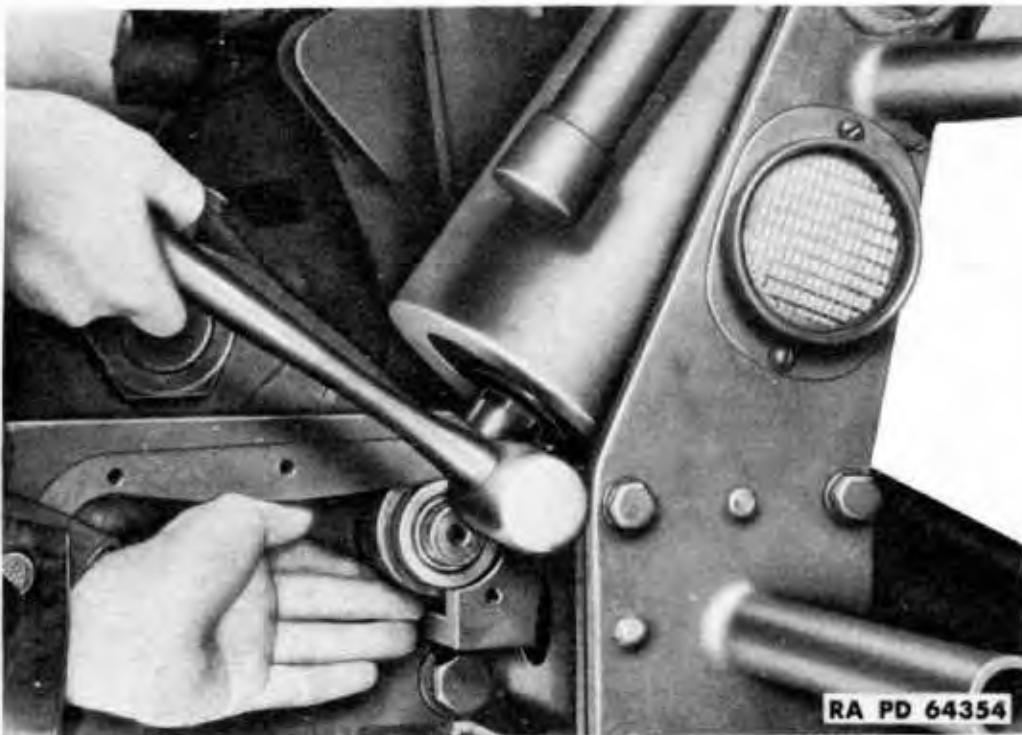


Figure 137 — Installing Counterpoise Rod Pin in Bearings

(3) Examine counterpoise rod for evidence of binding which might indicate that rod is bent. Straighten or replace bent rod.

(4) Lubricate all internal parts with a light coating of GREASE, O.D., No. 0, above +32 F, or GREASE, O.D., No. 00, below +32 F before assembling.

c. Assembly.

(1) Place counterpoise rod guide and rod guide collar in bottom of cylinder.

(2) Install piston head, outer spring, and inner spring, and see that both springs seat properly.

(3) Place spring head in upper end of inner spring and place piston in outer spring.

(4) Install spring compressor rod through upper end of cylinder and place thrust bearing and nut on lower end of rod.

(5) Compress springs until piston is $2\frac{3}{4}$ inches below top of cylinder; then install spacing collar and replace counterpoise cover. Tighten securely.

(6) Remove spring compressor tool and check the alignment of openings through which counterpoise rod is to be installed; correct any misalignment with a round bar.

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RA PD 5773

Figure 138 — Adjustment of Counterpoise Spring

(7) Pivot cylinder to horizontal position and install rod, guiding it through the spring head and piston, with a screwdriver.

(8) Place a rod bearing on the rod pin so that the end of the pin extends through the bearing, and lower the rear end of counterpoise cylinder, positioning rod eye in axle bracket. With outer bearing in position on pin as described above, install pin and bearing, inserting pin in eye of rod. Place the other bearing behind rod and hold in position while tapping pin in place with 2-pound hide face hammer (fig. 137).

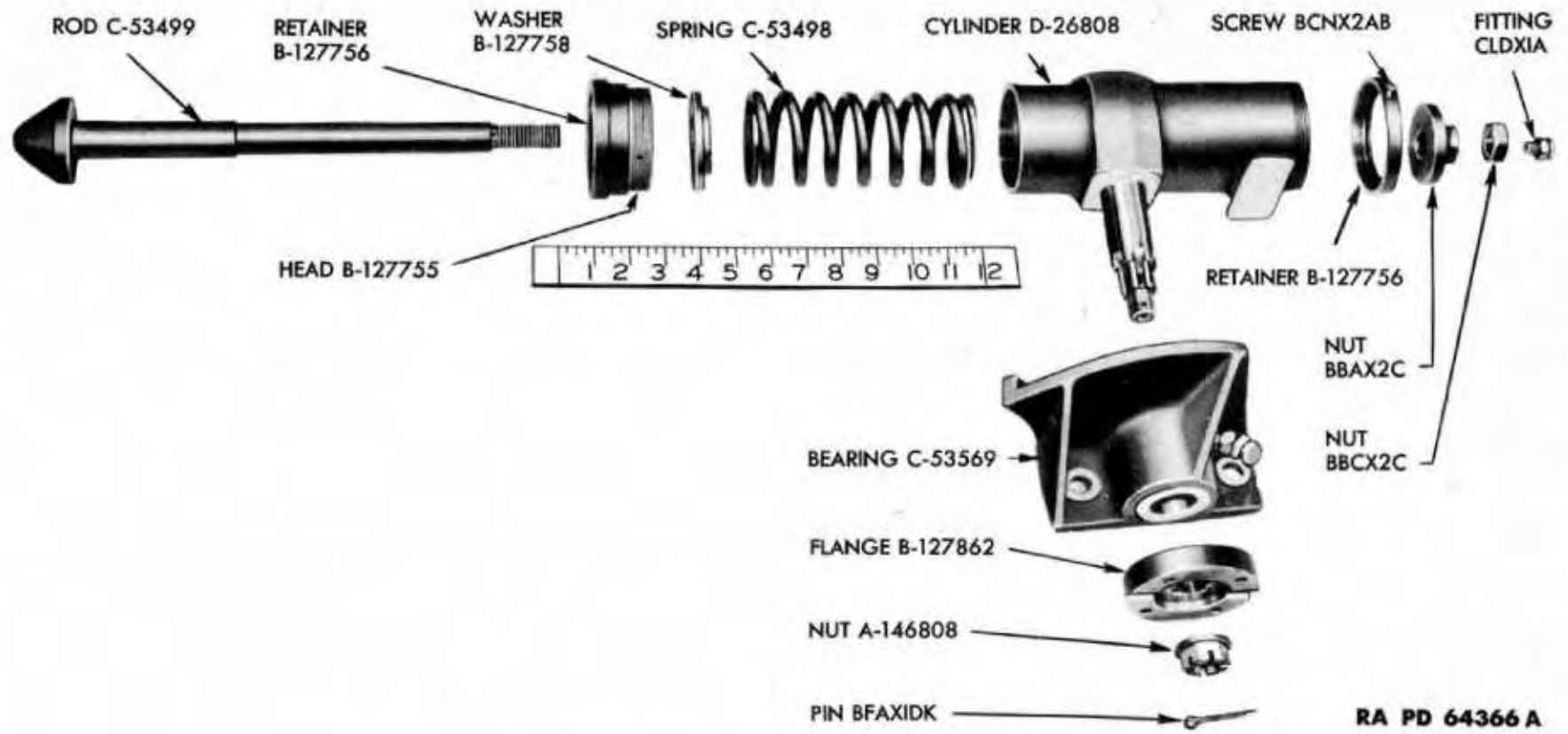
(9) Install axle bracket cover and secure with five screws and lock washers.

(10) Install counterpoise rod nut and lock nut and compress springs sufficiently to relieve pressure on spacing collar; then remove cylinder cover and lift out collar.

(11) Replace cover and tighten securely. Tighten $\frac{1}{4}$ -20 socket-head set screw.

(12) Adjust counterpoise rod nut and lock nut until same number of threads are exposed as were visible before disassembly.

NOTE: This method of adjusting can be used only when the same springs have been reinstalled. In the event a new spring has been installed, final adjustment should be made while lowering and raising carriage. Adjustment should be such that carriage (with gun mounted)



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Figure 139 — Carriage Buffer Assembly — Exploded View

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will descend to the ground without undue force and enable it to be lifted to traveling position with one man at each wheel.

(13) After final adjustment is obtained, lock counterpoise rod nuts securely (fig. 138), and install the dust guard. For adjustment procedure, see paragraph 73 i.

90. BUFFER ASSEMBLIES (fig. 139).

a. Replacement of Buffer Spring.

- (1) Place carriage in firing position.
- (2) Remove two cap screws, nuts, and lock washers from buffer cylinder bearing, using $\frac{3}{4}$ -inch wrench on the head and a $1\frac{5}{16}$ -inch wrench on the nut.
- (3) Remove four cap screws and lock washers from buffer shaft, which secure buffer flange to buffer cylinder bearing.
- (4) Remove cotter pin from buffer cylinder shaft, and remove buffer cylinder stud nut. Remove buffer cylinder flange.
- (5) Remove buffer unit from buffer cylinder bearing by withdrawing shaft from bearing.
- (6) Remove lubrication fitting and nut, located on top end of buffer cylinder plunger rod.
- (7) Remove the upper of the two screws and washers in the lower end of the cylinder and unscrew the head, in which are secured the lower retainer buffer and bushing.
- (8) Unscrew the retaining nut of the buffer rod. As this nut is released, the spring expands and will push the rod and washer out of bottom of cylinder. If this does not occur, tap the rod down and out of the cylinder. Remove the spring and washer.

b. Inspection.

- (1) Examine the buffer spring for cracks and measure the free length of springs, for a spring that has collapsed, or acquired a "set," will not function properly. A new spring measures approximately 6 inches.
- (2) Inspect all bushings, upper and lower buffers, and shafts for wear. Replace all worn parts.
- (3) Lubricate spring and rod before assembly.
- (4) Check points on axle arms where buffer rod rests. The amount of wear should be about equal for both rear arms and both front arms.

c. Assembly.

- (1) Place head, in which is installed the lower retainer, buffer, and bushing, on the buffer rod. Place washer and spring on buffer cylinder

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Figure 140 — Removal of Wheel

plunger rod. Screw the head into the cylinder and install the set screw in the retainer.

(2) Install retaining nut and locking nut on upper end of rod and screw on the retainer and install set screw. Install lubrication fitting.

d. Installation.

(1) Install bearing on chassis and secure with two cap screws, lock washers, and nuts, using $\frac{3}{4}$ -inch wrench on head of cap screw and $1\frac{3}{16}$ -inch wrench on the nut.

(2) Install cylinder on bearing by thrusting shaft of cylinder through the bearing. Install flange, nut, and cotter pin.

(3) Fit buffer shaft to flange, being careful to index splines of shaft and flange, correctly. Secure with four cap screws, using $\frac{9}{16}$ -inch wrench.

e. Adjustment. A slight adjustment of the buffer cylinder plunger rod is possible, by turning the lock nut and retaining nut on top of rod. Tightening the nuts will compress the spring, while loosening them will expand the spring. The maximum adjustment possible is about an inch. Operate the buffer mechanism from traveling to firing position, and back again. There should be no undue binding of the motion.

91. WHEEL AND HUB ASSEMBLIES.

a. Removal.

- (1) Jack up wheel and support frame of carriage with blocks.
- (2) Remove wheel and tire, taking out five stud nuts for left

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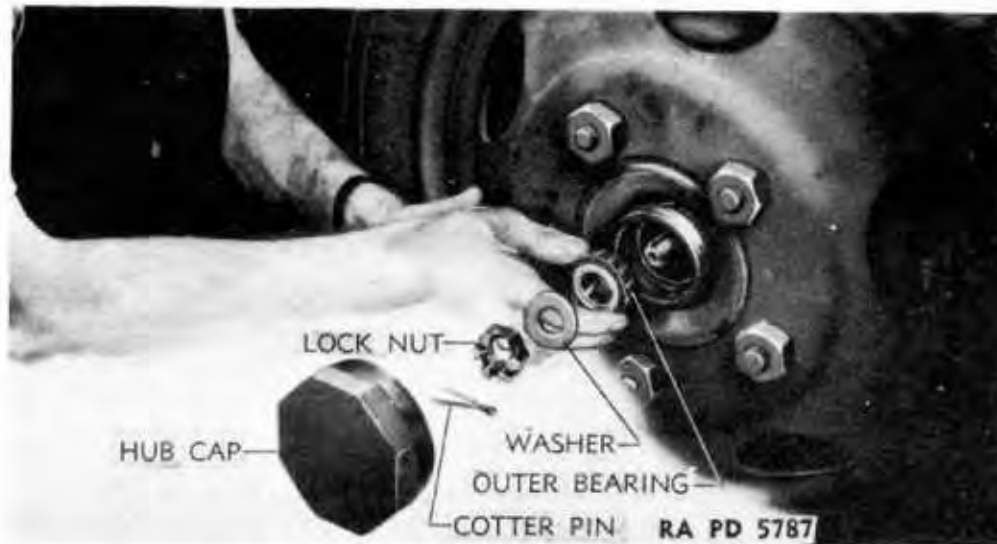


Figure 141 — Removal of Wheel and Brake Drum and Hub Assembly

wheels, and for right wheels (fig. 140). Dismount wheel and tire assembly as one unit. (Wheel studs have right-hand threads on right side of carriage and left-hand threads on left side of carriage.)

(3) Remove hub cap, using hub cap wrench. All four hub caps have right-hand threads.

(4) Remove cotter pin from hub retaining nut and unscrew nut from spindle. Remove safety washer.

(5) Remove hub part away from spindle assembly and remove outer bearing cone. Remove hub and drum assembly.

(6) The wheel and hub may also be removed together as shown in figure 141.

b. Disassembly. Remove inner bearing cone from spindle, using two thin pry bars or heavy-duty screwdrivers to pry off bearing. Bearing cone is a light press fit on spindle.

CAUTION: Use extreme care in removing bearing cone assembly to avoid damaging the bearing or grease retainer behind bearing.

c. Inspection.

(1) Examine hub assembly and inspect for worn, cracked, or broken bearing outer races.

(2) Inspect bearings and clean by flushing in SOLVENT, dry-cleaning. Protect them from dirt until installed.

d. Assembly.

(1) Lubricate and install inner bearing cone on wheel spindle and press or tap into position, using brass drift.

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NOTE: Coat inside of hub and spindle with a $\frac{1}{16}$ -inch coat of grease to prevent rusting.

(2) Place hub assembly in position on wheel spindle, lubricate and replace outer bearing cone, lock washer, and nut, but do not tighten.

(3) Replace wheel and tire assembly on hub, installing five stud nuts for left wheels and for right wheels, and tighten securely.

(4) Adjust wheel bearings, turning hub retaining nut until bearings are tight and wheel cannot be shaken by hand but can be rotated free without binding. There should be no looseness in bearings. Install cotter pin in retaining nut, replace hub cap, and tighten with hub cap wrench.

(5) Lower wheel to ground and check stud nuts, drawing them even and tight.

Section IX

SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGES M3 AND M3E1

92. ARRANGEMENT OF SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGES M3 AND M3E1.

a. The principal sighting device for the Carriages M3 and M3E1 is the Sighting System M2. This system is used for direct aiming at aircraft or ground targets.

b. The sighting system includes two tracking telescopes mounted to move with the gun in azimuth and elevation. The azimuth and elevation handwheel operators follow the target through these telescopes, pointing the gun as required to keep the target centered on the cross lines in the telescope.

c. To avoid damage to the electrical units when practicing with the director, perform one of the following steps:

(1) Energize the oil gears of the gun and practice with the gun under direct control.

(2) Disengage the clutch on the elevation oil gear, turn on power on that gear, and throw in the slewing handle of the gun (in order to protect the azimuth oil gear and the azimuth indicator unit).

d. Lateral and vertical deflections are determined by observation of the tracer stream during fire. The deflections are then applied to the gun by means of the Antiaircraft Automatic Gun Control Equipment Set M1. The effect is to shift the tracking telescopes laterally or vertically, so that when the operator brings the telescope cross lines

SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGES M3 AND M3E1

back onto the target, the gun will have been moved the necessary amount. The control equipment set is described in FM 4-151.

e. The control equipment set operates the telescope lateral and vertical deflection mechanisms through flexible shafts which connect to couplings in the carriage chassis. A 360-degree drive mechanism is provided in the carriage to prevent twisting of these flexible shafts as the gun is traversed.

f. A gunner's quadrant is provided for use in performing adjustments involving measurement of gun elevation.

93. BORE SIGHT.

a. The bore sight is used to indicate the direction of the axis of the bore of the gun, for alinement and verification of sights. Each bore sight is composed of a breech element and a muzzle element.

b. Description.

(1) The breech bore sight is a disk which fits accurately in the breech chamber of the gun. It is provided with a handle for ready insertion and removal. In the event that a manufactured breech bore sight is not available, an empty 37-mm cartridge case may be substituted after removing the primer from the case.

(2) The muzzle bore sight includes a quantity of black linen cord, to be stretched tightly across the muzzle vertically and horizontally in the witness lines (score marks) thereon, and a web belt to be buckled around the muzzle to hold the cord in place. In the event that black linen cord and a web belt are not available, any kind of small cord or string may be used and held in place by a small quantity of grease placed in appropriate places around the muzzle.

c. Operation.

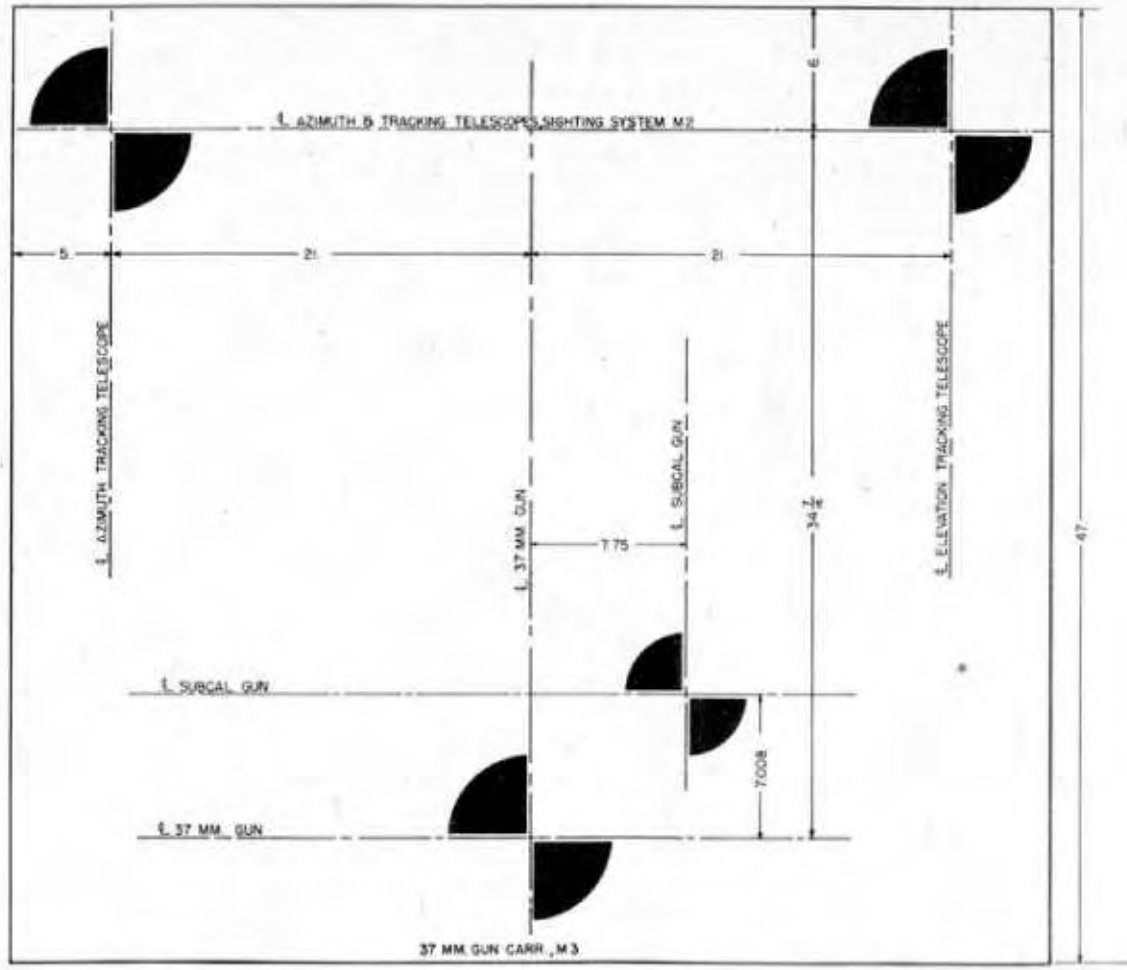
(1) Remove the back plate and the lock frame. Place the breech bore sight in the breech opening. Insert the muzzle bore sight.

(2) Look through the aperture in the breech bore sight; the direction of the axis is indicated by the center point of the muzzle bore sight.

d. **Care and Preservation.** Handle the breech bore sight carefully to prevent nicks and burs. Wind the cord and web belt into a compact bundle when not in use.

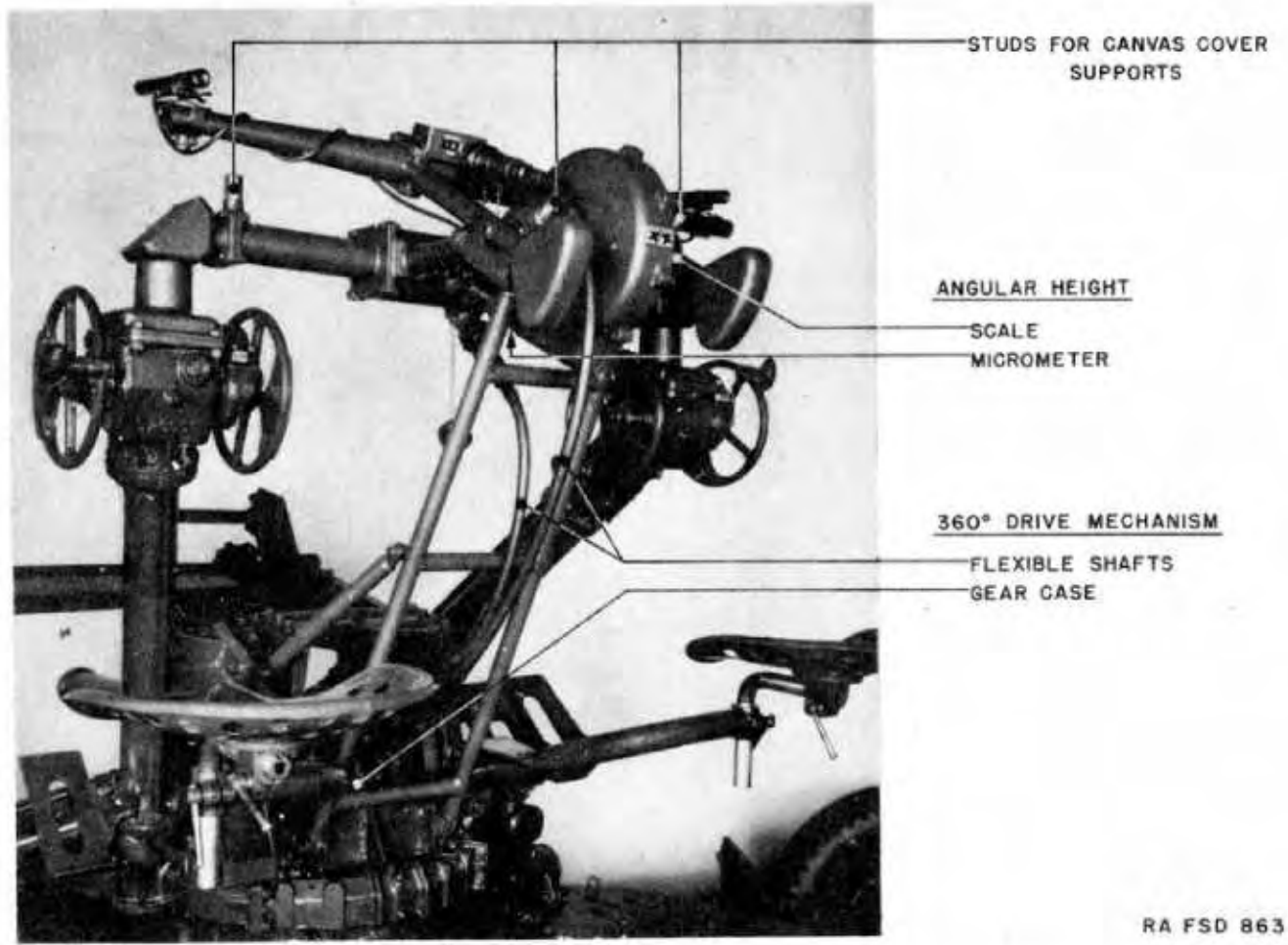
94. TESTING TARGET.

a. A testing target (fig. 142) is designed for use with this materiel. When available, it may be used instead of an extremely distant object for alinement and verification of sights. Instructions for its use are given in paragraph 96 a (4).



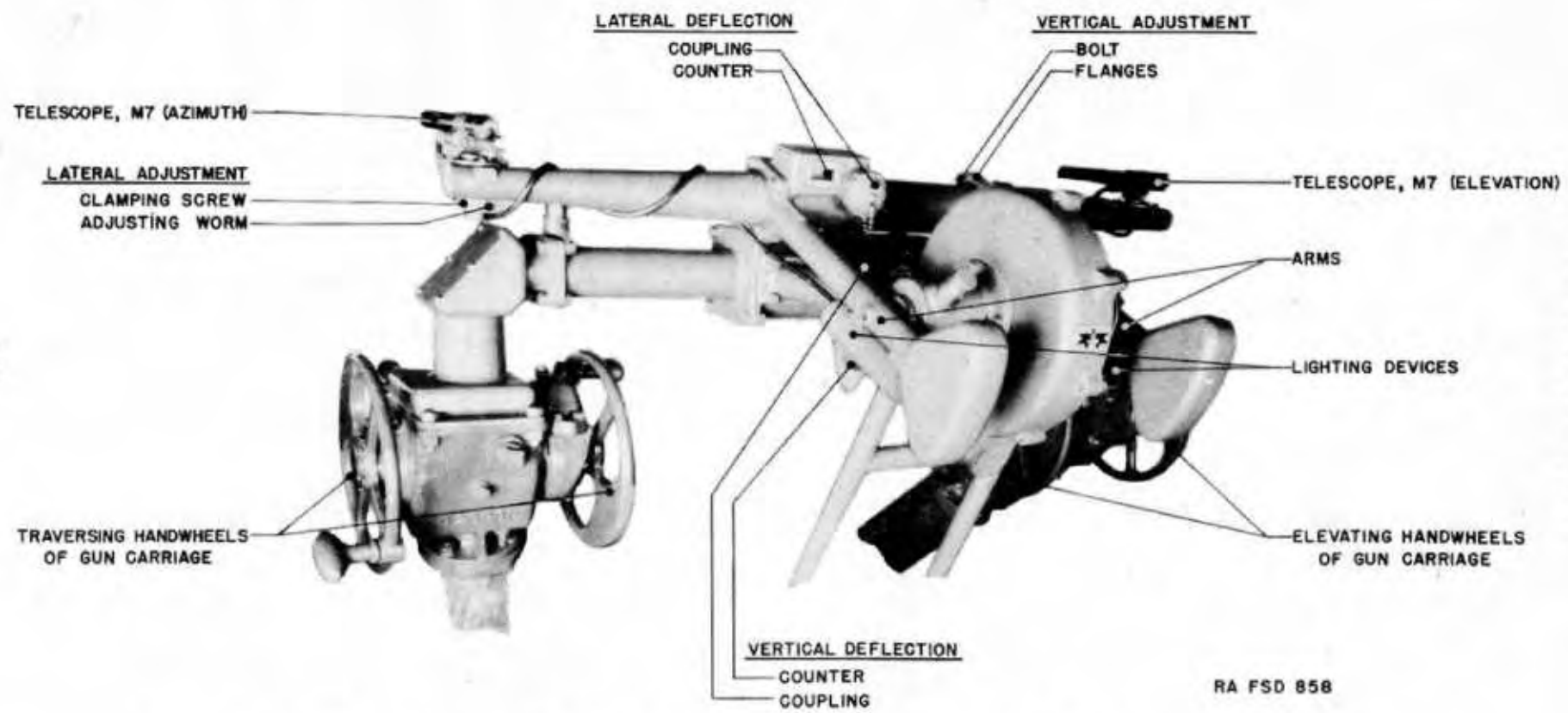
RA PD 5728

Figure 142 — Testing Target for Sighting System M2



RA FSD 863

Figure 143 — Sighting System M2 With Telescopes M7



RA FSD 858

**Figure 144 — Sighting System M2 With Telescopes M7 — Location of Controls and Adjustments —
360-Degree Drive Mechanism not Shown**

**SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGES
M3 AND M3E1**

95. SIGHTING SYSTEM M2.

a. One Sighting System M2 (figs. 143 and 144) mounting two Telescopes M7, is provided on each 37-mm Automatic Gun Carriage M3, and is the means by which the gun is aimed in direction and elevation. The necessary settings of lateral and vertical deflection are introduced by means of the flexible shafts from the control equipment set through couplings in the carriage chassis.

(1) **DESCRIPTION OF SIGHTING SYSTEM.**

(a) The rear portion of the system is supported by a framework attached to the carriage and the forward portion rests on the elevating and traversing handwheel brackets.

(b) The two telescope holders, mounted on horizontal supports, are positioned laterally by means of the lateral deflection mechanism driven from the associated motion of the control equipment set.

(c) The telescopes, supports, and associated parts are positioned in elevation by means of counterweighted arms. These arms are driven by a differential gear, which combines the motions received from the elevating drive of the carriage and from the vertical deflection mechanism of the control equipment set.

(d) The values of the lateral and vertical deflection settings are indicated on counters. With "normal" deflection settings (500-mil indications on both counters), the line of sight is alined with the bore of the gun. When deflections are introduced, both lines of sights are offset accordingly, still remaining parallel to each other. Lateral deflections are measured in the slanting plane through the target.

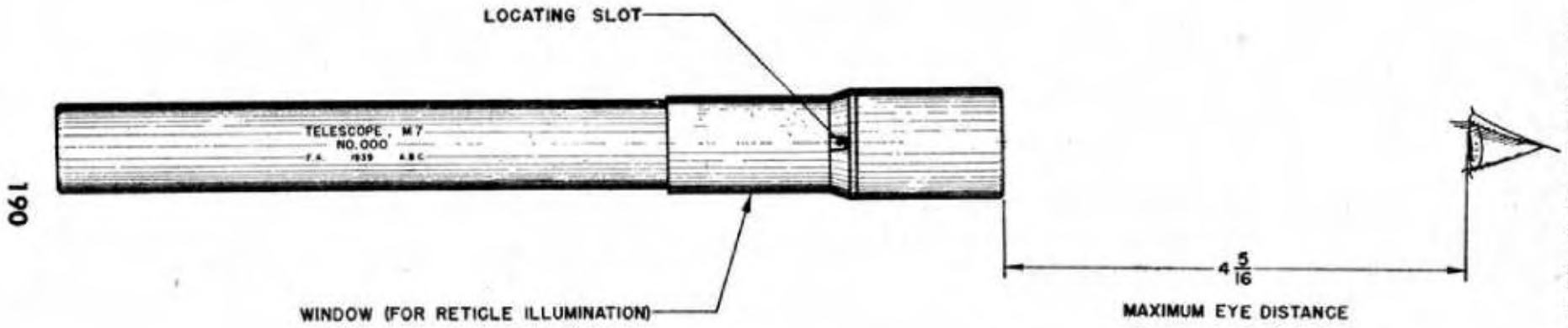
(e) Each telescope is clamped in a holder from which it is readily removed for horizontal positioning of the reticle lines.

(f) A 360-degree drive mechanism is provided to prevent twisting of the flexible shafts as the gun is traversed. This mechanism includes a gear case with four flexible shafts. Two of the shafts connect to the deflection mechanisms of the sight, and the other two shafts terminate in couplings mounted on the carriage to which the flexible shafts of the control equipment set may be connected. The gear case, centrally mounted in the base of the carriage, contains differential gears which separate the motion of the deflection settings from the traversing of the mount. Unlimited traversing of the carriage is thus made possible.

(2) **DESCRIPTION OF TELESCOPE M7.**

(a) This is a 1-power erecting telescope (fig. 145) having a comparatively long eye distance (over 4 inches) and narrow field of view (11 deg).

(b) The horizontal and vertical telescopes present slightly different reticle patterns. Each reticle has a vertical and horizontal line,



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Figure 145 — Telescope M7

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centrally located, with one line broken near the intersection. In each case, the locating slot of the telescope is positioned so that the broken line is the line not required for tracking.

(c) A dust cap, which consists of a leather cap for each end, connected by a strap, is provided for each telescope. One packing chest furnished with padlock and keys, with compartments for both telescopes, is provided for each carriage.

(d) The lighting device provided for each telescope includes a metal tube containing two standard flashlight cells, a switch, and a flexible cord with plug to fit in the lamp socket of the telescope holder. The metal tube snaps into a sleeve on the arm of the sighting system.

(3) OPERATION.

(a) To place the system in operation, remove the canvas cover. Withdraw the pins and remove the cover supports from the studs. Remove the covers from the couplings in the front of the base of the carriage and turn the couplings so that both deflection counters indicate "normal" (500 mils). Set the control box to "normal" and connect the flexible shafts between the corresponding couplings of the control box and the sighting system. Clamp the Telescopes M7 in their holders. The dust caps may be left on the telescopes until the system is ready for use. When necessary, illuminate each reticle by closing the switch in the front end of the lighting device.

(b) Operate the traversing and elevating handwheels of the mount so that the target appears continuously at the centers of the reticles.

(c) To place the system in traveling position, remove the Telescopes M7 from their holders, put on the dust caps, and place the telescopes in the packing chest. Be certain that the lighting device switches are turned to "OFF"; the "OFF" position of each is plainly marked. Place the cover supports on their studs and insert the pins to hold them in place. Put on the canvas cover.

(4) DISASSEMBLY AND ASSEMBLY.

(a) The main operation performed by the using arms are the application and removal of the cover supports; the insertion and removal of the telescopes, incident to normal use; the removal of counters for adjustment; and the removal and replacement of covers and screws for lubrication. The only other assembling and disassembling operations performed by the using arms are those necessary to renew the lamps or dry cells of the lighting device.

(b) To replace the dry cells, grasp the cap at the forward end of the lighting device and pull it forward, removing the tube containing the dry cells from the cylindrical sleeve on the arm. Unscrew the tube and replace the dry cells, placing both cells with their central terminals

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toward the cap. Use two standard flashlight battery cells, type BA-30. Screw the tube into the cap and replace it in the sleeve on the arm.

(c) To replace a lamp, remove the plug on the flexible cord from the lamp socket; then unscrew the socket, rendering the lamp accessible. Replace the lamp, using a standard No. 14 screw-base flashlight lamp, and return the socket and plug to their original positions.

96. TESTS AND ADJUSTMENTS OF SIGHTING SYSTEM M2.

a. The alinement of the sighting system should be verified frequently and adjusted if necessary.

(1) **ALINEMENT OF TELESCOPES WITH EACH OTHER.** The optical axis of both telescopes should be parallel at all elevation and deflection settings. Checks should be made with a number of combinations of these settings within the operating range by sighting on a celestial body or other extremely distant object. The left-hand telescope is adjustable laterally by means of the adjusting worm, the clamping screw first being temporarily loosened. The right-hand telescope is adjustable vertically at the point where the support flange is mounted; the bolts have sufficient clearance for this adjustment and may be temporarily loosened for this purpose. (Should the limit of adjustment at this point be reached, the flange on the left-hand side may be adjusted similarly.) When making these adjustments, approach the point from each direction and adjust for the minimum average error.

(2) **ALINEMENT OF TELESCOPES WITH THE BORE.** The optical axes of both telescopes having been alined with each other as described above, their alinement with the bore may then be checked by bore sighting. Place the bore sights in the gun and bore sight on a celestial body or some object 2,500 yards or more from the gun position. In this process of bore sighting, the axis of the bore is laid on the bore sighting point by means of the tracking handwheels, and the lateral and vertical sights are brought on the point by turning the flexible shafting which is attached to the sights. When this process is completed, the vertical and lateral deflection counters should read "normal" or "500." If they do not and time allows, they should be set to read "500" by removing the frame (vertical counter) or cover plate (lateral counter) and turning the counter pinion until the reading "500" is obtained. If time does not allow the adjustment of the deflection counters, the reading of both counters may be taken down on a memorandum pad for future reference. The purpose of the "500" or normal adjustment of the deflection counters or, at least, the making of a memorandum of the reading of the counters when the gun is bore sighted, is to move the gun laterally and vertically until the counters indicate that reading, and then to consider the gun

SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGES M3 AND M3E1

bore sighted and ready for connection to the control box. This would be done at some future time in case it was necessary to emplace the gun quickly and no time was available for bore sighting. When the lateral counter is set above "500," the gun should point to the right of the sights. When the vertical counter is set above "500," the gun should point above the axis of the sights. Set the lateral and vertical deflections to "normal" (500), approaching each, first in one direction then in the other, and adjust the counters so that the "500" indication occurs when the mean position of the cross lines is on the object. When the lateral counter is set above 500, the gun should point to the right of the sights. When the vertical counter is set above 500, the gun should point above the axis of the sights. To adjust a counter, remove the frame (vertical counter) or cover plate (lateral counter), with the counter assembled to the under side, turn the counter pinion until the desired reading is indicated and replace, taking care to mesh the gearing properly. The screws in the frame or cover plate may be temporarily removed by the using arms for making this adjustment.

(3) **ADJUSTMENT OF ANGULAR HEIGHT INDICATIONS.** Although not ordinarily used in the operation of the sighting system, an angular height scale and micrometer are included (with system of early manufacture only). To verify these indications, level the carriage, set the lateral deflection to "normal," and sight on a datum point of known angular height. The indication on the angular height scale (100-mil steps) and micrometer (1-mil steps) should agree with the angular height of the datum point; if not in agreement, the scale may be offset, after temporarily loosening the screws in its elongated holes and the micrometer may be shifted after temporarily loosening the screws in the clamping disk. In the absence of a datum point of known angular height, the vertical deflection may be set at "normal" and the gun elevation, measured by a gunner's quadrant, used instead.

(4) **USE OF TESTING TARGET.** If a testing target is available, it may be used for alinement and verification of sights in lieu of an extremely distant object or celestial body. Level the carriage, depress the gun to zero elevation using a gunner's quadrant, and place the bore sights in position. Maintaining the target vertical in a plane perpendicular to the axis of bore at least 50 feet distant from the gun, place the testing target so that the axis of the bore falls on the corresponding aiming point of the target. Set the vertical and lateral deflections to "normal" (500 mils), approaching the setting first in one direction, then in the other. Should the target aiming points fail to appear at the centers of their respective telescope reticles, or the angular height scale and micrometer fail to indicate zero, the adjusting procedure outlined in preceding paragraphs is to be followed.

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97. CARE AND PRESERVATION OF SIGHTING SYSTEM M2.

a. General Precautions.

(1) This sighting system is rugged and suited for the purpose for which it has been designed. It will not, however, stand rough handling or abuse, and inaccuracy or malfunctioning will result from such mistreatment.

(2) Disassembly and assembly by the using arms is permitted only to the extent specifically authorized herein. Unnecessary turning of screws or other parts not incident to the use of the system is expressly forbidden.

(3) Keep the system in the condition indicated for traveling when not in use.

(4) Be certain that both sighting system and control box are set to "normal" before connecting flexible shafts unless there is not time to set the counters on the gun to normal after bore sighting or in case certain settings of the counters are being used in lieu of bore sighting the gun.

(5) Stops are provided limiting the motion of the system in angular height. Avoid any attempt to travel past these stops as injury to the flexible shafts may result.

b. Lubrication.

(1) Ball bearings and worm drives are lubricated at assembly. Further lubrication of these will be required only at long intervals, and is performed by ordnance personnel.

(2) Keep the flexible shaft casings free from oil.

(3) The following elements will require the occasional application by the using arms of a few drops of oil:

Element	Means of Access
Elevating drive.	Remove screw in sloping cover above elevating handwheel bracket.
Vertical deflection drive.	Remove cover on front, ahead of vertical deflection coupling and counter.
Lateral deflection drive.	Remove screw in housing, ahead of lateral deflection coupling and counter.
360-degree drive mechanism.	Remove top cover.
Counter drive.	Remove counters, as for adjustment. (Check indications when replacing.)
Couplings for flexible shafts.	Remove covers.

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c. **Lighting Devices.** Remove the flashlight battery cells whenever the lighting devices are not in use. Chemical reaction set up in the cells as they become exhausted will cause the cells to swell, thereby making removal difficult and damaging the battery tube.

d. **Telescopes.** To obtain satisfactory vision, it is necessary that the exposed surfaces of the lenses and other parts be kept clean and dry. Corrosion and etching of the surface of the glass, which greatly interfere with the good optical qualities of the instrument, can be prevented or greatly retarded by keeping the glass clean and dry. See paragraph 65 for instructions for cleaning glass surfaces.

Section X

SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGE M3A1

98. ARRANGEMENT OF FIRE CONTROL AND SIGHTING EQUIPMENT FOR CARRIAGE M3A1.

a. This fire control equipment is designed to operate as a coordinated system under the conditions encountered in short range anti-aircraft fire on fast moving targets.

b. Gun pointing data originate at the Antiaircraft Director M5 or M5A1. The director determines the target position in space from the angular position of two tracking telescopes with which the operators follow (track) their target, one telescope giving the horizontal position or azimuth, and the other telescope giving the vertical angle or elevation. Ranges are estimated by the range setter at the director and may be adjusted quickly from observation of the tracer stream during fire. Smooth and accurate tracking at high angular rates of travel is made possible by use of a system of tracking known as aided tracking. The director produces firing azimuth (angle of train) and quadrant elevation data for transmission to the gun. The anti-aircraft director is described in TM 9-659.

c. The Remote Control System M1 points the gun in azimuth and elevation according to the controlling data furnished from the director. The system includes electrical and hydraulic power equipment (oil gears) mounted on the carriages and connected to the traversing and elevating mechanisms. The generating unit is described in TM 9-616.

d. Electric power to operate the director and the power mechanisms for remote gun control is supplied by either Generating Unit M5 or M6.

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e. The Sighting System M5 provides an emergency system of fire control in the event that some part of the remote control system fails to function, or in the event that the director or power plant does not function properly. The sighting system may be used in the engagement of either aerial or ground targets. The director can be used in the engagement of ground targets if the elevation cut-out stop on the gun is adjusted so that the gun will depress below zero degree and if the director is operated by direct tracking.

f. A gunner's quadrant is provided for use in performing adjustments involving measurement of gun elevation.

99. REMOTE CONTROL SYSTEM M1.

a. General.

(1) The Remote Control System M1 (figs. 146, 147, and 148) is an electrically controlled hydraulic power system designed for use with the 37-mm Antiaircraft Gun Carriage M3A1. It is controlled by the Antiaircraft Director M5 with power supplied from the Generating Unit M5 or M6. The function of the remote control system as a whole is to point the gun accurately in azimuth and elevation according to the output data supplied from the antiaircraft director. This type of control is known as "remote gun control."

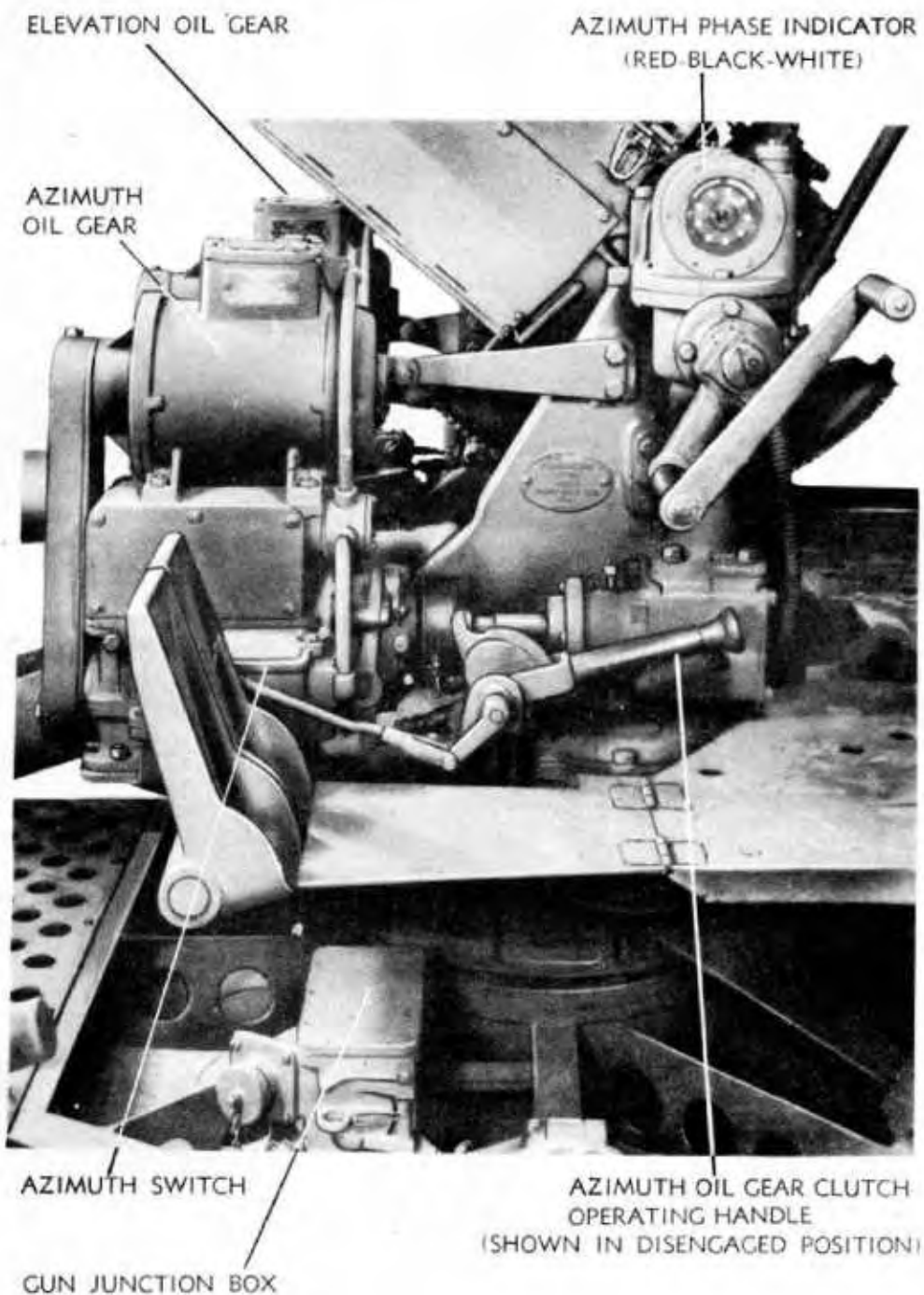
(2) Two oil gear units, one for azimuth and one for elevation, supply controlled driving power for traversing and elevating the gun. The gun must be brought into approximate alinement with the director before the oil gear may be engaged, but once the oil gear is engaged, the gun will follow the director accurately. Approximate alinement of the gun with the director is shown by an azimuth phase indicator (with "red-black-white" dial) (fig. 173) mounted on top of the azimuth gear box. The oil supply in these oil gear units has to be replenished from time to time, and since the guns are often operated at points removed from the remainder of the battery, thereby being removed from the battery supply of oil, it is considered necessary that each gun be provided with 1 quart of OIL, hydraulic, to be requisitioned through normal channels. One quart of OIL, hydraulic, per gun for each battery should be maintained as an "on-carriage" item at all times.

(3) The system permits continuous tracking in azimuth, but is limited in elevation by an elevation limit switch which automatically goes to "OFF" before the mechanical limit stops are reached.

b. Description.

(1) The major components are the Oil Gears M1 and the Wiring Set M3. The Wiring Set M3 includes the gun junction box, the contact ring, the azimuth phase indicator, and other on-carriage wiring,

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RA PD 17076

Figure 146 — Remote Control System M1 — Azimuth Side

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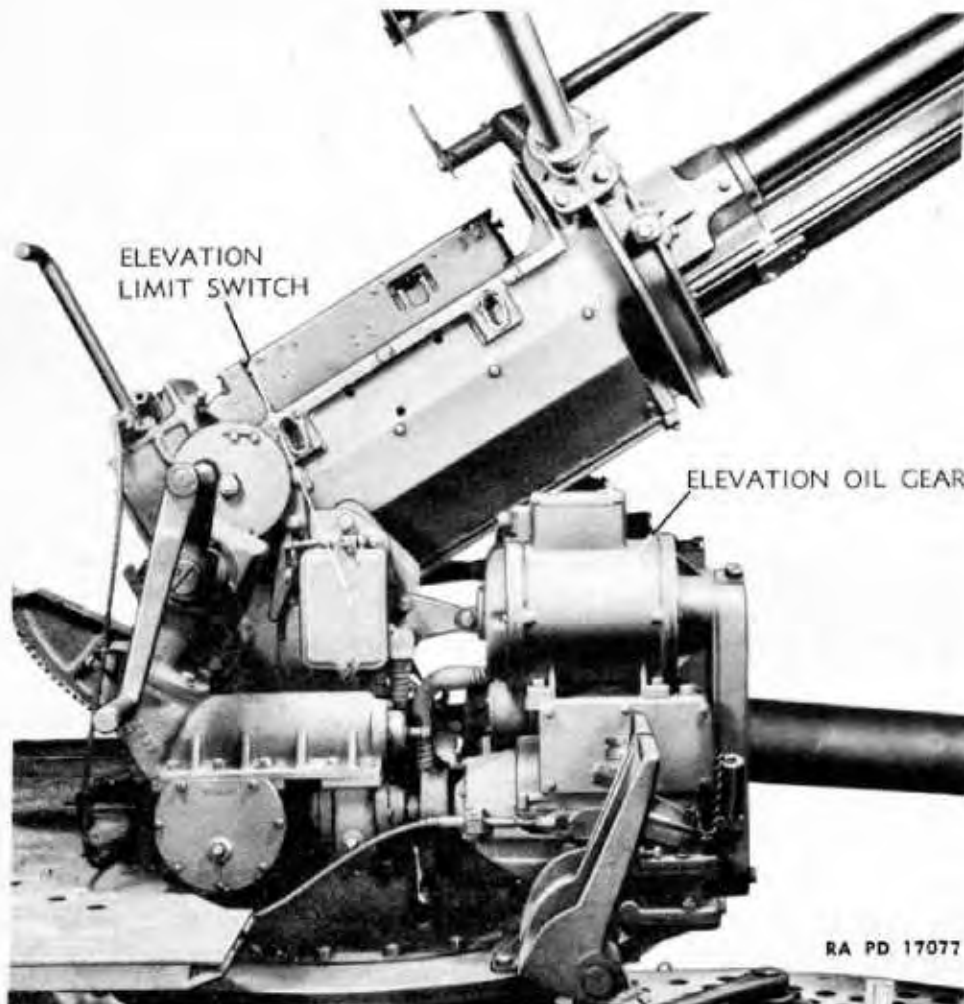


Figure 147 — Remote Control System M1 — Elevation Side

but does not include the oil gears. Cable connections from the director and generating unit are made to the gun junction box (fig. 149) on the carriage chassis. Electrical connections pass to the top carriage through the contact ring, which permits traversing the gun without kinking or twisting the external connecting cables.

(2) The Cable System M8 (fig. 150) includes the off-carriage cables required for connecting the director and generating unit.

(3) Two Oil Gears M1 are mounted on the top carriage. The elevation oil gear is on the right front portion, and the azimuth oil gear on the left front portion of the top carriage. Each oil gear (fig. 154) is a weathertight assembly consisting of an electric motor at the top,

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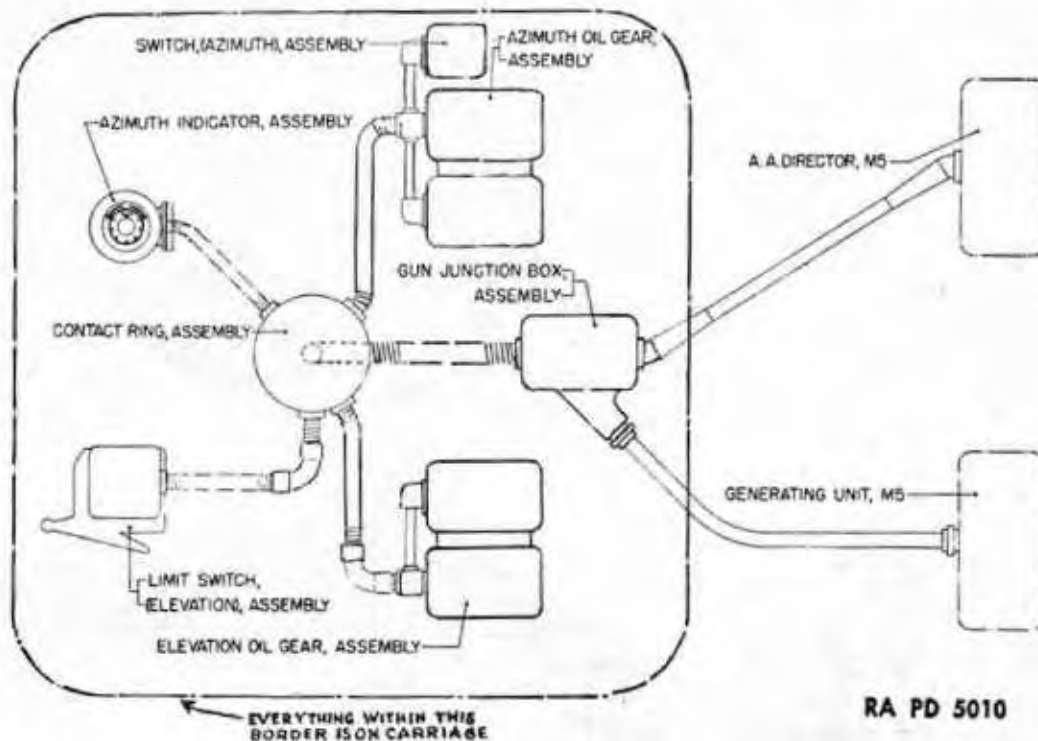
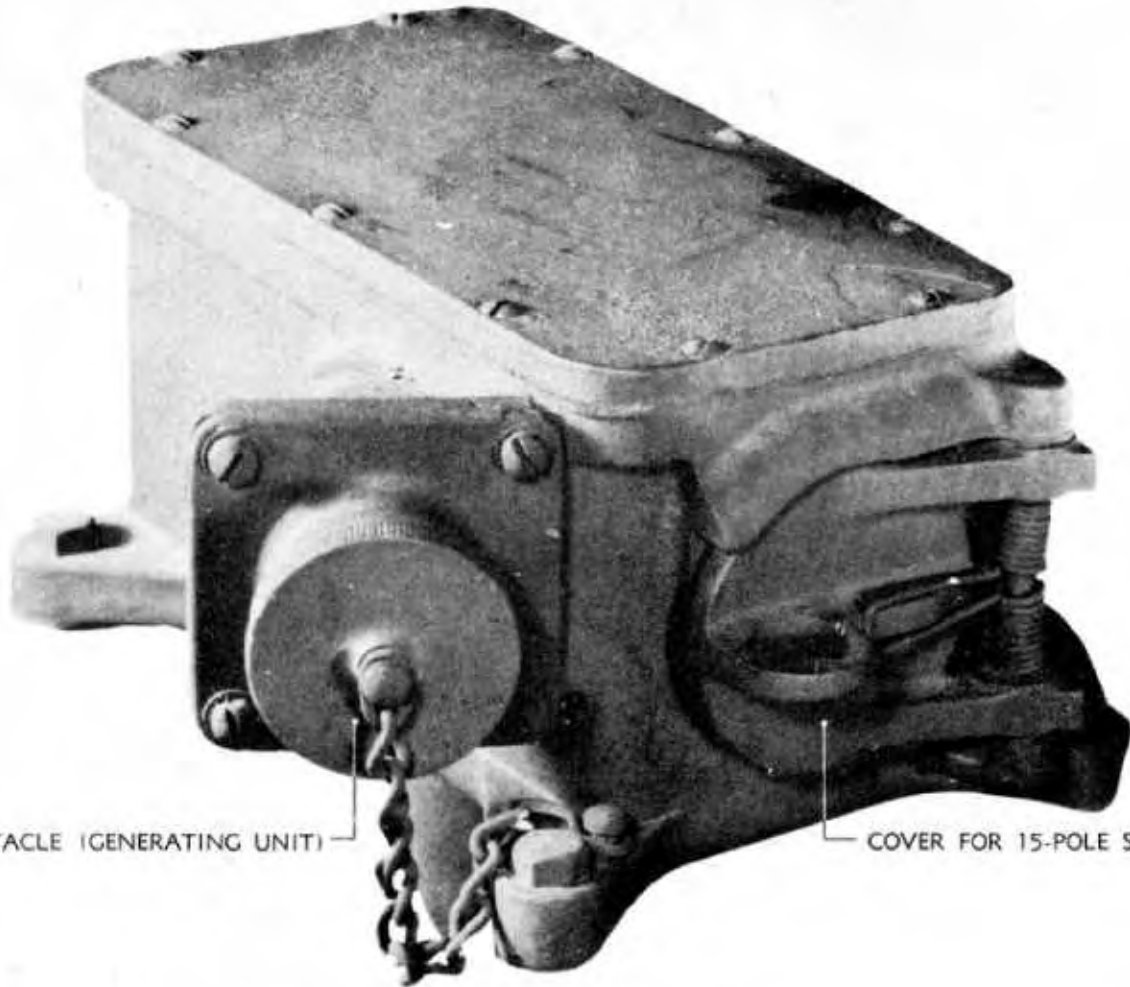


Figure 148 — Remote Control System M1 — Arrangement of Components

then an electrical control unit, and at the bottom, an oil pump and oil motor in a single housing. The electric motor drives the oil pump through a chain drive enclosed in an oiltight housing. The electrical control unit operates a sensitive valve which controls the flow of oil to the oil motor. The lower rear portion of each oil gear houses a clutch mechanism for disengaging or engaging the oil gear to the gun maneuvering mechanism. The clutch is engaged when the top of the clutch lever is in the forward position.

(4) The clutch lever and power switch (azimuth switch) of the azimuth oil gear are both connected to the clutch operating handle of the gun carriage (fig. 151); the clutch is engaged and the switch is "ON" when the operating handle is in the forward position. The clutch lever and power switch (elevation limit switch) of the elevation oil gear operate independently of each other. The elevation oil gear clutch lever is operated directly by hand and has an auxiliary lever located behind the clutch lever which locks the clutch lever in either "IN" or "OUT" position. The clutch is disengaged when the top of the lever points toward the coupling and engaged when the top of the lever points away from the coupling. The power switch (elevation limit switch) is mounted on the gun trunnion and is arranged to trip automatically at the upper and lower elevation limits (fig. 152).

(5) The azimuth phase indicator (fig. 153) is used as an alignment indicator when synchronizing the gun with the director, after



COVER FOR 3-POLE RECEPTACLE (GENERATING UNIT)

COVER FOR 15-POLE SOCKET (DIRECTOR)

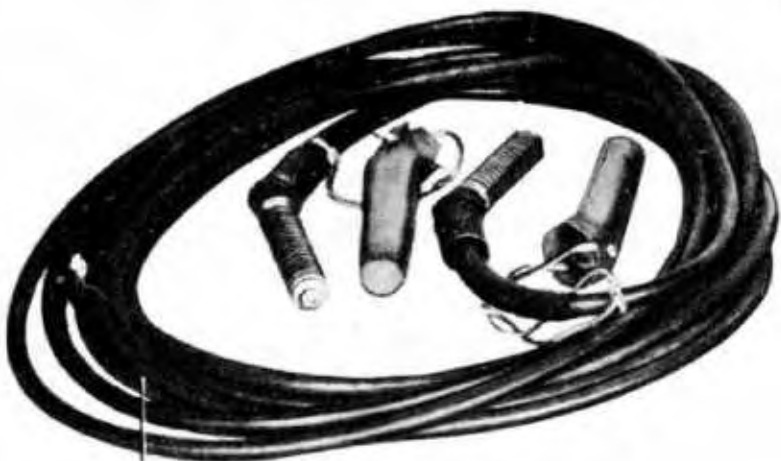
RA PD 7109

Figure 149 – Gun Junction Box

RA PD 40155

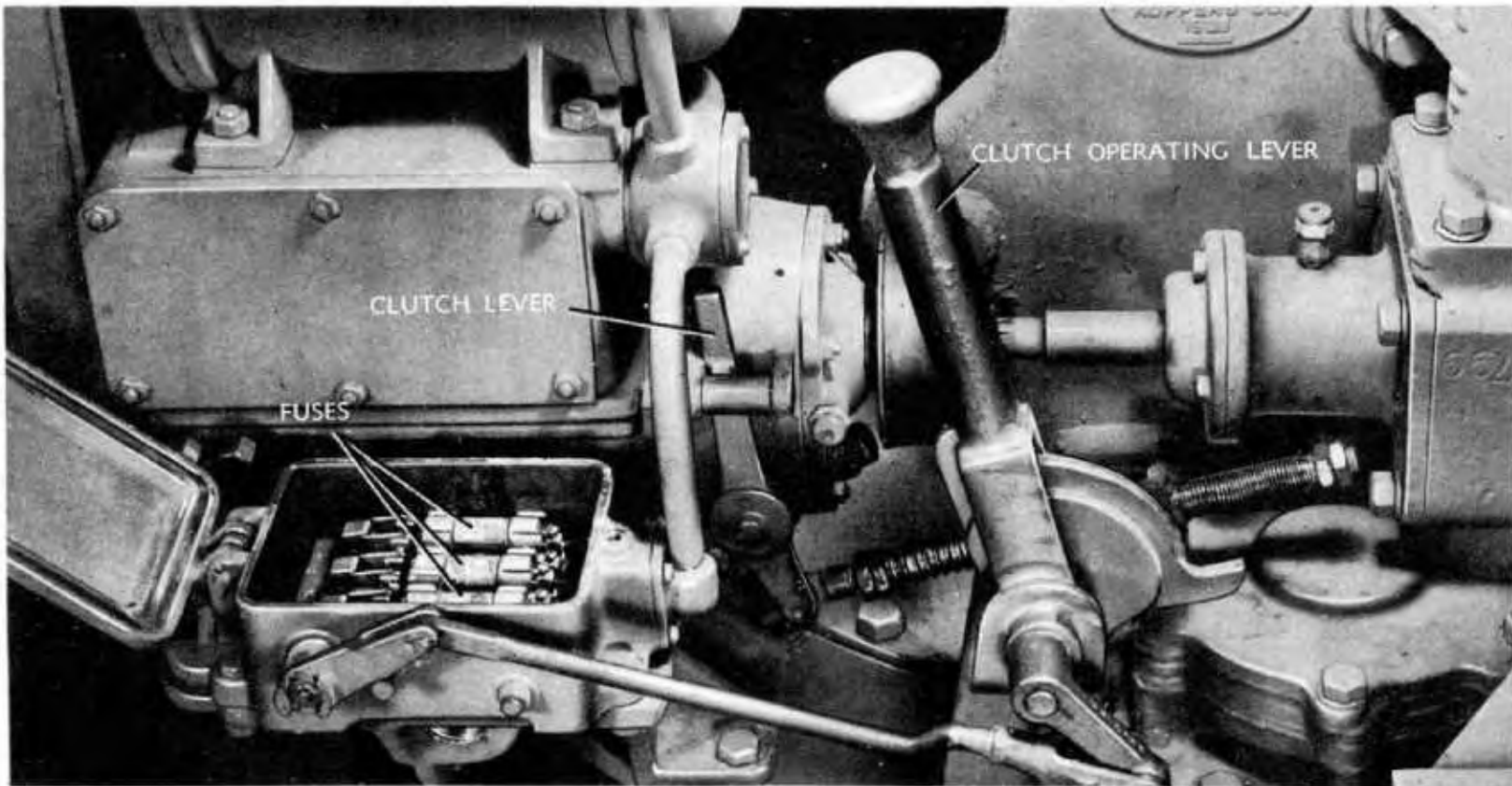


CABLE (3 COND), ASS'Y - C78180



CABLE (15 COND. AND PLUG), ASS'Y - D43665

Figure 150 — Off-carriage — Cable System M8



RA PD 39517

Figure 151 — Azimuth Oil Gear Clutch Operating Lever and Switch Fuses

SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGE M3A1

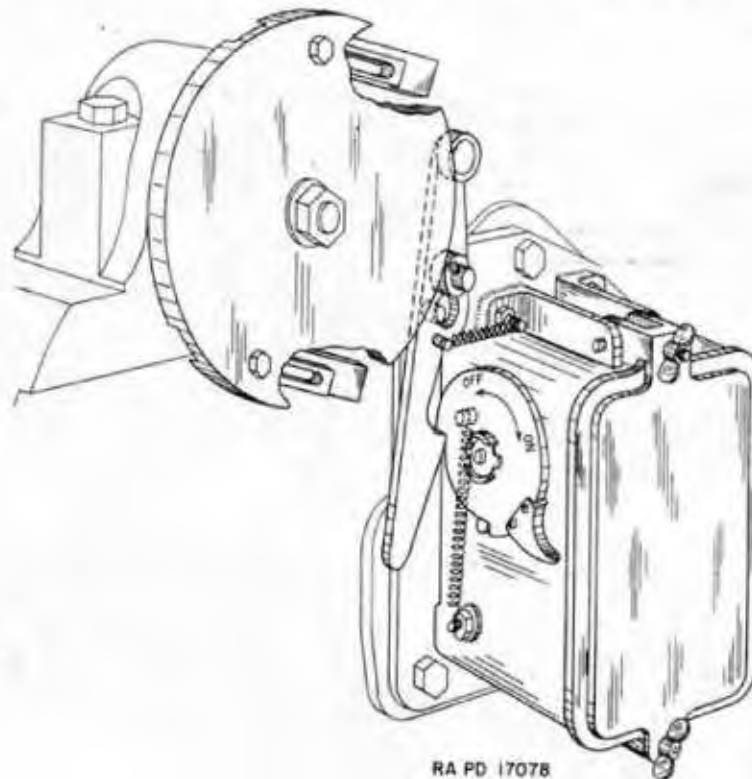


Figure 152 – Elevation Limit Switch

slewing the gun carriage. It consists of a circular black shutter operated by a synchronous repeater and a mechanical dial with red, black, and white sectors. The synchronous repeater follows the rotation of the coarse azimuth transmitter in the director, and the dial is geared to the traversing mechanism of the gun carriage. An index pin on the mechanical dial, protruding through a slot in the shutter, holds the shutter in the red or white phase if the gun is not lined up with the director within the same 20-degree segment of azimuth. If the gun is alined with the director, the surface will become black; if not, either red or white will show. A narrow strip of red or white indicates approximate alinement.

(6) Some azimuth phase indicators in service have been modified to eliminate the index pin and the red and white sectors. On these modified indicators, two arrows on the indicator face are matched against each other to indicate the alinement.

100. REMOTE CONTROL SYSTEM OPERATION.

a. Initial Set-up.

(1) Before firing operations are started the gun carriage must be leveled accurately and lined up with the director (b, below).

(2) Since there are no provisions for parallax corrections, and since in the prescribed method of fire adjustment it is necessary for

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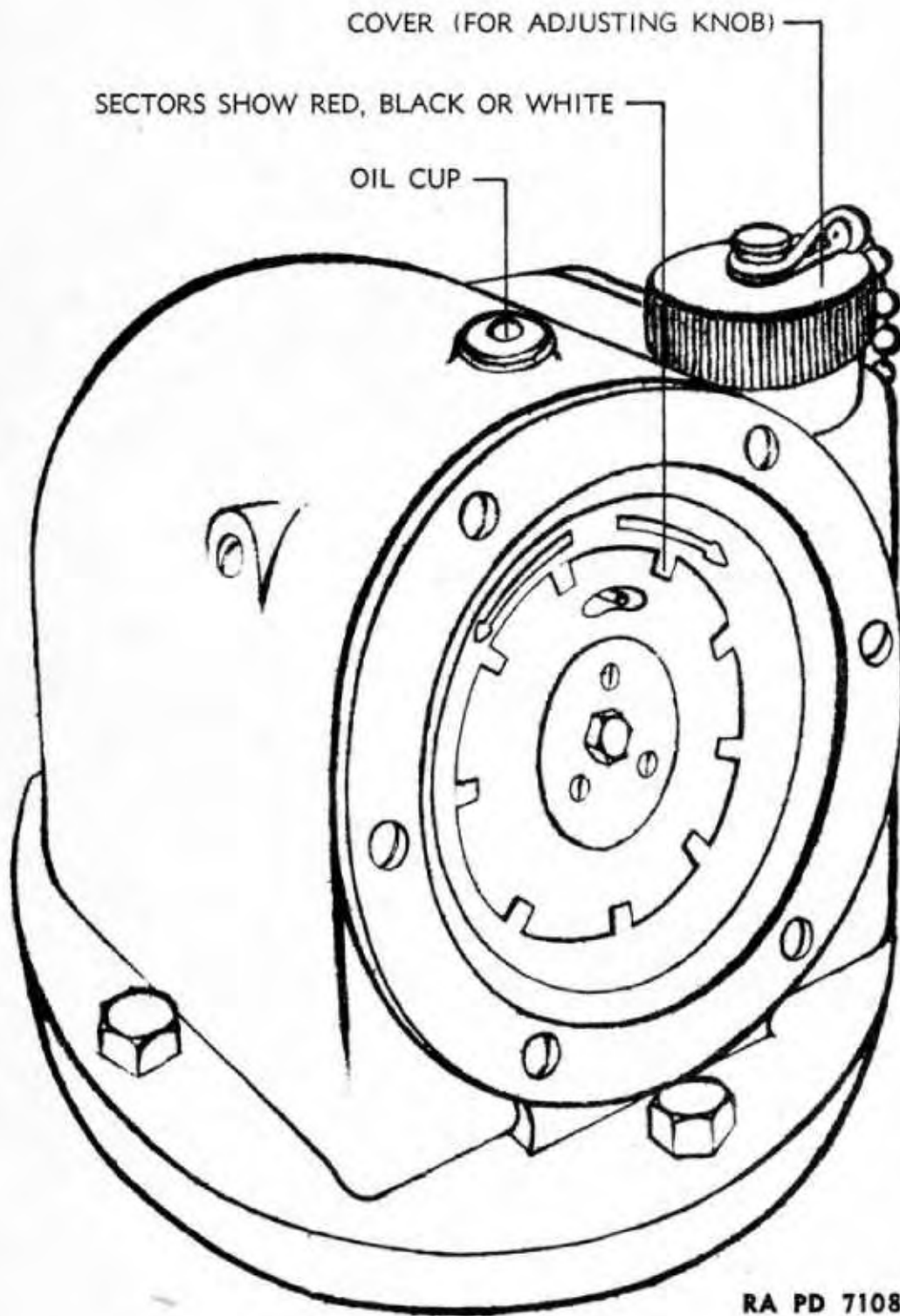


Figure 153 — Azimuth Phase Indicator — Red-black-white Indicator

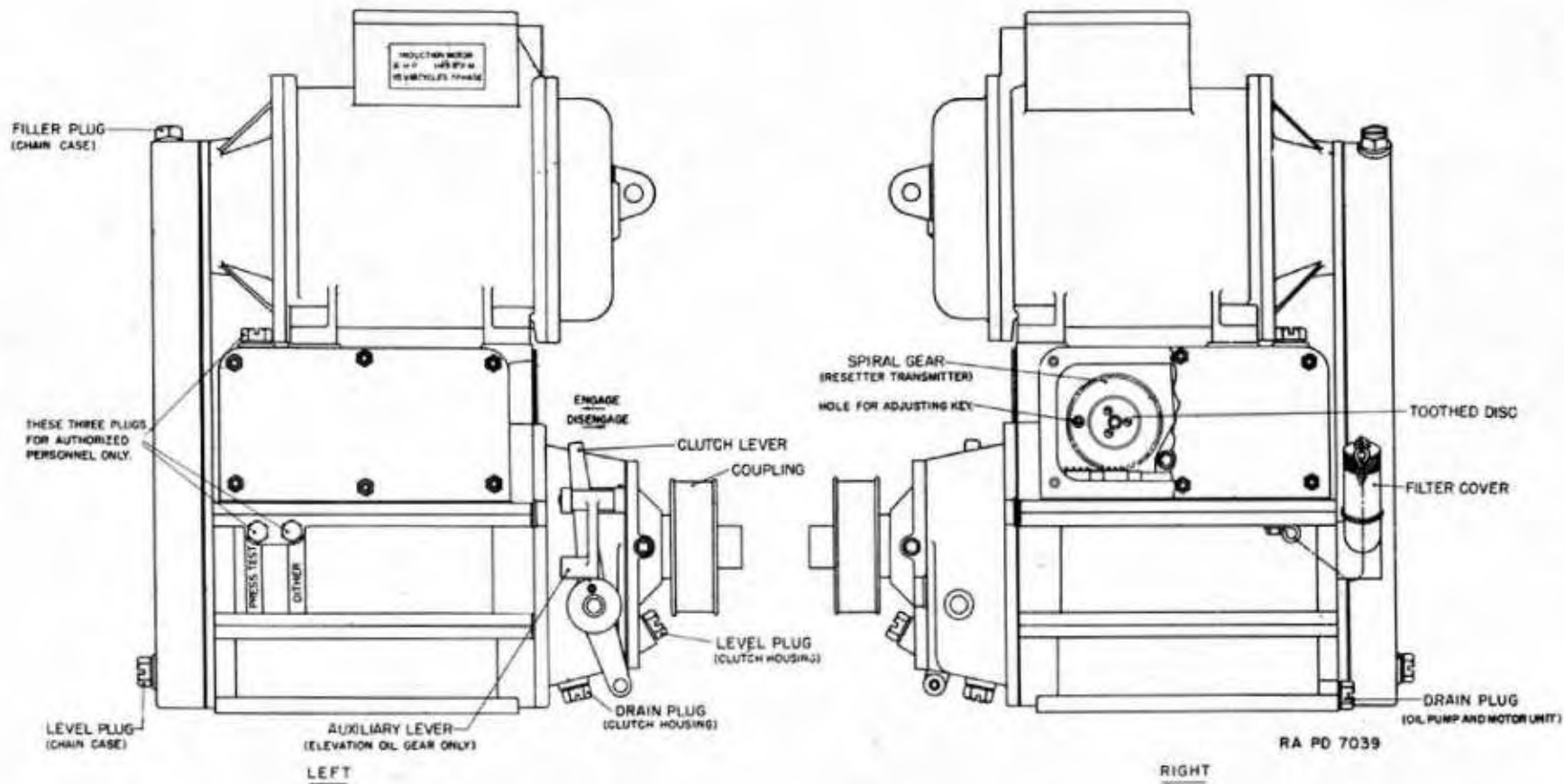


Figure 154 — Oil Gear — Portion of Cover Cut Away To Show Adjustment of Resetter Transmitter

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the trackers to see tracers that cross the gun-target line, the director should be emplaced 13 feet from the pintle center of the gun. This results in a dead sector which extends about 35° to either side of the director in which the gun should not be fired due to hazard to the director personnel. Ordinarily, the director will be placed from 13 feet to 15 feet from the pintle center of the gun in order to eliminate the possibility of injury to the director crew and to give them room in which to operate.

(3) Connect the generating unit and director to the gun mount by the cables provided, making sure that all switches are open until cable connections have been completed. The "D" plugs of the director cable have an adapter ring which must be turned to lock the plug in its socket. The plugs of the generating unit cable have a round nut which must be screwed to the body of the mating receptacle.

(4) The main power switch is on the control panel of the generating unit. This switch should not be thrown until the cables have been connected and the cable plugs secured.

b. Lining Up Gun and Director. When the preliminary operations at the director have been completed, and the director telescopes have been set to the same elevation as the gun, the following procedure will be taken:

(1) Start the generator unit and then close the main switch on the control panel to apply power.

(2) Be sure that the azimuth and elevation hand cranks are disengaged. Keep personnel clear of mount. Slew the gun (azimuth oil gear clutch operating handle to the rear) until the azimuth phase indicator dial is blacked out, and then push the operating handle forward, energizing the remote control system.

(3) Engage the elevation clutch and close the elevation limit switch.

(4) Bore sight the gun on the aiming point (reference point) by means of the director.

(5) When the gun is accurately on the aiming point, the azimuth telescope on the director should be checked to see if the vertical cross line of the telescope is on the point. If it is, the gun and director are alined in azimuth; if not, the director will have to be traversed independently of the gun to bring the vertical cross line accurately on the point.

(6) The bore sighting should be checked on a second aiming point or on the same aiming point after the director and gun have been traversed through a large arc.

(7) After the gun and director have been accurately alined, the mechanical dial of the azimuth phase indicator must be adjusted, if

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the indicator shows either red or white. This can be done by removing the cover over the adjusting knob (fig. 153), depressing the knob, and turning it to rotate the dial. Rotate the dial so that the pin projecting through the shutter is in the center of the slot and the indicator face is completely black.

NOTE: It should not be necessary, ordinarily, to black the azimuth indicator face by means of the adjusting knob, if the face is blacked out, before orientation in azimuth. It has been found that the azimuth indicator is delicate and goes out of adjustment very easily. Thus, the less the adjusting knob is used the better will be the operation of the indicator.

(8) The gun can be checked for elevation by means of a gunner's quadrant. With the system energized, check the gun elevation against the reading of the elevation dial at the director. The check should be performed at two points, preferably zero degree and 30 degrees.

(9) After all the necessary adjustments have been made, both the gun and the director should be set at an elevation of 30 degrees (or any other selected elevation, provided the same setting is used at both the gun and director) so that the gun will line up with the director as soon as the system is energized.

c. Tracking the Target.

(1) When the target is sighted, the elevation limit switch on the gun carriage should be closed by pressing the switch down (fig. 152) so as to energize the elevation oil gear. The elevation oil gear clutch lever should always be engaged before the elevation switch is closed.

(2) Close the main switch on the generating unit to energize the system.

(3) When the director picks up the target, bring the gun into line with the director by traversing the gun until the azimuth indicator shows black, and then push the operating handle forward. This last operation throws the azimuth switch and engages the clutch in the azimuth oil gear. It is not necessary for the azimuth phase indicator to be completely black when throwing the azimuth switch, as the gun will synchronize with the director if initially aligned within 10 degrees; that is, if a narrow strip of red or white shows through the shutter.

(4) After the director picks up and tracks the target, it computes the firing azimuth and quadrant elevation and transmits these electrically to the oil gears which operate the gun. The remote control system eliminates all human pointing errors at the gun. Once the target is picked up and a rate set in, no corrections can be made at the gun.

(5) The gun can be traversed through 360 degrees but no firing should be done when traversing through the dead sector (about 35 degrees to either side of the director) due to the hazard to director

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personnel. The gun battery should be located so that the dead sector of each gun is covered by another gun.

(6) Whenever the gun has engaged one of the elevation limit stops and tripped the elevation limit switch, the gun will have to be elevated or depressed manually to bring it inside the limiting angle, and then realigned with the director. As soon as this has been done, the hand crank should be disengaged and the switch reset.

d. Changing Targets.

(1) When the order is given to track a new target, pull back the operating handle and slew the gun to align with the director again. When the azimuth phase indicator shows black, indicating alinement with the director, push the operating handle forward, energizing the oil gear.

(2) The elevation clutch and switch should remain engaged as there is no provision for slewing the gun in elevation.

e. **Cease Tracking.** Both the gun and director should be set at an elevation of 30 degrees (or any other selected elevation, provided the same setting is used at both the gun and director) so that a new target can be picked up without delay.

f. **Faults.** If the gun does not follow the director both in azimuth and elevation when tracking a target, the errors made are caused either by the mistakes of the operators at the director and the gun or by some mechanical or electrical imperfection in the remote control system or the director. Faults at the gun may be:

(1) **BAD LINING-UP.** The breech peep sight and muzzle cross wires should be used if they are available.

(2) **TOP CARRIAGE OUT OF LEVEL.** The correct leveling of the gun and top carriage cannot be overstressed. Any error in leveling will cause a corresponding error in elevation.

(3) Engaging the oil gear before the gun is approximately in line with the director.

(4) Forgetting to reset the elevation limit switch after it has been automatically thrown to "OFF."

101. REMOTE CONTROL SYSTEM CARE AND PRESERVATION.

a. Routine Maintenance.

(1) The operations described below can be performed by the using troops under supervision of competent personnel. Any further maintenance operations, such as disassembly of oil gears or azimuth indicator, should be done only by ordnance maintenance personnel. Periodic examination of the various units should be made to insure that

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the system will not become inoperative due to the need of some minor adjustment or repair that could have been readily performed prior to the time of operation.

(2) If the induction motor in either oil gear does not run when power is applied, the trouble may be due to blown fuses in the elevation limit switch or azimuth switch. There are three fuses in each switch box. The fuses are accessible for replacement on removal of the switch box cover. Fuses are rated 15-ampere, 250-volt. Remove power from the system before attempting to replace fuses. Secure switch box cover tightly after fuse replacement.

(3) If the gun follows erratically, indicating low oil level, remedy by replenishing the oil supply. Fill the unit through the oil filter. Use only OIL, hydraulic. Fill until oil flows out through the small pilot hole in the filter body. Screw filter cover on tightly after filling.

(4) If the system still fails to operate properly, the cause may be either a fault in the electrical connections, or a malfunction of the mechanical parts of the oil gear; however, no changes in the electrical circuits may be made by the using troops, and if the operating symptoms indicate any reversed leads or mechanical failure, the repairs must be made by qualified personnel. The using troops are permitted to perform unit replacement of oil gears in case of failure of a unit, but proper facilities must be available to prevent entrance of dust into the interior when cover plates are removed. If gun fails to follow properly in elevation, check the adjustment of the equilibrator. Faulty adjustment of the equilibrator will overload the elevation oil gear.

b. Replacement of Oil Gear Units.

(1) Disconnect the three leads to the electric motor by removing the terminal well cover plate on the top of the motor and loosening the three terminal screws. Note the lead markings (mark the leads if there are no lead markings) to insure that the leads can be reconnected to their corresponding terminals. Remove the four screws securing the conduit elbow to the motor housing and withdraw the wires from the terminal well.

(2) Remove the left cover plate of the transmitter and electrical differential assembly, exposing the terminal screws. This cover is on the same side as the clutch lever. Disconnect three leads (R1, R2, and R3) to the differential and two leads (X and Y) to the resetter transmitter by loosening the terminal screws. Do not disconnect the interconnecting leads (S1, S2, and S3, and 1, 2, and 3). Note the lead markings (mark the leads if there are no lead markings) to insure that the leads can be reconnected to their corresponding terminals. Remove the three screws securing the conduit box to the housing and withdraw the wires from the housing.

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(3) Remove the four bolts securing the oil gear to the carriage, and the single bolt at the rear of the electric motor. Remove the oil gear by pulling it forward from the front of the carriage, being careful not to damage the drive shaft or coupling mechanism.

(4) Note that in replacing a unit, a distinction must be made between the azimuth oil gear and the elevation oil gear. Although both units are similar in outward appearance, they cannot be interchanged as their gearing ratios are different. The azimuth unit has a 64-tooth spiral gear A182178 on the resetter transmitter, while the elevation unit has a 108-tooth spiral gear A182177. Also, a different pinion meshes with these gears in each unit. In the absence of accurate name plate data, the unit can be positively identified by removing the adjusting side cover (this cover is on the same side as the filter cap) and counting the teeth on the resetter transmitter spiral gear.

(5) Mount the replacement oil gear on the carriage, pass the cable leads into the corresponding openings, and secure the conduit fittings. Be sure to insert the gaskets under the cable adapters. Connect the leads to the correspondingly marked terminals, and tighten the terminal screws securely. Replace cover plates with their gaskets. Use new gaskets if necessary.

(6) When replacing the elevation oil gear, it will be necessary to adjust the resetter transmitter. This is done before replacing the adjusting side cover. To adjust (fig. 109), loosen the three screws in the central toothed disk which secures the spiral gear to the resetter transmitter. Energize the system, and set the director telescopes to exactly a 45-degree elevation. By use of the adjusting key (subpar. g, below), turn the toothed disk until the elevation of the gun as checked by the gunner's quadrant is exactly 800 mils (45 deg). Tighten the three screws to retain the adjustment.

(7) It is not necessary to adjust the resetter transmitter of the azimuth oil gear, as the equivalent adjustment is performed during the orienting operation.

c. Conversion of Elevation Oil Gear to Azimuth Oil Gear or Vice Versa.

(1) The specific instructions below supplement instructions contained in the preceding portions of this paragraph.

(2) One spare oil gear is furnished with every two carriages. The parts necessary to convert the replacement unit to the same type as the unit being removed are obtained by interchanging parts between units. These parts consist of a spiral gear and either a sleeve or a locking lever.

(3) In order to convert an elevation oil gear to an azimuth unit, the right-hand side cover plate must be removed, the three screws clamping the spiral gear between the disk and adapter on the gear

SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGE M3A1

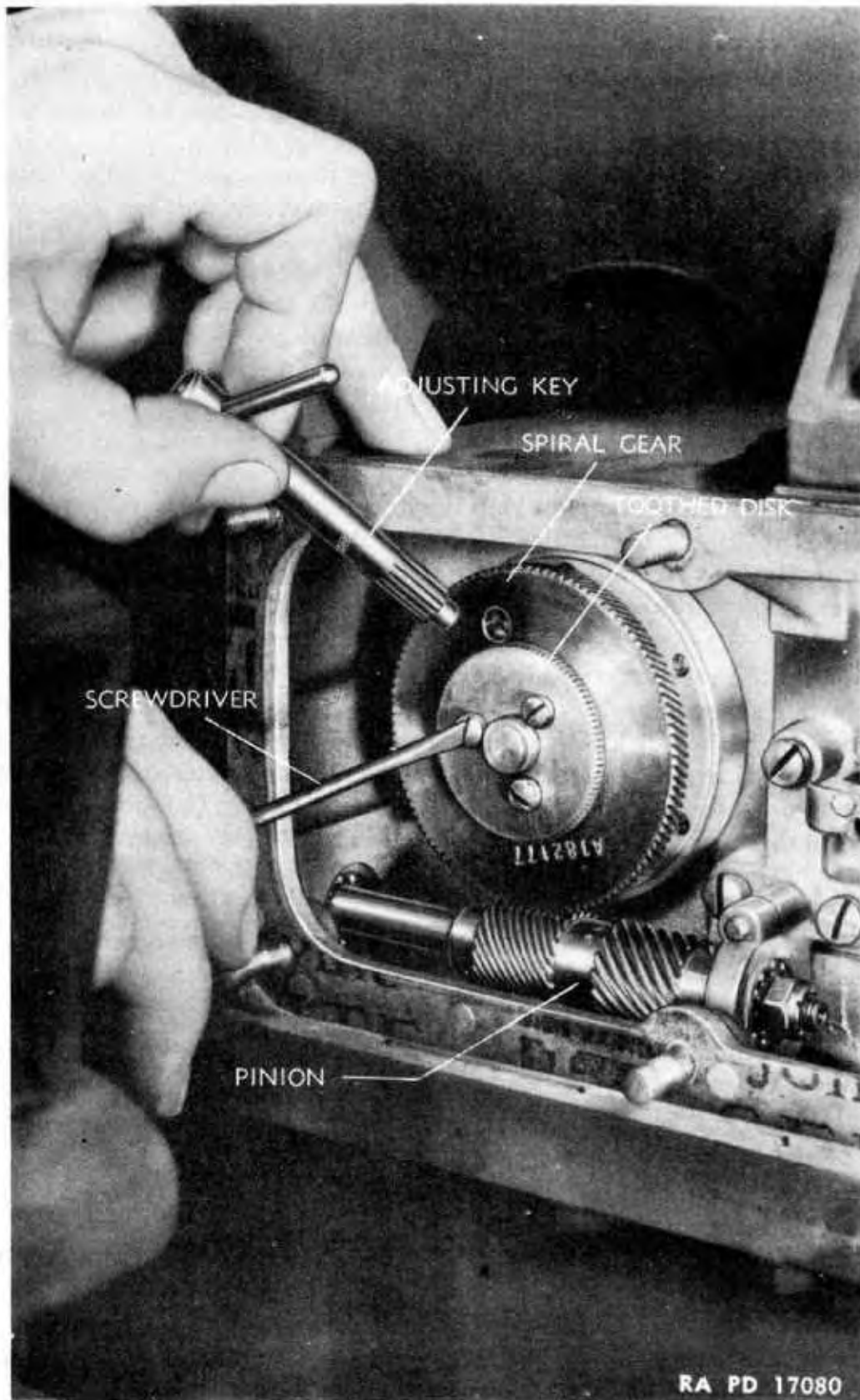


Figure 155 — Adjustment of Resetter Transmitter Spiral Gear

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assembly (figs. 155 and 158) must be withdrawn, and the disk and gear removed.

(4) The taper pin securing the double pinion on the shaft assembly must be driven out and the pinion slid over to the left side of the shaft and secured by replacing the taper pin. A second drilled hole in the shaft secures the taper pin in its new position.

(5) Mount the spiral gear (azimuth) A182178, replace the disk, and secure the two to the adapter by means of the three screws that were withdrawn, taking care to mesh the gear with the right-hand pinion as shown in figure 153. Replace the gasket and cover plate.

(6) On older units with a single motor supporting lug, remove the four nuts holding the rear bell housing of the induction motor to the motor housing. Rotate the bell housing 180 degrees and secure in place in the new position. This operation is not required on newer units having two motor supporting lugs.

(7) Interchange the pipe plug and lubricate fitting in the clutch housing cover and secure in place.

(8) Remove the cotter pin on the shaft pin which supports the auxiliary locking lever (fig. 154). Drive out the shaft pin and remove the locking lever. Insert the sleeve in place of the locking lever, drive the shaft pin back in place, and secure it by means of the cotter pin.

(9) An azimuth unit can be converted to an elevation unit by reversing the above replacements and assemblies.

d. Care of Cable System.

(1) Give the cable the best of care.

(2) No cable of this size will withstand repeated kinking or twisting. Avoid bending the cable on a short radius, or allowing it to chafe against a movable object.

(3) Do not allow vehicles to run over unprotected cables.

(4) Keep plugs and receptacles clean; accumulated dirt will cause faulty connections.

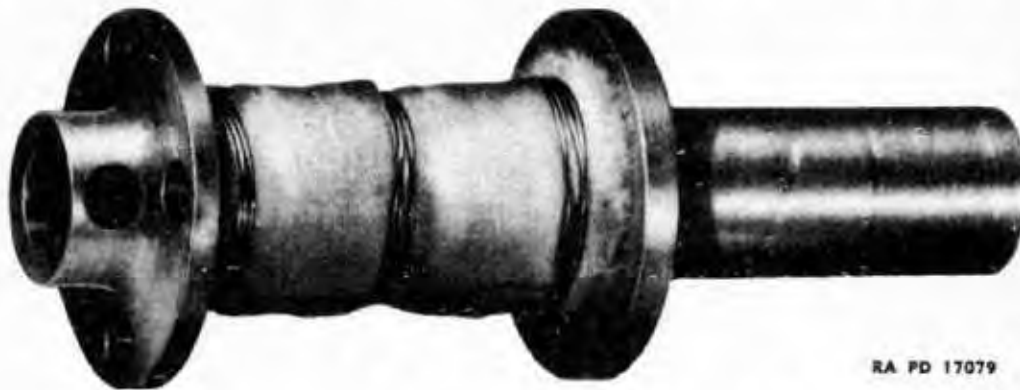
(5) When the cables are not connected, all plugs must be kept closed with the covers provided to exclude dirt and moisture from these units. The "D" plugs of the director cable are furnished with leather covers that should be pulled over the plugs when not connected.

(6) When disconnecting a cable, pull on the body of the plug, never pull on the cable or spring. The "D" plugs have to be turned to unlock them before they can be disconnected.

(7) In case it becomes necessary to tape the ends of any of the flexible cables, use rubber tape only.

(8) Oil and grease are detrimental to rubber; keep the cables free

SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGE M3A1



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Figure 156 – Filter Bobbin Assembly for Oil Gear Filter

of these solvents. If oil or grease does get on the cable, wipe it off and wash the place with soapy water.

(9) Protect the cable receptacles in the gun junction box by means of the covers provided for that purpose.

e. Lubrication and Renewal of Oil.

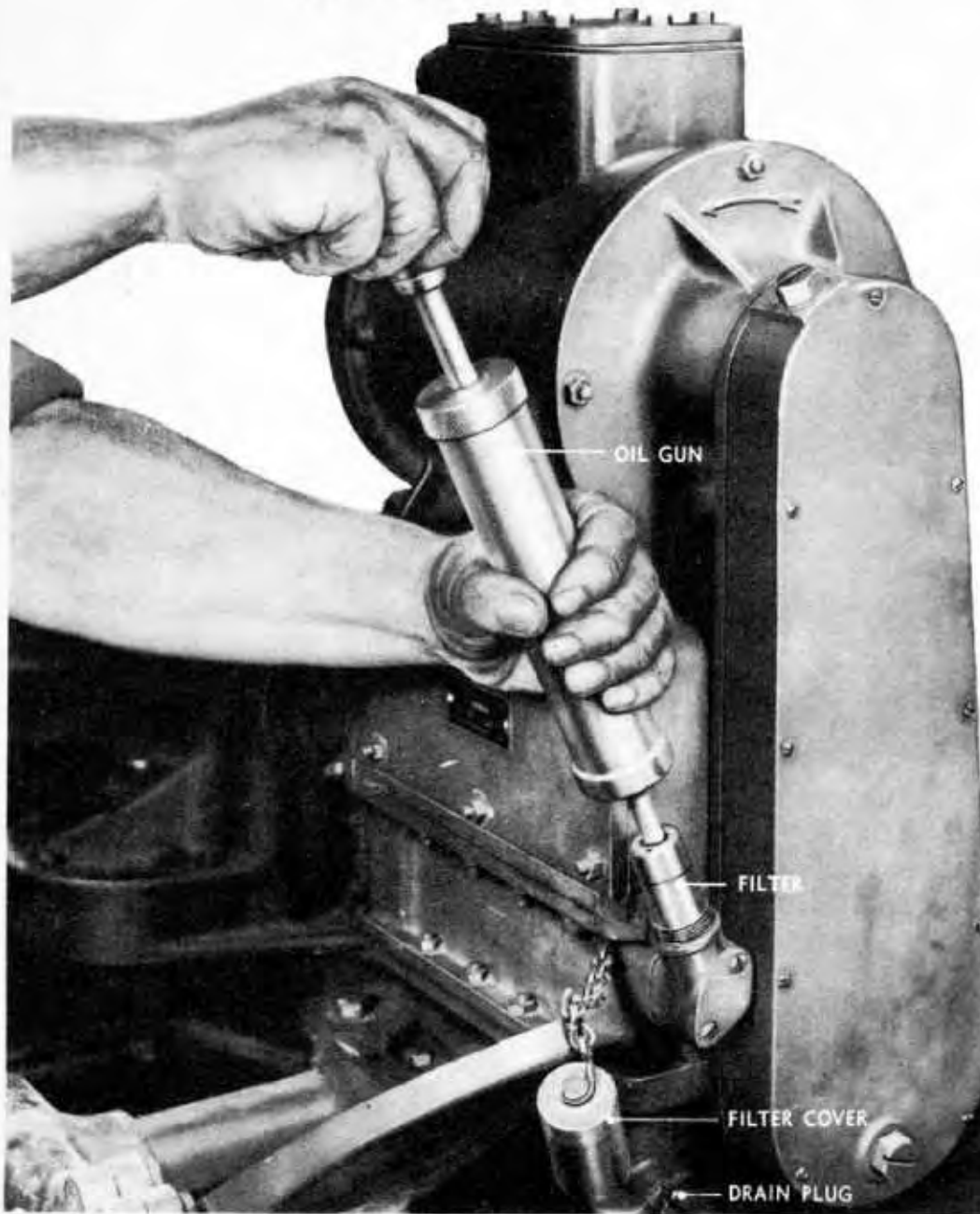
(1) Cleanliness is of the utmost importance in handling the oil for the oil gears. Dust or moisture must not be allowed to get into the oil at any time. The oil gun must be kept clean, and should be used only for the specified hydraulic oil.

(2) If the system is in frequent use, the oil should be changed every 3 months. To change the oil, drain through the drain plug under the filter assembly, replace drain plug, and tighten securely; then fill through the filter (fig. 157) until oil flows from the overflow hole in the side of the filter. The oil gun should be held straight and centered in the filter opening. Use only OIL, hydraulic, as the hydraulic medium. If dirt is suspected in the oil system, the oil gear unit should be removed and cleaned thoroughly by ordnance maintenance personnel.

(3) The filter contains a filter bobbin assembly which may require replacement after several oil changes. The filter bobbin assembly consists of a perforated metal tube with a muslin strip wrapped around the perforated portion so as to form the filter element (fig. 156). To replace the filter bobbin assembly, proceed as follows: Unscrew the retainer at the top of the filter opening, using the spanner wrench provided (subpar. g, below). Lift out the old filter bobbin assembly and replace with a new one. Screw the retainer back into place. Care must be taken during the foregoing operations to prevent dirt from entering the interior parts.

(4) At weekly intervals or oftener, depending on service conditions, drain the chain case and the clutch housing (fig. 154) to keep the oil at the level of the level plug holes. The chain requires lubrication with O.D. grease at 6-month intervals but, since this calls for par-

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RA PD 8420

Figure 157 — Use of Oil Gun in Filling Oil Gear

tial disassembly, it should be performed only by qualified personnel. To drain, remove the lower plug in the chain case and the upper plug in the clutch housing and let the oil drain to the plug levels. Draining is necessary because of oil seepage from the pump and motor.

(5) The resetter transmitter spiral gear (fig. 158) is lubricated by a cork lubricating ball located in a recess under the driving pinion. This recess should be filled with OIL, hydraulic, at frequent intervals. The cover over the spiral gear must be removed to permit lubrication.

SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGE M3A1

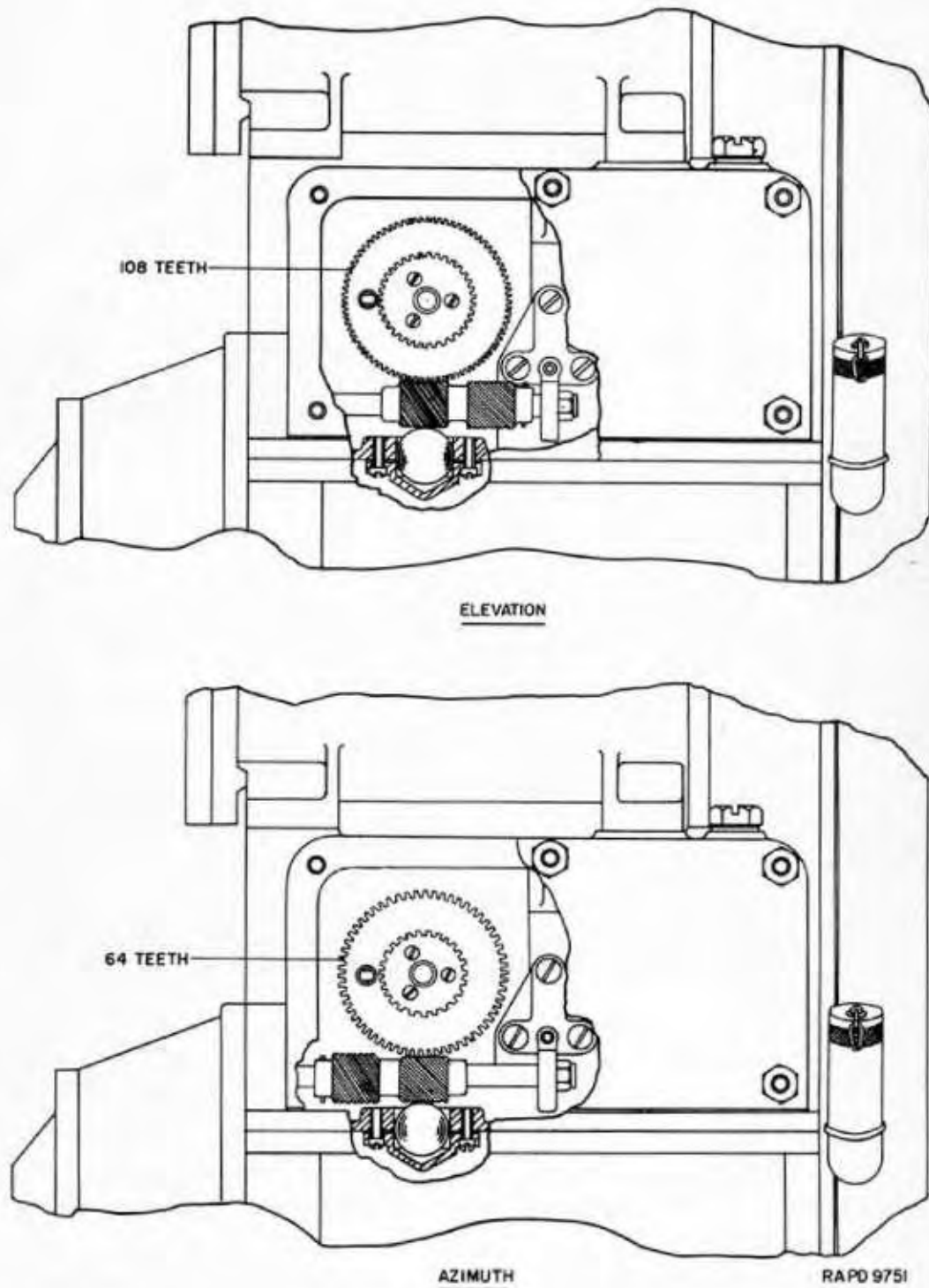


Figure 158 — Changes in Gearing for Conversion of Elevation Oil Gear to Azimuth Oil Gear

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f. **Precautions.** The following precautions should be taken in the operation and maintenance of the system:

(1) Power should be switched off before cables are connected or disconnected. See that cables are securely held in the receptacles before turning the power on.

(2) The elevation clutch lever should be put in the "IN" position (top of lever away from the coupling) before switching on the power supply.

(3) Never put oil from a previously unsealed container in the oil gears.

(4) Be sure the top carriage is level before firing. Only when the carriage is level will the gun accurately follow the director.

(5) The oil gear when filled with oil must always be kept upright; otherwise, oil will get into the electrical control elements and cause damage. If, through accident, the oil does get into the electrical control compartment, remove the side covers from this compartment and wipe up oil.

g. **Tools and Equipment.** A tool box containing tools and equipment for maintenance of the oil gear is furnished with the system. Certain of these tools are required specifically for ordnance maintenance operations, and are not intended for use by battery personnel. No screwdriver is provided, as there is usually a screwdriver in the gun carriage tool box. The tools supplied are listed below. When not in use, these tools should always be kept in the box provided.

GAGE, coupling (for assembling oil gear to carriage)

GUN, oil (for adding oil to oil gear unit, fig. 157)

KEY, adjusting (for adjusting resetter transmitter, fig. 155)

TUBE, (for inserting sensitive valve)

WRENCH, box, 12-point ($\frac{3}{8}$ - and $\frac{7}{16}$ -in.)

WRENCH, box, 12-point, ($\frac{5}{8}$ - and $\frac{3}{4}$ -in.)

WRENCH, spanner (for changing filter bobbins assembly)

102. SIGHTING SYSTEM M5.

a. General.

(1) The Sighting System M5 (figs. 159 and 160) forms the direct fire element of the sighting and fire control equipment for use when a failure occurs in the power plant or the remote control system. It is also intended for use where the gun must be brought into action with great speed and there is not sufficient time to set up the director, power plant, and remote control system.

(2) The Sighting System M5 (figs. 159 and 160) is made up of

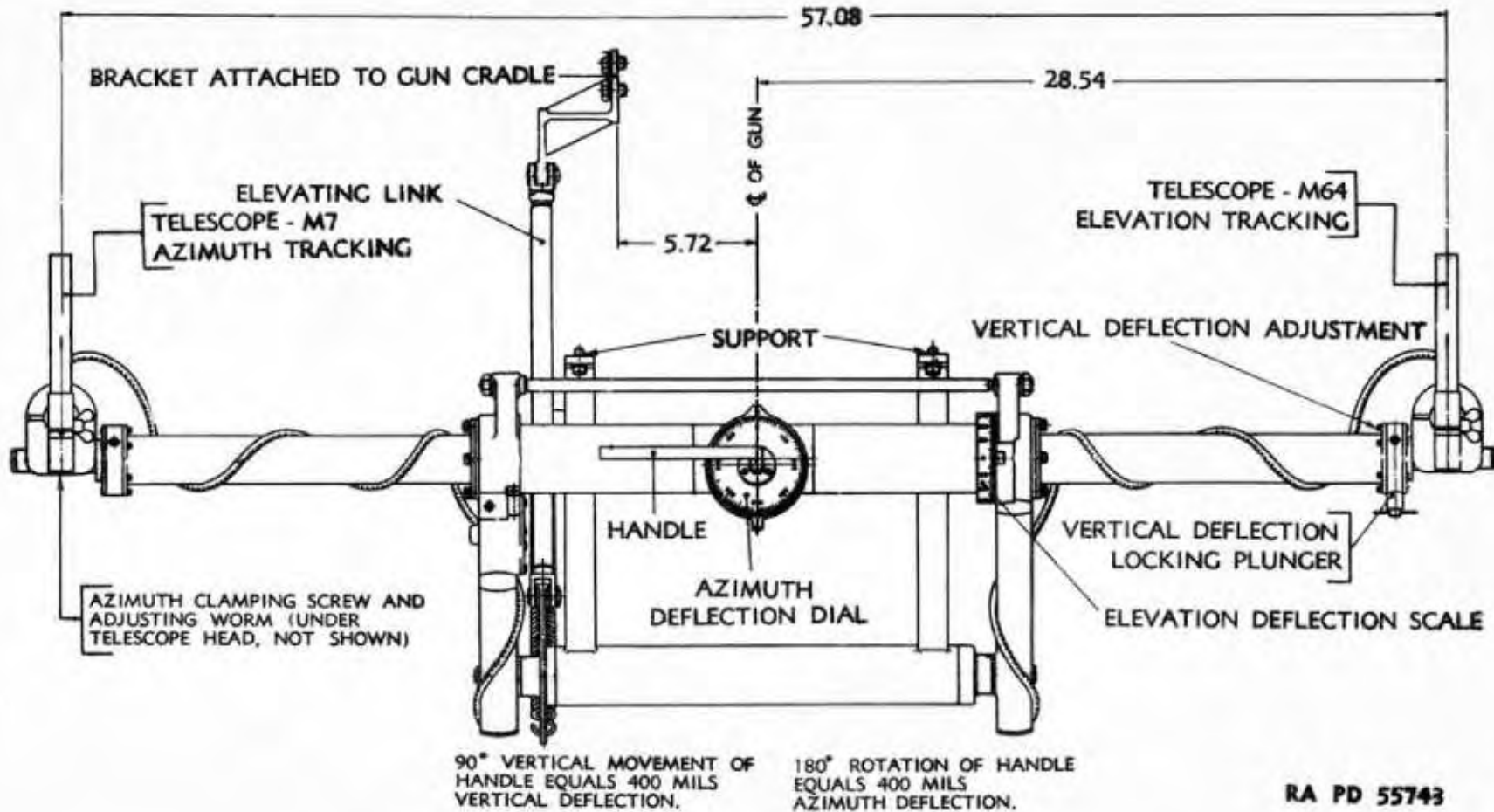
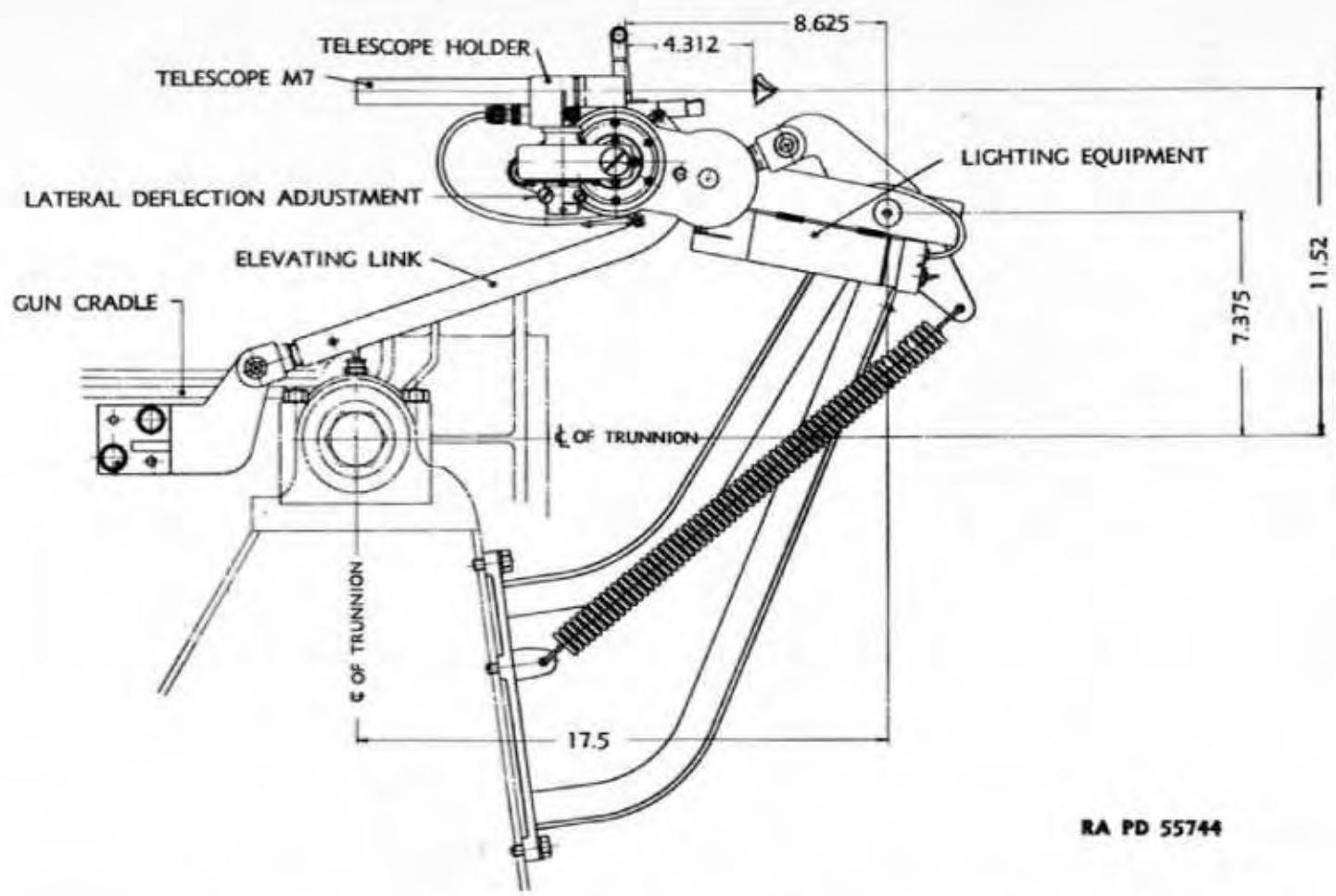
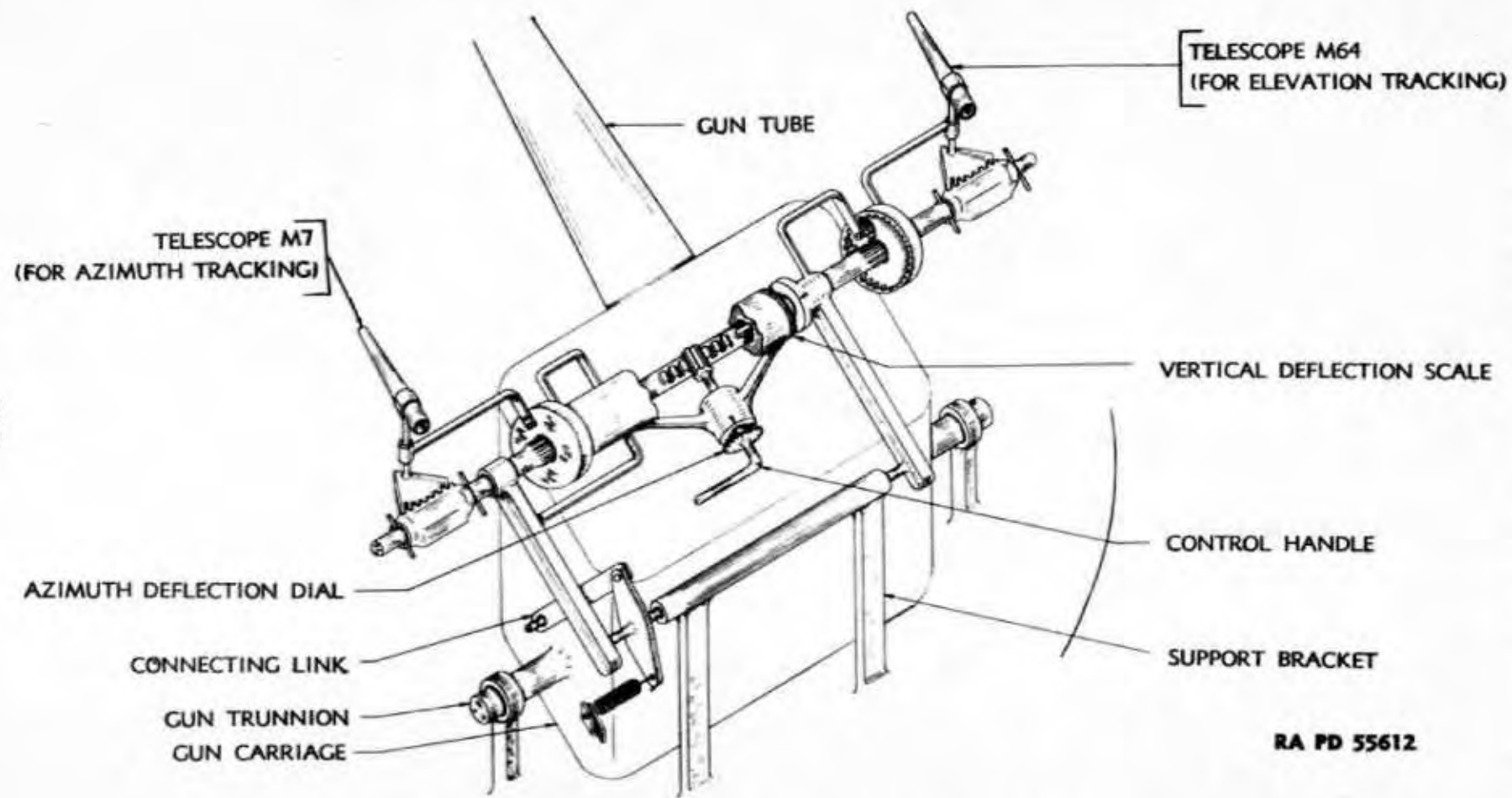


Figure 159 — Arrangement of Sighting System M5 — Top View



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Figure 160 — Arrangement of Sighting System M5 — Left Side View



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Figure 161 — Operation of Sighting System M5

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the Telescope M7 (for sighting in azimuth), the Telescope M64 (for sighting in elevation), and supporting framework attached to the top carriage. Azimuth and elevation deflection mechanisms (fig. 161) integral with the frame work, permit the application of corrections in azimuth and elevation for direction and speed of the wind and the target. The lighting equipment, consisting of two complete units, illuminates the reticles of the telescopes for night firing.

b. Description.

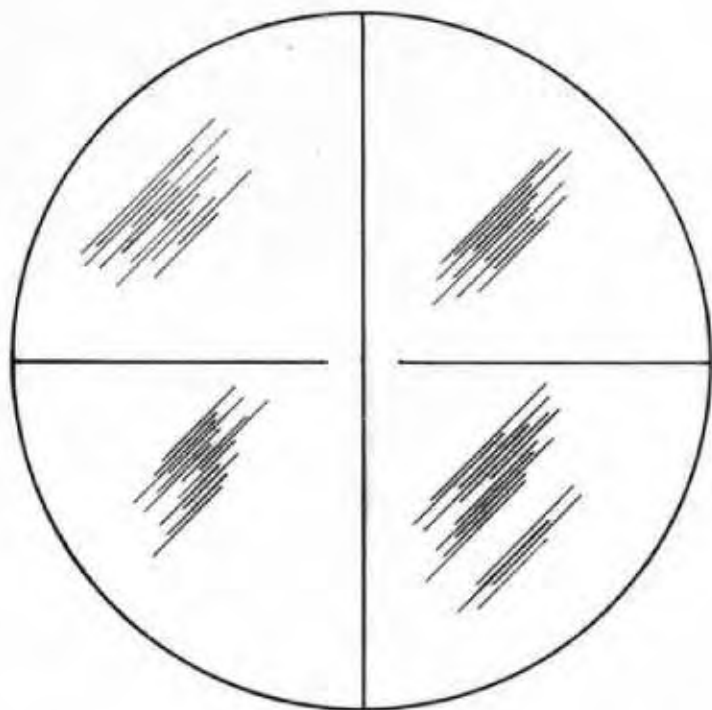
(1) **TELESCOPE M7.** The Telescope M7 (for sighting in azimuth) is a 1-power, erect image telescope having a field of view of 11 degrees and an exit pupil diameter of 0.6 inch (fig. 145). The reticle pattern (fig. 162) consists of a continuous vertical line and a horizontal line broken in the center. The telescope has a red spot. The corresponding telescope holder has a red spot. The telescope has locating slots for positioning in the mount.

(2) **TELESCOPE M64.** The Telescope M64 (for sighting in elevation) is similar in appearance but differs from the Telescope M7 (fig. 145) in the reticle pattern (fig. 162). The reticle pattern of the Telescope M64 has a continuous horizontal line and a vertical line broken at the center. Below and parallel to the horizontal line are range lines numbered 4 (for 400 yards), 8 (for 800 yards), 13 (for 1,300 yards), and 17 (for 1,700 yards). The range lines are graduated for 37-mm Armor-piercing Shot M59. The telescope has a white spot. The corresponding telescope holder has a white spot. The telescope has locating slots for positioning it in the telescope holder.

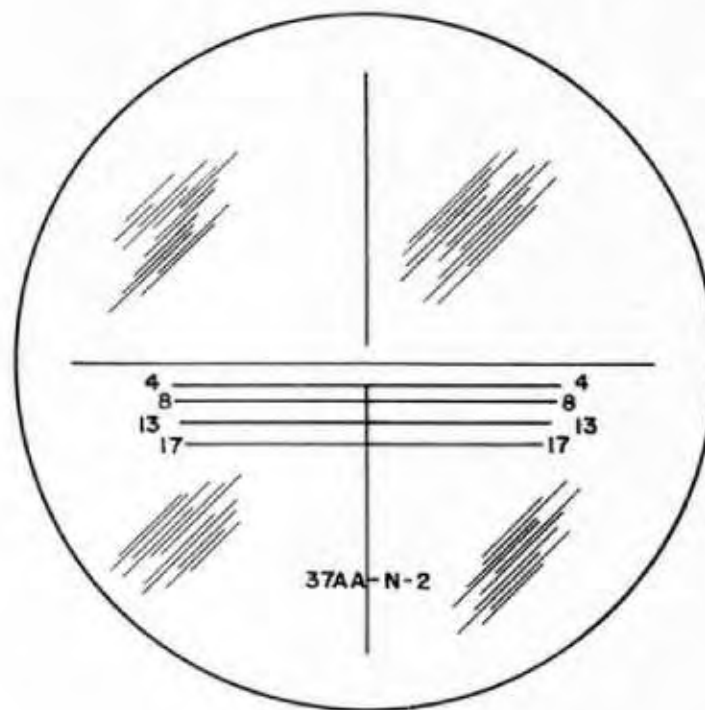
(3) **FRAMEWORK.** The framework of the sighting system includes supporting brackets, azimuth and elevation deflection mechanisms, and two telescope holders.

(4) **SUPPORTING BRACKETS.** The supporting brackets are fastened to the top, support the telescope holders, and link them to the gun cradle so that the telescopes will be elevated when the gun is elevated.

(5) **DEFLECTION MECHANISMS.** The azimuth deflection mechanism operated by the lever at the center of the azimuth deflection dial, moves the telescopes through gearing, in azimuth. The azimuth deflection dial is graduated at 10-mil intervals for 400 mils on either side of center. The detent in the mechanism permits 5-mil deflection intervals and prevents creep due to vibration during firing. The elevation deflection mechanism, operated by the handle at the center of the azimuth deflection dial, moves the telescopes, through gearing, in elevation. The elevation deflection scale is graduated at 10-mil intervals from 0 to 400 mils in either direction. Pulling the handle *downward* depresses the telescopes. The detent mechanism permits 5-mil deflection intervals and prevents creep due to vibration during firing. The vertical deflection locking plunger is used to lock the



TELESCOPE M7
(AZIMUTH)



TELESCOPE M64
(ELEVATION)

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Figure 162 — Reticle Patterns for Telescope M7 (Azimuth) and Telescope M64 (Elevation)

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vertical deflection mechanism at zero deflection when firing at ground or water-borne targets.

(6) **TELESCOPE HOLDERS.** Each telescope holder has a lug for positioning the slot in the telescope and a clamping thumbscrew for clamping. A lamp in the holder provides illumination for the telescope reticle. The azimuth telescope holder has a red spot for identification with the Telescope M7. The elevation telescope holder has a white spot for identification with the Telescope M64. The telescopes are similar in appearance and the color helps to prevent inserting a telescope in the wrong holder.

(7) **LIGHTING EQUIPMENT.** The lighting equipment (figs. 159 and 160) of the sighting system, consisting of two complete and identical lighting devices, illuminates the reticles of the two telescopes for night firing. Each device consists of a battery tube containing two dry cell flashlight batteries, a plug and cord assembly, and a toggle switch. When the toggle switch is turned "ON" the light from the lamp passes through the window in the under side of the telescope, thus illuminating the reticle.

c. Operation Against Aircraft Targets.

(1) To pick up the target, the azimuth tracker brings the gun approximately on the target in azimuth by sighting over the top of his telescope. The elevation tracker elevates or depresses the gun, bringing the gun approximately in line with the target.

(2) When gun is approximately on target, the azimuth tracker sights through his telescope. He tracks the target by traversing the gun so as to keep the *vertical* cross line of reticle centered on target. The elevation tracker sights through his telescope and elevates or depresses gun by means of elevating handwheels. In this manner, he keeps the horizontal cross line of reticle on target.

(3) As soon as the target is picked up, the deflection operator sets in initial azimuth and elevation deflections. These initial deflections are based on estimate of conditions at the moment, such as direction and velocity of wind, distance and speed of target, etc.

(4) When firing starts, the deflection operator observes path of tracers, and changes deflections so as to bring fire on target.

(5) Both lateral and vertical deflections are set in by the same handle. Rotation of handle will set in lateral deflections. Vertical motion of handle will set in vertical deflections. Deflection in mils is indicated on the deflection dial and scale.

(6) *Clockwise* rotation of handle will turn telescopes to left, setting in a *right* deflection. *Counterclockwise* rotation of handle will turn telescope to right, setting in a *left* deflection. A *downward* movement of handle will depress the telescopes, setting in a *plus* deflection.

SIGHTING AND FIRE CONTROL EQUIPMENT FOR CARRIAGE M3A1

(7) Observing the path of tracers, the operator sets in deflections so as to bring fire on target as follows:

- (a) Rotation of handle clockwise will move tracers to right.
- (b) Rotation of handle counterclockwise will move tracers to left.
- (c) Elevation of handle will depress the tracers.
- (d) Depression of handle will lift the tracers.

d. Operation Against Ground or Water-borne Targets.

(1) Turn the control handle to set the telescopes at zero vertical deflection as indicated on the vertical deflection scale. Turn the cross pin of the vertical deflection locking mechanism to enter the deep slot. The plunger will lock the vertical deflection when the cross pin is in the deep slot but does not lock when the cross pin is in the shallow slot.

(2) To pick up the target the azimuth tracker turns the traversing crank while sighting over the top of his telescope. The elevation tracker turns the elevating crank, sighting in a similar manner to bring the gun to bear approximately on the target.

(3) When the gun is approximately on target, the azimuth tracker sights through his telescope and tracks the target by traversing the gun so as to keep the *vertical* cross line of the reticle on the target.

(4) The elevation tracker elevates or depresses the gun to bring the proper reticle range line (corresponding to the announced or estimated range) to bear on the target. This sets in the required elevation.

(5) As soon as the target is picked up, the deflection operator sets in initial azimuth deflections. These are based on estimate of conditions at the moment, such as direction and velocity of wind, distance and speed of target.

(6) When firing starts, the deflection operator observes path of tracers, and changes the azimuth deflection so as to bring fire on target. Rotation of handle will set in lateral deflections. The deflections, in mils, are indicated on the deflection dial. Clockwise rotation of handle will turn telescopes to left, setting in a *right* deflection. *Counterclockwise* rotation of handle will turn telescopes to right, setting in a left deflection.

(7) Observing the path of tracers, the operator sets in deflections so as to bring fire on target as follows:

- (a) Rotation of handle clockwise will move tracers to right.
- (b) Rotation of handle counterclockwise will move tracers to left.

e. Tests and Adjustments.**(1) TESTS.**

- (a) At regular intervals, the telescopes must be tested to make

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certain that they are parallel with the bore of the gun. This test and adjustment is referred to as "bore sighting." To determine whether telescopes require adjustment, proceed as follows:

(b) *Preliminary.*

1. Equipment required for bore sighting consists of bore sights and a testing target. A sharply defined distant aiming point may be used instead of a testing target. The testing target is a paper sheet marked with accurately spaced aiming points to show the lines of sight through the gun bore and the individual telescopes. The testing target should be supported square with the gun, about 50 yards in front of the muzzle, and true with a plumb line. It should be moved if necessary until the bore aiming point is seen centered in the bore sights. The bore sights are metal disks which fit accurately in the breech and muzzle openings of the gun. Holes centered in the bore sights permit sighting on a line through the center of the gun bore.

2. Level the gun carriage.

3. By means of the bore sight, aline the gun on the testing target or on an object about 750 yards distant.

4. Turn deflection handle until lateral deflection dial and vertical deflection scale indicate zero. Lock the vertical deflection mechanism.

5. Cross lines in both telescopes should coincide with respective cross lines on testing target, or with the distant target.

(2) **AZIMUTH ADJUSTMENT.**

(a) *If both telescopes are out of adjustment, proceed as follows:*

1. Turn deflection handle until vertical cross line of elevation telescope coincides with its cross line of test target.

2. Loosen azimuth clamping screw on lower end of telescope holder shaft and turn adjusting worm (fig. 160) until vertical cross line of this telescope coincides with its cross line on test target. Tighten clamping screw.

CAUTION: Do not disturb the adjustment when tightening clamping screw.

3. Loosen the three screws clamping the azimuth deflection dial (fig. 159), and turn dial until it indicates zero. Tighten screws, exercising care not to disturb adjustment.

(b) *If azimuth telescope alone is out of adjustment, proceed as described in step (2) (a) 2, above.*

(c) *If elevation telescope alone is out of adjustment, it is not necessary to adjust for azimuth unless error is very great, as azimuth tracking is accomplished by using azimuth telescope.*

(3) **ELEVATION ADJUSTMENT.**

(a) *Keep gun bore sighted on testing target (or distant target).*

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Elevate or depress deflection handle until vertical deflection scale indicates zero.

(b) The horizontal cross lines of both telescopes should coincide with the respective lines on testing target (or with distant target).

(c) If both telescopes are out of adjustment, proceed as follows:

1. Elevate or depress handle until horizontal cross line of elevation telescope coincides with its cross line on testing target.

2. Loosen set screw on scale assembly and slip the vertical deflection scale until it reads zero.

3. The azimuth telescope should not require adjustment for elevation, as both telescopes are adjusted when assembled. After proper adjustment by manufacturer, end bearings were pinned to the flanges so that the two telescopes should always remain in adjustment with each other.

4. However, in case the azimuth telescope is slightly out of adjustment in elevation, do not attempt to adjust it, *as regards elevation* because elevation tracking is accomplished with the elevation telescope.

f. Transporting and Storing.

(1) When preparing telescopes for traveling or storing, remove them from holders, install dust caps, and place telescopes in packing chest especially provided.

(2) After exposure to wet weather, dry the telescopes before placing them in packing chest. If possible, store them in a warm, dry place. Rubber shields have been designed to prevent fogging of the objective lenses of the Telescopes M7 and M64 when used in adverse weather conditions.

(3) When storing the carriage, or whenever lighting equipment is not in use for more than 1 day, remove dry cells from battery tube. This will prevent damage to tube caused by chemical reaction taking place as dry cells deteriorate.

(4) Exhausted batteries must be removed immediately. Removal may be difficult if this precaution is not observed.

g. Care and Preservation.**(1) HANDLING PRECAUTIONS.**

(a) The Sighting System M5 is designed to withstand ordinary field usage, but should not be subjected to unnecessary rough handling or abuse.

(b) Care should be exercised to avoid abuse of the telescopes, also to avoid placing undue strain on supporting members which would cause misalignment.

(c) Stops are provided, limiting the deflection motion of the sighting system. Do not attempt to travel past these stops, as injury to the

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deflection system may result. Unnecessary turning of screws or other parts not incident to the use of the sighting system is expressly forbidden.

(2) LUBRICATION.

(a) *General.* Oil cups are provided to permit lubrication of the segments and racks on each end of the system and the gearing mechanisms of the system. Use OIL, lubricating, for aircraft instruments and machine guns. Internal bearings will not need lubrication, as they are self-lubricating.

(b) *Rack and Gear Segments.*

1. An oil cup is mounted in the housing assembly on the azimuth side to permit lubrication of the rack and gear segment.

2. A similar oil cup is mounted in the housing assembly on the elevation side to permit lubrication of the rack and gear segments.

(c) *Deflection Gears.* Oil cups are mounted in the bearings on each side of the system to provide lubrication of the vertical deflection gearing.

(d) An oil cup is provided in the supporting arm assembly to permit lubrication of the detent gearing.

(e) See that no oil touches the optical parts. Wipe all excess lubricant off the instrument to prevent accumulation of dust and grit.

103. MAINTENANCE AND REPAIR.

a. *Policy.* The policy in regard to disassembly, repair, maintenance, and adjustments for all sighting and fire control instruments is described in paragraph 65 a.

b. *Correction of Malfunctioning.*

(1) The procedure for using personnel in case of malfunction of any part of the remote control system is to attempt to locate the major unit in which the fault originates. When the unit at fault is located, a simple repair, such as replacement of a blown fuze, may be all that is necessary to restore the system to satisfactory operation. More extensive repairs requiring access to the interior through removal of cover plates are to be performed only by qualified personnel. Faults which may arise in the individual units and permissible methods of correcting them are indicated in the paragraphs covering the separate units.

(2) Faults which originate in the generating unit, director, or connecting cables will affect the remote control system as a whole, and may sometimes appear to be due to faulty oil gears or other units which are not actually at fault. Similarly, certain faults at the director may evidence themselves by faulty operation at the gun.

(3) Faults which originate in the generating unit or its connecting

SIGHTING EQUIPMENT FOR COMBINATION GUN MOUNT M42

cable are characterized by faulty operation at the director and at the gun, in both azimuth and elevation.

(4) Faults which originate in the director or its connecting cable are characterized by faulty operation in either azimuth or elevation elements, but very seldom in both elements. The fault will generally be noticeable in both the gun and director. For example, jerky following of the gun in azimuth accompanied by a similar jerky motion at the director will indicate a director fault (probably a defective azimuth torque amplifier), replacement of which can be accomplished only by qualified personnel.

Section XI

SIGHTING EQUIPMENT FOR COMBINATION GUN MOUNT M42

104. GENERAL (figs. 163 and 164).

a. The Sighting System M6 is designed for mounting on the Combination Gun Mount M42 to provide a means of tracking the target and applying deflections.

b. The rear portion of the system is supported by a framework attached to the top carriage. The forward portion is mounted on the elevating and traversing handwheel brackets.

105. CARE AND PRESERVATION.

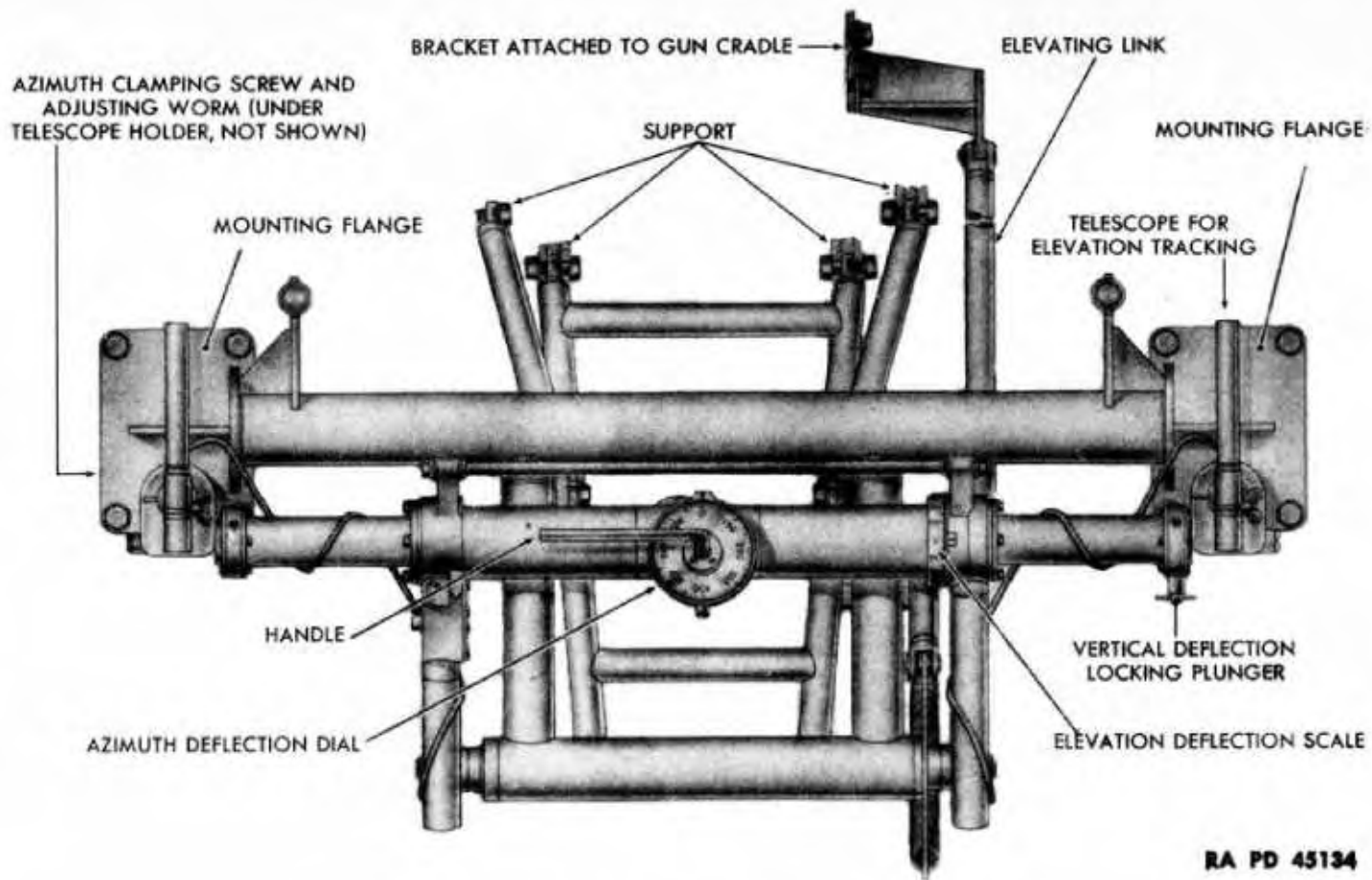
a. Handling Precautions.

(1) The Sighting System M6 is designed to withstand ordinary field usage, but should not be subjected to unnecessary rough handling or abuse.

(2) Care should be exercised to avoid abuse of the telescopes, also to avoid placing undue strain on supporting members which would cause misalignment.

(3) Stops are provided, limiting the deflection motion of the sighting system. Do not attempt to travel past these stops, as injury to the deflection system may result. Unnecessary turning of screws or other parts not incident to the use of the sighting system is expressly forbidden.

(4) The link bracket on the sighting system will be damaged if the gun tube strikes the tarpaulin support while the gun is being elevated. So that this damage will not occur, the tarpaulin support must be removed before the gun is elevated. To facilitate removal of the tarpaulin support, grease the two mounting studs at regular intervals, and keep the studs free from dust and dirt.

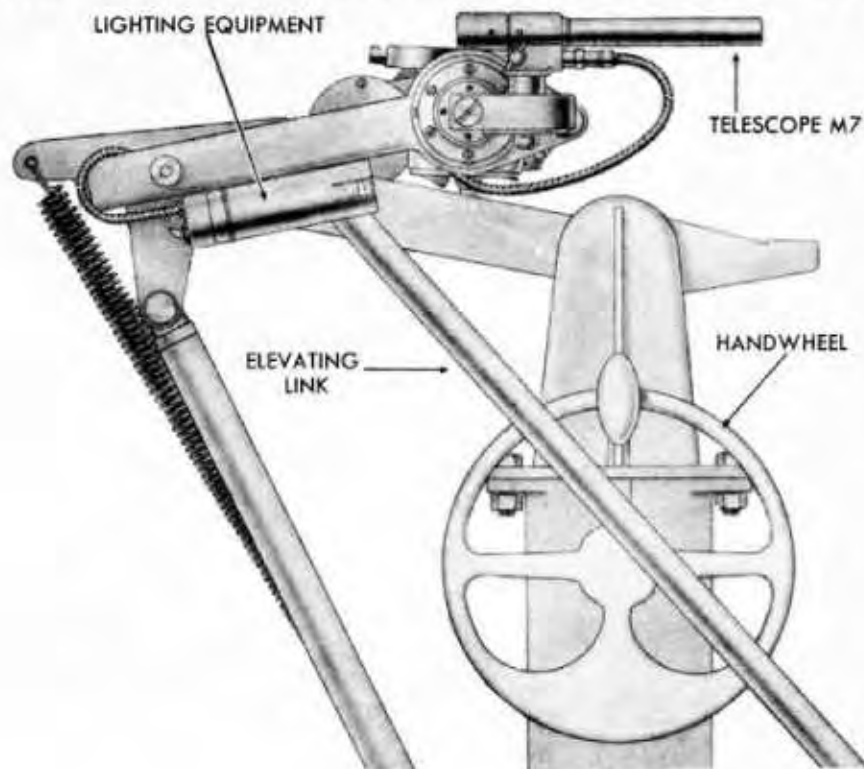


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Figure 163 - Sighting System M6 - Top View

SIGHTING EQUIPMENT FOR COMBINATION GUN MOUNT M42



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Figure 164 – Sighting System M6 – Right Side View

b. Lubrication.

(1) **GENERAL.** Oil cups are provided to permit lubrication of the segments and racks on each end of the system and the gearing mechanisms of the system. Use OIL, lubricating, for aircraft instruments and machine guns. Internal bearings will not need lubrication, as they are made of self-lubricating bronze.

(2) **RACK AND GEAR SEGMENTS.**

(a) An oil cup is mounted in the housing assembly on the azimuth side to permit lubrication of the rack and gear segment.

(b) A similar oil cup is mounted in the housing assembly on the elevation side to permit lubrication of the rack and gear segments.

(3) **DEFLECTION GEARS.** Oil cups are mounted in the bearings on each side of the system to provide lubrication of the vertical deflection gearing.

(4) An oil cup is provided in the supporting arm assembly to permit lubrication of the detent gearing.

(5) See that no oil touches the optical parts. Wipe all excess lubricant off the instrument to prevent accumulation of dust and grit.

c. Cleaning Optical Parts.

(1) Surfaces of telescope lenses must be kept clean and dry in order to prevent corrosion and etching.

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- (2) Use PAPER, lens, tissue, when wiping lenses and optical parts.
- (3) For further instructions on cleaning optical parts, refer to paragraph 65 d.

106. SIGHTING SYSTEM M6 (figs. 162 and 165).

a. **General.** Telescopes M7 and M64 are provided for the Sighting System M6. Telescope M7 is an azimuth (traversing) telescope. It is mounted in a holder at the left side of the system. Telescope M64 is an elevation telescope. It is mounted in a holder at the right side of the system. The only difference in the two telescopes is in the reticle pattern as shown in figure 162. A handle at the rear of the sighting system is used to shift the telescopes slightly in azimuth and elevation so as to set in deflection corrections based on observation of tracer fire. An illuminating device is furnished for use in night firing.

b. Telescopes M7 and M64.

(1) Telescope M7 is a 1-power, erect image telescope having a field of view of 11 degrees and an exit pupil diameter of 0.6 inch. A vertical and a horizontal line are etched on the reticle (fig. 162). The horizontal line is broken at the center while a vertical line continues through the field of view. The telescope has locating slots which position it in the holder so that the continuous line on the reticle is in a vertical position.

(2) The only difference between Telescope M7 and Telescope M64 is in the reticle pattern. The reticle pattern of Telescope M64 consists of horizontal graduations etched on the reticle to represent ranges of 400, 800, 1,300 and 1,700 yards, and marked 4, 8, 13, 17. A vertical line, broken at the center, is also etched on the reticle. This line and the top horizontal line, which is continuous through the field of view, establishes the geometric axis of the reticle. The reticle identification, 37 AA-N-2, is etched on the reticle at the bottom of the field of view (fig. 162). These markings show the reticle to be graduated in accordance with firing table 37 AA-N-2. The reticle is correct for H.E. Shell M54 and Practice Shell M55A1 used in the 37-mm Gun M1A2 when firing with a muzzle velocity of 2,500 feet per second. The graduations are compensated for initial jump.

c. **Lighting Device.** The lighting device (fig. 164) of the sighting system, consisting of two complete units, is provided to light the reticles of the two telescopes. Each unit consists of a battery tube containing two dry cell flashlight batteries, a plug and cord assembly, and a toggle switch. When toggle switch is turned to the "ON" position, the light from the lamp passes through the window in the under side of the telescope, thus illuminating the reticle.

d. Operation.

- (1) To pick up the target, the azimuth tracker brings the gun ap-

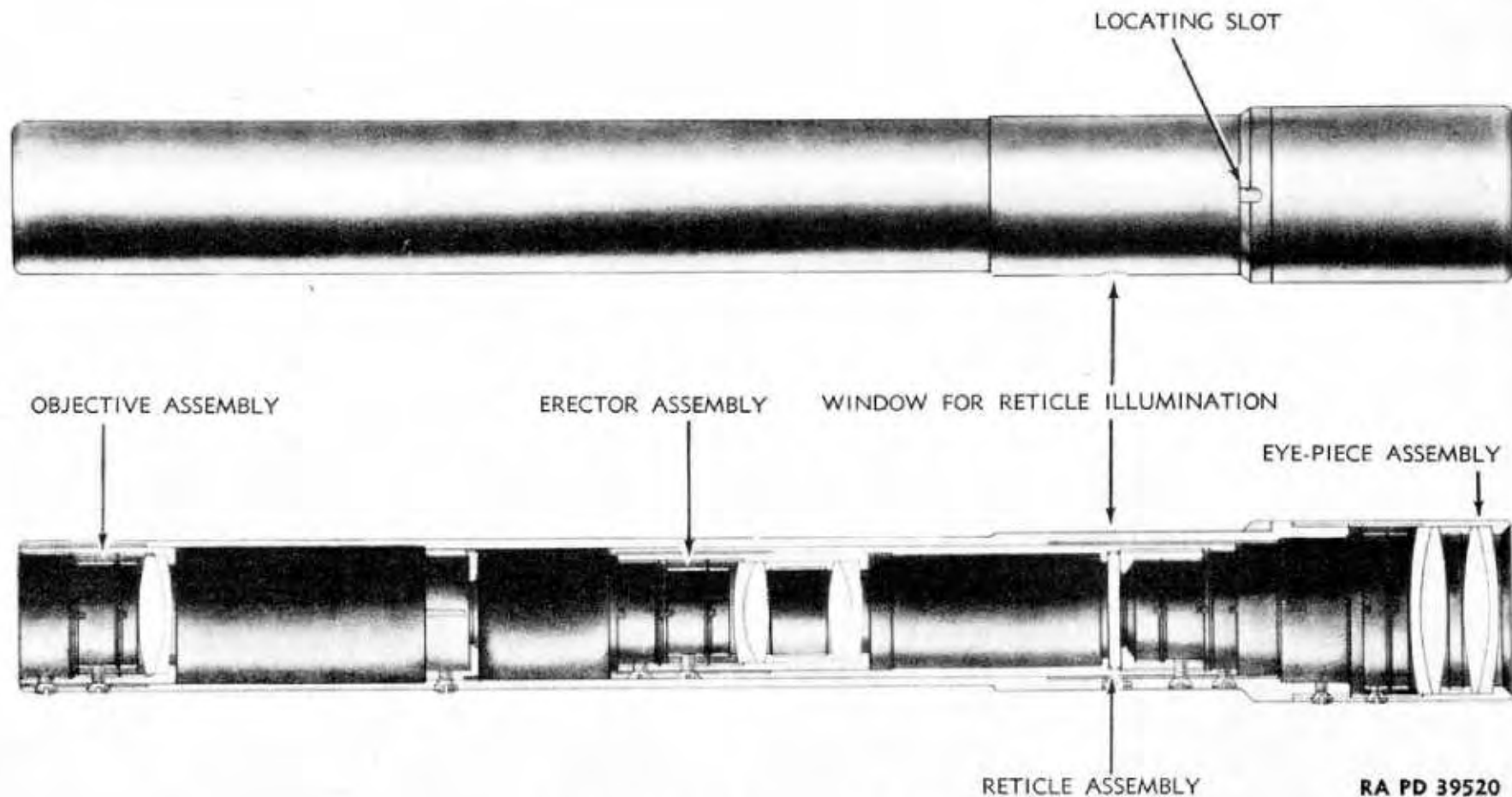


Figure 165 — Telescope M7 or M64

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37-MM AA GUN MATERIEL

proximately on the target in azimuth by sighting over the top of his telescope. The elevation tracker elevates or depresses the gun, bringing the gun approximately in line with the target.

(2) When gun is approximately on target, the azimuth tracker sights through his telescope. He tracks the target by traversing the gun so as to keep the vertical cross line of reticle centered on target. The elevation tracker sights through his telescope and elevates or depresses gun by means of elevating handwheel (fig. 164). In this manner he keeps the horizontal cross line of reticle on target.

(3) As soon as the target is picked up, the deflection operator sets in initial azimuth and elevation deflections. These initial deflections are based on estimate of conditions at the moment, such as direction and velocity of wind, distance and speed of target, etc.

(4) When firing starts, the deflection operator observes path of tracers, and changes deflections so as to bring fire on target.

(5) Both lateral and vertical deflections are set in by the same handle. Rotation of handle will set in lateral deflections. Vertical motion of handle will set in vertical deflections. Deflections in mils are indicated on the deflection dial and scale.

(6) Clockwise rotation of handle will turn telescopes to left, setting in a right deflection. Counterclockwise rotation of handle will turn telescopes to right, setting in a left deflection. An upward movement of handle will elevate the telescopes, setting in a minus deflection. A downward movement of handle will depress the telescopes, setting in a plus deflection.

(7) Observing the path of tracers, the operator sets in deflections so as to bring fire on target as follows:

- (a) Rotation of handle clockwise will move tracers to right.
- (b) Rotation of handle counterclockwise will move tracers to left.
- (c) Elevation of handle will depress the tracers.
- (d) Depression of handle will lift the tracers.

(8) The vertical deflection locking plunger (fig. 163) can be used to lock the vertical deflection at zero deflection when firing on ground or water-borne targets. The plunger will operate when the cross pin is turned to enter the deep slot, but will not operate when the cross pin is turned to enter the shallow slot.

e. Tests and Adjustment.**(1) GENERAL.**

(a) At regular intervals, the telescopes must be tested to make certain that they are parallel with the bore of the gun. This test and adjustment is referred to as "bore sighting." To determine whether telescopes require adjustment, proceed as follows:

SIGHTING EQUIPMENT FOR COMBINATION GUN MOUNT M42

(b) *Equipment and Preliminary Procedure.*

1. Equipment required for bore sighting consists of bore sights and a testing target. A sharply defined distant aiming point may be used instead of a testing target. The testing target is a paper sheet marked with accurately spaced aiming points to show the lines of sight through the gun bore and the individual telescopes. The testing target should be supported square with the gun, about 50 yards in front of the muzzle, and true with a plumb line. It should be moved if necessary until the bore aiming point is seen centered in the bore sights. The bore sights are metal disks which fit accurately in the breech and muzzle openings of the gun. Holes centered in the bore sights permit sighting on a line through the center of the gun bore.

2. Level the gun carriage.

3. By means of the bore sight, aline the gun on the testing target or on an object about 750 yards distant.

4. Turn deflection handle until lateral deflection dial and vertical deflection scale indicate zero (fig. 164).

5. Cross lines in both telescopes should coincide with respective cross lines on testing target, or with the distant target.

(2) AZIMUTH ADJUSTMENT.

(a) If both telescopes are out of adjustment, proceed as follows:

1. Turn deflection handle until vertical cross line of elevation telescope coincides with its cross line of test target.

2. Loosen azimuth clamping screw on lower end of telescope holder shaft and turn adjusting worm (fig. 163) until vertical cross line of this telescope coincides with its cross line on test target. Tighten clamping screw.

CAUTION: Do not disturb the adjustment when tightening clamping screw.

3. Loosen the three screws clamping the azimuth deflection dial (fig. 163), and turn dial until it indicates zero. Tighten screws, exercising care not to disturb adjustment.

(b) If azimuth telescope alone is out of adjustment, proceed as described above.

(c) If elevation telescope alone is out of adjustment, it is not necessary to adjust it for azimuth unless error is very great, as azimuth tracking is accomplished by using azimuth telescope.

(3) ELEVATION ADJUSTMENT.

(a) Keep gun bore sighted on testing target (or distant target). Elevate or depress deflection handle until vertical deflection scale indicates zero.

37-MM AA GUN MATERIEL

(b) The horizontal cross lines of both telescopes should coincide with the respective lines on testing target (or with distant target).

(c) If both telescopes are out of adjustment, proceed as follows:

1. Elevate or depress handle until horizontal cross line of elevation telescope coincides with its cross line on testing target.

2. Loosen set screw on scale assembly and slip the vertical deflection scale until it reads zero.

3. The azimuth telescope should not require adjustment for elevation, as both telescopes are adjusted when assembled. After proper adjustment by manufacturer, end bearings were pinned to the flanges so that the two telescopes should always remain in adjustment with each other.

4. However, in case the azimuth telescope is slightly out of adjustment in elevation, do not attempt to adjust it, as regard elevation because elevation tracking is accomplished with the elevation telescope.

f. Cleaning.

(1) To obtain satisfactory vision, it is necessary to keep exposed surfaces of lenses and other parts clean and dry.

(2) When wiping optical parts, use PAPER, lens, tissue.

CAUTION: Under no conditions should polishing liquids, pastes, or abrasives be used for cleaning lenses.

(3) Keep optical parts free from oil and grease. Do not touch lenses or windows with fingers. In case oil does come in contact with lens, apply SOAP, liquid, lens cleaning, with a tuft of PAPER, lens, tissue; then rub gently with clean PAPER, lens, tissue. If SOAP, liquid, lens cleaning is not available, breathe heavily on lens and wipe with clean PAPER, lens, tissue.

(4) Moisture, caused by condensation, may collect on optical parts. If not too great, this moisture can be removed by placing the instrument in a warm place.

CAUTION: Do not apply strong concentration of heat, as it is liable to cause unequal expansion of parts and result in breakage.

g. Transporting and Storing.

(1) When preparing telescopes for traveling or storing, remove them from holders, install dust caps, and place telescopes in packing chest especially provided.

(2) After exposure to wet weather, dry the telescopes before placing them in packing chest. If possible, store them in a warm, dry place.

(3) When storing the carriage, or whenever lighting equipment is

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not in use for more than 1 day, remove dry cells from battery tube. This will prevent damage to tube caused by chemical reaction taking place as dry cells deteriorate.

(4) Exhausted batteries must be removed immediately. Removal may become difficult if this precaution is not observed.

Section XII

AMMUNITION

107. GENERAL.

a. Ammunition for the GUN, automatic, AA, 37-mm, M1A2, is issued in the form of fuzed complete rounds of fixed ammunition. A complete round consists of a primer and a propelling charge, contained in a cartridge case which is rigidly crimped to the projectile, that is, all the ammunition components used in firing the gun once. The term "fixed" signifies that the propelling charge is not adjustable and that the round is loaded into the gun as a unit.

108. NOMENCLATURE.

a. Standard nomenclature is used herein in all references to specific items of issue. Its use for all purposes of record is mandatory.

109. FIRING TABLES.

a. For applicable firing tables, see section XVII.

110. CLASSIFICATION.

a. Dependent upon the type of projectile, ammunition for this gun is classified as high-explosive, armor-piercing, or practice. The high-explosive projectile is designed to produce effect by fragmentation of the shell body and within a smaller area by detonation; therefore, it has a relatively thin wall and a large bursting charge of high-explosive filler. Solid shot containing no explosive and thick-walled shell containing a small amount of high explosive are used for penetrating armor plate. The practice projectile, fitted with a dummy fuze, is an inert shell containing no filler. In all other respects it is similar to the high-explosive shell. All projectiles used in this weapon are fitted with a tracer element, built into the base, to provide a means of observing the projectile's path in flight. The tracer assembly of the high-explosive shell is known as a "shell-destroying tracer" because it is so arranged that it will detonate the bursting charge, should the projectile fail to strike a target or fail to function upon striking a target.

37-MM AA GUN MATERIEL

111. IDENTIFICATION.

a. **General.** Ammunition is completely identified by marking on original packing container (par. 117). Once removed from its packing, it may be identified by painting and marking (including ammunition lot number) as described in subparagraph d, below. The muzzle velocity of projectiles may be obtained from the firing tables. See figures 166 to 170 and the paragraphs below.

b. **Model Designation.** To identify a particular design, a model designation is assigned at the time the model is classified as an adopted type. This model designation becomes an essential part of the nomenclature and is included in the marking on the item. The present system of model designation consists of the letter "M" followed by an Arabic numeral. Modifications are indicated by adding the letter "A" and the appropriate Arabic numeral. Thus M55A1 indicates the first modification of an item for which the original model designation was M55.

c. **Ammunition Lot Number.** When ammunition is manufactured, an ammunition lot number, which becomes an essential part of the marking is assigned in accordance with pertinent specifications. This lot number is stamped or marked on each complete round and on all packing containers. It is required for all purposes of record, including reports on condition, functioning, and accidents, in which the ammunition is involved. To provide for the most uniform functioning, all of the rounds of any one lot of fixed ammunition consist of: projectiles of one lot number, fuzes of one lot number, primers of one lot number, propellant powder of one lot number. Therefore, to obtain the greatest accuracy in any firing, successive rounds should be from the same ammunition lot, whenever practicable.

d. **Painting and Marking.**

(1) **PAINTING.** All projectiles are painted primarily to prevent rust. Secondary purposes are: to provide, by the color, a ready means of identification as to type; and, in addition, in the case of high-explosive ammunition formerly painted yellow, to provide camouflage. The color scheme is as follows:

Armor-piercing	Black; marking in white
High-explosive	Olive-drab; marking in yellow
Practice	Blue; marking in white

(2) **MARKING.** The following information is marked on the ammunition:

(a) *On the Projectile (Stenciled).*

1. Caliber and type of gun in which fired.
2. Model of shell.
3. "WITH TRACER."
4. Ammunition lot number.

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5. Lot number of filled projectile. (Ordinarily the projectile lot number is not required after the complete round is assembled. Hence, it is stenciled below the rotating band, in which position it is covered by the neck of the cartridge case.)

(b) On the Base of Cartridge Case (Stenciled Unless Otherwise Indicated).

1. Loader's initials.
2. Model of shell.
3. Cartridge case lot number (stamped in the metal).
4. Caliber and model of cartridge case (stamped in the metal).
5. Manufacturer's initials (stamped in the metal).
6. Year of manufacture (stamped in the metal).

112. CARE, HANDLING, AND PRESERVATION.

a. General. Ammunition is packed to withstand conditions ordinarily encountered in the field. Care must be taken to keep packing containers from becoming broken or damaged. All broken containers must be repaired immediately and careful attention given to the transfer of all markings to the new parts of the container.

b. Since explosives are adversely affected by moisture and high temperature, due consideration should be given the following:

(1) Do not break the moisture-resistant seal until ammunition is to be used. Ammunition removed from airtight containers, particularly in damp climates, is apt to corrode, thereby causing the ammunition to become unserviceable.

(2) Protect the ammunition, particularly fuzes, from high temperatures, including the direct rays of the sun. More uniform firing is obtained if the rounds are at the same temperature. Do not attempt to disassemble any fuze.

c. Ammunition should be protected from mud, sand, dirt, water, and grease. If the rounds become wet or dirty they should be wiped off at once. Verdigris or light corrosion should be wiped off. Ammunition should not be polished, however, to make it look better or brighter.

d. Explosive ammunition must be handled with appropriate care at all times. The explosive elements in primers and fuzes are particularly sensitive to undue shock and high temperature.

e. Rounds prepared for firing but not fired will be returned to their original condition and packings, and appropriately marked. Such ammunition will be used first in subsequent firings in order that stocks of opened packings may be kept at a minimum.

CAUTION: Do not handle duds. Because their fuzes are armed, and hence extremely dangerous, duds will not be moved or turned, but will be destroyed in place in accordance with directions in TM 9-1900.

37-MM AA GUN MATERIEL

113. AUTHORIZED ROUNDS.

a. The ammunition authorized for use in the GUN, automatic, AA, 37-mm, M1A2, is listed in table I below and is illustrated in figures 166 to 169. It will be noted that the nomenclature (standard nomenclature) completely identifies the round. Specific data pertaining to these rounds is listed in table II described in paragraph 115. The numbers in parentheses after the nomenclature in table I refer to the corresponding assemblies in table II.

**TABLE I — AUTHORIZED AMMUNITION
FOR GUN, AUTOMATIC, AA, 37-MM, M1A2**

Service Ammunition

SHELL, fixed, H.E., M54, w/TRACER, SD, and FUZE, P.D., M56, 37-mm auto. guns M1A2 and M9 (muzzle velocity 2,600 f/s)(1)

SHOT, fixed, A.P., M74, w/TRACER, 37-mm auto. gun, M1A2 (antiaircraft)(2)

SHOT, fixed, A.P.C., M59, w/TRACER, 37-mm auto. gun, M1A2 (antiaircraft)(3)

Target Practice Ammunition

SHELL, fixed, practice, M55A1, w/TRACER, and FUZE, dummy, M50, 37-mm auto. guns M1A2 and M9 (muzzle velocity 2,600 f/s)(4)

114. PREPARATION FOR FIRING.

a. Fixed rounds of 37-mm ammunition, once removed from their packings, are ready for firing.

115. DESCRIPTION OF AMMUNITION.

a. The ammunition authorized for use with the 37-mm GUN, automatic, AA, 37-mm, M1A2 (par. 113) is described in table II. The "assembly number" in table II refers to the number in parentheses following each item in table I. The "figure number" in table II refers to the figure number of the illustration wherein the item is shown.

116. FUZES.

a. **General.** A fuze is a mechanical device used with a projectile to explode it at the time and under the circumstances desired. The fuzes described herein are all assembled to the rounds as issued.

b. **Classification.** Fuzes may be classified as time, impact, or a combination of both. The point detonating fuze assembled to the high-explosive shell is an impact type which functions upon striking a resistant object. Since it is designed to function on impact with a very

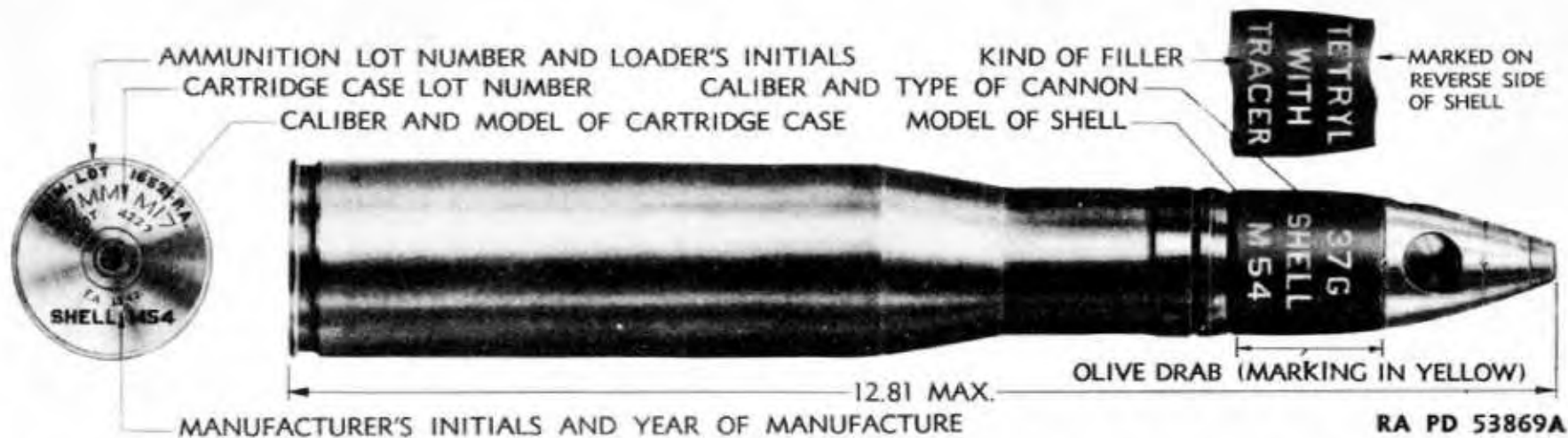


Figure 166 — SHELL, Fixed, H.E., M54, W/TRACER, SD, and FUZE, P.D., M56, 37-mm Auto. Guns, M1A2 and M9

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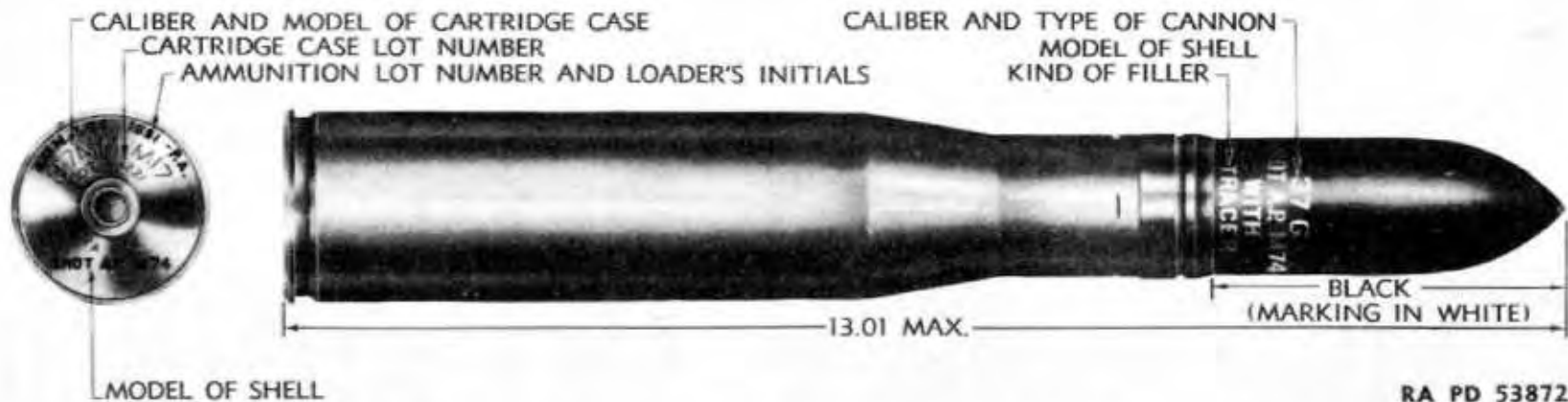


Figure 167 — SHOT, Fixed, A.P., M74, W/TRACER, 37-mm Auto. Gun, M1A2 (Antiaircraft)

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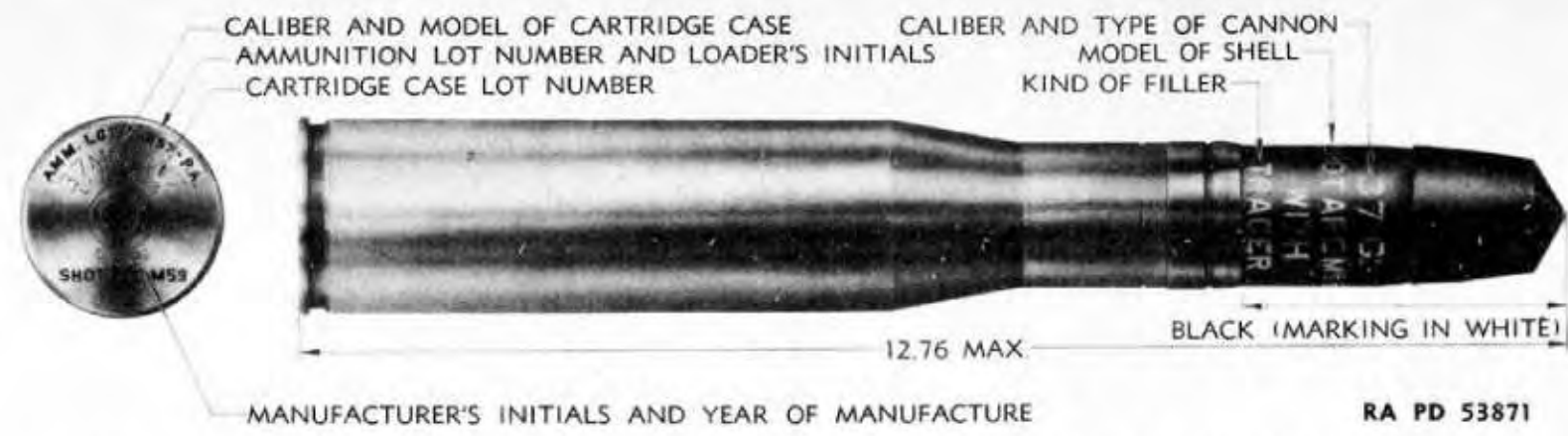


Figure 168 — SHOT, Fixed, A.P.C., M59, W/TRACER, 37-mm Auto. Gun, M1A2 (Antiaircraft)

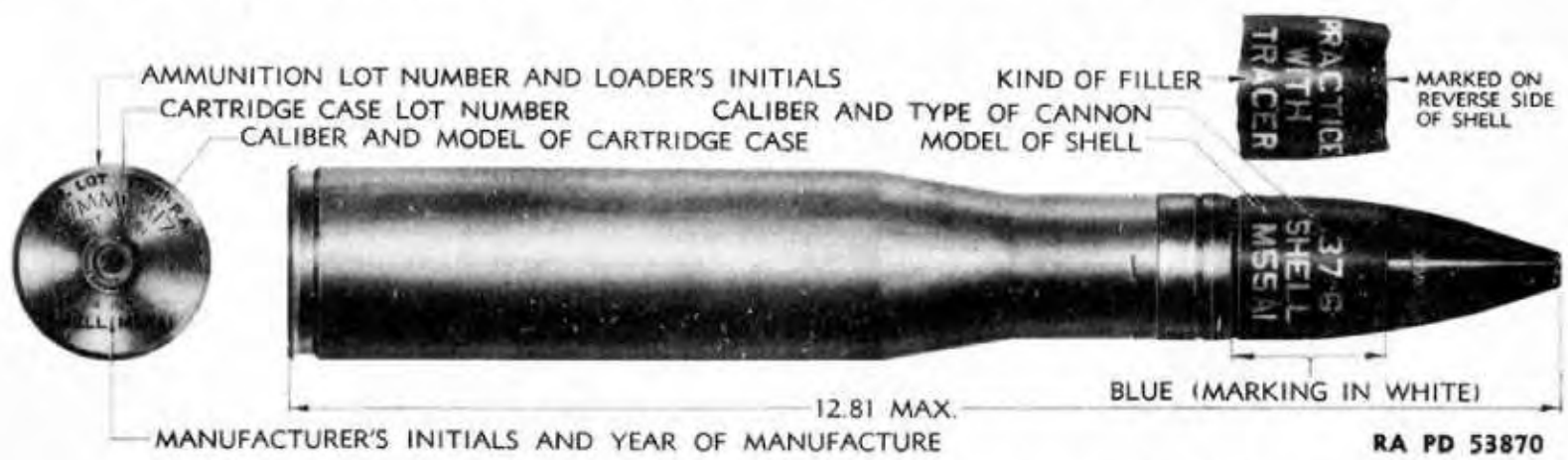


Figure 169 — SHELL, Fixed, Practice, M55A1, W/TRACER, and FUZE, Dummy, M50 37-mm Auto. Guns, M1A2 and M9

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light materiel target, such as an airplane wing or the envelope of a balloon, it is termed "superquick."

c. Boresafe Fuzes. Certain fuzes are considered "boresafe." A boresafe (detonator-safe) fuze is one in which the explosive train is so interrupted that, prior to firing and while the projectile is still in the bore of the cannon, premature functioning of the bursting charge is prevented should any of the more sensitive elements, primer, and/or detonator, malfunction. The FUZE, P.D., M56, is considered boresafe.

d. Fuze, P.D., M56.

(1) **DESCRIPTION.** This fuze, shown assembled to the projectile in figure 166, is a superquick type. The fuze is fitted with a firing pin and safety blocks which arm under rotational force after the projectile has left the bore of the gun. The arrangement of the firing pin is such that it will cause the fuze to function promptly on impact with any light materiel target. The fuze is further rendered boresafe by a centrifugally actuated interrupter, set on an angle, and carrying a section of the explosive powder train.

(2) **PREPARATION FOR FIRING.** This fuze being a single action type requires no setting or other preparation for firing.

e. Fuze, Dummy, M50. This fuze, shown assembled to the projectile in figure 169, is an inert fuze made of a plastic compound. It simulates the service fuze (subpar. d, above) in size, shape, and weight.

117. PACKING.

a. The fixed rounds of 37-mm ammunition are packed in individual fiber containers which in turn are packed 25 per wooden box (fig. 170), or they are packed 20 rounds per metal-lined wooden box. The former packing is currently standard. The following data are considered representative for estimating weight and volume requirements (for complete packing data see SNL P-5).

	AVERAGE Weight (lb)	VOLUME (cu ft)
Complete round without packing material.....	2.85	—
One round per fiber container, 25 containers (25 rounds) per wooden box	98.5	2.06
Over-all dimensions of packing box: 17in. x 13 ¹⁵ / ₁₆ in. x 15 ¹ / ₃₂ in.		
Twenty rounds in metal-lined packing box.....	85.	2.09
Over-all dimensions of packing box: 17 ¹ / ₈ in. x 12 ¹⁵ / ₁₆ in. x 16 ⁹ / ₃₂ in.		

TABLE II — 37-MM AMMUNITION

Assembly No.	Figure No.	PROJECTILE				CHARGE		COMPLETE ROUND		FUZE		PROPELLING CHARGE		PERCUSSION PRIMER	
		Kind	Type	Model	Weight as Fired (lb)	Kind	Weight (lb)	Weight (lb)	Length (in.)	Type and Model	Action	Powder	Weight (lb)	Model	Type
1	166	Shell	H.E.*	M54	1.34	Tetryl	0.10	2.62	12.81	P.D., M56	Super-quick	FNH	0.38	M23A2‡	20-gr.
2	167	Shot	A.P.†	M74	1.92	None	.....	3.07	13.01	None	.....	FNH	0.25	M23A2	20-gr.
3	168	Shot	A.P.C.†	M59	1.91	None	.....	3.12	12.76	None	.....	FNH	0.31	M23A2‡	20-gr.
PRACTICE AMMUNITION															
4	169	Shell	Practice†	M55A1	1.34	None	.....	2.62	12.81	Dummy M50	Inert	FNH	0.38	M23A2‡	20-gr.

A.P.—armor-piercing
 A.P.C.—armor-piercing capped
 FNH—flashless, nonhygroscopic
 gr.—grain

H.E.—high-explosive
 * with shell destroying tracer
 † —with tracer
 ‡ —rounds of earlier manufacture employed the 20-grain Percussion Primer M23A1

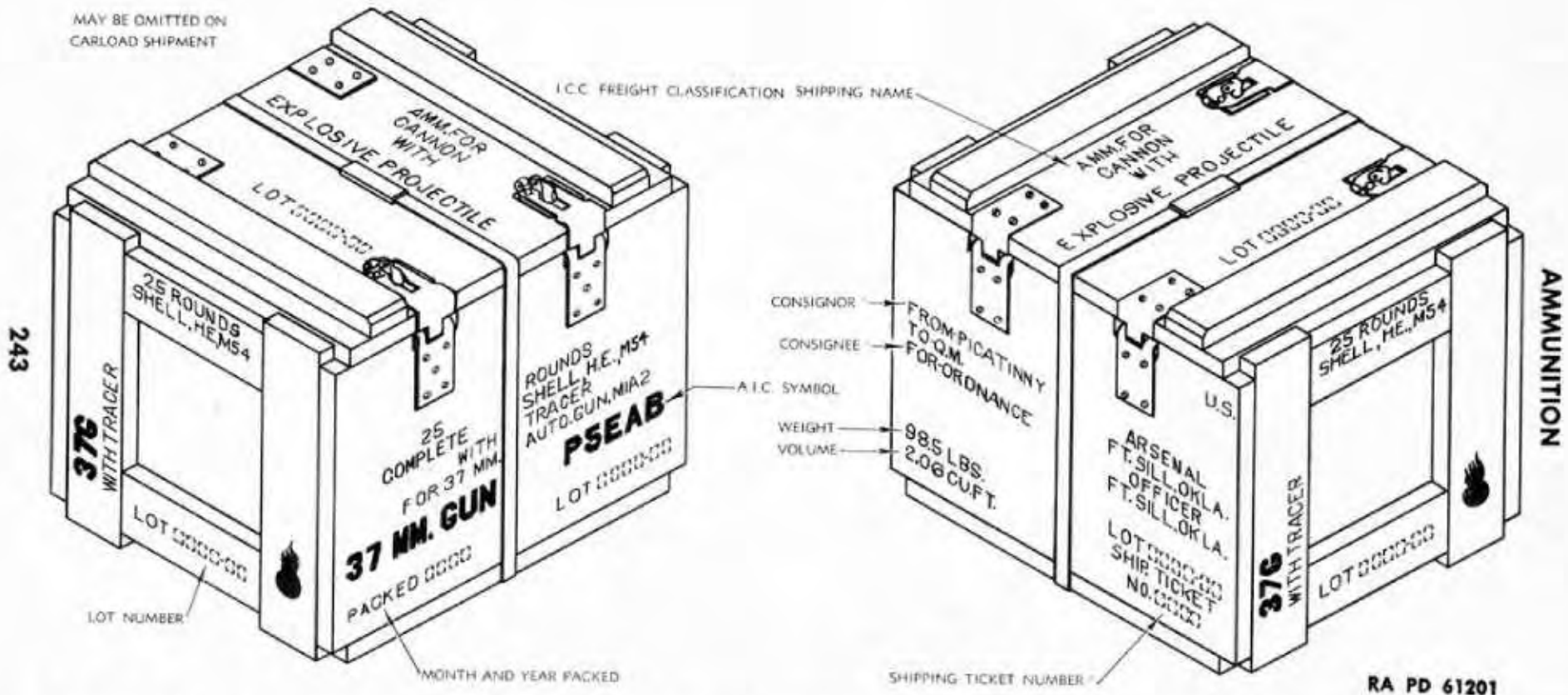


Figure 170 — Representative Marking of Packing Box for SHELL, Fixed, H.E., M54, W/TRACER, SD, and FUZE, P.D., M56, 37-mm Auto. Gun, M1A2 (Antiaircraft)

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b. Marking for Shipment. Markings required on all ammunition containers (boxes, crates, or packages) are as follows:

- (1) Nomenclature (standard nomenclature) of the item packed.
- (2) Lot number.
- (3) I.C.C. freight classification shipping name.
- (4) A.I.C. symbol (SNL P-5).
- (5) Weight.
- (6) Volume.
- (7) Final destination provided by shipping directive.
- (8) Consignee.*
- (9) Consignor.*
- (10) Shipping ticket number.*
- (11) U. S. number.*
- (12) Month and year packed.
- (13) Inspector's stamp.

118. FIELD REPORT OF ACCIDENTS.

a. When an accident involving the use of ammunition occurs during training practice, the procedure prescribed in AR750-10 will be observed by the ordnance officer under whose supervision the ammunition is maintained or issued. Where practicable, reports covering malfunctions of the ammunition in combat will be made to the Chief of Ordnance, giving the type of malfunction, type of ammunition, type of weapon, the lot number of the complete rounds or separate-loading components, and conditions under which fired.

Section XIII

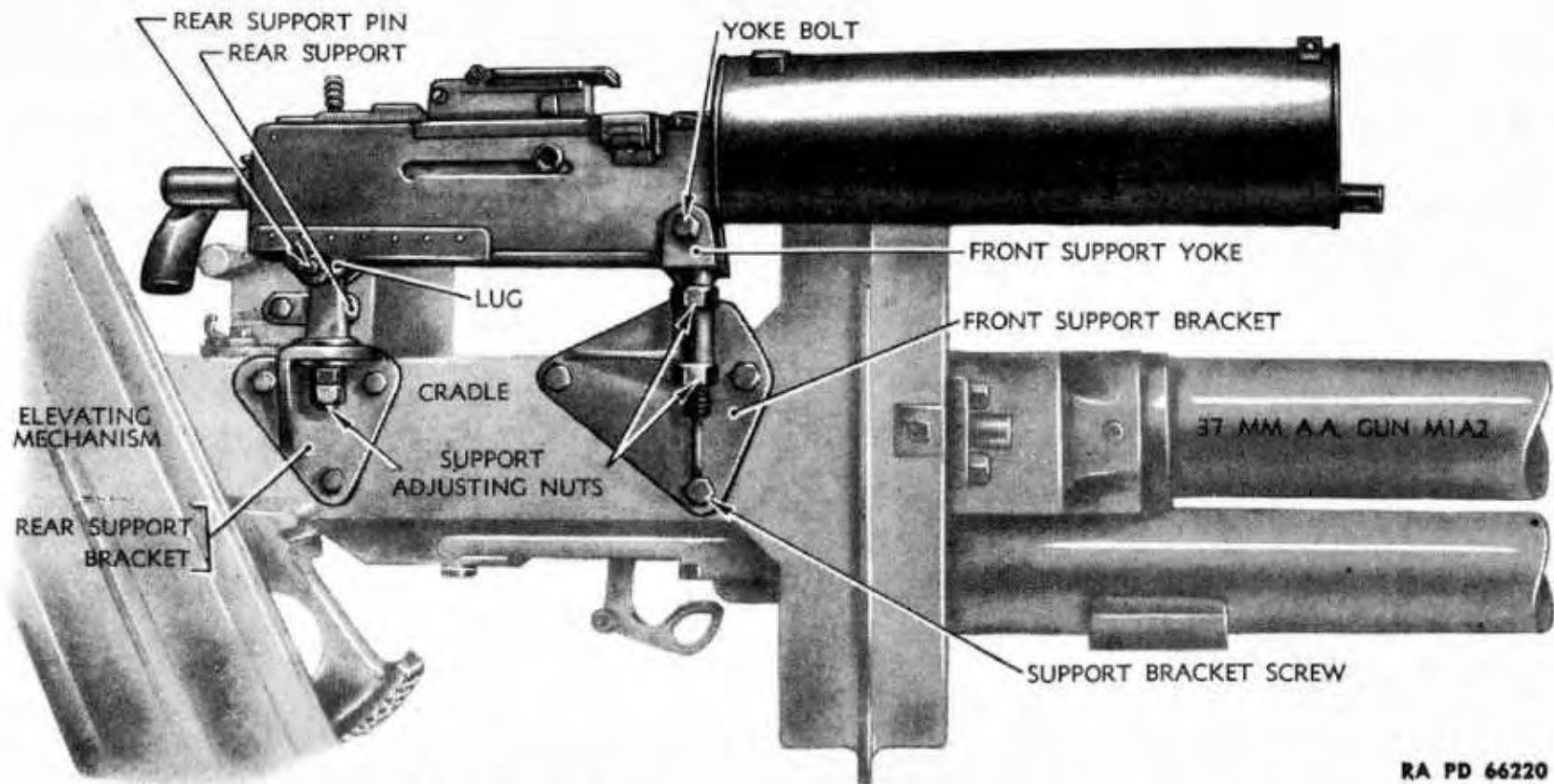
SUBCALIBER EQUIPMENT FOR CARRIAGES

M3 AND M3A1

119. PURPOSE.

a. Subcaliber equipment, which is used for training purposes only and is not taken into the theater of operations, consists of the Subcaliber Browning Machine Gun, cal. .30, M1917A1; water-cooled; the Subcaliber Mount M8 and accessories. This equipment is used to provide practice in laying and firing the 37-mm materiel. The use of small bore ammunition prevents wear on the regular piece during practice and is less costly. The actual handling, loading, and range obtained with sub-

* May be omitted on carload shipment.



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Figure 171 — Gun Support, cal. .30, Subcaliber Mount M8, for Carriage M3

37-MM AA GUN MATERIEL

caliber equipment are different from the service materiel. Full information concerning this gun, for using arms, is contained in FM 23-55.

120. LUBRICATION OF SUBCALIBER MOUNT M8.

a. For Mount M8, use engine oil in the grades recommended for the 37-mm Gun Carriages M3 and M3A1 (par. 55). Engine oil shall be applied lightly to all exposed and moving parts weekly, when gun is not being fired, and daily, when being fired. Exposed and moving parts should be wiped clean before lubrication. At all times when not being fired, Mount M8 (including the trigger mechanism, brackets, and gun), should be protected from the weather by a tarpaulin and inspected daily for signs of rusting.

121. DESCRIPTION OF SUBCALIBER MOUNT M8 FOR CARRIAGE M3.

a. **General** (fig. 171). Subcaliber Mount M8 for Subcaliber Machine Gun, cal. .30, M1917A1 on Carriage M3 is bolted to the right side of the 37-mm gun cradle. In addition to the brackets and bolts holding the gun to the cradle, the gun is provided with a trigger mechanism for firing the subcaliber gun. The trigger mechanism on the actuating lever support is secured to the rear support of the gun mount by two actuating lever support screws.

b. **Front Support.** The front of the gun is supported by the front support yoke resting in a triangular-shaped bracket, bolted to the right side of the 37-mm gun cradle. A U-shaped yoke supports the front part of the gun (mechanism) and is secured with a pin, locked by a cotter pin. The lower threaded portion of the yoke is secured in the front support bracket by adjusting nuts. To give small changes in range, the adjusting nuts raise or lower the front end of the gun by tightening or loosening them as the case may be and by drawing them tight against the bracket slot.

c. **Rear Support.** The rear support of the gun consists of a T-shaped, rectangular block having a projection toward the center of the carriage. The lower threaded portion of the support slides horizontally (in azimuth) in a slot in the rear bracket. The rear end of the gun pivots vertically for change in range.

122. OPERATION OF TRIGGER FIRING MECHANISM, SUBCALIBER MOUNT M8 (fig. 172).

a. Depression of the foot pedal on the foot firing mechanism of the carriage moves the foot firing cam, pushing the firing rod upward. The longer arm of the actuating lever moves upward, rotating on the actuating lever pin. The shorter arm of the actuating lever lifts the trigger rod. The trip rod passes through a hole in the pin of the trigger lever,

SUBCALIBER EQUIPMENT FOR CARRIAGES M3 AND M3A1

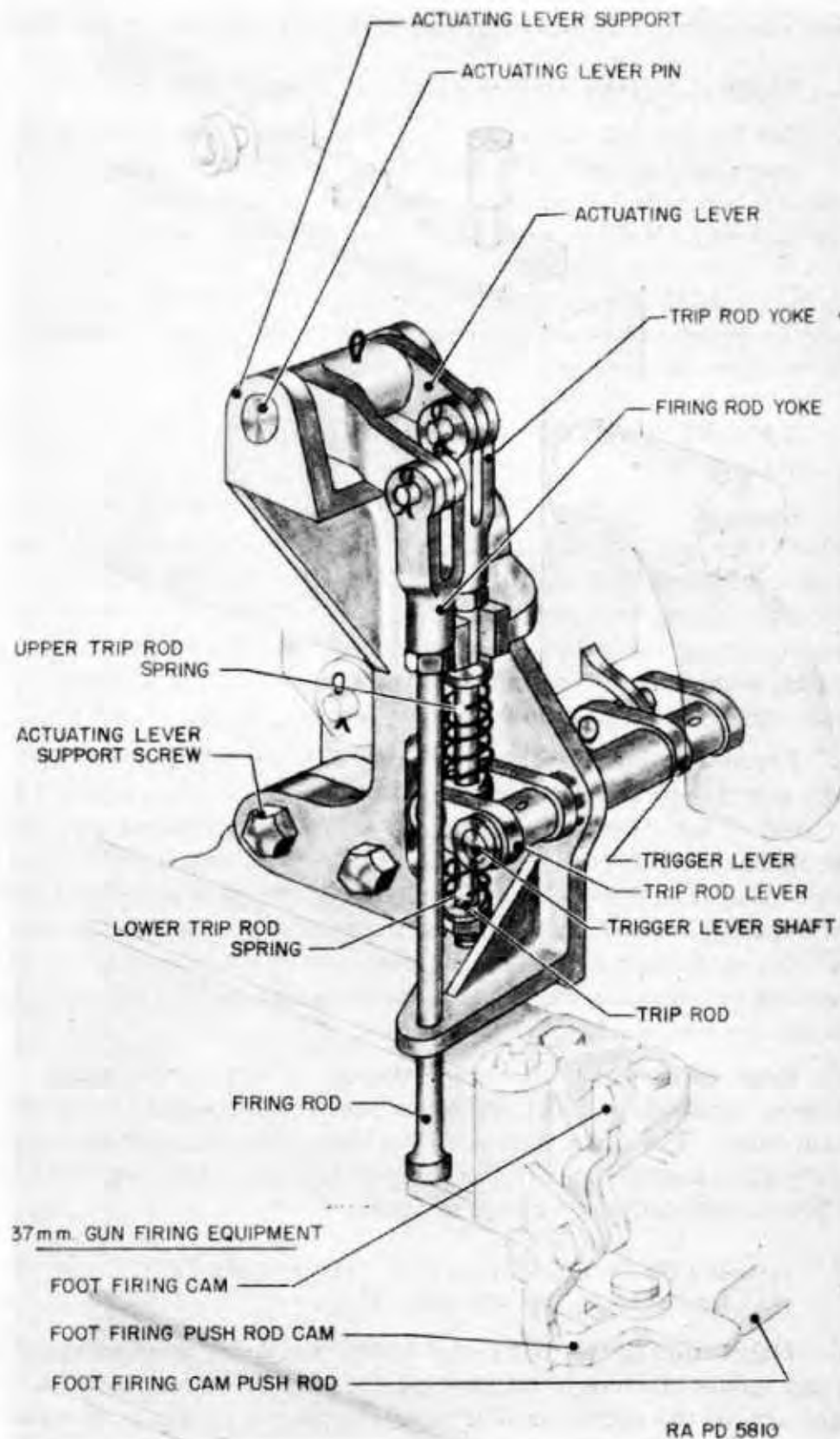


Figure 172 – Subcaliber Firing Mechanism Mount M8 for Carriage M3

37-MM AA GUN MATERIEL

held in place by the upper and lower trip rod springs. When the trip rod lever moves upward, the trigger lever also moves upward. The trigger lever trips the trigger of the gun. The gun will continue to fire as long as the pedal is held down and ammunition supplied.

123. DISASSEMBLY AND ASSEMBLY OF SUBCALIBER MOUNT M8.

a. **Removing Gun From Mount.** Supporting the gun with the hand, remove the yoke bolt. Drive out rear support pin after cotter pin has been removed. Lift gun out of supports and set in level place.

b. **Removing Firing Mechanism.** Supporting the firing mechanism with the hands, remove actuating lever support screws. Remove the assembly.

c. **Disassembly of Firing Mechanism.**

(1) Remove firing rod by driving out the pin which supports the rod in the yoke.

(2) Remove firing rod yoke by loosening firing rod yoke nut. Unscrew firing rod yoke.

(3) Remove cotter pin holding trip rod castle nut and remove nut and the lower trip rod spring and washer.

(4) Remove pin securing trip rod to yoke. Holding trip rod collar, upper spring, and washers with the hand, slip trip rod from trip rod lever, trip rod collar, and actuating lever support.

(5) Remove trip rod yoke from trip rod by removing trip rod adjusting nut. Unscrew rod yoke.

(6) Slip trip rod lever and trigger lever from trigger lever shaft after taper pins have been taken out. Drive trigger lever shaft from actuating lever support.

d. **Disassembly of Mount.** Remove front support yoke and rear support by removing support adjusting nuts. Unscrew support bracket screws and remove front and rear support brackets from cradle. Remove ammunition box support by unscrewing ammunition chest support screws.

e. **Assembly.** Reverse the operations described above.

Section XIV

ORGANIZATIONAL SPARE PARTS AND ACCESSORIES

124. ORGANIZATIONAL SPARE PARTS.

a. A set of spare parts is supplied to the using arms for field replacement of those parts most likely to become broken, worn, or otherwise

ORGANIZATIONAL SPARE PARTS AND ACCESSORIES

unserviceable. The set should be kept complete at all times by requisitioning new parts for those used. After it has been received, try each part as soon as practicable to see that it fits the materiel properly. Replace any parts which do not function properly. For listing of organizational spare parts for the 37-mm gun and carriages see SNL A-29; for Combination Gun Mount M42 see SNL A-29; and for cal. .50 machine gun see SNL A-37.

- b. Care of spare parts is covered in section VI.

125. ACCESSORIES.

- a. Accessories include the tools and equipment required for such disassembling and assembling as the using arms are authorized to perform, and for cleaning and preserving the guns, carriages, and mount. Accessories should not be used for purposes other than those prescribed, and when not in use should be properly stored. There are a number of accessories, the names or general characteristics of which indicate their use. Others embodying special features or having special uses, are described in the following paragraphs.

126. ACCESSORIES FOR 37-MM GUN AND CARRIAGE.

- a. **Ammeter (for Electric Brakes) A162447.** This ammeter (fig. 173) is used for measuring the current taken by the electric brakes of the carriage. It is used by connecting one terminal of the meter to one wire, and the other terminal of the meter to the point to which the wire is normally attached. When the current is supplied to the brakes this meter registers the current flowing through the brakes.

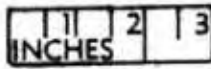
- b. **Ammunition Clip 37-mm, 10-round B163287.** The ammunition clip (fig. 173) is a long, narrow channel-shaped piece to which are riveted 10 spring clips. One round of ammunition is held by each spring clip. The loaded clip is fed into the gun through the opening in the left side plate of the feed box.

- c. **Artillery Gun Book.** The gun book (O.O. Form 5825, blank), is used for the purpose of keeping an accurate record of the materiel. It must always remain with the materiel regardless of where it may be sent. The book is divided as follows: Record of assignment, company commander's daily gun record, inspector's record of examination, as well as forms to be filled out in case of premature explosion. This book should be in possession of the organization at all times, and its completeness of records and its whereabouts are the responsibility of the company commander. It must also contain date of issuance of the materiel, by whom issued and the place where issued. If a new gun is installed on the mount or carriage, all data recorded in the book with reference to sights, carriages, etc., must be copied into the new book before the old book is relinquished.

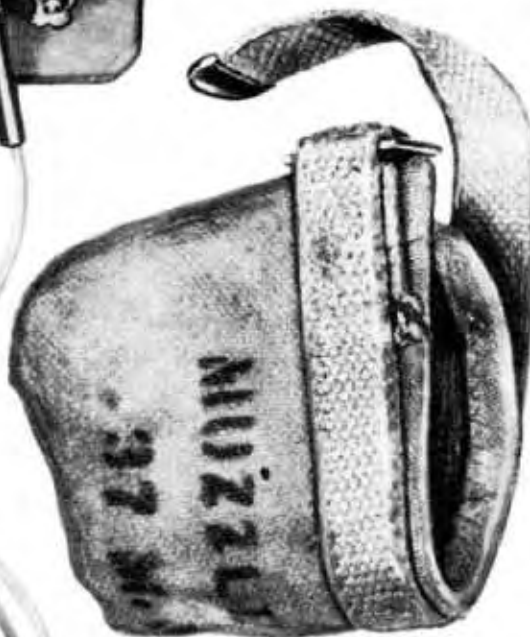
37-MM AA GUN MATERIEL



AMMETER



BORE BRUSH
37-MM, M8



MUZZLE COVER
37-MM GUN



AMMUNITION CLIP
37-MM, 10 ROUND

RA PD 19549

Figure 173 — Accessories for 37-mm Gun and Carriages

ORGANIZATIONAL SPARE PARTS AND ACCESSORIES

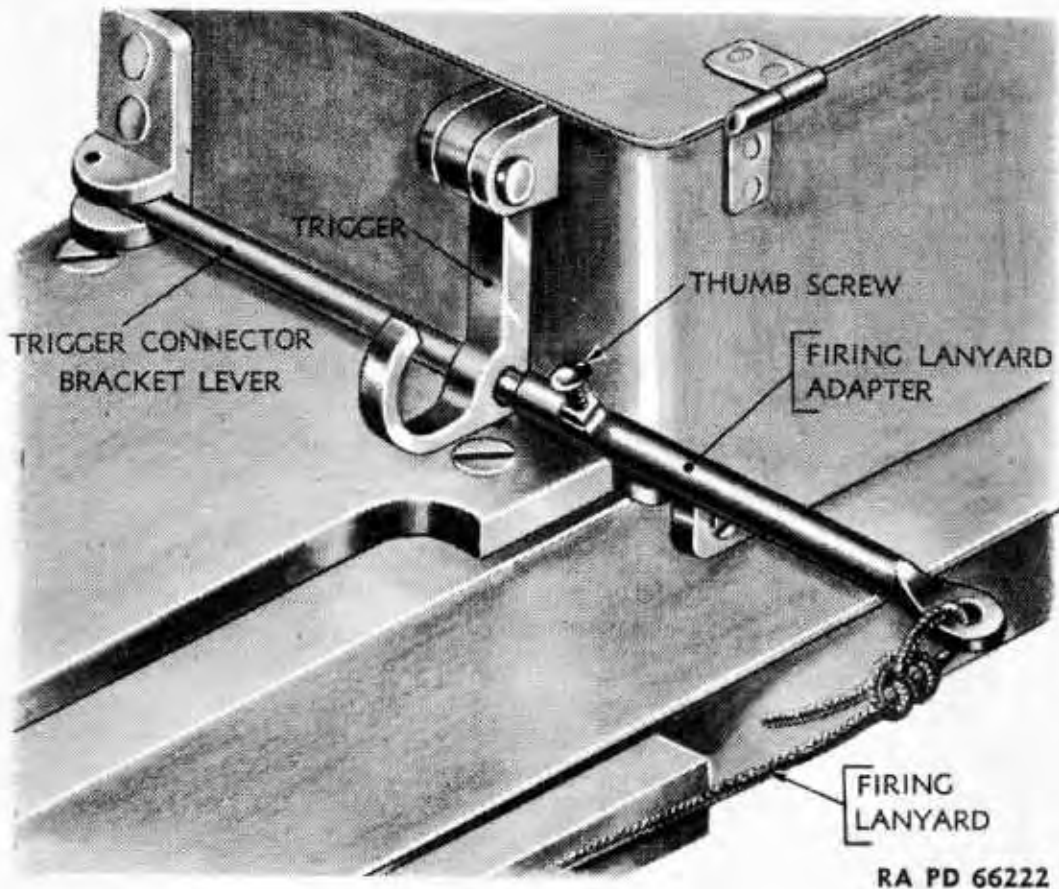


Figure 174 – Firing Lanyard Adapter

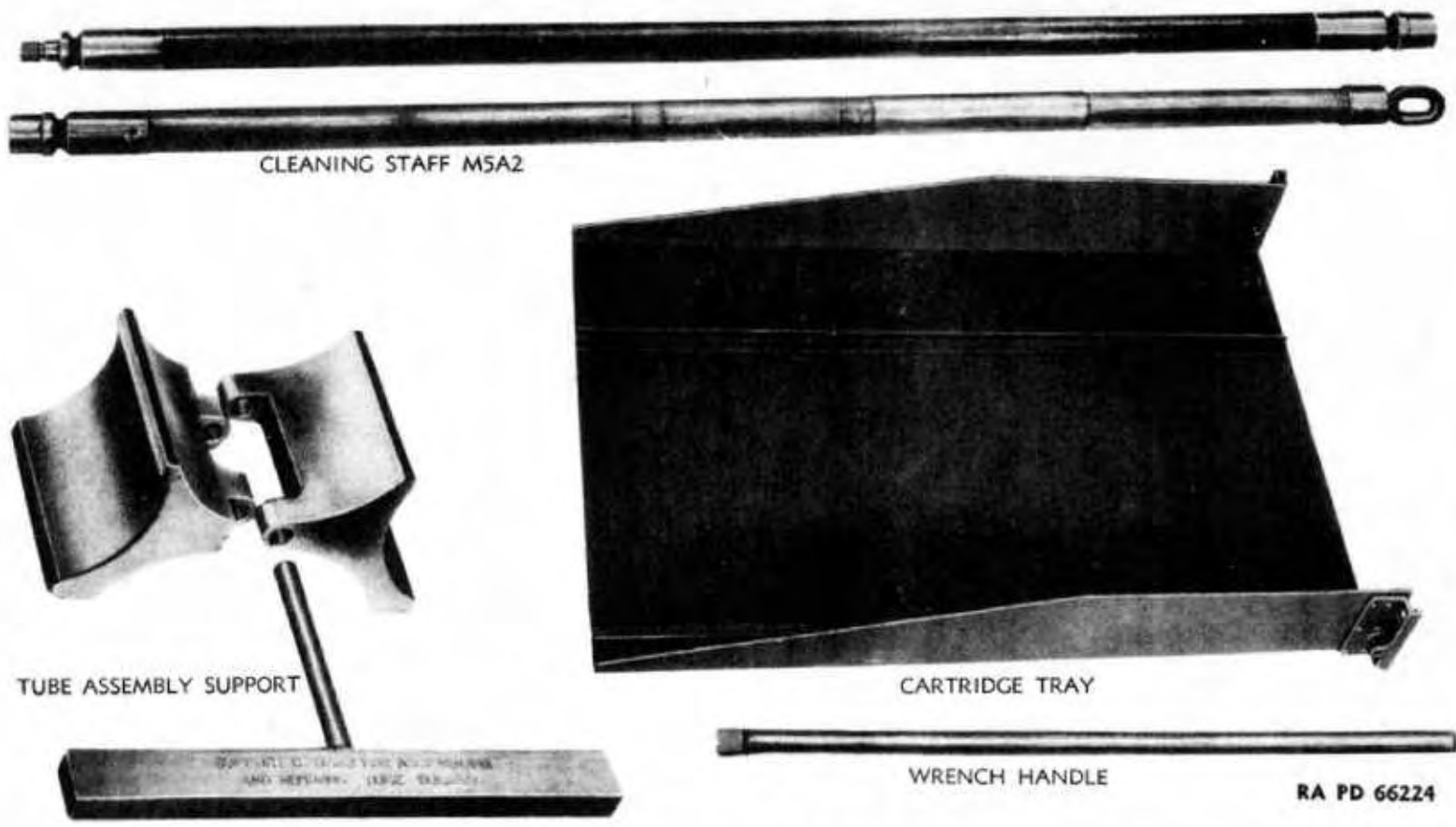
NOTE: Record of assignment data must be removed and destroyed prior to entering combat.

d. Bore Brush, 37-mm, M8, B157305. The bore brush (fig. 173) is used for cleaning and also for applying grease in the bore of the gun. The brush assembly consists of a coiled brush fitted on a male coupler and held securely by a nut. When needed, the brush is affixed to the cleaning staff.

e. Cartridge Tray. The cartridge tray assembly (fig. 175) supports the loaded ammunition clip as it feeds into the gun. This tray is of chute appearance and snaps to the left side plate of the feed box.

f. Cleaning Staff, M5A2, B154621. The cleaning staff (fig. 175) consists of two wooden staff sections fastened together with brass couplings. Its use with bore brush attached is cleaning bore of gun.

g. Counterpoise Cylinder Wrenches, B161475 and B161476. The counterpoise cylinder wrenches (fig. 176) are L-shaped having 1½- and 1¾-inch hexagon-head openings. These wrenches are used by placing the smaller inside the larger for adjusting counterpoise cylinder nuts.



CLEANING STAFF M5A2

TUBE ASSEMBLY SUPPORT

CARTRIDGE TRAY

WRENCH HANDLE

RA PD 66224

Figure 175 — Accessories for 37-mm Gun and Carriages

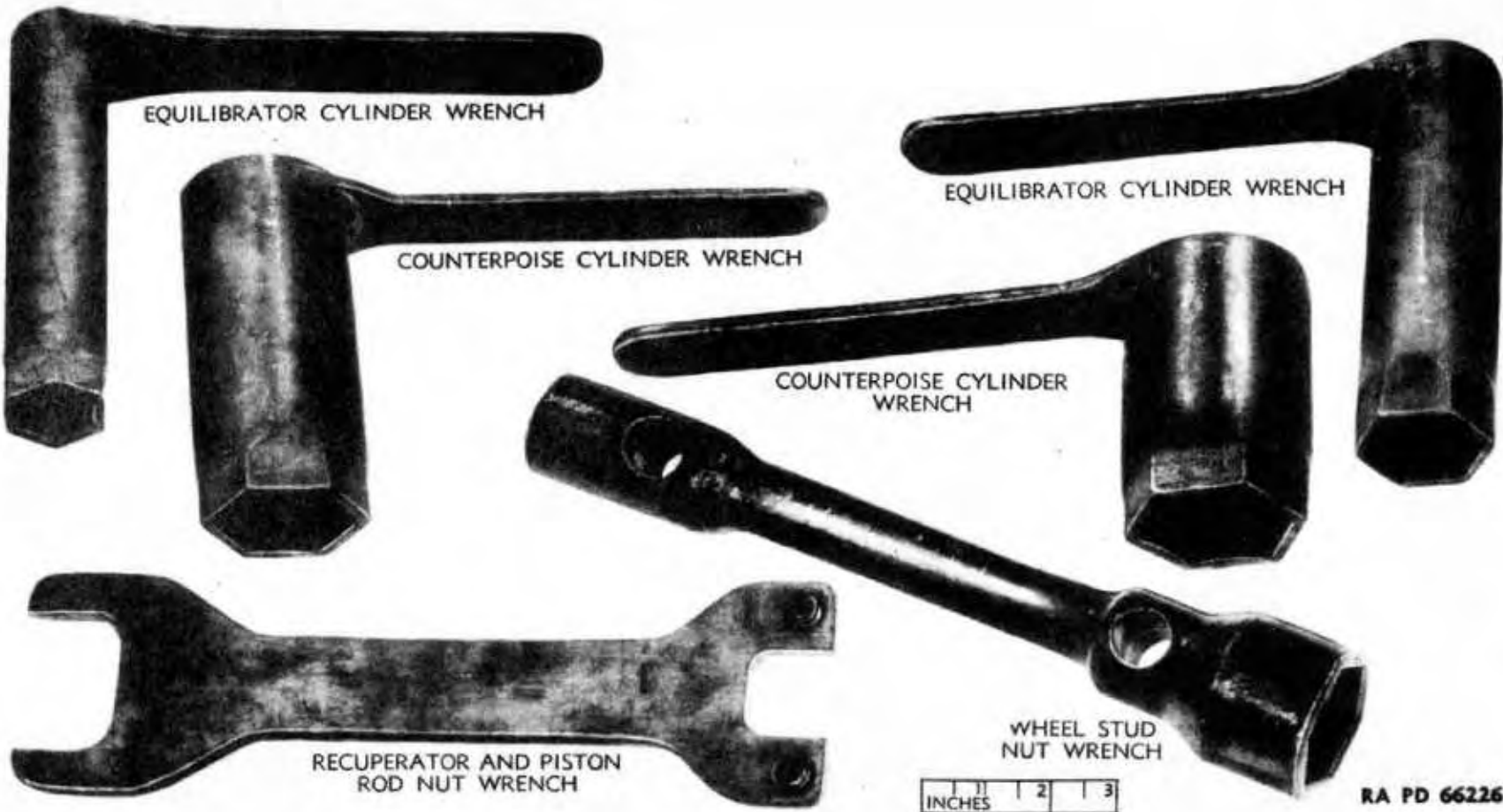


Figure 176 – Accessories for 37-mm Gun and Carriages

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h. Equilibrator Cylinder Wrenches, B161473, B161474. The equilibrator cylinder wrenches (fig. 176) are L-shaped having 1 $\frac{1}{8}$ - and 1 $\frac{1}{2}$ -inch hexagon-head openings. These wrenches are used by placing the smaller within the larger for removing and adjusting equilibrator cylinder nuts.

i. Firing Lanyard Adapter, A148867. This adapter (fig. 174) is inserted over the trigger connector bracket lever of the 37-mm gun for firing the gun at a safe distance. A thumbscrew is provided for securing the adapter to the lever. The foot firing mechanism lever which actuates the trigger connector bracket lever will have to be removed for installation of the firing lanyard adapter.

j. Gun Cooling System.

(1) The gun cooling system is used to water-cool the tube of the 37-mm gun after about 50 rounds of sustained fire at maximum rate has been completed. When single shots or bursts of less than 30 rounds are fired, the gun should be cooled after approximately 100 rounds. Never fire more than 100 rounds before cooling.

(2) The gun cooling system consists of one cal. .50 Water Chest M3 and two 2-ply braided cord rubber water hoses, one for the breech connection pipe and the other for the muzzle connection cap. The water hose used for the breech connection pipe consists of one female gooseneck coupling which is fitted to the outlet connection of the water chest and one threaded male connector which is fitted to the brass breech connection pipe female coupling. This coupling and connector are inserted into the hose and held firmly in place by steel clamps. The water hose used for the muzzle connection cap consists of one connection composed of a connection, nut, and bushing. This fits into the muzzle cap. This connection is inserted into the hose and held firmly by a steel clamp. The muzzle cap assembly composed of a handle, nut, rubber ring, and cap fits to the muzzle of the gun. The breech pipe assembly composed of a breech plug, rubber ring, pipe, and brass coupling fits into the breech of the gun. See paragraph 44 for further instructions on the use of this accessory.

k. Muzzle Cover 37-mm Gun, C53689. The muzzle cover (fig. 173) is of machine stitched cotton duck material, resistant to fire, water, and weather. The cover protects the muzzle of the gun when not in use or when traveling.

l. Priming Rod, B163769. The priming rod is a long hooked rod which is used to retract the lock from a short distance behind the gun.

m. Recuperator and Piston Rod Nut Wrench, B163290. This is a specially designed open-end wrench (fig. 176) used for removing the recuperator and piston rod nut.

STORAGE AND SHIPMENT

n. **Tube Assembly Support, C70603.** The tube support (fig. 175) is used to support the gun tube when removing it from the gun.

o. **Tube Wrench, B163292.** This is a 16-inch open-end wrench used to loosen the gun tube when unscrewing it from the gun.

p. **Wheel Stud Nut Wrench C59566.** This wheel stud nut wrench (fig. 176) with handle is used to remove the nuts which secure the wheel in place. This is a double hexagon-head socket wrench.

q. **Wrench Handle, B108566.** This handle (fig. 175) is used in conjunction with the wheel stud nut wrench.

Section XV

STORAGE AND SHIPMENT

127. PREPARATION FOR DOMESTIC SHIPMENT.

a. **General.** The 37-mm antiaircraft gun and carriage can be shipped and stored either with or without the gun mounted. All precautions should be taken to prevent corrosion during shipment and storage, keep the recoil mechanism exercised, and to prevent the deterioration of rubber during storage. The materiel should be prepared for both shipment and storage as directed in subparagraph b, below.

b. Preparation of 37-mm Gun and Carriage.

(1) **LUBRICATION.** The materiel should be completely lubricated before shipment or storage (pars. 54, 55, and 56).

(2) CLEANING.

(a) The materiel shall be thoroughly cleaned and made free of all foreign matter, using SOLVENT, dry-cleaning, or a soap solution.

(b) Special attention should be given to breech and firing mechanisms, and where possible a partial disassembly of these components should be made to insure thorough cleaning.

(c) Apply SOLVENT, dry-cleaning, by scrubbing with a clean brush or wiping with clean saturated cloths.

(d) Apply soap solution by vigorously brushing or scrubbing the surfaces thoroughly until all traces of contamination have been removed. Rinse the cleaned surfaces with clean, hot water and dry thoroughly.

(e) Avoid contact of bare hands with the cleaned surfaces.

(3) **PAINTING.** Painted surfaces that have become checked, pitted, or rusted must have the rust spots removed and the surfaces repainted.

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(a) *Removing Rust Spots.* The following may be used in removing rust spots:

1. CLOTH, abrasive, aluminum-oxide, for cleaning finished and unfinished external surfaces where wear of the parts cleaned will not affect the functioning of the mechanism.

2. CLOTH, crocus, for removing rust or stain and polishing parts of the breechblock and firing mechanism and other finished surfaces of metal.

(b) *Application of PRIMER, Synthetic, Rust-inhibiting.* Apply a liberal coating of PRIMER, synthetic, rust-inhibiting, over entire area of the cleaned surfaces to be repainted as follows:

1. *Brushing or Spraying.* PRIMER, synthetic, rust-inhibiting, should be used on bare metal as a base coat for synthetic enamel. It may be applied either by brushing or spraying. The primer will brush satisfactorily as received or after the addition of not more than 5 percent by volume of the proper thinner. For spraying, the primer may be thinned with not more than 15 percent by volume of THINNER. Allow to dry thoroughly.

(c) *Sandpapering Surfaces.* Sandpaper the primed surfaces with PAPER, flint, class B, No. 00, and wipe all particles of dust from surfaces.

(d) *Application of Enamel.* Apply coat of ENAMEL, synthetic, olive-drab, lusterless, and allow to dry thoroughly before the materiel is used.

(4) APPLICATION OF PRESERVATIVE. NOTE: Application of preservatives should be accomplished immediately after cleaning.

(a) Apply a coating of COMPOUND, rust-preventive, light, to the interior portions of the breech mechanism.

(b) Swab the bore of the 37-mm antiaircraft gun, using COMPOUND, rust-preventive, light.

(c) External unpainted surfaces of the 37-mm antiaircraft gun and carriage shall be coated with COMPOUND, rust-preventive, thin film. NOTE: Rubber equipment must be kept free from petroleum oils and greases including rust-preventive compound.

(5) COVERS. Install breech and muzzle covers supplied with materiel, and fasten securely.

(6) MISCELLANEOUS. Free end of brake hose and coupling shall be taped and tied securely to the carriage.

(7) GENERAL INSPECTION. Make a systematic inspection just before shipment or storage, and list all broken or missing items that are not repaired or replaced, and attach this list to the materiel.

STORAGE AND SHIPMENT

128. LOADING MATERIEL ON RAILROAD CAR.

a. General. All loading and blocking instructions as specified herein are minimum, and are in accordance with the Association of American Railroads, "Rules Governing the Loading of Commodities on Open Top Cars," special supplement, revised, 1, March 1943.

b. Instructions.

(1) **INSPECTION.** Railroad cars must be inspected to see that they are suitable to carry loads to destination. Floors must be sound and all loose nails or other projections not an integral part of the car should be removed.

(2) **RAMPS.** Permanent ramps should be used for loading the materiel when available, but when such ramps are not available, improvised ramps may be constructed of rail ties and other available lumber.

(3) **HANDLING.**

(a) Cars loaded in accordance with specifications given herein must not be handled in hump switching.

(b) Cars must not be cut off while in motion and must be coupled carefully, and all unnecessary shocks avoided.

(c) Cars must be placed in yards or sidings so that they will be subjected to as little handling as possible. Separate track or tracks, when available, must be designated at terminals, classifications, or receiving yards, for such cars, and cars must be coupled at all times during such holding and hand brakes set.

(4) **PLACARDING.** Materiel not moving in combat service must be placarded, "DO NOT HUMP."

(5) **CLEARING LIMITS.** The height and width of load must be within the clearance limits of the railroads over which it is to be moved. Army and railroad officials must check all clearances prior to each move.

(6) **MAXIMUM LOAD WEIGHTS.**

(a) In determining the maximum weight of load, the following shall govern, except where load weight limit has been reduced by the car owner.

Marked Capacity of Car	Total Weight of Car Load	Load Weight
40,000 lb	66,000 lb	66,000 (lb less lt. wt. of car)
60,000 lb	103,000 lb	103,000 " " " " " "
80,000 lb	136,000 lb	136,000 " " " " " "
100,000 lb	169,000 lb	169,000 " " " " " "
140,000 lb	210,000 lb	210,000 " " " " " "
200,000 lb	251,000 lb	251,000 " " " " " "

37-MM AA GUN MATERIEL

EXAMPLE

Capacity of car	100,000 lb
Total weight of car and load	169,000 lb
*Light weight of car (to be subtracted)	37,000 lb
Permissible weight of load	132,000 lb

(b) Load must be so placed on the car that there will not be more weight on one side of the car than on the other. One truck of the carrying car must not carry more than one-half of the load weight.

(7) BRAKE WHEEL CLEARANCE (A, fig. 177). Each railroad car must be loaded with a resulting brake wheel clearance of at least 6 inches in front, at each side and at the top. Brake wheel clearance shall be increased as much as is consistent with proper location of load.

(8) DISTRIBUTION OF LOAD. Materiel should be centered as nearly as possible so that equal weight bears on each truck of the car. NOTE: When loading railroad cars, materiel shall be so loaded as to require a minimum number of cars. To accomplish this, various types of materiel may be loaded on the same car, provided all have the same destination.

(9) BRAKES. After loading and bracing the materiel, set the hand brake.

(10) TIRES. Inflate the tires to 10 pounds per square inch above the prescribed pressure.

(11) TYPE OF CARS. Flat or drop end gondola cars may be used.

(12) DRAWBAR. Drawbars shall be detached from the carriage and placed on car floor securely braced and blocked. Space on car floor not otherwise utilized may be used for stowage of the drawbar.

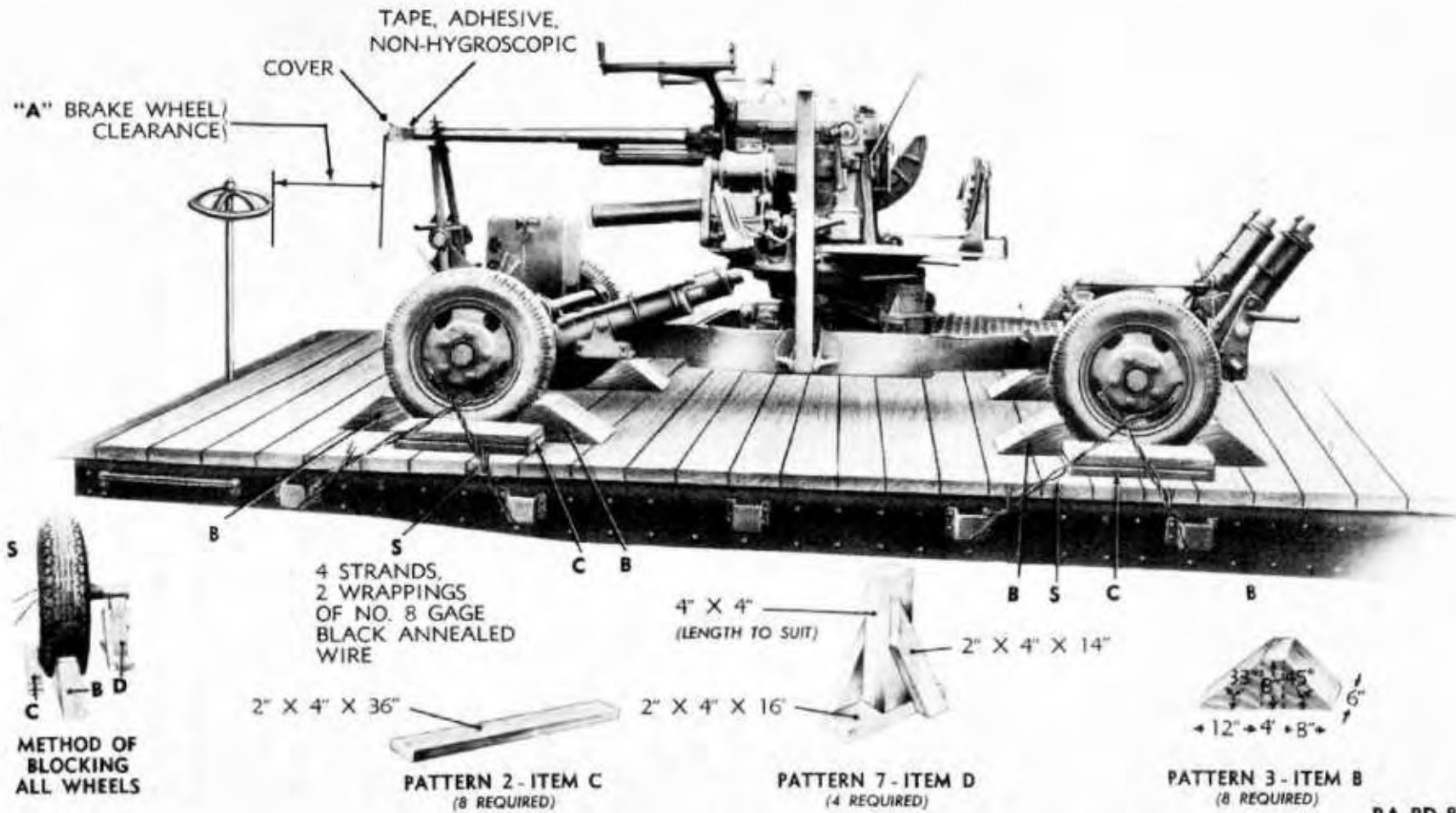
c. **Blocking.** All item reference letters given below refer to the details and locations in figure 177.

(1) PATTERN 3, ITEM B (8 PATTERNS 3 REQUIRED). Place one pattern 3 at the front and one at the rear of each wheel. Nail the heel of the pattern to the car floor with three 40-penny nails and toenail that portion under tire to car floor with two 40-penny nails before patterns 2 are applied.

(2) PATTERN 2, ITEM C (8 PATTERNS 2 REQUIRED). Place two patterns 2 on each side of the carriage against the outside of each tire. Nail the bottom pattern to the car floor with three 40-penny nails and the top pattern to the pattern below with three 40-penny nails.

(3) PATTERN 7, ITEM D (4 PATTERNS 7 REQUIRED). Place one pattern 7 under the axle near the inside face of each wheel. These patterns should be cut so as to fit snugly between the car floor and the

* This marking is stenciled on each side of car indicated as "LT.WT."



STORAGE AND SHIPMENT

Figure 177 — Method of Blocking 37-mm Antiaircraft Gun and Carriage on Railroad Car

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37-MM AA GUN MATERIEL

axle partially to relieve the weight from the tires. Nail each pattern to the car floor with six 40-penny nails.

(4) **STRAPPING, ITEM S.** Secure each wheel by passing wire consisting of 4 strands, 2 wrappings of No. 8 gage black annealed wire through two openings in the wheels and securing the wire to the stake pockets on each side of the car. Twist tie with rod or bolt enough to remove slack. The openings in the wheels through which the wire passes should be approximately the same distance from the car floor.

(5) **DRAWBAR.** Secure drawbar that has been removed from carriage to car floor by securely blocking and bracing.

129. LIMITED STORAGE INSTRUCTIONS.

a. When the 37-mm antiaircraft gun and carriage are stored uncrated, preparation will be in accordance with paragraph 127 b.

b. **Periodical Inspections.** Periodical inspections shall be made while the materiel is stored, to note among other things, general condition, missing parts, and the need for repairs. If found to be corroding at any part, the entire procedure as given in paragraph 127 b will be repeated.

c. Inspect the tires, repair any leaks that have developed, and inflate, if necessary.

Section XVI

OPERATION UNDER UNUSUAL CONDITIONS

130. GENERAL.

a. Because of the different climates in which this materiel may be expected to operate, special instructions are given in this section for operation under Arctic and tropical conditions.

b. "Arctic" means a climate such as usually is experienced in Alaska, Newfoundland, Labrador, or Iceland, and usually applies to temperatures constantly below zero degree F. "Tropical" means a climate usually experienced in Panama, the Philippines, or Cuba. Only extended and not temporary periods of climatic conditions govern the classification.

c. Materiel, previously lubricated for a colder climate, or a hotter climate than the one in which it is to be used should be relubricated with the lubricants prescribed for use in that climate.

131. TROPICAL CLIMATES.

a. **Lubrication.** Lubricate the gun and carriage with prescribed lubricants for temperatures above 32 F. as described in paragraphs

OPERATION UNDER UNUSUAL CONDITIONS

55, 56, and 57. In extremely hot climates, lubricate more frequently. If rusting of machine guns is experienced, they should be oiled with OIL, lubricating, preservative, medium.

b. Inspection and Care.

(1) Materiel should be inspected frequently when being operated in hot, moist areas. Covers and other items which may deteriorate from mildew or be attacked by insects or vermin should be aired and dried frequently.

(2) Tire pressures should be checked frequently and tires should be kept out of the direct sunlight as much as possible.

(3) Ammunition should be kept out of the direct rays of the sun. Moisture-resistant seals should not be broken until ammunition is to be used.

132. ARCTIC CLIMATES.

a. Lubrication. When preparing the gun and carriage for use in Arctic climates, all heavy lubricants must be removed and gear cases, etc. flushed out with SOLVENT, dry-cleaning, before applying lighter lubricants. Lubricate as described in paragraphs 54, 55, and 56.

b. Operation.

(1) Do not allow ice to form around any portion of the gun or carriage that will prevent its proper operation.

(2) Keep platform of carriage free from ice and snow to prevent injury to personnel which may be caused by insecure footing.

(3) Keep the breechblock thoroughly clean and lightly lubricated to prevent slow action of this part.

(4) CLEANING IN TEMPERATURES BELOW +32 F.

(a) The cleaning of a cold gun bore after firing cannot be accomplished in the normal manner at temperatures below 32 F. because the water in the cleaning solution will freeze in the tube. If cleaning cannot be done with the tube hot, it may be necessary to add alcohol, glycerine, or antifreeze (ethylene glycol type). To 10 parts by volume of cleaning solution, add the number of parts of one of the antifreezes as shown below:

Temperature (degrees F)	Glycerine	or	Alcohol	or	Ethylene Glycol
20	2½		2		2
10	5		4		3⅓
0	6½		6½		5
-15	10		9		7¼
-30	13		16		10
-40	16		27		12

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(b) If it is not possible to mix a cleaning solution with an antifreeze solution as indicated above, the bore may be cleaned with SOLVENT, dry-cleaning, or OIL, lubricating, preservative, special. This should only be done in an emergency as it is not effective as using the cleaning solution.

133. EXCESSIVELY MOIST OR SALTY ATMOSPHERES.

a. When the materiel is active, clean and relubricate exposed metal surfaces such as the gun bore, breech mechanism, and feed box mechanism more frequently, as water will emulsify with oils and greases and destroy their rust-preventive qualities. Inspect parts frequently for corrosion.

b. Canvas covers and other items that may deteriorate from dampness should be inspected frequently and dried as often as possible.

c. When the materiel is inactive, all unpainted surfaces should be covered with a film of COMPOUND, rust-preventive, thin film. The bore of the gun tube and the breech mechanism should be kept heavily oiled and should be inspected frequently for rust.

134. EXCESSIVELY SANDY OR DUSTY CONDITIONS.

a. When the gun is active in dusty areas, remove lubricants from working portions of the gun which might gather and retain quantities of dust and grit. This includes sliding surfaces, elevating rack and pinion, and equilibrator chain, as dust and sand, mixing with lubricants on these parts will cause rapid wear. Clean and lubricate parts after action.

b. Inspect and lubricate gun and carriage more frequently when operating in dusty or sandy areas.

c. Cover the gun muzzle and gun to protect from entry of dust whenever it will not interfere with use of gun.

Section XVII
REFERENCES

135. PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes or revisions of references given in this section and for new publications relating to materiel covered in this manual:

- a. Introduction to Ordnance Catalog (explaining SNL system) ASF Cat.
ORD 1 IOC
- b. Ordnance Publications for Supply Index (index to SNL's) ASF Cat.
ORD 2 OPSI
- c. Index to Ordnance Publications (listing FM's, TM's, TC's, and TB's of interest to ordnance personnel, OPSR, MWO's, BSD, S of SR's, OSSC's, and OFSB's, and includes Alphabetical List of Major Items with Publications Pertaining Thereto) OFSB 1-1
- d. List of Publications for Training (listing MR's, MTP's, T/BA's, T/A's, FM's, TM's, and TR's concerning training) FM 21-6
- e. List of Training Films, Film Strips, and Film Bulletins (listing TF's, FS's, and FB's by serial number and subject) FM 21-7
- f. Military Training Aids (listing Graphic Training Aids, Models, Devices, and Displays)..... FM 21-8

136. STANDARD NOMENCLATURE LISTS.

a. Ammunition.

- Ammunition, fixed, including subcaliber ammunition for harbor defense, heavy field, and railway artillery SNL P-6
- Ammunition for antiaircraft artillery SNL P-5
- Ammunition, rifle, carbine, and automatic gun... SNL T-1

b. Care and Maintenance.

- Cleaning, preserving and lubricating materials; recoil fluids; special oils, and miscellaneous related items SNL K-1

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Soldering, brazing and welding material, gases and related items	SNL K-2
c. Fire Control.	
AA director M5	SNL F-209
Quadrant, gunner's, M1 (mils) (previously, M1919)	SNL F-140
Quadrant, gunner's M1918 (mils)	SNL F-13
Set, control equipment, automatic gun, A.A., M1 (for cal. .50 A.A. machine gun and 37-mm automatic gun)	SNL F-182
System, remote control, M1 (for 37-mm A.A. gun carriage M3A1)	SNL F-208
System, sighting, M2 (for 37-mm A.A. gun carriage M3)	SNL F-183
System, sighting, M5 (for 37-mm A.A. gun carriage M3A1)	SNL F-241
d. Gun Materiel.	
Gun, automatic, 37-mm, M1A2; and Carriage, automatic gun, 37-mm, M3, M3A1, and M3E1	SNL A-29
Gun, machine, cal. .30, Browning, M1917 and M1917A1	SNL A-5
Gun, machine, cal. .50, Browning, M2, water-cooled, flexible	SNL A-37
Unit, generating, M5 (for directors M5 and M5A1 and for seacoast uses)	SNL F-227

137. EXPLANATORY PUBLICATIONS.

a. Auxiliary fire control instruments (field glasses, eye glasses, telescopes, and watches)	TM 9-575
b. Care and Maintenance.	
Chemical decontamination materials and equipment	TM 3-220
Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department	TM 9-850
Defense against chemical attack	FM 21-40
Gun, automatic, 37-mm, M1A2; and Carriage, automatic gun, 37-mm, M3 and M3E1	OFSB 6-A-29

REFERENCES

- Gun, automatic, 37-mm, M1A2; Carriage, gun,
37-mm, M3A1 Lubrication
Guide No. 60
- Maintenance and care of pneumatic tires and
rubber treads TM 31-200
- c. **Fire Control.**
- A.A. cable systems; cable repair kits, all types;
and voltage controller M1 TM 9-649
- Directors M5A1, M5, and M6 TM 9-659
- Fire control automatic weapons FM 4-151
- Generating units M5 and M6 TM 9-616
- Gunnery, fire control, and position finding, anti-
aircraft automatic weapons FM 4-110
- d. **Firing Tables.**
- Shell, fixed, H.E., M54 FT 37AA-N-2
- Shell, fixed, practice, M55A1 FT 37AA-N-2
- e. **Gun Materiel.**
- Browning machine gun, cal. .30, M1917 FM 23-55
- Browning machine gun, cal. .50, M2, water-
cooled, and mounts TM 9-226
- Browning machine gun, cal. .50, HB, M2, ground
37-mm antiaircraft gun (case I firing) FM 23-60
FM 4-140
- f. Gunner's quadrant, M1918 and M1 TM 9-527
- g. Ordnance storage and shipment chart — group
A — major items OSSC A

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