

TM 9-328

WAR DEPARTMENT TECHNICAL MANUAL

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

Rescinded by
D/A Circular 310-31
dtd. 4 JAN 56

RESTRICTED DISSEMINATION OF RESTRICTED MATTER—

The information contained in restricted documents and the essential characteristics of restricted materiel may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also paragraph 23, AR 380-5, 15 March 1944.)

WAR DEPARTMENT

• 30 DECEMBER 1943

UF 153 .A7 T4 TM 9-328 1943

4.5-inch gun M1 and 4.5-inch
gun carriages M1 and M1A1

#29705838

WAR DEPARTMENT TECHNICAL MANUAL

TM 9-328

This Technical Manual supersedes TM 9-328, dated 1 March 1943, Changes No. 1, dated 2 October 1943; and supersedes the pertinent information in TB ORD 113, dated 23 June 1944; and together with TM 9-331, dated 22 November 1943, supersedes TB ORD 109, dated 14 June 1944.

**4.5-INCH GUN M1
AND 4.5-INCH GUN
CARRIAGES
M1 AND M1A1**



WAR DEPARTMENT

30 DECEMBER 1943

RESTRICTED DISSEMINATION OF RESTRICTED MATTER—

The information contained in restricted documents and the essential characteristics of restricted materiel may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also paragraph 23, AR 380-5, 15 March 1944.)

WAR DEPARTMENT

Washington 25, D. C., 30 December 1943

TM 9-328, 4.5-inch Gun M1 and 4.5-inch Gun Carriages M1 and M1A1, is published for the information and guidance of all concerned.

**[A.G. 300.7 (6 Dec 43)
O.O. 461/3374 O.O.(R)]**

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

DISTRIBUTION: R 9(4); Bn 9(2); IC 6(4); C 9(5)

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

CONTENTS

		Paragraphs	Pages
CHAPTER	1. INTRODUCTION	1- 4	1- 9
CHAPTER	2. GUN AND CARRIAGE.....	5- 71	10-170
SECTION	I. Description and functioning of gun	5- 10	10- 31
	II. Description and functioning of carriage	11- 25	31- 70
	III. Operation	26- 39	70- 93
	IV. Malfunctions and corrections....	40- 44	93-103
	V. Lubrication	45- 47	103-112
	VI. Care and preservation.....	48- 56	112-137
	VII. Inspection and adjustment.....	57- 62	137-145
	VIII. Disassembly and assembly.....	63- 71	145-170
CHAPTER	3. SIGHTING EQUIPMENT	72- 77	171-184
CHAPTER	4. AMMUNITION	78- 91	185-203
CHAPTER	5. SUBCALIBER EQUIPMENT.....	92-105	204-217
CHAPTER	6. TOOLS, PARTS, AND ACCESSORIES	106-108	218-227
CHAPTER	7. STORAGE AND SHIPMENT.....	109-111	228-235
CHAPTER	8. OPERATION UNDER UNUSUAL CONDITIONS	112-116	236-251
CHAPTER	9. REFERENCES.....	117-120	252-254
INDEX			255-261

This page has been left blank intentionally.

RESTRICTED

This Technical Manual supersedes TM 9-328, dated 1 March 1943, changes No. 1, dated 2 October 1943; and supersedes the pertinent information in TB ORD 113, dated 23 June 1944; and together with TM 9-331, dated 22 Nov. 1943, supersedes TB ORD 109, dated 14 June 1944.

CHAPTER 1**INTRODUCTION****1. SCOPE.**

a. This Technical Manual is published for the information of the using arms and services.

b. In addition to descriptions of the 4.5-inch Gun M1 and the 4.5-inch Gun Carriages M1 and M1A1, this manual contains technical information required for the identification, operation, inspection, and care of the materiel.

c. Such disassembly, assembly, adjustment, and repair of the howitzer and carriages as may be handled by the using arm personnel are prescribed in this manual. This work will be undertaken only under the supervision of an officer or the artillery mechanic.

d. Chapter 3 of this manual contains information required for the identification, operation, and care of the items of sighting and fire control equipment which are mounted directly on the weapon. This section also prescribes authorized adjustments of this equipment. Other items of sighting and fire control equipment not mounted directly on the carriage are described in separate Technical Manuals. Refer to chapter 9 for a list of these Technical Manuals.

e. Authorized ammunition for this weapon is described in chapter 4 of this manual, which also provides information required for its identification, use, and care. Refer to chapter 9 for a list of publications containing pertinent information regarding the ammunition authorized for this weapon.

f. In all cases where the nature of the repair, modification, or adjustment is beyond the scope of the 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 for the performance of the work.

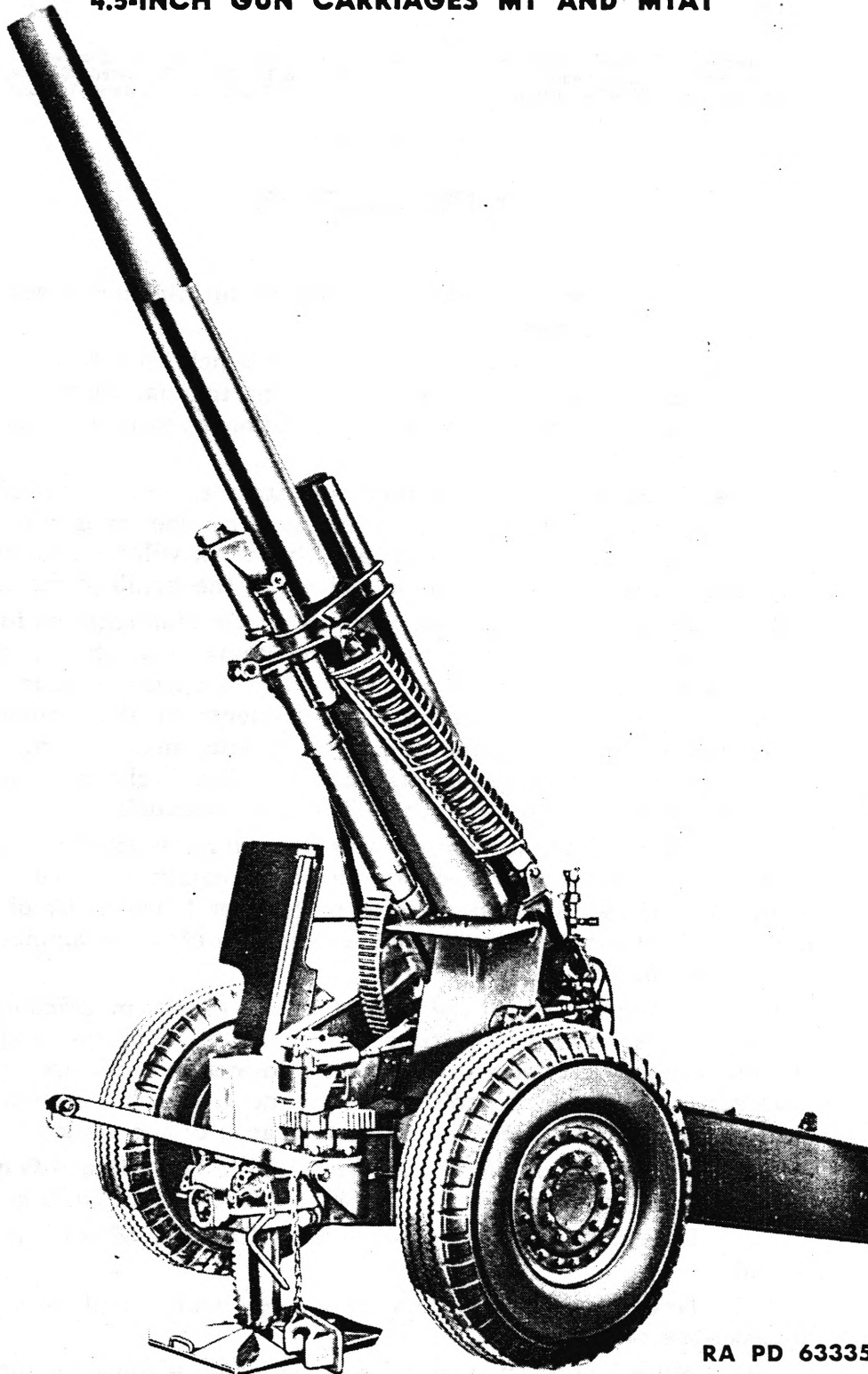
g. This manual differs mainly from TM 9-328, 4.5-inch Gun M1 and 4.5-inch Gun Carriage M1, dated 1 March 1943, as follows:

(1) Information on the 4.5-inch Gun Carriage M1A1 has been added.

(2) New lubrication orders have been added and lubrication instructions revised.

(3) Material on "off-carriage" sighting and fire control equipment has been deleted.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**



RA PD 63335

**Figure 1—4.5-inch Gun M1 and 4.5-inch Gun Carriage M1—Firing
Position—Maximum Elevation**

INTRODUCTION

TM 9-328
1

RA PD 63336

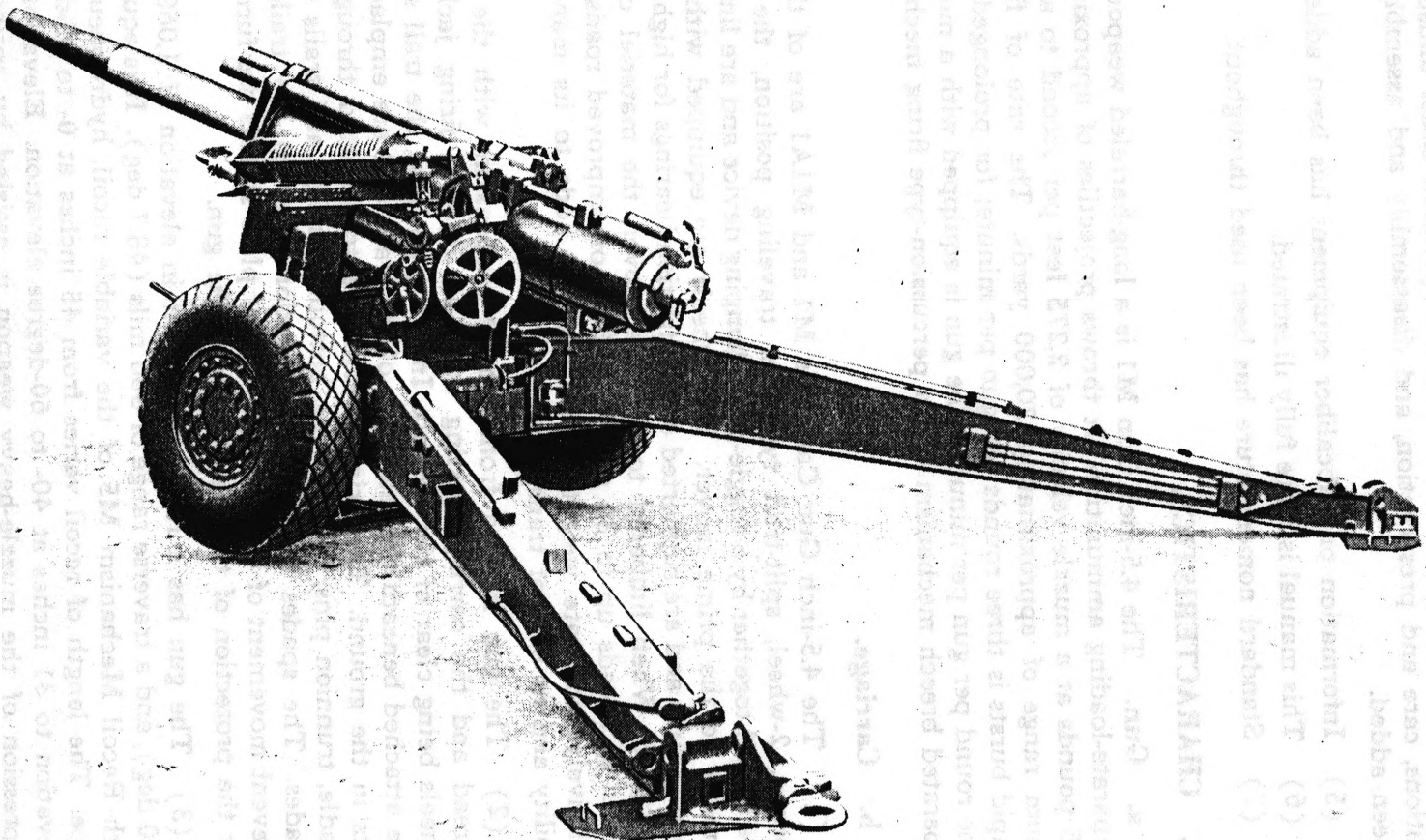


Figure 2—4.5-inch Gun M1 and 4.5-inch Gun Carriage M1A1—
Firing Position—Three-quarter Rear View

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

(4) More complete instructions for operation under unusual conditions, care and preservation, and disassembly and assembly have been added.

(5) Information on subcaliber equipment has been added.

(6) This manual is more fully illustrated.

(7) Standard nomenclature has been used throughout.

2. CHARACTERISTICS.

a. **Gun.** The 4.5-inch Gun M1 is a long-barreled weapon using separate-loading ammunition. It throws projectiles of approximately 55 pounds at a muzzle velocity of 2,275 feet per second to a maximum range of approximately 20,000 yards. The rate of fire for rapid bursts is three rounds per gun per minute; for prolonged firing, one round per gun per minute. The gun is equipped with a manually operated breech mechanism and a percussion-type firing mechanism.

b. **Carriage.**

(1) The 4.5-inch Gun Carriages M1 and M1A1 are of the unsprung, 2-wheel, split-trail type. In traveling position, the trails are locked together by a toggle-type clamping device and are limbered directly to the prime mover. The wheels are equipped with large combat tires and are supported on antifriction bearings for high-speed transport. When limbered to a prime mover, the materiel can be drawn at speeds up to 30 miles per hour on improved roads. The relatively moderate weight of the materiel adds to its maneuverability and its ease of transport.

(2) The gun is fired from 3-point suspension, with the trails spread and the carriage resting upon an integral firing jack, the wheels being clear of the ground. In firing position, the trail spades are attached beneath the rear ends of the trails and are emplaced in pits in the ground. The firing stresses are transmitted through the cradle, trunnion pins, top carriage, bottom carriage, and trails to the spades. The spades transmit the reaction back to the trails and prevent movement of the carriage. Armor plate shields are furnished for the protection of the men manning the gun.

(3) The gun has a range movement in elevation of 1,068 mils (60 deg), and a traverse range of 866 mils (48.7 deg). It is equipped with Recoil Mechanism M5 of the variable recoil, hydropneumatic type. The length of recoil varies from 45 inches at 0- to 25-degree elevation to 31 inches at 40- to 60-degree elevation. Elevation and depression of the muzzle-heavy weapon is assisted by spring-type equilibrators.

TM 9-328
2

INTRODUCTION

RA PD 63337

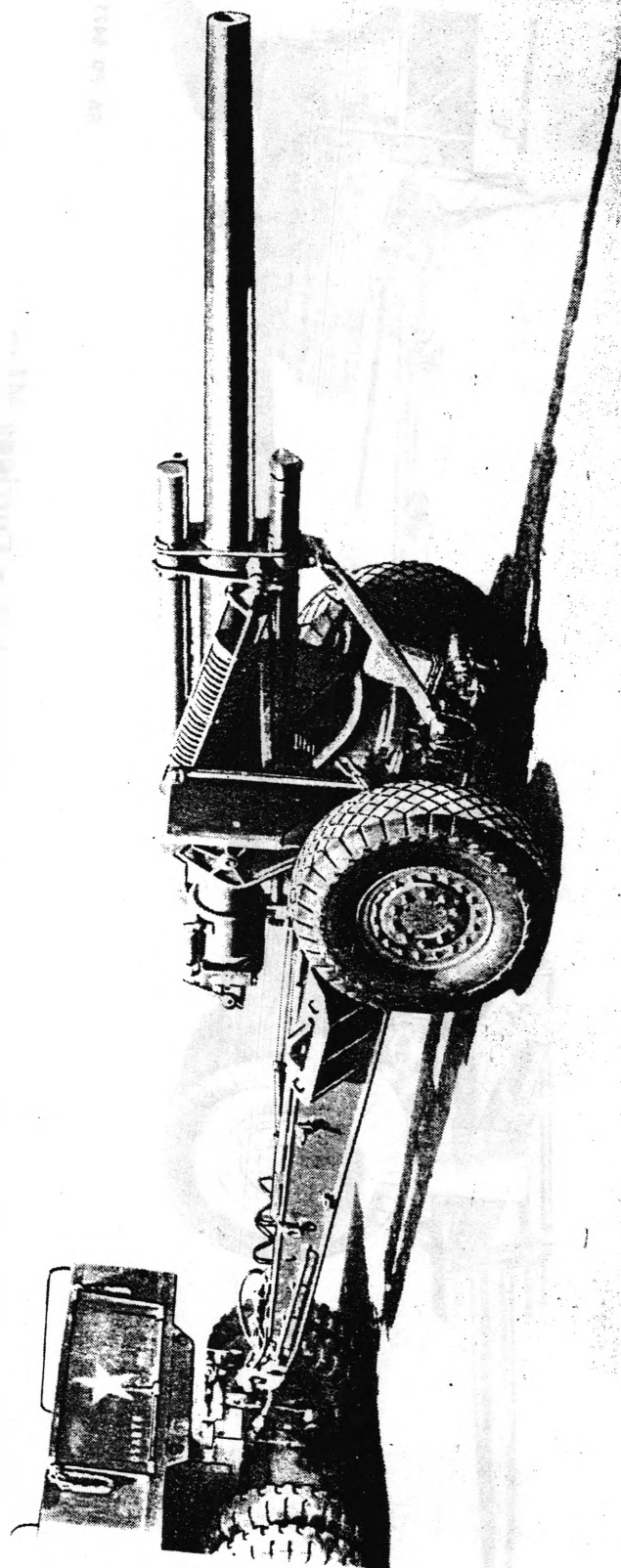
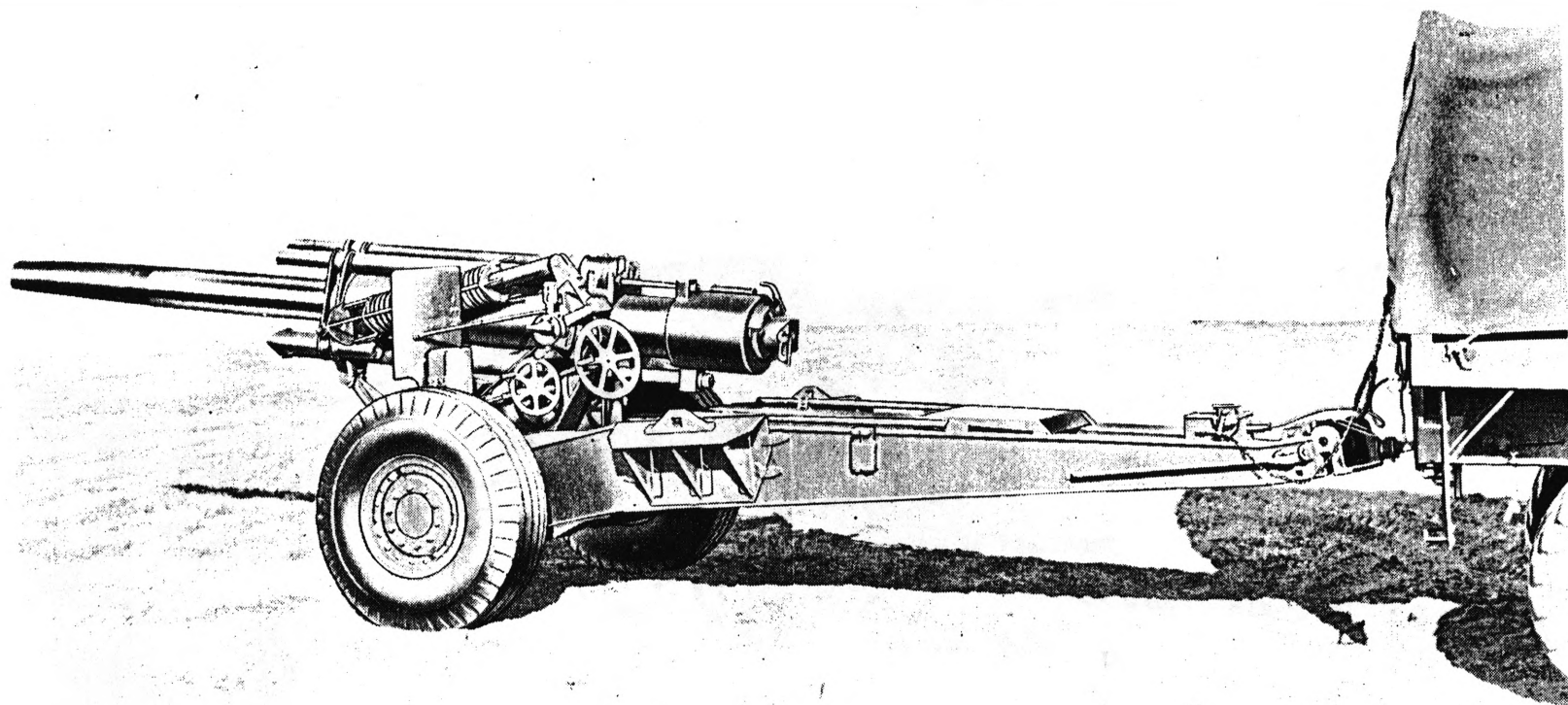


Figure 3—4.5-inch Gun M1 and 4.5-inch Gun Carriage M1A1—
Traveling Position—Limbered to Prime Mover

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 54717

**Figure 4—4.5-inch Gun M1 and 4.5-inch Gun Carriage M1—
Traveling Position—Limbered to Prime Mover**

INTRODUCTION

(4) The 4.5-inch Gun Carriage M1A1 is equipped with air brakes with emergency brake application controlled by the relay-emergency valve. The 4.5-inch Gun Carriage M1 is equipped with electric brakes with emergency brake application controlled by the safety switch. Hand brakes are provided on both models for parking.

3. DIFFERENCES AMONG MODELS.

a. While a number of minor changes and modifications have been made in the guns and carriages, the majority of these do not affect service of the materiel by the using troops.

b. Gun. Among the differences in the models of guns which affect service by the using troops are the following:

(1) STOP FOR FIRING MECHANISM BLOCK ARM. On guns of late manufacture and those so modified, a stop has been screwed into the rear face of the breechblock carrier which restricts the screwing in of the Firing Mechanism M1 to assure proper seating of the primer.

(2) RECUPERATOR OIL INDEX. On some models, the recuperator oil index normally protrudes one-quarter of an inch; on others, it normally protrudes three-eighths of an inch.

c. Carriages. Among the differences in the models of the carriages which affect service by the using troops are the following:

(1) BRAKES. The 4.5-inch Gun Carriage M1A1 is equipped with air brakes while the 4.5-inch Gun Carriage M1 is equipped with electric brakes. Emergency brake application of the air brake system is controlled by the relay-emergency valve while that of the electric brake system is controlled by the safety switch. Parking brakes of different types are used with the two systems.

(2) INNER WHEEL SPINDLE ROLLER BEARINGS. The inner wheel spindle bearings of carriages equipped with air brakes have a greater inside diameter than those of carriages equipped with electric brakes.

(3) FIRING JACK. On carriages of late manufacture and those so modified, the firing jack housing is equipped with a firing jack key opening spring cover and a permanently attached firing jack key backing cover, a self-locking traveling locking lever (inserted from the right) which is fastened by chain and snap to a staple welded to the key backing cover; and the firing jack housing bottom cover is chained to the traveling lock. Firing jacks without these modifications have removable, chained, key opening covers, chained firing jack travel locking pins (inserted from the left), and firing jack housing bottom covers are not chained to the traveling lock. Canvas firing jack covers with clamps are currently being supplied to protect the upper portions of the firing jacks from dirt and moisture. Such covers of earlier issue had no clamps. Some models are equipped with metal firing jack rack plunger top covers.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

(4) **LOADING TRAY RETAINERS.** On M1A1 Carriages of late manufacture and those so modified, retainers have been welded to the tops of the trails to furnish a means of carrying the loading tray in traveling position.

(5) **TRAVELING TRAVERSING LOCKS.** On carriages of late manufacture and those so modified, plates have been welded to the top trail hinge castings and stops have been welded to the bottom plate of the top carriage. These locks prevent movement of the top carriage and tipping parts of the weapon during travel.

(6) **AIR FILTERS (AIR BRAKE).** Air filters of two different designs are used on different models. Both function and are serviced in the same manner.

(7) **PANORAMIC TELESCOPE CASE.** On carriages of late manufacture and those so modified, a panoramic telescope case auxiliary bracket has been fitted into the panoramic telescope case.

4. DATA.

a. General Data Pertaining to the 4.5-inch Gun M1.

Weight of 4.5-inch Gun M1, complete.....	4,075 lb
Caliber	4.5 in.
Length of bore.....	42 cal.
Length (muzzle to rear face of breech ring).....	193.64 in.
Type of breechblock.....	Stepped-thread, interrupted thread
Chamber capacity.....	531 cu in.
Muzzle velocity.....	2,275 ft per sec
Muzzle energy.....	1,972 ft-ton
Maximum powder pressure.....	40,000 lb per sq in.
Rifling:	
Length	156.83 in.
Number of grooves.....	32
Twist.....	Uniform, right-hand, one turn in 25 calibers
Weight of projectile.....	55 lb
Weight of powder charge:	
Normal charge.....	6.40 lb
Supercharge	11.41 lb
Travel of projectile in tube.....	162.16 in.
Maximum range with supercharge.....	20,000 yd
Rate of fire:	
Rapid bursts	3 rounds per gun per minute
Prolonged firing.....	1 round per gun per minute

INTRODUCTION

b. General Data Pertaining to 4.5-inch Gun Carriage M1 and M1A1.

Carriage, complete with weapon (without covers or accessories).....	13,000 lb
Spade	184 lb
Firing jack float.....	85 lb
Wheel, complete with tire and tube.....	615 lb
Right shield.....	79 lb
Top and bottom (left) shield.....	86 lb
Effort required to lift off the ground:	
Coupled trails, for limbering to prime mover.....	552 to 371 lb
One trail without spade.....	349 to 198 lb
One trail with spade.....	390 to 249 lb
Recoil mechanism:	
Model	M5
Type	Hydropneumatic
Recoil at maximum elevation.....	31 in.
Recoil at minimum elevation.....	45 in.
Weight	1,671 lb
Dimensions:	
Width of track, center to center of wheels.....	82 in.
Maximum width, traveling position (outside walls of tires).....	96 in.
Maximum height, traveling position (top of right shield).....	71 in.
Height of center line of bore from ground, zero elevation.....	50 in.
Length of gun and carriage, limbered.....	26½ ft
Road clearance (bottom of firing jack housing).....	9 in.
Road clearance (lunette in traveling position).....	29 in.
Maneuvers:	
Range of elevation (maximum elevation and depression are dependent upon emplacement of spades).....	1,068 mils (60 deg)
Range of traverse.....	866 mils (48.7 deg)
Traverse to left of midposition.....	418 mils (23.5 deg)
Traverse to right of midposition.....	448 mils (25.2 deg)
Rate of traverse per turn of handwheel....	10.3 mils (34.7 min)
Rate of elevation per turn of handwheel....	14.8 mils (50 min)
Prime mover.....	Truck, 4-ton 6x6 Tractor, medium M5

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

CHAPTER 2

GUN AND CARRIAGE

Section I

DESCRIPTION AND FUNCTIONING OF GUN

5. GENERAL.

a. The 4.5-inch Gun M1 (fig. 5) consists of an alloy steel tube screwed into a breech ring and locked in place by a screw which is inserted through the forward upper wall of the breech ring.

b. The gun is supported and slides in recoil and counterrecoil on smoothly finished bearing surfaces, forward of the breech ring. Rotation of the tube in the mount is prevented by two keys on the upper right surface of the tube.

c. The breechblock is of the stepped-thread interrupted-screw type, designed for use with separate loading ammunition. It is supported on a breechblock carrier, hinged to the right side of the breech ring. The breech is operated manually. The carrier is counterbalanced by a spring and cylinder-type counterbalance.

d. The gun is fired by the percussion type Firing Mechanism M1, removably screwed into the firing mechanism housing at the rear of the breechblock carrier. The firing mechanism is actuated by a lanyard-operated percussion hammer.

e. The gun designation (fig. 6), serial number, weight, name of manufacturer, and year of manufacture are stamped on the breech ring.

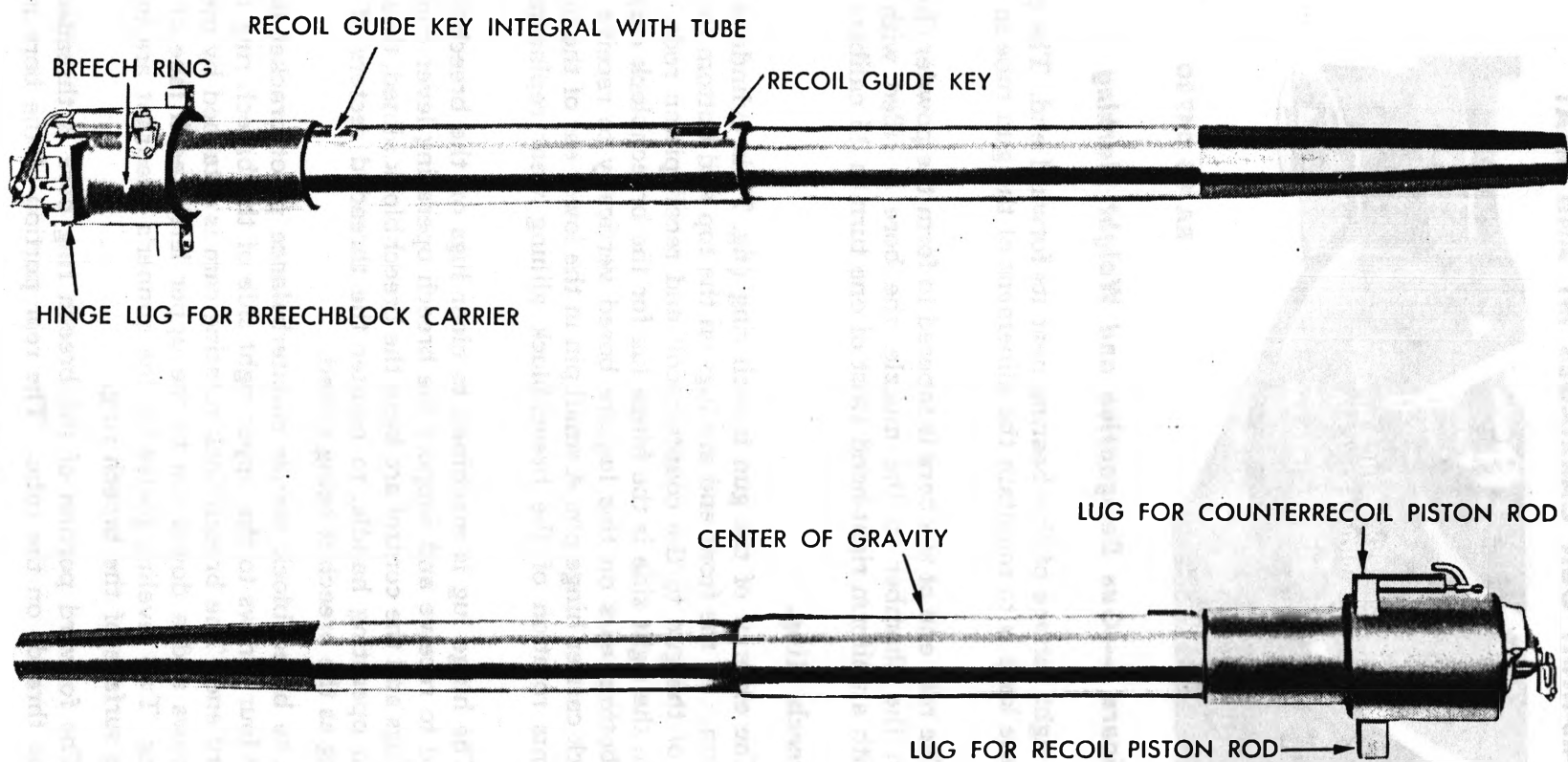
6. BARREL ASSEMBLY.

a. Gun Tube.

(1) The gun tube (fig. 5) is formed in one piece. The exterior of the breech end is threaded to receive the breech ring. Immediately forward of the thread is a tapered recess to receive the breech ring lock screw.

(2) A major portion of the exterior of the tube is smoothly finished to form the recoil slide which provides a sliding bearing in the mount. The forward section of this bearing surface is smaller in diameter than the rearward section, the change in diameter forming a shoulder between the bearings. The tube is uniformly tapered to the muzzle.

(3) An integral longitudinal recoil guide key (fig. 5) is formed in the upper right external surface of the tube near the rear end of the rearward bearing. A similarly shaped recoil guide key is screwed to



GUN AND CARRIAGE

TM 9-328

6

Figure 5—4.5-inch Gun M1—Right (Above) and Left (Below)

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1



Figure 6—Gun Designation and Weight Marking

the upper right surface of this bearing near its forward end. The purpose of these keys is to maintain the alinement of the gun tube in the mount.

(4) The rear end of the bore is tapered to form the powder chamber. From the chamber to the muzzle, the bore is rifled with 32 grooves with a uniform right-hand twist of one turn in 25 calibers.

b. Breech Ring.

(1) The exterior of the gun breech ring (fig. 7) is cylindrical in general form. At the front end are lugs on the top and bottom for attachment of the gun to the counterrecoil and recoil piston rods. At the rear on the right side is the hinge lug for the breechblock carrier. Top and bottom ears on this lug are bored vertically to receive the breechblock carrier hinge pin. A small pin in the lower ear of the hinge lug prevents rotation of the breechblock alining wear replacement washer.

(2) The hinge lug is machined to clear lugs on the breechblock carrier and to receive and support the breech operating lever control arc. The lugs and the control arc keep the breechblock alined, through the breech operating handle, to reenter the threaded sectors of the breech ring as the breech is being closed.

(3) The breechblock carrier counterbalance pivot bracket is attached by four screws to the upper right side of the breech ring near the forward end. The breechblock rotating cam is attached by means of two screws and a dowel pin to the upper left breech face of the breech ring. Two leveling plates for the gunner's quadrant are inlaid in the top surface of the breech ring.

(4) The forward portion of the breech ring bore is threaded to receive the threads on the tube. The rear portion of the bore is di-

GUN AND CARRIAGE

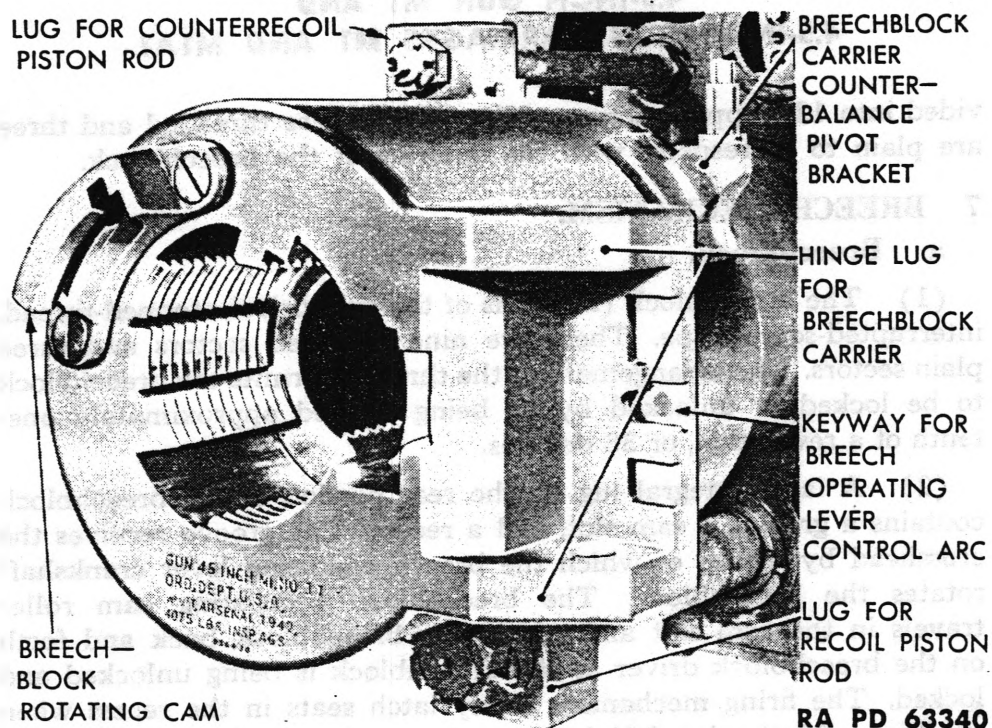


Figure 7—Breech Ring of 4.5-inch Gun M1

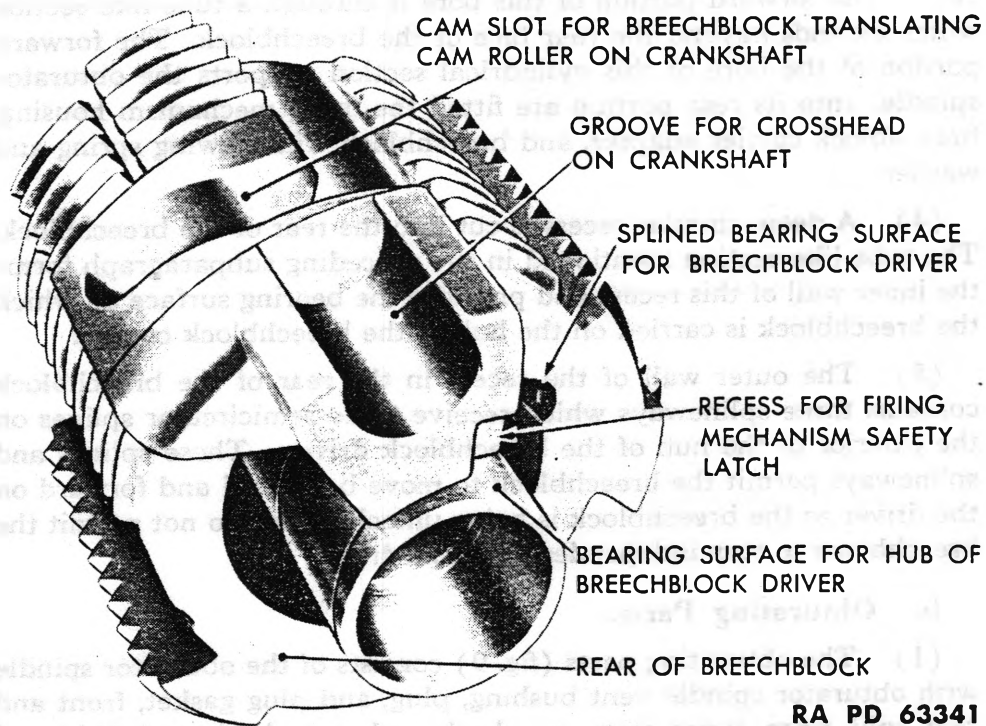


Figure 8—Breechblock From Rear

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

vided into 12 stepped sectors. Nine of these are threaded and three are plain to correspond with the exterior of the breechblock.

7 BREECH MECHANISM.

a. Breechblock.

(1) The breechblock (fig. 8) is of the cylindrical, stepped-thread, interrupted-screw type. There are nine threaded sectors and three plain sectors. The arrangement of the threads permits the breechblock to be locked or unlocked by its being rotated approximately one-tenth of a revolution, or 38 degrees.

(2) A large integral lug on the rear portion of the breechblock contains a groove, a cam slot, and a recess. The groove receives the crosshead by means of which the breech operating lever crankshaft rotates the breechblock. The breechblock translating cam roller travels in the cam slot and moves the breechblock back and forth on the breechblock driver as the breechblock is being unlocked and locked. The firing mechanism safety latch seats in the recess when the Firing Mechanism M1 is screwed into place; it locks the breechblock against rotation, and therefore against opening.

(3) The breechblock has a central stepped bore from front to rear. The forward portion of this bore is through a tube-like section which extends beyond the rear face of the breechblock. The forward portion of the bore of this cylindrical section supports the obturator spindle. Into its rear portion are fitted the firing mechanism housing, breechblock carrier adapter, and breechblock withdrawing spring and washer.

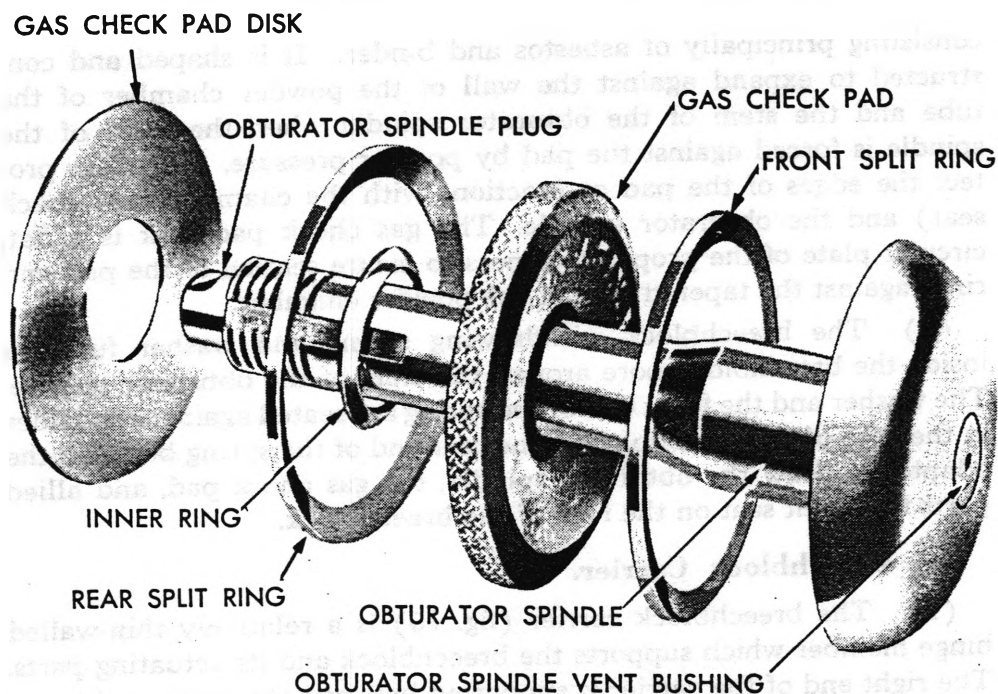
(4) A deep, circular recess is cut into the rear of the breechblock. The tube-like section mentioned in the preceding subparagraph forms the inner wall of this recess and provides the bearing surface on which the breechblock is carried on the hub of the breechblock carrier.

(5) The outer wall of the recess in the rear of the breechblock contains three splineways which receive three semicircular splines on the exterior of the hub of the breechblock driver. These splines and splineways permit the breechblock to move backward and forward on the driver as the breechblock is being unlocked, but do not permit the breechblock to turn independently of the driver.

b. Obturating Parts.

(1) The obturating parts (fig. 9) consists of the obturator spindle with obturator spindle vent bushing, plug, and plug gasket, front and rear split rings, inner ring, gas check pad, gas check pad disk, and breechblock withdrawing spring and washer.

GUN AND CARRIAGE



RA PD 63342

Figure 9—Obturating Parts

(2) The rings, pad, and disk are assembled under the head of the obturator spindle on the front face of the breechblock and serve to seal the rear of the powder chamber against the rearward escape of powder gases when the gun is fired. The obturator spindle is drilled centrally from front to rear to permit flame from a primer, seated in the plug at the rear end of the spindle, to enter the powder chamber of the gun and ignite the charge to fire the gun.

(3) The obturator spindle (fig. 9) has a mushroom-shaped head and a cylindrical stem which fits into the central bore of the breechblock. The rear surface of the head is beveled to fit the forward surfaces of the front split ring and the gas check pad, against which the head bears.

(4) The rear end of the stem of the obturator spindle is threaded externally to receive the firing mechanism housing by which it is retained in the breechblock. Keyways, cut in both sides of the rear of the stem of the obturator spindle, engage corresponding keys in the breechblock carrier adapter and prevent rotation of the spindle. The obturator spindle plug, which is threaded into the rear end of the stem, is taper-bored to receive the primer case. The plug gasket protects the plug threads from powder gases.

(5) The gas check pad (fig. 9) is a slightly pliable pressed ring

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

consisting principally of asbestos and binder. It is shaped and constructed to expand against the wall of the powder chamber of the tube and the stem of the obturator spindle when the head of the spindle is forced against the pad by powder pressure. The rings protect the edges of the pad at junctions with the chamber (gas check seat) and the obturator spindle. The gas check pad disk is a flat, circular plate of the proper thickness to insure seating of the pad and rings against the tapered wall of the powder chamber.

(6) The breechblock withdrawing spring and washer function inside the breechblock bore around the stem of the obturator spindle. The washer and the front end of the spring are seated against a shoulder in the bore of the breechblock. The rear end of the spring bears on the adapter to draw the obturator spindle, the gas check pad, and allied parts to a tight seat on the face of the breechblock.

c. Breechblock Carrier.

(1) The breechblock carrier (fig. 10) is a relatively thin-walled hinge member which supports the breechblock and its actuating parts. The right end of the carrier is supported between the upper and lower ears of the hinge lug of the breech ring and is bored vertically to receive the breechblock carrier hinge pin about which it swings. Lugs, including one with a stop surface for the breech operating lever, are located on the right side of the carrier.

(2) A cylindrical hub, with inner and outer bearing surfaces, extends from the front of the left end of the breechblock carrier. The inner surface of this hub provides a bearing for the breechblock while the outer surface forms a bearing for the breechblock driver. The forward end of the hub is threaded to receive the driver retaining ring. The ring is locked with a lock screw.

(3) The carrier houses the breech operating lever crankshaft and related breechblock operating parts. The crankshaft bearing is screwed to an inner vertical rib of the carrier. A transverse bore through the right wall is provided for the breech operating lever journal. The firing mechanism safety latch is mounted between two horizontal channeled lugs on the outside rear face of the carrier. A rod-like stop with a notched head for the handle arm of the Firing Mechanism M1 is screwed into the rear face of the carrier above the left corner of the upper retaining lug for the firing mechanism safety latch. The breech operating lever closing latch is mounted on the upper right surface of the carrier.

d. Breechblock Actuating Mechanism.

(1) The breech operating lever crankshaft (fig. 10) is a cylindrical shaft with two crank arms at one end. One arm carries a

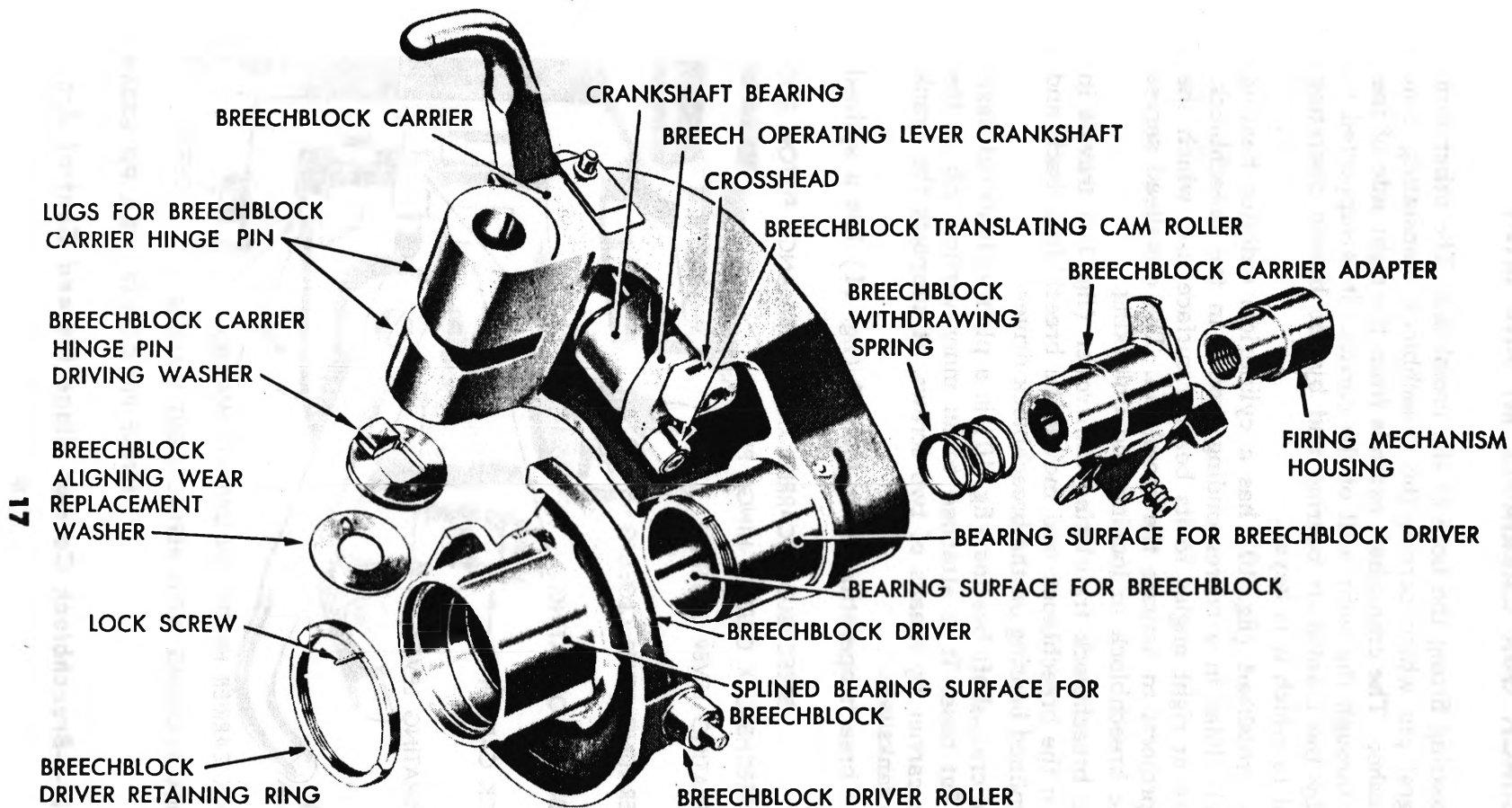


Figure 10—Breechblock Carrier and Driver—Partially Exploded

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

cylindrical bearing fitting the bore of the crosshead. The other arm has an integral pin which carries the breechblock translating cam roller and washer. The crankshaft extends from the right side of the breechblock through the right wall of the carrier. It is supported in the carrier by the crankshaft bearing and by the breech operating lever journal to which it is keyed.

(2) The crosshead (fig. 10) has a cylindrical exterior bearing surface which slides in a corresponding groove in the breechblock. It has a bore at right angles to its bearing surface into which the crank arm projects to actuate the crosshead. The crosshead serves to rotate the breechblock in locking and unlocking.

(3) The breechblock translating cam roller (fig. 10) travels in a cam slot in the breechblock and moves the breechblock back and forth in its splined bearing on the breechblock driver.

(4) The crankshaft bearing (fig. 10) is a plain cylindrical bearing with a flat base. It is attached to an inner vertical rib of the breechblock carrier by means of two screws. It supports the crank end of the crankshaft.

(5) The breech operating lever journal (fig. 11) has a splined

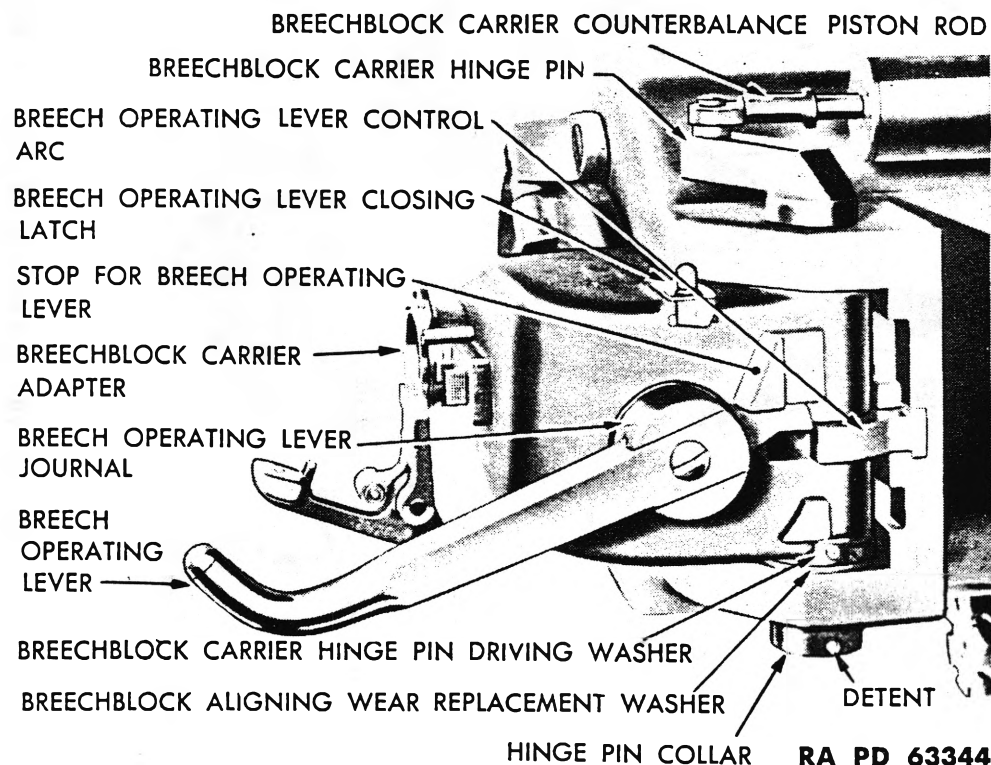


Figure 11—Breechblock Carrier Hinge Pin and Control Arc

GUN AND CARRIAGE

bore to fit the crankshaft and an exterior cylindrical bearing surface to fit the bore in the right side of the carrier. The outer end of the journal has an increased diameter, forming a shoulder which bears in a recess in the outer surface of the breechblock carrier. This extended hub is slotted at right angles to the crankshaft to receive the breech operating lever, which is attached to the end of the crankshaft by means of a screw.

(6) The breechblock driver (fig. 10) is a splined hub with an outside circular flange at the rear which curves toward the breechblock. A portion of the right side of the flange is removed to clear the rear lug of the breechblock. The driver is rotatably mounted on its bearing surface on the front of the breechblock carrier and is retained in position by the driver retaining ring. The rear of the hub of the driver lies against a shoulder on the carrier.

(7) The forward portion of the hub of the driver extends into the recess in the rear of the breechblock and is splined to the breechblock. The breechblock can be moved forward and backward independently of the driver, but both are made to rotate as a unit.

(8) The breechblock driver roller (fig. 10) is mounted on the breechblock driver roller pin set in a lug on the upper left edge of the flange of the driver.

(9) The breechblock rotating cam (fig. 12) is an arc-shaped bracket attached to the upper left rear face of the breech ring by means of a dowel and two screws. The cam is grooved in a curved path to guide the breechblock driver roller when the breechblock is near the closed position.

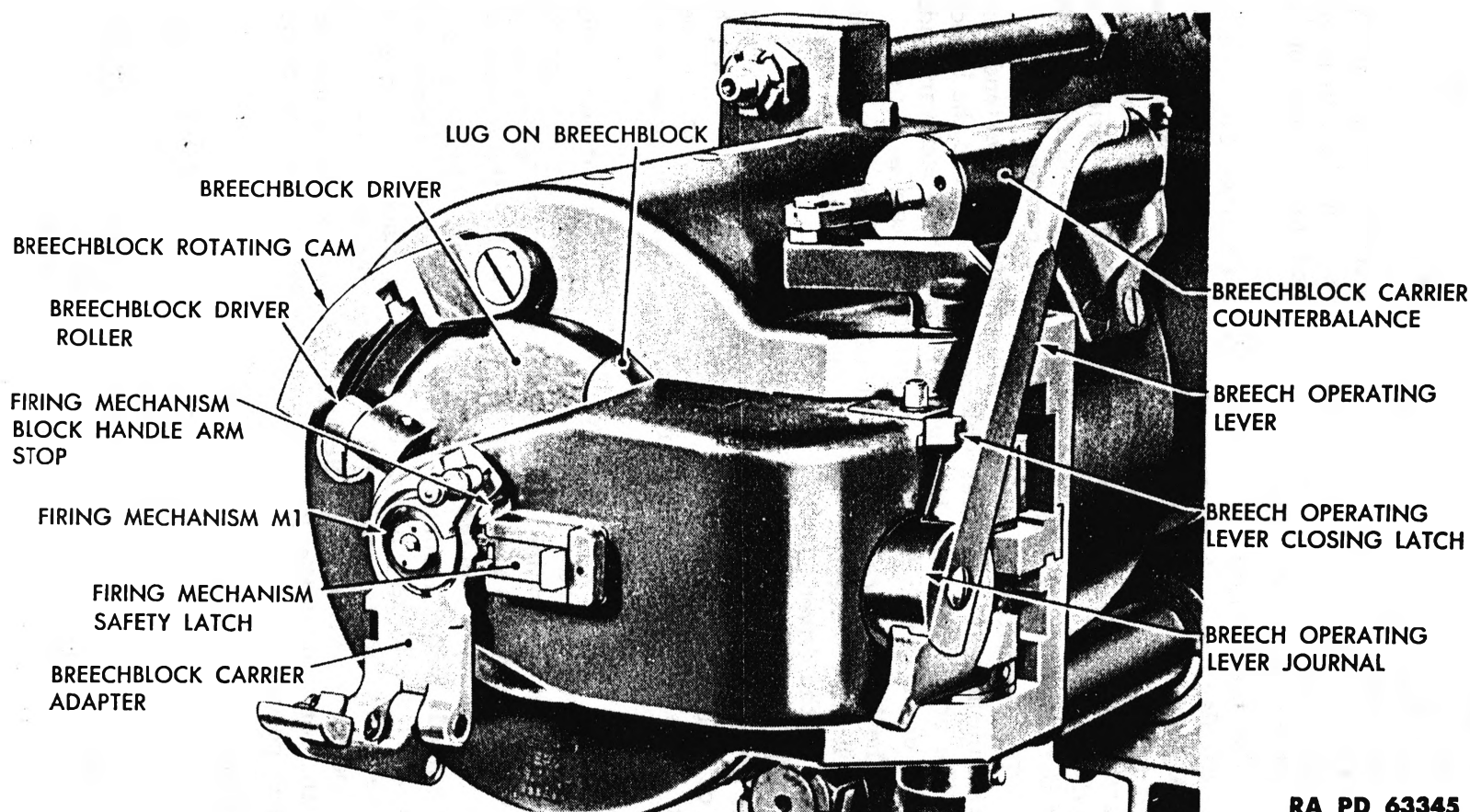
(10) The breech operating lever (fig. 11) is a flat-sided lever with a bent tubular hand grip. Its lower end is inserted through the slot in the breech operating lever journal to which it is secured by means of a screw which extends into the right end of the crankshaft.

(11) The breech operating lever control arc (fig. 11) is a smooth-topped sector mounted midway between the upper and lower ears of the hinge pin lug. It is held in place by a countersunk screw. An integral projecting finger on the lower end of the breech operating lever rides on the upper surface of the control arc to prevent rotation of the lever and crankshaft when the carrier is in open position.

e. Breechblock Carrier Hinge Pin.

(1) The breechblock carrier hinge pin (fig. 11) hinges the breechblock carrier to the breech ring. It consists of a cylindrical body with an arm extending outwardly from its head (fig. 12). The carrier hinge pin body pin extending from the top of the arm is provided for the attachment of the breechblock carrier counterbalance piston rod.

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 63345

Figure 12—Breech Mechanism of the 4.5-inch Gun M1

GUN AND CARRIAGE

(2) The hinge pin extends downward through the hinge lugs on the breech ring and carrier and is retained by the breechblock carrier hinge pin collar and detent. The hinge pin is squared near its lower end to fit the square hole in the breechblock carrier hinge pin driving washer (figs. 10 and 11). This washer is keyed to the bottom of the carrier and thus forces the hinge pin and carrier to swing as a unit.

(3) The flat breechblock alining wear replacement washer (fig. 11), under the driving washer, provides a supporting bearing surface for the driving washer and carrier. The washer is prevented from rotating by a pin in the lower ear of the hinge lug of the breech ring.

f. Breechblock Carrier Counterbalance.

(1) The breechblock carrier counterbalance (fig. 12) is a cylinder with its ends closed by cylinder heads and containing a heavy compression spring. This spring is compressed between the rear breechblock carrier counterbalance cylinder pivot head and the counterbalance piston, a disk which fits the cylinder freely and is keyed to the inside wall of the cylinder. It is compressed by the counterbalance piston rod, which connects the counterbalance piston with the arm of the breechblock carrier hinge pin.

(2) The counterbalance facilitates closing the breech when the gun is elevated, under which condition gravity opposes the swinging of the breechblock into the breech recess. It also tends to hold the carrier in open position by means of spring tension when the counterbalance piston rod and the arm of the breechblock carrier hinge pin pass dead-center position.

(3) The mechanism is supported and hinged on the counterbalance pivot bracket which is mounted on the forward right side of the breech ring. It is attached to the arm of the hinge pin by means of the counterbalance piston rod. The piston rod end has an eye of keyhole shape to permit removal and replacement over the head of the pin.

g. Breech Operating Lever Closing Latch.

(1) The breech operating lever closing latch (fig. 12) latches the lever in fully raised position, thereby locking the breech in closed position. It is a small plunger which fits slidably into a shouldered groove in the upper right edge of the breechblock carrier.

(2) The latch is spring-loaded to keep it extended except when it is being manually retracted. A round knurled knob is screwed through the latch and into a recess in the carrier. The recess limits the movement of the latch to the right and left, holding the latch in the carrier.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

h. Firing Mechanism Safety Latch.

(1) The firing mechanism safety latch (fig. 12) prevents the breech from being opened before the firing mechanism has been unseated. It also prevents the firing mechanism from being seated before the breechblock has been returned to closed and locked position.

CAUTION: While it is possible to open or close the breech with the firing mechanism partially removed or inserted, this practice is strictly prohibited.

(2) The firing mechanism safety latch is an L-shaped piece with a knurled, rectangular handle. One leg is tongued to slide from side to side in grooves in lugs on the rear of the breechblock carrier. The other extends forward in the bore of the carrier and is grooved on the left side for the firing mechanism safety latch plunger, which slides forward and backward in this groove. The front end of this leg of the latch enters a recess in the breechblock when the latch is forced to the right, locking the breechblock in position. The plunger has an angular point which projects to the left into openings in the breechblock carrier adapter and firing mechanism housing.

(3) The latch and plunger are drilled to receive a small pin which is mounted in the carrier and extends to the left. The pin and holes do not normally mate. When the mechanism is to be disassembled, the latch and plunger must be maneuvered until the pin enters the holes in the latch and plunger. This permits the latch to be moved sufficiently to the right to clear the plunger from its holes in the adapter and the firing mechanism housing.

(4) The right end of the latch is drilled to receive the latch spring, which presses the latch to the left. Movement of the latch to the right is confined by the firing mechanism safety latch stop, which is screwed to the rear face of the carrier at the right ends of the safety latch lugs.

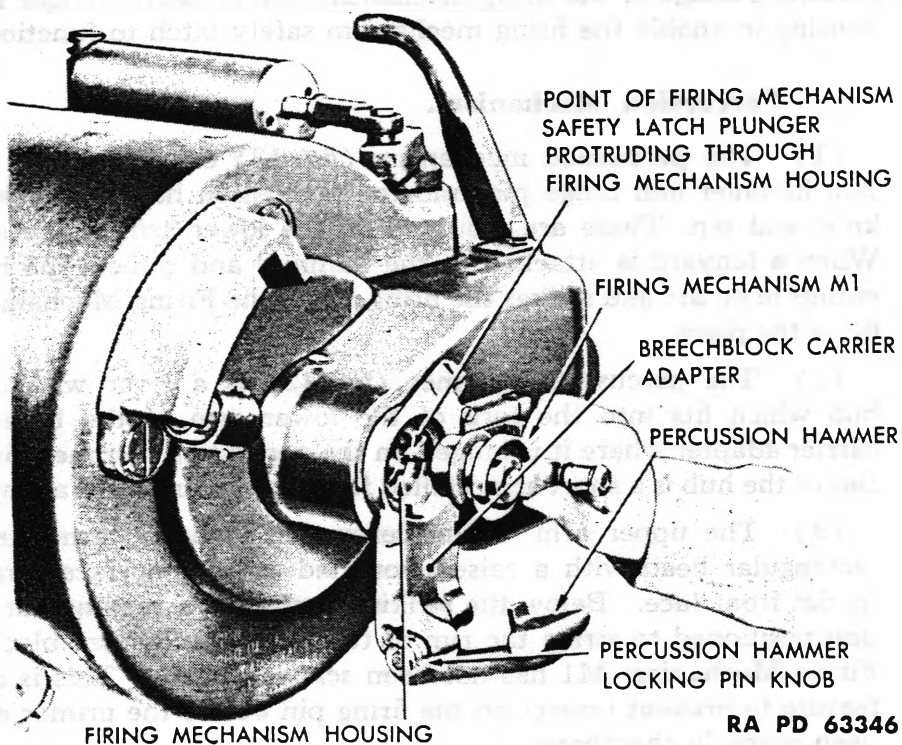
(5) With the breechblock locked and the Firing Mechanism M1, seated in its housing, the firing mechanism safety latch plunger is held to the right by the Firing Mechanism M1, pressing it back into the opening in the housing. This forces the safety latch to the right and engages the front end of the latch with the recess in the breechblock, locking the breechblock against rotation.

(6) When the Firing Mechanism M1 is removed, the latch and plunger move to the left under spring pressure. The latch frees the breechblock, and the plunger projects into the firing mechanism housing sufficiently to prevent replacement of the Firing Mechanism M1. Rotation of the breechblock to unlock moves the recess out of alignment with the latch. This locks the latch in the leftward position until the breechblock is rotated back to locked position.

GUN AND CARRIAGE

3. FIRING MECHANISM.

a. **General.** The firing mechanism consists not only of the Firing Mechanism M1, which is removed and replaced as a unit between the firing of successive rounds, but also of the breechblock carrier adapter and the firing mechanism housing which retain the Firing Mechanism M1 in the breech, and the percussion mechanism which actuates the Firing Mechanism M1.



RA PD 63346

Figure 13—Firing and Percussion Mechanism

b. Breechblock Carrier Adapter.

(1) The breechblock carrier adapter (fig. 13) is a sleeve, shouldered externally and internally, which fits into the rear end of the bore of the breechblock carrier and into the rear of the breechblock. It has a flat, cam-shaped upper arm, recessed to retain the firing mechanism block plunger, and a rectangular lower arm which supports the percussion mechanism.

(2) Integral keys inside the front end of the adapter engage keyways in the rear end of the stem of the obturator spindle while an integral key on the left side of the adapter engages a keyway in the bore of the breechblock carrier. These keys and keyways pre-

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

vent the adapter and obturator spindle from rotating in the carrier. The adapter is retained in the carrier by the firing mechanism housing which fits the interior of the adapter, bears against a shoulder inside the adapter, and screws onto the rear end of the stem of the obturator spindle.

(3) A slotted hole in the right side of the adapter mates with a similar hole in the right side of the firing mechanism housing and permits passage of the firing mechanism safety latch plunger into the housing to enable the firing mechanism safety latch to function.

c. Percussion Mechanism.

(1) The percussion mechanism (fig. 13) consists of the percussion hammer and hinge pin, and the percussion hammer locking pin knob and pin. These are mounted on the lower arm of the adapter. When a lanyard is attached to the hammer and pulled, the hammer swings in an arc and strikes the firing pin of the Firing Mechanism M1, firing the piece.

(2) The percussion hammer (fig. 13) is a lever with a bored hub which fits into the fork of the lower arm of the breechblock carrier adapter where it is hinged on the percussion hammer hinge pin. Below the hub is a short arm, drilled for the attachment of a lanyard.

(3) The upper arm of the percussion hammer terminates in a rectangular head with a raised, rounded striking surface formed on its flat front face. Below the striking surface is a rectangular projection positioned to strike the rim of the firing mechanism block if the Firing Mechanism M1 has not been screwed home. This is a safety feature to prevent impact on the firing pin before the primer case has been properly chambered.

(4) The percussion hammer locking pin, spring, and knob (fig. 13) are housed in a bore in a rearward extension of the lower arm of the adapter. Movement of the locking pin is controlled by the percussion hammer locking pin knob; the locking pin is pressed toward the hammer by means of the spring. The knob is provided with a small safety lock setting pin which may be engaged to lock the locking pin in different positions.

(5) When the locking pin is released, it protrudes in the path of the hammer and prevents the hammer from being raised. When the knob is drawn to the left and turned, the locking pin is held from the path of the hammer, and the hammer is permitted to swing in its arc. When the hammer is raised, the knob can be turned until the locking pin enters a recess in the hammer, holding the hammer in an inoperative, upright position.

GUN AND CARRIAGE

d. **Firing Mechanism Housing.** The firing mechanism housing (fig. 13) is a shouldered cylinder which fits the interior of the breech-block carrier adapter. It has a stepped central bore, threaded in front to screw onto the obturator spindle and threaded in the rear to receive the Firing Mechanism M1. A slotted hole in the right-hand wall provides for passage of the firing mechanism safety latch plunger into the threaded space for the Firing Mechanism M1.

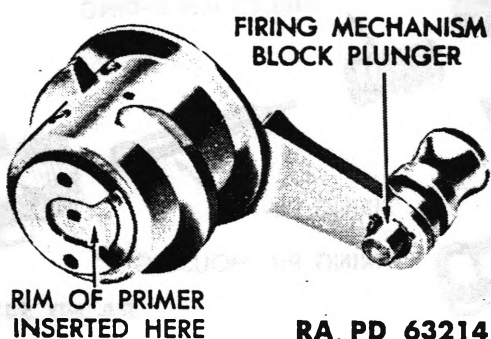


Figure 14—Firing Mechanism M1—Front

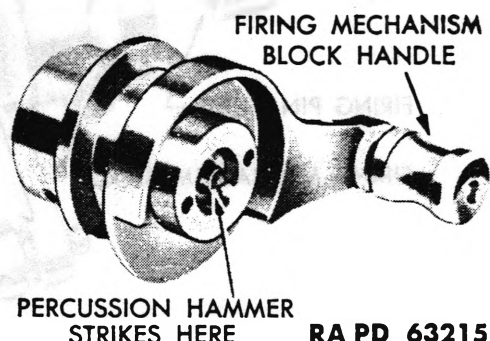


Figure 15—Firing Mechanism M1—Rear

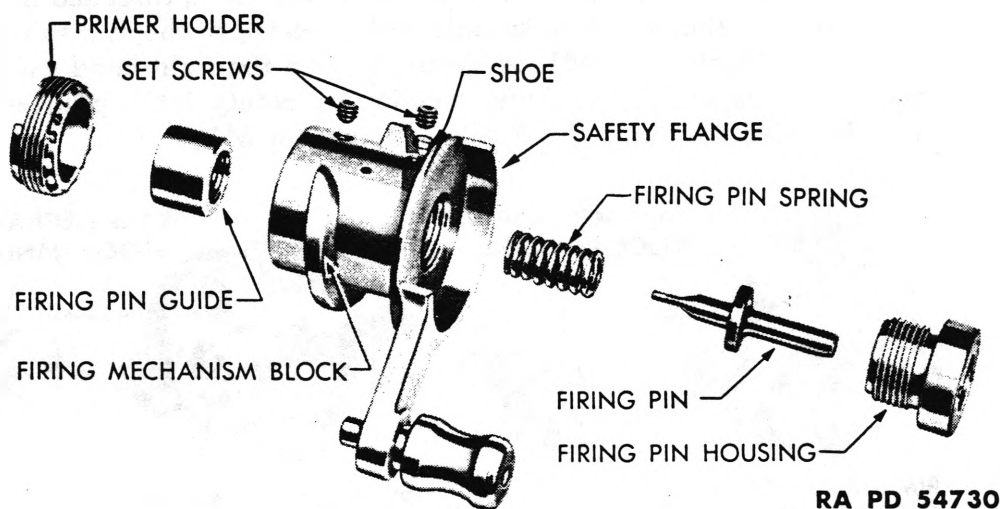
e. **Firing Mechanism M1.**

(1) The Firing Mechanism M1 (figs. 14 and 15) consists of the firing pin, primer holder, and related parts, housed in the firing mechanism block. The mechanism screws, as a unit, into the firing mechanism housing in the rear end of the breechblock. It is removed and replaced between the firing of successive rounds.

(2) The firing mechanism block (fig. 16) is a short, flanged cylinder with a rearward rim extending around a major portion of the flange. This rim prevents the percussion hammer from striking the firing pin unless the mechanism is screwed into firing position. An arm integral with the flange extends to the side at the rear of the block. At the end of this arm is a spring-loaded firing mechanism block plunger and handle by means of which the mechanism is latched in firing position and manipulated in removal and replacement. The block has a coarse thread on its outside, and its bore is threaded in front to receive the primer holder and in the rear to receive the firing pin housing.

(3) The firing pin (fig. 16) has a shouldered, cylindrical body with a rounded rear contact surface and a flat-ended, pin-like nose. The firing pin is held in the bore of the block by the firing pin housing at the rear and by the firing pin spring, guide, and primer holder at the front. The firing pin housing is a bushing which screws into the rear of the block. Its bore forms a bearing for the rear portion of the

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 54730

Figure 16—Exploded View of Firing Mechanism M1

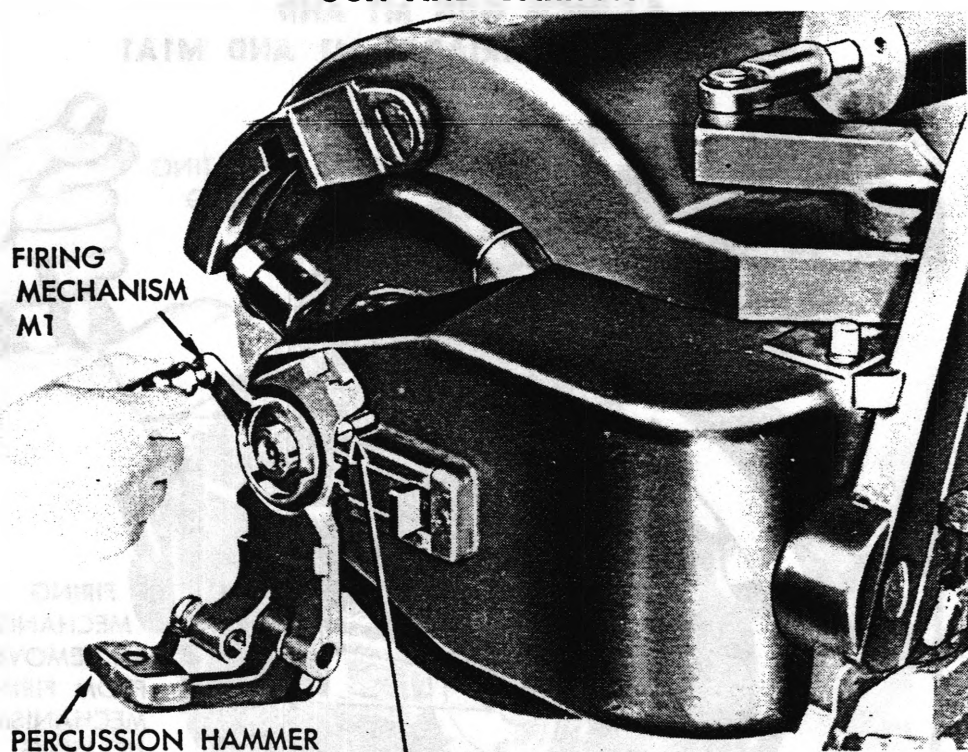
firing pin. The firing pin guide (fig. 16) is a cup which fits, closed end forward, in the forward end of the bore of the block. A hole in the closed end supports the point of the firing pin. The firing pin spring is compressed between the closed end of the guide and the shoulder of the pin.

(4) The primer holder (fig. 16) is ring-shaped. It screws into the front of the block, holding the guide and spring in place. Its flanged front has a U-shaped slot to receive the head of the primer case with the cap of the case directly in front of the nose of the firing pin. The primer holder is locked in the block by a safety set screw which engages one of a number of notches machined in the rear outer edge of the holder. The firing pin housing also is locked by a safety set screw and a copper shoe (fig. 16) is inserted ahead of the screw to prevent damage to the threads of the housing. Holes are provided in the exposed heads of the holder and housing for use of the firing mechanism wrench in assembly and disassembly.

9. BREECH MECHANISM FUNCTIONING.

a. **General.** The functioning of the breech mechanism, either in opening the breech or in closing it, comprises the following two cycles of operation: unscrewing the interrupted threads of the breechblock and breech recess; swinging the breechblock out of the breech recess. Operation of the breech is by hand, opening and closing being accomplished by means of the breech operating lever at the right side of the breech.

GUN AND CARRIAGE



FIRING MECHANISM BLOCK HANDLE ARM STOP RA PD 63347

Figure 17—Removing Firing Mechanism M1

b. Opening the Breech.

(1) FIRST CYCLE.

(a) When the breech is closed and the Firing Mechanism M1 is seated in firing position, the front end of the firing mechanism safety latch is seated in a recess in the rear of the breechblock, preventing rotation of the breechblock. The breechblock is released for rotation by removing the Firing Mechanism M1 (fig. 17). This permits the firing mechanism safety latch to slide to the left, and out of engagement, under pressure of its spring.

(b) The breech operating lever closing latch must be moved to the left (fig. 18) to release the breech operating lever from its upright position. When the lever is drawn rearward and downward, it rotates the breech operating lever journal and crankshaft inside the breechblock carrier. This causes the crosshead on one of the arms of the crankshaft to force the breechblock to rotate clockwise and disengage the interrupted threads. Disengagement of the threads requires but one-tenth of a revolution of the breechblock.

(c) As the threads disengage and the crankshaft continues to turn, the breechblock translating cam roller on the opposite arm of the crankshaft follows the cam groove in the breechblock lug to move the breechblock rearward in the carrier (fig. 19). This rearward

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

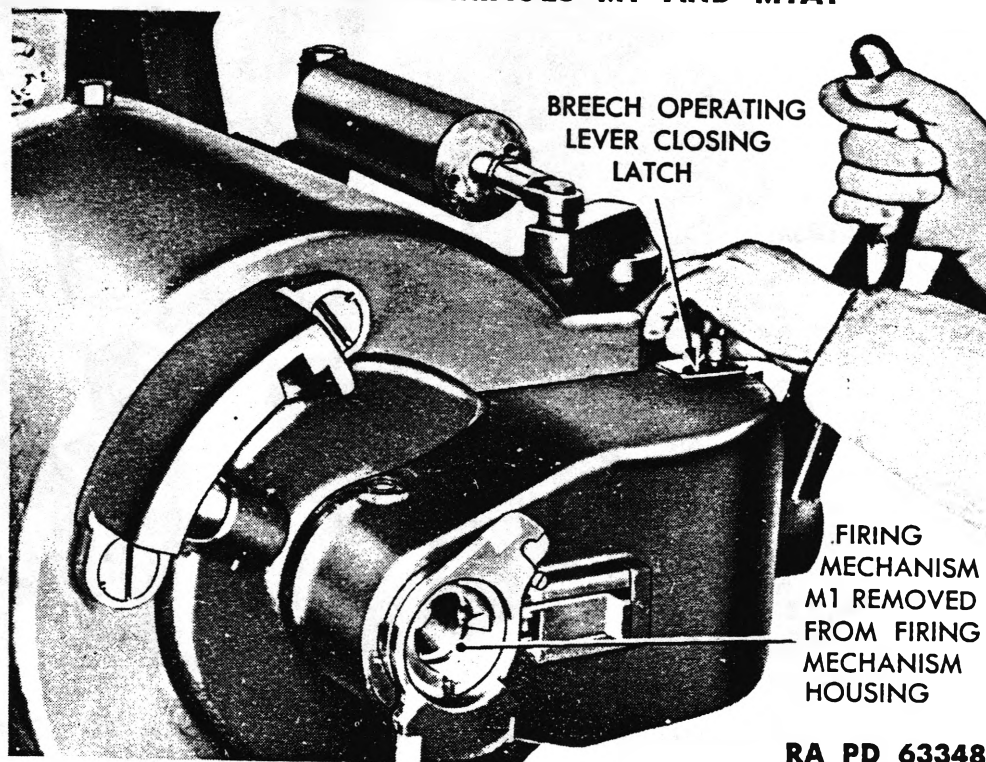


Figure 18—Releasing Breech Operating Lever Closing Latch

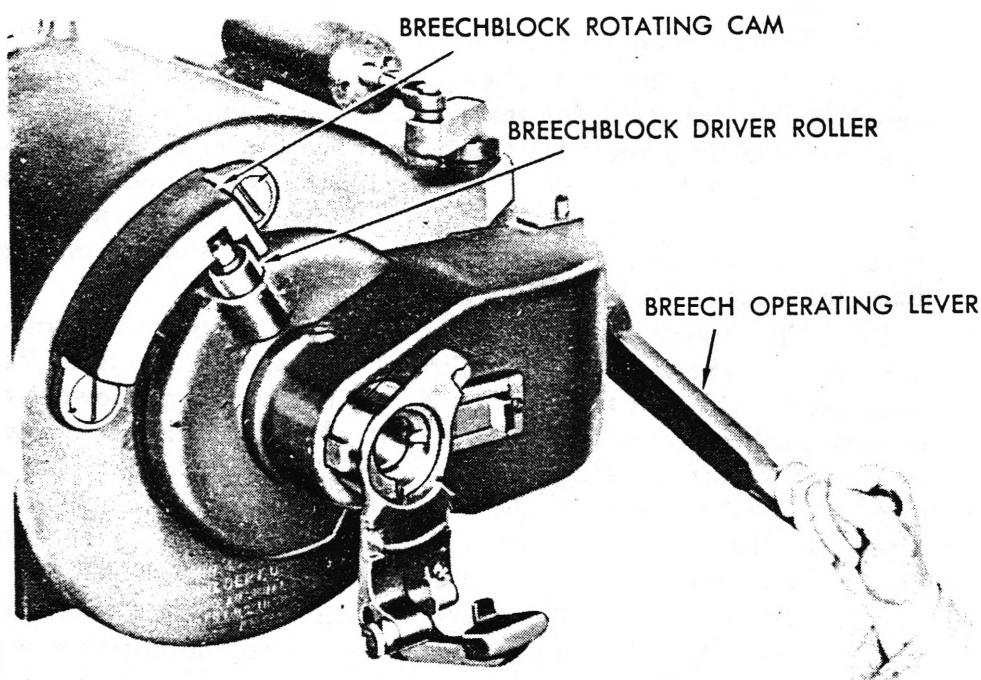
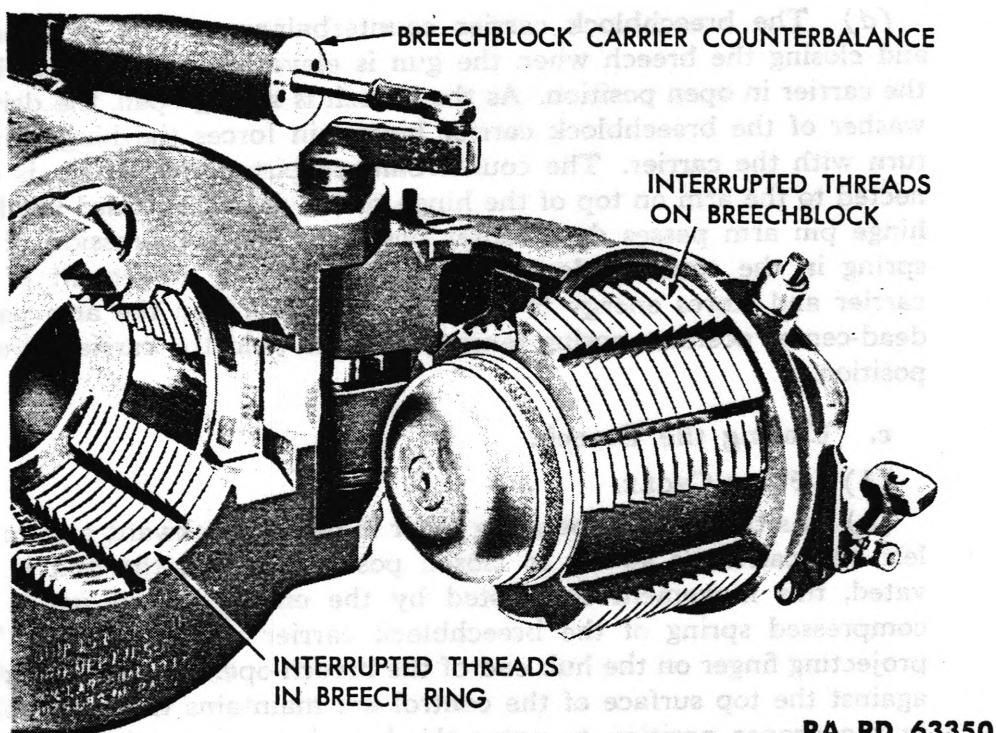


Figure 19—Unsealing Breech

GUN AND CARRIAGE

movement starts withdrawal of the obturator spindle head from the powder chamber and places the breechblock and spindle head in position to clear the breech ring as they are swung rearward with the carrier.

(d) Rotation of the breechblock is stopped in proper alignment by the contact of the breech operating lever with its stop lug on the carrier.



RA PD 63350

Figure 20—Breech Mechanism Open

(2) SECOND CYCLE.

(a) As the breech operating lever is swung to the right and forward, the breechblock and carrier are swung about the axis of the breechblock carrier hinge pin until stopped in the open position against the breech ring (fig. 20). Clearance cuts are provided on the breech ring and breechblock to permit the block to swing freely.

(b) As the carrier swings away from the breech, the projecting finger on the hub end of the breech operating lever slides on the top surface of the breech operating lever control arc. This maintains the breechblock in the proper position to enter the breech ring when the carrier is swung back to closed position.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

(c) The change from rotating movement of the breechblock to swinging motion of the carrier is controlled by the breechblock driver roller which is mounted on the flange of the breechblock driver. The driver rotates as a unit with the breechblock on the carrier. The roller travels in the curved cam groove of the breechblock rotating cam, which is mounted on the left upper rear face of the breech ring. The roller leaves the cam groove after the breechblock is locked in position by the control arc.

(d) The breechblock carrier counterbalance assists in opening and closing the breech when the gun is elevated, and tends to hold the carrier in open position. As the breech is swung open, the driving washer of the breechblock carrier hinge pin forces the hinge pin to turn with the carrier. The counterbalance piston rod, which is connected to the arm on top of the hinge pin, is drawn outward until the hinge pin arm passes dead-center position. The compression of the spring in the counterbalance resists the opening movement of the carrier and stores energy to assist in closing. When the arm passes dead-center position, spring tension tends to hold the carrier in open position.

c. Closing the Breech.

(1) FIRST CYCLE.

(a) As the breech operating lever is drawn backward and to the left, the carrier is swung to closed position. When the gun is elevated, this movement is assisted by the energy stored up in the compressed spring of the breechblock carrier counterbalance. The projecting finger on the hub end of the breech operating lever applied against the top surface of the control arc maintains the breechblock in the proper position to enter the breech recess, and the breechblock driver roller enters the groove of the breechblock rotating cam.

(2) SECOND CYCLE.

(a) As the lever is raised upward and forward, the crankshaft is rotated and the breechblock translating cam roller and crosshead draw the breechblock forward in the breech recess and rotate the breechblock counterclockwise to engage the interrupted threads. As the breech operating lever is pressed fully forward to lock the breech, the lever is latched by the breech operating lever closing latch.

(b) When the Firing Mechanism M1 is screwed into its housing until its handle arm contacts the firing mechanism block handle arm stop, the firing mechanism safety latch is pressed to the right against the tension of its spring. This forces the front end of the safety latch to seat in the breechblock and prevents the breechblock from being rotated.

GUN AND CARRIAGE

10. FIRING MECHANISM FUNCTIONING.

a. In order that the firing mechanism may function, the breech must be fully closed, a percussion-type primer must be inserted in the primer holder in the front end of the Firing Mechanism M1, and the Firing Mechanism M1 must be screwed into the firing mechanism housing until its handle arm contacts the firing mechanism block handle arm stop. Firing is accomplished by a sharp pull on the lanyard, which swings the percussion hammer to strike the firing pin.

b. When the rear contact surface of the firing pin is struck by the percussion hammer, the pin is driven forward against the tension of the firing spring. This causes the nose of the firing pin to protrude through the firing pin guide and to strike the cap of the primer seated in the primer holder, firing the piece.

c. If the Firing Mechanism M1 has not been fully screwed into the firing mechanism housing, the percussion hammer is prevented from striking the firing pin by the rim on the rear of the firing mechanism block which contacts the forward projecting lug on the hammer. When the Firing Mechanism M1 is screwed home, the projecting lug on the hammer passes through a gap in the rim of the block, allowing the hammer to strike the firing pin. The stop prevents the Firing Mechanism M1 from being screwed too far into the housing.

Section II

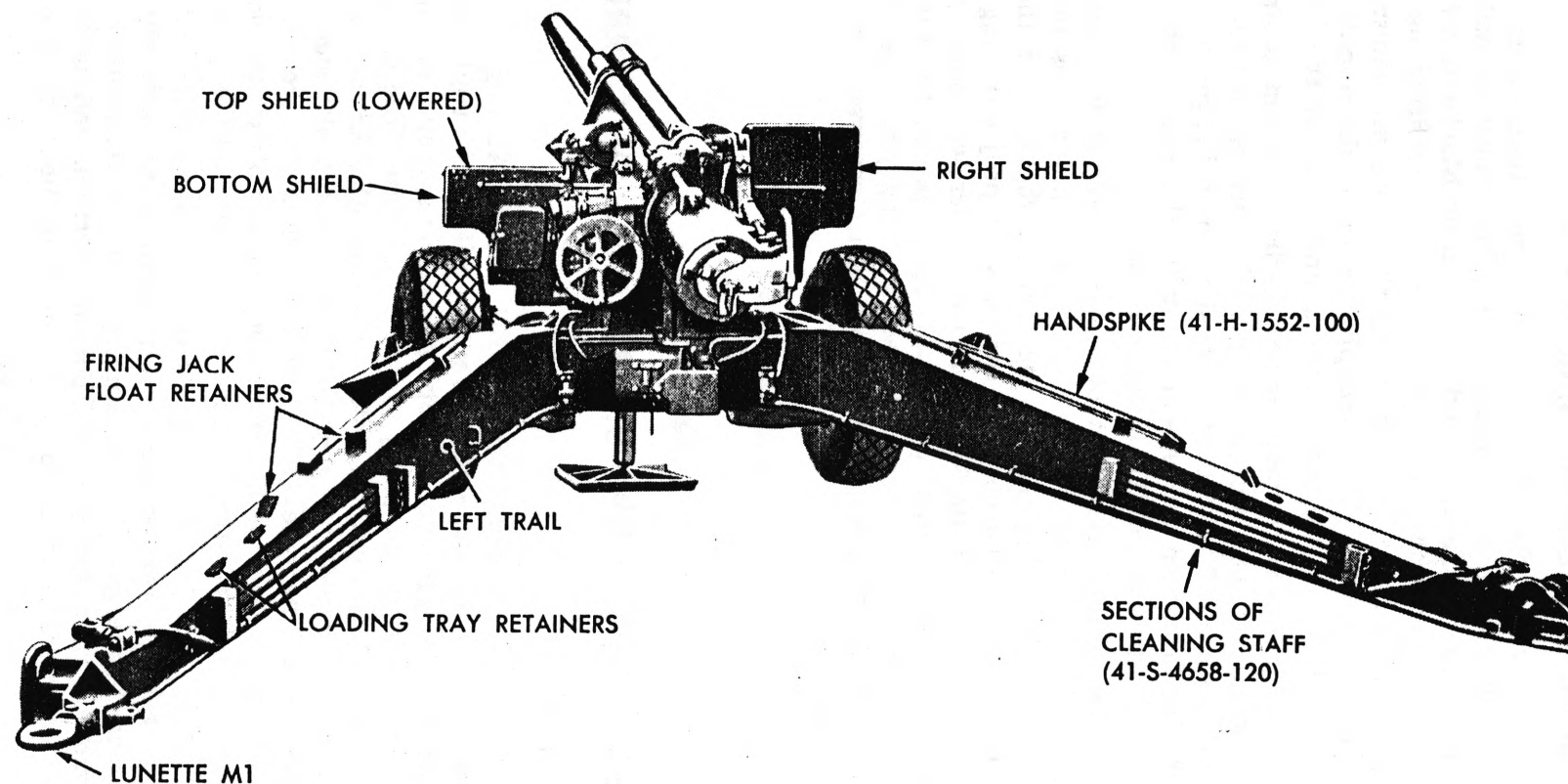
DESCRIPTION AND FUNCTIONING OF CARRIAGE

11. GENERAL.

a. The 4.5-inch Gun Carriages M1 and M1A1 (fig. 21) are of the 2-wheel split-trail type. In traveling position, the trails are locked together by a toggle-type clamping mechanism and are limbered directly to the prime mover by means of a lunette. The 4.5-inch Gun Carriage M1A1 is equipped with air brakes; the 4.5-inch Gun Carriage M1 is equipped with electric brakes. Each brake mechanism is equipped with a hand lever for parking and means are provided in each braking system for automatic emergency brake application in the event of a break-in-two between the carriage and the prime mover.

b. The gun is fired from 3-point suspension, with the trails spread and the carriage resting upon an integral firing jack, the wheels being clear of the ground. The firing stresses are transmitted through the trunnion pins, top carriage, bottom carriage, and trails, to the spades which are attached to the rear ends of the trails. The spades,

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 63351

Figure 21—4.5-inch Gun M1 and 4.5-inch Gun Carriage M1A1—Rear View—Trails Spread

GUN AND CARRIAGE

being buried in the ground, transmit the reaction back to the trails and prevent movement of the carriage.

c. Recoil energy is absorbed and the gun is returned to battery after firing by the Recoil Mechanism M5 of the hydropneumatic, variable recoil type. This recoil mechanism is of built-up construction and incorporates the cradle which supports the gun and in which the gun slides in recoil and counterrecoil. The tipping parts of the gun and carriage are supported on trunnion pins in the top carriage.

d. For ease of traversing, the top carriage is traversed on the top carriage pintle. Spring-type equilibrators assist in elevating and depressing the muzzle-heavy weapon. A traveling lock is provided to stabilize the tipping parts of the weapon and stops are provided to immobilize the traversing parts in traveling position. Shields are provided for the protection of the personnel. The wheels support the carriage on antifriction bearings. The wheels are equipped with pneumatic tires.

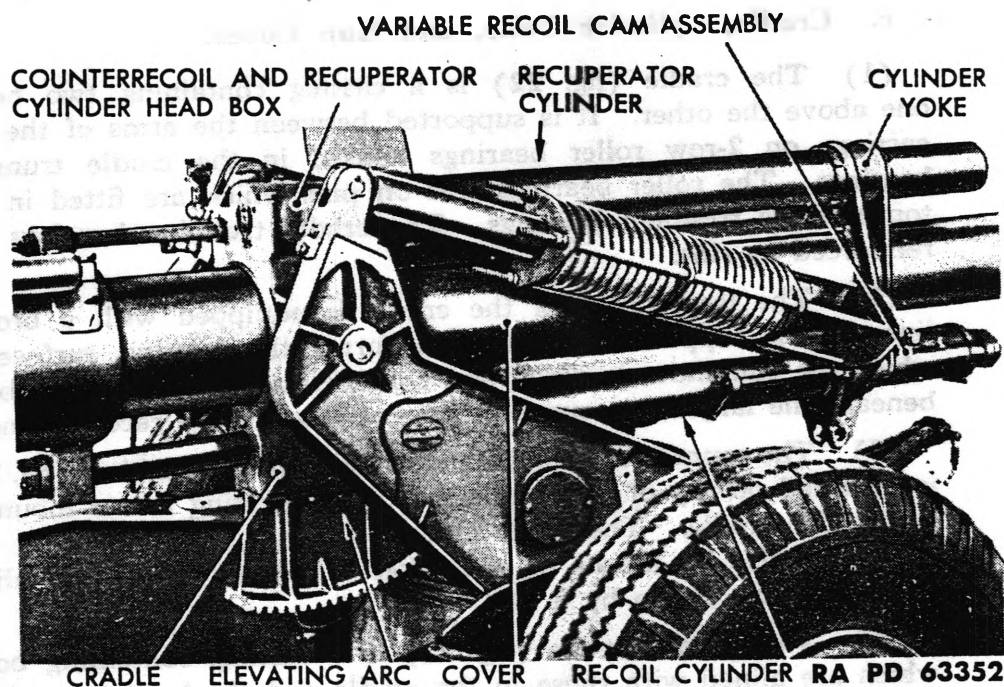


Figure 22—Recoil Mechanism M5—Right Side

12. RECOIL MECHANISM AND CRADLE.

a. General. The Recoil Mechanism M5 (fig. 22), of the 4.5-inch Gun Carriages M1 and M1A1, is of the hydropneumatic, variable recoil type. It is composed principally of the cradle cylinder yoke, and gun cover, the recoil cylinder, variable recoil

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

cam assembly, replenisher, counterrecoil and recuperator cylinder head box, recuperator cylinder, counterrecoil cylinder, and their assembled parts.

b. Purpose.

(1) The purpose of the recoil portion of the recoil mechanism is to absorb and control the backward thrust of the weapon created by firing, and to check its movement in a manner so gradual as not to cause displacement of the carriage.

(2) The purpose of the counterrecoil and recuperator portions of the recoil mechanism is to store part of the recoil energy and, upon completion of the recoiling action, to return the gun to battery in order that it may be fired again. Buffer action controls the concluding movement of the gun as it returns to battery, permitting it to do so without appreciable shock to the mechanism.

c. Cradle, Cylinder Yoke, and Gun Cover.

(1) The cradle (fig. 22) is a casting containing two bores, one above the other. It is supported between the arms of the top carriage on 2-row roller bearings housed in the cradle trunnion bearings. The roller bearings rest on pins which are fitted in the top carriage trunnion bearings. The cradle trunnion bearings are reinforced by ribs.

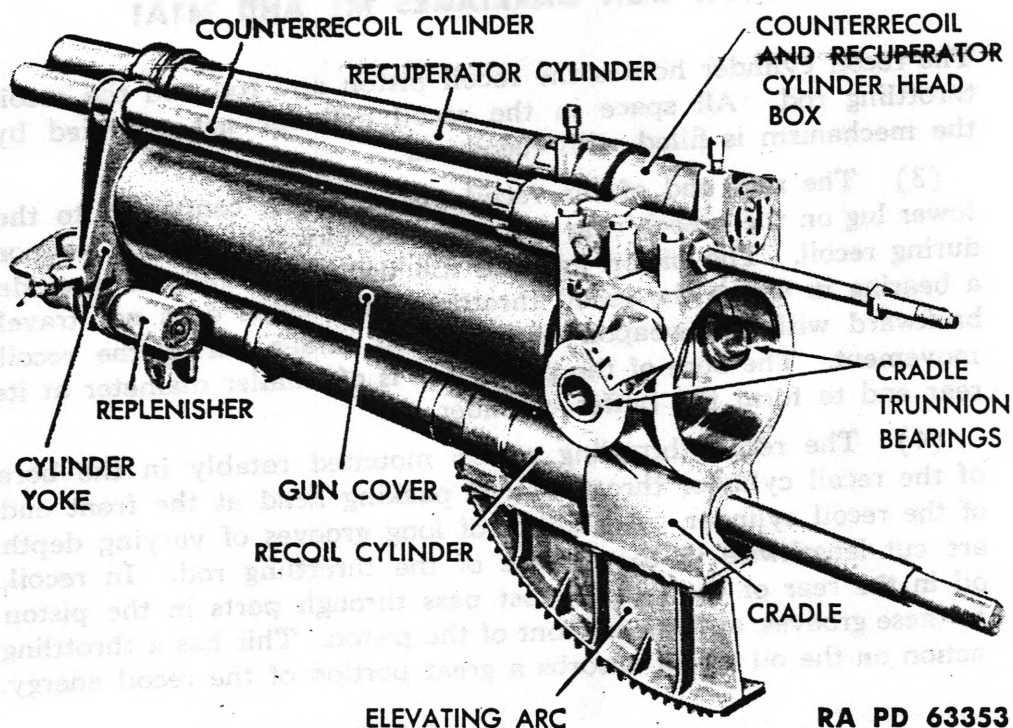
(2) The larger bore of the cradle is equipped with a bronze liner which supports the gun and forms the bearing surface in which the gun slides in recoil and counterrecoil. The smaller bore, beneath the larger one, supports the rear end of the recoil cylinder.

(3) The counterrecoil and recuperator cylinder head box (fig. 22) is mounted on top of the cradle, and the elevating arc is mounted below the cradle. The front end of the arc is attached to the recoil cylinder by means of a bracket. The arc is held in alignment with the cradle by a key.

(4) The cylinder yoke (fig. 22) is a casting, containing bores which are aligned with those in the cradle and the head box. It is located near the front ends of the recoil, recuperator, and counterrecoil cylinders. It supports and holds in alignment the front ends of the gun and cylinders. It also supports the variable recoil cam assembly and the replenisher.

(5) Pins in the sides of the yoke form trunnion attachments for the front ends of the equilibrators. A fork at the bottom of the yoke is drilled for a pin which holds the traveling lock in locked position.

GUN AND CARRIAGE



RA PD 63353

Figure 23—Recoil Mechanism—Left Side—Removed From Carriage

(6) The gun cover (fig. 23) is of welded steel construction and connects the cradle and yoke on which it is held in position by shouldered bearings. It protects the portion of the bearing surface on the gun between the cradle and yoke. The gun recoil wiper, held in place by the gun recoil wiper washer (fig. 26) is mounted on the front of the yoke around the barrel and prevents dirt, water, and other foreign matter from getting inside the cover.

(7) At the upper right side, the interiors of the cradle liner and cover are fitted with recoil guides which contain keyways in which the recoil guide keys on the gun tube travel during recoil and counterrecoil to keep the gun from rotating in its mount.

d. Recoil Cylinder.

(1) The recoil cylinder (fig. 23) is located directly beneath the gun. It is threaded on its rear end to fit the mating bore in the cradle. The front end is supported by the yoke and is locked on the yoke by means of nuts.

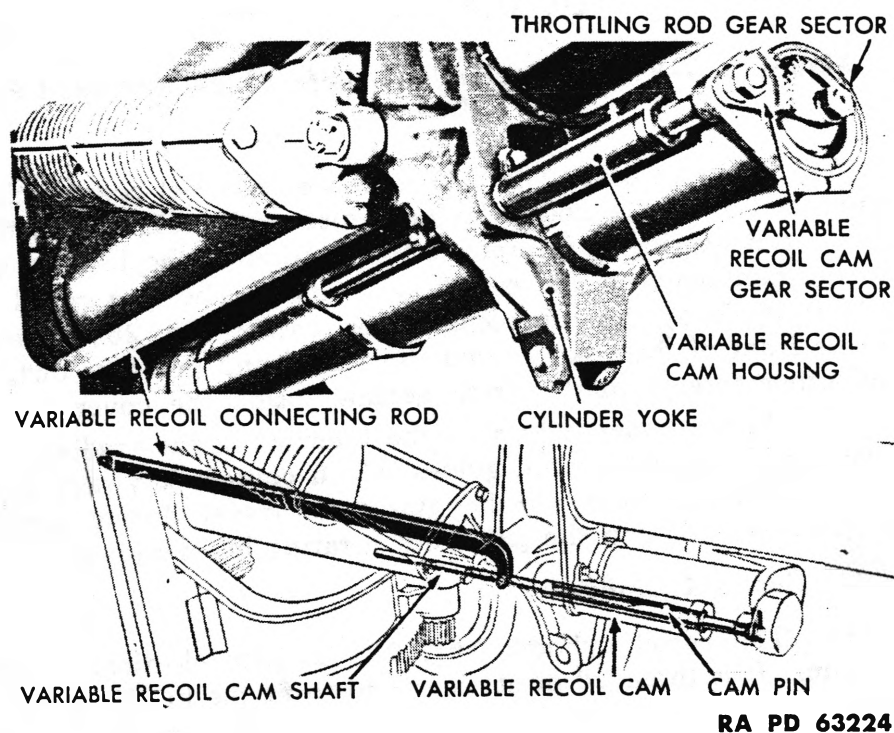
(2) The recoil rod stuffing box head seals the rear end of the recoil cylinder and forms a guide for the recoil piston rod. The front end is sealed by the recoil cylinder throttling rod packing head which also forms the end bearing for the recoil throttling rod.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

The recoil cylinder houses the recoil piston and rod and the recoil throttling rod. All space in the recoil cylinder not occupied by the mechanism is filled with recoil oil.

(3) The rear end of the recoil piston rod is connected to the lower lug on the breech ring and travels backward with the weapon during recoil. The piston and rod are drilled centrally to provide a bearing in which the recoil throttling rod, which does not travel backward with the weapon during recoil, slides during the recoil movement. The bore of the piston rod is of smaller diameter at its rear end to form the buffer chamber.

(4) The recoil throttling rod is mounted rotably in the bore of the recoil cylinder throttling rod packing head at the front end of the recoil cylinder. A number of long grooves of varying depth are cut lengthwise in the surface of the throttling rod. In recoil, oil in the rear of the piston must pass through ports in the piston to these grooves, and out in front of the piston. This has a throttling action on the oil which absorbs a great portion of the recoil energy.



RA PD 63224

Figure 24—Variable Recoil Cam—Assembled and Phantom Views

(5) The throttling rod is turned by the throttling rod gear sector (fig. 24) at its front end which meshes with a similar sector

GUN AND CARRIAGE

actuated by the variable recoil cam. Turning of the throttling rod regulates the volume of oil which can pass through the grooves. This, in turn, varies the length of recoil of the weapon.

(6) The rear end of the throttling rod is of smaller diameter and is provided with throttling grooves to form a spearhead type buffer. Near the end of the counterrecoil movement, this buffer enters the buffer chamber of the recoil piston rod. The oil trapped in the buffer chamber must escape through the grooves, and, in doing so, cushions the final movement of the weapon as it returns to battery.

e. Variable Recoil Cam Assembly.

(1) The variable recoil cam assembly (figs. 22 and 24) controls the length of recoil of the weapon at various elevations. The variable recoil cam housing is mounted in and on the right side of the cylinder yoke near the front end of the recoil cylinder. It houses the tubular variable recoil cam which is machined with a spiral slot. The variable recoil cam gear sector, mounted on the front end of the cam, engages a similar sector on the front end of the recoil throttling rod.

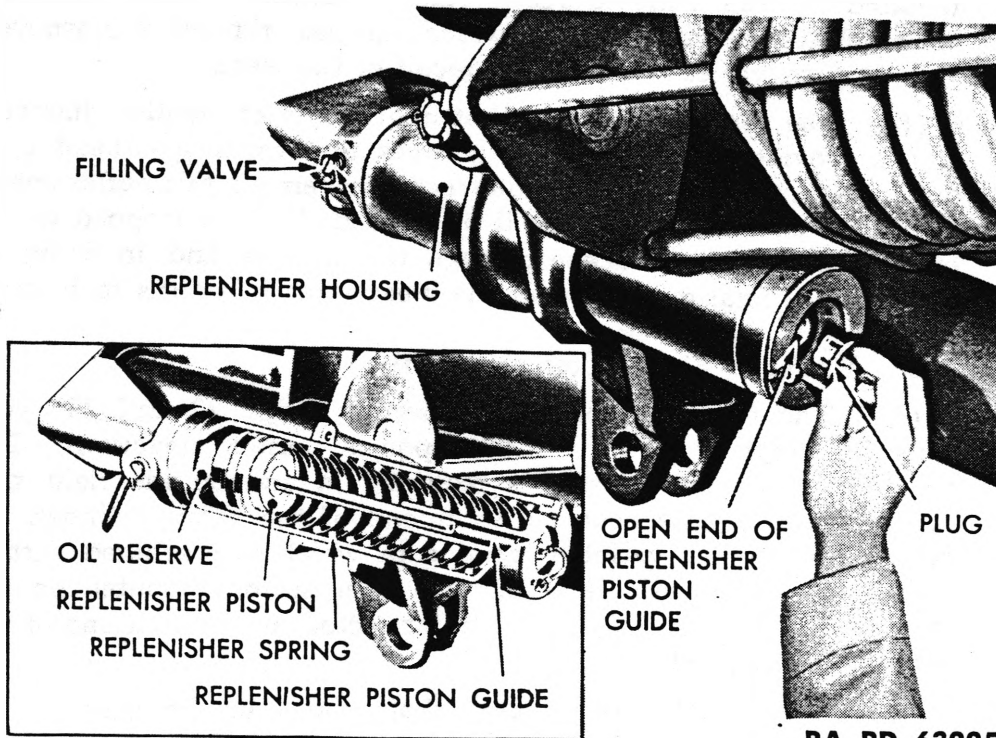
(2) The variable recoil cam shaft slides in the bore of the cam. This shaft is provided with a cam pin which engages the spiral slot in the cam (fig. 28). The shaft is connected to the top carriage by the variable recoil connecting rod. As the weapon is elevated or depressed, the connecting rod moves the shaft forward or backward. This causes the cam pin on the shaft to turn the cam and its gear sector, which turns the gear sector on the throttling rod. The turning of the throttling rod regulates the opening of the oil passages in the recoil cylinder and determines the length of recoil.

f. Replenisher.

(1) The replenisher (figs. 23 and 25) serves as an oil reservoir for the recoil cylinder. It stores excess oil forced from the recoil cylinder by expansion of the oil due to increased atmospheric temperature, or to heat developed by firing. It supplies oil required to compensate for contraction of the oil due to low temperatures.

(2) The replenisher housing is mounted in a bore in the cylinder yoke at the left and near the front end of the recoil cylinder. A tube in the head of the replenisher connects the replenisher with the recoil cylinder. The replenisher is fitted with a spring-loaded piston. The piston, which has an oiltight packing arrangement, is forced rearward against spring pressure as oil enters the replenisher. The spring-loaded piston forces the oil into the recoil cylinder when oil is required.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 63225

Figure 25—Replenisher—Assembled and Sectional View

(3) An extension on the rear of the piston slides in the replenisher piston guide which closes the rear end of the replenisher. The guide is open at the rear and provides a means for determining the amount of reserve oil in the replenisher. This reserve can be determined by inserting a rule in the open rear end of the guide and measuring the distance from the rear face of the guide to the rear end of the piston extension (par. 29 b). The replenisher piston guide plug (fig. 25) is provided to protect the open end of the guide from dirt and other foreign matter.

g. Counterrecoil and Recuperator Cylinder Head Box. This casting (fig. 23), which contains two bores, is bolted to the top of the cradle. The rear end of the counterrecoil cylinder is assembled into the front of the smaller bore at the left. The rear end of the recuperator cylinder is assembled into the front of the other bore. The inside diameters of these two cylinders are continuous with the bores in the head box. The two bores are connected by an opening and house units of the counterrecoil and recuperator mechanisms.

h. Counterrecoil Cylinder.

(1) The counterrecoil cylinder (fig. 23) is the smaller of the two cylinders mounted above the gun. Its front end is closed by

GUN AND CARRIAGE

the counterrecoil respirator body and is supported by, and is a slip fit in, a bore in the cylinder yoke. Its rear end is assembled in its bore in the counterrecoil and recuperator cylinder head box. The rear end of this bore is sealed by the counterrecoil rod stuffing box head which forms the bearing for the counterrecoil piston rod.

(2) The counterrecoil piston and piston rod slide in the counterrecoil cylinder (fig. 28). This rod is connected to the top lug of the breech ring and travels backward with the weapon during recoil. The piston is fitted with an oiltight packing arrangement which permits it, when drawn backward in recoil, to force the oil in the cylinder to the rear and through the opening in the counterrecoil and recuperator cylinder head box into the recuperator cylinder.

(3) The counterrecoil respirator (fig. 26) in the front end of the counterrecoil cylinder is equipped with a spring-loaded ball check valve. Its purpose is to release any air pressure in front of the counterrecoil piston when the piston is moved forward during counterrecoil.

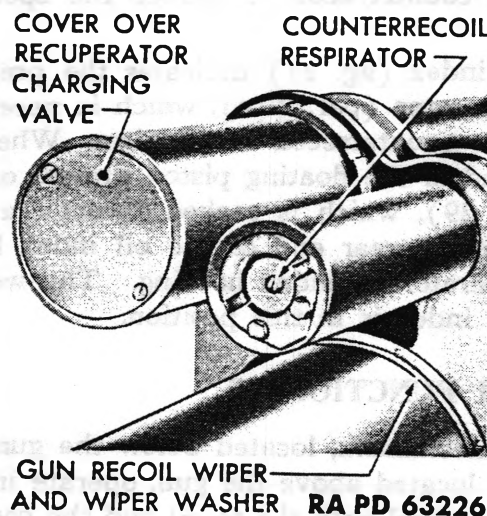


Figure 26—Front Ends of Recuperator and Counterrecoil Cylinders

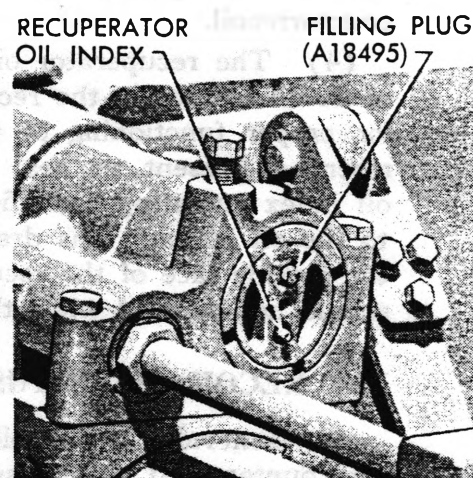


Figure 27—Rear Ends of Recuperator and Counterrecoil Cylinders

i. Recuperator Cylinder.

(1) The recuperator cylinder (fig. 23) is the larger of the two cylinders mounted above the weapon. Its front end is supported in a bore in the cylinder yoke and is locked by two nuts. Its rear end is assembled in the front of the right bore of the counterrecoil and recuperator cylinder head box. The front end is sealed

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

by the front recuperator cylinder head which is equipped with the recuperator charging valve and protected by a cover (fig. 26). The rear end of the recuperator cylinder bore of the head box is sealed by the recuperator oil index housing. This housing is fitted with an oil filling valve and plug and the oil index (fig. 27).

(2) The recuperator cylinder houses the recuperator floating piston (fig. 28). The floating piston is a grease seal which separates the oil at the rear end of this cylinder from the compressed nitrogen at the front end. This piston moves forward or backward, depending upon the direction from which the greater pressure comes. The seal is obtained by grease held tightly packed by spring tension between two heads. Both heads are fitted with elastic packing held tightly against the cylinder walls by the tension of Belleville springs.

(3) The counterrecoil regulator valve is housed in the recuperator cylinder bore of the head box. It permits free passage of oil from the counterrecoil cylinder to the recuperator cylinder during recoil of the gun but regulates the flow of oil back into the counterrecoil cylinder during counterrecoil to reduce the speed of counterrecoil.

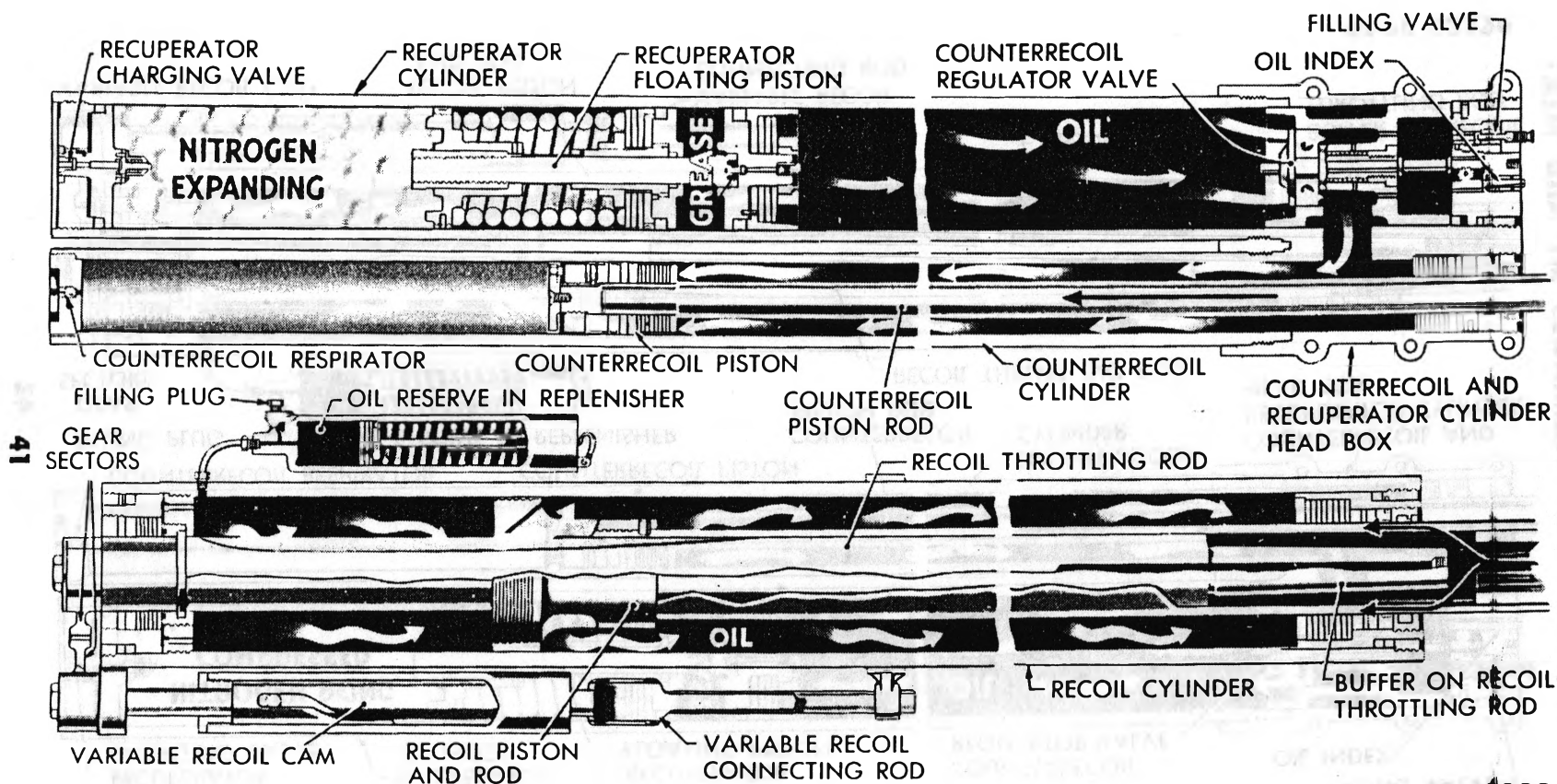
(4) The recuperator oil index (fig. 27) indicates the presence of an oil reserve in the recuperator (par. 29 c), which is necessary for proper functioning of the counterrecoil mechanism. When no reserve is present, the rear end of the floating piston presses on the oil index actuating rod (fig. 29), which is racked through a gear to the oil index. This draws the rear end of the oil index below the outside face of the recuperator oil index housing. The weapon should not be fired when the index is in this position.

13. RECOIL MECHANISM FUNCTIONING.

a. **General.** The recoil mechanism, located below the gun, and the counterrecoil mechanism, located above the gun, operate in conjunction with one another to control both the recoil and the counterrecoil of the weapon. The only direct connection between the two mechanisms is the breech ring to which both are attached by their respective piston rods.

b. Recoil Action.

(1) When the gun is fired, the gun recoils in the cradle, and the recoil and counterrecoil pistons are drawn backward through their cylinders by their piston rods, which are attached to the breech ring (fig. 28). The recoil throttling rod, which has been automatically adjusted to the elevation of the weapon, remains stationary in its bore in the recoil piston rod.



GUN AND CARRIAGE

RA PD 63228

TM 9-328
13

Figure 28—Phantom View of Recoil Mechanism—Weapon in Recoil

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

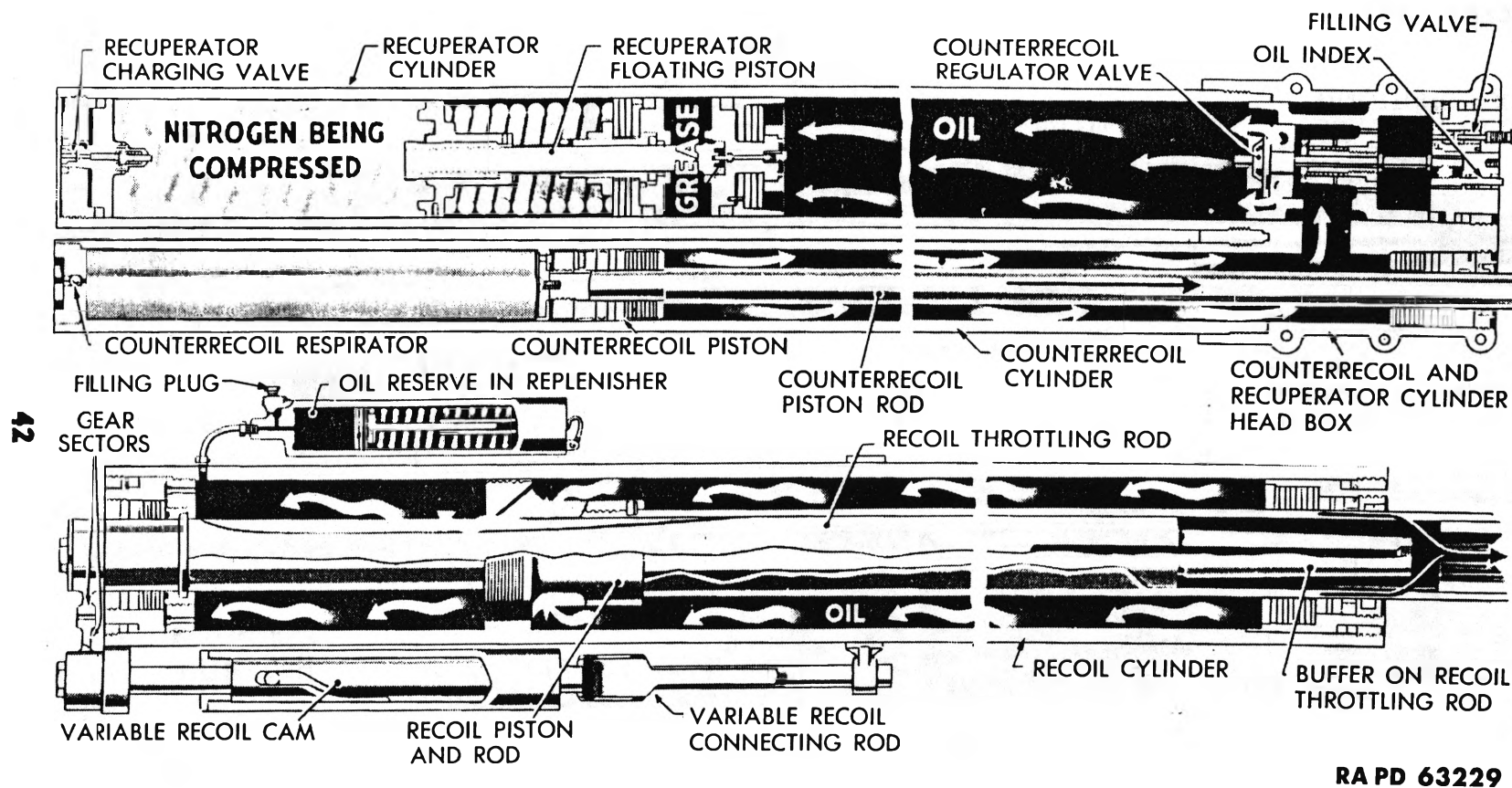


Figure 29—Phantom View of Recoil Mechanism—Weapon in Counterrecoil

GUN AND CARRIAGE

(2) The oil in the recoil cylinder in the path of the piston is forced through ports in the piston, through the grooves in the throttling rod, to the other side of the piston. This has a throttling action on the oil, causing resistance which absorbs a great portion of the recoil energy.

(3) At the same time, the oil in the counterrecoil cylinder in the path of the counterrecoil piston is forced through the communicating opening in the counterrecoil and recuperator cylinder head box. This forces open the spring-loaded regulator valve, and the oil forces the floating piston forward, further compressing the nitrogen in the space ahead of the floating piston. The resistance which must be overcome to build up the nitrogen pressure helps to counteract the recoil action of the weapon.

(4) The throttling of the oil, the increased nitrogen pressure, and the combined friction of the packings of the recoiling parts bring the weapon to rest.

c. **Counterrecoil Action.** When the weapon has fully recoiled, the highly-compressed nitrogen immediately begins to expand, forcing the floating piston and the oil in back of it in the opposite direction (fig. 29). The regulator valve is closed, and the oil is forced to return to the counterrecoil cylinder through the counterrecoil controlling holes in the regulator valve. In the counterrecoil cylinder, the oil forces the piston forward, and the counterrecoil piston rod pulls the weapon into battery.

d. **Buffer Action.** Near the end of the counterrecoil movement, the buffer chamber at the end of the recoil piston rod encloses the rear end of the recoil throttling rod (fig. 29). Oil, accumulated in the chamber during recoil is trapped. It is forced out by way of the throttling grooves in the buffer and an oil passage in the recoil throttling rod. This throttling of the oil cushions the final movement of the weapon as it is drawn into battery.

14. TOP CARRIAGE.

a. The top carriage (fig. 30), of welded steel construction, has a circular base and two rearward-extending arms. It supports the tipping parts of the weapon, the elevating and traversing mechanism, the shields, and the sighting equipment. It is supported by, and rotates on, the bottom carriage to which it is secured by the top carriage pintle (par. 18 d).

b. Equilibrator brackets for the rear ends of the equilibrators are provided on the upper ends of the arms. A bracket for the variable recoil connecting rod is located on the upper edge of the right arm.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

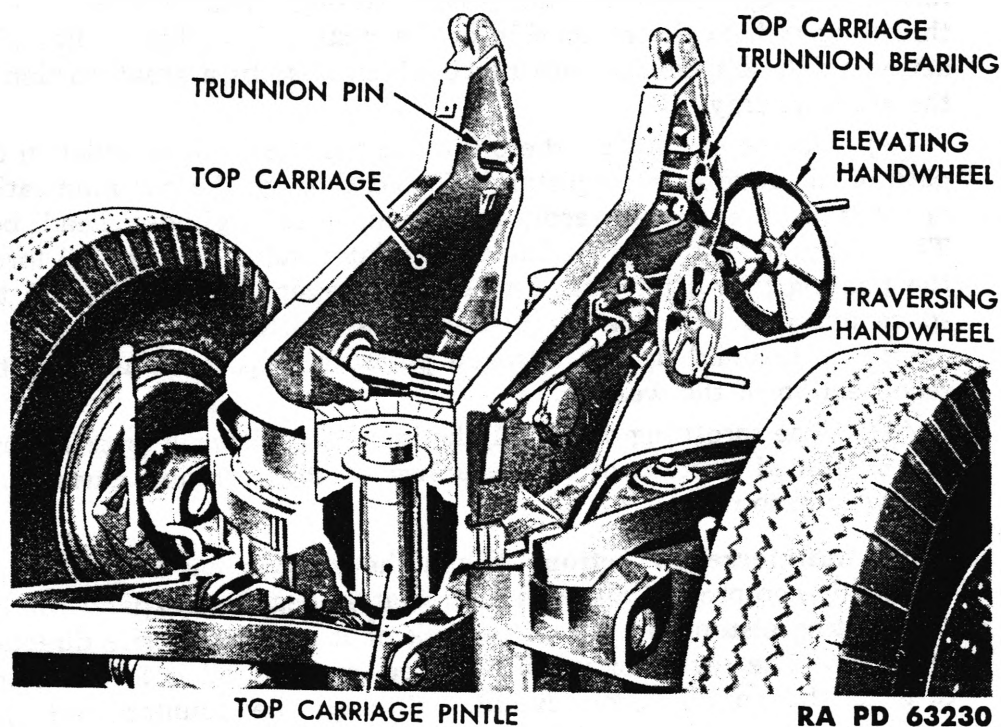


Figure 30—Top Carriage, One Trunnion Pin in Position (Portion of Carriage Cut Away To Show Top Carriage Pintle)

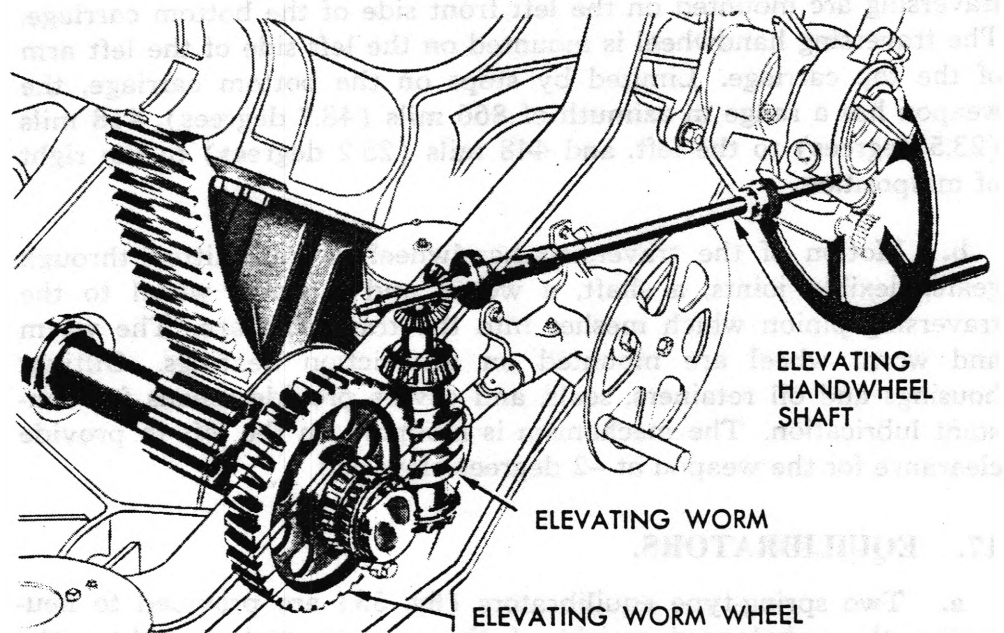
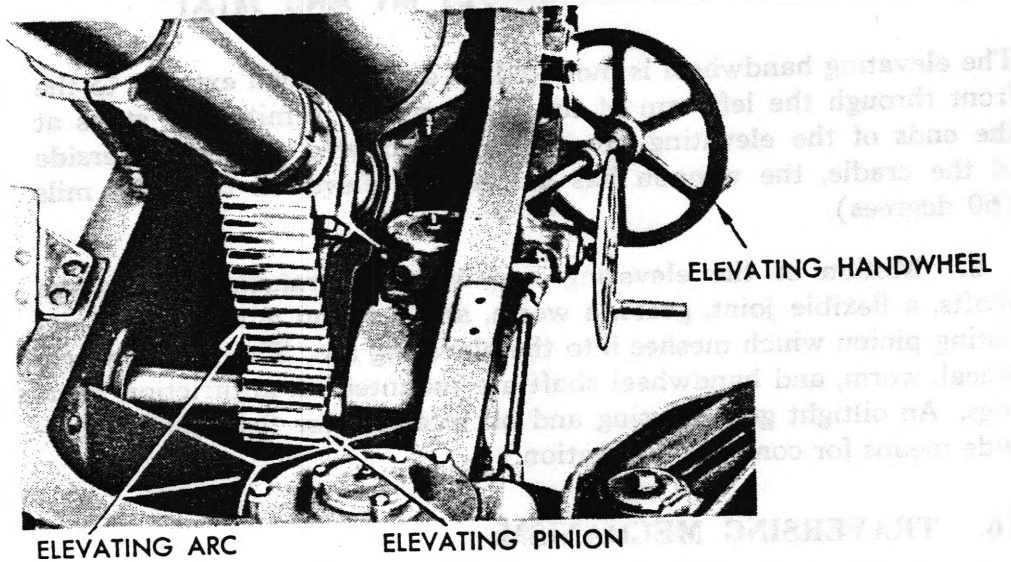
c. **Trunnion Bearings.** The gun, cradle, and recoil mechanism are supported on trunnion pins (fig. 30) which extend through the trunnion bearings in the side arms of the top carriage and into 2-row, taper roller bearings mounted in the trunnion bearings of the cradle. The trunnion pins and the cones of the roller bearings, which are secured to the pins by retainers, remain stationary with the pins. The cups of the roller bearings are secured to the cradle by caps and tip with the cradle. Each assembly is oil-sealed.

d. **Shields.** The armor plate shields (fig. 21) are secured to the top carriage. The top portion of the left shield is hinged and may be lowered and secured in the desired position by the locking device. The panoramic telescope case, mounted on the left shield, is equipped with a hinged cover and padlock, and is for stowage of the panoramic telescope when the latter is not in use.

15. ELEVATING MECHANISM.

a. The elevating mechanism (fig. 31) controls the movement of the weapon in elevation and depression by tipping the cradle and weapon on the trunnion pins secured in the arms of the top carriage.

GUN AND CARRIAGE



RA PD 63231

Figure 31—Elevating Mechanism—Assembled and Phantom Views

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

The elevating handwheel is mounted on a shaft which extends to the front through the left arm of the top carriage. Limited by stops at the ends of the elevating arc, which is mounted on the underside of the cradle, the weapon has a range in elevation of 1,068 mils (60 degrees).

b. Motion of the elevating handwheel is transmitted through shafts, a flexible joint, gears, a worm, and a worm wheel to the elevating pinion which meshes into the elevating arc. The pinion, worm wheel, worm, and handwheel shaft are mounted on antifriction bearings. An oiltight gear housing and oil retainers for the bearings provide means for constant lubrication.

16. TRAVERSING MECHANISM.

a. The traversing mechanism (fig. 32) rotates with the top carriage and controls the movement of the weapon in azimuth by means of the traversing pinion which is rolled in the teeth of the stationary traversing arc mounted on the left front side of the bottom carriage. The traversing handwheel is mounted on the left side of the left arm of the top carriage. Limited by stops on the bottom carriage, the weapon has a range in azimuth of 866 mils (48.7 degrees), 418 mils (23.5 degrees) to the left, and 448 mils (25.2 degrees) to the right of midposition.

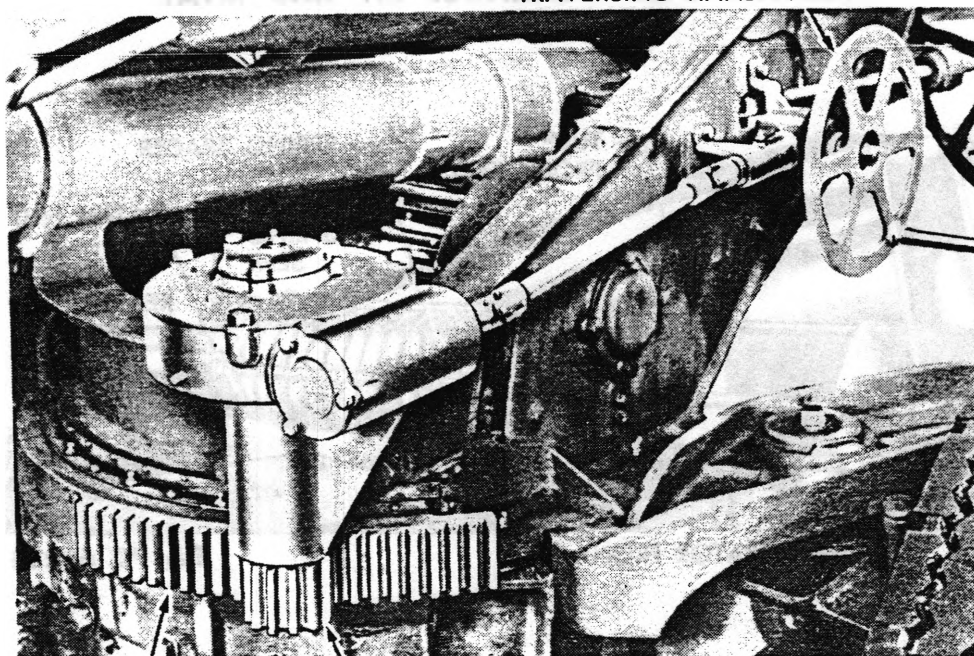
b. Motion of the traversing handwheel is transmitted through gears, flexible joints, a shaft, a worm, and a worm wheel to the traversing pinion which meshes into the traversing arc. The worm and worm wheel are mounted on antifriction bearings. Oiltight housings and oil retainers, seals, and covers provide means for constant lubrication. The mechanism is mounted on the left to provide clearance for the weapon at -2 degrees elevation.

17. EQUILIBRATORS.

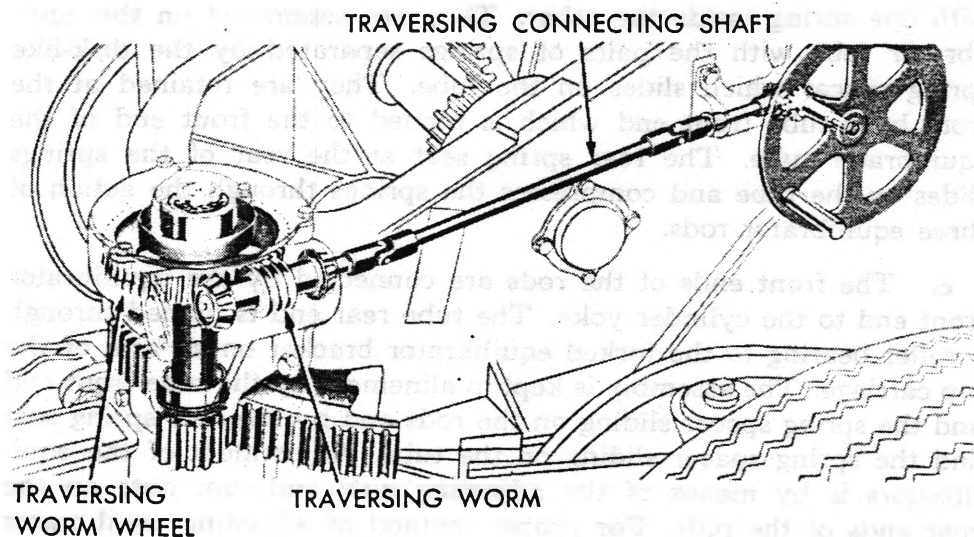
a. Two spring-type equilibrators (fig. 33) are provided to neutralize the unbalanced weight of the weapon and to reduce the manual effort required to elevate it. The equilibrators connect the cylinder yoke with the equilibrator brackets on the upper ends of the top carriage. The springs are compressed as the gun is depressed, counterbalancing the muzzle-heavy weight of the tipping parts and eliminating the need for manually braking their descent. The energy stored in the compressed springs is released as the gun is elevated; the springs are permitted to expand, applying lifting pressure to the weapon, and assisting in elevating it.

GUN AND CARRIAGE

TRaversing HANDWHEEL



TRaversing ARC TRaversing PINION



TRaversing WORM WHEEL TRaversing WORM

RA PD 63232

Figure 32—Traversing Mechanism—Assembled and Phantom Views

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

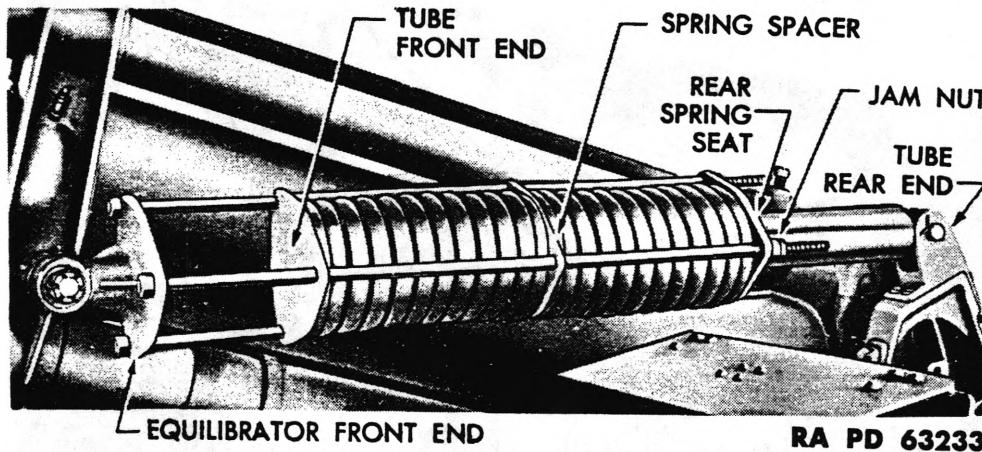


Figure 33—Equilibrator and Connections to Top Carriage and Yoke

b. The four springs in each equilibrator are assembled in pairs, with one spring inside the other. They are assembled on the equilibrator tube with the pairs of springs separated by the disk-like spring spacer which slides on the tube. They are retained at the front by a tube front end which is pinned to the front end of the equilibrator tube. The rear spring seat at the rear of the springs slides on the tube and compresses the springs through the action of three equilibrator rods.

c. The front ends of the rods are connected by the equilibrator front end to the cylinder yoke. The tube rear end is pinned through a roller bearing to the forked equilibrator bracket on an arm of the top carriage. The assembly is kept in alignment by the tube front end and the spring spacer sliding on the rods and by the rear spring seat and the spring spacer sliding on the tube. Adjustment of the equilibrators is by means of the adjusting nuts and jam nuts on the rear ends of the rods. For proper method of adjusting equilibrator see paragraph 54 c.

18. BOTTOM CARRIAGE.

a. The bottom carriage (fig. 34) is of welded steel construction. It supports the weight of the carriage and weapon on the wheel spindles and wheels. It transmits firing stresses to the firing jack and

GUN AND CARRIAGE

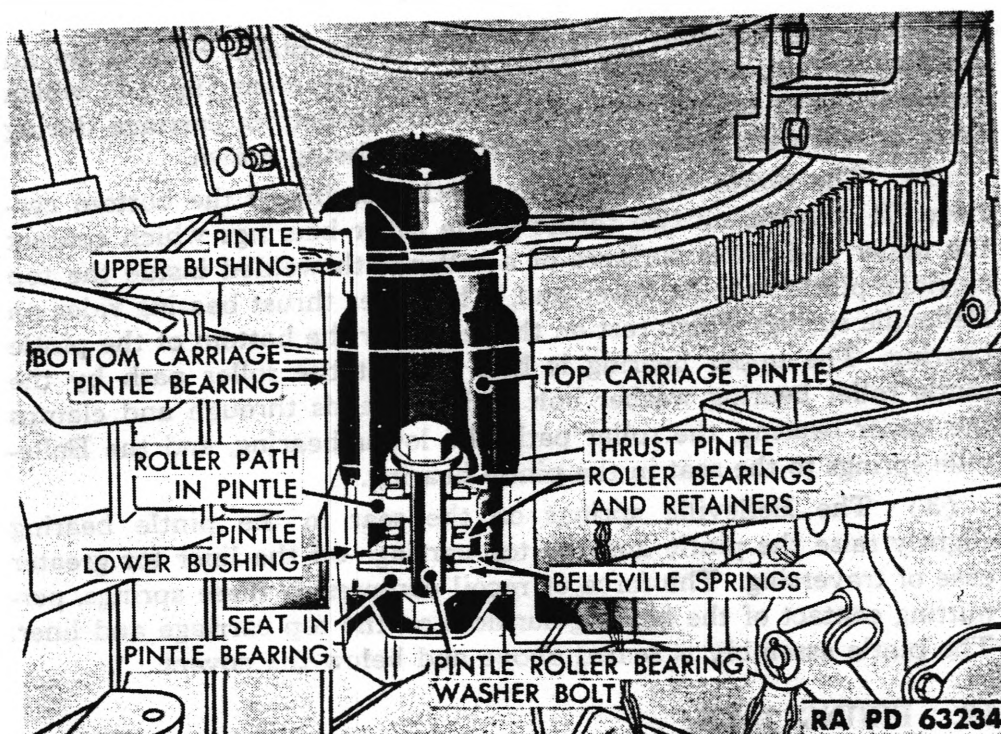


Figure 34—Cutaway View of Top Carriage and Bottom Carriage Showing Pintle, Pintle Bearing, and Connection

the trails. The firing jack, the traveling lock, and the traversing arc are mounted on the front of the bottom carriage. The sides of the bottom carriage contain bushing-lined bores to receive the trail hinge pins.

b. The bottom carriage liner, a bearing washer of large diameter, is mounted on the top surface of the bottom carriage. When the gun is fired, the smoothly finished undersurface of the top carriage bears on this liner. When the gun is traversed, the weight of the top carriage and the parts it supports are traversed on the top carriage pintle and the pintle bearing in the bottom carriage and not on the bearing surfaces of the top carriage and the liner.

c. **Pintle Bearing.** The pintle bearing (fig. 34) is a vertical, cylindrical bore through the center of the bottom carriage. On its walls are the bottom carriage upper and lower pintle bushings. It is provided with a seat near the bottom which closes the bore except for a bolt hole through the center of the seat.

d. Top Carriage Pintle.

(1) The top carriage pintle (figs. 30 and 34) is a tubular projection extending from the center of the bottom surface of the top carriage. It is the pivot for the movement of the top carriage in

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

traversing the weapon. It is shackled to the pintle bearing by an antifriction bolt, nut, and thrust bearing arrangement (fig. 34) which prevents lifting of the top carriage from the bottom carriage during firing or when the weapon and carriage are being drawn.

(2) The pintle rotates in the pintle bearing of the bottom carriage. It is borne on two thrust pintle roller bearings which contact the upper and lower surfaces of a roller path welded inside the top carriage pintle near its lower end. The lower thrust bearing rides on Belleville springs which rest on the seat near the bottom of the pintle bearing. The upper bearing is held against the roller path by the pintle roller bearing washer bolt which extends through and clamps the upper bearing, the roller path, the lower bearing, and the Belleville springs to the seat in the pintle bearing.

(3) The Belleville springs on the seat in the pintle bearing slightly raise the pintle and the top carriage off the liner for greater ease of traversing. The force of recoil compresses these springs, permitting contact of the bearing surfaces on the top carriage and liner. The pintle assembly is sealed above and below the covers.

19. FIRING JACK.

a. The firing jack (figs. 35 and 36) is screwed to the front of the bottom carriage, to which it remains attached at all times. The weapon is fired with the weight of the front part of the weapon resting on the firing jack and the wheels raised clear of the ground. The firing jack is provided with the fabric Firing Jack Cover M532, with clamp. The cover is clamped over the opening in the top of the firing jack housing to protect the firing jack rack plunger from dirt, water, and other foreign matter. It is to remain in place at all times except when the rack plunger is being cleaned or lubricated.

b. The firing jack rack plunger (fig. 37) is raised and lowered by the pinion on the firing jack pinion shaft meshing in the teeth of the rack plunger. The pinion shaft is rotated by the firing jack pinion shaft worm wheel and the firing jack worm shaft. The latter is actuated by either or both firing jack worm shaft ratchet wheels and firing jack ratchet case assemblies.

c. The firing jack worm shaft ratchet wheels are engaged by spring-loaded firing jack ratchet plungers. The handles of the ratchet plungers are inscribed with arrows to indicate the direction of movement for which the ratchets are set to raise or lower the rack plunger. The handles of the ratchet plungers are rotated 180 degrees to reverse the action of the ratchets.

d. The firing jack ratchet case assemblies are provided with short, permanently connected firing jack ratchet case handles for

GUN AND CARRIAGE

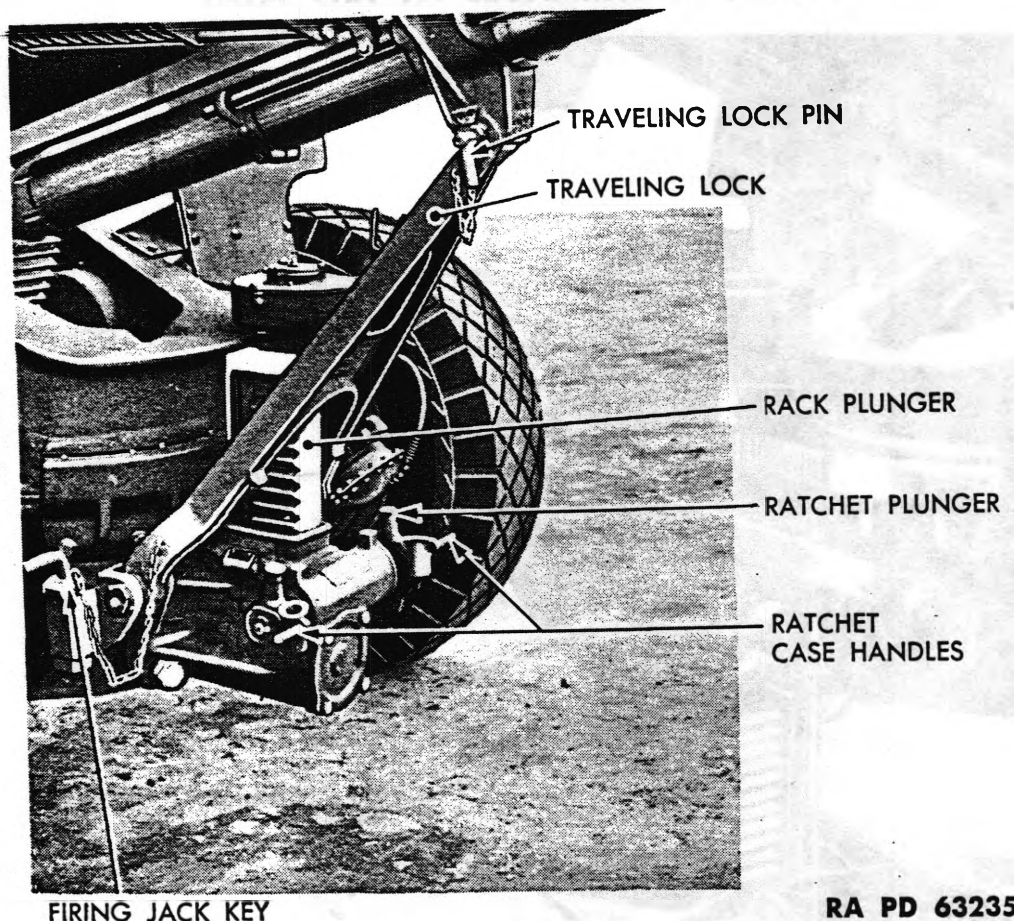


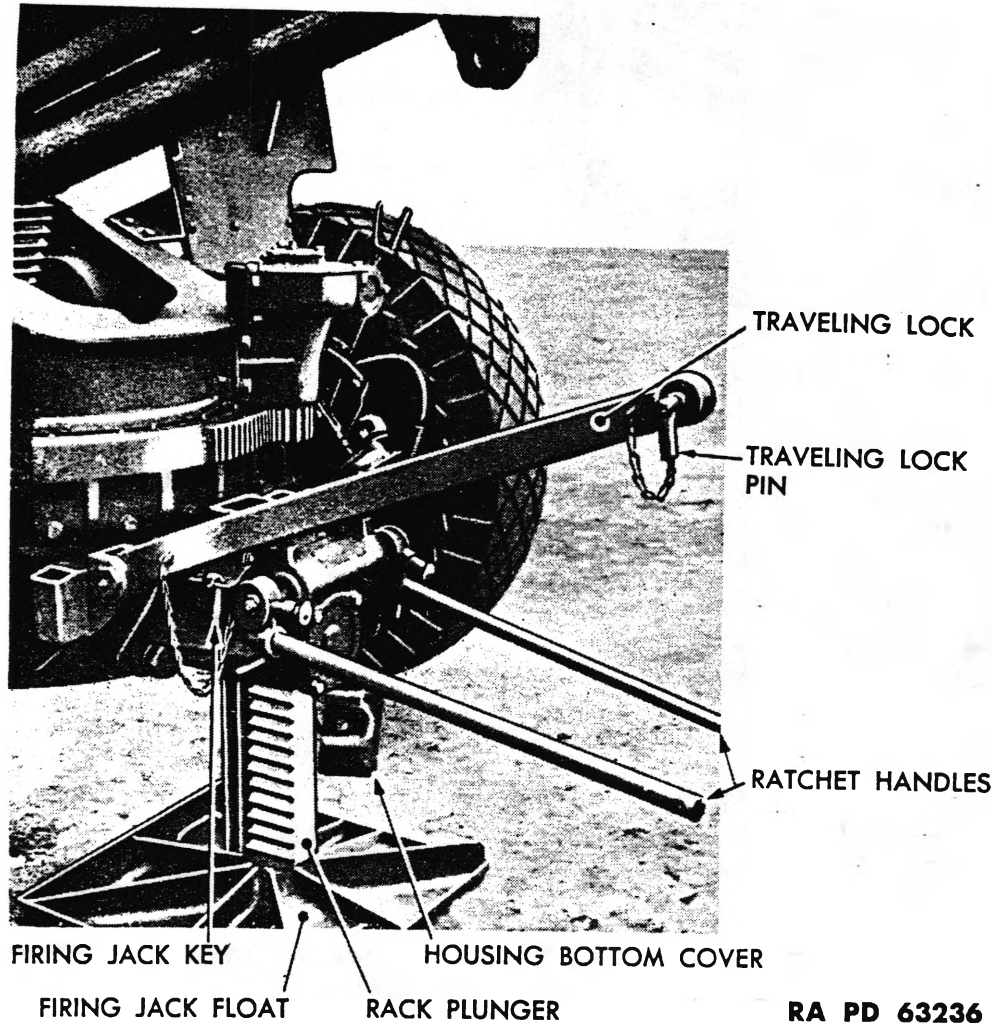
Figure 35—Firing Jack and Traveling Lock in Traveling Position (Cover Removed)

quick-action operation of the rack plunger to loaded position. Long, tubular, removable firing jack ratchet handles are inserted in the ratchet cases to raise and lower the loaded rack plunger. When not in use, these handles are carried in supports on the front of the right shield.

e. The firing jack float (fig. 36) is attached to the lower end of the rack plunger to give the firing jack sufficient bearing surface on the ground. In traveling position, the float is mounted between carrying brackets on the tops of the folded trails. In use, the flattened sides of the ball on the lower end of the rack plunger are inserted in the slotted seat in the center of the float. Then, the float is turned 90 degrees to lock the float in place.

f. In firing position (fig. 36), the rack plunger, with the firing jack float in place, is depressed until the firing jack key can be in-

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



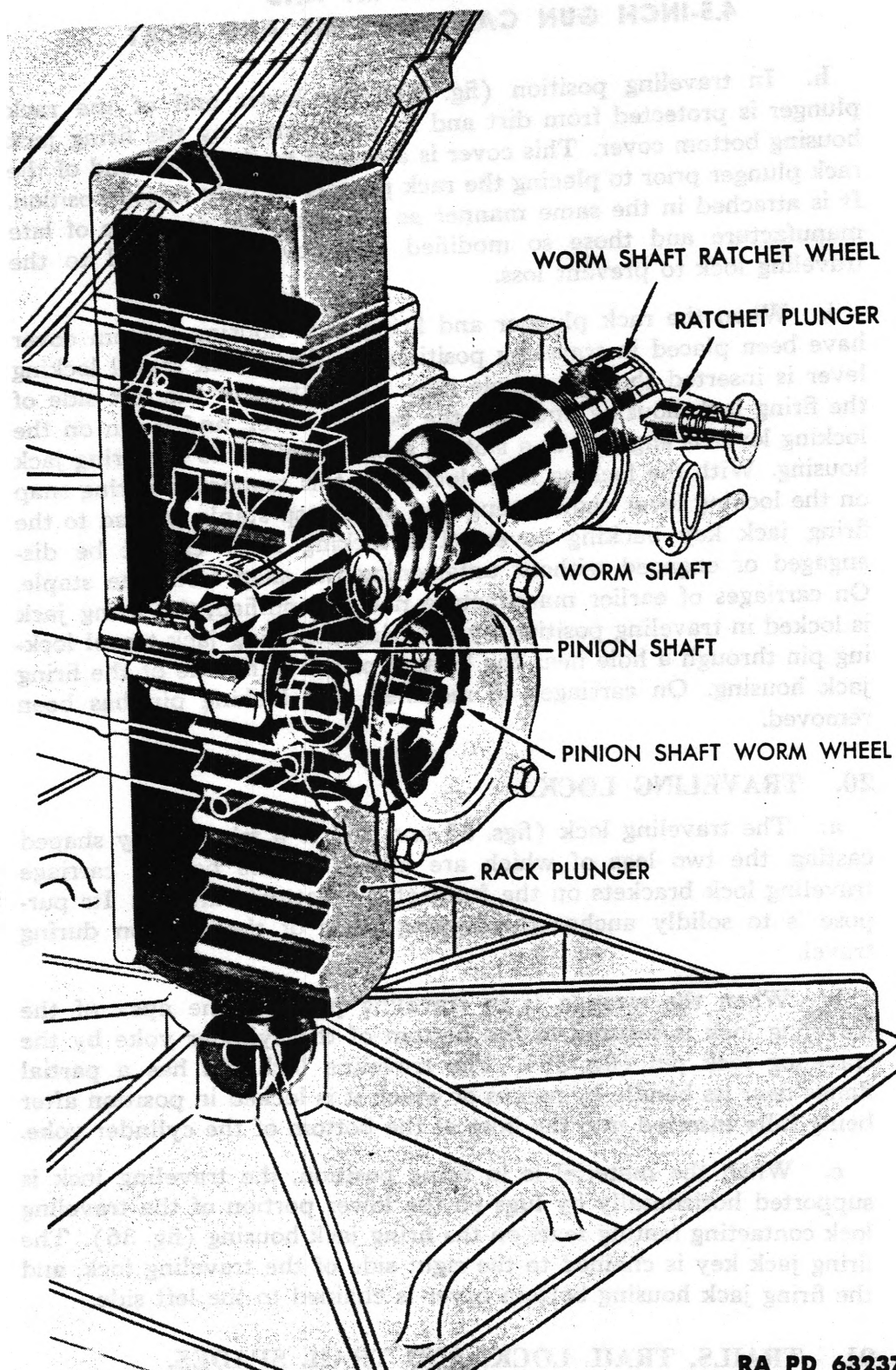
RA PD 63236

**Figure 36—Firing Jack and Traveling Lock in Firing Position
(Cover Removed)**

serted through the opening near the top of the right side of the firing jack housing and seated in the opening on the other side of the housing. When the rack plunger is raised to seat against the key, the jack is locked and the firing stresses are taken off the moving parts of the jack mechanism and transmitted from the housing through the key and rack plunger directly to the float.

g. The firing jack key is chained to the traveling lock and carried in the firing jack key pocket on the right side of the front of the bottom carriage. The opening near the top of the right side of the firing jack housing is fitted with the firing jack key opening spring cover while the opening on the left side is closed by the firing jack key backing cover.

GUN AND CARRIAGE



RA PD 63237

Figure 37—Firing Jack—Phantom View

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

h. In traveling position (fig. 35), the lower end of the rack plunger is protected from dirt and foreign matter by the firing jack housing bottom cover. This cover is attached to the lower end of the rack plunger prior to placing the rack plunger in fully raised position. It is attached in the same manner as the float. On carriages of late manufacture and those so modified, this cover is chained to the traveling lock to prevent loss.

i. When the rack plunger and firing jack housing bottom cover have been placed in traveling position, the firing jack travel locking lever is inserted through a hole near the bottom of the left side of the firing jack housing and into the bottom cover, and a pin on the locking lever is engaged in a slot on a piece welded to the firing jack housing. With the locking lever locked in this manner, a spring snap on the locking lever chain is engaged on a hasp staple welded to the firing jack key backing cover. The locking lever cannot be disengaged or engaged without unfastening the snap from the staple. On carriages of earlier manufacture not so modified, the firing jack is locked in traveling position by inserting the firing jack travel locking pin through a hole near the bottom of the right side of the firing jack housing. On carriages so modified, this locking pin has been removed.

20. TRAVELING LOCK.

a. The traveling lock (figs. 35 and 36) is a triangularly shaped casting, the two legs of which are hinged to the bottom carriage traveling lock brackets on the front of the bottom carriage. Its purpose is to solidly anchor the tipping parts of the weapon during travel.

b. When the weapon is in traveling position, the apex of the traveling lock is secured to the bottom of the cylinder yoke by the traveling lock pin (fig. 35). The traveling lock pin has a partial flange near its handle by means of which it is locked in position after being fully inserted into the bore at the bottom of the cylinder yoke.

c. When the materiel is in firing position, the traveling lock is supported horizontally by lugs on the lower portion of the traveling lock contacting mating seats on the firing jack housing (fig. 36). The firing jack key is chained to the right side of the traveling lock, and the firing jack housing bottom cover is chained to the left side.

21. TRAILS, TRAIL LOCK, AND TRAIL SPADES.

a. The two trails (fig. 21) are tapered, welded steel box-type girders. The trails for the 4.5-inch Gun Carriages M1 and M1A1

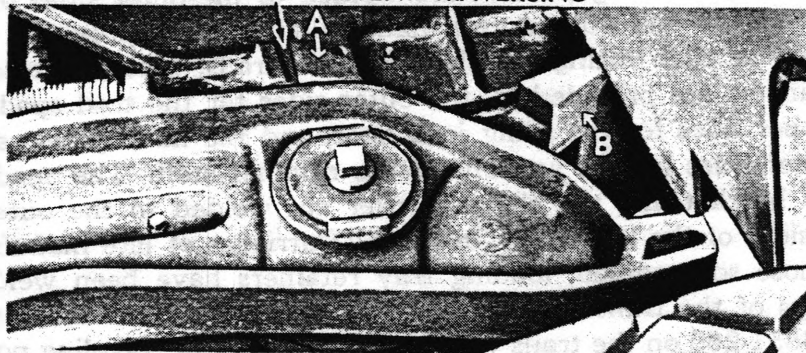
GUN AND CARRIAGE

differ in that the trails for the M1 carry electric brake equipment while those for the M1A1, and those of the M1 models so modified as to convert them into M1A1 models, carry air brake equipment.

b. In traveling position, the trails are closed and locked by the trail lock, and the weapon is coupled to the pintle of the prime mover by the Lunette M1, mounted on the rear end of the left trail. In firing position, the trails are unlocked and spread, trail spades are attached under the rear ends of the trails, and the spades are emplaced in pits dug in the ground.

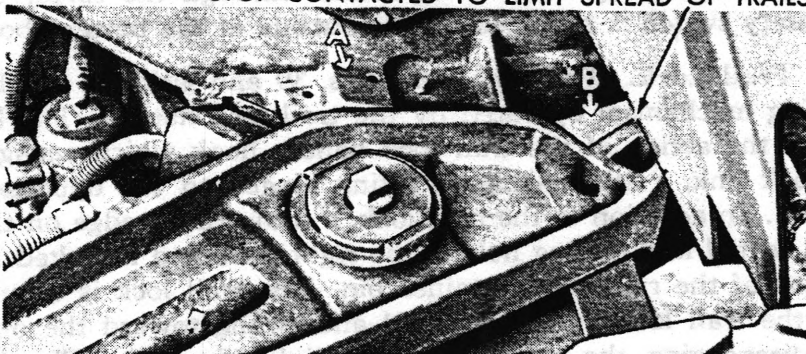
c. Trail hinges are welded to the top and bottom of the front ends of the trails. Through bores in these hinges, the trails are hinged to the bottom carriage by the trail hinge pins. The trail hinges have extended arms provided with shoulders which contact wedge-shaped stops welded to the top and bottom of the front of the bottom carriage (fig. 38 A) to control the maximum spread of the trails. When fully spread, each trail forms an angle of 30 degrees with the center of the carriage.

STOP CONTACTED TO PREVENT TRAVERSING



TRAILS CLOSED

STOP CONTACTED TO LIMIT SPREAD OF TRAILS



TRAILS OPEN

RA PD 63238

Figure 38—Stops to Control Maximum Spread of Trails (B) and Stops to Prevent Top Carriage Movement During Travel (A)

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

d. Plates and rib supports are welded to the inside surfaces of the top trail hinges adjacent to the top carriage. When the trails are closed with the top carriage properly centered, these plates contact stops welded to the bottom plate of the top carriage (fig. 38 B). They prevent movement of the top carriage during travel. On some carriages, triangular stops, welded to the inner surfaces of the trails, contact the rear of the bottom carriage and cause the trails to be centered when closed and locked.

e. The rear ends of the trails have smooth bottom surfaces with recesses for the attaching lugs of the trail spades, and square holes in the rear for the insertion of the spade keys which lock the spades in position (figs. 39 and 40). They also have round roles in their ribs through which the handspikes are inserted for use as auxiliary lifting handles. The Lunette M1 is assembled in the rear end of the left trail and fastened with two lunette pins.

f. Tubular lifting handles are welded to the outer sides of both trails (figs. 39 and 40). A trail handspike socket is provided at the rear end of each lifting handle. On both trails, brackets, retainers, and carriers are provided on the outer sides for the trail spades; on the upper sides for the firing jack float, and the handspikes; and on the inner sides for the sections of the rammer staff. The spade key carrier bracket and the sledge carrier are welded to the outer and inner sides of the left trail. On M1A1 Carriages of late manufacture and those so modified, loading tray retainers have been welded to the tops of the trails to furnish means of carrying the loading tray 41-T-3851-260 on the trails when the materiel is in traveling position.

NOTE: On M1 Carriages, the battery box (fig. 52), located near the end of the left trail, houses the dry-cell battery which supplies current for operating the electric brakes through the safety switch. The safety switch is mounted on the outside of the battery box.

g. **Trail Lock.** The trail lock (figs. 39 and 40) is a toggle-type clamping mechanism operated by the trail lock handle. The handle controls the action of the trail lock handle hook which engages the trail lock link, a stirrup-shaped fitting hinged to the opposite trail (fig. 39). In addition to the trail lock, a projecting wedge on the left trail is seated in a mating hole in the right trail, and is locked by the insertion of the right trail retainer pin. The trail lock is disengaged when the trail lock handle is lifted and swung toward the opposite trail, disengaging the hook from the link (fig. 40). The link is threaded to permit adjustment of the tension of the trail lock.

h. **Trail Spades.** The trail spades are built of plates, and function as spades and floats. Spades of current manufacture and those

GUN AND CARRIAGE

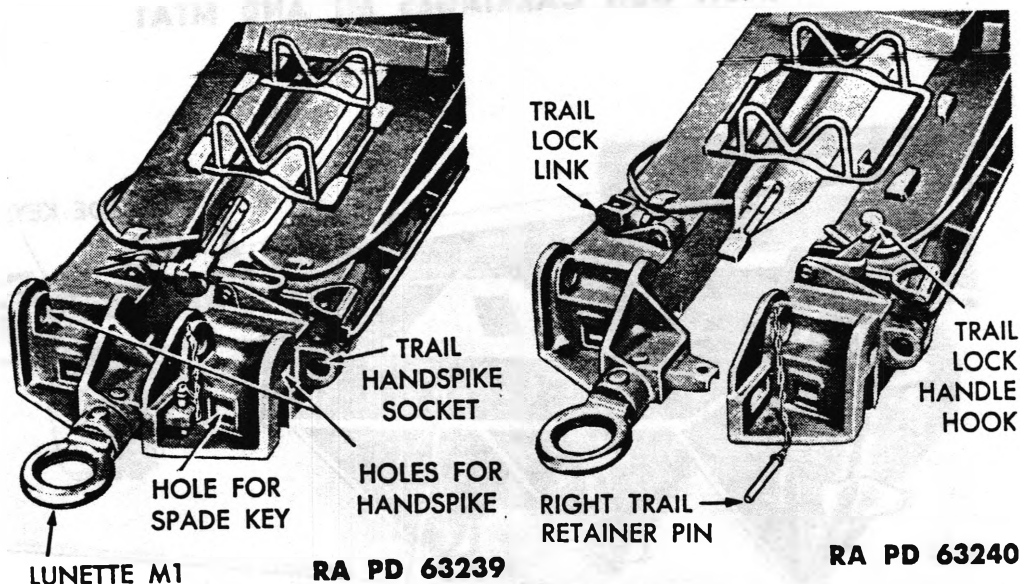


Figure 39—Trail Lock—Engaged

Figure 40—Trail Lock—Disengaged

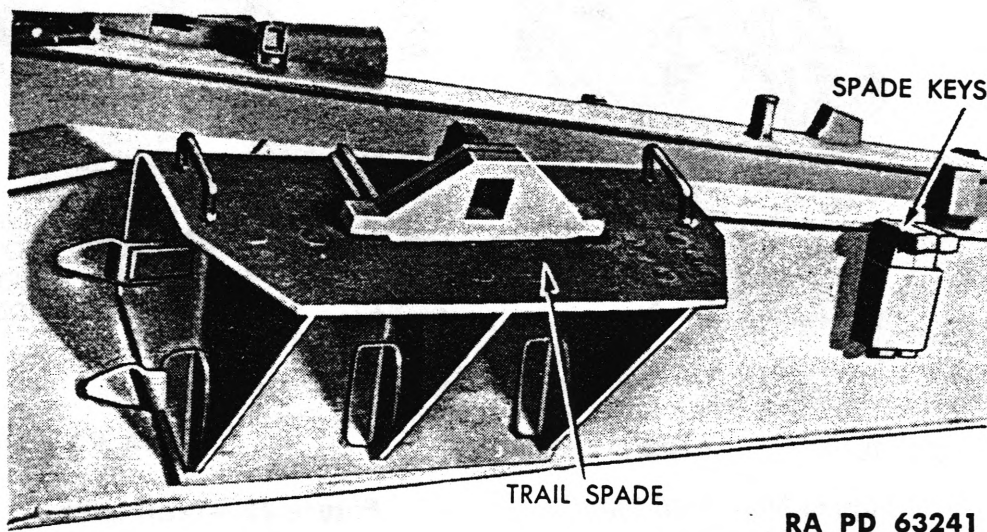
so modified are equipped with lifting handles. In firing position, the spades are attached beneath the rear ends of the trails, their lugs being inserted in the recesses in the under surfaces of the ends of the trails; then each spade is secured to its trail by a spade key which is forced into the matched holes in the trail and the lug of the spade. In traveling position, the spades are carried in brackets on the outer sides of the trails (fig. 41) while the spade keys are carried in the spade key carrier bracket on the outer side of the left trail. On carriages of late manufacture and those so modified, extension plates have been welded to the upper trail spade brackets to hold the spades more securely in traveling position.

22. WHEEL SPINDLES, HUBS, AND ADJUSTMENT AND RETAINING PARTS.

a. **Wheel Spindles.** The wheel spindles (figs. 42 and 43) are seated in taper seats in tubes welded to the sides of the bottom carriage. The tubes are reinforced by plates. The wheel spindles are secured in place by taper pins. The brake backing plates for electric brakes or the air brake shields for air brakes are mounted on flanges on the ends of the tubes which support the wheel spindles.

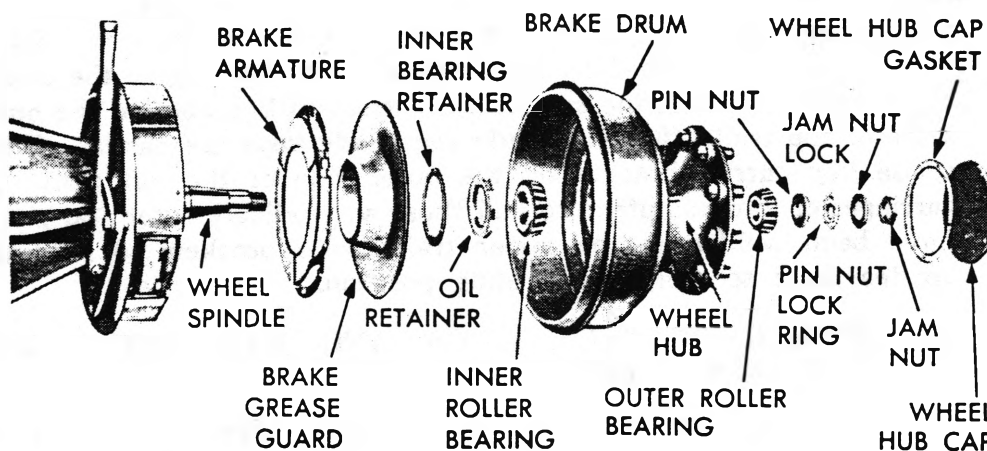
b. **Wheel Hubs.** The wheel hubs (figs. 42 and 43) are supported on bearing surfaces on the wheel spindles by the outer and inner wheel spindle tapered roller bearings. The electric or air brake drums are bolted to the inner flanges of the wheel hubs while the wheels are fastened to the outer flanges of the wheel hubs by disk and rim wheel studs and nuts.

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 63241

Figure 41—Trail Spade and Spade Keys in Traveling Position

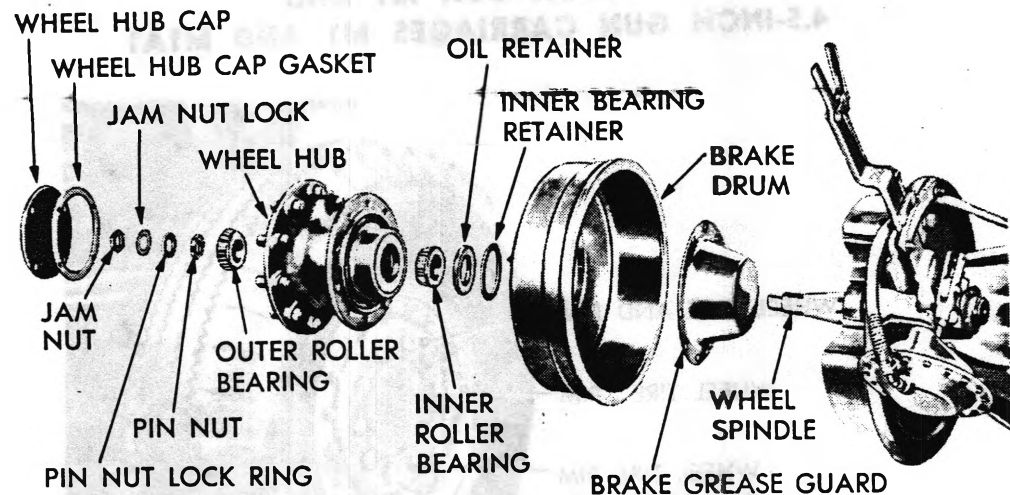


RA PD 63242

Figure 42—Electric Brake Drum, Hub, Bearings, and Adjustment and Retaining Parts—Exploded View

NOTE: While identical wheel hubs, outer wheel spindle roller bearings, and adjustment and retaining parts are used on the M1 and M1A1 Carriages, the wheel spindles of the M1A1 Carriages are machined to a larger diameter than those of the M1 Carriages, and different inner wheel spindle roller bearings are required.

GUN AND CARRIAGE



RA PD 63243

Figure 43—Air Drum, Hub, Bearings, and Adjustment and Retaining Parts—Exploded View

c. **Wheel Spindle Roller Bearings.** The inner wheel spindle roller bearing of each hub assembly seats against a shoulder inside the hub. This bearing and its oil retainer are a drive fit in the hub and both are secured in position by the inner bearing retainer which is attached by screws to the inner rim of the hub. The outer wheel spindle roller bearing (figs. 42 and 43) and the entire hub assembly are secured to the wheel spindle and are adjusted by means of the wheel spindle pin nut, pin nut lock ring, jam nut lock, and jam nut. The wheel hub cap and gasket, fastened over the outer end of the bore of the hub by four screws, protect the inside of the wheel hub against the entrance of dirt and other foreign matter.

d. The wheel spindle pin nut is screwed against the outer wheel spindle roller bearing until the bearings are adjusted properly. This nut is provided with a pin which enters the appropriate hole in the lock ring, which is placed against the nut on the wheel spindle. The lock ring, in addition to having a number of holes near its circumference, has a flat-sided hole in its center, shaped to fit the flattened upper surface of the wheel spindle. The shape of this hole prevents the lock ring from turning on the wheel spindle. The jam nut lock, a soft metal disk, is placed on the wheel spindle after the lock ring has been seated. After the jam nut has been screwed tightly on the spindle, a portion of the circumference of the jam nut lock is bent against one of the edges of the jam nut, locking this nut in place.

23. WHEELS AND TIRES.

a. **Wheels.** Each wheel consists of the wheel disk and rim, the wheel tire rim, and 18 wheel tire rim retaining nuts (fig. 44). The

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

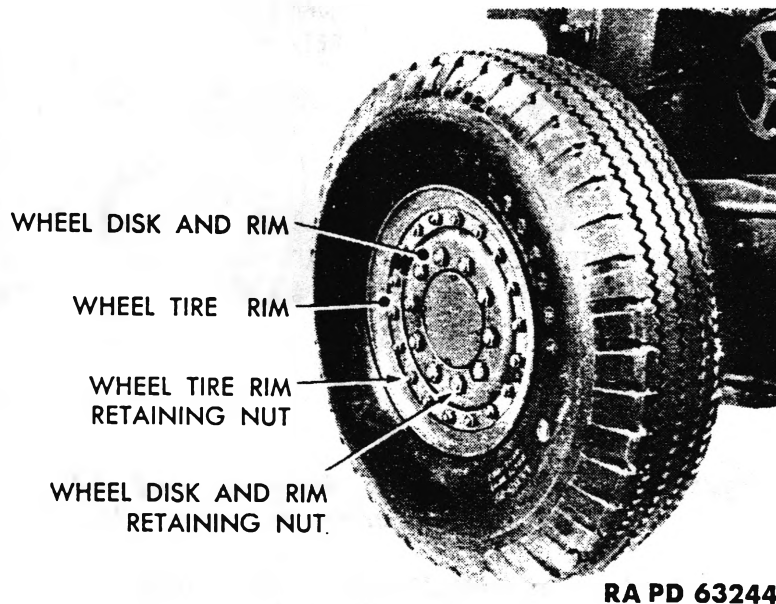


Figure 44—Wheel and Tire

wheel disk and rim is a saucer-shaped disk, the outer flange of which is riveted to a tire rim having a bead only at the rear. The front of the rim bears 18 studs. The wheel tire rim is a separate piece which serves as the outer bead for the tire. It is held to the wheel disk and rim by 18 nuts with right-hand threads. The wheel is attached to the disk and rim wheel studs in the wheel hub by 10 nuts with right-hand threads.

CAUTION: When a tire is to be removed from a wheel, the tire must be deflated before removing the 18 wheel tire rim retaining nuts and the wheel tire rim. Failure to heed this precaution may result in serious injury to personnel.

NOTE: If the wheel is to be removed complete with tire, remove the inner row of 10 nuts only. It is not necessary to deflate the tire.

b. **Tires.** The tires (fig. 44) are 14.00—20 combat tires equipped with 14.20—20 combat tire tubes and wheel tire beadlocks. The recommended pressure for these tires is 95 pounds.

24. AIR POWER BRAKES.

a. **General.** The 4.5-inch Gun Carriage M1A1 is equipped with air power brakes. The brake mechanisms at the carriage wheels are actuated by compressed air furnished by an air compressor unit on the prime mover and conducted to the carriage by two air brake coupling hoses. The carriage brakes are applied by means of a control lever on the prime mover.

GUN AND CARRIAGE

b. **Principal Parts.** The principal parts of the air power braking system on the carriage consist of the following: two air lines, service and emergency; two air filters; the relay-emergency valve; the emergency reserve tank; two brake diaphragms; two slack adjusters; two wheel brake mechanisms; and two hand brakes.

c. **Air Lines.** The two air lines consist of air hoses and tubes interconnecting the various units of the brake system. The service air line leads to the top of the relay-emergency valve. It operates the relay portion of this valve and thus actuates all service brake applications. The emergency air line leads to the lower part of the relay-emergency valve. Its purpose is to keep the emergency reserve tank on the carriage charged at all times. The tank, in turn, supplies the compressed air which actually makes all brake applications. Both air lines are appropriately marked. Dummy couplings on the outer sides of the trails near their rear ends are provided to retain the air brake hose couplings and to exclude dirt when the air brake coupling hoses are not connected to the prime mover.

d. **Air Filters.** The air filters (fig. 45) are connected in the service and emergency air lines to filter water and dirt from the air before it enters the actuating units of the system. They are equipped with filter units which must be periodically removed and washed with dry-cleaning solvent. Plugs in the bottoms of the filters provide the means of draining accumulated water and dirt.

NOTE: Air filters of two designs are used on different carriages. While differing slightly in construction and appearance, they work on the same principle.

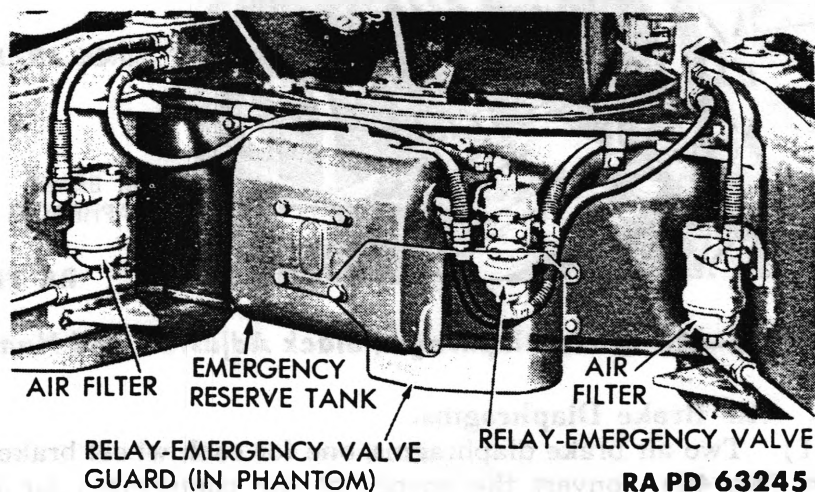


Figure 45—Air Filters, Relay-emergency Valve, and Reservoir

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

e. **Relay-emergency Valve.** The relay-emergency valve (fig. 45) is a combined relay valve which speeds up the brake action from the prime mover to the carriage, and emergency valve which produces an automatic brake application in the event of a break-in-two between the prime mover and carriage or a ruptured air line. Each portion of the valve has a flexible diaphragm which controls its action. This valve is mounted on the rear of the bottom carriage and is protected by a guard. Its functioning is described in paragraph 24 k.

f. **Emergency Reserve Tank.** The emergency reserve tank (fig. 45) stores air both for service and emergency brake applications. It is mounted on the rear of the bottom carriage and is equipped with a cock for the drainage of moisture, and to relieve pressure when the brakes become locked.

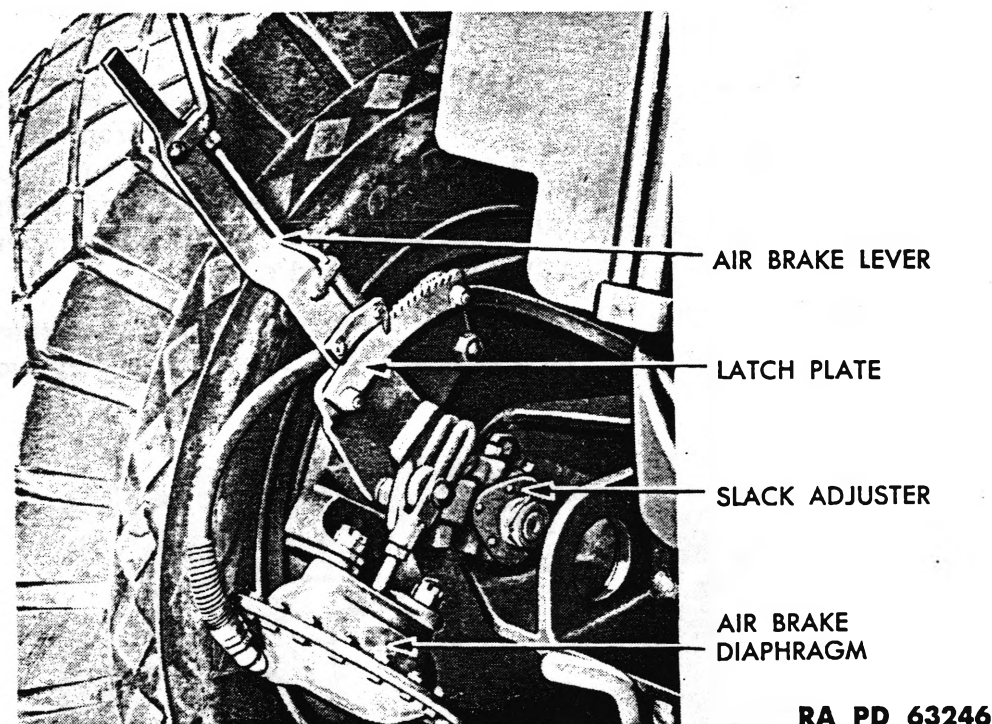


Figure 46—Air Brake Diaphragm, Slack Adjuster, and Hand Brake

g. **Air Brake Diaphragms.**

(1) Two air brake diaphragms, one for each wheel brake mechanism (fig. 46), convert the energy of the compressed air into the mechanical force necessary to force the brake shoes against the brake drum. The diaphragms are of the stud-mounting type and are mounted to the front of the bottom carriage by means of brackets.

GUN AND CARRIAGE

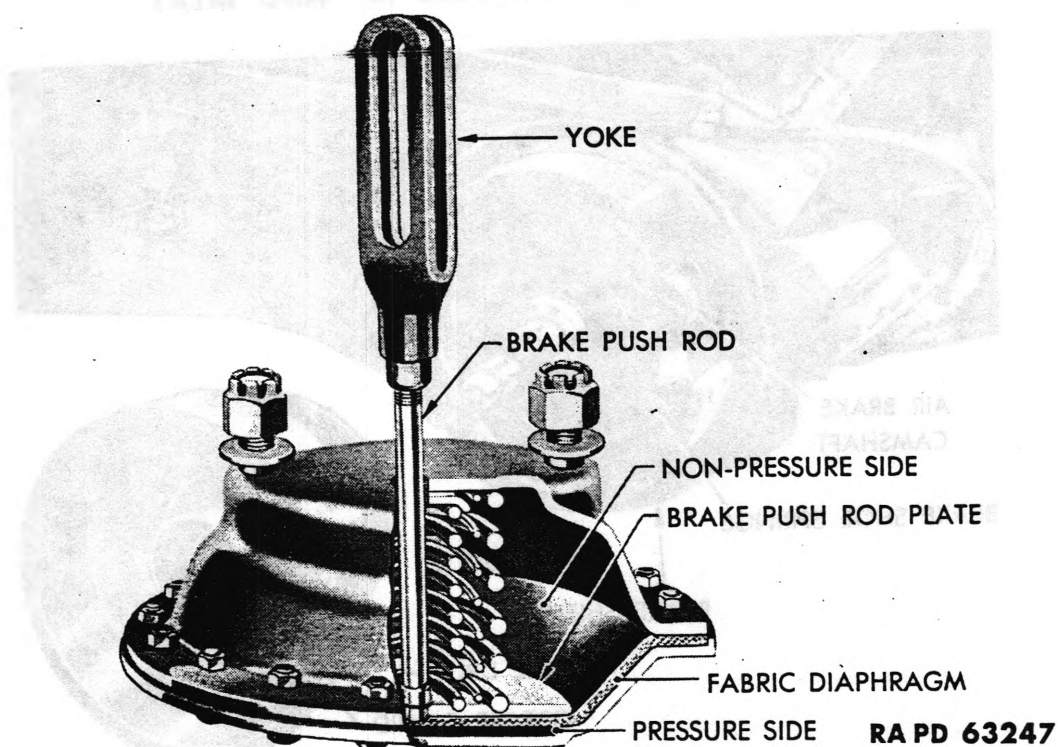


Figure 47—Cutaway View of Air Brake Diaphragm

(2) Each air brake diaphragm consists of two dished plates between which is a diaphragm of oilproof rubberized fabric (fig. 47). The fabric diaphragm is airtight and responds to slight variations in pressure. It divides the unit into a non-pressure and a pressure side. Three nested springs on the non-pressure side of the fabric diaphragm hold a push rod plate against the diaphragm in its released position, forcing the diaphragm into the pressure side. When compressed air enters the pressure side through the inlet in the bottom of the unit, it forces the diaphragm and push rod plate toward the pressure side.

(3) A brake push rod is fastened to the brake push rod plate. Air pressure exerted against the diaphragm and push rod plate forces the push rod out. The yoked outside end of the push rod is hinged to the slack adjuster, which acts as a cam to rotate the brake camshaft (fig. 46). This, in turn, causes the cams to spread the brake shoes, expanding them to apply the brake lining to the brake drums. When the air pressure is released, the diaphragm and other parts return to their normal positions.

h. Slack Adjusters. The two slack adjusters, one for each brake mechanism (fig. 46), serve as brake levers to connect the mechanical brakes with the air brake diaphragms. They also provide a convenient method of brake adjustment. In normal braking, the slack

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

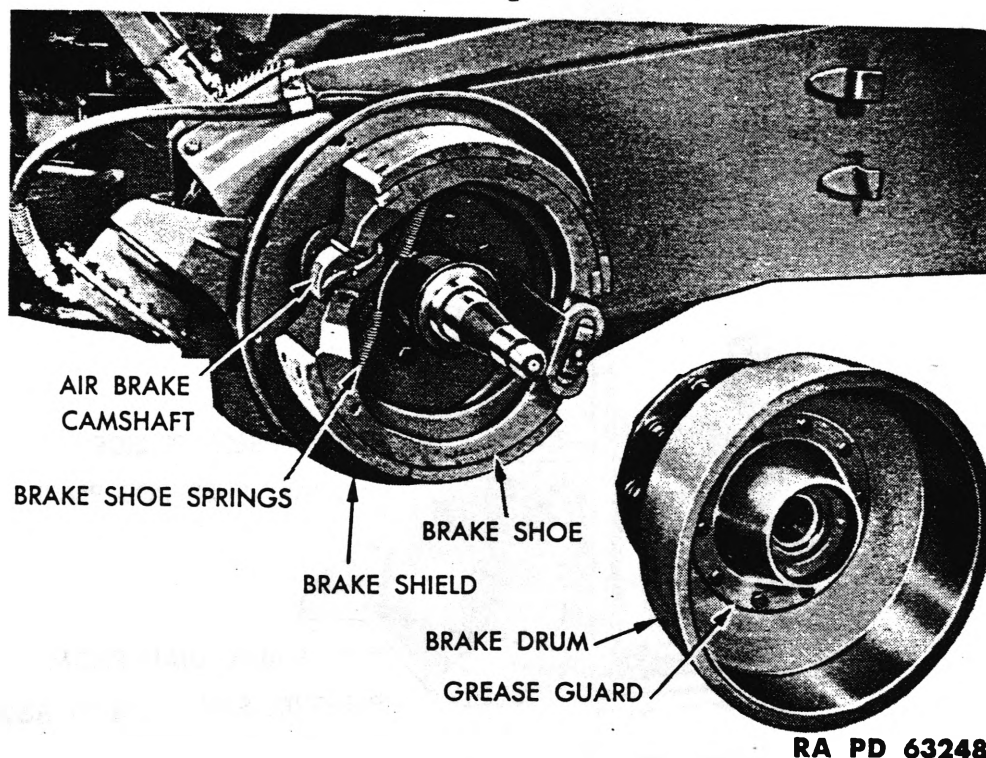


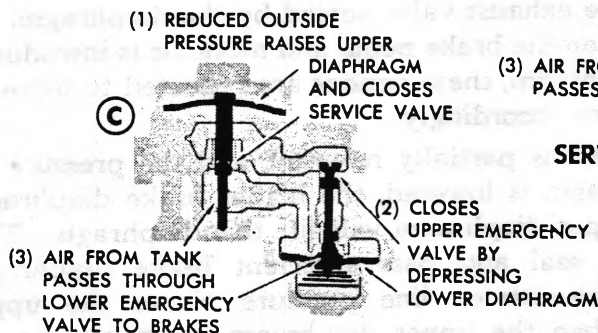
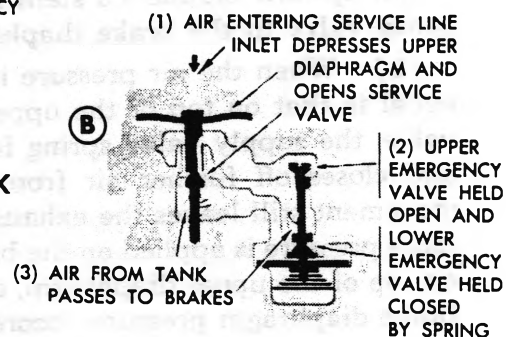
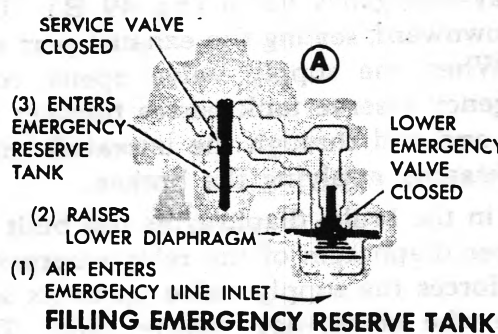
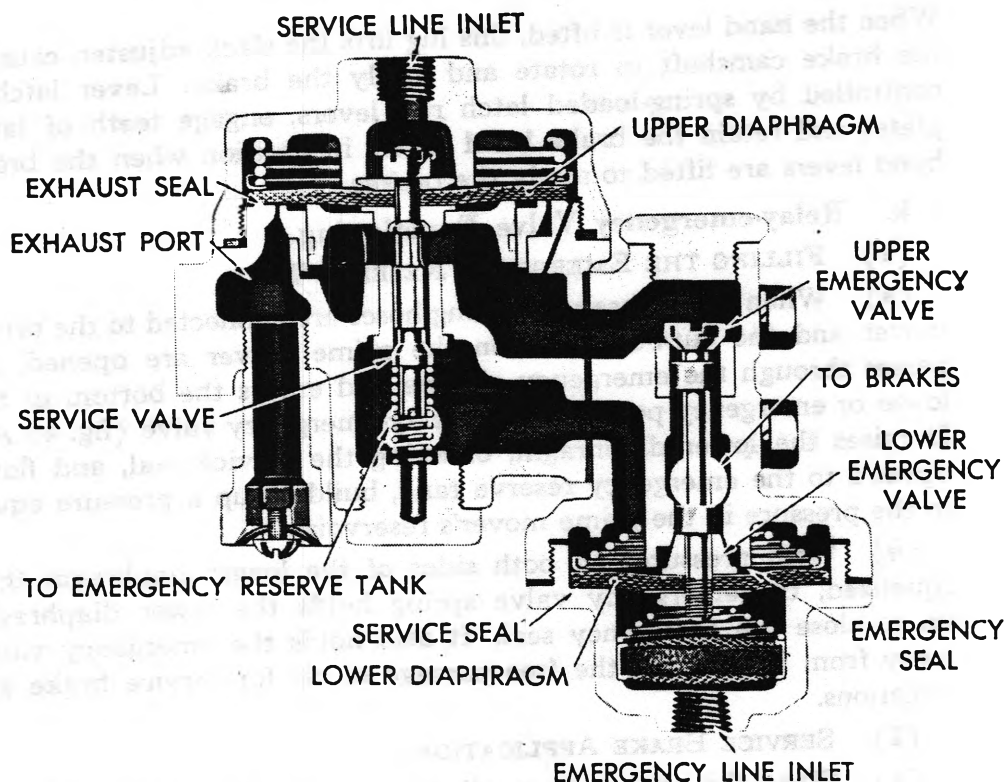
Figure 48—Air Brake Mechanism and Brake Drum

adjusters rotate bodily with the brake camshafts as the brakes are applied or released. The most efficient brake action will be obtained when the travel of the arm of the slack adjuster is held to a minimum and full leverage is used.

i. **Brake Mechanisms.** The brake mechanisms (fig. 48) consist principally of the brake drums which are attached to the wheel hubs, and the brake shoes, air brake camshafts, and brake shoe springs which are attached through the air brake shields to the bottom carriage. Each brake shoe pivots on one end and both are expanded against the brake drum by the action of the camshaft when the brakes are applied. When the brakes are released, the camshaft disengages the shoes and the shoes are pulled away from the drums by the action of the brake shoe springs. Grease guards inside the brake drums protect the linings from grease while the shields, in addition to serving as supports, protect the brake mechanisms from water, mud, sand, and other matter thrown by the wheels.

j. **Hand Brakes.** A brake hand lever (fig. 46) is provided for each carriage brake. Each is pivoted on a brake camshaft. A lug on the side of the hand lever is positioned under the slack adjuster.

GUN AND CARRIAGE



RA PD 63249

Figure 49—Relay-emergency Valve—Sectional View

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

When the hand lever is lifted, this lug lifts the slack adjuster, causing the brake camshaft to rotate and apply the brake. Lever latches, controlled by spring-loaded latch rod levers, engage teeth of latch plates and retain the brake hand levers in position when the brake hand levers are lifted to apply the brakes.

k. Relay-emergency Valve Functioning.

(1) FILLING THE EMERGENCY RESERVE TANK.

(a) When the air brake coupling hoses are connected to the prime mover and the cut-out cocks on the prime mover are opened, air passes through the emergency air line and enters the bottom of the lower or emergency portion of the relay-emergency valve (fig. 49 A). It raises the lower diaphragm, breaking the service seal, and flows upward to the emergency reserve tank, building up a pressure equal to the pressure in the prime mover's reservoir.

(b) With pressures on both sides of the lower diaphragm thus equalized, the emergency valve spring holds the lower diaphragm up to close the emergency seal. It also holds the emergency valve away from its seat for the free passage of air for service brake applications.

(2) SERVICE BRAKE APPLICATION.

(a) When the brakes are applied, pressure is introduced into the top or relay portion of the relay-emergency valve (fig. 49 B). This deflects the upper diaphragm downward, sealing the exhaust port and unseating the supply valve. When the supply valve opens, compressed air stored in the emergency reserve tank passes through the valve, upward around its stem and through the unseated emergency valve to the brake diaphragms, applying the brakes.

(b) When the air pressure in the brake diaphragms has built up equal to that on top of the upper diaphragm of the relay-emergency valve, the supply valve spring forces the supply valve up to its seat and closes off further air from the emergency reserve tank. This movement still leaves the exhaust valve sealed by the diaphragm. If more pressure is applied on the brake pedal and more air is introduced on top of the upper diaphragm, these actions are repeated to increase brake diaphragm pressure accordingly.

(c) If the brake pedal is partially released, and the pressure on top of the upper diaphragm is lowered, the higher brake diaphragm pressure beneath the upper diaphragm will lift this diaphragm. This will break the exhaust seal and pass sufficient brake diaphragm pressure to equalize the service line pressure above the upper diaphragm (fig. 49). Then the upper diaphragm again will be deflected downward to prevent further exhaust. Complete release of the brake pedal eliminates pressure above the upper diaphragm, per-

GUN AND CARRIAGE

mits the upper diaphragm to be raised, allows all brake diaphragm pressure to escape, and releases the brakes.

(3) EMERGENCY BRAKE APPLICATION.

(a) Should the carriage break away from the prime mover, or the emergency air line burst, the sudden reduction in pressure will remove the pressure from below the lower diaphragm (fig. 49 C). The result will be that the pressure from the emergency reserve tank will act upon the upper side of the lower diaphragm, deflecting it downward. This will break the emergency seal and permit air from the emergency reserve tank to flow upward around the emergency valve stem and thus produce an emergency application of the carriage brakes.

(b) At the same time, the emergency valve will be drawn downward to its seat by the movement of the lower diaphragm, cutting off any opportunity for air to escape by way of the exhaust. Also, the service seal will be closed so that the brakes will be held applied without leakage through the ruptured emergency line.

25. ELECTRIC BRAKES.

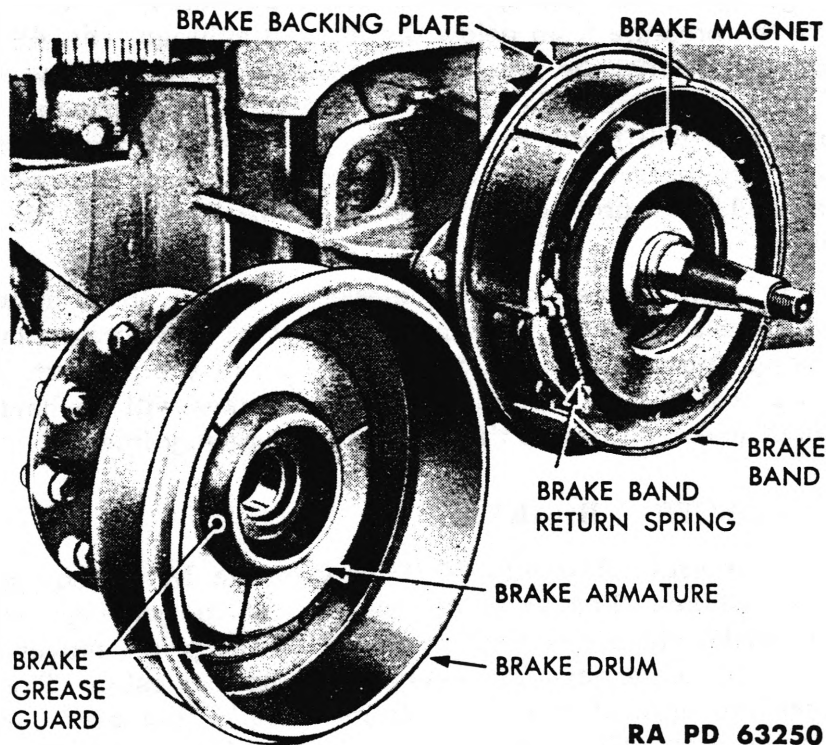
a. **General.** The 4.5-inch Gun Carriage M1 is equipped with electric brakes. The brake mechanisms at the carriage wheels are actuated by electric current produced on the prime mover and conducted to the carriage by a detachable jumper cable. The carriage brakes are applied separately from those of the prime mover by means of a controller and a load control switch.

b. **Brake Mechanisms.** Each wheel unit (fig. 50) of the electric brake system is composed principally of a circular brake armature which is assembled to the inside rear wall of the brake drum and revolves with the wheel, and a circular electric brake magnet and brake band which are mounted on the stationary brake backing plate of the brake mechanism. The brake backing plate is mounted on the flanged end of a wheel spindle supporting tube protruding from one side of the bottom carriage.

c. The brake magnet is so mounted on the backing plate as to permit a slight rotary motion in either direction. It is provided with magnet return springs which return it to its normal position when it has been rotated in either direction. The brake band is so mounted that it is expanded when pressure is applied to either of its ends. The ends of the band are normally held in a contracted position by the action of two brake band return springs.

d. There is a tubular lug on the back of the magnet (fig. 51). This lug contacts one of two pivoted brake band lever cams to ex-

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**



RA PD 63250

Figure 50—Electric Brake Mechanism in Drum and on Backing Plate

pand the brake band. One of the lever cams is utilized in forward stops; the other, in backward stops. The lever cams bear against prepared surfaces on the ends of the brake band.

e. Electric Brake Functioning.

(1) Electric current, released by the controller of the prime mover, causes the magnet to cling to and revolve with the brake armature in the brake drum until the tubular lug on the back of the brake magnet presses one of the lever cams against an end of the brake band. This expands the brake band against the brake drum and applies braking effort. The more current released, the tighter the magnet will cling to the armature and the harder the band is pressed against the drum.

GUN AND CARRIAGE

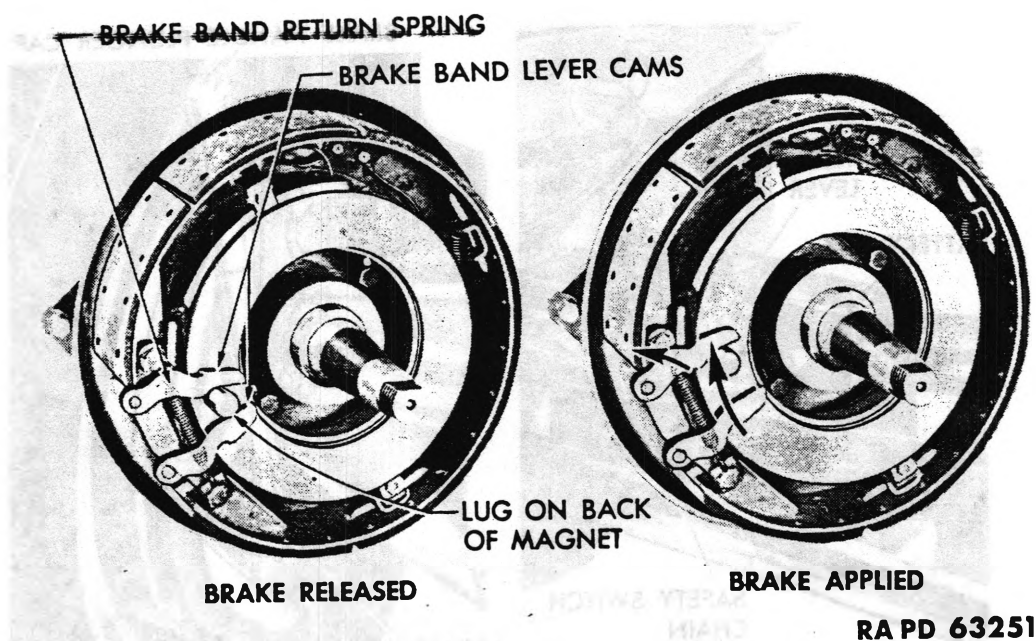


Figure 51—View of Electric Brake Magnet and Band

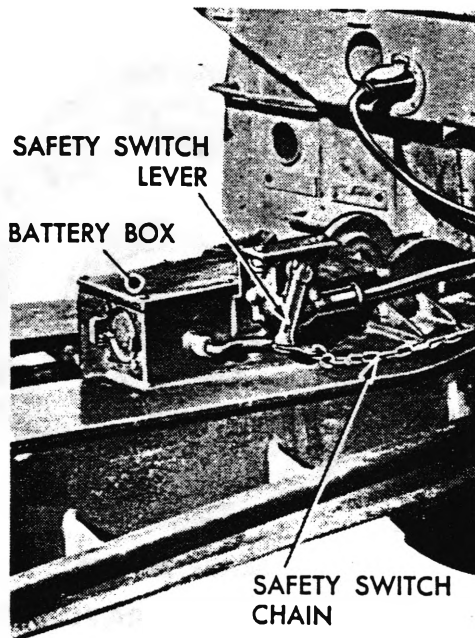
(2) When the current is shut off, the armature is released by the magnet and the brake band return springs are allowed to pull the end of the brake band to its normal position and to draw the brake band away from contact with the brake drum. One of the magnet return springs causes the magnet to return to its released position. A slight slipping action between the armature and magnet eliminates grabbing and locked brakes.

f. **Safety Switch.** The safety switch (fig. 52) automatically applies the electric brakes on the carriage wheels in the event of a break-in-two between the carriage and the prime mover. The switch has a pendulum-like lever which is held in the "on" and "off" positions by a spring. The safety switch is located on the battery box on the left trail and operates the brakes with current supplied by a 6-volt dry cell battery carried in the battery box.

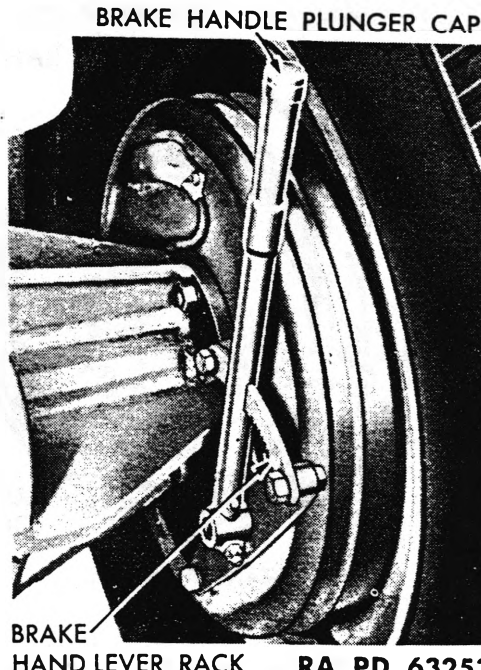
g. **Safety Switch Functioning.** As the break-in-two occurs, the safety switch chain, which connects the safety switch with the prime mover, pulls the switch forward. This closes the circuit from the dry battery to the brakes, energizes the brake magnets, and sets the brakes. The safety switch chain is provided with a spring clip which permits its being pulled from the safety switch lever, without damage to the chain, after the lever has been pulled forward.

NOTE: The safety switch chain is part of the equipment of the carriage and should be unfastened from the prime mover and wrapped around the battery box when the carriage is uncoupled.

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 63252



RA PD 63253

Figure 52—Safety Switch and Battery Box **Figure 53—Hand Brake Mounted on Brake Backing Plate**

h. **Hand Brakes.** The parking or mechanical brake mechanisms are operated by brake hand levers (fig. 53) assembled to the inner sides of the brake backing plates. Each lever is secured in the engaged position by a spring-loaded brake hand lever plunger engaging the teeth of a rack. The cap at the top of the brake hand lever body is pressed down to release the plunger and the brakes.

i. The lower end of the brake hand lever body is mounted on one end of the brake hand lever shaft by means of a splined connection which permits adjustment of the position of the lever body when the brake band has become worn (par. 54 h (8)). The other end of the shaft is assembled with a cammed roller (fig. 51) which, when the brake is applied, forces the brake band thrust lever into contact with the brake thrust lever roller mounted on the end of the brake band. This expands the brake band against the brake drum.

Section III OPERATION

26. INTRODUCTION.

a. This section outlines the operation of the weapon and carriage. It prescribes precautions to be taken for the protection of the personnel and materiel. Many of the operations described

GUN AND CARRIAGE

herein will be performed simultaneously. This section is not to be construed as a field manual on the service of the piece.

27. TO OPERATE BREECH MECHANISM.

a. **To Open Breech.** Remove Firing Mechanism M1. With the left hand, release the breech operating lever closing latch, while with the right, pull the breech operating lever backward and downward until it contacts its stop on the breechblock carrier. Then swing the breech operating lever in a horizontal arc to the right.

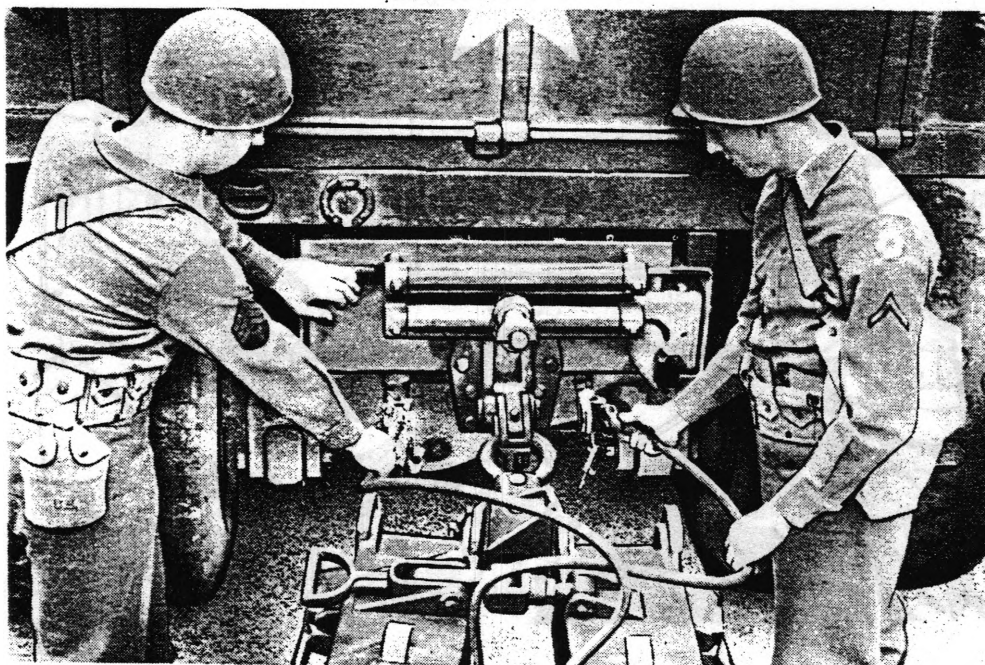
b. **To Close Breech.** Swing the breech operating lever in a horizontal arc to the left. When the breechblock driver roller enters the breechblock rotating cam, raise the breech operating lever upward and forward until the breech operating lever closing latch latches the lever.

28. TO PLACE WEAPON IN FIRING POSITION.

a. **General.** With the prime mover, maneuver the weapon into position with the muzzle pointing in the direction of fire. Set the mechanical hand brakes on the piece.

b. **Carriages Equipped With Air Brakes.**

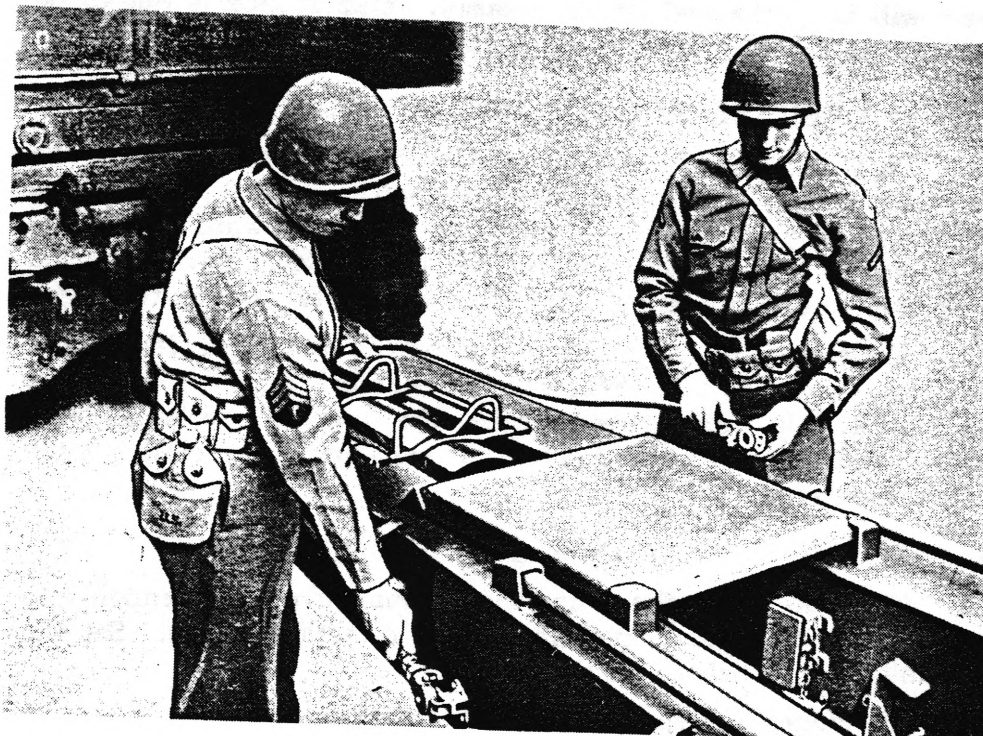
(1) Close the cut-out cocks of the air lines on the rear end of the prime mover. Uncouple the service and emergency air brake hose couplings (fig. 54).



RA PD 63254

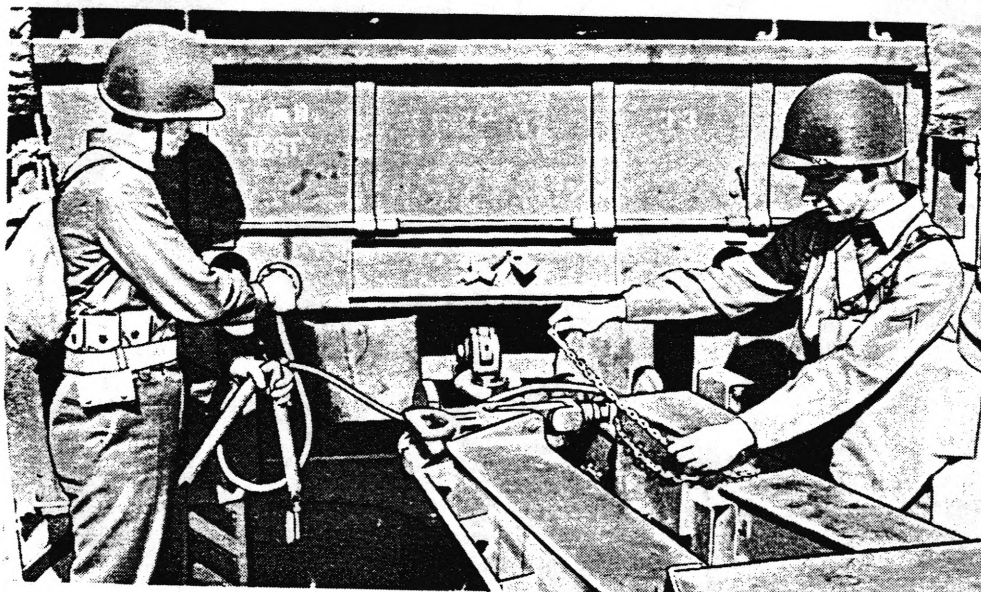
Figure 54—Disconnecting Air Brakes (M1A1 Carriage)

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**



RA PD 63255

**Figure 55—Locking Air Lines in Dummy Couplings
(M1A1 Carriage)**



RA PD 63256

Figure 56—Disconnecting Electric Brakes (M1 Carriage)

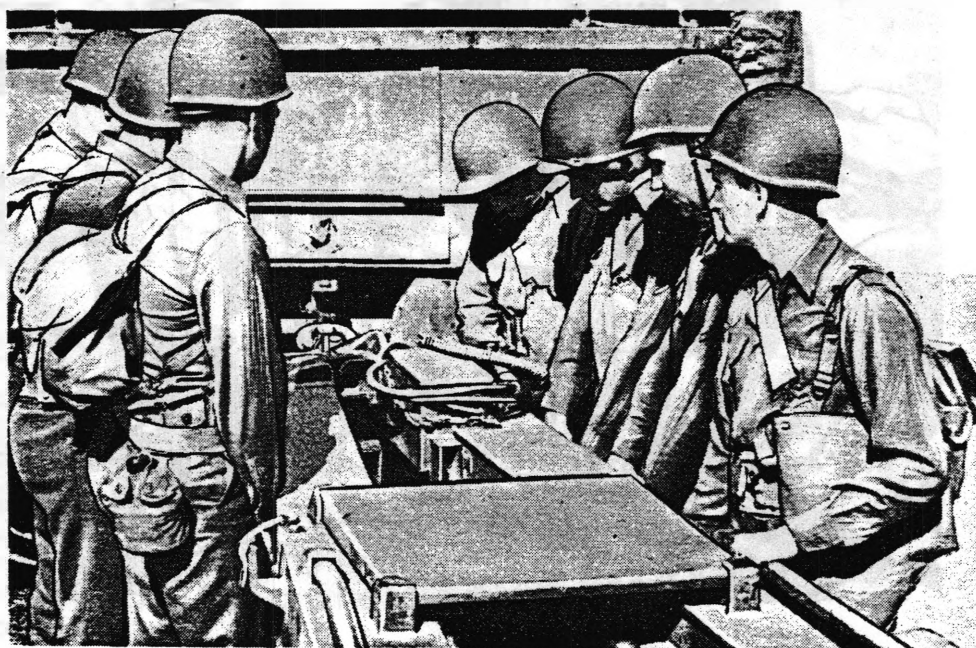
GUN AND CARRIAGE

(2) Lock the service and emergency air brake hose couplings in the dummy couplings on the sides of their respective trails (fig. 55). Remove the over-all cover. Open the drain cock on the air brake emergency reserve tank.

c. Carriages Equipped with Electric Brakes. Disconnect the jumper cable and the safety switch chain from the prime mover (fig. 56). Wrap them around the battery box on the left trail. Remove the over-all cover.

d. With three men on each of the handles on the sides of the trails, disconnect the lunette of the gun carriage from the pintle of the prime mover (fig. 57). Unload the prime mover and move it from the vicinity of the piece.

e. Remove the trail spades from the trails and place them near the positions they will occupy. Remove the handspikes and insert them in their sockets in the ends of the trails. Remove the spade keys and lay them near the ends of the trails. Remove the right trail retainer pin and release the trail lock (fig. 58).

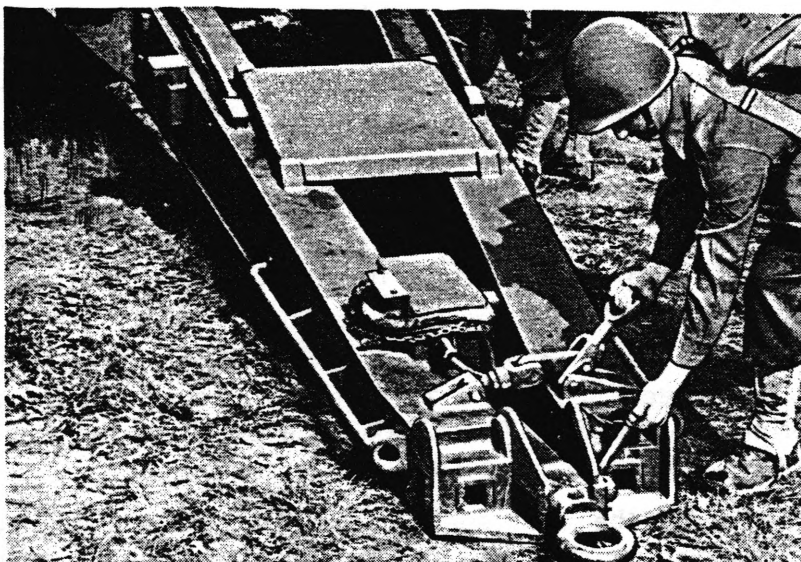


RA PD 63257

Figure 57—Unlimbering Carriage From Prime Mover

f. Break the trails and spread them sufficiently to remove the firing jack float and loading tray from their retainers on the tops of the trails (fig. 59). Place the float in front of the piece. In some cases, it will be necessary to place the end of a handspike between the ends of the trails and use it as a lever to break the trails. Spread

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**



RA PD 63258

Figure 58—Releasing Trail Lock



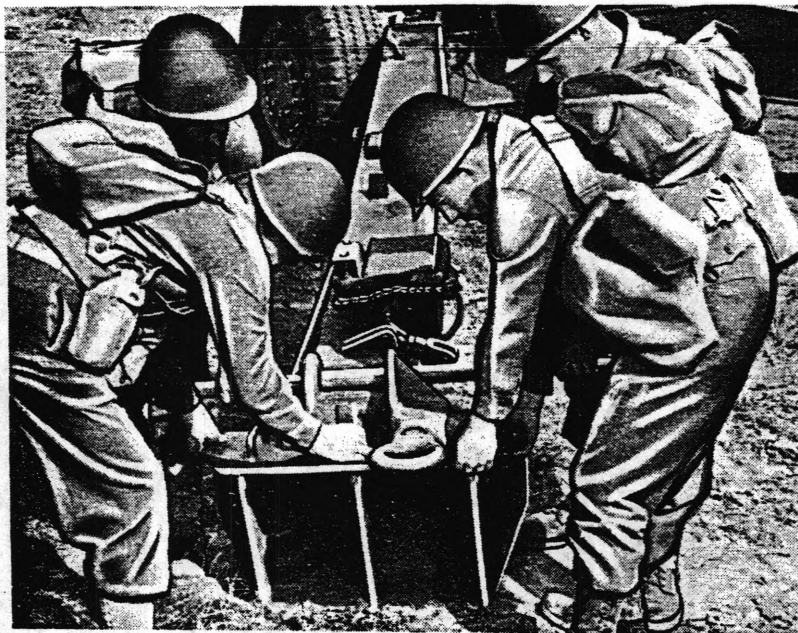
RA PD 63259

Figure 59—Breaking Trails

the trails to their fully open position against their stops on the bottom carriage.

g. Insert the handspikes horizontally through the two holes in the webs at the end of each trail. Lift the two trails simultaneously and assemble the trail spades to the trails, locking them with the

GUN AND CARRIAGE



RA PD 63260

Figure 60—Connecting Trail Spades

spade keys (fig. 60). Mark the outlines for the pits for the trail spades, close the trails sufficiently to clear the outlines of the pits, and dig the pits for the spades.

h. Spread the trails simultaneously and lower the trail spades into the pits (fig. 61). The horizontal floats of the trail spades should be level with the top of the ground after the carriage has been raised with the firing jack.

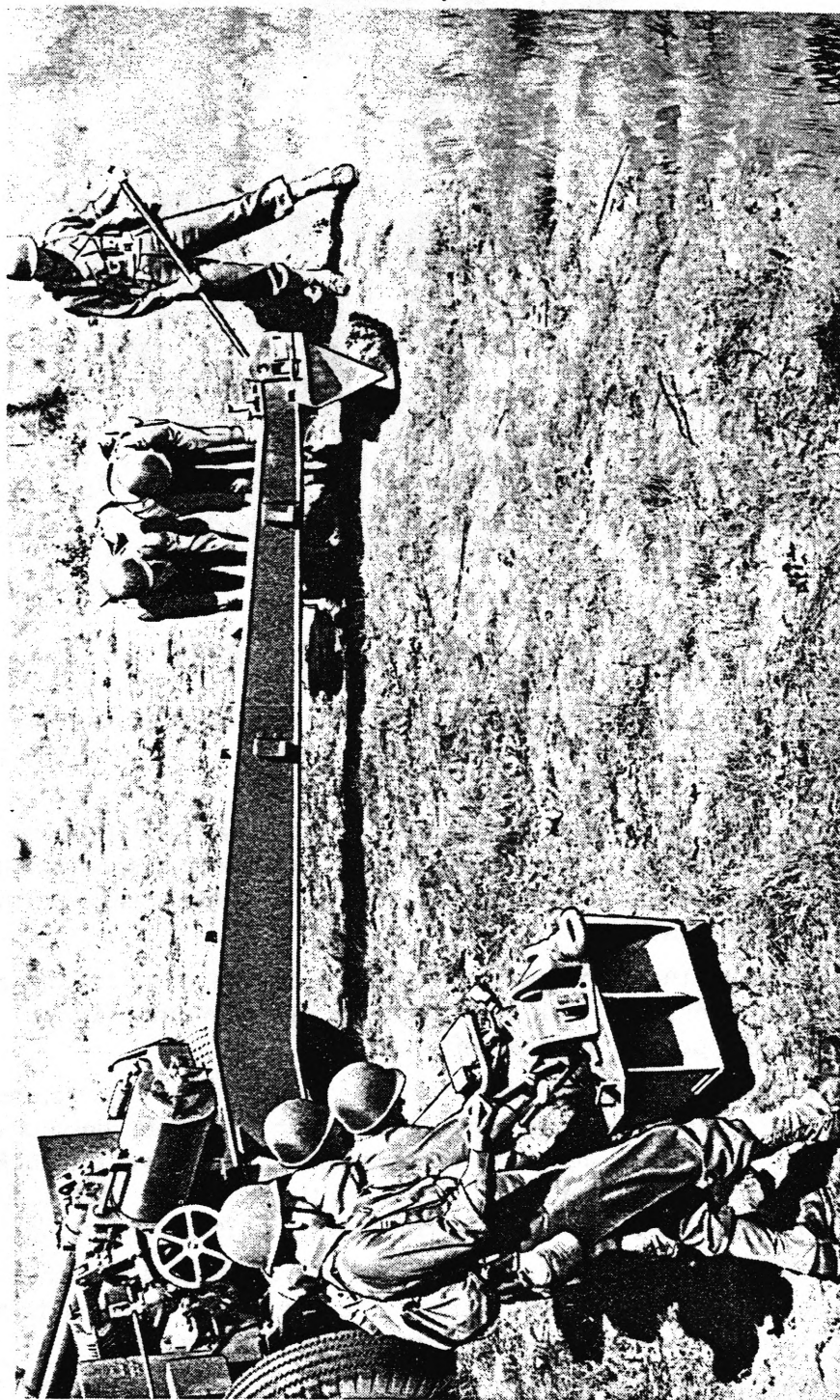
i. Remove the panoramic telescope from its case on the rear of the left shield and lock it in position in its mount. Lower and lock the top portion of the left shield.

j. Release the firing jack travel locking lever by removing the spring snap on the locking lever chain from its hasp staple welded to the firing jack key backing cover. Remove the locking lever from its hole near the bottom of the left side of the firing jack housing and replace the spring snap on its hasp staple.

k. By means of the firing jack ratchet case handles, lower the firing jack rack plunger and remove the firing jack housing bottom cover from the lower end of the rack plunger (fig. 62).

l. Continue lowering the rack plunger until the flatsided ball at its lower end is seated in the socket in the center of the firing jack float. Lock the float on the lower end of the rack plunger by rotating the float one-quarter turn, or 90 degrees (fig. 63).

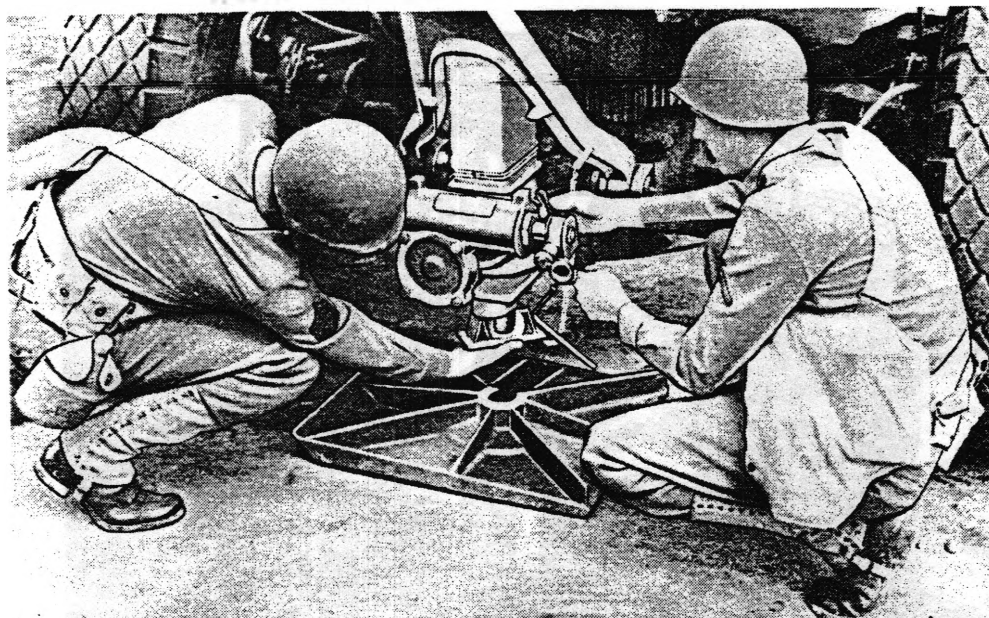
4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



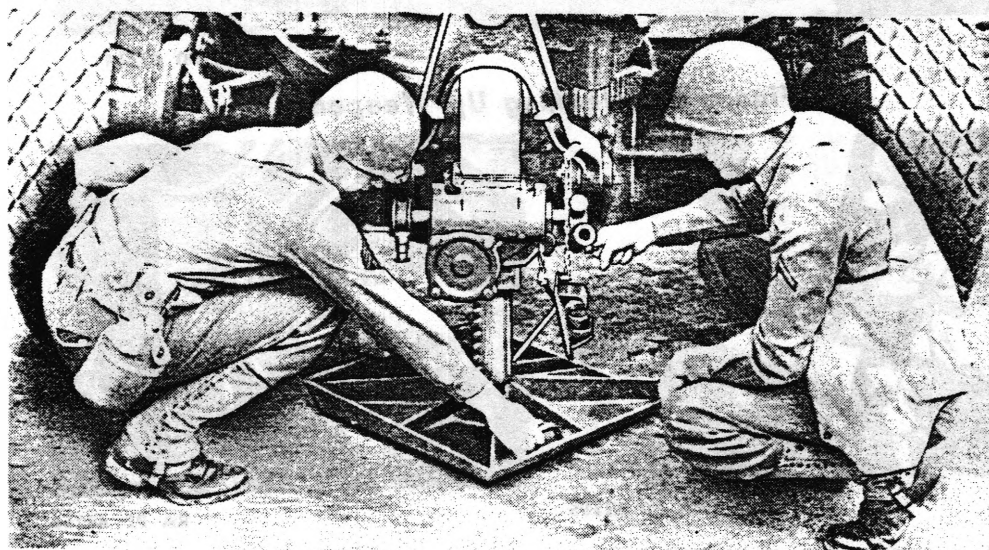
RA PD 63261

Figure 61—Placing Trail Spades in Pits

GUN AND CARRIAGE



RA PD 63262

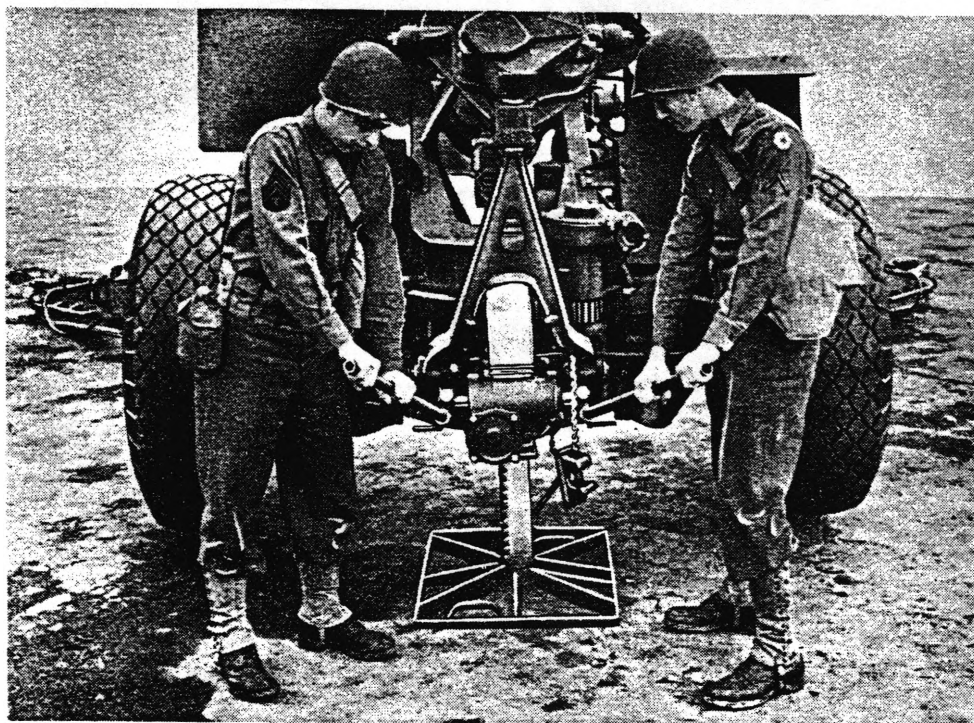
Figure 62—Removing Firing Jack Housing Bottom Cover

RA PD 63263

Figure 63—Assembling Firing Jack Float

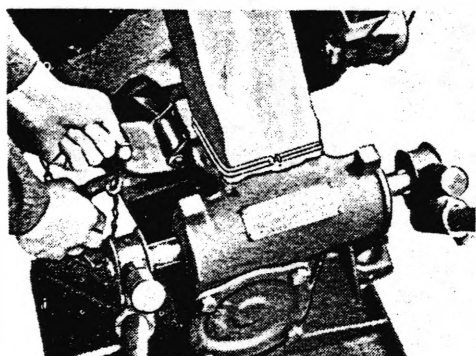
m. Remove the firing jack ratchet handles from their supports on the right shield and insert them in their sockets in the ratchet cases. Turn the firing jack ratchet plunger handles until the arrows inscribed upon them are pointed downward. Operate the firing jack ratchet handles (fig. 64) to raise the carriage until the top of the rack plunger is below the openings in the sides of the top of the firing jack housing.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1



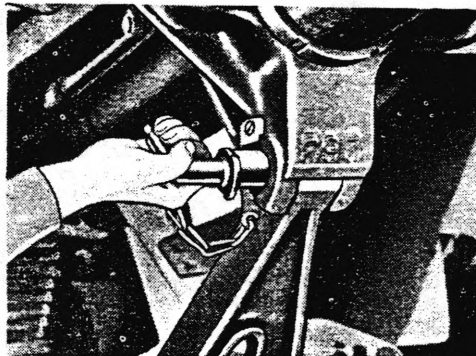
RA PD 63264

Figure 64—Jacking Up Weapon



RA PD 63265

Figure 65—Inserting Firing Jack Key



RA PD 63266

Figure 66—Removing Traveling Lock Pin

n. Remove the firing jack key from its pocket on the bottom carriage, lift the firing jack key opening spring cover, and insert the key (fig. 65). Then turn the firing jack ratchet plunger handles until the arrows inscribed on them are pointed upward, and lower the carriage (raise the rack plunger) until the top of the plunger contacts the firing jack key. This will take the weight of the weapon off the firing jack mechanism.

GUN AND CARRIAGE

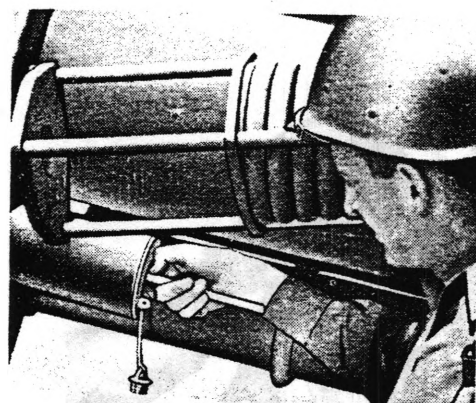
o. Release the traveling lock by removing the traveling lock pin (fig. 66) and elevating the weapon. This should not be done until the weapon has been raised on the firing jack, as the lowered traveling lock may interfere with the jacking operations. Remove the muzzle cover.

29. TO CHECK LIQUID IN RECOIL MECHANISM.

a. Before firing, the recoil mechanism should be checked to determine if there is the proper amount of liquid in the replenisher and the recuperator cylinder. This check also should be made after every tenth round if time permits. Insufficient liquid (oil reserve) in the recoil mechanism when the gun is fired will result in damage to the mechanism.

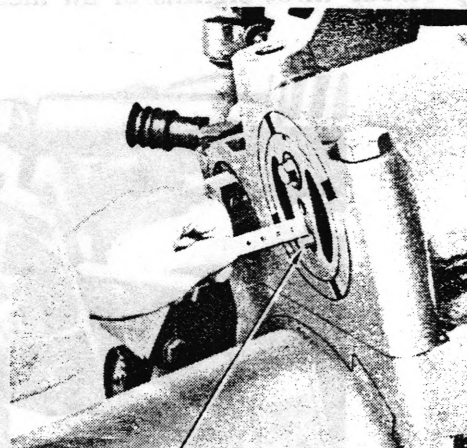
b. To Gage Oil Reserve in Replenisher.

(1) The position of the replenisher piston indicates the amount of oil reserve in the replenisher. To measure the position of the replenisher piston, pull out the plug from the center of the replenisher piston guide at the rear end of the replenisher, insert a rule 41-R-2909 in the opening, and push it in until it comes in contact with the rear end of the extension on the replenisher piston (fig. 67). Read on the rule the graduation that is flush with the rear face of the replenisher piston guide. Do not use the recessed surface.



RA PD 63267

Figure 67—Gaging Oil Reserve in Replenisher



OIL INDEX

RA PD 54763

Figure 68—Measuring Recuperator Oil Index

(2) The normal position of the rear end of the extension on the replenisher piston is $5\frac{1}{2}$ inches (140-mm) from the rear face of the replenisher piston guide. This position indicates a full recoil cylinder and a proper oil reserve in the replenisher.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

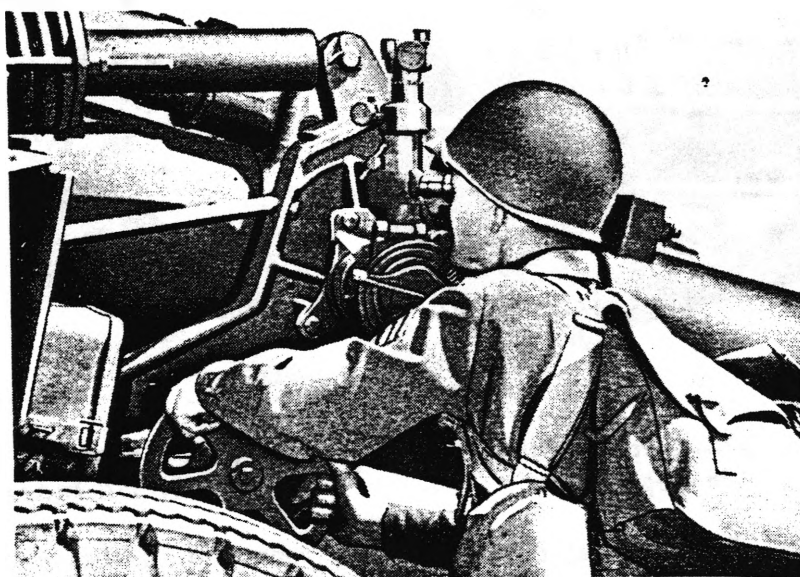
(3) When the end of the piston is within $3\frac{1}{2}$ inches (89-mm) of the rear face of the replenisher piston guide, it indicates too much reserve oil. Oil should be removed from the replenisher before firing is continued. This is done by means of the oil releasing tool 41-T-3251-611.

(4) When the end of the piston is $7\frac{1}{2}$ inches (190-mm) or more from the rear face of the replenisher piston guide, it indicates no reserve, and sufficient oil should be added to establish the proper reserve. To establish the replenisher reserve, see paragraph 53 d.

c. To Gage Oil Reserve in Recuperator Cylinder.

(1) The position of the recuperator oil index indicates the oil reserve in the recuperator cylinder. The oil index is located in the recuperator oil index housing below the oil filling valve. To measure the position of the oil index, hold one end of a rule firmly against the housing with the edge of the rule parallel to, and close to, the oil index (fig. 68). Read on the rule the graduation opposite the rear end of the oil index.

(2) On recoil mechanisms of earlier manufacture, the oil index will protrude one-quarter of an inch (6-mm) beyond the rear face of the oil index housing; on those of later manufacture, it will protrude three-eighths of an inch (9-mm).

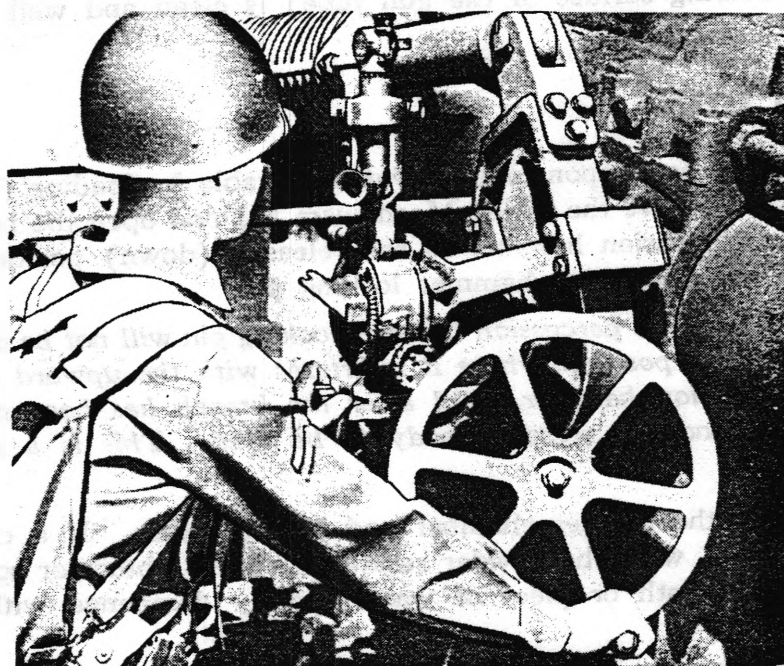


RA PD 63355

Figure 69—Traversing Gun

GUN AND CARRIAGE**30. TO TRAVERSE.**

a. The traversing handwheel is located on the left side of the carriage ahead of the elevating handwheel. One complete turn of the handwheel in a clockwise direction traverses the carriage to the right approximately 10.3 mils (34.7 minutes). The range of traverse is 866 mils (48.7 degrees), or 418 mils (23.5 degrees) to the left, and 448 mils (25.2 degrees) to the right of midposition. Approximately 84 turns of the handwheel are required to traverse the mount from one side to the other of its range of traverse.



RA PD 63356

Figure 70—Elevating Gun**31. TO ELEVATE.**

a. The elevating handwheel is located at the left rear of the carriage in back of the traversing handwheel. One complete turn of the handwheel in a clockwise direction elevates the weapon approximately 14.8 mils (50 minutes). The range of elevation is 1,068 mils (60 degrees). Approximately 72 turns of the handwheel are required to elevate the weapon from 0 to 60 degrees. The amount of elevation and depression above and below zero degrees is dependent upon the emplacement of the spades.

32. PRIOR TO FIRING.

a. Check the replenisher and recuperator cylinder oil reserves (par. 29). When it is known that rapid fire is to take place, release

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

oil from the replenisher until the rear end of the piston is 7½ inches (190-mm) from the rear of the replenisher. The heat of firing should bring the piston quickly to its normal position due to expansion of the oil.

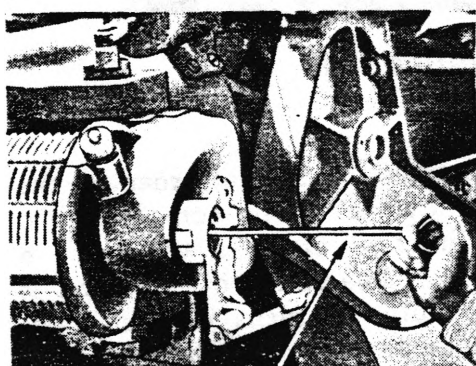
b. Inspect the bore and breech to see that no dirt or foreign matter is accumulated. If there is foreign matter, clean thoroughly and wipe dry. Normally, the bore should be wiped or cleaned to remove the coating applied after the previous firing. Examine the breechblock, primer vent, and gas check pad. Inspect the recoil mechanism for oil leakage. Make certain that the recoil slide (the exposed bearing surface of the gun tube) is clean and well lubricated.

33. TO LOAD.

a. Lower the weapon to an elevation suitable for loading (about 150 mils). Remove the Firing Mechanism M1 and open the breech. Latch the percussion hammer in the released (down) position by means of the percussion hammer locking pin.

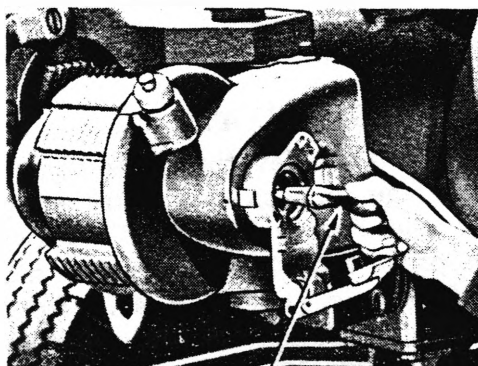
CAUTION: The percussion hammer locking pin will not be drawn from its locked position, where it interferes with the upward swing of the percussion hammer, until after the breech has been closed and locked and the piece is ready to be fired. This is a safety precaution.

b. Swab the powder chamber and breech recess. If a charge has been fired, wipe the powder residue from the obturator spindle head with a cloth or piece of waste slightly dampened with oil.



VENT CLEANING TOOL
(41-T-3081-120) RA PD 63271

Figure 71—Cleaning Primer Vent



PRIMER SEAT CLEANING
REAMER (41-R-501-80) RA PD 63272

Figure 72—Reaming Primer Seat

GUN AND CARRIAGE

Clean the primer vent with the vent cleaning tool 41-T-3081-120 (fig. 71). Ream the primer seat with the primer seat cleaning reamer 41-R-501-80 (fig. 72). Inspect the bore for burning fragments of powder bags or other objects and for bore injuries. In night firing, swab the bore with water.

c. **Prepare Projectile.** Verify the type, weight, and lot number, and examine carefully for defects. Remove the grommet and inspect the rotating band with special care; remove any burrs with a file. Clean the entire surface of the projectile with a dry piece of waste, or cloth. Sand or dirt on the projectile might cause premature detonation when the piece is fired and will cause undue wear on the bore.



FUZE WRENCH M7A1 (41-W-1596-50)

RA PD 63357

Figure 73—Fuzing Projectile

d. **Fuze Projectile.** Unscrew the eyebolt lifting plug from the fuze socket. Insert the designated fuze, being careful that it is fitted with its felt or rubber washer. Screw it home by hand. Give the fuze its final seating with the Fuze Wrench M7A1 41-W-1596-50 (fig. 73). No great force should be used. If there is any difficulty in screwing the fuze home, the fuze should be removed and another inserted. If the same trouble is encountered with the second fuze, the shell should be rejected. Set the fuze.

e. **Load Projectile.** Bring up the prepared projectile on the loading tray 41-T-3851-260. In carrying the loading tray, grasp the handles and raise it with the front slightly above the rear.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

LOADING TRAY (41-T-3851-260)

LOADING RAMMER
HEAD (41-H-1826-300)

RA PD 63358

Figure 74—Loading Projectile

Get a firm grip on the handles as a shell may be easily dropped if the tray is not carried in the proper position. Place the lip of the tray in the breech recess. Place the loading rammer head 41-H-1826-360 squarely against the base of the projectile (fig. 74), pushing the projectile carefully until it has cleared the threads of the breech recess. Exercise extreme care that the fuze does not come in contact with anything.

f. **Ram Projectile.** Ram the projectile home with a powerful stroke (fig. 75). It is important that projectiles be rammed home with a uniform force since variations in the ramming force will cause slight variations in range. It is also important to avoid damage to the rotating bands on the projectile as such damage is likely to cause erratic flight of the projectile.

g. **Prepare Propelling Charge.** For description and preparation for firing of the propelling charge, see paragraph 86 c. Bring the prepared propelling charge up to the breech immediately after the projectile has been rammed.

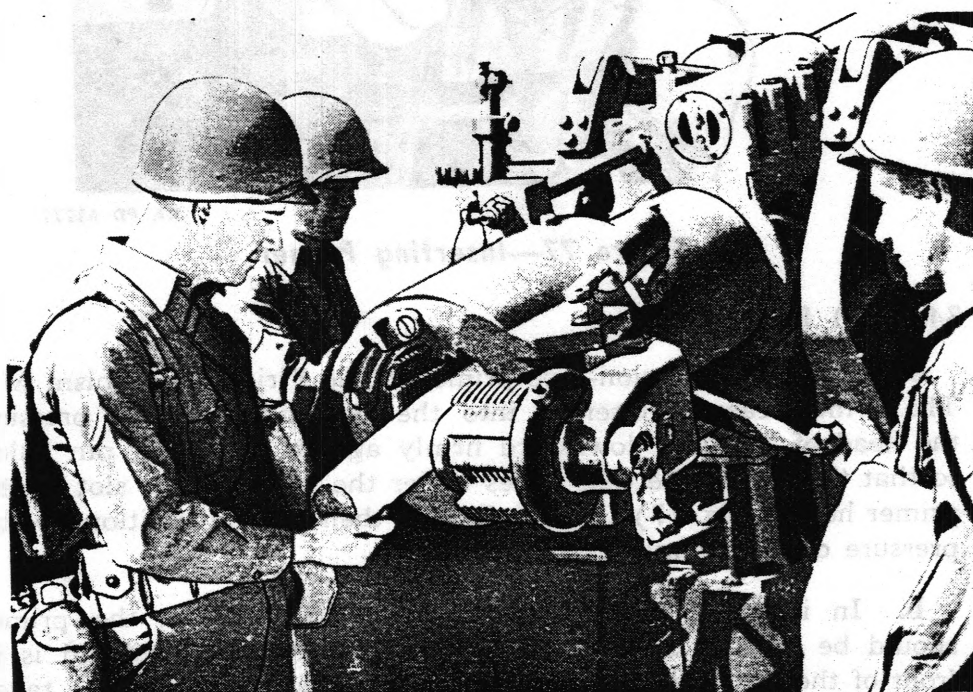
CAUTION: *An exposed propelling charge will not be near the weapon at any other time.*

GUN AND CARRIAGE



RA PD 63359

Figure 75—Ramming Projectile



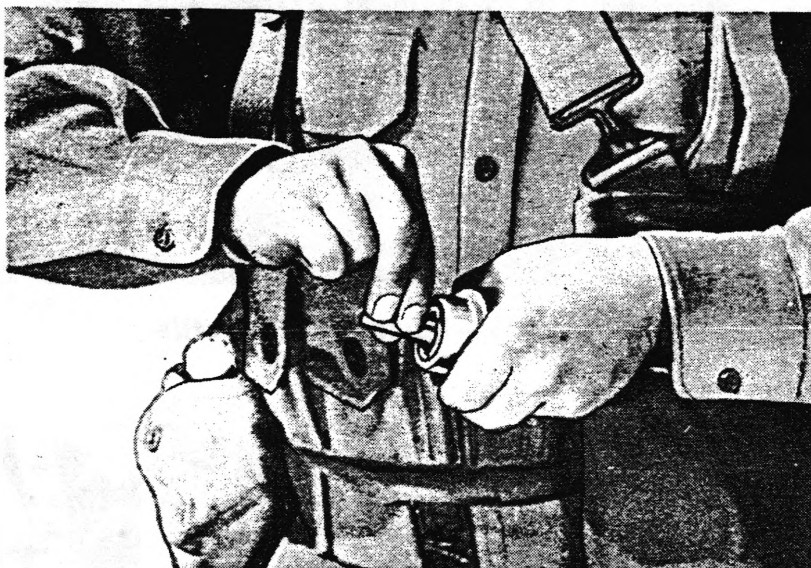
RA PD 63360

Figure 76—Loading Propelling Charge

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

h. Load Propelling Charge. Place the charge in the chamber (fig. 76) with the igniter end to the rear and push it in until the base of the charge is flush with the rear end of the chamber. The igniter pad must come directly in front of the vent when the breech is closed to insure ignition of the charge.

i. Close Breech. To insure transmission of the flash from the primer to the charge, the obturator spindle head should come in contact with the base of the charge when the breech is closed, must push the charge forward to its final position, and must remain in contact with it.



RA PD 63277

Figure 77—Inserting Primer

34. TO FIRE:

a. Insert a percussion-type primer in the Firing Mechanism M1. The primer case is inserted into the primer holder by pressing the head of the case downward firmly against the firing pin guide so that the rim of the case slides under the edges of the slot in the primer holder (fig. 77). The primer is then held in position by the pressure of the firing spring.

b. In inserting the primer in the primer holder, the primer should be held in such a manner that no part of the hand is in front of the wad end of the primer. This precaution must be taken to avoid a severe burn in case of premature discharge of the primer.

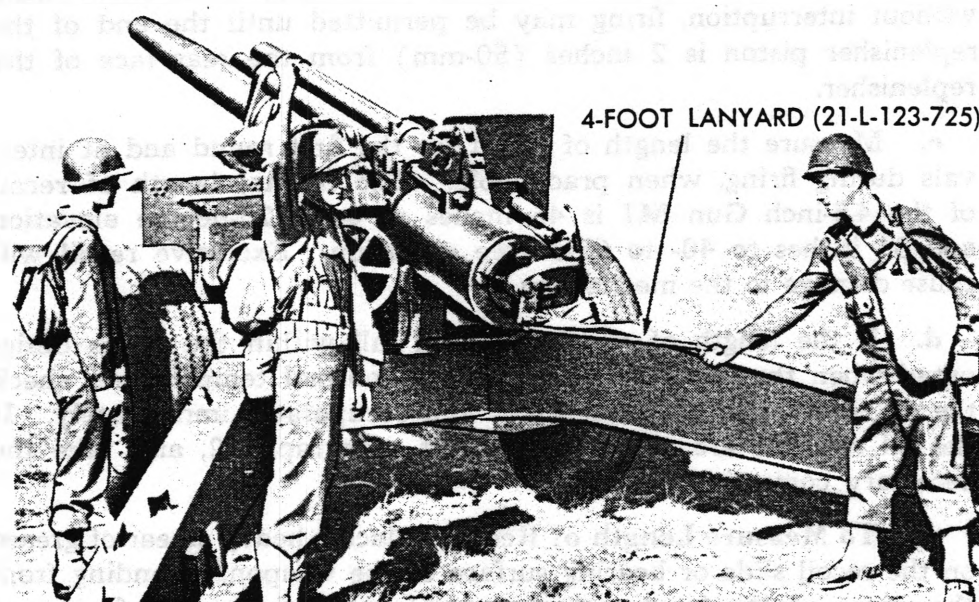
GUN AND CARRIAGE

c. Should the primer be slightly oversize, or the primer holder dirty, the primer will stick before it is properly seated. Force should not be exerted. Remove the primer and clean the primer holder, or insert another primer.

d. Insert the firing mechanism in the firing mechanism housing, taking care that the front end of the primer has entered the obturator spindle plug. Seat the mechanism by turning the firing mechanism handle in a clockwise direction until it has contacted the firing mechanism block handle arm stop and has been latched. If the mechanism will not seat properly, the primer may be oversize, or its seat in the plug or in the primer holder may be dirty, or the breech may not be fully closed.

CAUTION: Make certain that the Firing Mechanism M1 is screwed home and is latched in position.

e. Attach the lanyard. Draw the percussion hammer locking pin to the left and out of the path of the hammer, turning the percussion hammer locking pin knob to place the pin in locked-out position.



RA PD 63361

Figure 78—Firing the Piece

f. Grasp the handle of the 4-foot lanyard 21-L-123-725 with the right hand, and without raising the hand, pull with a quick, strong pull (not a jerk) prolonged sufficiently to insure the percussion hammer hitting the firing pin (fig. 78). The lanyard will be pulled from a position as near the rear of the piece as is convenient, and sufficiently out of the line of recoil to insure safety.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

g. If the long 50-ft. lanyard 21-L-106 is used, it will be attached immediately before, and detached immediately after, the round is fired.

35. OBSERVATION DURING FIRING.

a. Observe the movement of the weapon in recoil. It should be smooth with uniformly decreasing velocity. The point of maximum recoil should be reached without shock. Then the counter-recoil system should return the weapon completely into battery without shock. If uneven, jerky movement or shock is observed, or, if the weapon will not return fully to battery, inspect the recoil mechanism to determine the cause (par. 42).

b. Check the recoil mechanism to determine if there is any oil leakage. Measure the oil reserves in the replenisher and the recuperator at intervals during firing. The temperature of recoil oil rises during firing and causes the recoil oil to expand.

NOTE: In an emergency, when it is necessary to continue firing without interruption, firing may be permitted until the end of the replenisher piston is 2 inches (50-mm) from the rear face of the replenisher.

c. Measure the length of recoil for the first round and at intervals during firing, when practicable. The normal length of recoil of the 4.5-inch Gun M1 is 45 inches at 0- to 25-degree elevation and 31 inches to 40- to 65-degree elevation. Excessive recoil will cause damage to the mechanism.

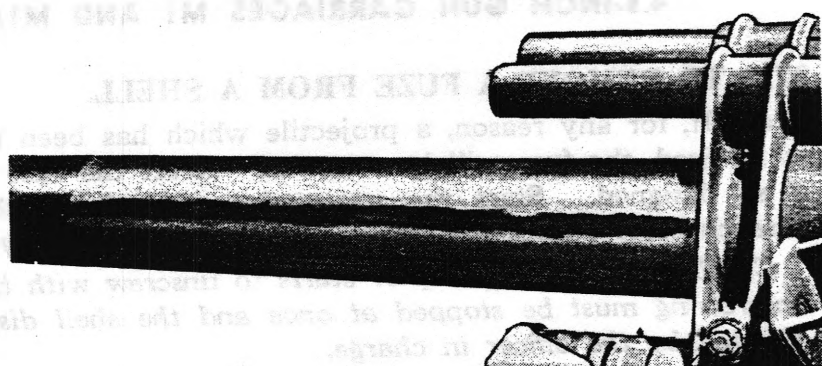
d. If the length of recoil does not fall within the limits designated when the weapon is operating at normal temperature, check the oil reserves in the replenisher and recuperator immediately. If the oil reserves are abnormal, consult paragraph 42, and take the necessary corrective measures.

e. **To Measure Length of Recoil.** Place a heavy smear of grease on the recoil slide or bearing surface of the weapon, extending from the wiper on the front end of the cylinder yoke to the front end of the recoil slide (fig. 79), or tie a piece of string around the recoil slide in front of the wiper. After the weapon has fired and returned to battery, measure the distance between the wiper and the point to which the wiper has moved the grease or string.

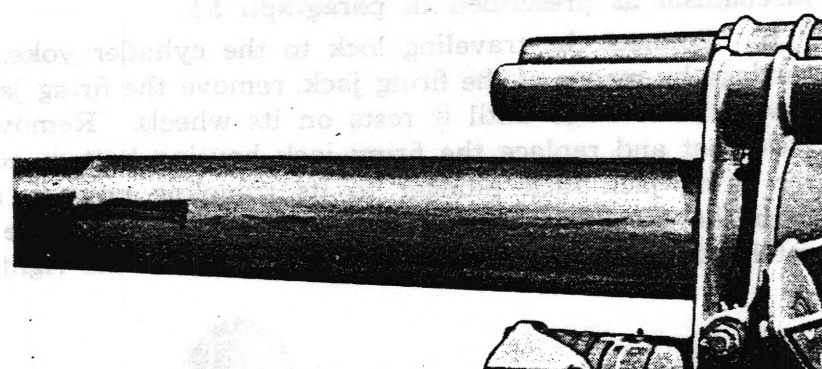
36. TO UNLOAD.

a. **Service Rounds.** Whenever possible, live, fuzed projectiles are to be unloaded from the piece by being fired out of the weapon.

GUN AND CARRIAGE



ABOVE—GREASE BEFORE RECOIL



BELOW—GREASE AFTER RECOIL

RA PD 63362

Figure 79—Grease on Recoil Slide Before and After Recoil

Where conditions do not permit the firing of the weapon, the round is to be removed with the cleaning and unloading Rammer M6 (C91880). Lower the weapon to zero elevation with the loading tray 41-T-3851-260 in place of the breech, insert the rammer head into muzzle of gun and ram the round out of the gun onto the loading tray. This operation must be done by or under the personal supervision of the battery commander.

b. Dummy Projectile. To unload the dummy projectile, lower the weapon to zero elevation. Pull out the dummy charge, and then, with the loading tray in place, remove the projectile with the hook-type extractor 72-1-5, type C. Insert the extractor in the extractor recess at the rear end of the projectile, hook it against the shoulder of the plunger seated in the base of the projectile, and pull the projectile out of the gun onto the loading tray. If the extractor is not available, the projectile may be removed by use of the cleaning and unloading Rammer M6. This operation is performed from the muzzle end of the weapon.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

37. TO REMOVE A FUZE FROM A SHELL.

a. If, for any reason, a projectile which has been fuzed is not to be fired, the fuze will be removed. Reset the fuze to "SAFE," if so designed. Start the unscrewing operation with the Fuze Wrench M7A1; complete the unscrewing of the fuze by hand.

CAUTION: If the adapter starts to unscrew with the fuze, the unscrewing must be stopped at once and the shell disposed of as directed by the officer in charge.

38. TO PLACE IN TRAVELING POSITION.

a. If weapon has been fired, clean, dry, and oil the bore and chamber and disassemble, clean and oil the breech and firing mechanism as prescribed in paragraph 51.

b. Connect the traveling lock to the cylinder yoke. Raise the carriage by means of the firing jack, remove the firing jack key, and lower the carriage until it rests on its wheels. Remove the firing jack float and replace the firing jack housing bottom cover. Raise the firing jack rack plunger to its traveling position and lock it with the firing jack travel locking lever. Secure the firing jack ratchet handles to their clamp on the front of the right shield.



RA PD 63280

Figure 80—Prying Spade From Ground

GUN AND CARRIAGE

c. Knock out the spade keys, lift the trails from the lugs on the tops of the spades, and close the trails, placing the firing jack float and the loading tray in their retainers on the tops of the trails. Pry the spades out of the ground with the handspikes (fig. 80). Place the spades, spade keys, and handspikes in their carrying racks on the trails. Clamp the trails together with the trail lock and lock with the right trail retainer pin. Install covers (fig. 81).



RA PD 63363

Figure 81—Weapon With Covers in Place

d. Release the hand brakes on the carriage. Back up the prime mover until the lunette can be placed over the pintle of the prime mover. On M1 Carriages equipped with electric brakes, connect the jumper cable and safety chain. On M1A1 Carriages equipped with air brakes, connect the service and emergency air hose couplings after crossing the coupling air hoses; close the drain cock of the emergency reserve tank.

39. BRAKE OPERATION.

a. The prime mover used with this materiel should be equipped for operating the type of brakes—air or electric—with which the particular gun carriage is equipped.

CAUTION: To avoid injury to the personnel, to insure safe road transportation, and to prevent "jackknifing" of the load, the driver should have the load under control at all times by avoiding any slack between the load and the prime mover. On down grades,

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

curves, and rough or slippery roads, the speed should be held to approximately 10 miles per hour.

b. Air Brakes.

(1) Before starting to tow the materiel, the air pressure must register at least 70 pounds on the dash gage of the prime mover in order that the braking system may be fully effective. Pressure should be checked occasionally while traveling. If the gage indicates a rapid falling off of pressure, stop the vehicle, and check the air brake system to determine the cause of the falling pressure.

(2) Never use the emergency feature of the air brake system for parking purposes. Mechanical hand brakes are provided for this purpose.

(3) The best possible stop will be made when the first brake application is as hard as the speed of the vehicle and the condition of the road will permit, and then graduated off as the speed is reduced. Never apply the brakes lightly at first and then increase the pressure as the speed diminishes. Stops made in this manner require more time and the final high pressure produces a severe final stop.

(4) Do not "fan" the brake pedal as this gives poor brake performance and wastes air pressure. "Fanning" does not increase the brake line pressure; instead, it decreases both air tank and brake line pressure.

(5) The air brake system is so designed that when the brake pedal is depressed to the limit of its stroke, an emergency application results which will apply the brakes in the hardest possible manner. Such application should be made only in an emergency and must not be employed in ordinary braking service.

c. Electric Brakes.

(1) When applying the brakes for an ordinary stop, the handle of the controller on the prime mover should be advanced gradually for a light brake application. Heavy brake application should be reserved for emergency stops and should not be employed in ordinary brake service.

(2) The load control on the controller is provided to permit the driver to regulate the braking power and prevent skidding regardless of load and road conditions. For slippery roads, the control should be set on "LIGHT."

(3) When applying the brakes for a slowdown or stop, always apply the brakes on the load before applying the brakes on the prime mover.

GUN AND CARRIAGE

(4) When the speed of the prime mover is above the idling speed of the engine at the time a stop is to be made, leave the engine in gear and release the accelerator. This will permit the engine to slow down and function as a brake. When the speed of the vehicle corresponds to the idling speed of the engine, throw out the clutch and gradually apply the brake.

(5) When electric brakes are new, several applications must be made before maximum efficiency is obtained because the magnet must wear grooves in the armature to insure proper contact.

Section IV

MALFUNCTIONS AND CORRECTIONS

40. MISFIRE.

a. Misfire occurs if the piece fails to fire when desired. Failure of the piece to fire is due to one of two causes: failure of the primer to fire; or failure of the propelling charge to ignite.

SAFETY CAUTION. After two attempts have been made to fire the primer, a minimum of at least 30 seconds must be allowed to elapse before removing the firing mechanism, in order to examine the primer (AR 750-10).

b. **General Precautions.** The following general precautions will be taken in all cases:

(1) The piece will be kept trained on the target or in a safe place in the field of fire.

(2) All persons will be kept clear of the path of recoil until after the breech is opened.

(3) When removing the firing mechanism, opening the breech, or reaming the vent, the operator will stand clear of the path of recoil, and all other persons will be kept from the rear of the breech.

(4) In no case will the breech be opened before the primer is removed.

(5) Whenever a new primer is inserted and another attempt to fire results in failure, all precautions and procedure will be as prescribed for the first failure. The firing of more than two primers in an attempt to ignite the propelling charge usually is not justified.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

c. **Primer Failure (Discharge of Primer Is Not Heard, After at Least Two Attempts Have Been Made To Fire the Primer, the Lanyard Being Pulled With Considerable Snap).**

SAFETY CAUTION. *After two attempts have been made to fire primer, a minimum of at least 30 seconds must be allowed to elapse before removing firing mechanism, in order to examine primer AR (750-10).*

Cause	Remedy
Defective primer. Improperly seated mechanism. Lack of, or insufficient, blow on primer.	Remove firing mechanism, noting whether mechanism has been screwed fully home. If it has not been seated, this may have caused failure. Inspect primer. If head has been properly indented, primer will be handled carefully and disposed of quickly because of possibility of hangfire. New primer should be inserted; another attempt be made to fire.
Defective firing mechanism caused by heavy or gummed oil on firing pin; deformed point of firing pin; or broken firing pin spring.	If primer head has not been struck properly, a new primer should be inserted in spare firing mechanism, the firing mechanism inserted in the firing mechanism housing, and an attempt be made to fire. First, firing mechanism should be inspected for: dirty or gummy parts; lubricant too heavy for prevailing temperature; firing pin or firing pin spring broken; or firing pin housing or primer holder loosened. Then wash parts with SOLVENT, dry-cleaning. Replace broken or damaged parts.
Hangfire caused by damp or fouled vent through obturator spindle; abnormal condition of propelling charge.	If primer has fired, a cleaning bit will be run through the vent, another primer will be inserted, and another attempt will be made to fire. If this attempt is unsuccessful, it may be assumed that the failure is due to the propelling charge.

GUN AND CARRIAGE**d. Propelling Charge Failure (Discharge of Primer Is Heard, or Hangfire Is Indicated).**

SAFETY CAUTION. After two attempts have been made to fire the primer, a minimum of at least 30 seconds must be allowed to elapse before removing the firing mechanism, in order to examine the primer AR (750-10).

Cause	Remedy
Abnormal condition of charge. Missing igniter; wet igniter; igniter charge folded over and not accessible to flash of primer; failure to remove igniter protector cap; increment section between base section and breech.	Remove firing mechanism and remove primer. Run cleaning tool through obturator vent, insert a new primer, and make another attempt to fire. If this attempt is unsuccessful, after a wait of 30 seconds, the breech will be opened, propelling charge removed and disposed of as directed by executive officer, and a new propelling charge inserted in the weapon.

41. OTHER MALFUNCTIONS OF WEAPON.**a. Breechblock Failure.**

Seized breechblock.	Notify Ordnance maintenance personnel.
---------------------	--

b. Breech Mechanism Does Not Operate Freely.

Lack of lubrication, or scores on threads of breech recess or breechblock.	Disassemble breechblock and clean thoroughly. If threads are scored, repair must be made by Ordnance maintenance personnel.
--	---

c. Breech Will Not Open or Fully Close With Firing Mechanism M1 in Place.

Safety feature. Firing mechanism safety latch is functioning.	Remove Firing Mechanism M1. If mechanism is removed, latch may be stuck at right; move latch to left.
---	---

d. Threaded Sectors of Breech Ring and Breechblock Do Not Mate.

Improper assembly of breech mechanism; missing breech operating lever control arc; broken parts.	Insert missing control arc. Disassemble breech mechanism and reassemble in proper manner. Replace any broken or deformed parts.
--	---

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

e. Escape of Gases; Powder Fouling on Threads of Breech-block.

Cause	Remedy
Bruised or burned gas check pad; burred or ruptured split rings; broken or weakened breechblock withdrawing spring.	Disassemble breech mechanism; replace damaged obturator parts.

f. Operating Lever Does Not Latch Properly.

Weak or broken breech operating lever closing latch spring.	Disassemble operating lever latch and replace spring.
Lack of lubrication; roughness of shaft or bearings.	Lubricate. If this does not correct malfunction, notify Ordnance maintenance personnel.

42. MALFUNCTION OF CARRIAGE.

a. Air in Replenisher or Recoil System.

Replenisher piston packing defective; imperfect replenisher connections; leaking recoil cylinder.	Check replenisher connections; keep them tight and free from dirt. If air accumulates after replenisher oil reserve has been drained and properly filled, refer to Ordnance maintenance personnel.
---	--

b. Oil Leaks from Rear of Replenisher.

Whether or not a serious leak exists must be determined by frequency of filling required.	Oil may drip rapidly, or may run in a stream, from rear of replenisher when weapon is elevated, provided weapon has been at zero elevation for some time. A leak at any packing that does not exceed 3 drops per minute is not considered serious. If leakage is greater, notify Ordnance maintenance personnel.
---	--

c. Position of Replenisher Piston Does Not Change During Firing.

Replenisher piston stuck.	Insert a block of hardwood in the rear of replenisher guide and against the end of the piston; tap block with hammer. Never strike walls of replenisher. If replenisher housing becomes dented in any way, notify Ordnance maintenance personnel.
---------------------------	---

GUN AND CARRIAGE

d. Oil Index Projects Less Than One-quarter Inch (6-mm) When or Shortly After Oil Reserve Has Been Established.

Cause	Remedy
Loss of gas pressure either through recuperator front cylinder head or past floating piston.	Gas escaping by floating piston is indicated by an emulsified condition of the reserve oil drained off. If, when proceeding to establish oil reserve in ordinary manner, oil index does not move out and pump works easily, gas pressure has probably been lost. Substantiate this by attempting to drain reserve; oil will not spurt from a mechanism without at least some pressure. Notify Ordnance maintenance personnel.

e. Oil Index Remains Stationary When Reserve Oil Is Pumped in Against Evident Pressure.

Packing too tight; oil index broken or locked by some foreign substance.	Drain off all reserve oil and refill. While injecting oil, tap oil index gently with each stroke of pump. If oil index fails to move after 67 full strokes of Oil Pump M3, refer to Ordnance maintenance personnel.
--	---

f. Excessive Leaks From Recuperator Filling Valve.

Sticking of filling valve or defective packing.	Notify Ordnance maintenance personnel.
---	--

g. Oil Drips From Counterrecoil Rod, Recoil Rod, or Control Rod Stuffing Boxes in Excess of 3 Drops Per Minute.

Broken springs; more compression required on springs; damaged packing.	Notify Ordnance maintenance personnel.
--	--

h. Oil Leaks From Forward End of Counterrecoil Cylinder.

Black oil appearing in front of counter-piston is a normal condition due to lubrication. Clear oil is an indication of a leak due to broken packing springs or lack of compression on springs.	Report a leak of clear oil to Ordnance maintenance personnel.
--	---

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

i. Weapon Will Not Return to Battery.

Cause	Remedy
Too much oil in replenisher.	Reduce amount of oil in replenisher to normal.
Insufficient amount of reserve oil in recuperator cylinder.	Drain off reserve oil and refill.
Insufficient gas pressure.	Report to Ordnance maintenance personnel.

j. Weapon Returns to Battery with Too Much Shock.

Insufficient oil in replenisher.	Refill replenisher to normal.
Excess amount of reserve oil in recuperator cylinder.	Drain recuperator reserve oil and refill.
Change of viscosity of oil, due to heat of rapid firing.	Allow weapon to cool.
Friction factors of various packings are too low.	Report to Ordnance maintenance personnel.

k. Weapon Slow To Return to Battery When Oil Indication Is Normal.

Insufficient gas pressure; packing exerts too much friction.	Report to Ordnance maintenance personnel.
--	---

l. Uneven or Jerky Counterrecoil.

Bearing surfaces fit too tightly, are scored, or lack proper lubrication; foreign substances in oil.	Report to Ordnance maintenance personnel.
--	---

m. Weapon Recoils More than Normal Allowable Distance.

Insufficient oil in recoil mechanism.	Refill replenisher to normal.
Insufficient gas pressure in recuperator; insufficient friction; malfunction of variable recoil mechanism.	Report to Ordnance maintenance personnel.

n. Weapon Does Not Recoil Sufficiently.

High viscosity of oil due to low temperature.	After firing two or more rounds, the recoil will become normal if this is the cause.
Bearing surfaces fit too tightly, are scored, or lack lubrication; Packing exerts too much friction; malfunction of variable control cam assembly.	Report to Ordnance maintenance personnel.

GUN AND CARRIAGE

o. **Weapon in Counterrecoil Does Not Cause Hissing Sound of Escaping Air.**

Cause

Remedy

Air vents are stopped up.

Clean the vents in the replenisher, which are continuations of teat holes in piston guide. If air is not escaping from respirator in front end of counterrecoil cylinder, report to Ordnance maintenance personnel.

p. **Weapon Will Not Attain Maximum Elevation.**

Variable recoil cam assembly jammed; interference between tipping and non-tipping parts; malfunction of elevating mechanism.

Report to Ordnance maintenance personnel.

q. **Backlash in Elevating and Traversing Mechanisms.**

Wear and improper meshing of worms, wormwheels, gears, pinions, or arcs; improper assembly; end play in shafts.

Notify Ordnance maintenance personnel.

r. **Excessive Handwheel Effort Required to Elevate or Depress.**

Equilibrators out of adjustment. Equilibrator spring or springs weak or broken; undue friction.

Adjust equilibrators (par. 54 c). Notify Ordnance maintenance personnel.

Parts improperly mated, worn, or damaged; lack of lubricant; dirty or gummy lubricant; elevating arc and pinion binding; bearings "locked-up".

Notify Ordnance maintenance personnel.

s. **Excessive Tire Wear.**

Misalignment of wheels; bent wheel spindles.

Notify Ordnance maintenance personnel.

Wheel bearings loose; wheels loose on hubs; wheels bent.

Adjust bearings (par. 70 e). Tighten loose wheel retaining nuts. Replace bent wheels.

Low tire inflation pressure.

Keep tires inflated to recommended pressure—95 pounds per square inch.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

43. MALFUNCTION OF AIR BRAKES.

a. No Brakes, or Intermittent Brakes.

Cause	Remedy
Leak in air line; loose or damaged connection or coupling; restriction in air line.	Test with soapsuds (par. 54 g (2)). Tighten loose connections; replace damaged part or length of air line.
Leaking brake diaphragm or fractured fabric diaphragm.	Test with soapsuds (par. 54 g (2)). Tighten bolts uniformly. If this does not stop leakage, notify Ordnance maintenance personnel.
Malfunction of relay portion of relay-emergency valve.	Test with soapsuds (par. 54 g (2)). Notify Ordnance maintenance personnel.
Moisture in carriage emergency reserve tank or air filters. If weather is cold, there may be ice in these units.	Remove drain plugs; drain; replace plugs.
Clogged air filter strainer.	Remove strainer and clean (par. 54 g (4)).
Brake lining or drum condition.	Notify Ordnance maintenance personnel.

b. Weak Brakes.

Insufficient travel of brake diaphragm push rods while in contact with slack adjusters, excessive travel of push rods.	Adjust brakes by means of slack adjusters (par. 54 g (6)).
Worn, glazed, or greasy brake lining.	If greasy, wash lining with SOLVENT, dry-cleaning; otherwise notify Ordnance maintenance personnel.
Insufficient air pressure at brakes.	Notify Ordnance maintenance personnel.
Restriction in air lines.	Clean; repair or replace damaged length of air line.

c. Grabbing Brakes.

Loose or worn wheel bearings.	Adjust bearings (par. 70 e). If worn, notify Ordnance maintenance personnel.
Only one brake functioning.	If air line or connections leak, tighten or replace; if one brake is out of adjustment, adjust by means of slack adjuster. Otherwise notify Ordnance personnel.

GUN AND CARRIAGE

d. Locked Brakes.

Cause	Remedy
Air line hose crossed by improper connection of service and emergency air lines.	Couple lines properly. Empty carriage emergency reserve tank by opening drain cock, or build up pressure by operating the air compressor on the prime mover.

e. Brakes Do Not Apply Automatically When Emergency Air Line Is Disconnected.

Malfunction of emergency portion of relay-emergency valve.	Notify Ordnance maintenance personnel.
--	--

44. MALFUNCTION OF ELECTRIC BRAKES.

a. No Brakes or Intermittent Brakes.

Broken wire in circuit.	Check entire wiring for broken wires. Repair or replace.
Controller defective.	Short out controller by connecting both wires to one terminal and see if brakes are effective.
Poor connections.	Check, clean, and tighten all connections at brake, controller, load control, and sockets.
Broken wire on magnet.	If broken wire is on outside of magnet, repair if possible. If no current flows through magnet, report to Ordnance maintenance personnel.
Poor ground condition in circuit.	Clean up and tighten ground connections.
Defective plug or socket.	Check plug and socket for loose connections, dirty or corroded blades, or a broken socket. Repair or replace.

b. Weak Brakes.

Worn out or greasy brake lining.	If greasy, wash lining with SOLVENT, dry-cleaning. Lining may be worn to full extent of magnet travel. Refer to Ordnance maintenance personnel for new lining.
Glazed or greasy magnet facing.	Roughen facing of magnet with coarse emery cloth.
Stop lights connected in circuit.	Check to determine if stop lights have been connected in circuit by mistake.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

Cause	Remedy
Wire broken in insulation. Bare wire. Loose connection. Poor contact at load control.	Check wiring for defective parts or connections. Short out load control. Correct if possible, otherwise, notify Ordnance maintenance personnel.
Insufficient current due to poor connections at brake, controller, load control, ground, or jumper cable plugs and sockets.	Test with ammeter (par. 54 h (6)). Clean up and tighten all connections, check plug and socket for corroded or dirty blades or broken sockets. Repair or replace socket.
Poor ground connection at brakes.	Ground contacts must be solid and clean.
Worn wheel bearings; incorrect armature spacing.	Refer to Ordnance maintenance personnel.
c. Brakes Grabbing.	
Only one brake working. Loose or worn wheel bearings.	Test with ammeter (par. 54 h (6)). Tighten bearings (par. 70 e). If this does not correct condition, report to Ordnance maintenance personnel for replacement.
Stop lights in brake circuit.	Determine if stop lights have been connected improperly.
Worn lining; drums out of round; bands distorted; lining loose on rivets; broken or weak band or magnet springs; controller burned out; poor contactor blade spacing; magnet bushing worn.	Refer to Ordnance maintenance personnel.
Contactor arm in controller pitted.	Smooth out contractor arm with cloth, abrasive, aluminum oxide, 5/o-180 (fine).
Poor electrical connections.	Check wiring for loose connections, bare wires, or broken wires in insulation.
Sticky or grease-coated lining.	Wash lining with SOLVENT, dry-cleaning.

GUN AND CARRIAGE

d. Brakes Dragging.

Cause	Remedy
Loose wheel bearings.	Adjust bearings (par. 70 e).
Drums out of round; lining improperly applied to bands; damaged wheel bearings; broken spring in hand control; insufficient spacing between armature and magnet; brakes not used sufficiently for proper wear-in.	Refer to Ordnance maintenance personnel.

e. Battery on Carriage Runs Down.

Safety switch left in "ON" position.	Keep safety switch lever in "OFF" position.
Excessive use of battery to apply brakes.	Do not use battery current for parking; use hand brakes. Use battery current for braking only as necessary.
Short circuit in brake system.	Check for bare wire. Tape or replace damaged cable.

Section V

LUBRICATION

45. INTRODUCTION.

a. **General.** Lubrication is an essential part of preventive maintenance, determining to a great extent the serviceability of parts and assemblies. Satisfactory operation and long life of the materiel are not assured unless the materiel is kept clean and well lubricated.

b. Apply sufficient lubricants, but avoid wasteful practices. Excessive lubrication will result in dust accumulations on some moving parts and, if not removed, may cause wear and malfunctioning. Particular attention should be given to the lubrication of sliding surfaces which contain no oilholes, plugs, or fittings. Keep all exposed parts clean and well lubricated. The materiel should always be lubricated after washing.

c. **Supplies.** In the field, it may not be possible to supply a complete assortment of lubricants called for by the Lubrication Order to meet the recommendations. It will be necessary to make

4.5-INCH GUN M1 AND
CARRIAGES M1 AND M1A1

No. 77

WAR DEPARTMENT LUBRICATION GUIDE

ORDNANCE DEPARTMENT

GUN, 4.5-in., M1; CARRIAGE, GUN, 4.5-in., M1, M1A1 HOWITZER, 155-mm, M1; CARRIAGE, HOWITZER, 155-mm, M1, M1A1

SNL C-38 (4.5-in.); SNL C-39 (155-mm).

For detailed instructions, refer to TM 9-331.

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 CARRIAGE

To clean parts, use SOLVENT, dry-cleaning, or OIL, fuel, Diesel. Dry before lubricating. Swab gun bore as well as breech and firing mechanism after removal of gas check pad from obturator spindle 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.

A1 Recoil Cylinder Replenisher **RS**
Fill and Drain
Cap. 33 pt.

A2 Exposed Recoil Slide **OG D**
Clean and coat, wipe off
excess before firing

A3 Cradle Liner **OG W**

A4 Equilibrator Trunnion **OG M**
Bearing

A5 Recoil Cylinder Replenisher Level **D**
Check daily and before firing

G1 Cradle Liner **OG W**

OMP Cradle Trunnion Bearing **WB M**

B1 Sight Mount Worm Shaft **OE W**

D OE Gun Bore
Daily and after firing,
clean and oil

M OG Variable Recoil Control
Springing

M OG Equilibrator Trunnion Bearing

W OG Cradle Liner

W OE Equilibrator Springs, Rods
and Tubes Clean and oil

W OG Cradle Liner

M WB Cradle Trunnion Bearing

W OG Cradle Liner
(Reached from below)

RS Recuperator and Counter-
recoil Fill and Drain
Cap. 16 pt.

F1

F2

F3

F4

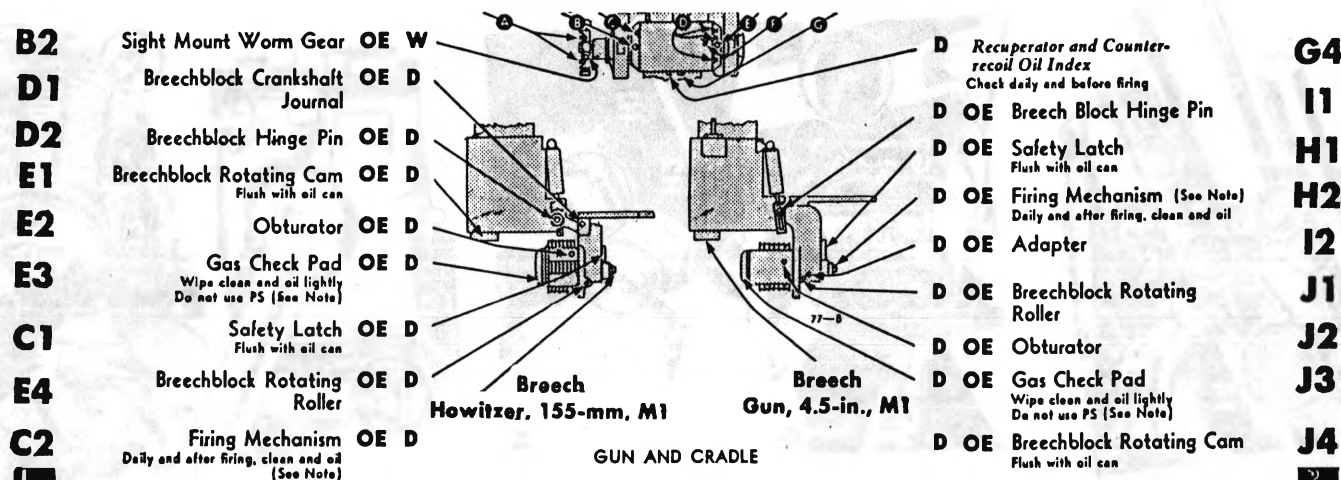
G1

OMP

G2

G3

Figure 82—Lubrication Order
104

**NOTES**

OMP—Ordnance Maintenance Personnel

BREECH AND FIRING MECHANISM—To clean the breech daily and after firing, disassemble obturator from breech and firing mechanism and remove gas check pad from obturator spindle. Before reassembling, wipe surfaces of gas check pad clean (do not use solvent or bore cleaning solution) and apply a thin film of OE SAE 30 above +32°F. or SAE 10 below +32°F.

LUBRICATED BY ORDNANCE PERSONNEL—Cradle Trunnion Bearings. (Refer to TM9-1331.)

Copy of this Guide will be carried on the materiel 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 TEMPERATURES			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	D—Daily
OG—GREASE, O.D.	OG No. 0	OG No. 00	OG No. 00	RS—Oil, recoil, special	W—Weekly
				PS—OIL, lubricating, preservative, special	M—Monthly

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

No. 77 [NOT TO BE REPRODUCED in whole or in part without permission of the Office of the Chief of Ordnance.] CHECK-CHART

14 Jan 44
Supersedes all previous issues.

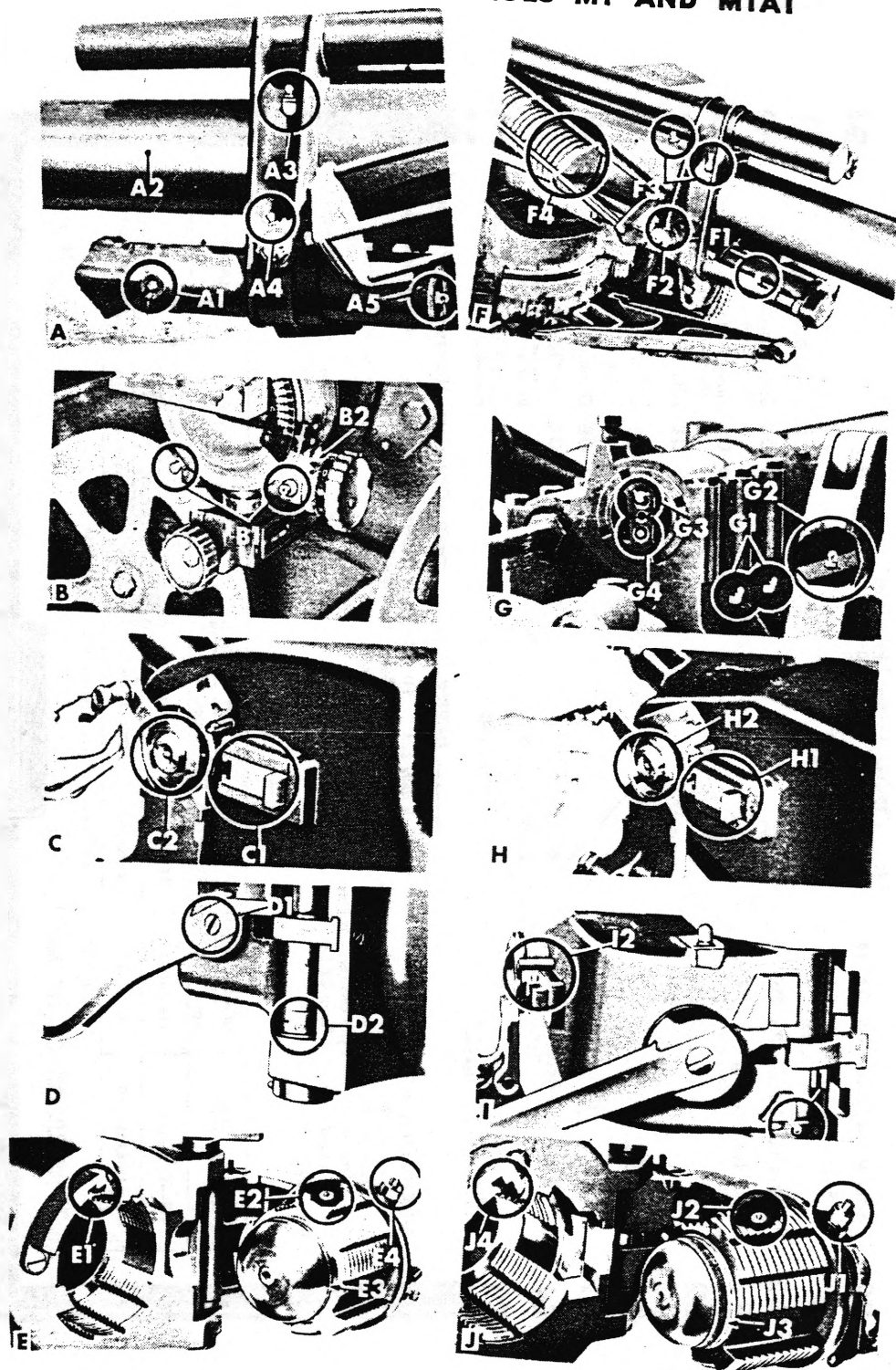
GUN AND CARRIAGE

45

TM 9-328

RA PD 63282

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 63206

Figure 82A—Lubrication Points

GUN AND CARRIAGE

the best use of those available, subject to inspection by the officer concerned, in consultation with responsible Ordnance maintenance personnel.

46. LUBRICATION ORDER.

a. War Department Lubrication Order No. 77 (formerly War Department Lubrication Guide No. 77) (figs. 82 and 83) prescribes lubrication instructions for the 155-mm Howitzer M1; 4.5-in. Gun M1 and Carriages M1 and M1A1.

b. A Lubrication Order 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 an order, the using arms shall immediately requisition a replacement from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Michigan.

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

d. Service intervals specified on the order are for normal operating conditions. Reduce these intervals under extreme conditions such as excessively high or low temperatures, 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.

e. Lubricants are prescribed in the "KEY" in accordance with three temperature ranges, "above $+32^{\circ}\text{F}$," " $+32^{\circ}\text{F}$ to 0°F ," and "below 0°F ." The time to change grades of lubricants is determined by maintaining a close check on operation of the materiel during the approach to change-over periods. Sluggish action is an indication that lubricants are thickening and the signal to change to grades prescribed for the next lower temperature range. Ordinarily it will be necessary to change grades of lubricants *only when air temperatures are consistently in the next higher or lower range*, unless malfunctioning occurs sooner due to lubricants being too thin or too heavy.

47. DETAILED LUBRICATION INSTRUCTIONS.

a. **Lubrication Equipment.** Each piece of materiel is supplied with lubrication 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.

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

No. 77

WAR DEPARTMENT  **LUBRICATION GUIDE**
ORDNANCE DEPARTMENT

GUN, 4.5-in., M1; CARRIAGE, GUN, 4.5-in., M1, M1A1
HOWITZER, 155-mm, M1;
CARRIAGE, HOWITZER, 155-mm, M1, M1A1

SNL C-38 (4.5-in.); SNL C-39 (155-mm).

For detailed instructions, refer to TM 9-331.

Clean fittings before lubricating. Lubricate after washing.

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

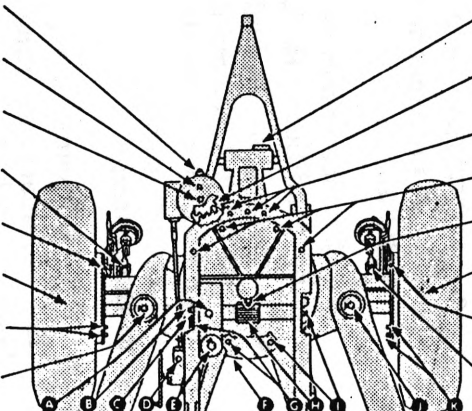
Requisition replacement Guide from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Michigan.

Reduce intervals under severe operating conditions.

NOTE— See Reverse Side for lubrication of GUN and CRADLE

Lubricant • Interval

M1	Traversing Worm Gear Case Level	M
M2	Traversing Worm Gear Case Fill	OE
M3	Traversing Worm Gear Bearing	OG M
N1	Slack Adjuster (M1A1 only) (Lubricate through plug hole)	OG 6M
N2	Brake Camshaft Bearing (M1A1 only) (See Note)	OG 6M
O1	Wheel Bearings	WB 6M
O2	Brake Anchor Pins (M1A1 only) (See Note)	OG 6M
P1	Trail Hinge Pin (To lubricate, remove plug)	OE D

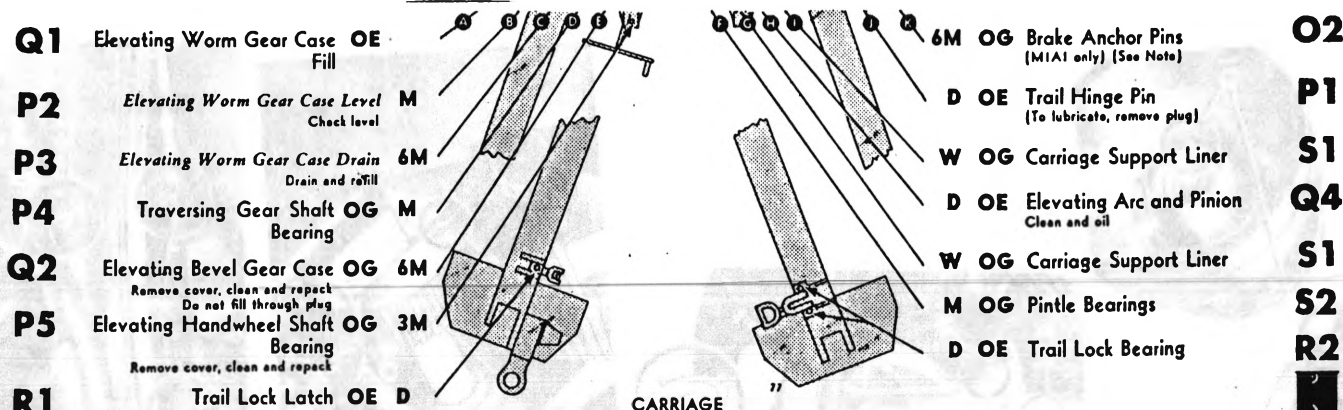


Interval • Lubricant

6M	OG	Firing Jack Pinion Case
		Clean rack and pinion and repack
D	OE	Traversing Arc and Pinion
		Clean and oil
W	OG	Traversing Clamp
W	OG	Carriage Support Liner
M	OG	Pintle Bearings
6M	WB	Wheel Bearings
		Remove, clean and repack
6M	OG	Brake Camshaft Bearing (M1A1 only) (See Note)
6M	OG	Slack Adjuster (M1A1 only) (Lubricate through plug hole)

Figure 83—Lubrication Order

Figure 83—Lubrication Order—(Contd.)



NOTES

BRAKE CAMSHAFT BEARINGS AND BRAKE ANCHOR PINS—Every 6 months, when wheels are removed for bearing lubrication, remove plug and insert fitting. Lubricate sparingly through fitting. Replace fitting.

OIL CAN POINTS—Daily, lubricate Handwheel Handles, Firing Jack Quick Action Handle, Jack Keys, Traveling Lock Wishbone Hinges, Traveling Lock Pins, Hand Brake Lever Latches, Hand Brake Lever Release Knob, Firing Jack Ratchets and other surfaces with OE.

LUBRICATED BY ORDNANCE PERSONNEL—Traversing Handwheel

Gear Case, Elevating Pinion Shaft Bearing (right side), Traversing Worm Gear Case, Traversing Mechanism Spur Gear Shaft Bearing, Pintle Thrust Bearings, Carriage Felt Seal, Carriage Support Liner (Refer to TM9-1331.)

Copy of this Guide will be carried on 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 TEMPERATURES			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	D—Daily W—Weekly M—Monthly
OG—GREASE, O.D.	OG No. 0	OG No. 00	OG No. 00	PS—OIL, lubricating, preservative, special	3M—3 months 6M—6 months

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

No. 77 [NOT TO BE REPRODUCED in whole or in part without permission of the Office of the Chief of Ordnance.] CHECK-CHART

14 Jan 44
Supersedes all previous issues.

GUN AND CARRIAGE

TM 9-328
47

RA PD 63283

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

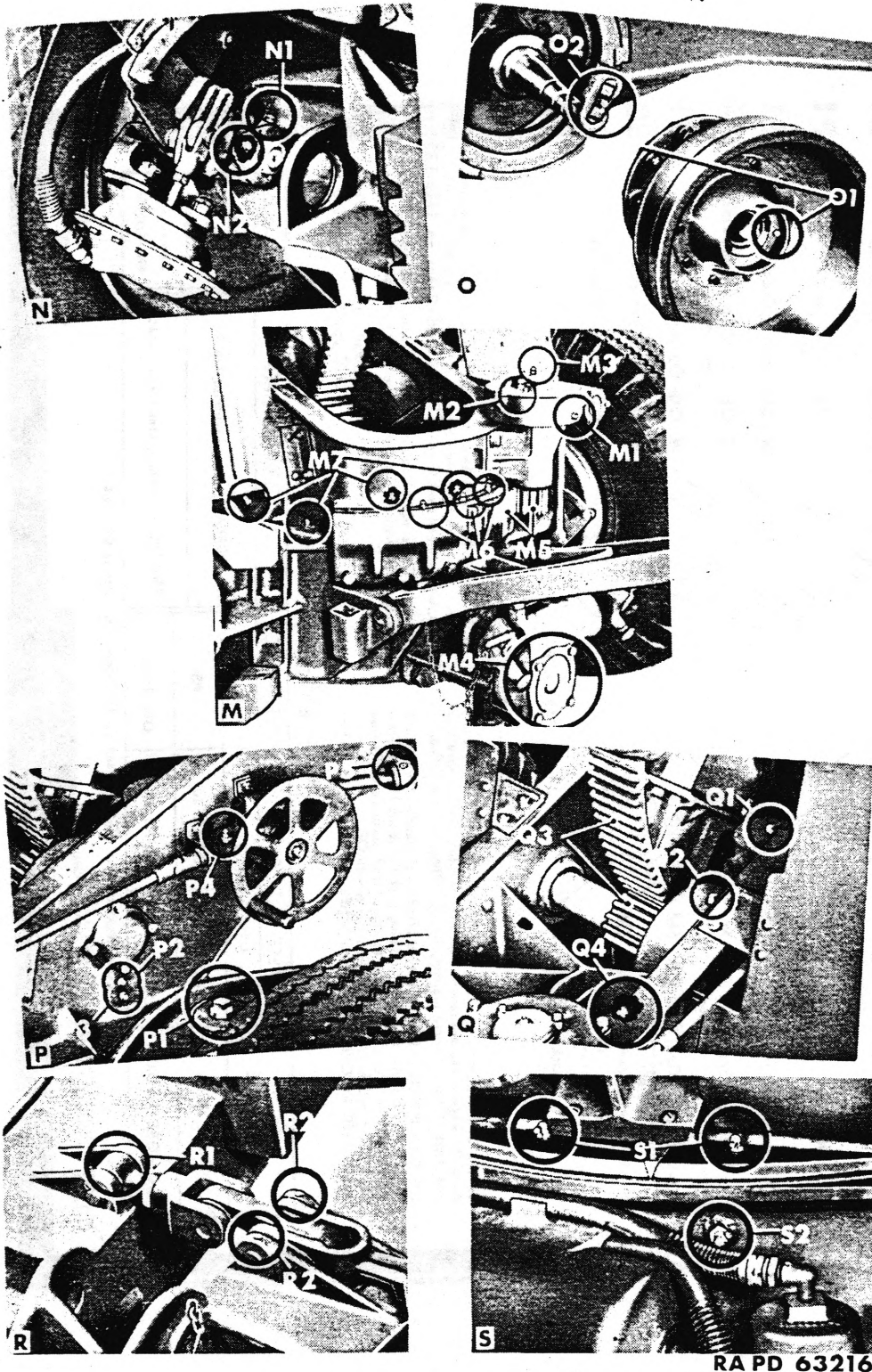


Figure 83A—Lubrication Points

GUN AND CARRIAGE

b. Points of Application.

(1) Lubrication fittings, grease cups, oilers, and oilholes are readily identifiable on the materiel by a red circle. Wipe lubricators and the surrounding surface clean before applying lubricants.

(2) Where relief valves are provided, apply new lubricant until the old lubricant is forced from the vent.

c. **Cleaning.** Use SOLVENT, dry-cleaning, or OIL, fuel, Diesel, to clean or wash all parts. Use of gasoline for this purpose is prohibited. After washing, dry all parts thoroughly before applying lubricant. Swab gun bore as well as breech and firing mechanism after removal of gas check pad from obturator spindle with a solution of $\frac{1}{2}$ pound of SODA ASH to each gallon of warm water or with a thick suds of issue soap and warm water.

d. **Lubrication Notes on Individual Units and Parts.** The following instructions supplement those notes on the Lubrication Order which pertain to lubrication and service of individual units and parts.

(1) **BRAKE CAMSHAFT BEARINGS AND BRAKE ANCHOR PINS.** Every 6 months, when wheels are removed for bearing lubrication, remove plug and insert fitting. Lubricate sparingly through fitting. Replace fitting.

(2) **BREECH AND FIRING MECHANISM.** To clean the breech daily and after firing, disassemble obturator from breech and firing mechanism and remove gas check pad from obturator spindle. Before reassembling, wipe surfaces of gas check pad clean (do not use solvent or bore cleaning solution) and apply a thin film of OIL, engine, SAE 30, above $+32^{\circ}\text{F}$, or SAE 10 below $+32^{\circ}\text{F}$. To insure easy breech operation and to avoid misfiring in cold weather, lubricate all parts (except gas check pad) with OIL, lubricating, preservative, special. To clean firing mechanism, remove, clean pin with bore cleaning solution, dry and lubricate with OIL, lubricating, preservative, special.

(3) **WHEEL BEARINGS.** Remove bearing cone assemblies from hub. Wash bearing, cones, spindle, and inside of hub, and dry thoroughly. Do not use compressed air. Wet the spindle and inside of hub and hub cap with GREASE, general purpose, No. 2, to a maximum thickness of one-sixteenth of an inch only, to retard rust. Lubricate bearings with the general purpose grease, 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.

(4) **OILCAN POINTS.** Daily, lubricate handwheel handles, firing jack quick-action handle, jack keys, traveling lock wishbone hinges,

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

traveling lock pins, hand brake lever latches, hand brake lever release knob, firing jack ratchets and other rubbing surfaces with OIL, engine, SAE 30, above +32°F; SAE 10 from +32°F to 0°F; or OIL, lubricating, preservative, special, below 0°F.

(5) POINTS TO BE SERVICED AND/OR LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL ONLY.

- (a) Cradle trunnion bearings.
- (b) Traversing handwheel gear case.
- (c) Elevating pinion (shaft) bearing (right side).
- (d) Traversing worm gear case.
- (e) Traversing mechanism pinion (spur gear shaft) bearing.
- (f) Pintle thrust bearings.
- (g) Carriage felt seal.
- (h) Carriage support liner.
- (i) Elevating handwheel shaft bearings and equilibrator rear end bearings.

e. Reports and Records.

- (1) Unsatisfactory performance of materiel will be reported to the Ordnance Officer responsible for maintenance.
- (2) A complete record of seasonal changes of lubricants and recoil oils will be kept in the Artillery Gun Book for the materiel.

Section VI**CARE AND PRESERVATION****48. GENERAL.**

a. It is of vital importance that all parts of the materiel be kept in proper condition in order that the weapon be ready for immediate service. Lubricating, cleaning, and preserving materiels provided with the gun and carriage will enable the personnel to keep the parts in proper working condition. This section of the manual prescribes the uses of these materiels.

b. Moving parts of the various mechanisms should be lubricated in the prescribed manner, and periodical examinations should be made to insure that the lubricant is reaching the parts for which it is intended, and to insure that the weapon as a whole is receiving the attention necessary for satisfactory operation.

GUN AND CARRIAGE

c. Dirt and grit, accumulated in traveling or from the blast of the piece in firing, settle on bearing surfaces, and in combination with the lubricant itself, form a cutting compound. Powder fouling attracts moisture and hastens the formation of rust. It is essential that all parts be cleaned at frequent intervals, depending upon use and service.

d. If rust should accumulate, its removal from bearing surfaces requires special care in order that clearances shall not be unduly increased. CLOTH, crocus, should be used for this purpose. The use of coarse abrasives is strictly forbidden.

e. In disassembly, assembly, or inspection, extreme care must be exercised to prevent dust, dirt, or other foreign matter from entering the mechanisms.

f. When materiel is not in use, the proper covers must be used.

g. When the weapon is to be unused for a considerable time, the bore, breech mechanism, and bright unpainted surfaces should be cleaned with SOLVENT, dry-cleaning, and the surfaces coated with COMPOUND, rust-preventive.

h. Should an enemy shell burst near the weapon, it must be determined that the weapon has not been damaged to a dangerous degree before the next round is fired. Damage of a serious nature should be reported to the Ordnance officer.

49. CLEANING, PRESERVING, AND LUBRICATING MATERIALS.

a. **Cleaners and Abrasives.** The following cleaners and abrasives are for use with this materiel. They are extracted from SNL K-1 and requisitioned as required. See TM 9-850 for detailed information as to usage.

BURLAP, jute, 8 oz., 40-inch wide	PAPER, lens, tissue
CLOTH, abrasive, aluminum oxide, 3/0—120 grit	SODA ASH, type 1
CLOTH, abrasive, aluminum oxide, 5/0—180 grit	SOLVENT, dry-cleaning
CLOTH, crocus	SPONGE, natural or cellulose
CLOTH, wiping, cotton mixed, sterilized	WASTE, cotton, white

b. **Lubricating and Preserving Materials.** The following lubricating and preserving materials are for use with this materiel. They

TM 9-328

49-51

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

are extracted from SNL K-1 and requisitioned as required. See TM 9-850 for detailed information as to usage.

COMPOUND, rust-preventive, OIL, engine, SAE 10

light

OIL, engine, SAE 30

GREASE, general purpose,

OIL, lubricating, for aircraft instruments and machine guns

No. 2

GREASE, O.D., No. 0

OIL, neat's-foot

GREASE, O.D., No. 00

OIL, recoil, heavy

c. **Paints and Related Materials.** The following paints and related materials are required for use with this materiel. See SNL K-1 and TM 9-850 for detailed information.

ENAMEL, synthetic, olive drab, PRIMER, synthetic, rust-inhibitive

THINNER, for synthetic enamels

d. **Miscellaneous Materials and Tools.** The following miscellaneous materials and tools are required for use with this materiel. See SNL K-1 and TM 9-850 for detailed information.

BRUSH, paint, metalbound, flat, PALM, sailmaker's

No 1, (3-in.)

TWINE, jute, 1,800 ft. per pound,

CHALK, railroad, blue, 1 x 4 in.

single ply

CHALK, railroad, white, 1x4 in.

NEEDLES, sacking, 4½-in.

50. ORGANIZATION SPARE PARTS AND ACCESSORIES.

a. All organization spare parts, tools, and accessories should be kept in an orderly manner so that they can be quickly located when required. They should be protected from loss or damage by being kept in their proper chests. Those items susceptible to rust and corrosion must be cleaned thoroughly at regular intervals and coated with a film of oil. Parts supplied in protective containers should be kept in the containers until required.

b. The sets of organization spare parts and accessories for the gun and carriage should be maintained as completely as possible at all times. The sets should be checked with the lists in the Standard Nomenclature Lists (chap. 9), and all used parts, and all missing parts, tools, and accessories should be replaced immediately.

51. CLEANING AFTER FIRING.

a. **Bore.** This procedure is to be followed immediately after firing and while the gun is still warm. It is to be repeated at the end of 24 hours and again at the end of 48 hours. The purpose of the second and third washing, drying, and oiling operations is to remove the effects of "sweating," a chemical reaction of the burned powder which cannot be removed with the initial procedure.

GUN AND CARRIAGE

(1) **CLEAN BORE.** Assemble the cleaning staff 41-S-4658-120 and attach the cleaning and unloading Rammer M6 C91880. Wrap the head with pieces of burlap soaked in a solution made by dissolving $\frac{1}{2}$ pound of SODA ASH, or 1 pound of sal soda, in a gallon of water. With four or five men on the staff, work the rammer through the bore, using a pushing and pulling action. A man posted at the muzzle of the gun can indicate by movements of his hands the progress of the rammer in the bore and prevent its slipping from the muzzle of the gun.

CAUTION: Do not use SOLVENT, dry-cleaning. In the absence of SODA ASH or SAL SODA, a solution of hot water and issue soap may be used, or hot water may be used alone. SOLVENT, dry-cleaning, should not be used because the corrosive salts from the primer composition, which cause rust, are not readily dissolved by petroleum products; they are readily dissolved by water-base solutions.

(2) **CLEAN CHAMBER.** Use the cleaning and unloading Rammer M6 on a single section of the staff. Wrap the rammer with burlap soaked in the solution. Use another section of the staff or an axe handle as a lever to hold the cleaning element against the sides of the chamber. Pressure must be applied to clean thoroughly.

(3) **DRY BORE AND CHAMBER.** Follow the procedure given for cleaning, using the same accessories and method, but substituting dry burlap for burlap soaked in the solution.

(4) **OIL BORE.** Assemble the Bore Brush M22 (38-B-992-50) to the staff. Place the brush over a bucket to catch the oil which drips from the brush, and apply oil to the brush, using a paint brush for this purpose. Use OIL, engine, lubricating (seasonal grade). Apply a light coating of oil to the bore by working the brush through the bore.

(5) **OIL CHAMBER.** The chamber and threads of the breech-ring may be thoroughly coated with oil by using a paint brush nailed at right angles to the end of a 5-foot, round-cornered piece of wood. The long handle will permit reaching all parts of the breech recess and doing a good job with a minimum of waste.

b. Breech Mechanism. After firing, the breech mechanism should be disassembled (par. 66), cleaned, oiled, and assembled. Any malfunction or deformation of parts should be reported to Ordnance maintenance personnel for correction. Particular care should be given the cleaning of the primer seat and the vent through the obturator spindle. During firing, residue works its way back through the venthole in the spindle to the primer seat. If this is not removed, the primer will seat imperfectly. If the vent is not free and clear, the flash from the primer cannot properly ignite the charge.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

c. **Firing Mechanism M1.** After firing, the firing mechanism should be disassembled (par. 64), cleaned, oiled, and assembled. Special care must be exercised to keep this mechanism well oiled and free from rust, powder stains, and dirt.

52. GUN.

a. General.

(1) It is known that the wear on cannon does not depend entirely upon the number of rounds fired, but very much upon the care taken to allow cooling between rounds and upon a thorough cleaning and oiling schedule followed through in a consistent manner. It is essential that every projectile be cleaned thoroughly before it is inserted in the weapon.

CAUTION: Copper fouling must not be removed under any circumstances.

(2) The bore should be cleaned before firing, whenever practicable. It is important that, whenever possible, the gunner inspect the bore to make certain that it does not contain any extraneous particles that might cause damage to the weapon.

(3) The covers must be kept in place when the gun is not in action.

(4) The surfaces of the leveling plates should be protected from injury. Any necessary repairs will be made by Ordnance maintenance personnel.

(5) It is important that any cutting or abrasions of the threads or bearing surfaces of the breechblock or breech ring be reported to Ordnance maintenance personnel for correction.

(6) As the accuracy life of cannon is decreased by a fast rate of fire and the attendant heat, the piece should be washed, oiled, and allowed to cool as often as it is practicable.

b. Regular Cleaning Procedure. This cleaning procedure is to be followed at intervals specified by the officer in charge. The interval will be dependent upon atmospheric, traveling, or other conditions.

(1) **CLEAN BORE AND CHAMBER.** Swab the bore and chamber in the manner described in paragraph 51 a (1) and (2), using SOLVENT, dry-cleaning (which readily removes oil and dirt) in place of SODA ASH or sal soda solutions.

(2) **DRY BORE AND CHAMBER.** Dry the bore and chamber in the manner described in paragraph 51 a (3).

(3) **OIL BORE AND CHAMBER.** Oil the bore and chamber in the manner described in paragraph 51 a (4) and (5).

GUN AND CARRIAGE

c. **Inactivity.** If the weapon is to be unused for a considerable length of time, the bore should be given a coating of **COMPOUND** rust-preventive, heavy.

d. **Breech Mechanism.**

(1) At frequent intervals, when the gun is not being fired, the breech and firing mechanisms will be disassembled, cleaned, and oiled. These intervals will be specified by the officer in charge, and their frequency will be dependent upon atmospheric and other conditions.

(2) When the gun is not in use, the over-all or breech cover will be in place to prevent dust and grit from getting into the recesses of the breech mechanism and impeding its easy operation.

(3) If the breechblock does not rotate smoothly, or if the mechanism requires greater effort than usual to operate, this should be considered sufficient warning to warrant disassembly of the breech mechanism (par. 66), to determine the cause. If corrective measures are beyond the scope of the using force, the matter should be brought to the attention of Ordnance maintenance personnel.

e. **Gas Check Seat.** Extreme care must be taken to prevent injury to the gas check seat as this affects the seating of the obturator spindle gas check pad front and rear split rings and is likely to cause leakage of gas and burning of the gas check pad. A leak may result in serious erosion. Because the gas check seat is susceptible to moisture, rusting is likely to occur. The seat and rings, therefore, should be well protected by oil at all times, and by **COMPOUND**, rust-preventive, when the gun is not in use.

NOTE: The gas check seat is that portion of the rear of the powder chamber on which the split rings and the gas check pad bear when the breech is in sealed position and the gun is fired.

f. **Gas Check Pad.** The gas check pad C70683 must be kept in a condition that will permit its being compressed without injury. It should be oiled frequently with **OIL**, engine, **SAE 10**, and the oil should be rubbed in well. A pad of the proper resiliency will yield slightly under heavy pressure from the thumbs.

g. **Firing Mechanism M1.**

(1) The parts of the Firing Mechanism M1 require the same attention as those of the breech mechanism. Therefore, frequent disassembly for the purpose of cleaning and oiling is required. The intervals will be specified by the officer in charge, and their frequency will be dependent upon atmospheric and other conditions.

(2) Fouling of the firing pin, or the use of a heavier oil than is authorized will cause absorption of the energy of the firing pin spring and percussion hammer, and may result in misfire. This is especially true in cold weather (par. 102 i).

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

(3) Keep the primer seat and the vent in the obturator spindle clean by frequent use of the vent cleaning tool 41-T-3081-120 (fig. 71), and primer seat cleaning reamer 41-R-501-80 (fig. 72). The slightest accumulation of fouling in the primer seat will cause difficulty in inserting and extracting the primer.

(4) Except when the weapon is loaded and is being fired, the Firing Mechanism M1 will be removed from the weapon. When not in use, it will be kept in the protected place reserved for its stowage. The percussion hammer will be pinned in the upright position to prevent unnecessary movement. The lanyard will be detached and the hammer will not be unnecessarily brought in contact with the firing pin or the firing mechanism housing. Bringing the hammer into contact with the housing will result in damage to the rear face of the housing.

53. RECOIL MECHANISM.

a. General.

(1) The replenisher and the recuperator cylinder must contain the proper oil reserves at all times or damage to the materiel will result when the gun is fired. The oil reserve in the replenisher supplies any needed recoil oil to the recoil cylinder during the recoil of the gun. It also compensates for expansion and contraction of the recoil oil due to heat and cold. The oil reserve in the recuperator cylinder separates the floating piston from the counterrecoil regulator.

(2) The compressed nitrogen in the recuperator cylinder will put pressure on the oil in the counterrecoil system only so long as there is oil between the regulator and the floating piston. In the event that these pieces come in contact, further movement of the floating piston is prevented and the pressure on the oil drops to zero.

(3) The recoil mechanism should be examined regularly for leakage of oil. There is no cause for alarm should the oil drip rapidly, or even run in a stream, from the rear of the replenisher when the gun is elevated, provided that the weapon has been at zero elevation for some time. This condition may exist in a normal replenisher. A leak at any packing that does not exceed 3 drops per minute is not considered serious; if the loss of oil is greater, report the matter to the Ordnance maintenance personnel.

(4) Keep the airholes in the replenisher open. The two airholes are small continuations of the teat wrench holes in the replenisher piston guide and provide for the circulation of air at the rear of the replenisher piston. Use a wire for cleaning (wood may splinter and stop up the hole).

GUN AND CARRIAGE

(5) Use a screwdriver to remove and replace the replenisher oil filling valve plug. Use a ½-inch socket wrench (hexagonal) to remove the recuperator filling plug A18495 to avoid injury of the head. Be careful that the gasket beneath the plug is not lost. Examine the threads of the plug before replacing it. If the threads are in good condition, screw the plug up on the gasket, but do not force it excessively.

b. Recoil Oil.

(1) OIL, recoil, heavy, is used in the recoil mechanism. Care must be taken not to use recoil oil other than that prescribed. Water and other foreign matter must not be introduced into recoil mechanisms that use recoil oil.

(2) Recoil oil must not be put into any container not marked with the name of the oil, nor left in open containers, nor be subjected to excessive heat, nor mixed with any other type oil. The transfer of recoil oil to a container not marked with the name of the oil may result in the wrong oil getting into the recoil mechanism, or in the use of recoil oil for lubricating purposes.

(3) When putting recoil oil in the system, it should be filtered through a piece of clean cloth as well as through the wire strainer of the filling funnel. Every precaution must be taken to prevent the introduction of water or grit into the mechanism, either in the oil or through failure to clean thoroughly the connections and servicing equipment.

(4) Exposure of recoil oil in an open can may result in the accumulation of moisture. Condensation in a container partly filled with oil, or the pouring of oil from one container to another which has moisture on its inner walls, results in moisture being carried along with the oil into the recoil mechanism.

(5) If there is a possibility that recoil oil may contain water, it should be tested by one of these methods. Fill a clean glass container of pint capacity with the recoil oil. Permit the oil to settle. The water, being heavier than the oil, will sink to the bottom, if present. With the container slightly tilted, drops or bubbles will form in the lower portion. Invert the container and hold it to the light. Drops or bubbles of water, if present, may be seen slowly sinking in the oil. If the oil has a cloudy appearance, the cloudiness may be ascribed to particles of water.

(6) Another test for water is to heat the oil to 212 F (boiling point of water) in a shallow pan. Water in the oil will appear on the surface as minute bubbles. This test will disclose water not determinable by the settling test. Should either test show water, the oil on hand should be turned in.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

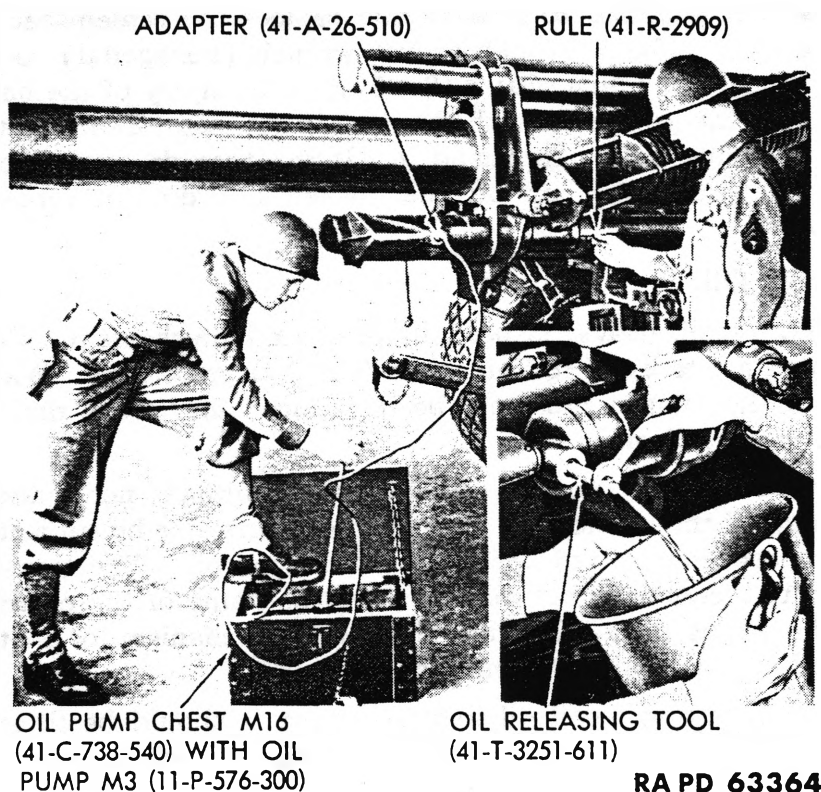


Figure 84—Establishing Replenisher Oil Reserve

c. To Test Operation of Replenisher Piston.

(1) Remove the replenisher piston guide plug from the rear of the replenisher and insert a rule 41-R-2909 through the opening of the replenisher piston guide and against the rear end of the piston extension. Then release oil from the replenisher by screwing the oil release tool 41-T-3251-611 into the filling valve located on the front of the replenisher housing (insert, fig. 84). If movement of the replenisher piston takes place, the replenisher piston is functioning.

(2) If the replenisher piston does not move, insert a block of hardwood through the opening in the piston guide against the end of the piston and tap with a hammer. When the replenisher has not been exercised, the piston extension may become rusted in the guide. Any rust on the extension should be removed.

d. To Establish Replenisher Oil Reserve.

(1) The position of the replenisher piston extension in the piston guide governs the filling of the replenisher (par. 29 b). Before filling the replenisher, test the operation of the replenisher piston in the manner described in the preceding subparagraph.

GUN AND CARRIAGE

(2) Unscrew the replenisher oil filling valve plug from the filling valve on the front left side of the replenisher, and screw the adapter 41-A-26-510 on the filling tube loosely into the filling hole. Purge the tube and tighten the adapter without the use of a wrench except for the final tightening. Extreme care must be taken to prevent injury to the threads of the filling hole as any damage may put the entire weapon out of commission until repaired.

NOTE: Purging means removing all air from the filling device before forcing oil into the recoil mechanism. This is accomplished by only partially screwing home the adapter to the mechanism, operating the filling device, and letting the air in the filling device escape until no more bubbles appear at the connection, then tightening the adapter fully.

(3) Work the pump (fig. 84) until the rear end of the replenisher piston extension is $5\frac{1}{2}$ inches (140-mm) from the rear face of the replenisher. Remove the filling tube adapter and replace the replenisher oil filling valve plug.

e. To Exercise Replenisher Piston.

(1) The replenisher may be exercised by pumping oil into the replenisher until the rear end of the piston extension projects to the rear of the replenisher. Any visible rust should be polished off the extension. Enough oil should then be withdrawn by means of the oil release tool to bring the piston back to normal position.

(2) Guns not being fired should be exercised in the manner prescribed at least once a month.

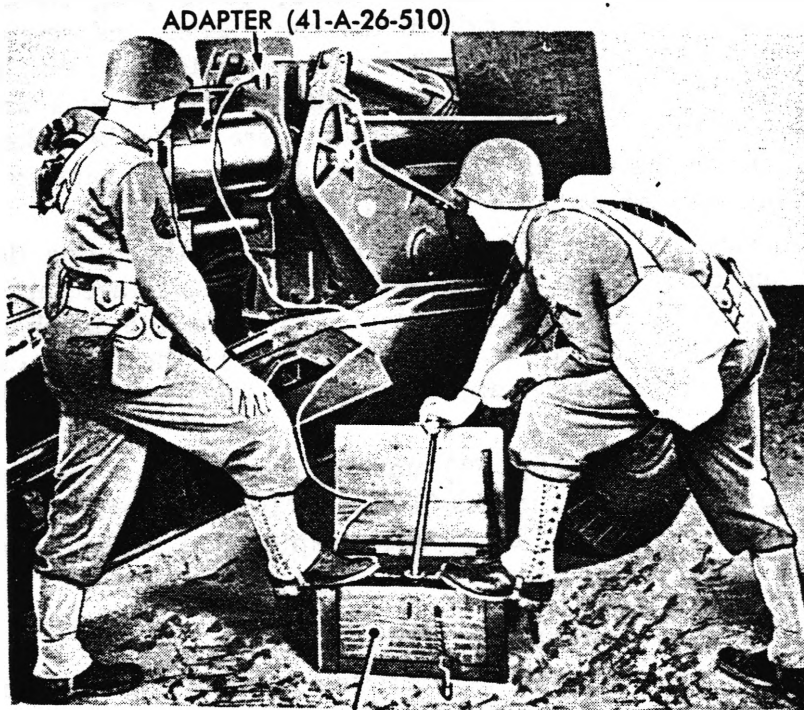
f. To Establish Recuperator Oil Reserve.

(1) The position of the oil index (par. 29 c) indicates the oil reserve in the recuperator cylinder. When the counterrecoil of the gun, or the position of the oil index, indicates that there is too small a quantity of oil in the recuperator, it will be necessary to drain off the reserve oil before refilling. This is accomplished by removing the filling plug A18495 and inserting the oil release tool 41-T-3251-611 in the recuperator oil index housing at the rear end of the recuperator cylinder.

(2) The reserve oil will spurt out in a stream and suddenly drop to a trickle. The amount of reserve oil which will escape will be approximately 1 pint. At this point, the flow of oil should be stopped by unscrewing the oil release tool. It will be noted that the oil index has moved out of sight before all of the reserve oil has been released. If the oil index has not moved, tap it gently with a small piece of wood as it may be frozen.

(3) To replenish the reserve, clean the adapter of the coil of the Oil Pump M3, screw the adapter loosely in the filling valve, purge

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**



OIL PUMP CHEST M16 (41-C-738-540)
WITH OIL PUMP M3 (11-P-576-300)

RA PD 63365

Figure 85—Establishing Recuperator Oil Reserve

the pump, tubing, and connection, and tighten the adapter in the filling valve.

(4) Start working the oil pump while closely watching the oil index (fig. 85). As soon as the oil index starts to move outwardly, begin counting the strokes of the pump handle. Count the number of strokes required to bring the oil index to its farthest outward position. Multiply the number of strokes required to accomplish this result by two. Add this number of strokes to the oil reserve. This will constitute a full reserve. Detach the adapter and replace the filling plug.

54. CARRIAGE.

a. General.

(1) The care and preservation of the carriage in service requires proper cleaning, strict observance of the lubrication program, tightening of loosened parts, and repair or replacement of broken parts. When traveling, it calls for proper attachment of the traveling lock, secure locking of the trail lock, firing jack, and accessories in their

GUN AND CARRIAGE

positions on the carriage, the full protective use of the covers, the proper adjustment of brakes, and the correct inflation of tires.

(2) All bearing surfaces, screw threads, and exterior parts must be clean and as free from dirt as possible. Special attention should be given exposed teeth and bearing surfaces. Cotter pins must be properly spread. Bolts, nuts, and screws must be tight and locked to prevent their coming loose. The best available tools should be used.

(3) The carriage should receive a general inspection periodically.

(4) When the carriage is stored, or is not to be used for a considerable length of time, all bright and unpainted surfaces must be protected with COMPOUND, rust-preventive. They should first be cleaned with SOLVENT, dry-cleaning.

(5) Vigilance must be exercised to detect any cutting or abrasion of the teeth of the pinions and arcs of the elevating and traversing mechanisms, or on the rack plunger and pinion of the firing jack. Any deformation of this nature should be reported to the Ordnance maintenance personnel for correction. Rust must not be permitted to accumulate on these parts.

(6) There is a drain hole in each of the pockets of the top carriage. These must be kept open to prevent any accumulation of water which would cause rust.

(7) All lubricating fittings should be kept clean and, if necessary, a piece of wire may be used in cleaning out oil passages. Do not use a sliver of wood as it may splinter and clog the passage. Exercise care so as not to damage the interior of the fitting. Do not paint oil fittings and be particularly careful not to get paint into their openings. A smear of heavy grease on the surfaces of fittings exposed to the weather will retard the formation of rust.

b. Elevating and Traversing Mechanisms.

(1) By turning and stopping the handwheels, check the elevating and traversing mechanisms for backlash. Backlash amounting to one-sixth of a turn of the handwheel should be reported to Ordnance maintenance personnel for correction. Backlash is an indication of wear or improper adjustment and will result in inaccuracies in firing and excessive muzzle whip.

(2) The teeth of the elevating and traversing arcs and pinions require little lubrication, but as a protection against rust, they must be covered with a thin coating of oil. Under normal conditions, dust and grit will adhere to this oily film and cause wear; consequently, the teeth must be thoroughly cleaned and relubricated daily.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

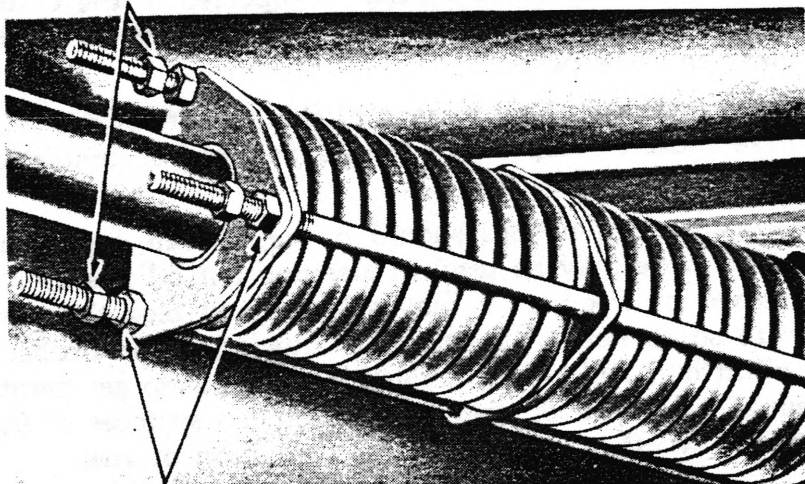
(3) If a considerable amount of dust or sand is present, the teeth should be wiped dry before the gun is operated, situation permitting, and then be relubricated after the action is over. With the surfaces dry, there is less wear than when they are coated with lubricant contaminated with dust or sand.

c. Equilibrators.

(1) To determine the proper functioning of the equilibrators on the 4.5-inch Gun carriages M1 and M1A1, elevate and depress the weapon throughout its full movement. If the tube can be elevated and depressed with approximately the same handwheel effort at all ranges of elevation or depression, the adjustment of the equilibrators is satisfactory.

(2) Equilibrators should be properly adjusted at all times. Adjust the tension in the equilibrators in the following manner:

JAM NUTS—BACKED OFF



ADJUSTING NUTS

RA PD 63286

Figure 86—Adjusting Equilibrators

(a) Insert a dummy round and enough additional weight into the powder chamber to approximate the combined weight of projectile and powder charge, so that when adjustment of the equilibrators has been effected, the effort to elevate and depress the tube will be same as when the weapon is in service.

(b) Loosen the three jam nuts BBDX2C on the rear end of the equilibrators rods B167187 (fig. 86) and back them off a short distance. Then turn all three adjusting nuts BBBX2C on each equilibrators an equal amount in the direction desired.

GUN AND CARRIAGE

(c) ~~If the tube is difficult to elevate, the adjusting nuts should~~ be tightened on the rod to increase the spring tension. If the tube is difficult to depress, the adjusting nuts should be loosened to reduce the spring tension in the equilibrator.

(d) Be sure that each equilibrator is extending approximately the same force on the cradle and tube. To avoid having unequal tension on the equilibrators, the adjusting nuts for each equilibrator should be in about the same position.

(e) Tighten all jam nuts after the adjustment is completed.

(3) Under no circumstances will the adjusting nuts be removed from the rods by anyone other than authorized Ordnance maintenance personnel. The springs are under a very great compression, and an unauthorized disassembly may cause injury to personnel.

d. Firing Jack.

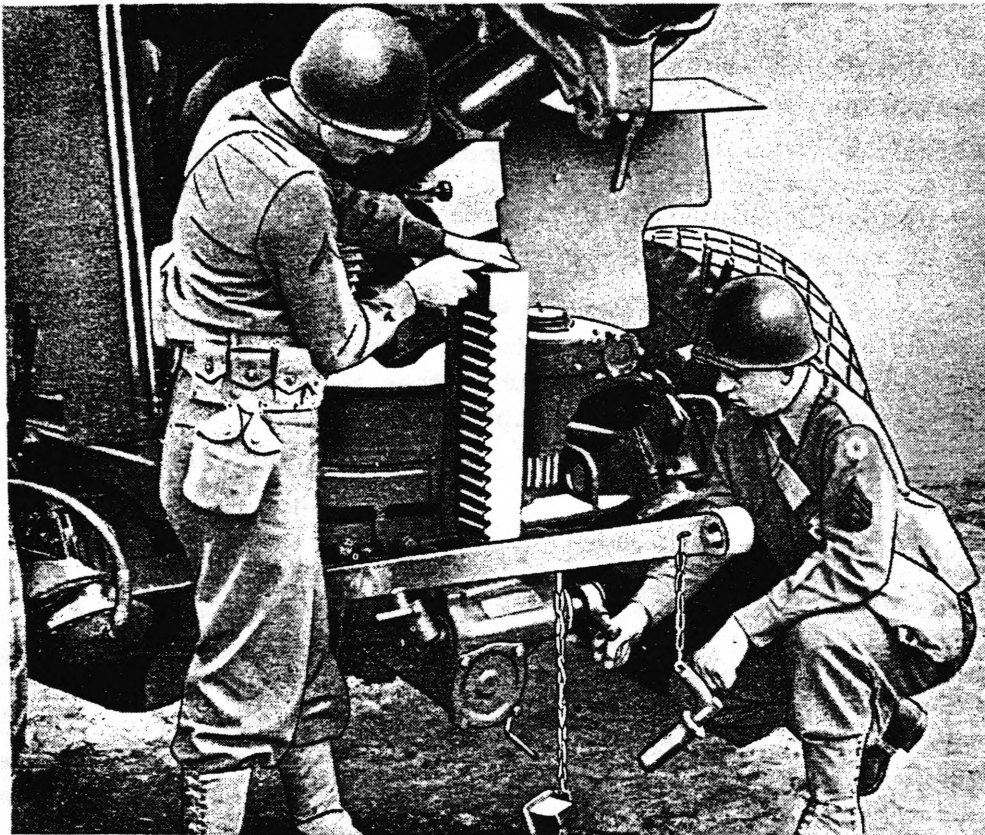
(1) The firing jack is protected from dirt, moisture, and other foreign matter by the firing jack housing bottom cover which closes the bottom opening in the housing and the firing jack cover with Clamp M528 which fits over the upper end of the housing and the rack plunger. The bottom cover should be in place except when the firing jack is in use; the firing jack cover should be in place at all times except when the firing jack is being cleaned or lubricated.

(2) The firing jack rack plunger should be kept oiled at all times to protect it against rust. The rack plunger and the pinion on the firing jack pinion shaft which actuates the rack plunger should be cleaned often to insure the effective operation of these parts.

(3) To clean the rack plunger and pinion, remove the firing jack cover. Release the rack plunger from traveling position by removing the firing jack travel locking lever and lowering the rack plunger sufficiently to remove the firing jack housing bottom cover. Then raise the rack plunger to the limit of its upward movement, in which position the pinion no longer will engage the teeth on the rack plunger. Lift the rack plunger from the firing jack housing (fig. 87). Clean and lubricate the rack plunger.

(4) Reach downward through the opening in the top of the firing jack housing and wipe the teeth of the pinion, turning the firing jack ratchet case handles to expose the teeth one after another. Lubricate the pinion.

(5) The rack plunger is replaced simply by holding it in position in the upper opening of the firing jack housing and rotating the firing jack ratchet case handles until the teeth have meshed and the lower end of the rack plunger has been exposed below the bottom of the housing. Attach the firing jack housing bottom cover, raise the rack

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

RA PD 63287

Figure 87—Removing Firing Jack Rack Plunger

plunger to traveling position, and insert and secure the firing jack travel locking lever. Replace the firing jack cover and clamp.

e. **Wheel Bearings.** Wheel bearings should be kept properly adjusted and lubricated at all times. For lubrication of wheel bearings, see paragraph 47 d (3). For adjustment of wheel bearings, see paragraph 70 e.

f. **Tires and Tubes.** The pressure to be maintained in the tires is 95 pounds per square inch. To obtain maximum mileage, the air pressure in the tires should be checked prior to operations and thereafter left alone unless there is a loss of air pressure. Bleeding of air from the tires results in an increase in the flexing of the tire side walls which increases the danger of failure. Remove all foreign substances from the rubber, being especially careful to keep tires as free from oil and grease as possible. Oil and grease have a deteriorating effect upon rubber.

g. **Air Brakes.**

(1) Frequent tests should be made to insure the proper operation of the air brake system. With the carriage air brake system

GUN AND CARRIAGE

coupled to that of the prime mover and with the air pressure registering 70 pounds per square inch, test the operation of the brakes to determine whether all parts function properly when the brakes are applied from the prime mover.

(2) **TO TEST FOR AIR LEAKAGE.** Test the entire brake system periodically for air leaks. This is done by applying soapsuds to all points where a leak might occur. Any leak causing a soap bubble of 2-inch diameter in five seconds is considered serious and must be remedied immediately. Follow this procedure:

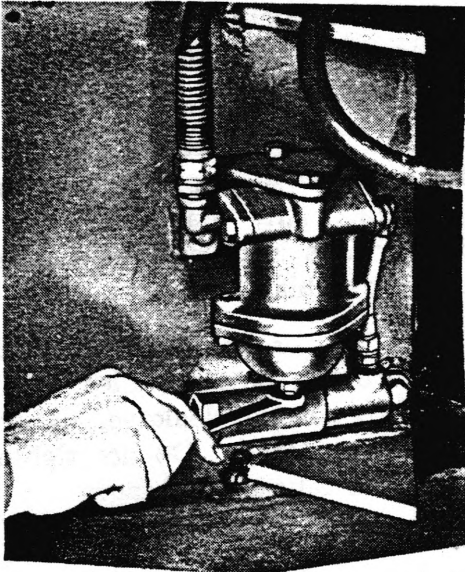
(a) *Brake Diaphragms.* With the brakes applied, coat the edges of the fabric diaphragm and around the bolt holes with soapsuds. No leakage is permissible. In case of leakage, tighten the bolts uniformly until the leakage is eliminated. Do not tighten the bolts in a manner that will distort the fabric diaphragm.

(b) *Relay-emergency Valve.* Test the relay portion of the valve for leakage by charging the emergency reserve tank and applying soapsuds to the exhaust port. If there is any leakage with the brakes released, the supply valve is not seating properly; if air leaks with the brakes applied, the upper diaphragm is fractured or is not seating properly. With the emergency reserve tank charged, disconnect the emergency air line between the prime mover and the carriage—the air brakes on the carriage should apply automatically. Apply soapsuds to the emergency air line or coupling to determine if the lower diaphragm is seating properly. If air leaks at the exhaust port, the emergency valve is not seating properly. If any of these tests indicate a leaking relay-emergency valve, notify Ordnance maintenance personnel.

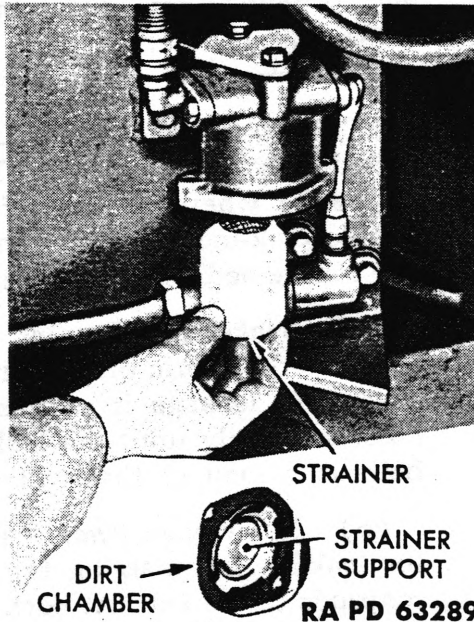
(c) *Air Filters, Air Lines, and Connections.* With the system under pressure, test the junctures of the air filters and the tank and all air line connections with soapsuds for leakage. Tighten any loose connections. Replace any damaged part or length of air line. All connections must be sealed properly against leakage to insure effective braking and to permit the functioning of the automatic emergency brake application in case of a break-in-two between prime mover and carriage.

(3) **TO DRAIN WATER FROM EMERGENCY RESERVE TANK AND AIR FILTERS.** Drain the emergency reserve tank and air filters each day to expel the accumulated water. This is done by opening the drain cock at the left near the bottom of the tank (on carriages so modified, this cock is at the right side of the tank behind the guard), and by removing the drain plugs from the bottoms of the air filters (fig. 88). This is especially important when the materiel is used in cold weather. Then these operations should be performed more frequently to prevent

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 63288



RA PD 63289

Figure 88—Draining Moisture From Air Filter **Figure 89—Removing Strainer From Air Filter**

the accumulation of ice. These units should be drained of accumulated condensation every 8 hours of travel to insure satisfactory operation.

(4) TO CLEAN AIR FILTERS.

(a) In order to function properly, the strainers in the air filters should not be clogged with dirt to the point where they restrict the free flow of air. They should be checked at frequent intervals and the strainers should be cleaned or replaced where necessary.

NOTE: Air filters of two different designs are used on different carriages. While they work on the same principle, they differ slightly in appearance and construction. The dirt chamber of one is connected to the body by two screws; the chamber of the other is connected to the body by four bolts; both employ the same strainer and strainer support.

(b) To remove the strainer for inspection, cleaning, or replacement, remove the screws (bolts) connecting the dirt chamber to the body of the air filter. Draw the strainer from the body if it has not dropped out (fig. 89). Wash the strainer in **SOLVENT**, dry-cleaning. Remove the strainer support from the dirt chamber and clean the chamber. Reassemble.

(5) **TO TEST AUTOMATIC EMERGENCY BRAKING FEATURE.** The emergency portion of the emergency-relay valve, which applies the

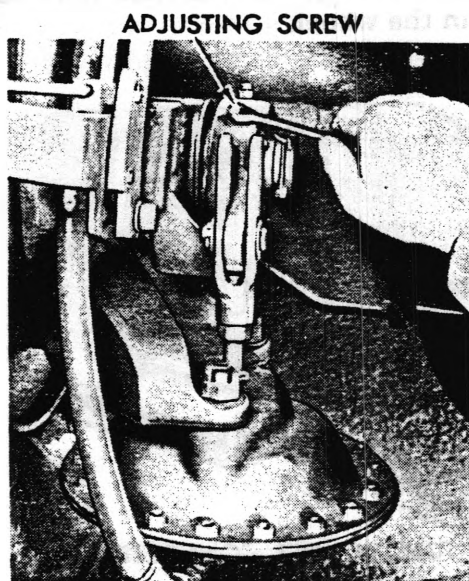
GUN AND CARRIAGE

brakes automatically in case of a break-in-two between the prime mover and the carriage, should be tested daily when traveling to insure proper functioning in case of an emergency. Be sure that there is sufficient pressure in the emergency reserve tank. Disconnect the emergency air hose coupling between the prime mover and the carriage. The brakes should apply automatically.

CAUTION: Do not move vehicles with less than 70 pounds of air pressure in the air tanks.

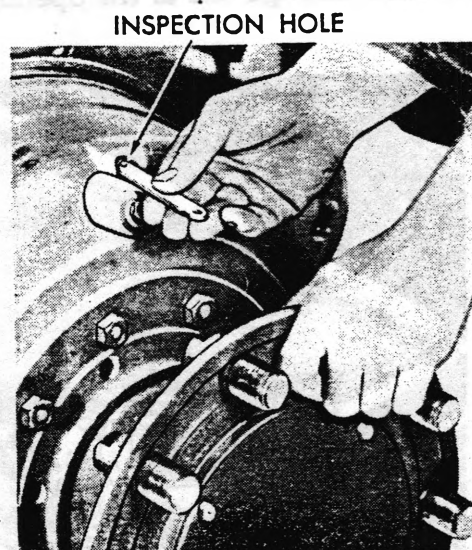
(6) TO ADJUST AIR BRAKES.

(a) It is essential that the travel of the brake diaphragm push rods be kept as short as possible because excessive travel shortens the service life of the fabric diaphragm, wastes air, and reduces the effectiveness of braking. It is also important that there be a minimum of drag of the brake lining against the drums when the brakes are released.



RA PD 63290

Figure 90—Adjusting Air Brakes



RA PD 63291

Figure 91—Checking Brake Lining

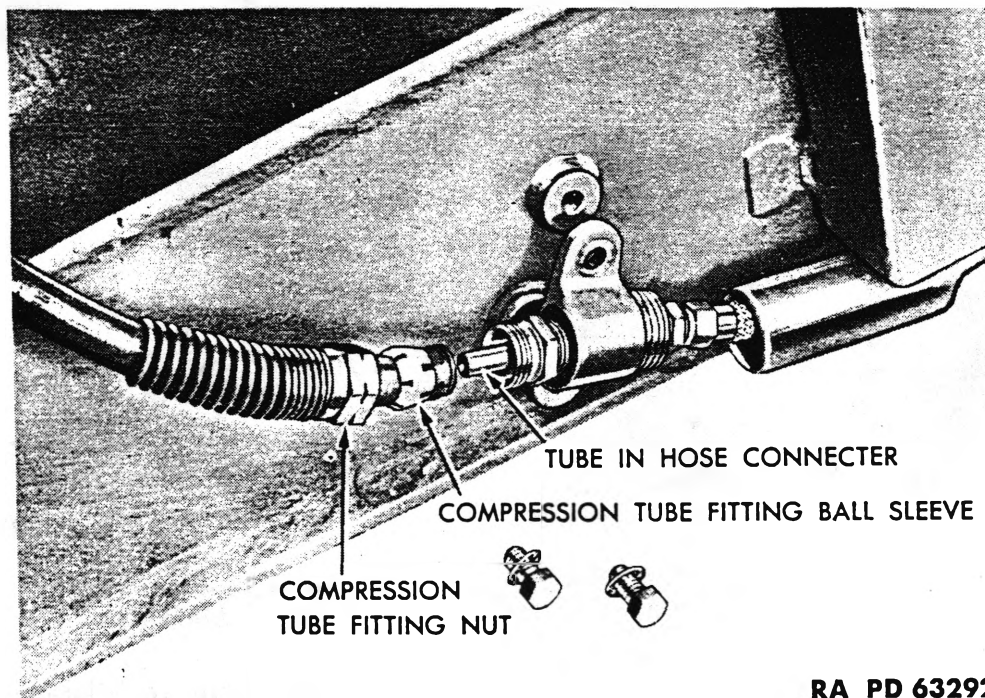
(b) Check the travel of the push rods by measuring the distance each push rod extends from its brake diaphragm with the brakes released and with the brakes applied. This travel should be kept at a minimum which is approximately $\frac{3}{4}$ -inch and must not exceed a maximum which is $1\frac{3}{4}$ inches. If the push rod travel is in excess of 1 inch, an adjustment should be made.

(c) Adjustment is made by means of the air brake slack adjusters. To adjust the brakes, lift the carriage with the firing jack until the

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

wheels are free of the ground. Release the brakes. Rotate the wheel and at the same time turn the adjusting screw (fig. 90), until the brake linings engage the brake drum and stop the wheel from turning. Then back off the adjusting screw until the wheel turns freely. Adjust both brakes in the same manner. Keep the slack adjusters lubricated, including the guides for the slack adjusters on the push rod yokes.

(d) To insure that there will be no drag when the brakes are released, there should be a clearance of 0.025 inch to 0.050 inch between the brake lining and brake drum. This clearance may be checked by inserting a feeler or thickness gage through the inspection hole in the drum and rotating the drum, exercising caution in doing so not to twist and damage the gage. This hole is covered by a plate which is pivoted on a screw, and while the illustration (fig. 91) shows the operation being performed with the wheel removed, the plate and hole may be reached through one of the openings in the wheel.



RA PD 63292

Figure 92—Disassembled View of Hose Connector

(7) TO REPLACE AIR LINE HOSE AND HOSE CONNECTORS.

(a) Clean the air hose with soap and water, and examine for cracks and deterioration. Clean and check all hose connectors for leakage and damaged threads. Check for broken, loose, or lost attachment parts. Replace any damaged part or length of air hose.

GUN AND CARRIAGE

(b) ~~Make sure that the end or ends of the air hose are cut squarely.~~ Assemble the hose guard spring and compression tube fitting nut over the hose (fig. 92). Assemble the compression tube fitting ball sleeve over the hose with its outer edge three-eighths of an inch from the end of the hose. Force the end of the hose over the tube in the connector. By joining the nut and the connector, and drawing the threads up tightly, the castellated edges of the ball sleeve will be impressed into the hose to make a tight joint. Hose connector fittings should be screwed home firmly, but too much pressure will crush the ball sleeve and damage the fittings.

h. Electric Brakes. Proper attention must be given the electric brake system to insure proper functioning. It is essential that the using arms has knowledge which will permit the correction of malfunctions which may occur during travel. The following information and that contained in paragraph 44 will prove helpful.

(1) Frequent tests should be made to determine if the entire electric brake system is operating in a satisfactory manner. With the carriage coupled to the prime mover and the jumper cable and safety switch chain connected, tow the carriage and apply the brakes, first with the controller on the prime mover, and then by pulling the safety switch chain.

(2) **CONTROLLER AND WIRING.** To insure dependable braking, there must be an adequate supply of current transmitted to the brake mechanisms at the wheels. There must be no loose connections or bare wires. Test the battery of the prime mover to determine that it is sufficiently charged to turn over the starting motor. Check for poor connections throughout the system. Look for partly broken or worn wires. When brakes are new, several applications must be made before maximum efficiency is obtained.

(3) **DRY CELL BATTERY.** The dry cell battery in the battery box on the carriage actuates the brakes through the safety switch in the event that the carriage breaks away from the prime mover. The using arm personnel must make certain that this battery will produce sufficient current to actuate the brakes at all times. The safety switch must be in "OFF" position at all times except when there is a break-in-two or when the automatic emergency feature is being tested. Check the wiring and the safety switch to make sure they are in proper order.

(4) **BRAKE MAGNET.** The facing of the brake magnet may become glazed. This is due to some foreign substance embedding itself in the material, resulting in a polished surface. If the facing cannot be roughened with coarse CLOTH, abrasive, aluminum-oxide, notify Ordnance maintenance personnel.

(5) **BEARINGS AND WHEELS.** Worn bearings or loose wheels will cause erratic action of the brakes and will be evidenced by the wide

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1



Figure 93—Checking Current at Brake With Ammeter

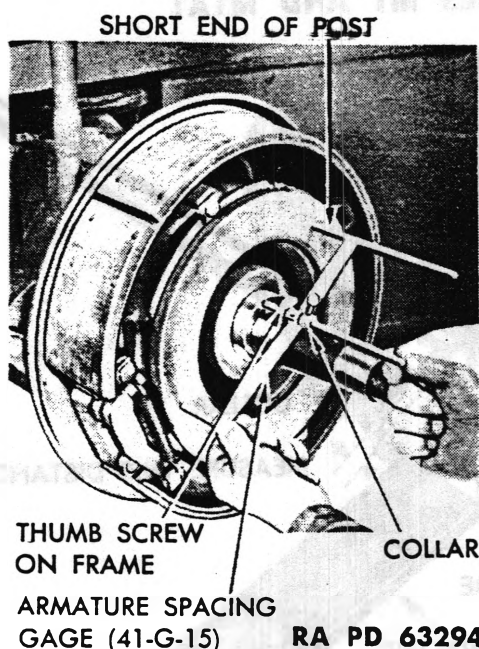
track the pole faces of the magnets make on the brake armature. The wheel spindle roller bearings must be adjusted (par. 70 e). Broken or badly worn bearings must be replaced; notify Ordnance maintenance personnel.

(6) TO CHECK CURRENT AT BRAKES.

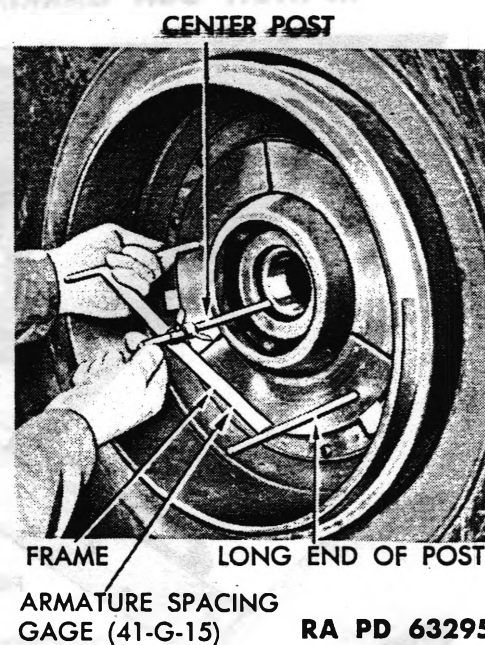
(a) Remove the terminal cover from the brake backing plate. Disconnect one brake wire only. Connect one side of the ammeter (for electric brakes) 17-A-6730 to the brake; the other side to the terminal of the live wire that was removed from the brake (fig. 93). Leave the other brake in circuit. Take a reading; it should not be less than 2.2 amperes. If this amount of current is not flowing through each brake, proper operation will not be obtained. Check for poor connections and partly broken or worn wires.

(b) Check the current consumption of the brake on the opposite side, with the first brake connected in the circuit. The readings of both brakes should not vary more than 0.5 of an ampere. In case there is a greater variation, check all connections for poor contact or for a broken wire at the magnet. Test the battery of the prime mover to see if it is sufficiently charged to turn over the starting motor. When the test is completed, remove the ammeter from the circuit and connect the live wire to the brake terminal. Replace terminal covers.

GUN AND CARRIAGE



RA PD 63294



RA PD 63295

Figure 94—Gaging Magnet**Figure 95—Gaging Armature****(7) USE OF ARMATURE SPACING GAGE.**

(a) For the most satisfactory operation of the electric brakes, the brake armature should not only be kept in constant contact with the brake magnet by means of the flat springs of the armature, but the armature should be depressed approximately one-eighth of an inch by the magnet. That the armature will be depressed to the required extent can be determined while the brake drum is removed from the wheel spindle by means of the armature spacing gage 41-G-15.

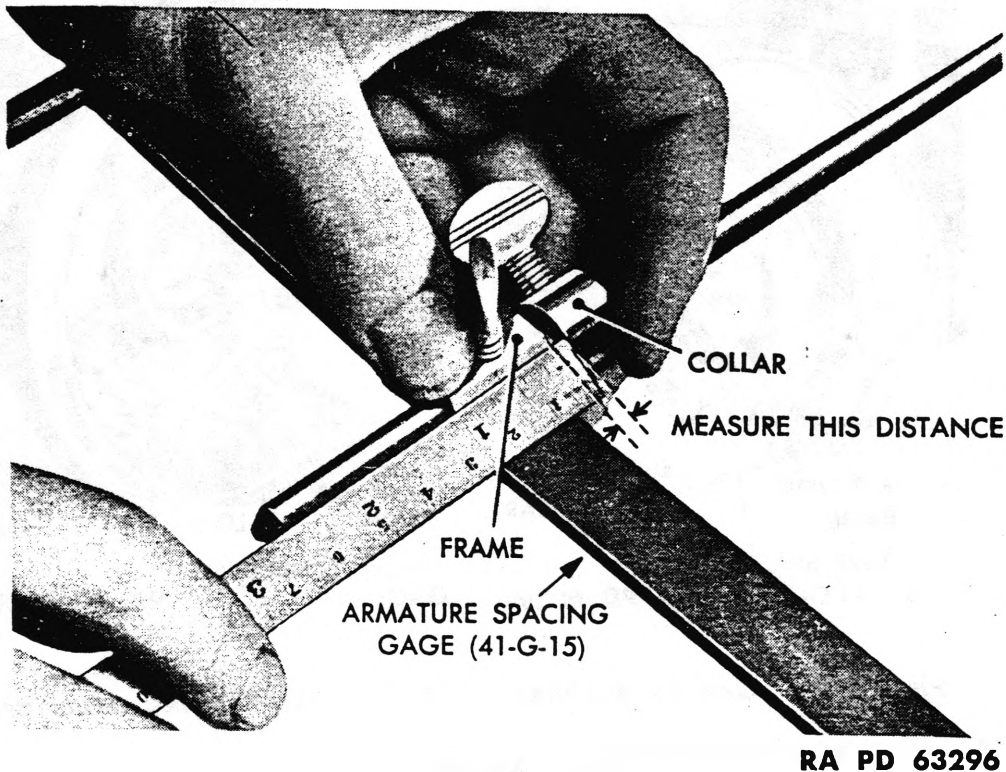
(b) To prepare for testing, block the armature out against its stops by means of small wooden blocks (fig. 95).

(c) Place the short ends of the outer posts of the spacing gage against the face of the magnet (fig. 94), slide the center post against the bearing seat on the wheel spindle, and tighten the thumb screw on the frame of the gage. Slide the collar of the gage against the frame and tighten the collar thumb screw.

(d) Place the long ends of the outer posts of the gage against the face of the brake armature (fig. 95). Loosen the thumb screw on the frame, slide the center post until it touches the shoulder of the inner wheel bearing, and tighten the frame thumb screw.

(e) The distance from the collar to the frame is the distance the armature will be depressed (fig. 96) when the hub and brake drum assembly is installed on the wheel spindle. If this distance is greater

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 63296

Figure 96—Measuring Armature Gage

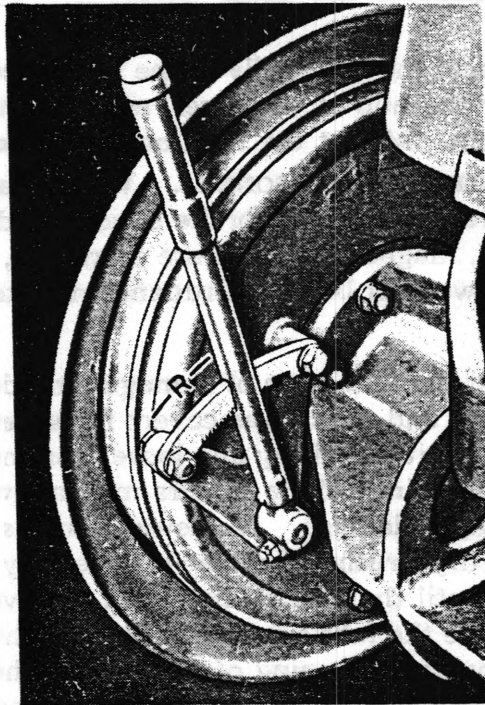
than five thirty-seconds of an inch, the bearing seat must be shimmed out; if the distance is less than one-eighth inch, the armature must be shimmed out. In either of these cases, notify the Ordnance maintenance personnel.

NOTE: No provision is made to adjust the clearance between the brake bands and the brake drums of this electric brake system. No adjustment is required for service braking operations inasmuch as wear of the brake lining is compensated for by wider movement of the magnet by the armature. The extent of this movement is greater than normally will be required by brake bands with sufficient lining for satisfactory braking. Hand brakes, however, may require adjustment as the lining becomes worn.

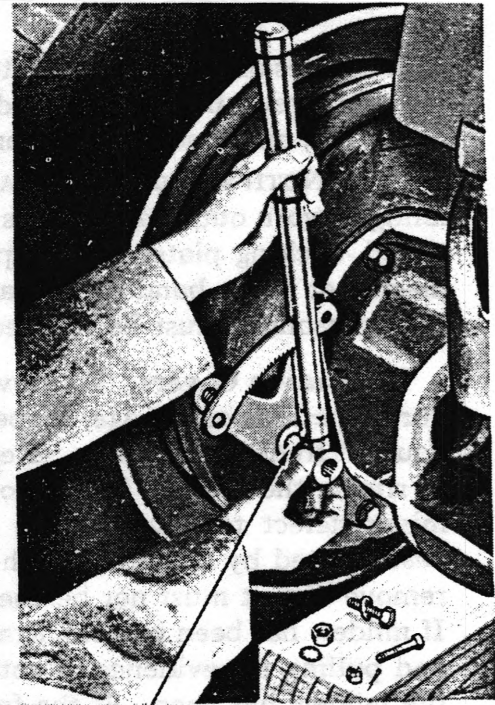
(8) TO ADJUST HAND BRAKES.

(a) There always should be a reserve of movement (*R*, fig. 97) of the brake hand levers on the brake hand lever racks after the hand brakes have been applied. This reserve diminishes as the brake bands become worn. As the wear increases, it is necessary to move the levers a greater distance to apply the hand brakes and sufficient movement on the rack may not be permitted to set the brakes properly.

GUN AND CARRIAGE



RA PD 63297

HAND LEVER
BRAKE SHAFT

RA PD 63298

**Figure 97—Reserve Movement
of Brake Hand Lever****Figure 98—Removing Lever
From Hand Lever Brake Shaft**

(b) Raise the carriage with the firing jack. With the brake released, disconnect the rack by removing the nut from the cap screw at the front end and the cap screw from the rear end. Remove the cotter pin from the castle nut at the bottom of the hub of the lever, unscrew the castle nut, tap out the screw, and open the slot in the bottom of the hub, if necessary. Slip the hub of the lever from the serrated end of the hand lever brake shaft (fig. 98).

(c) Rotate the shaft sufficiently to compensate for the excess movement required to engage the worn brake band. This can be accomplished most easily by snapping the safety switch to "ON" position to force the brake armature to cling to the brake magnet and turning the carriage wheel to take the load of spreading the brake band off the hand lever brake shaft. With the shaft held in the desired position, replace the hub of the lever on the shaft and snap the safety switch to "OFF" position. Temporarily line up the rack and lever to determine whether the lever is positioned properly. The lever should be at the rear end of the rack when the brake is free and it should begin to apply the brake as soon as it is pulled forward.

(d) When the brake hand lever has been positioned properly on the hand lever brake shaft, tap the outer side of the hub of the lever

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

with a series of hammer blows to seat the shaft fully in the hub. Insert the cap screws in the bore under the hub of the lever, assemble the castle nut, and insert the cotter pin. Mount the rack on its bracket.

(9) **NOTIFY ORDNANCE MAINTENANCE PERSONNEL.** When brake lining is worn out, brake drums are out of round, brake bands are distorted, backing plates are warped, magnet bushings are worn out, or magnet or brake band springs are weak or broken, Ordnance maintenance personnel must be notified.

i. **Canvas Covers.** To prevent the formation of damaging mildew during periods of storage, shape out and air canvas covers 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 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 the mildew has been removed. If mildew has been present, examine the fabric carefully by stretching and pulling for evidence of rotting or weakening of the fabric where the mildew has been. If the 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.

55. WASHING.

a. Serious damage to Ordnance materiel, in many cases requiring repair and replacement of component parts of sighting equipment, fire control instruments, cannon, and carriages, has frequently resulted from the use of water, steam, or air from a high pressure hose for cleaning purposes. For this reason, operating personnel is cautioned to prevent water, dirt, or grit from being forced into any part of the gun or carriage when using water, steam, or air under pressure for cleaning. This caution especially applies to that portion of the gun tube enclosed by the cradle, gun cover, and cylinder yoke, as well as the trunnion bearings, trail hinge pins, bearing surfaces of the top and bottom carriages, and gear cases.

b. Under no circumstances will a hose, either normal-pressure or high-pressure, be used for cleaning any sighting equipment or fire control instruments. Before washing, take off removable sighting equipment from the materiel to be cleaned. In cases where such equipment is not to be removed by using arm personnel, extreme care should be taken to cover the parts properly.

c. Since continued friction or rubbing will smooth and produce a gloss on surfaces finished with ENAMEL, synthetic, olive drab,

GUN AND CARRIAGE

lusterless, it must be avoided because gloss destroys camouflage value. The materiel 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 wiping cloth. The surface should never be rubbed or wiped, except while wet, or a gloss will be developed.

d. It is not desirable that materiel painted with lusterless enamel be kept as clean as when glossy paint was used. A small amount of dust 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.

e. Continued friction of wax-treated tarpaulins on the sides of the materiel will also produce a gloss. It should be removed with the dry-cleaning solvent.

56. PAINTING.

a. Ordnance materiel is painted before being issued to the using arms and one maintenance coat per year will ordinarily be ample for protection. With few exceptions, this materiel will be painted with ENAMEL, synthetic, olive drab, lusterless. Sighting and fire control instruments, one of the exceptions, require a crystalline finish and will not be painted by the using arms.

b. Complete information on painting is contained in TM 9-850.

Section VII

INSPECTION AND ADJUSTMENT

57. PURPOSE.

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

b. Inspection is for the purpose of determining by critical examination the condition of the materiel, whether repairs or adjustments are required, that all modifications authorized by field service modification work orders have been made, and to insure serviceability and proper functioning of the materiel. Its immediate aim is trouble prevention, which includes:

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

- (1) Detecting faulty or careless preventive maintenance.
- (2) Determining when repair or replacement of parts is required because of ordinary wear or breakage.
- (3) Determining that all modifications authorized by Field Service and War Department Modification Work Orders have been completed.

58. GENERAL INSPECTION PROCEDURE.

a. Inspection should always be accompanied by corrective measures to remedy any deficiencies or defects found. When properly carried out, inspection and necessary corrective maintenance will insure the maximum rehabilitation and performance of the materiel.

b. The results of inspection should be noted in the Artillery Gun Book War Department Form O.O. 5825 (28-F-67990) by the inspector. Any unusual condition which might result in improper operation, damage to materiel, or injury to personnel will be remedied immediately.

c. Suggested improvements in design, maintenance, safety, and efficiency of operation prompted by chronic failure or malfunction of the weapon, spare parts, or equipment should be forwarded to the Office of the Chief of Ordnance, Field Service Division, Maintenance Branch, with all pertinent information necessary to initiate corrective action. Such suggestions are encouraged in order that other organizations may benefit.

59. INSPECTION ON RECEIPT OF MATERIEL.

a. Upon receipt of materiel, it is the responsibility of the officer in charge to ascertain whether the materiel is complete with spare parts and equipment and is in serviceable operating condition, and that all modifications authorized by field service modification work orders have been completed. A record should be made of any missing parts and any malfunction. Such condition should be corrected as quickly as possible.

b. Attention should be given to small and minor parts, as these are the more likely to become lost and may seriously affect the proper functioning of the materiel.

c. This visual inspection upon receipt should be followed as quickly as possible by a complete inspection which will disclose the functioning of the materiel (pars. 61 and 62).

GUN AND CARRIAGE

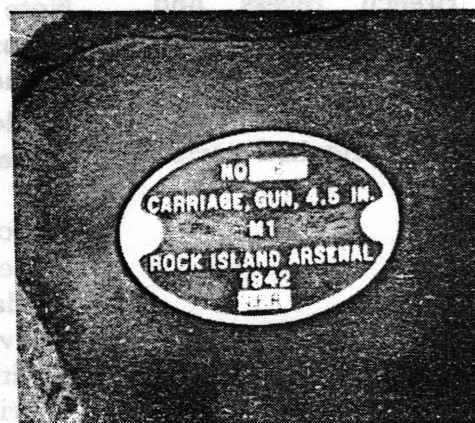
60. SERIAL NUMBERS.

a. Three serial numbers are required for records concerning the components of this materiel. They are the gun serial number, the recoil mechanism serial number, and the carriage serial number.

b. **Gun Serial Number.** Stamped on the lower rear face of the breech ring (fig. 6).



RA PD 54769



RA PD 54770

Figure 99—Recoil Mechanism Serial Number **Figure 100—Carriage Serial Number—Marked M1 or M1A1**

c. **Recoil Mechanism Serial Number.** On brass plate on right side of recoil mechanism cover near the cylinder yoke (fig. 99).

d. **Carriage Serial Number.** On brass plate on right arm of top carriage (fig. 100).

61. INSPECTION OF GUN.

a. The following instructions will be scrupulously observed by all concerned:

**Parts to be Inspected in
Order of Inspection**

The gun is a unit.

Points to Observe

Note the general appearance. Test the smoothness of operation of the breech mechanism, both in opening and closing. Test the firing mechanism by firing two primers. Disassemble the breech mechanism and see that it is thoroughly cleaned and well lubricated (see item below on breechblock carrier). Note the condition of the bore for deposits on the lands and in the grooves, bruises on the gas check seat, erosion at the origin of rifling, and burs or roughness of the lev-

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

Parts to be Inspected in Order of Inspection

Points to Observe

	eling plates. Note that the recoil slide is smooth, well lubricated, and free from rust or defects.
Breech recess and breechblock threads.	Note whether there are scores, bruises, or burs on the threads of the breechblock and breech recess.
Breechblock carrier and its attached parts.	While the breech mechanism is disassembled, note roughened or scored condition of the bearing surfaces for the breechblock and breechblock driver, firing mechanism housing, breechblock carrier adapter, crosshead, breech operating lever crankshaft, and breechblock carrier hinge pin. Test the operation of the firing mechanism safety latch and the breech operating lever closing latch; replace weak or broken springs.
Obturator spindle and obturating parts.	Note whether there is erosion of the vent-hole and primer chamber. Note the condition of the obturator spindle plug, and the threads on the end of the spindle. Look for a bruised split ring, torn gas check pad, broken or weakened breechblock withdrawing spring. Try several primers in the obturator spindle plug; they should extend more than one-eighth of an inch when pressed in hard with the thumb or finger. Check head-space (par. 67 j).
Firing Mechanism M1 and spare.	Disassemble and observe whether they are properly lubricated. Examine condition of firing pins. If a firing pin is weak or broken, replace. Observe the condition of the threads, the holes in the firing pin guides, and the bearing surfaces of the parts. Assemble the firing mechanisms and seat a primer in the primer holder of each. Test the action of the springs.
Percussion hammer.	Test smoothness of operation. Note whether the rounded portion of the percussion hammer face or the safety lug

GUN AND CARRIAGE

**Parts to be Inspected in
Order of Inspection****Points to Observe**

Breechblock carrier
counterbalance.

is worn or burred. Test the operation of the percussion hammer locking pin.

Test the operation of the mechanism and see that it functions properly at various degrees of elevation.

62. INSPECTION OF CARRIAGE.

The carriage as a unit.

Note the general appearance. Note whether the oil and grease fittings are clean, that a red ring has been painted around all oilholes and fittings, and that the carriage is painted in accordance with regulations. Note any gloss on the finish or any unnecessarily bright metal that would affect camouflage value.

Recoil mechanism.

Determine whether the replenisher and recuperator cylinder contain the proper amounts of reserve oil. Note whether the oil index and the replenisher piston function properly. Make sure breather holes in the rear of the replenisher piston guide are not plugged. Examine the mechanism for oil leaks. See that the gun recoil wiper on the front of the cylinder yoke tightly fits the recoil slide on the gun tube so as to fully exclude dirt.

Elevating mechanism.

Elevate and depress the weapon through the full extent of its travel. Note whether the mechanism operates without binding or interference and with no more than one-sixth of a turn backlash. Look for loose connections. See that the safety nut which retains the hand-wheel is tight. Check the function of the variable recoil cam. Examine the elevating arc and pinion for undue wear, bruises, or burs. Check the lubrication.

Equilibrators.

The equilibrators should be inspected to see that the gun elevates and depresses satisfactorily throughout its full range. For proper method of adjusting equilibrators see paragraph 54 c.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

Parts to be Inspected in Order of Inspection	Points to Observe
Traversing mechanism.	Traverse the carriage throughout its complete movement. Note whether the operation is smooth. There should be no binding nor should the backlash be more than one-sixth handwheel turn. Look for loose mounting screws or nuts. Examine the traversing arc and pinion for undue wear, bruises, or burs. Check the lubrication.
Top carriage.	Examine for breaks and cracks, and for loose attachment screws and nuts of the shields and the telescope mount. See that the pockets are clean and that the drain hole in each pocket is not closed.
Bottom carriage, trails, and trail spades.	Examine for breaks and cracks. Determine whether the trail hinge, pins are properly lubricated. Examine accessory mountings on trails. Check the operation of the trail lock; adjust if necessary. Look for undue wear on the lunette. Note the general condition of the spades, loading tray, and firing jack float.
Firing jack, handles, and traveling lock.	Note the condition of firing jack rack plunger; remove any rust. Check ease of operation. Examine ratchets. Determine whether firing jack housing bottom cover is in place. Check condition and effectiveness of firing jack cover and clamp. Note security with which mounting holds the jack handles in traveling position. Examine the traveling lock and see that the chains on the traveling lock pin and firing jack housing bottom cover are sound.
Wheels and tires.	Check for any loose or missing nuts. Check the tires for correct pressure, 95 pounds per square inch. Note the condition of the tires and see whether the treads are taking the wear evenly. Raise and rotate the wheels to test for drag, bearing adjustment, and wheel alinement.

GUN AND CARRIAGE

Parts to be Inspected in Order of Inspection

Points to Observe

Air brakes.

To prevent malfunction of the air brake systems on field artillery materiel, the using arms will inspect and service the air filters, brake drums, and couplings of the air brake system in accordance with the following instructions.

Air filters.

The air filter assembly C85464, located inside the front of each trail on carriages or next to the air reservoir of transport wagons, is used to remove the dirt and moisture from the air before it comes into contact with the relay-emergency valve. To accomplish this, it is necessary that the strainer assembly A238212 (BWE221053) be kept clean, and the foreign matter removed from chamber A238221 (BWE230108). NOTE: Certain carriages are equipped with air assembly filter C93374 or C90650. The same principle is involved in the operation of all three types of filters, and the cleaning instructions apply to all types. The strainers of all air filters are interchangeable. Under normal operating conditions, plug A238225 (BWE-230111), should be removed and the moisture drained weekly. The plug should be removed any time the presence of moisture is suspected. Normally, strainers should be cleaned monthly. To detach the strainer, remove the four bolts BCAXI (BWE203788), the chamber A238221 (BWE230108), support A238213 (BWE214171), and gasket A238220 (BWE230109). The strainer can then be taken out with a slight downward pull. Clean the strainers by brushing off accumulated foreign matter, washing with SOLVENT dry-cleaning, and allowing to dry. Remove any rust or foreign matter on the interior of body C93966 (BWE230107). If the gasket A238220 (BWE230109), is damaged, re-

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1****Parts to be Inspected in
Order of Inspection****Points to Observe**

place it. Assemble in reverse order. Do not disassemble air filters in dusty surroundings.

Brake Drums.

In order to prevent damage to the brake shoes as a result of the accumulation of dirt and mud in the brake drums, they should be cleaned as follows whenever the wheel bearings are repacked: Disjoin tire and wheel assembly, hub and brake drum as directed in the pertinent Technical Manual. Remove all accumulated dirt and clean the drum thoroughly with dry-cleaning solvent.

Couplings.

Every effort will be made to prevent the introduction of foreign matter into the air brake system when the air brake lines are disconnected from the prime mover. Upon disconnection from the prime mover, the air lines should be connected immediately to the dummy couplings provided. If the coupling should touch the ground, the air line should be held with the coupling down and the air line tapped. Do not blow into the coupling as this will only move the sand or dirt from the coupling into the air line.

Testing air brakes.

The emergency application feature of the brake system should be tested daily by closing the emergency line cut-out on the prime mover and disconnecting the emergency line couplings with 70 to 90 pounds of pressure in the trailer reservoir. This simulates emergency application of the brakes without wasting air.

Electric brakes.

Check current at each brake. Check wiring for brakes in the insulation and ground connections. Check the plugs of the jumper cable and the sockets of the battery box for dirty or corroded blades or broken parts. Check the safety switch by pulling the safety switch lever and listening for the click caused

GUN AND CARRIAGE

Parts to be Inspected in
Order of Inspection

Points to Observe

by the armatures contacting the magnets in the brake mechanism as the wheels. Check the condition of the dry cell battery and connections. Test the effectiveness of the brakes by making several stops. Test the action of the hand brakes.

Section VIII

DISASSEMBLY AND ASSEMBLY

63. GENERAL.

a. Cleaning, lubrication, and inspection, and incidents of use and breakage, make necessary the disassembly and assembly of the breech mechanism and various parts of the carriage. This work comes under two headings: that which can be performed by the battery personnel with the equipment furnished; and that which must be performed by Ordnance maintenance personnel.

b. The battery personnel may, in general, do such dismounting as is required for the installation of the spare parts carried by the battery, and as is required for thorough inspection, cleaning, and lubrication. This work will be confined mainly to the breech mechanism and should be done in the manner prescribed and with proper tools.

c. Any difficulty which cannot be remedied by the prescribed methods will be brought to the attention of the Ordnance maintenance personnel. Battery personnel will not attempt to dismount the gun from the cradle, or the cradle from the carriage, or to do any work on the recoil mechanism (other than prescribed in this manual) due to the impracticability of furnishing the organization with the necessary equipment for the performance of the work.

d. No filing of sighting equipment or gun parts will be done by the battery personnel except by order of the commanding officer.

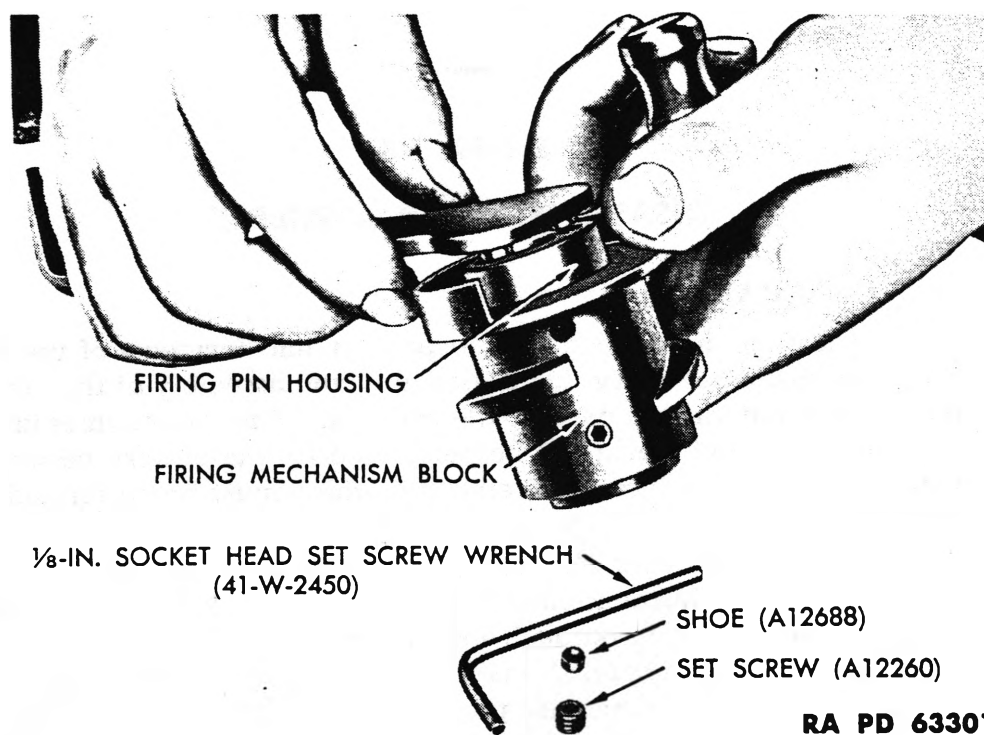
e. The use of wrenches which do not fit snugly on the parts should be avoided. They not only will fail to tighten the parts properly, but they will damage the corners of nuts and screwheads. There is also danger of spreading the wrenches and rendering them useless.

f. A steel hammer should not be used directly on any part of the gun or mechanical part of the carriage. A copper or wooden mallet or hide-faced hammer should be used, or a brass or copper drift, or a

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

wooden block should be interposed between the blow and the part to be struck.

g. It is desirable to complete the subassembling of units before attempting the assembly of the units to the gun. In all assemblies, the bearings, sliding surfaces, threads, and finished parts should be cleaned and lubricated as directed.



RA PD 63301

Figure 101—Removing Firing Pin Housing

64. DISASSEMBLING OF FIRING MECHANISM M1.

a. Remove both set screws A12260 from the firing mechanism block, using a one-eighth-inch socket-head set screw wrench 41-W-2450. Do not lose the shoe A12688 under the set screw for the firing pin housing. Unscrew the firing pin housing from the rear end of the block, using the firing mechanism wrench 41-W-3248-251 (figs. 101 and 102).

b. Remove the firing pin A12258 and the firing pin spring A12261 from the rear of the block (fig. 102). Push the copper shoe A12688 out of the set screw hole, if it has not already come out.

c. Unscrew the primer holder (fig. 103) from the front of the block, using the firing mechanism wrench. The primer holder has

GUN AND CARRIAGE

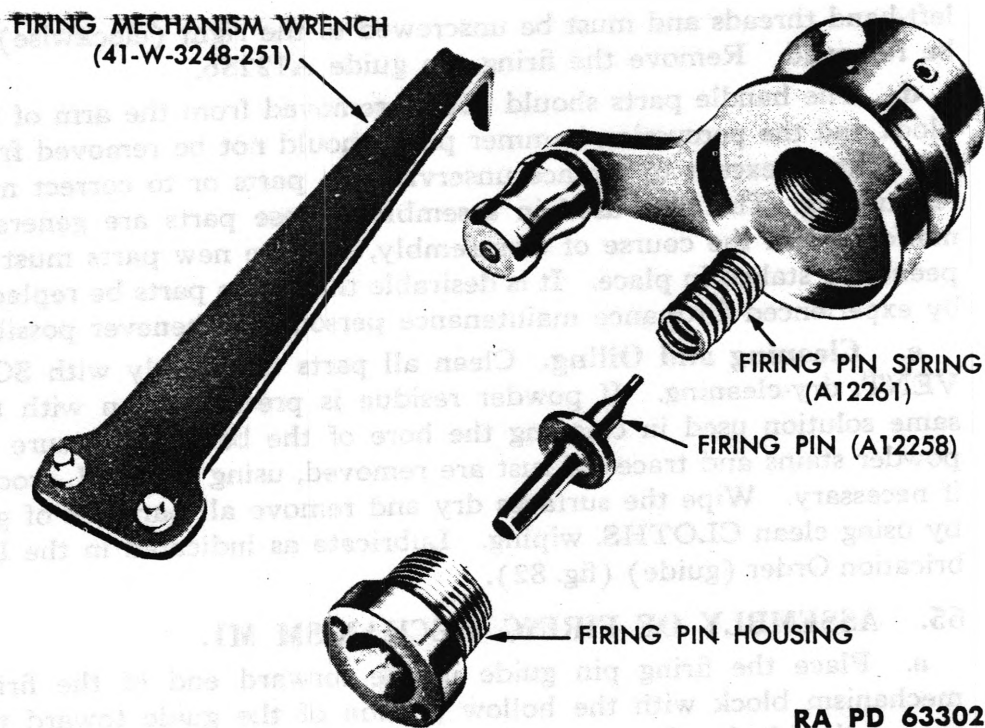


Figure 102—Parts in Rear of Firing Mechanism M1

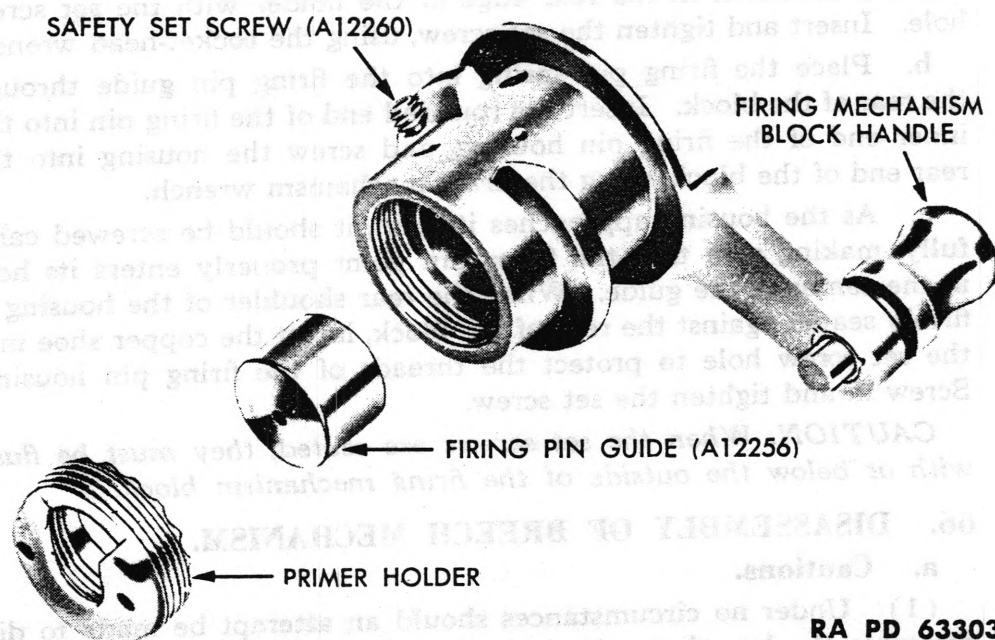


Figure 103—Parts in Front of Firing Mechanism M1

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

left-hand threads and must be unscrewed to the right (clockwise) to be removed. Remove the firing pin guide A12256.

d. The handle parts should not be removed from the arm of the block and the percussion hammer parts should not be removed from the adapter except to replace unserviceable parts or to correct malfunctioning. The pins used in assembling these parts are generally malformed in the course of disassembly, and the new parts must be peened or staked in place. It is desirable that these parts be replaced by experienced Ordnance maintenance personnel, whenever possible.

e. **Cleaning and Oiling.** Clean all parts thoroughly with SOLVENT, dry-cleaning. If powder residue is present, clean with the same solution used in cleaning the bore of the barrel. Be sure all powder stains and traces of rust are removed, using CLOTH, crocus, if necessary. Wipe the surfaces dry and remove all particles of grit by using clean CLOTHS, wiping. Lubricate as indicated in the Lubrication Order (guide) (fig. 82).

65. ASSEMBLY OF FIRING MECHANISM M1.

a. Place the firing pin guide in the forward end of the firing mechanism block with the hollow portion of the guide toward the rear of the block. Screw the primer holder into the forward end of the block. Use the firing mechanism wrench to seat the holder against the internal shoulder of the block, turning the holder to the left (counterclockwise) to install. Look in the set screw hole and aline the nearest notch in the rear edge of the holder with the set screw hole. Insert and tighten the set screw, using the socket-head wrench.

b. Place the firing pin spring into the firing pin guide through the rear of the block. Insert the rounded end of the firing pin into the inner end of the firing pin housing, and screw the housing into the rear end of the block, using the firing mechanism wrench.

c. As the housing approaches its seat, it should be screwed carefully, making sure that the firing pin point properly enters its hole in the center of the guide. When the rear shoulder of the housing is firmly seated against the rear of the block, insert the copper shoe into the set screw hole to protect the threads of the firing pin housing. Screw in and tighten the set screw.

CAUTION: When the set screws are seated, they must be flush with or below the outside of the firing mechanism block.

66. DISASSEMBLY OF BREECH MECHANISM.

a. Cautions.

(1) Under no circumstances should an attempt be made to disassemble the breech mechanism with the breech in closed position. Failure to observe this rule may result in the displacement of the

GUN AND CARRIAGE

split rings and the gas check pad, and the dropping of the rings into the threads of the breech recess. This probably would cause serious damage to the rings and threads and prevent either swinging the breechblock out of the breech recess or returning of the breechblock to closed position.

(2) Should this condition occur, through accident or carelessness, no attempt should be made to force the breechblock or the breechblock carrier. With the breechblock in unlocked position, disconnect the counterbalance mechanism from the hinge pin (c, below) and remove the hinge pin (n, below). Several strong men then should carefully remove the complete breechblock carrier and breechblock assembly rearward from the weapon, leaving the obstructing parts in the recess to be removed after the breechblock carrier and breechblock assembly has been removed.

b. Remove the firing mechanism if it is installed in the weapon.

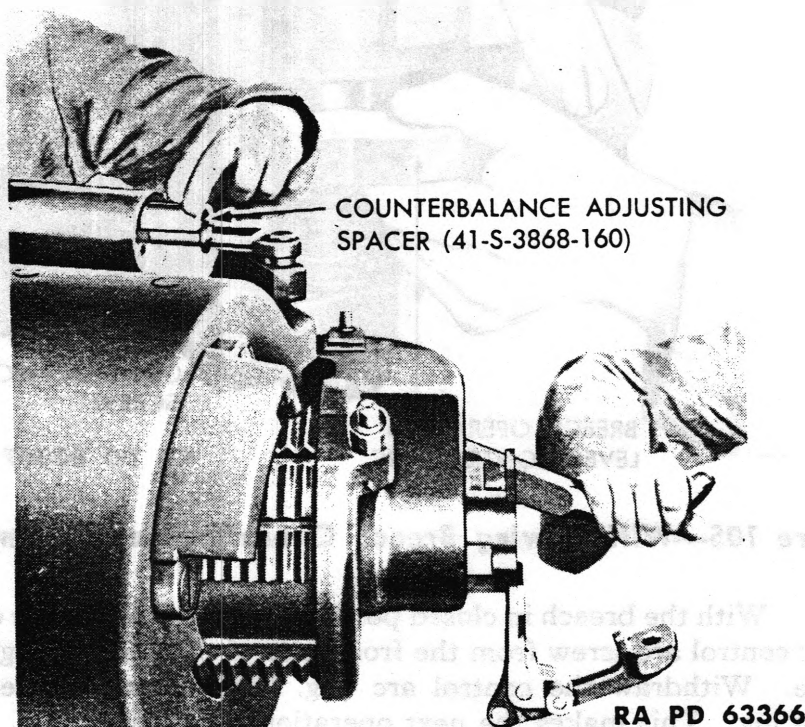


Figure 104—Disconnecting Counterbalance From Hinge Pin

c. Open the breech and swing the carrier until a U-block or counterbalance adjusting spacer 41-S-3868-160 can be placed between the shoulder of the eye on the breechblock carrier counterbalance piston

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

rod and the breechblock carrier counterbalance cylinder head (fig. 104). Then swing the carrier toward closed position until the eye on the counterbalance piston rod can be lifted over the head of the pin on the hinge pin arm.

CAUTION: *It is essential that the counterbalance mechanism be disconnected before disassembly of the breech mechanism is begun, in order to protect the personnel and the materiel from the results of accidental closing of the breech.*

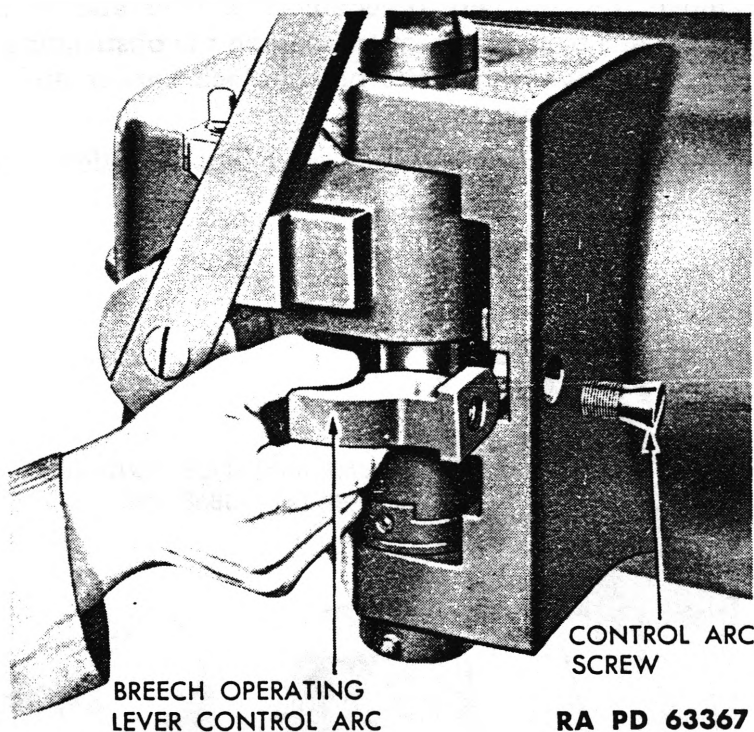


Figure 105—Withdrawing Breech Operating Lever Control Arc

d. With the breech in closed position, remove the breech operating lever control arc screw from the front face of the breech ring near the hinge. Withdraw the control arc (fig. 105) from its recess in the hinge lug. This makes the next operation possible.

e. Open the breech. With the carrier remaining in open position, lift the breech operating lever to latched position. This is possible due to the removal of the control arc. It places the breechblock in the position in which it would rest were the block sealed in the breech recess, and it permits the firing mechanism safety latch plunger to be retracted from the holes in the breechblock carrier adapter and the

GUN AND CARRIAGE

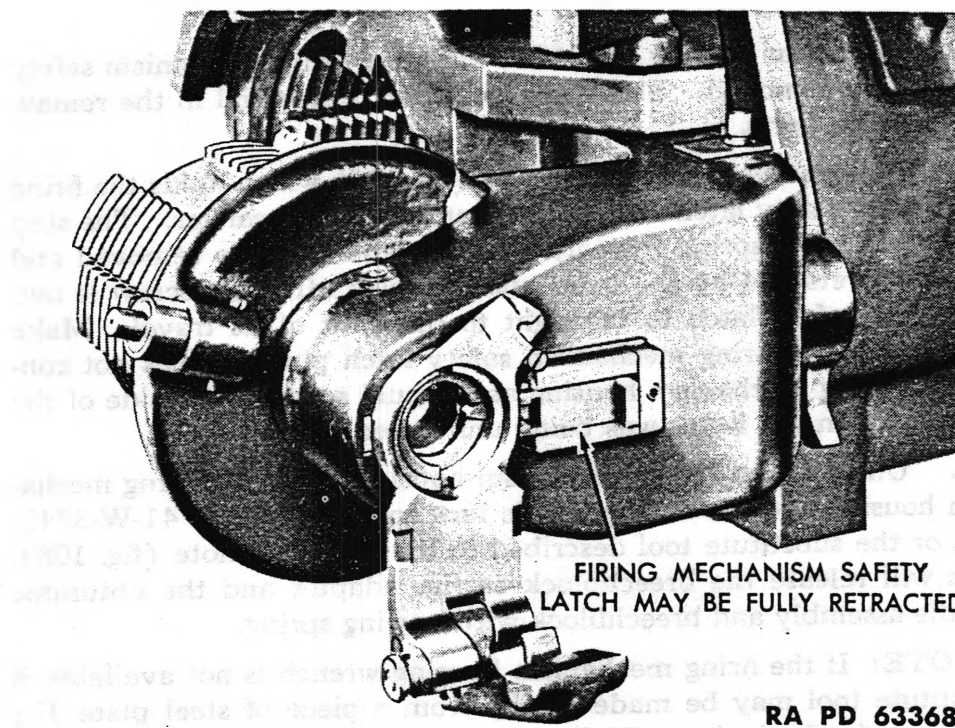


Figure 106—Open Breech Placed in "Closed" Position

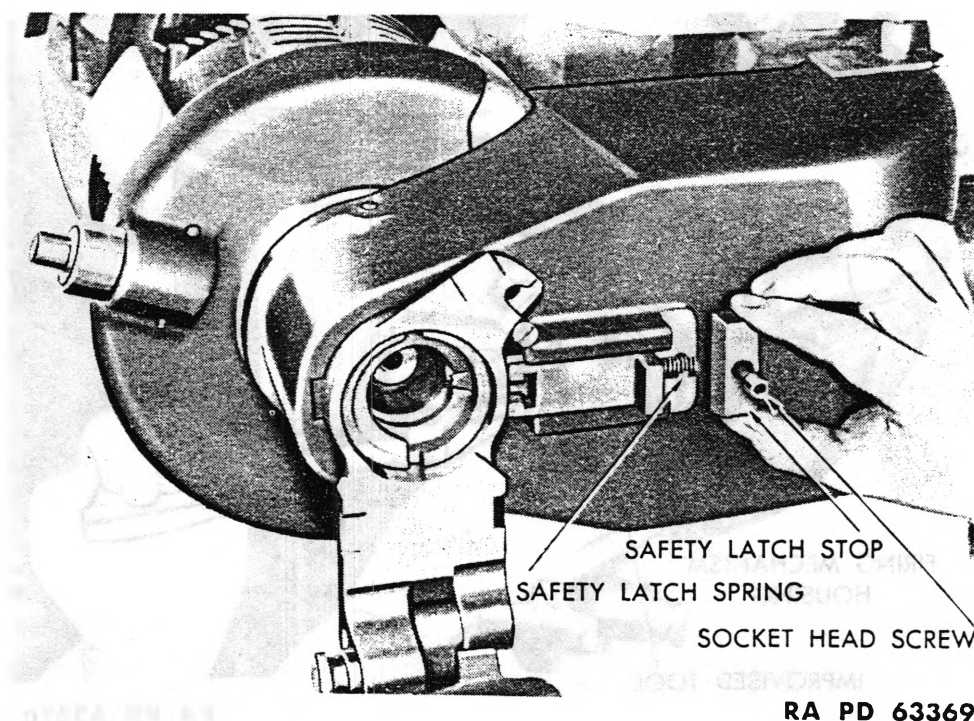


Figure 107—Disassembled View of Safety Latch Stop

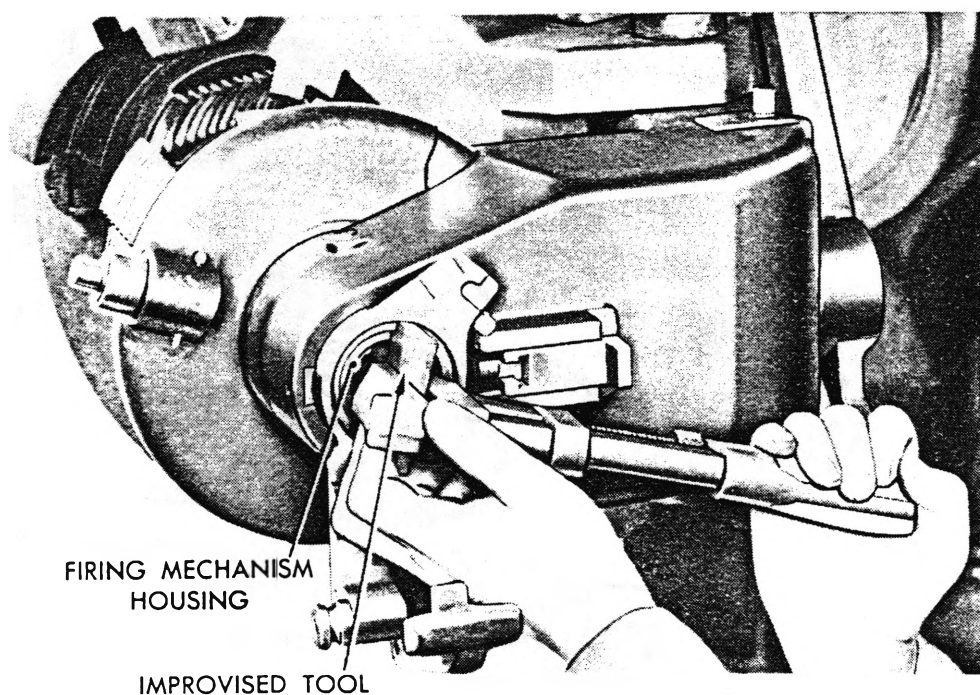
4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

firing mechanism housing (fig. 106) after the firing mechanism safety latch stop is removed. The latter condition is essential in the removing of these parts.

f. Remove the socket-head screw (fig. 107) which holds the firing mechanism safety latch stop to the rear face of the carrier. The stop and safety latch spring may fly off when the screw is removed and should be retained by the hand and removed after the screw is out. Move the safety latch to the right to the limit of its travel. Make certain that the firing mechanism safety latch plunger does not contact the firing mechanism housing as it would score the outside of the housing when the latter was being unscrewed.

g. Unscrew the firing mechanism housing, using the firing mechanism housing wrench, an adjustable face spanner wrench 41-W-3247-500, or the substitute tool described in the following note (fig. 108). This will release the breechblock carrier adapter and the obturator spindle assembly and breechblock withdrawing spring.

NOTE: If the firing mechanism housing wrench is not available, a substitute tool may be made locally from a piece of steel plate $2\frac{1}{2}$ inches wide, $\frac{1}{4}$ inch in thickness, and of convenient length. The working edge may be filed to the proper thickness. The housing may



RA PD 63370

Figure 108—Removing Firing Mechanism Housing

GUN AND CARRIAGE

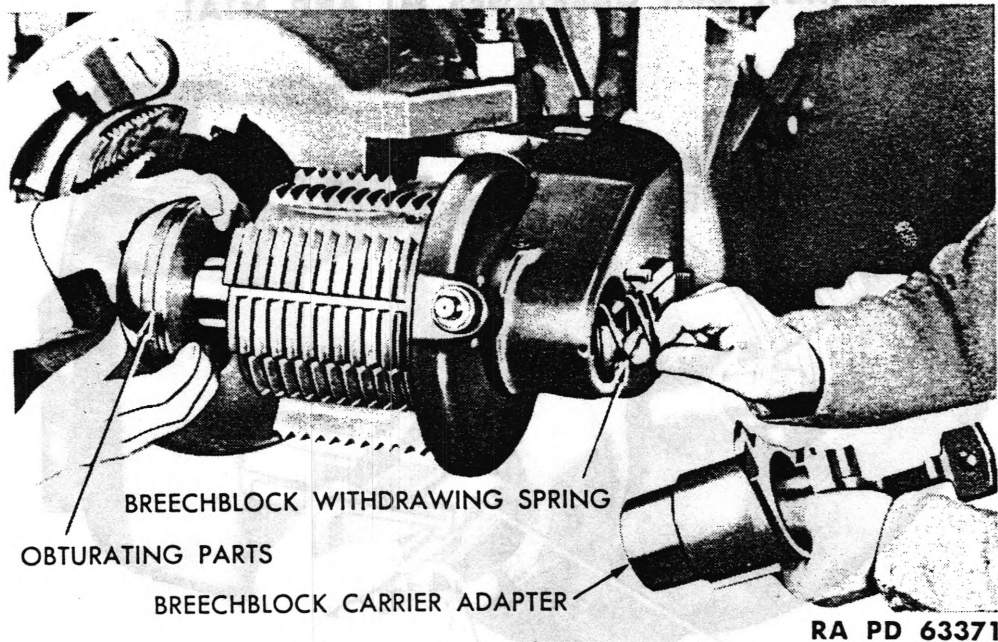


Figure 109—Removing Obturating Parts, Breechblock Withdrawing Spring, and Breechblock Carrier Adapter

be rotated with a drift and hammer, but continuation of this practice tends to deform the edges of the slots and ruin the part.

h. Withdraw the breechblock carrier adapter and the breechblock withdrawing spring from the rear of the carrier (fig. 109). Withdraw the obturator spindle from the front end of the breechblock, carrying with it the front split ring B163614, the gas check pad C70647, the rear split ring B163615, the inner ring A206739, and the gas check pad disk (fig. 9).

CAUTION: *The obturator spindle plug, gasket, and vent bushing are not to be removed and replaced except by trained ordnance maintenance personnel.*

i. Slide the firing mechanism safety latch and its plunger to the left, and withdraw it from the breechblock carrier (fig. 110). Withdraw the breechblock withdrawing spring bearing washer rearward out of the breechblock and breechblock carrier. This washer is located in the front of the rear bore of the breechblock.

j. Slide the breechblock forward off the breechblock driver (fig. 111), rotating the breechblock by slightly manipulating the breech operating lever, if necessary, to free the breechblock translating cam roller from the cam slot. The breechblock driver should be held while the breechblock is being removed.

k. Remove the slotted lock screw which locks the breechblock driver retaining ring to the carrier at the forward end of the breech-

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

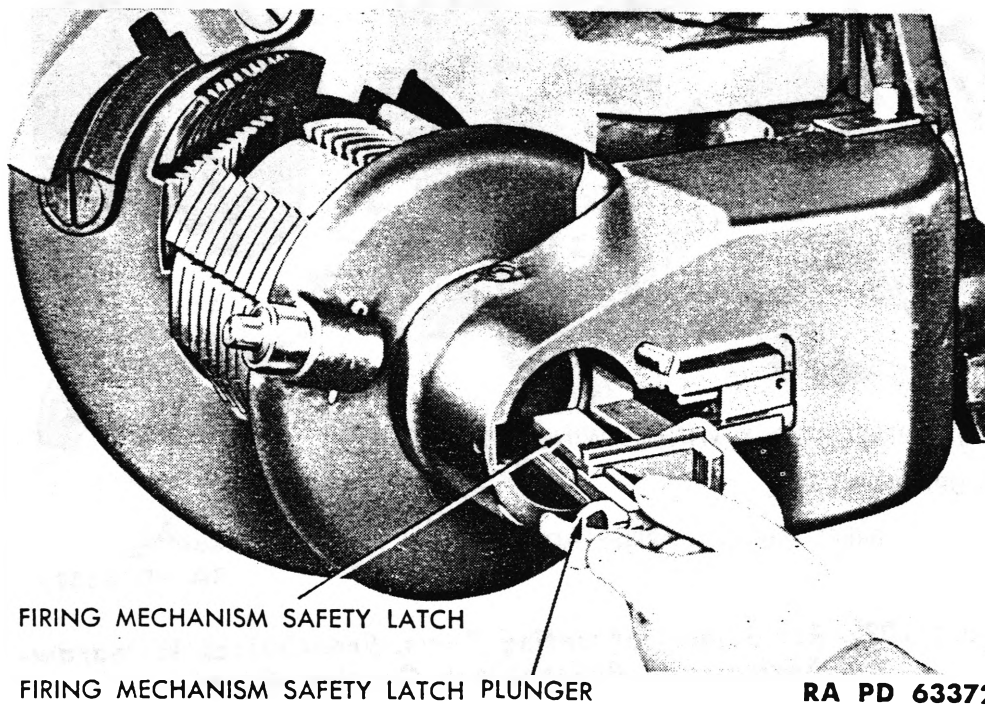


Figure 110—Removing Firing Mechanism Safety Latch and Plunger

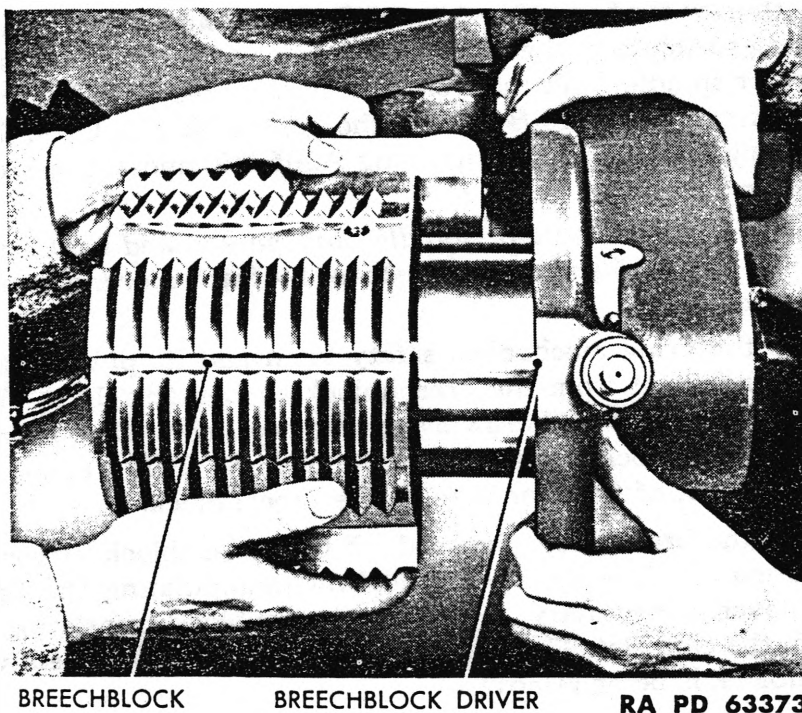


Figure 111—Removing Breechblock From Breechblock Driver

GUN AND CARRIAGE

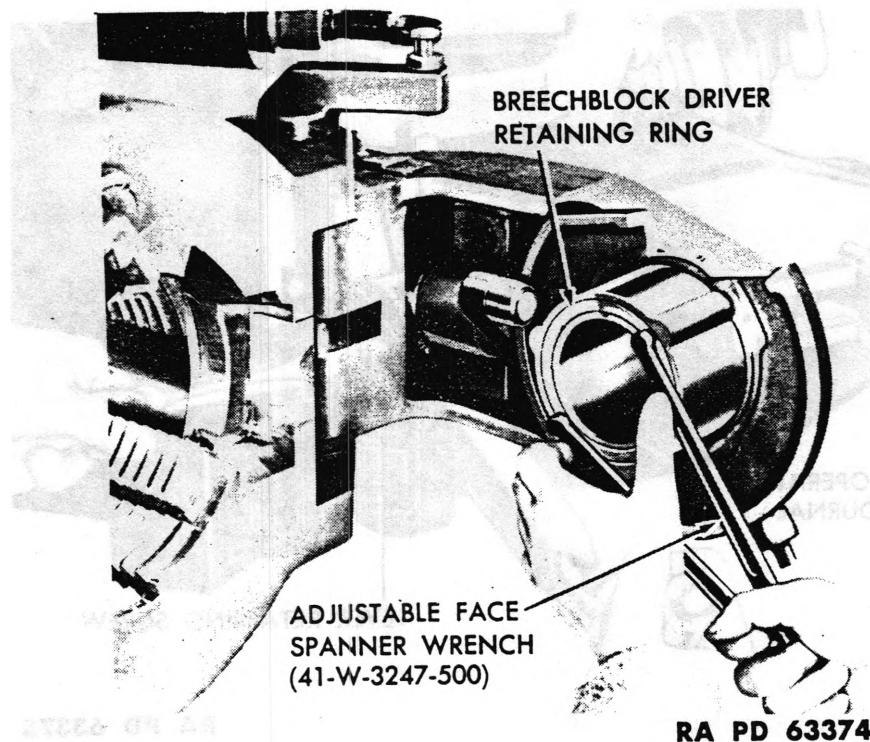


Figure 112—Removing Breechblock Driver Retaining Ring

block driver hub. Unscrew the retaining ring from the carrier, using the retaining ring wrench or an adjustable face spanner wrench 41-W-3247-500 (fig. 112). Slide the breechblock driver forward off its bearing surface on the breechblock carrier.

l. Remove the breech operating lever retaining screw (fig. 113) from the hub of the breech operating lever. Withdraw the lever from its slot in the breech operating lever journal. Withdraw the journal from the right end of the breech operating lever crankshaft.

m. Slide the crosshead off its pivot on the arm of the breech operating lever crankshaft. The breechblock translating cam roller on the other arm of the crankshaft is retained in a semi-permanent manner, and the roller should not be removed except when replacement is necessary. Remove the crankshaft bearing screws (fig. 114). Remove the crankshaft and crankshaft bearing from the breechblock carrier.

n. Drive the detent out of the collar on the lower end of the breechblock carrier hinge pin. Remove the collar. While the carrier is being held, withdraw the hinge pin from the hinge pin lug (fig. 115). A slight movement of the carrier may assist in the removal of the pin. Remove the carrier from the hinge pin lug. The hinge pin

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

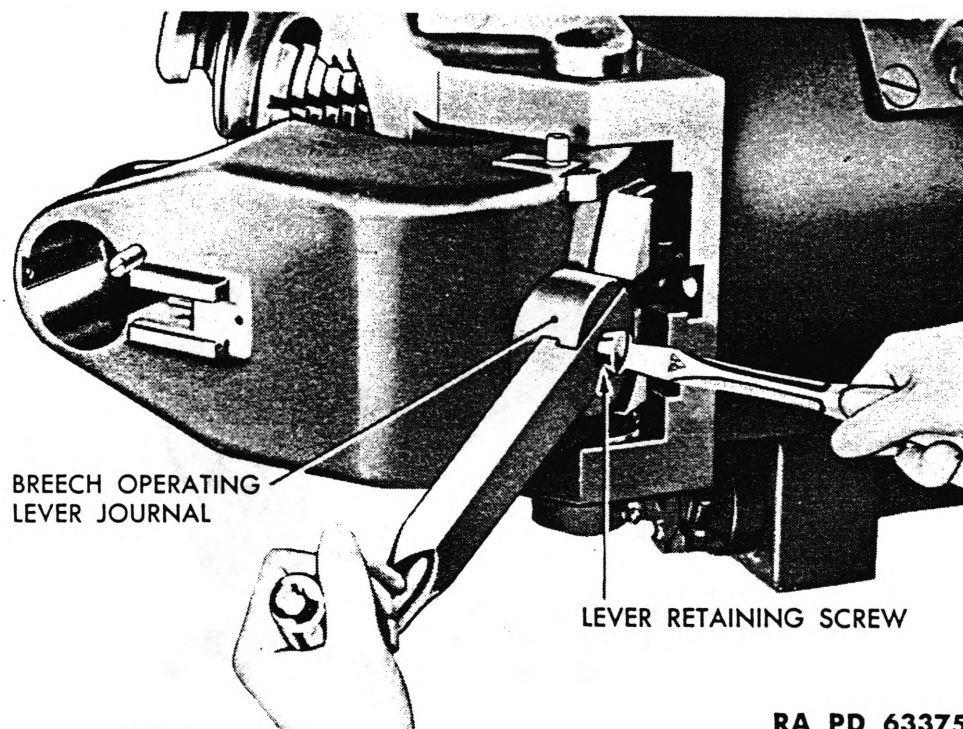


Figure 113—Removing Breech Operating Lever

driving washer generally will adhere to the carrier and should not be permitted to fall. Remove the breechblock alining wear replacement washer from the lower hinge pin lug.

CAUTION: The counterbalance mechanism is not to be disassembled except to correct malfunction or to replace damaged parts, and such work is only to be done by Ordnance maintenance personnel.

o. Cleaning and Oiling.

(1) Clean all parts thoroughly with SOLVENT, dry-cleaning. If powder residue is present, clean with the same solution used in cleaning the bore of the barrel. Be sure all powder stains and traces of rust are removed, using CLOTH, crocus, if necessary. Wipe the surfaces dry and remove all particles of grit by using clean CLOTHS, wiping. Lubricate as indicated in the Lubrication Order (guide) (fig. 82).

(2) Apply OIL, engine, SAE 10, to the gas check pad and rub it in well. This is to keep the pad compressible. A pad of the proper resiliency will yield slightly under heavy pressure from the thumbs.

67. ASSEMBLY OF BREECH MECHANISM.

a. Place the breechblock alinement wear replacement washer on

GUN AND CARRIAGE

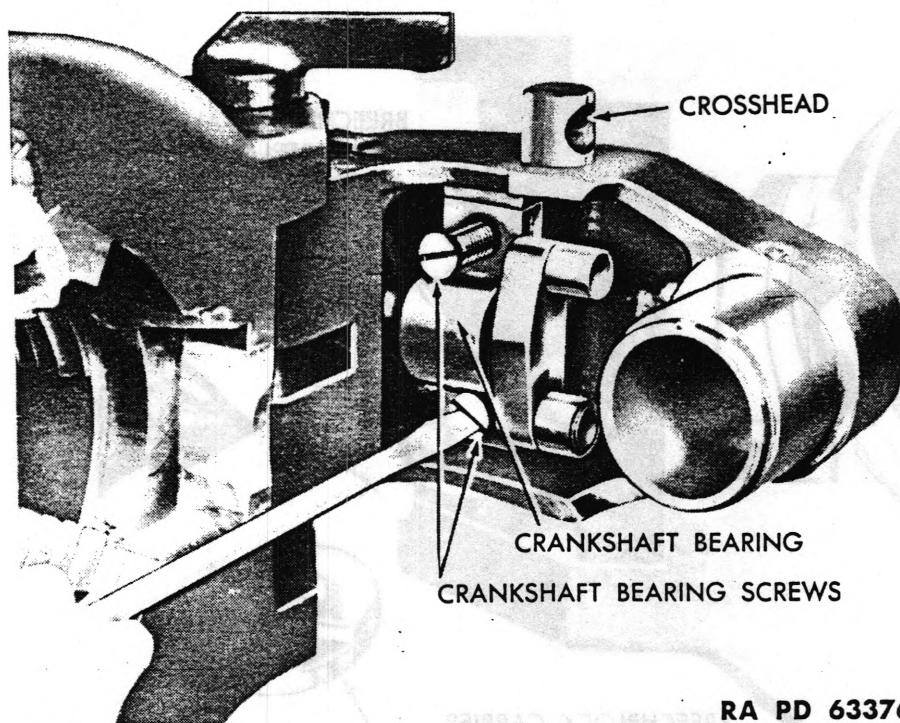


Figure 114—Removing Crankshaft Bearing

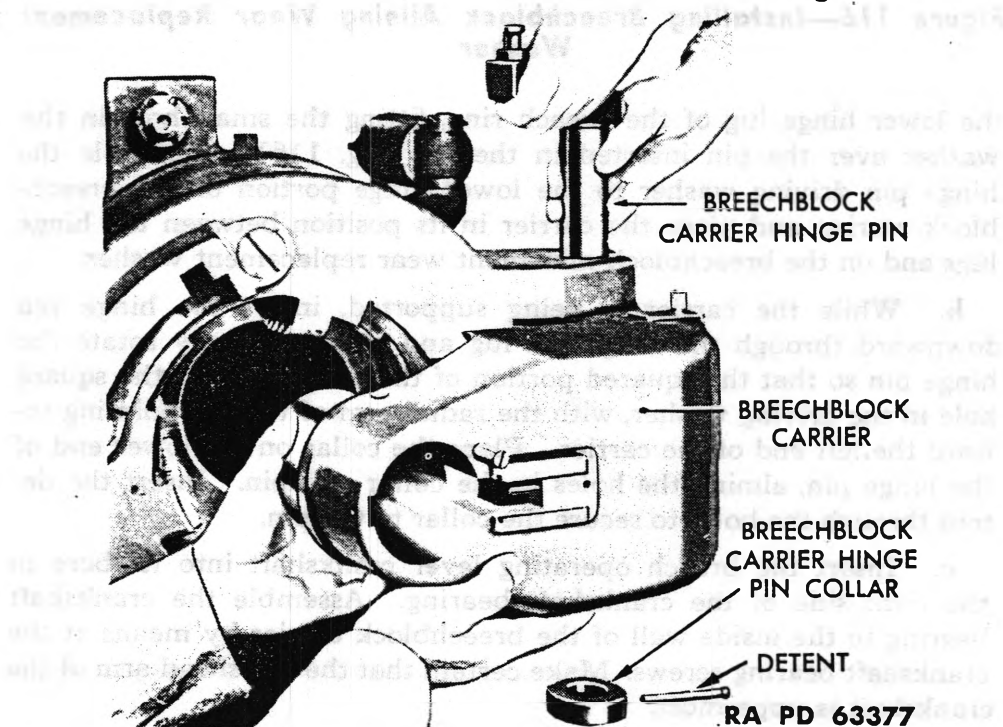


Figure 115—Removing Breechblock Carrier Hinge Pin

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

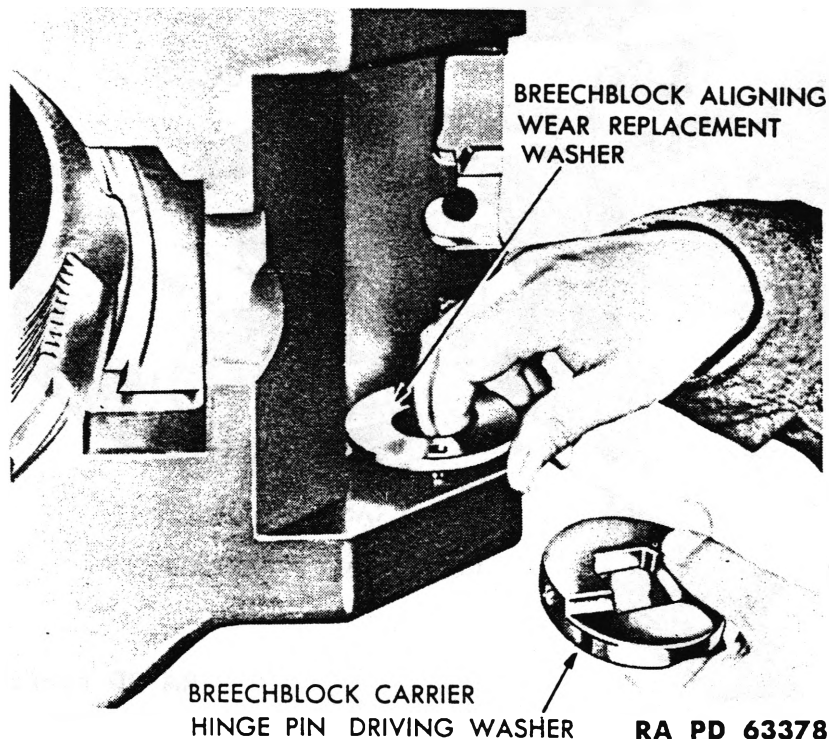


Figure 116—Installing Breechblock Alining Wear Replacement Washer

the lower hinge lug of the breech ring, fitting the small hole in the washer over the pin inserted in the lug (fig. 116). Assemble the hinge pin driving washer to the lower hinge portion of the breechblock carrier, and place the carrier in its position between the hinge lugs and on the breechblock alinement wear replacement washer.

b. While the carrier is being supported, insert the hinge pin downward through the hinge pin lug and carrier. Slowly rotate the hinge pin so that the squared portion of the pin will enter the square hole in the driving washer, with the radial arm of the pin pointing toward the left end of the carrier. Place the collar on the lower end of the hinge pin, alining the holes in the collar and pin. Insert the detent through the holes to secure the collar to the pin.

c. Insert the breech operating lever crankshaft into its bore in the right side of the crankshaft bearing. Assemble the crankshaft bearing to the inside wall of the breechblock carrier by means of the crankshaft bearing screws. Make certain that the crosshead arm of the crankshaft is uppermost.

d. Slide the breech operating lever journal on the right end of the crankshaft (fig. 117). Insert the breech operating lever into the

GUN AND CARRIAGE

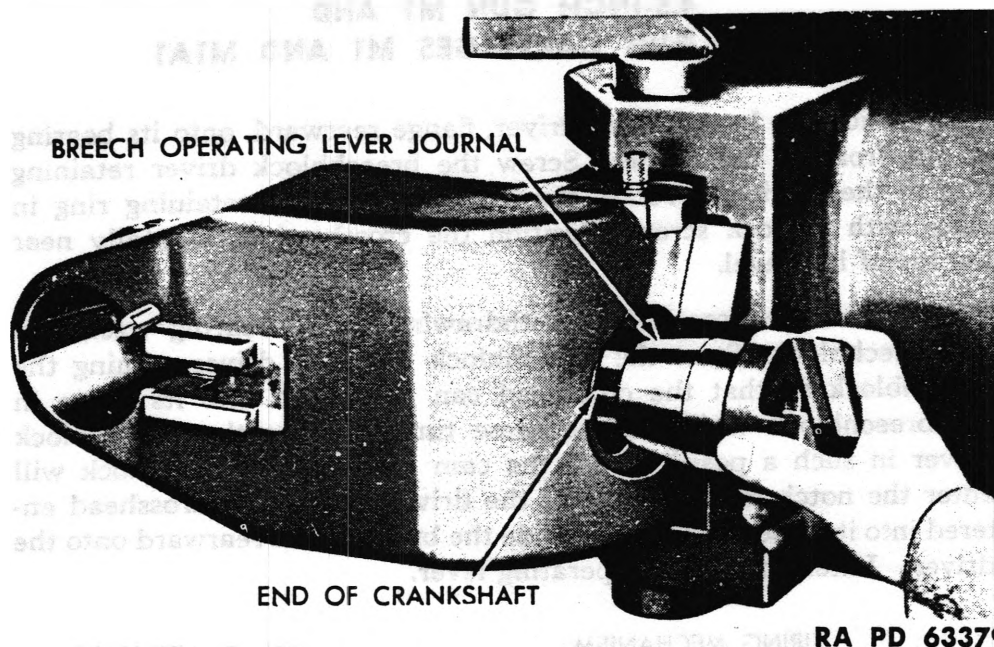


Figure 117—Inserting Breech Operating Lever Journal

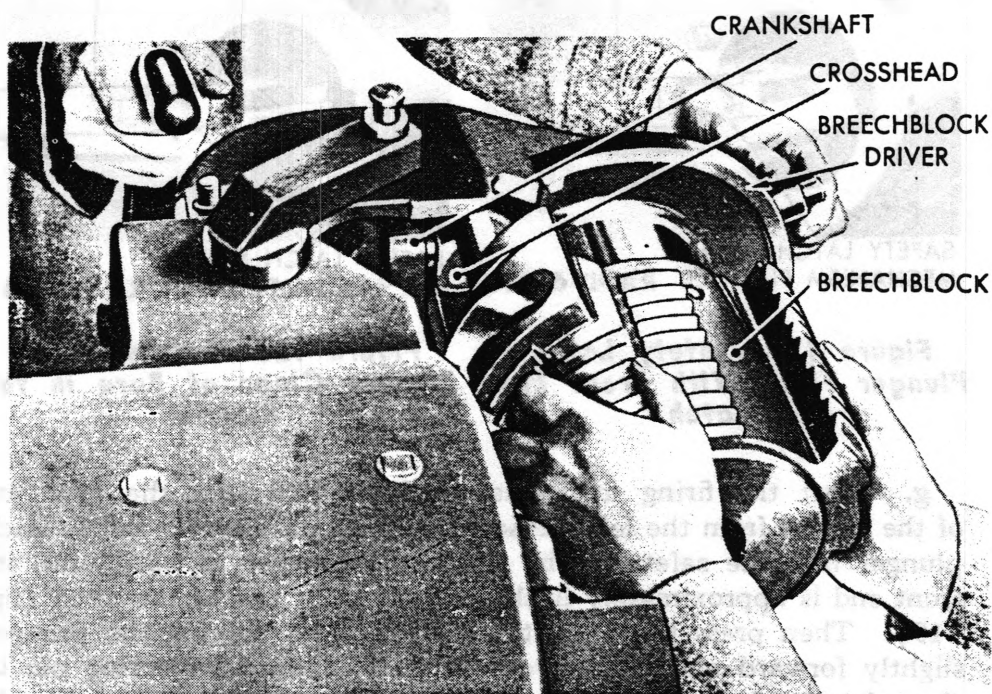


Figure 118—Installing Breechblock

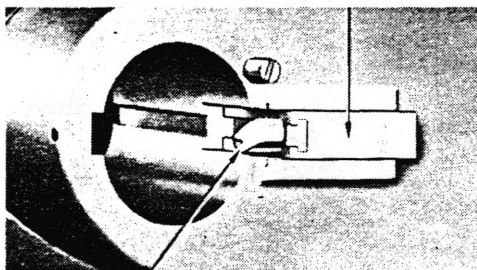
slot in the journal, handle upward, and secure the lever to the crankshaft with the breech operating lever retaining screw. Place the crosshead on its pivot on the arm of the crankshaft.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

e. Slide the breechblock driver, flange rearward, onto its bearing on the front of the carrier. Screw the breechblock driver retaining ring to the carrier to retain the driver. Lock the retaining ring in place with its lock screw. Position the crosshead horizontally near the top of its travel.

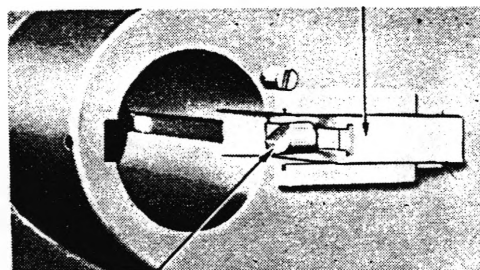
f. Insert the breechblock withdrawing spring bearing washer in the breechblock. Start the breechblock onto the driver, alining the breechblock so that the crosshead can be guided into its groove in the breechblock while, at the same time, holding the breechblock driver in such a position that the cam lug on the breechblock will enter the notch in the flange of the driver. With the crosshead entered into its groove (fig. 118), slide the breechblock rearward onto the driver. Latch the breech operating lever.

FIRING MECHANISM
SAFETY LATCH



SAFETY LATCH FIRING
MECHANISM PLUNGER RAPD 63318

FIRING MECHANISM
SAFETY LATCH



SAFETY LATCH FIRING
MECHANISM PLUNGER RA PD 63319

**Figure 119—Safety Latch
Plunger Flush With Front End
of Latch**

**Figure 120—Safety Latch
Plunger Clear of Bore in the
Carrier**

g. Start the firing mechanism safety latch into the rear lug of the carrier from the left. Insert the firing mechanism safety latch plunger into the safety latch. Push the plunger forward until its front end is approximately flush with the front end of the latch (fig. 119). Then press the latch toward the right, moving the plunger slightly forward and backward until the leftward-projecting pin in the safety latch recess of the carrier enters the hole in the right side of the body of the plunger. Push the latch and plunger to the right as far as they will go (fig. 120). The plunger will now clear the bore of the carrier and permit assembly of the breechblock carrier adapter.

CAUTION: Under no circumstances should the breechblock be swung into the breech recess until the obturator spindle, pad, rings, and disk have been properly secured in position by inserting the

GUN AND CARRIAGE

breechblock withdrawing spring, and breechblock carrier adapter, and screwing the firing mechanism housing to the correct assembled position on the obturator spindle (par. 66a).

h. Place the front split ring (smaller diameter) B163614, gas check pad C70647, rear split ring B163615, inner ring A206739, and gas check pad disk, in the order named, on the rear of the head of the obturator spindle (fig. 9). Insert the spindle into the bore of the breechblock.

i. Place the breechblock withdrawing spring into the rear bore of the carrier and press the breechblock carrier adapter in behind the spring, fitting the key on the left side of the adapter into the keyway in the left wall of the carrier bore, and the keys in the hole in the front of the adapter in the keyways in the sides of the stem of the obturator spindle. Insert the firing mechanism housing into the adapter and, while pressing forward on the adapter to compress the spring, screw the housing onto the rear end of the obturator spindle. Check the split rings for proper position under the head of the obturator spindle.

j. Screw the firing mechanism housing onto the obturator spindle as far as it will go (approximately 7 full turns) and then back it off slightly to the nearest position in which the slot in the housing will align with the firing mechanism safety latch plunger on the rear face of the breechblock carrier. This must be done to allow the plunger to enter the slot freely.

k. Investigation of reports from the field regarding malfunctions due to blowbacks of the primer occurring in weapons equipped with Firing Mechanism MI, indicate that these malfunctions are usually caused by excessive space between the Firing Mechanism MI and the obturator spindle plug. This space is commonly called "headspace." Unless the firing mechanism housing is screwed onto the obturator spindle approximately 7 full turns, excessive headspace will be obtained.

l. Headspace gage 41-G-200-700 has been designed to check assembly for proper headspace. Insert the gage in the firing mechanism housing as shown in figure 121. Space between the shoulder of the gage and the housing as shown in figure 121 A denotes proper assembly and proper headspace. If the shoulder of the gage rests on the housing as shown in figure 121 B, improper assembly and excessive headspace is denoted. When this condition exists, the firing mechanism housing must be screwed one or two complete turns farther onto the obturator spindle. Then the headspace should again be checked.

m. Push the safety latch to the left, inserting the pointed end of the plunger in the holes in the adapter and housing. Insert the

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

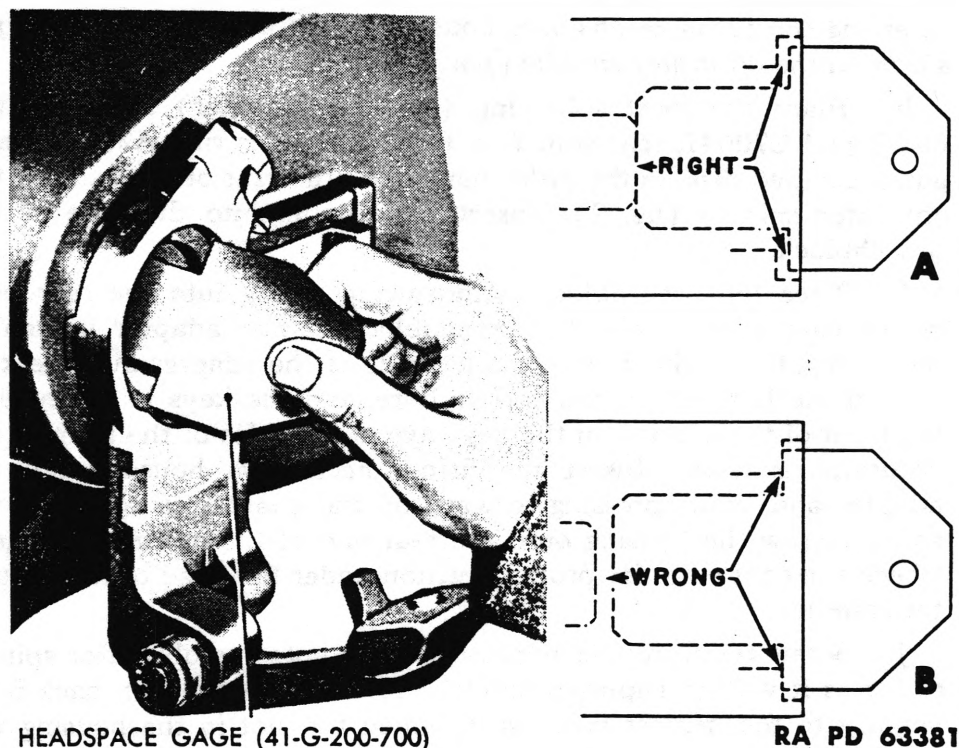


Figure 121—Checking "Headspace" With Headspace Gage

firing mechanism safety latch spring into the hole in the right end of the safety latch and assemble the stop to the carrier with its retaining socket-head screw. Test the safety latch against its stop.

n. Lower the breech operating lever against its open position stop on the carrier and carefully swing the carrier to closed position, easing the breechblock into the breech recess without permitting the edges of one part to strike those of another. Insert the breech operating lever control arc into its slot in the hinge lug of the breech ring. Secure the arc with its retaining screw.

o. Swing open the breechblock carrier slightly until the slotted eye on the end of the breechblock carrier counterbalance piston rod can be placed over the head of the pin on the arm of the carrier hinge pin. Swing open the carrier sufficiently to permit the U-block or spacer to be removed. Close the breech and lubricate through the fittings as indicated on the Lubrication Order (guide) (fig. 82).

68. DISASSEMBLY AND ASSEMBLY OF BREECH OPERATING LEVER CLOSING LATCH.

a. **Disassembly.** Unscrew the knob of the breech operating lever closing latch to the left (counterclockwise). When the knob is with-

GUN AND CARRIAGE

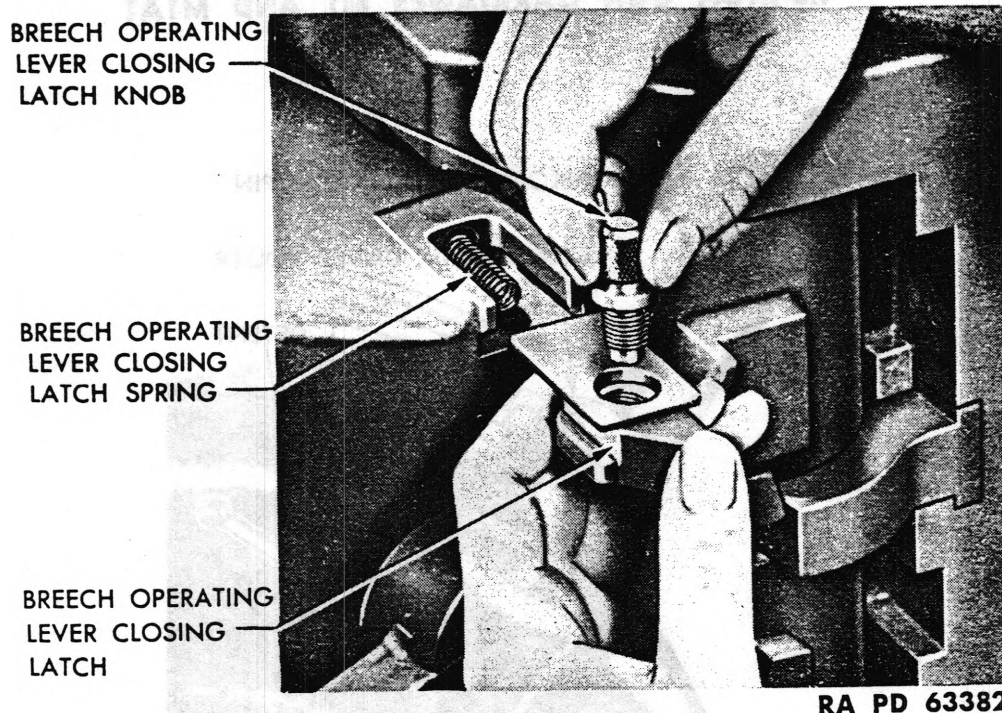


Figure 122—Disassembled View of Breech Operating Lever Closing Latch

drawn, the latch will slide outwardly to the right under the tension of its spring (fig. 122). Clean and lubricate.

b. Assembly. Insert the spring in its bore in the back of the latch recess. Slide the latch into its groove and hold it against the tension of the spring until the knob can be screwed home.

69. DISASSEMBLY AND ASSEMBLY OF BREECHBLOCK DRIVER ROLLER.

a. Disassembly. Remove the detent from the breechblock driver roller lug on the rear face of the breechblock driver. Withdraw the breechblock driver roller pin and release the breechblock driver roller (fig. 123).

b. Assembly. Slide the breechblock driver roller on its pin and insert the pin in the bore of the breechblock driver roller lug on the driver. Aline the holes in the pin and lug and insert the detent.

70. DISASSEMBLY AND ASSEMBLY OF WHEELS AND WHEEL HUBS.

a. Remove Wheel. Jack the carriage wheels off the ground with the firing jack. With the wheel stud nut socket wrench 41-W-3843-10 and the socket wrench handle 41-H-1541, remove the inner circle of 10 large hexagon wheel retaining cap nuts A157225 (fig. 124). The

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

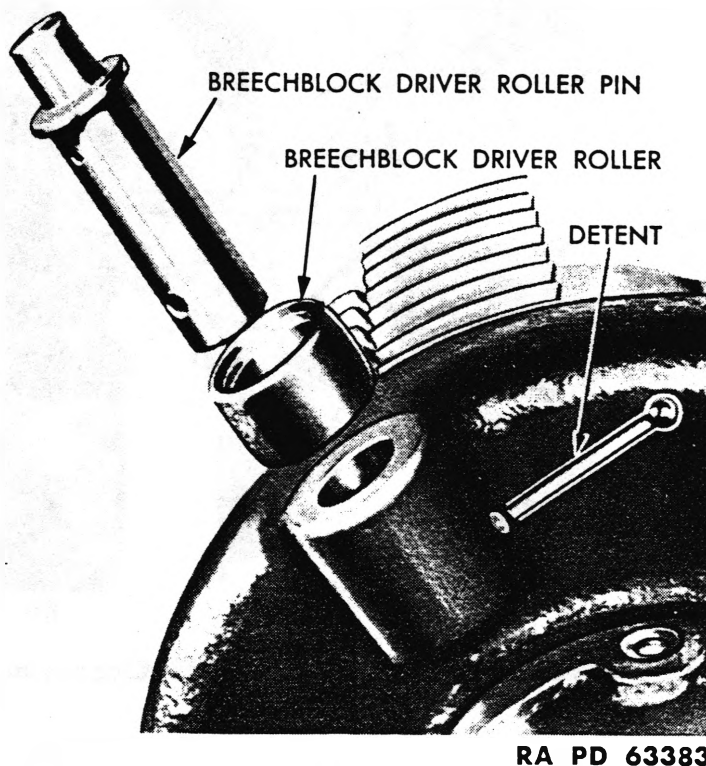


Figure 123—Exploded View of Breechblock Driver Roller

nuts on both wheels have right-hand threads and are turned counter-clockwise to remove. Tip out the top of the tire and wheel assembly to allow the wheel to clear the hub and roll the assembly out of the way.

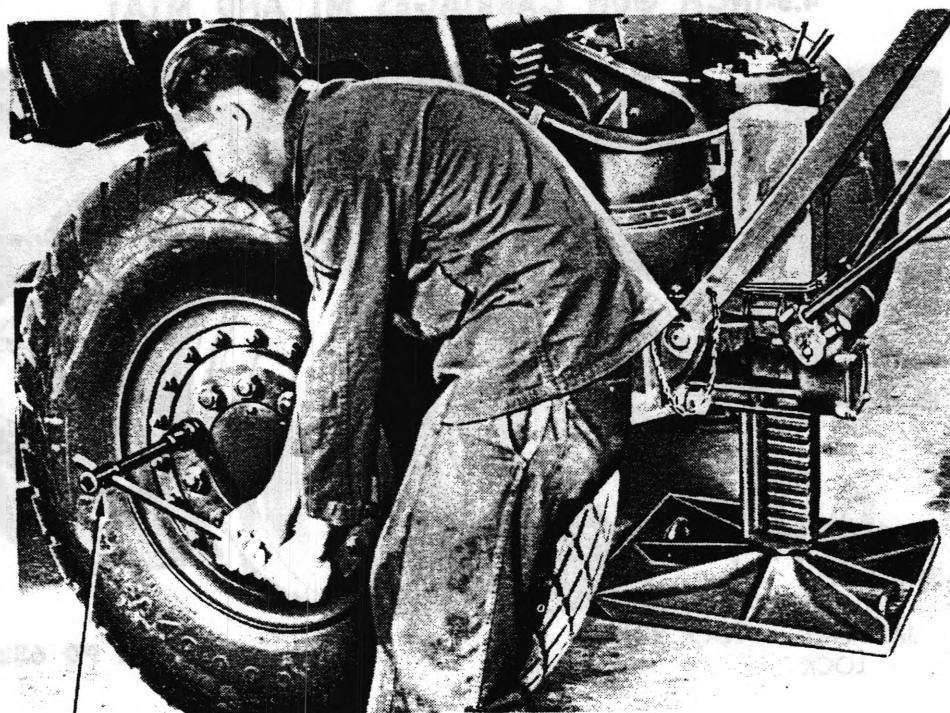
NOTE: Despite the fact that the tire and wheel assembly weighs approximately 600 pounds, it may be rolled easily if kept in an upright position.

b. Remove Wheel Bearings.

NOTE: The bearing adjusting and wheel retaining parts of the 4.5-inch Gun Carriages M1 and M1A1 are identical. The illustrations show the removal and installation of M1A1 Carriage parts, except as indicated.

(1) Remove the wheel hub cap and gasket by removing the four small hexagon-head cap screws. Straighten the edge of the wheel spindle jam nut lock which is bent over the wheel spindle jam nut (fig. 125). Using the wheel spindle nut wrench 41-W-3252-125, unscrew the jam nut (fig. 126).

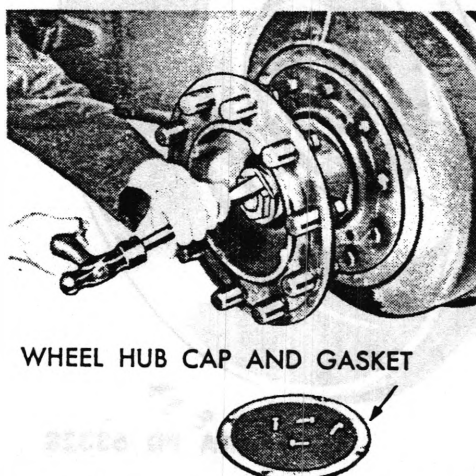
GUN AND CARRIAGE



SOCKET WRENCH (41-W-3843-10) WITH HANDLE (41-H-1541) RA PD 63324

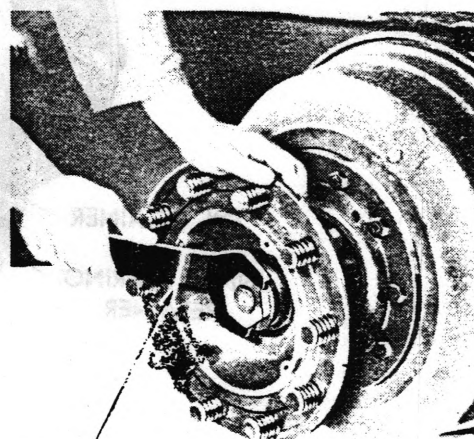
Figure 124—Removing Carriage Wheel

- (2) Draw the jam nut lock and the wheel spindle pin nut lock ring (fig. 127) from the wheel spindle. Using the spanner end of the wheel spindle nut wrench, unscrew the wheel spindle pin nut.
- (3) Slide the hub and brake drum assembly outwardly on the



WHEEL HUB CAP AND GASKET

RA PD 63325



WHEEL SPINDLE NUT WRENCH
(41-W-3252-125) RA PD 63326

**Figure 125—Straightening
Wheel Spindle Jam Nut Lock**

**Figure 126—Removing Wheel
Spindle Jam Nut**

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

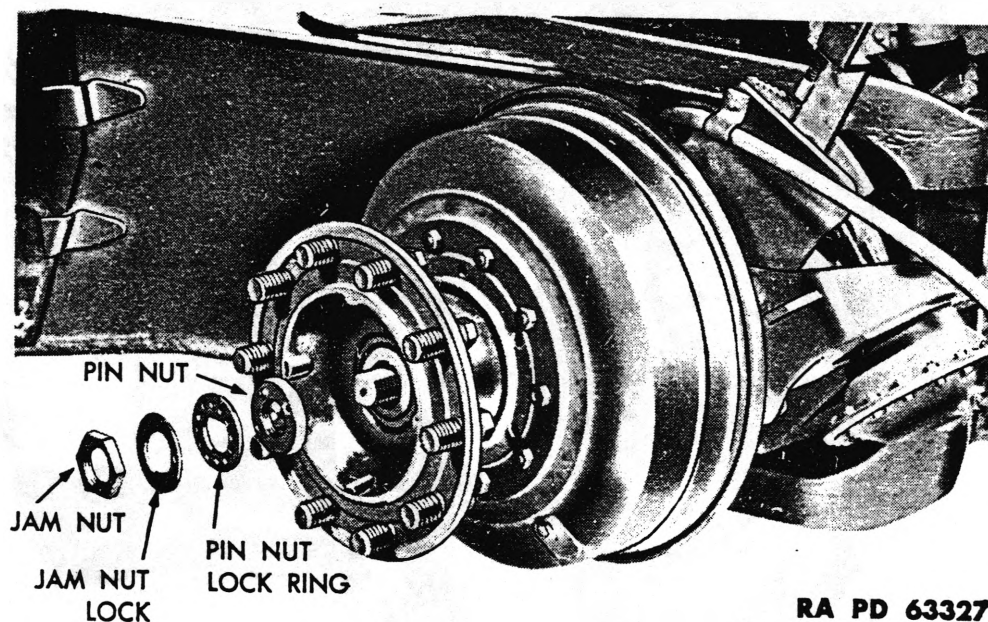


Figure 127—Exploded View of Bearing Adjusting and Wheel Retaining Parts

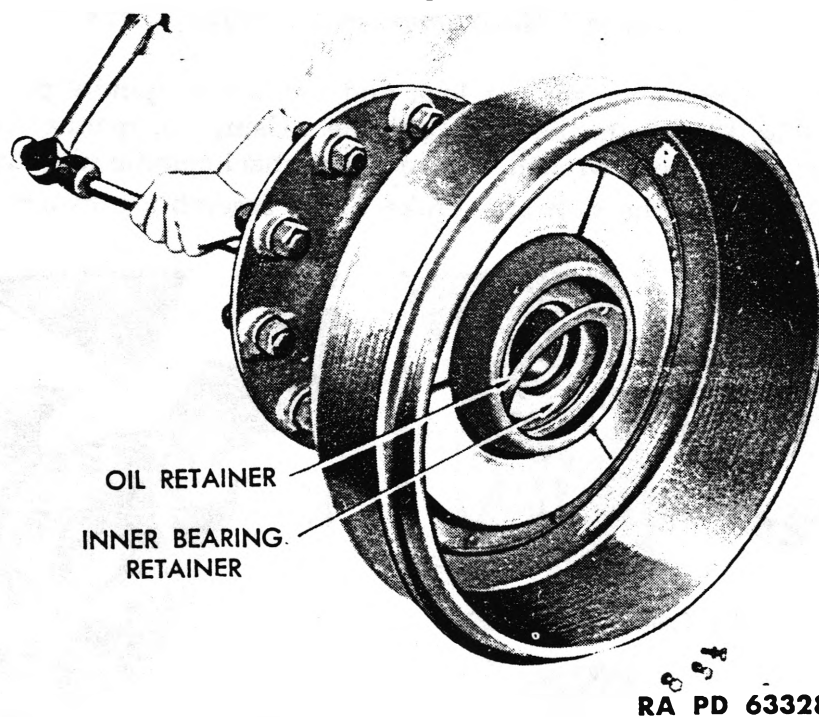


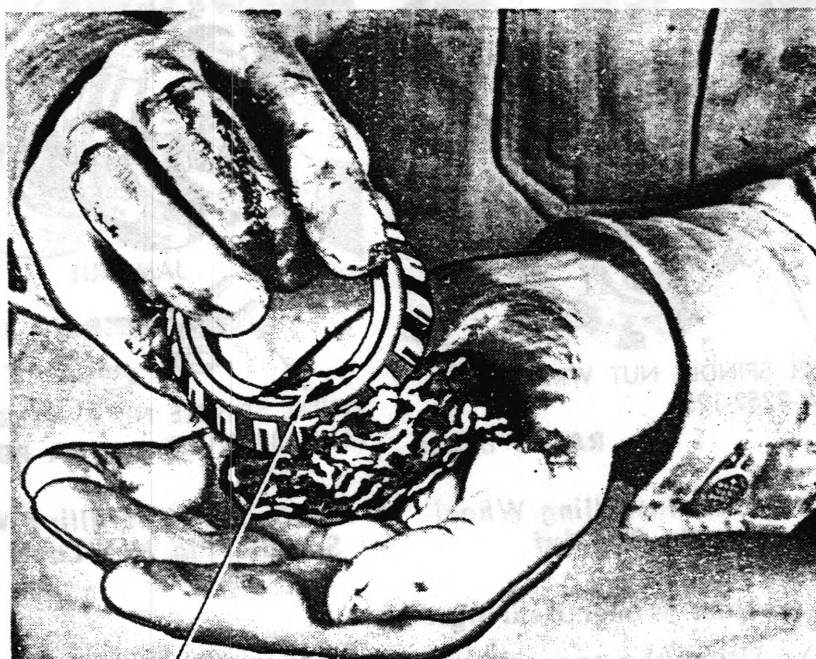
Figure 128—Removing Inner Wheel Spindle Roller Bearing (M1)

wheel spindle sufficiently to loosen the outer wheel spindle roller bearing. Remove the bearing. Two men should then remove the hub and

GUN AND CARRIAGE

brake drum assembly from the wheel spindle, exercising care to prevent injury to the oil retainer of the inner wheel spindle roller bearing.

(4) Remove the three hexagon-head cap screws which hold the wheel spindle inner bearing retainer. Tip this retainer at an angle. Tap out the inner wheel spindle roller bearing and oil retainer by driving against the bearing cone through the hub (fig. 128), forcing out these parts evenly by tapping all around the edges of the cone. The tipped out inner bearing retainer will permit the easy removal of the oil retainer and bearing without necessitating the removal of the brake grease guard from the brake drum.



GREASE FORCED THROUGH BEARING

RA PD 63329

Figure 129—Lubricating Bearing

c. **Lubricate Bearings.** Instructions for lubricating bearings are given in paragraph 47d (3). If no bearing packer is available, a ball of the proper grease should be placed in the palm of the hand and the grease should be kneaded into the opening at one edge of the roller cage until it protrudes from the opposite edge (fig. 129). This will insure that the cage is completely filled with lubricant.

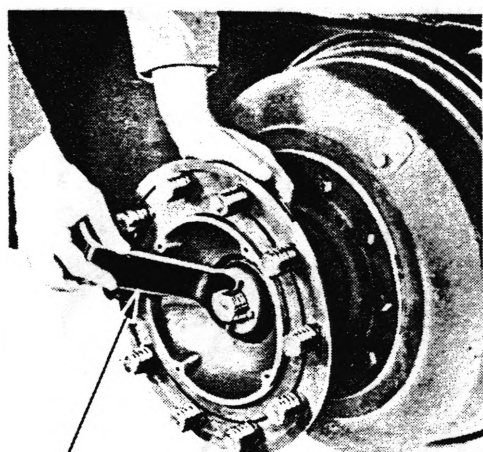
d. **Install Wheel Bearings.**

(1) Tip the inner bearing retainer at an angle to provide room to insert the inner bearing in position in its cup in the hub. Insert the oil retainer in the same manner. Install the bearing and the oil retainer by tapping the oil retainer into position with a brass drift.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

Tap it evenly so as not to bend it nor get it out of shape. Make sure the oil retainer is correctly in position. Install the inner bearing retainer in position with its three hexagon-head cap screws.

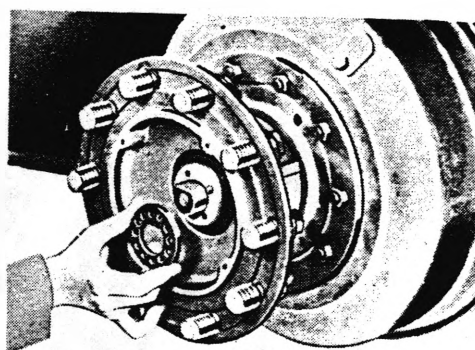
(2) Slide the hub and brake drum assembly on the wheel spindle, keeping it straight with the wheel spindle to prevent damage to the oil retainer. Install the outer wheel bearing.



WHEEL SPINDLE NUT WRENCH
(41-W-3252-125)

RA PD 63330

**Figure 130—Installing Wheel
Spindle Pin Nut**



JAM NUT
JAM NUT LOCK
WHEEL SPINDLE NUT WRENCH
(41-W-3252-125)

RA PD 63331

**Figure 131—Installing Wheel
Spindle Pin Nut Lock Ring**

e. Adjust Wheel Bearings.

(1) Using the spanner end of the wheel spindle nut wrench, screw on the wheel spindle pin nut (fig. 130) until the bearings are tight, yet the hub and brake drum assembly can be rotated without binding. The correct adjustment can be made by turning the pin nut so tightly that the hub and brake drum assembly cannot be turned without exerting considerable pressure, and then backing it off about one-sixth of a turn.

(2) Install the wheel spindle pin nut lock ring (fig. 131), making certain that the dowel pin on the pin nut enters a hole in the pin nut lock ring. It may be necessary to turn the lock ring over, or even to turn the pin nut one way or the other to permit the dowel pin to enter one of the holes in the lock ring. The bearing adjustment should not be changed farther than the next hole in the lock ring.

(3) Place the wheel spindle jam nut lock on the spindle and screw on the wheel spindle jam nut. Tighten the jam nut securely, tapping the handle of the wheel spindle nut wrench sharply with a

GUN AND CARRIAGE

hammer to insure the proper seating of the jam nut. Rotate the hub to test the freedom with which it turns, as the pin nut may have become tightened during the tightening of the jam nut. If such is the case, remove the jam nut and repeat the bearing adjustment.

CAUTION: Do not attempt to loosen the bearing adjustment by merely loosening the jam nut. This might permanently damage the bearings, wheel spindle, and hub.

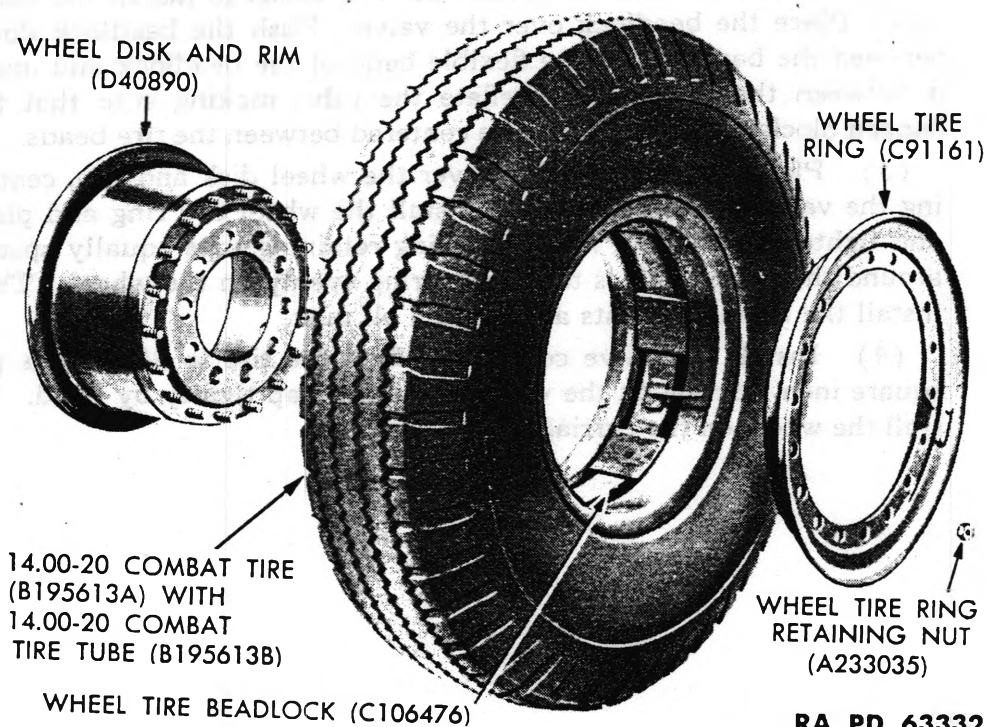
f. **To Install Carriage Wheel.** Roll the carriage wheel and tire assembly to the hub. Rock the wheel to get the lower portion under the hub and turn the hub to align the disk and rim wheel studs with the holes in the wheel disk. Install the wheel retaining cap nuts. With the wheel stud nut socket wrench, continue to tighten the cap nuts in rotation until all are as tight as possible.

71. REMOVAL AND INSTALLATION OF TIRES.

NOTE: For maintenance and care of pneumatic tires and rubber treads, refer to TM 31-200.

a. Removal.

(1) Remove the wheel from the carriage (par. 70 a). Remove the wheel tire valve cap and core.



RA PD 63332

Figure 132—Wheel and Tire—Disassembly

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

CAUTION: *Tires must be completely deflated before any attempt is made to remove wheel tire ring retaining nuts. An inflated tire may blow a partially removed wheel tire ring off the wheel and cause serious injury to personnel.*

(2) Remove all wheel tire ring retaining nuts A233035. Drive a tire iron between the wheel tire ring C91161 and the tire B195613A; then lift off the ring (fig. 132).

(3) Turn over the wheel disk and rim D40890 and tire, loosen the wheel from the tire by prying with a tire iron, and lift the wheel disk and rim out of the tire.

(4) Inflate the combat tire tube B195613B until the tire beads spread away from the flanged blocks of the wheel tire beadlock C106476. If the flange blocks of the beadlock stick to the tire, pry them loose with a tire iron. Pull out the beadlock.

(5) Deflate the tube and remove the tube.

h. Installation.

(1) Be sure that all dirt and rust have been removed from the tire and that the tube is clean; then insert the tube.

(2) Inflate the tube to spread the tire beads to install the beadlock. Place the beadlock over the valve. Push the beadlock down between the beads. Fold the flexible band of the beadlock and insert it between the tire beads. Deflate the tube, making sure that the flanged blocks of the beadlock are centered between the tire beads.

(3) Place the tire assembly over the wheel disk and rim, centering the valve in the valve slot. Install the wheel tire ring and place and tighten four of the wheel tire ring retaining nuts equally spaced around the wheel; this is to seat the ring evenly on the wheel. Then install the remaining nuts and tighten all nuts.

(4) Install the valve core and inflate the tire to 95 pounds per square inch. Screw on the wheel tire valve cap tightly by hand. Install the wheel on the carriage (par. 70 f.)

CHAPTER 3

SIGHTING EQUIPMENT

72. SIGHTING AND FIRE CONTROL EQUIPMENT.

a. **Sighting Equipment.** The Telescope Mount M25 with the Panoramic Telescope M12 (figs. 133 to 137) and the Instrument Light M34 comprise the on-carriage sighting equipment used with the 4.5-inch Gun M1 and 4.5-inch Gun Carriages M1 and M1A1. This equipment is designed to lay the gun in azimuth and elevation for either direct or indirect fire. The Fuze Setter M23 is furnished for setting the Mechanical Time Fuze M67.

b. **Fire Control Equipment.** The off-carriage sighting and fire control equipment includes the following:

Binocular M13	Gunner's Quadrant M1
Pocket watch, 15 or more jewels, complete	Aiming Circle M1, complete
Wrist watch, 15 or more jewels	Compass M2
Stop watch, type B, class 15	1-meter Base Range Finder M7
Aiming Post Light M14	Firing Table FT-4.5-A-1
Aiming Post M1, complete	Graphical Firing Tables M13 and M20, complete
B.C. Telescope M65, complete	Bore sight and testing target

c. The off-carriage equipment listed in the preceding subparagraph is not covered in this manual. For detailed description of the bore sight and testing target, Binocular M13, the watches, and Gunner's Quadrant M1, refer to TM 9-575; and for the Compass M2, the Aiming Circle M1, and B.C. Telescope M65, refer to TM 6-220. For use of graphical firing tables, refer to TM 9-526. Refer to TM 9-585 for use of the 1-meter Base Range Finder M7.

73. CARE AND PRESERVATION.

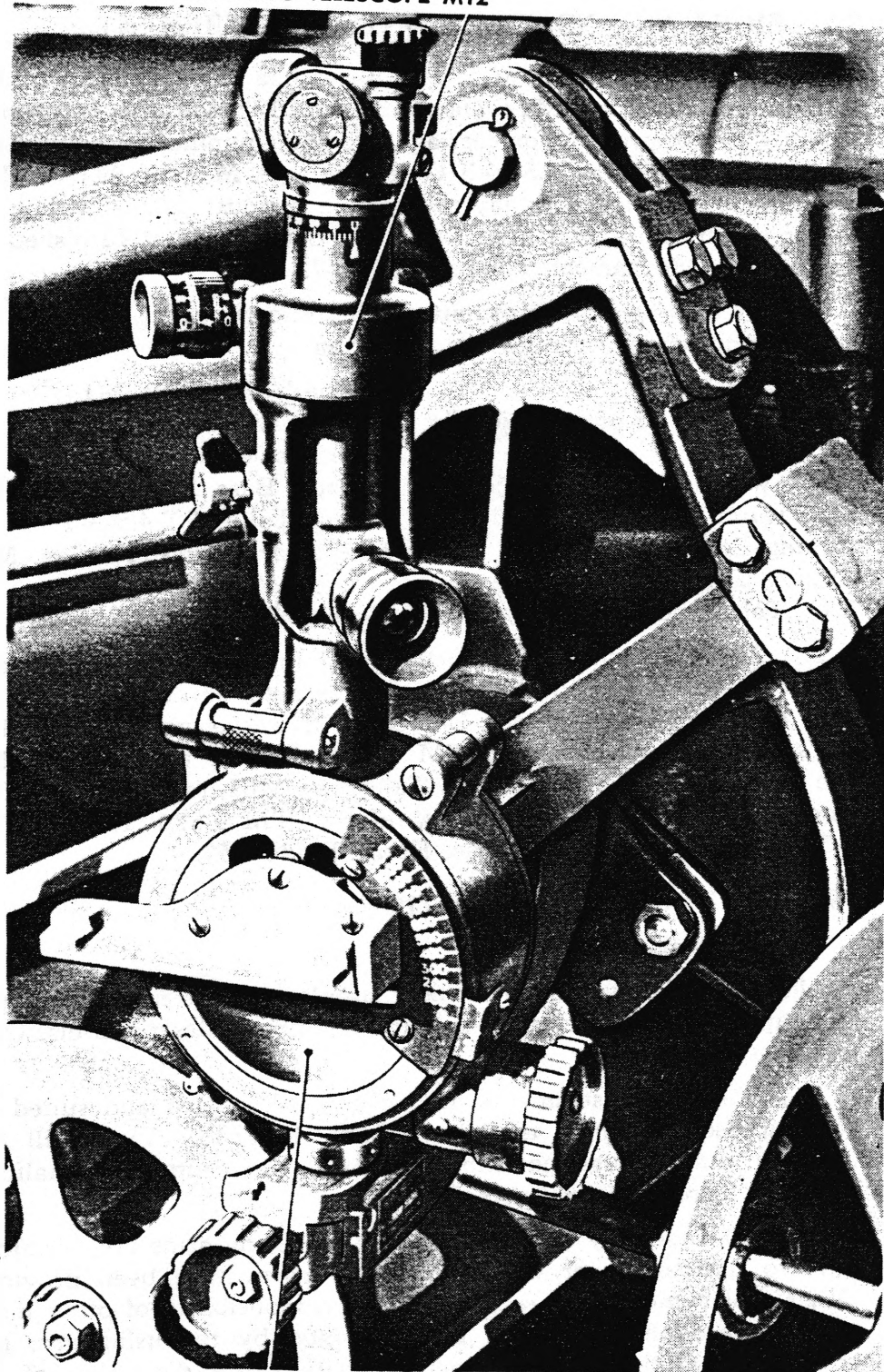
a. General.

(1) The instructions given here supplement the instructions pertaining to individual items of sighting equipment described elsewhere in this section.

(2) 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 mistreatment.

(3) Disassembly and assembly by the using arms are permitted only to the extent for which tools and parts have been provided. Other replacements and repairs are the responsibility of other maintenance personnel, but may be performed by the using arm personnel, when circumstances permit, within the discretion of the pertinent Ordnance officer.

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1
PANORAMIC TELESCOPE M12



TELESCOPE MOUNT M25

RA PD 63333

Figure 133—Telescope Mount M25 With Panoramic Telescope M12

SIGHTING EQUIPMENT

(4) Keep the instruments as dry as possible. If the instrument is wet, dry it carefully before placing it into its carrying case.

(5) When not in use, keep the instruments in the carrying case provided, or in the condition indicated for traveling.

(6) Any 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 to Ordnance personnel. Adjustments other than those for which tools have been provided are not to be performed by the using arms unless directed by the pertinent Ordnance officer.

(7) Many worm drives have throwout mechanisms to permit rapid motion through large angles. When using these mechanisms, it is essential that the throwout lever be fully depressed to prevent injury to the worm and gear teeth.

(8) Dry cell batteries should always be removed from the battery cases when not in use, in order that their deterioration on long standing will not damage the cases. When not in use, the various parts of the lights should be kept in the chest provided.

b. Optical Parts.

(1) To obtain satisfactory vision, it is necessary that the exposed surfaces of the lenses and other parts be kept clean and dry. Corrosion or etching of the surface of the glass interferes with the good optical qualities of the instrument; this can be prevented or greatly retarded by keeping the glass clean and dry.

(2) Under no condition will polishing liquids, pastes, or abrasives be used for polishing lenses and windows.

(3) For wiping optical parts, use only PAPER, lens, tissue. Use of cleaning cloths is not permitted. To remove dust, brush the glass lightly with a clean camel's-hair brush and rap the brush against a hard body in order to knock out the small particles of dust that cling to the hairs. Repeat this operation until all dust is removed. With some instruments, an additional brush with coarse bristles is provided for cleaning mechanical parts; it is essential that each brush be used only for the purpose intended.

(4) Exercise particular care to keep optical parts free from oil and grease. Do not wipe the lenses or windows with the fingers. To remove oil or grease from optical surfaces, apply SOAP, liquid, lens cleaning, sparingly with a tuft of clean lens paper, rubbing the surface dry gently with clean lens paper. If SOAP, liquid, lens cleaning, is not available, breathe heavily on the glass and wipe it off with clean lens paper; repeat this operation several times until the glass is clean.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

(5) Moisture may condense on the optical parts of the instrument when the temperature of the parts is lower than that of the surrounding air. This 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 damage of optical parts and inaccuracies of observation.

c. Lubricants.

(1) Where lubrication with oil is indicated, use OIL, lubricating, for aircraft instruments and machine guns, daily and after use.

(2) Where lubrication with grease is indicated, use GREASE, lubricating, special, weekly and after use.

(3) Wipe off all excess lubricant after application.

74. TELESCOPE MOUNT M25 WITH PANORAMIC TELESCOPE M12.

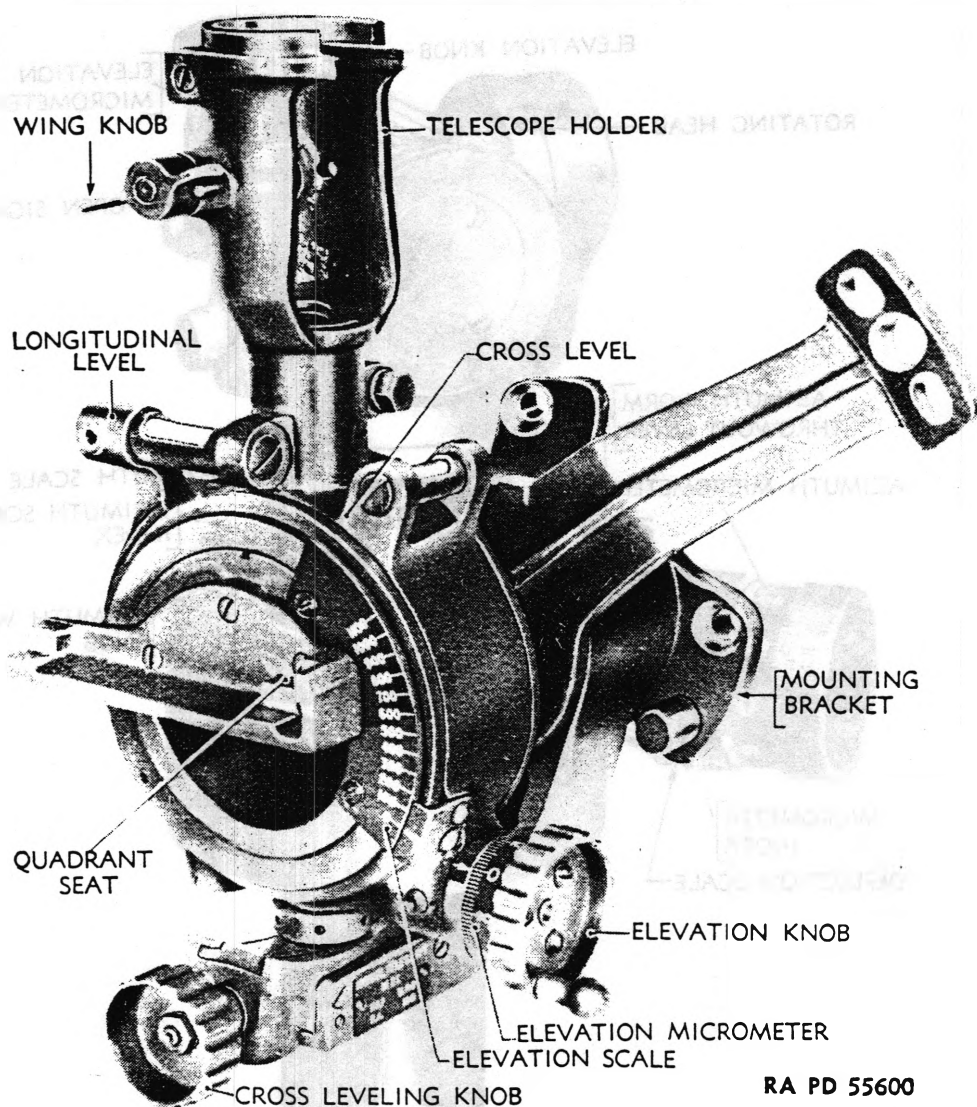
a. Description.

(1) The Telescope Mount M25 and the Panoramic Telescope M12 (figs. 133 to 137) are mounted on the left side of the 4.5-inch Gun Carriages M1 and M1A1 and form the sighting equipment for laying the gun in azimuth and elevation.

(2) The Telescope Mount M25 (fig. 134) contains longitudinal and cross-leveling mechanisms. The cross level is habitually kept centered by operating the cross-leveling knob. The centering of the cross-level bubble automatically introduces an azimuth correction which compensates for any error produced when the gun is elevated with the trunnions out of level. The longitudinal level is operated by the elevating knob. The centering of the longitudinal-level bubble places the azimuth scale of the telescope in a true horizontal plane, so that azimuth angles can be set accurately.

(3) The Panoramic Telescope M12 (fig. 135) is a conventional panoramic telescope with eyepiece offset 45 degrees to permit the observer to stand clear of the gun. It has cylindrical locating surfaces at the middle and bottom for centering the telescope in its socket. The line of sight is elevated or depressed by the elevation knob at the top, and coarse and fine index graduations are provided for the normal (zero elevation) position. The head is moved in azimuth by the azimuth worm knob which has a throwout lever to permit disengagement for rapid motion when required. The reticle (fig. 136) includes crosslines and a deflection scale graduated in 5-mil intervals and numbered at 50-mil intervals. The azimuth scale is graduated in 100-mil intervals, and indicates progressively from 0

SIGHTING EQUIPMENT



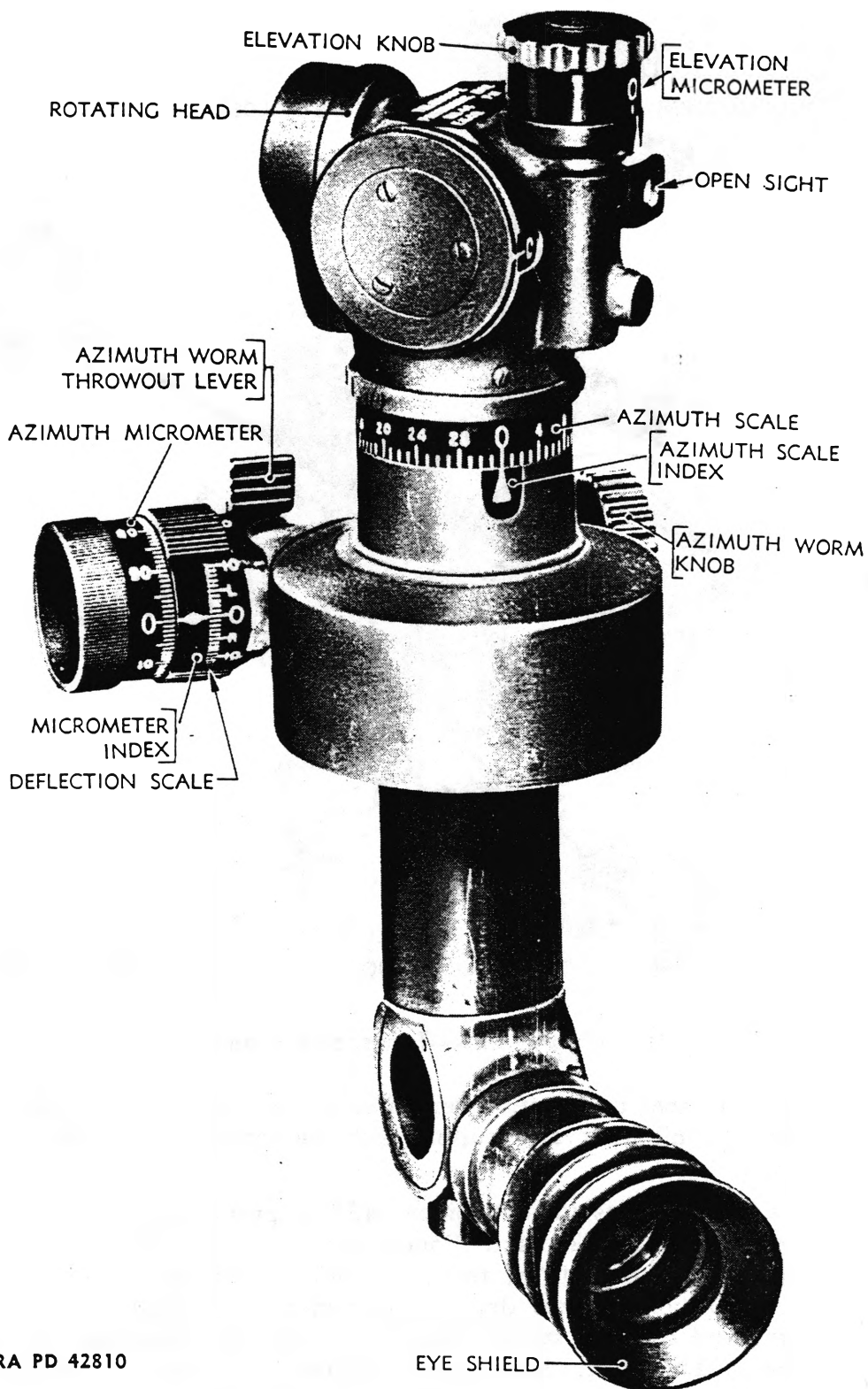
RA PD 55600

Figure 134—Telescope Mount M25

to 32 in two consecutive semicircles. Azimuth micrometer indications (1-mil intervals) supplement the indications on the azimuth scale.

(4) The Instrument Light M34 is provided for lighting Telescope Mount M25 and Panoramic Telescope M12. The light clamps to the body of the panoramic telescope. It consists of a case for holding two dry cell batteries, two plastic rods, a finger light and cable, a switch and two clamps for mounting the instrument. The plastic rods carry light from a single lamp to both the reticle and the azimuth micrometer of the panoramic telescope. The finger light is used for illuminating the elevation scale and micrometer

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 42810

Figure 135—Panoramic Telescope M12

SIGHTING EQUIPMENT

and for checking the level bubbles on the mount. The switch, protected by a shield, controls the lamps.

b. Operation.

(1) The Telescope Mount M25 and Panoramic Telescope M12 may be used in direct or indirect laying.

(2) To place the telescope in its socket, remove the telescope from the panoramic telescope case (fig. 137), turn the wing knob on the socket of the mount to its extreme counterclockwise position and place the telescope gently in the socket. Exert slight downward pressure to insure that the telescope is properly seated. Release the wing knob. Uncover both level vials of the telescope mount.

(3) **DIRECT AND INDIRECT LAYING FOR ELEVATION.** Three methods are available for setting the desired quadrant elevation into the telescope mount. It is essential that the mount be kept cross-leveled at all times during the operation. If the mount is not cross-leveled, an erroneous azimuth will be applied to the gun as it is elevated or depressed. The procedure for indirect laying is the same as for direct laying.

(a) *Method I.* Turn the elevation knob on the mount until the necessary quadrant elevation is indicated on the elevation scale and

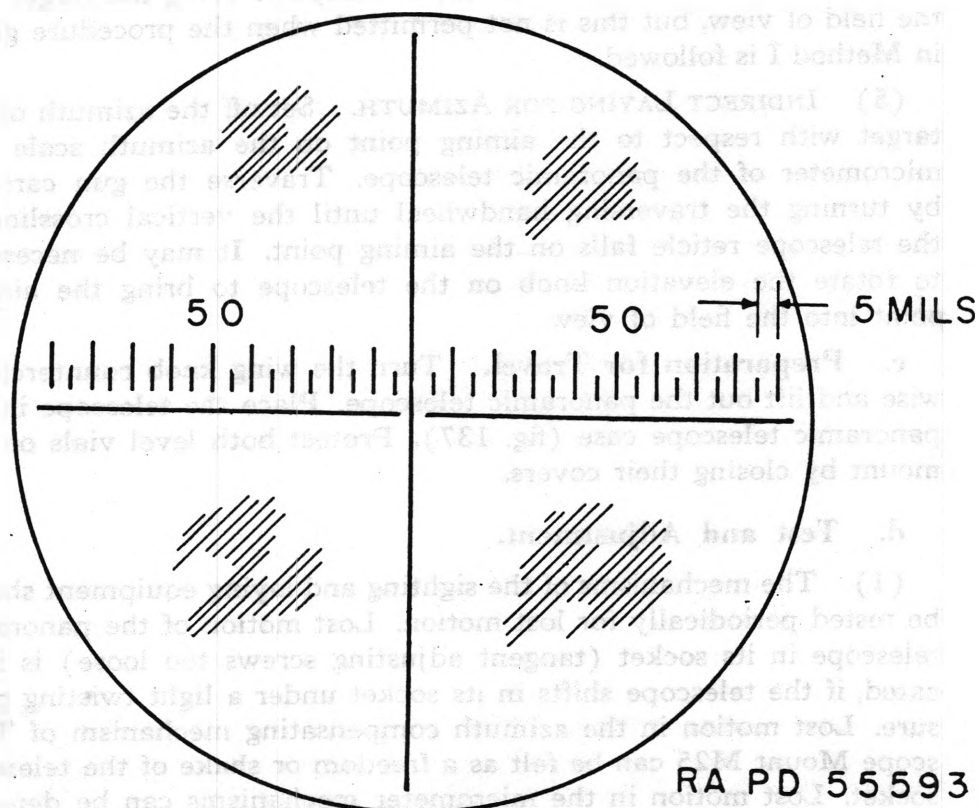


Figure 136—Panoramic Telescope M12—Reticle Pattern

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

micrometer. This operation depresses the mount by an angular displacement equal to the necessary gun elevation. Rotate the elevating handwheel of the gun carriage until the longitudinal-level bubble is centered. The gun is now laid in elevation.

(b) *Method II.* The angle of site and angle of elevation can be added algebraically by setting the elevation angle, as obtained from the firing table for the range, on the elevation scale and micrometer, and then elevating the gun until the intersection of the crosslines in the telescope fall on the target. When laying by this method, it is imperative that the elevation micrometer on the telescope be set at "0."

(c) *Method III.* When a high degree of accuracy is desired, proceed by Method I and then place an accurately set gunner's quadrant on the quadrant seat of the bracket. Rotate the elevating handwheel of the gun carriage until the level bubble of the quadrant is centered.

(4) **DIRECT LAYING FOR AZIMUTH.** Set off the required deflection correction on the azimuth micrometer of the telescope. Bring the crosslines of the reticle (fig. 136) to bear on the target by turning the traversing handwheel of the gun carriage. It may be necessary to rotate the elevation knob on the telescope to bring the target into the field of view, but this is not permitted when the procedure given in Method I is followed.

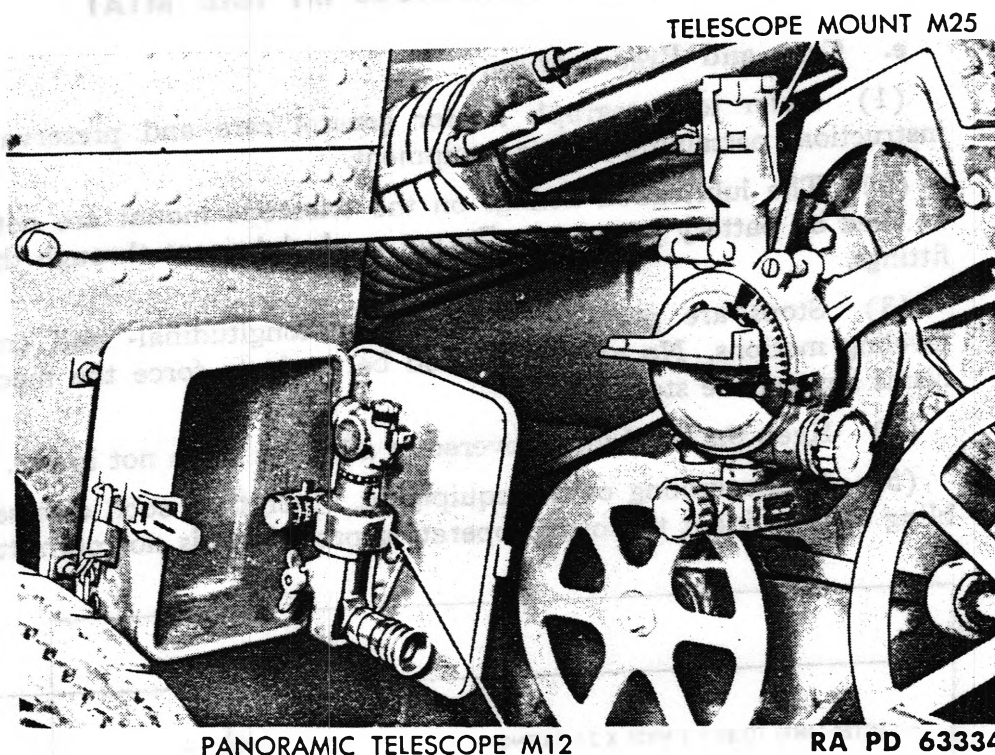
(5) **INDIRECT LAYING FOR AZIMUTH.** Set off the azimuth of the target with respect to the aiming point on the azimuth scale and micrometer of the panoramic telescope. Traverse the gun carriage by turning the traversing handwheel until the vertical crossline of the telescope reticle falls on the aiming point. It may be necessary to rotate the elevation knob on the telescope to bring the aiming point into the field of view.

c. **Preparation for Travel.** Turn the wing knob counterclockwise and lift out the panoramic telescope. Place the telescope in the panoramic telescope case (fig. 137). Protect both level vials on the mount by closing their covers.

d. **Test and Adjustment.**

(1) The mechanisms of the sighting and laying equipment should be tested periodically for lost motion. Lost motion of the panoramic telescope in its socket (tangent adjusting screws too loose) is indicated, if the telescope shifts in its socket under a light twisting pressure. Lost motion in the azimuth compensating mechanism of Telescope Mount M25 can be felt as a freedom or shake of the telescope socket. Lost motion in the micrometer mechanisms can be detected by operating the mechanism first in one direction and then in the

SIGHTING EQUIPMENT



PANORAMIC TELESCOPE M12

RA PD 63334

Figure 137—Panoramic Telescope M12 in Panoramic Telescope Case

opposite direction, returning both times to the same micrometer setting. If the telescope or level vial which is operated by the mechanism does not return to the same aiming point or level position, it is an indication of lost motion in the mechanism.

(2) The effect of small amounts of lost motion can be eliminated by habitually making the last movement always in the same direction. The last movement in setting and laying for deflection should be from left to right. The last movement in setting the scales should be in the direction of increasing the reading. Lost motion in the elevating mechanism of the carriage can be taken up by moving the elevating handwheel against the greatest resistance.

(3) If an appreciable degree of lost motion exists in the sighting equipment, adjustment should be made without delay by Ordnance personnel. Qualified battery personnel are authorized to correct looseness of the panoramic telescope in the socket of the mount by an adjustment of the tangent adjusting screws. Care must be exercised that there is no undue pressure by the tangent screws. The panoramic telescope should seat firmly without binding.

(4) Bore sighting procedure for verification and alinement of telescope mount and telescope is described in paragraph 76.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

e. Care and Preservation.

(1) Refer to paragraph 73 for general care and preservation instructions pertaining to this equipment.

(2) The lubrication fittings on the telescope mount are not to be used by battery personnel. Do not apply lubricant through these fittings.

(3) Stops are provided to limit the longitudinal- and cross-leveling motions. No attempt should be made to force the mechanisms beyond the stops.

(4) Keep the level vials covered at all times when not in use.

(5) Disassembling of the equipment, other than such disassembling as is incident to normal operating procedure, is not permitted.

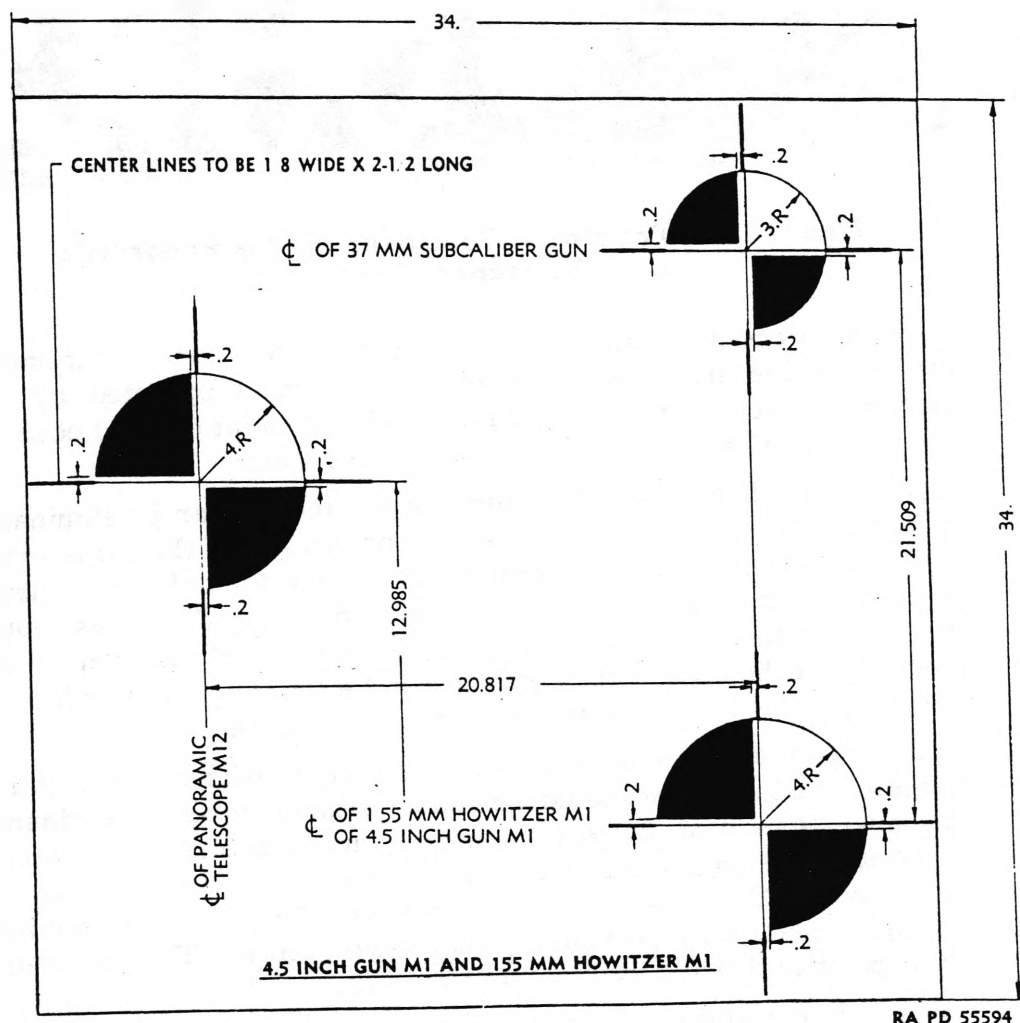


Figure 138—Testing Target

SIGHTING EQUIPMENT

(6) When using the throwout lever of the panoramic telescope, push the lever all the way against its stop. If the lever is pushed only part of the way, the gear teeth inside the telescope will scrape against each other as the head is rotated and will wear rapidly.

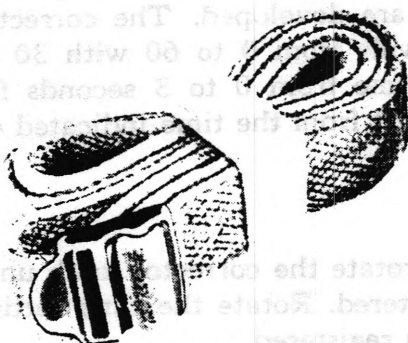
75. TESTING TARGET.

a. The testing target (fig. 138) is used during the bore-sighting operation (par. 76) for the alinement of sights and subcaliber equipment with the axis of the bore of the gun. The several aiming points are plainly designated. It is essential that the proper aiming points be selected for the materiel and equipment employed, and that the target be positioned in a vertical plane when in use. The normal distance from the gun at which the target should be located is about 50 yards.

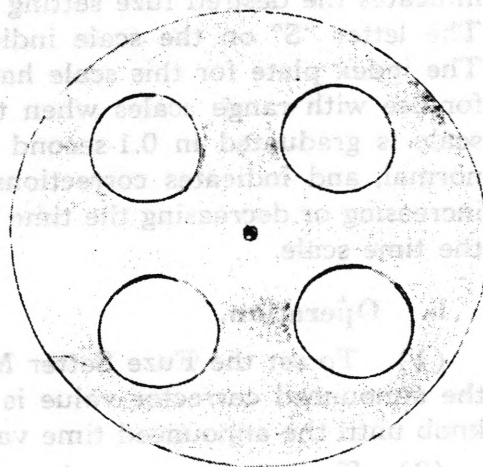
76. PROCEDURE FOR BORE SIGHTING.

a. The equipment required for bore sighting consists of the bore sight (fig. 139) and testing target (fig. 138). The procedure for bore sighting is as follows:

(1) Level the carriage transversely (axis of trunnions) and longitudinally (axis of bore). Place the testing target about 50 yards away from, and in a plane perpendicular to, the bore of the gun. Place the bore sights in the gun and move the testing target until the center line of the bore, as determined by the bore sights, pierces the lowest circle of the testing target. The placement of the target in the vertical plane should be verified by a plumb line. Set the panoramic telescope azimuth, deflection, and elevation at "0." The



MUZZLE BORE SIGHT



BREECH BORE SIGHT

RA PD 55576

Figure 139—Breech and Muzzle Bore Sights

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

center of the circle corresponding to the line of sight of the panoramic telescope should then appear exactly at the intersection of the cross-lines on the reticle.

(2) Failure of the center of this circle and the crosslines to coincide vertically indicates that the elevation knob of the panoramic telescope (fig. 135) is out of adjustment. Rotate the knob until the line of sight pierces the target on the horizontal center line. Loosen the locking screw at the center of the knob, slip the knob until the "0" is in line with the index and tighten the locking screw. Do not lift the knob during this adjustment as such movement may cause disarrangement of the stop rings within the knob.

(3) Failure of the circle and reticle to coincide laterally indicates that the azimuth micrometer is out of adjustment. Rotate the azimuth worm knob until the line of sight pierces the corresponding target on the vertical center line. Loosen the locking screw at the center of the micrometer index and slip the index until the arrow is in line with the "0" of the deflection knob (set to "0" against the deflection index). Tighten the locking screw.

77. FUZE SETTER M23.

a. **Description.** The Fuze Setter M23 is a hand-operated instrument, and is used for setting the 75-second Mechanical Time Fuze M67. A time scale and corrector scale with corresponding indexes record the desired time of flight of the shell before bursting. The time scale is graduated in half-second intervals from 0 to 75, and indicates the desired fuze setting plus or minus the corrector setting. The letter "S" on the scale indicates the safe setting for the fuze. The index plate for this scale has a second index which is intended for use with range scales when these are developed. The corrector scale is graduated in 0.1-second intervals from 0 to 60 with 30 as normal, and indicates corrections in time from 0 to 3 seconds for increasing or decreasing the time of burst from the time indicated on the time scale.

b. Operation.

(1) To set the Fuze Setter M23, rotate the corrector knob until the announced corrector value is registered. Rotate the time setting knob until the announced time value is registered.

(2) To insure accuracy in setting the scales, the operator should look squarely at the scales and their indexes. The final movement of the scales when making a setting should always be in a clockwise direction in order to take up backlash that may exist in the instrument.

SIGHTING EQUIPMENT

(3) Remove the safety wire or cotter pin from the fuze, and place the fuze setter, with the data set in, carefully over the fuze on the shell. Turn the instrument with the hand until the notch in the time ring on the fuze engages the stop in the setting ring in the fuze setter. Push the instrument down until the notch fully engages the stop, and continue to turn the fuze setter in a clockwise direction until the pawl in the adjusting ring assembly drops into the notch in the fixed fuze ring, indicating that the setting operation is complete. Lift the fuze setter off without rotating it.

(4) A fuze which has been set can be reset to the "S" (safe) position by setting the fuze setter time scale to "S," the corrector scale to normal (30), and resetting the fuze as described above.

CAUTION: Rotate the fuze setter only in a clockwise direction. Incorrect settings and loosening of the fuze from the shell may result from failure to follow these instructions.

c. **Tests and Adjustment.** Test the fuze setter on a dummy or inert fuze or on a live fuze for correct cutting of the fuze and for smooth operation. Set the corrector scale to normal (30), and set in some value on the time scale. Cut the fuze. The time setting of the fuze should agree with the setting on the fuze setter time scale within a tolerance of ± 0.05 fuze second. If the settings do not agree within this tolerance, repeat the operation with a different time value to make sure there was no slippage. Note engagement with fuze and any tendency to stick or bind. If the fuze setter fails to operate properly, turn it in for repairs by Ordnance personnel.

CAUTION: Where a live fuze is used, the precaution normally observed in handling ammunition must be followed. Remove the safety wire or cotter pin carefully for the test. After the test has been made, return the fuze setting to the "S" or safe setting, and replace the safety wire or cotter pin. When checking the accuracy of fuze setting by cutting trial fuzes, no fuze should be cut more than twice. The fuze from a dud must never be used. Further precautions are described in section VI of TM 9-1900, Ammunition, General, dated 3 July, 1942.

d. **Care and Preservation.**

(1) The fuze setter is rugged and suited for the purpose for which it is used. It will not, however stand rough handling or abuse. Inaccuracy or malfunctioning may result from such mistreatment.

(2) Do not force the knobs against the stops which are provided. Do not use a fuze setter which requires excessive force in setting.

(3) The exterior surfaces should be kept free from dirt, sand, mud, etc., and grease or oil which may seep from the interior mecha-

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

nism. The setting and adjusting rings in particular should be kept clean, and covered with a light coating of GREASE, lubricating, special, to prevent rust.

(4) Graduated surfaces should be cleaned occasionally with SOLVENT, dry-cleaning, and wiped dry after cleaning. The use of pastes, or abrasives is prohibited.

(5) The fuze setter should be protected from wet weather as much as possible. It should be wiped dry as soon as practicable after use in such weather, to prevent rusting and corrosion. Never place it in its cover while wet.

CHAPTER 4

AMMUNITION

78. GENERAL.

a. Ammunition for the 4.5-inch Gun, M1, is of the separate-loading type. For this type of ammunition the loading of each complete round into the cannon requires three separate operations: one, loading the projectile; two, loading the propelling charge; and three, loading the primer. These components, as well as the fuze, are issued and shipped separately, the fuze being assembled to the projectile just prior to firing. The four components mentioned make up a complete round, that is, they comprise all the components necessary to fire the gun once.

79. FIRING TABLES.

a. For applicable firing tables, see chapter 9.

80. CLASSIFICATION.

a. The projectiles authorized for this gun are classified as to type as "high-explosive" and "dummy." A high-explosive projectile is designed to produce effect by the shell fragments dispersed upon detonation of its high-explosive bursting charge and, within a smaller radius, by the blast. This type of projectile is designed, therefore, with relatively thin walls and a large charge of a high explosive. The dummy projectile is completely inert and is provided for training in loading and handling.

81. IDENTIFICATION.

a. **General.** Ammunition and ammunition components are completely identified by means of the painting and marking (including ammunition lot number) on the items themselves and on packing containers. Other essential information is marked on the components, for example: on the projectile, the weight zone and kind of filler; on the propelling charge, the weight of igniter, designation of each section, etc. See figures 140 to 147 inclusive, and the following paragraphs. The muzzle velocity may be obtained from firing tables.

b. **Model.** To identify a particular design, a model designation is assigned at the time the item is classified as an adopted type. This model designation becomes an essential part of the standard 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 appropriate arabic numeral. Thus "M65A1" indicates the first modification of an item for which the original model designation was "M65."

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

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. In the case of separate-loading ammunition, a separate lot number is assigned and marked on each of the components—projectile, propelling charge, fuze, and primer—as well as 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 components in any one lot are manufactured under as nearly identical conditions as practicable. For example, in the case of projectiles, any one lot consists of projectiles made by one manufacturer, assembled by one manufacturer, and of one weight zone. Therefore, to obtain the greatest accuracy when firing separate-loading ammunition, successive rounds should consist of:

- (1) Projectiles of one lot number (one type and one weight zone).
- (2) Propelling charges of one lot number.
- (3) Fuzes of one lot number.
- (4) Primers of one lot number.

d. **Painting and Marking.**

(1) **PAINTING.** Projectiles are painted primarily to prevent rust. Secondary purposes are to provide, by the color, a ready means for identification as to type, and camouflage. In accordance with the basic color scheme, ammunition for the 4.5-inch Gun M1 is painted:

High-explosiveLusterless, olive-drab: mark-in yellow.

DummyBlack: marking in white, except band at center of gravity, which is red.

(2) **MARKING.** For purposes of identification, the following is marked on the components of separate-loading ammunition described herein:

(a) *On the Projectile (Stenciled).*

Weight zone marking.

Caliber and type of cannon in which fired.

Kind of filler, for example: TNT, AN 50-50, etc.

Lot number of filled projectile, including loader's initials.

Model of projectile.

(b) *On the Projectile (Stamped in the Metal on the Base End).*

Caliber and designation of shell.

Contractor's initials or symbol.

Lot number of metal parts assembly, including manufacturer's initials.

Month and year of completion of shell.

AMMUNITION

(c) *On the Propelling Charge or Section Thereof (Stenciled).*
Powder lot number (includes type of powder, the word "LOT," initials of manufacturer, serial number of the lot, and year of manufacture).

Caliber and type of cannon in which fired.

Weight and lot number of igniter.

Designation of section (on the M8 Charge only): "BASE" on base section, "INCREMENT" on increment section.

(d) *On the Fuze (Stamped on the Body).*

Type and model of fuze. (The M51A3 Fuze will have the length of delay stamped immediately following the model number.)

Month and year loaded.

Lot number of loaded fuze, including loader's initials.

Action:

"S.Q.," "DEL;" or time in seconds.

(e) *On the Primer (Stamped on the Head).*

Initials of loader.

Lot number of loaded primer, including loader's initials.

Year of loading.

Mark number.

e. **Weight-zone Markings.** Variations in weight occur during the manufacture of high-explosive projectiles. Hence, such projectiles are grouped in weight zones in order that the appropriate ballistic corrections provided in firing tables may be applied for the variations in weight. The weight zone of the projectile is indicated thereon by means of squares with a prick punch mark in the center of each square—one to four or more squares being used, depending upon the weight of the projectile. For 4.5-inch projectiles, two squares indicate "normal" or "standard" weight, that is, the weight zone for which no weight corrections are necessary when determining a range of fire. The squares are of the same color as the marking.

82. CARE, HANDLING, AND PRESERVATION.

a. **General.** Ammunition components are packed to withstand conditions ordinarily encountered in the field. As shipped, the high-explosive service projectile is provided with a grommet to protect the rotating band and, in addition, is fitted with an eyebolt lifting plug. The dummy projectile is packed in a crate. Propelling charges, fuzes, and primers are packed in moisture-resistant containers. Since explosives are adversely affected by moisture and high temperature, due consideration should be given to the following:

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

(1) Do not break the moisture-resistant seal until ammunition is to be used.

(2) Protect the ammunition, particularly fuzes, primers, and propelling charges, from high temperatures, including the direct rays of the sun. More uniform firing is obtained if the rounds, propelling charges especially, are at the same temperature.

b. Do not attempt to disassemble any fuze.

c. Do not remove the eyebolt lifting plug from unfuzed rounds until the fuze is to be assembled thereto. The eyebolt lifting plug is provided for convenience in handling and to keep the fuze opening free of foreign matter.

d. Primers must always be stored in a dry place. Prolonged exposure to moisture or dampness may cause malfunctioning.

e. 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.

f. Each of the separate loading components should be free of foreign matter—sand, mud, grease, etc.—before loading into the gun.

g. Do not remove protection or safety devices from fuzes until just before use.

h. Components of rounds prepared for firing but not fired will be returned to their original condition and packings, and appropriately marked. Fuzes will be inspected prior to repacking. Such components will be used first in subsequent firing, in order that stocks of opened packings may be kept at a minimum.

i. When it is necessary to leave ammunition in the open, raise it on dunnage at least 6 inches from the ground and cover with a double thickness of tarpaulin. Suitable trenches should be dug to prevent water from flowing under the pile. For further precautions in storage, see TM 9-1900, Ammunition, General.

j. Do not handle duds. Because their fuzes are armed, duds are extremely dangerous. They will not be moved or turned, but will be destroyed in place in accordance with TM 9-1900.

83. AUTHORIZED ROUNDS.

a. The ammunition authorized for use in the 4.5-inch Gun, M1, is listed below. It will be noted that the nomenclature (standard nomenclature) completely identifies the ammunition.

AMMUNITION

TABLE I
AMMUNITION FOR 4.5-INCH GUN, M1

(In addition to the components shown, one PRIMER, percussion, 17-grain, Mk. IIA4, is required for each complete round.)*

PROJECTILE	PROPELLING CHARGE	FUZE**	
		Type and Model	Action
Service Ammunition			
SHELL, H.E., M65, unfuzed, 4.5" gun, M1 (adapted for FUZE, P.D., M51, w/BOOSTER, M-21, or M51A1, w/-BOOSTER, M21A2; or FUZE, time, mechanical, M67 or M67A1, w/BOOSTER, M21A1, or M67A2, w/BOOSTER, M21A2)***	CHARGE, propelling, M7 (normal), 4.5" gun, M1 or CHARGE, propelling, M8 (super), 4.5" gun, M1	FUZE, P.D., M51, w/BOOSTER, M-21, or M20A1; or M51A1, w/BOOSTER, M21A1, or M20A1† or	SQ or 0.05-sec. delay
		FUZE, P.D., M51A3, w/BOOSTER, M-21A2 or FUZE, time, mechanical, M67, or M67A1, w/BOOSTER, M21A1, or M67A2, w/BOOSTER, M21A2	SQ or 0.15-sec. delay Time
Drill Ammunition			
PROJECTILE, dummy, M8, 4.5" gun, M1	CHARGE, propelling, dummy, M6 (base and increment), 4.5" gun, M1	None	—

H.E.—High-explosive
P.D.—Point-detonating

sec.—second
SQ—Superquick

*PRIMER, percussion, 21-grain, Mk. II or Mk. IIA, or PRIMER, percussion, 18-grain, Mk. IIA3, authorized for use when PRIMER, percussion, 17-grain, Mk. IIA4 is not available.

**The BOOSTER, M24, is the authorized standard alternate for the BOOSTER, M21A1, fitted to fuzes listed hereunder.

***Fitted with eyebolt lifting plug and a grommet. Fuze to be assembled in field.

84. PREPARATION FOR FIRING.

a. The service ammunition is prepared for firing as follows:

(1) **HIGH-EXPLOSIVE SERVICE PROJECTILE.** The grommet and eyebolt lifting plug are removed, and the appropriate fuze is assembled to the projectile as described in paragraph 86.

(2) **PROPELLING CHARGE.** The igniter protector cap is removed and the charge is then adjusted as described in paragraph 87.

(3) **FUZE.** Set the fuze as described in paragraph 88.

(4) **PRIMER.** The primer is ready for firing as shipped, and need only be inserted into the firing mechanism of the gun.

NOTE: If ammunition components are not fired, return them to their original condition and packing. Reset time fuzes to "SAFE" before storing.

† FUZE, P.D., M51, w/BOOSTER, M21; and the M51A1, w/M21A1, are authorized for emergency combat only. The M51 or M51A1, w/M20A1 are authorized for service use during nonavailability of the M51A3, w/M21A2; also for training.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

85. PROJECTILES.

a. Service Shell.

(1) DESCRIPTION. The M65 High-explosive Shell (fig. 140) is designed for use primarily against personnel and light materiel targets. The fuzes for which it is adapted have the booster permanently assembled to the fuze at the time of manufacture, both elements being handled thereafter as a single unit in shipment and assembly to the projectile. The projectile, made of steel, is "boat-tailed" (surface to the rear of rotating band is conical) and has an ogive with a radius of 10 calibers. The rotating band, either of copper or gilding metal, is located 3.50 inches in front of the base end. It is 1.72 inches wide and has a single cannelure or groove. A steel base plate is set into the base end flush with the surface and secured by means of a 360-degree crimp. This base cover prevents gas from the propelling charge from reaching the bursting charge of the projectile through possible defects or flaws in the base. As shipped, a grommet protects the rotating band and an eyebolt lifting plug is assembled in the fuze cavity. The shell, as shipped assembled with lifting plug, is 21.92 inches long. A molded plastic fuze well cup is assembled in the booster cavity. The weight of the bursting charge is 4.49 pounds of TNT; or 4.08 pounds of 50-50 amatol. The weight of the projectile as shipped is 54.81 pounds when loaded with TNT.

(2) PREPARATION FOR FIRING.

- (a) Remove grommet and eyebolt lifting plug.
- (b) Assemble fuze to projectile as described in the paragraph devoted to the particular fuze.

b. Dummy Projectile. This projectile (fig. 141) has approximately the same weight and contour as the high-explosive service shell. However, unlike the service projectile, the nose is not cut away to provide a fuze hole. The projectile casing is in three main parts, an ogival bronze cap, a steel body, and a steel base, each screwing into the next neighboring part when assembled. The rotating band and bourrelet of the service shell are simulated by bronze bands. These bands are 1-piece rings seated on the shell body and base prior to screwing the several casing parts together, and upon assembly are held in position by the neighboring part. The body and base are hollowed to provide a cylindrical passage in which a steel plunger can slide for a distance of about 2 inches. This plunger is held to the rear of the projectile, when the projectile is at rest by a steel restraining spring pressing against a shoulder on the rear end of the plunger. When the projectile is rammed into the bore of the gun, the plunger overcomes the restraint of the spring, slides forward, and then is forced

AMMUNITION

rearward by the spring. This action tends to loosen the seating of the projectile, making for easier extraction. The several parts are replaceable. The projectile is removed after each loading operation by means of an extractor.

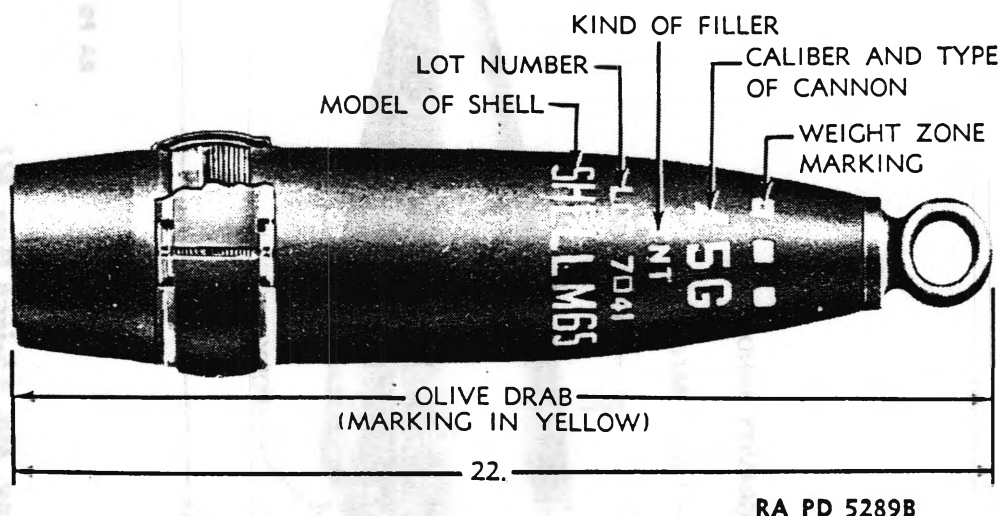


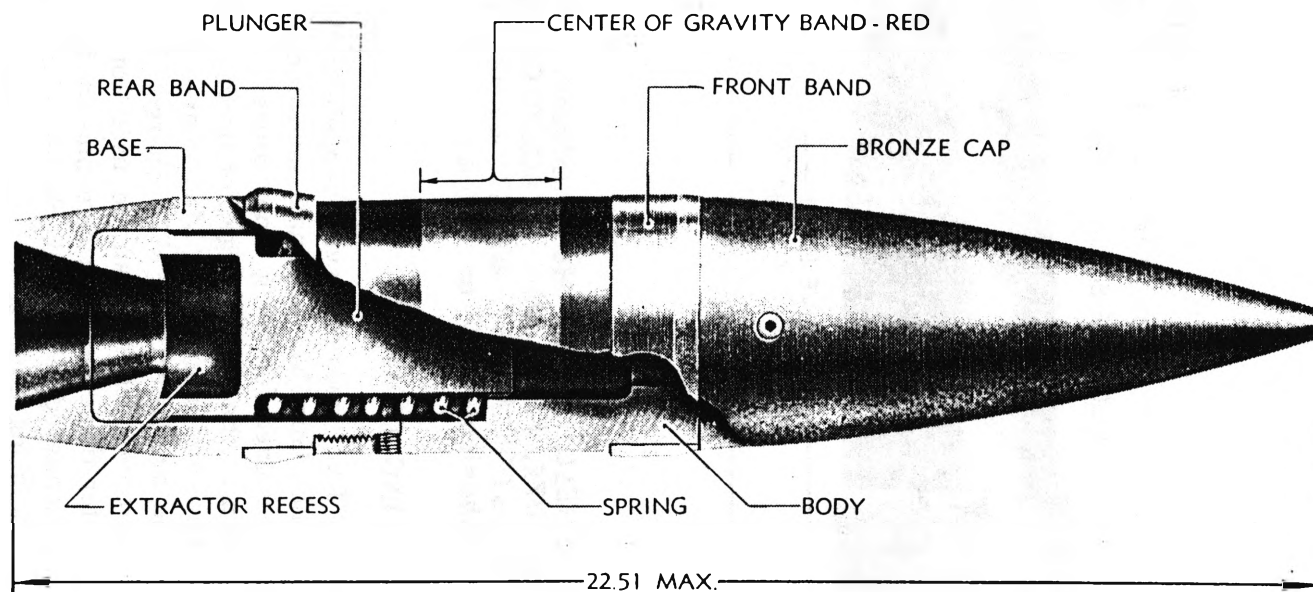
Figure 140—SHELL, H. E., M65, Unfuzed, 4.5-inch Gun M1 (adapted for FUZE, P. D., M51, w/BOOSTER, M21; M51A1 or M51A2, w/BOOSTER, M21A1; M51A3, w/BOOSTER, M21A2; or FUZE, time mechanical, M67 or M67A1, w/BOOSTER, M21A1)

86. PROPELLING CHARGES.

a. **General.** Two types of service propelling charges are authorized for the 4.5-inch Gun, M1—a single-section charge, known as the normal charge, designed for firing inner zones; and a base-and-increment type, known as the supercharge, for firing outer zones. Neither section of the base-and-increment (M8) charge can be used in conjunction with the single-section (M7) charge. The base section of the base-and-increment charge can be used for firing inner zones. However, a greater dispersion in range due to deviation in velocity may result as compared with that shown when the single-section charge is used for firing inner zones.

b. **CHARGE, Propelling, M7 (Normal), 4.5-inch Gun, M1.** This is a single-section charge made up of 6.40 pounds of smokeless powder loaded in a cartridge cloth bag (fig. 142). The loaded section is wrapped in cartridge or cotton cloth strapping wound in spiral

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1



RA PD 61180

Figure 141—PROJECTILE, dummy, M8, 4.5-inch Gun, M1

RA PD 5292

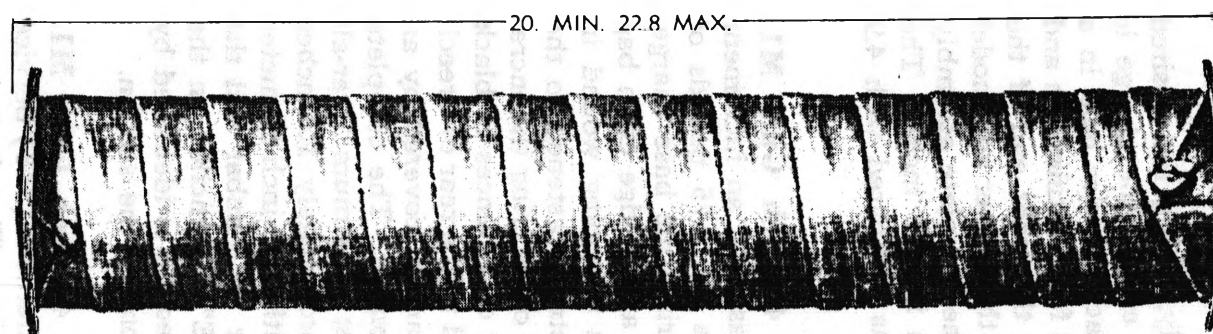


Figure 142—CHARGE, propelling M7 (normal), 4.5-inch Gun M1

RA PD 2128

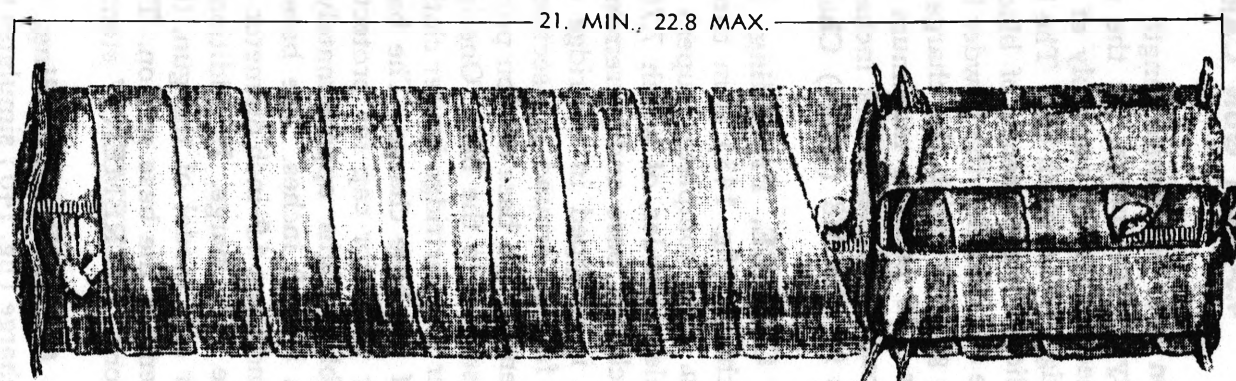


Figure 143—Charge, propelling M8 (super), 4.5-inch Gun M1

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

fashion over the entire length of the assembly, giving the desired rigidity to the charge. At the rear or breech end of the charge is fastened an igniter assembly of 5 ounces of black powder held in a cartridge igniter cloth bag. The bag is dyed red for identification and to indicate the presence of black powder. On the front end of the charge are stenciled the powder lot number and the caliber and model of the gun for which the charge is adapted. The complete assembly weighs 7.06 pounds; maximum over-all length is 22.8 inches. The maximum diameter is 3.9 inches throughout, as compared with 4.9 inches for the M8 (super) Charge.

c. CHARGE, Propelling, M8 (Super), 4.5-inch Gun, M1. This charge (fig. 143) is in two sections—a base and an increment section. The complete (super) charge consists of 10.75 pounds of smokeless powder, of which 7.75 pounds comprises the base charge. Each charge, base and increment, is loaded in a cartridge cloth bag which is wrapped in cartridge or cotton cloth strapping wound in spiral fashion around the section. Four tying straps fastened to the front end of the base section provide the means of securing the increment section to the base. One igniter assembly of 5 ounces of black powder in a cartridge igniter cloth bag is stitched to the rear or breech end of the base charge. The bag is dyed red and is covered by an igniter protector cap for protection during shipment. The complete assembly weighs approximately 11.41 pounds; maximum over-all length is 22.8 inches. The base section is approximately 16 inches long and has a 4.9-inch diameter, as compared with a 3.9-inch diameter for the M7 Charge. In addition to the powder lot number and the caliber and model of the gun, the word "BASE" is stenciled on the front end of the base section. The increment section is identified by the word "INCREMENT" stenciled on the front of the section.

d. CHARGE, Propelling, Dummy, M6, 4.5-inch Gun, M1. This charge (fig. 146) simulates the base-and-increment (M8) Service Charge, and has approximately the same dimensions. The charge consists of two sections made up of lead-weighted wood cylinders encased in cotton duck cloth. Four tying straps secure the increment section to the base. A simulated igniter assembly consisting of a red-dyed cotton duck bag filled with inert material is fastened to the rear end of the base, together with a cotton webbing handle for convenience in handling and extraction. Both sections are readily identified by the marking stenciled thereon. The words "DUMMY IGNITER" are stenciled on the inert igniter assembly.

e. Preparation for Firing. The M7 (normal) Charge requires no preparation for firing aside from removing the packing and the ig-

AMMUNITION

niter protector cap. The M8 (super) Charge also is ready for firing, once removed from packing materials, when the full charge is required. The charge is adjusted for use of the base section alone by untying the tying straps and removing the increment section.

87. FUZES.

a. **General.** A fuze is a mechanical device used with a projectile to explode it at the time and under the circumstances desired. Fuzes are classified, according to the manner of functioning, as "time" or "impact." Time fuzes contain a graduated time element in the form of a compressed black powder train or a mechanism similar to clock-work which is set to explode the shell a certain number of seconds after firing. Impact fuzes function upon striking a resistant object. The impact fuzes described herein are known as point-detonating (P.D.) because of their location on the projectile. A classification of impact fuzes, according to the speed of action, is "superquick" and "delay."

b. **Boresafe Fuzes.** Certain fuzes are considered to be 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 gun, premature detonation of the bursting charge of the projectile is prevented should any of the more sensitive explosives in the fuze, primer, and/or detonator, malfunction. All fuzes discussed in following paragraphs fall within boresafe classification.

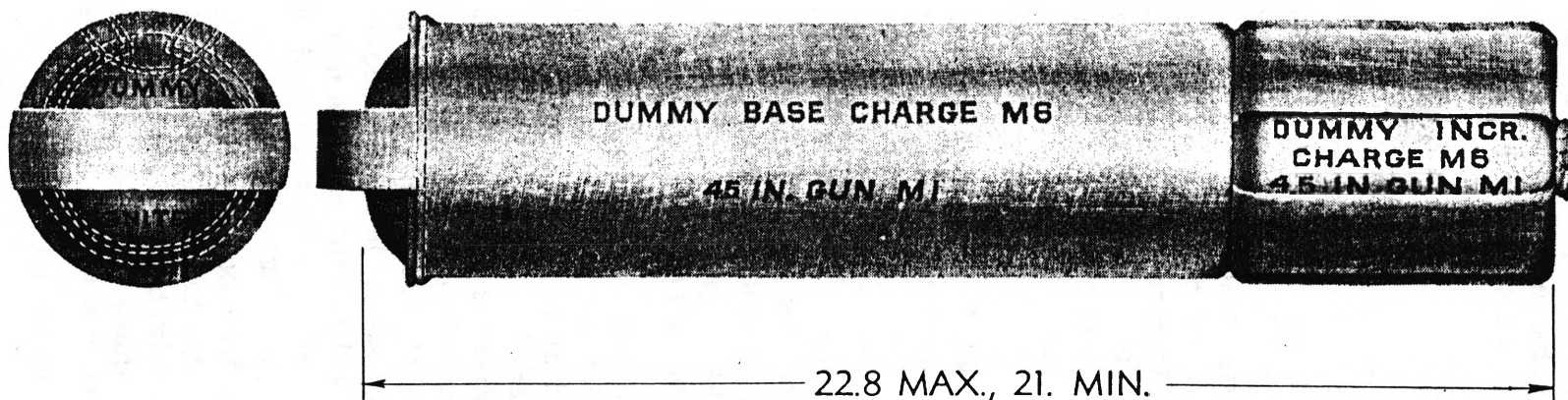
c. **FUZES, P.D., M51, w/BOOSTER, M21; M51A1, w/BOOSTER, M21A1; M51A3, w/BOOSTER, M21A2*.**

(1) **GENERAL.** The fuzes and boosters making up these assemblies are essentially the same in principle but differ in various respects due to modifications of either the fuze or the booster, as follows. The M51A1 differs from the M51 only with respect to the booster; the M21A1 Booster has a 1/4-inch flash hole in its rotor cover as compared with a 1/8-inch flash hole in the M21 Booster. In the M51A3, the delay action is further modified to provide for a 0.15-second delay instead of 0.05-second as in the earlier models. The M21A2 Booster assembled to the M51A3 Fuze is also a modification of the earlier boosters, adding a set-back pin for additional insurance against premature or accidental functioning.

(2) **DESCRIPTION.** In all of the fuzes (fig. 145) the booster is permanently attached to the fuze at the time of manufacture. Thereafter the fuze with booster is handled as a unit. The fuze contains two actions, superquick and delay. Although both actions are initiated on impact, the functioning of the shell depends upon the setting of

*See footnote on page 189.

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

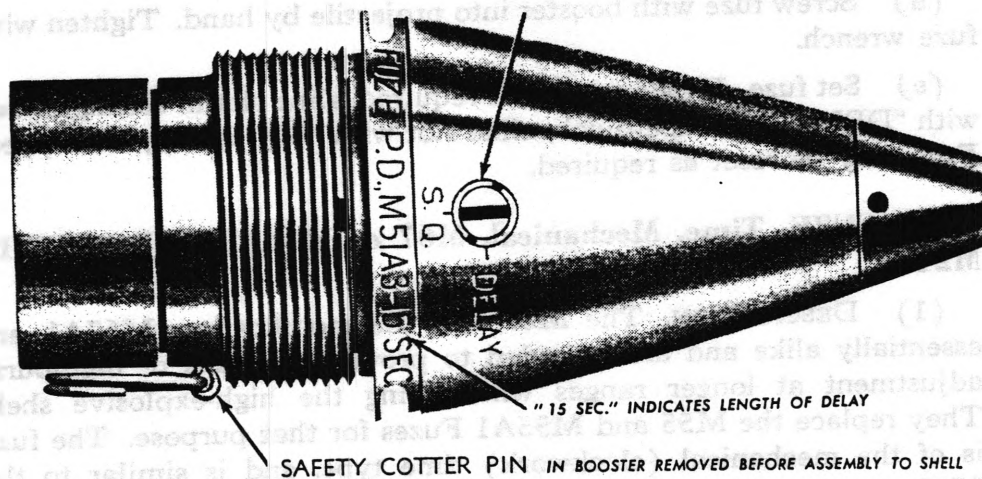


RA PD 61179

Figure 144—CHARGE, propelling, dummy, M6, 4.5-inch Gun M1

AMMUNITION

SETTING SLEEVE
AS INDICATED — SET FOR SUPER-
QUICK ACTION, AT RIGHT ANGLES
(PERPENDICULAR TO AXIS OF
FUZE) FOR DELAY ACTION.



RA PD 15053

Figure 145—FUZE, P.D., M51A3, w/BOOSTER, M21A2

the fuze. When the fuze is set "DELAY," the superquick action is so interrupted that the projectile functions with delay action. It should be noted, however, that if the superquick action malfunctions when the fuze is set "SQ," the projectile will function with delay action rather than become a dud. On the side of the fuze near the base is a slotted "setting sleeve" and two registration lines; the one parallel to the axis is marked "SQ," the other "DELAY." As shipped, the fuze is set "SQ." To set the fuze for delay action it is only necessary to turn the setting sleeve so that its slot is alined with "DELAY." A delay pellet—0.15-second in the M51A3, and 0.05-second in the M51 and M51A1 fuzes—incorporated in the delay action train provides for the delay action. The setting may be made or changed at will with a screwdriver or some other similar tool any time before firing. This can be done even in the dark by noting the position of the slot—parallel to the fuze axis for superquick action, at right angles thereto for delay. A cotter pin with pull ring is assembled to the booster to prevent accidental movement of the detonator during shipment. This cotter pin is to be withdrawn just prior to assembling the fuze with booster to the projectile.

(3) **PREPARATION FOR FIRING.** To fuze the projectile proceed as follows:

- (a) Remove eyebolt lifting plug from projectile.
- (b) Inspect fuze cavity and threads. They should be free of foreign matter which would interfere with the proper assembly of the fuze.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

- (c) Remove cotter pin from booster.
- (d) Screw fuze with booster into projectile by hand. Tighten with fuze wrench.
- (e) Set fuze. If delay action is required, align slot in setting sleeve with "DELAY"; if superquick, align slot with "SQ" setting as shipped. Fuze may be reset as required.

d. FUZE, Time, Mechanical, M67 or M67A1, w/BOOSTER, M21A1.

(1) **DESCRIPTION.** The M67, and the modification, M67A1, are essentially alike and are intended to provide a means of high-burst adjustment at longer ranges when firing the high-explosive shell. They replace the M55 and M55A1 Fuzes for that purpose. The fuze is of the mechanical (clockwork) time type, and is similar to the M43-type fuze in contour, and in design except that the escapement mechanism has been modified to give a longer burning time. There is no impact element. The upper and lower caps are staked together and turn as a unit when setting the fuze. A set or register line is stamped on the rim of the lower cap. A safety line with "S" below it, and time graduations to 75 seconds with 0.5-second intervals, are stamped on the body. The graduations run counterclockwise, viewed from the point of the fuze. Two setting grooves, one each on the lower cap and body, are provided for setting the fuze. A safety feature incorporated in the fuze is designed to prevent functioning should the fuze be set for 3 seconds or less. As shipped, the fuze is set "safe," that is, the set line in the lower cap is in alignment with the safety line "S" in the body. A pull wire is fitted to the fuze to secure the firing pin prior to firing. A cotter pin with pull ring is assembled to the booster to prevent accidental movement of the detonator during shipment. The booster is assembled to the fuze at the time of manufacture and handled thereafter as a single unit with the fuze, in shipment and assembly to the projectile. The cotter pin is to be withdrawn just prior to assembling the fuze with booster to the shell.

(2) **PREPARATION FOR FIRING.** To fuze the projectile proceed as follows:

- (a) Remove the eyebolt lifting plug from the projectile.
- (b) Inspect the fuze cavity and threads. They should be free of foreign matter which would interfere with the proper assembly of the fuze.
- (c) Remove the cotter pin from the booster.
- (d) Screw the fuze with booster into the projectile by hand. Tighten with the fuze wrench.

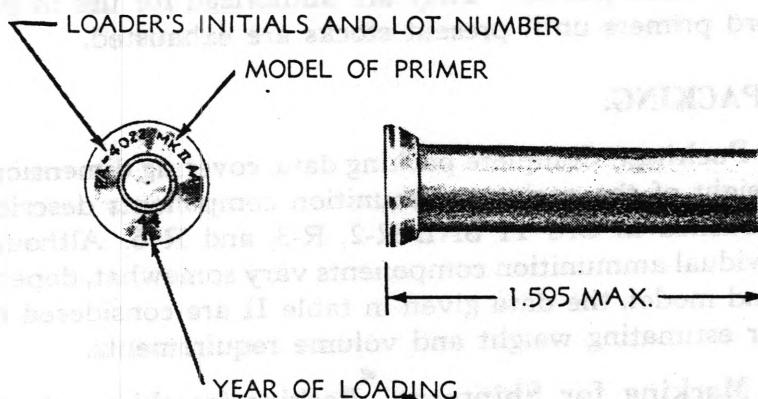
AMMUNITION

(e) Remove the safety pull wire. This can be done readily by pulling the end of the wire from the hole in the lower cap and sliding the wire off the end of the fuze.

(f) Set fuze by means of fuze setter, the lower cap being turned in a counterclockwise direction as viewed from the point of the fuze. The torque required to set the fuze is between 80 and 100 inch-pounds.

e. **BOOSTER, M24.** This booster is authorized as standard alternate for BOOSTER, M21A1, and as such is interchangeable with the M21A1. It differs from the BOOSTER, M21A1, in that it has a barrel-type rotor of Semple type whereas the M21A1 has flat-type rotor.

NOTE: Time fuzes prepared for firing but not fired will be reset "safe" (S), and safety devices restored, before returning to packings. *Fuzes will not be disassembled.* The only authorized assembling or disassembling operation is that of assembling the fuze to the projectile, or, if not fired, removing the fuze from the projectile. Any attempt to disassemble fuzes in the field is dangerous and is prohibited except under specific directions from the Chief of Ordnance.



RA PD 69092A

Figure 146—PRIMER, percussion, 17-grain, Mk. 11A4

88. PRIMERS.

a. **General.** A primer used with rounds of separate-loading ammunition consists in general of a small quantity of sensitive explosive together with a larger quantity of black powder—all contained in a brass cylindrical container similar in shape to a shotgun shell or a blank cartridge. The function of the primer is to fire the igniter charge which is attached to the service propelling charge.

In order that the primers may be readily accessible at the firing position they are carried by cannoneers in a canvas primer belt. The primer belt (BELT, primer, M8) is similar to a cartridge belt and is worn around the waist in a similar manner. It is constructed of canvas duck and is fitted with loops for 20 primers. Two pockets are also

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

provided, one for the firing mechanism in use and one for spare firing mechanism.

b. PRIMER, Percussion, 18-grain, Mk. IIA3, and 17-grain, Mk. IIA4.

(1) **DESCRIPTION.** Except that the Mk. IIA4 has a conical gas check whereas the Mk. IIA3 has a ball-type, these primers are alike. The primer (fig. 146) consists of a brass case containing a percussion element, the gas check, and 18 grains of black powder, in the case of the Mk. IIA3 and 17-grains in the Mk. IIA4. These primers have superseded the Mk. IIA1, a 21-grain percussion primer without a gas check, as standard for use with the 4.5-inch gun, although certain lots of the Mk. IIA1 Primer may be used in the event that the standard or alternative primers are not available. For the specific lots, see SNL R-3.

c. PRIMER, Percussion, 21-grain, Mk. II, and Mk. IIA. These primers, like the Mk. IIA1, have no gas check and contain a 21-grain charge of black powder. They are authorized for use in place of the standard primers until present stocks are exhausted.

89. PACKING.

a. Packing. Complete packing data, covering dimensions, volume, and weight of the various ammunition components described herein, are published in Ord 11 SNL R-2, R-3, and R-6. Although weights of individual ammunition components vary somewhat, dependent upon type and model, the data given in table II are considered representative for estimating weight and volume requirements.

b. Marking for Shipment. Packing for shipment, and bundle packing identification and shipping plates, are marked as follows:

- (1) Name and address of destination or port officer.*
- (2) Name and address of ultimate consignee (or code marking).*
- (3) List and description of contents.
- (4) Ammunition Identification Code (AIC) symbol, as published in SNL's.
- (5) Gross weight in pounds, displacement in cubic feet.
- (6) The number of the package.*
- (7) The letters "U.S." in several conspicuous places (not mandatory).
- (8) Order number, contract number, or shipping number.
- (9) Ordnance insignium and escutcheon.

*May be omitted on individual package in carload shipments of packages of standard weights and dimensions containing standard quantities.

AMMUNITION

RA PD 23099

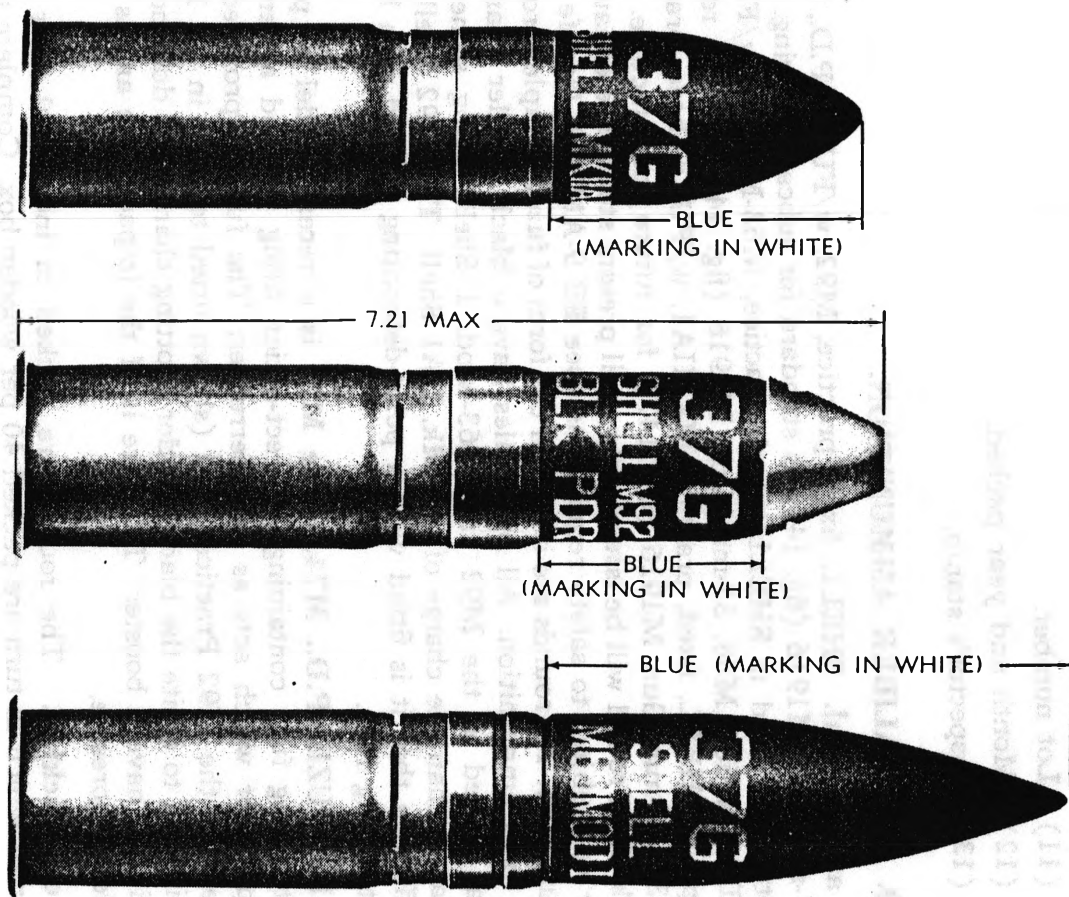


Figure 147—Ammunition for 37-mm Subcaliber Gun

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

- (10) Name/or designation of consignor preceded by the word "From."*
- (11) Lot number.
- (12) Month and year packed.
- (13) Inspector's stamp.

90. SUBCALIBER AMMUNITION.

a. General. SHELL, fixed, practice, M92, w/FUZE, P.D., M74, 37-mm Gun M1916 (fig. 147) is standard for subcaliber firing. Substitute standard is SHELL, fixed, practice, M63-Mod. 1, w/FUZE, B.D., practice, M58, 37-mm Gun M1916 (fig. 147). These rounds replace SHELL, fixed, practice, Mk. IIA1, w/FUZE, base, practice, M38, 37-mm Gun M1916 (fig. 147), for future manufacture. The Mk. IIA1 round will be issued only until present stocks are exhausted, for use subject to safety regulations (see SB 9-AMM-2, Unsafe Ammunition). All rounds are issued in the form of fuze complete rounds of fixed ammunition. All projectiles have a black powder charge—that loaded in the M92 and M63-Mod. 1 Shells being somewhat heavier than the charge of the Mk. IIA1 Shell. The M92 Shell also differs in that it is fitted with a point-detonating instead of a base-detonating fuze.

b. FUZE, P.D., M74.—The M74 is a recent model of point-detonating fuze containing a direct-action firing pin and a Semple-type rotor which acts as an interrupter. The fuze is provided for use with the M92 Practice Shell (shown fitted to shell in fig. 147). It is used to ignite the black powder spotting charge and does not require or have a booster. The fuze is of the impact type and is considered boresafe.

c. Packing. The rounds are packed in individual fiber containers which in turn are packed 40 per wooden box. Complete packing data will be found in SNL R-1.

91. FIELD REPORT OF ACCIDENTS.

a. When an accident involving the use of ammunition occurs during training practice, the procedure prescribed in AR 750-10 will be observed by the Ordnance officer under whose supervision the ammunition is maintained or issued. Where practicable, reports covering malfunctions of ammunition in combat will be made to the Chief of Ordnance, giving the type of malfunction, type of ammunition, the lot number of the complete rounds or separate-loading components, and conditions under which fired.

*May be omitted on individual package in carload shipments of packages of standard weights and dimensions containing standard quantities.

TABLE II
PACKING DATA

Item	Inner Container	Other Packing	No. of Items Contained	Weight (pounds)	Volume (cubic feet)	Over-all Dimensions (feet)
SERVICE PROJECTILE	Uncrated, with vulcanized fiber steel grommet and lifting plug	None	1 Proj.	55.2	0.32	1.83 by 0.42 diameter
DUMMY PROJECTILE	—————	Crated	1 Proj.	63.0	0.98	2.40 by 0.64 by 0.64
PROPELLING CHARGE, M7	Cartridge storage case	Wirebound box	1 Charge	23.9	0.99	2.59 by 0.60 by 0.60
	Individual cntr.	Bundle (crated)	3 Charges	61.0	2.25*	2.44 by 1.03 by 0.89
PROPELLING CHARGE, M8	Cartridge storage case	Wirebound box	1 Charge	29.8	0.66	2.59 by 0.51 by 0.50
	Individual cntr.	Bundle (crated)	3 Charges	73.0	3.18*	2.44 by 1.23 by 1.06
FUZES	Individual cntr.	Box	25 Fuzes	77.3	1.49	1.50 by 1.32 by 0.75
PRIMERS	Metal container (50 primers)	Box	2,400 Primers	95.5	1.56	2.12 by 0.90 by 0.82

*When quantities of 1-bundle crates are shipped or stored, the actual volume required may be reduced to approximately 78% of the calculated gross volume, provided advantage is taken of the nesting characteristics of the crates.

AMMUNITION

TM 9-328
91

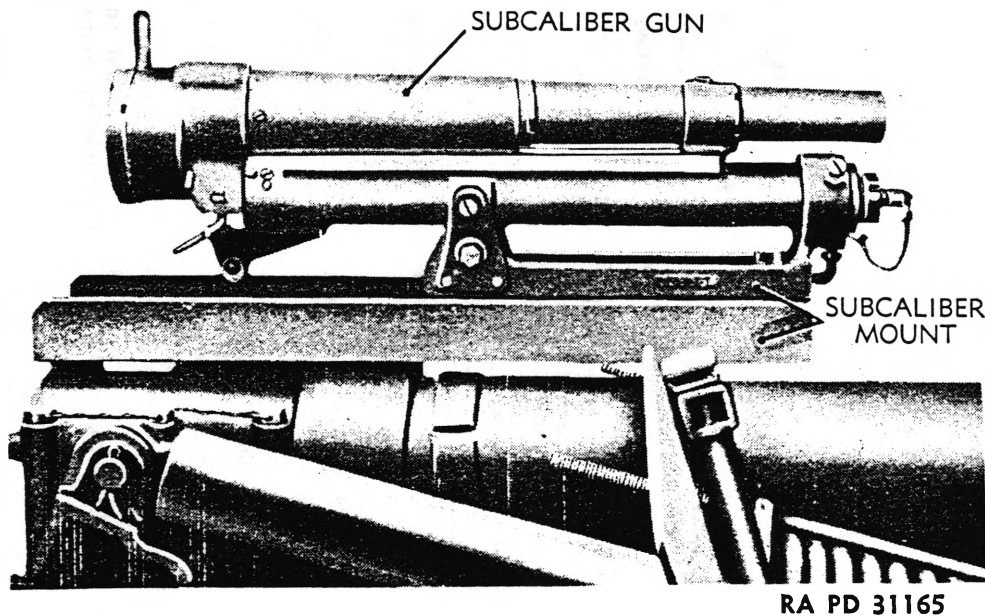
**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

CHAPTER 5
SUBCALIBER EQUIPMENT

92. GENERAL.

a. **Purpose.** Subcaliber equipment provides a means for more extensive training in laying and firing, through the use of small caliber ammunition, than would be permissible with standard 4.5-inch ammunition. It prevents wear on the regular piece during practice and is less costly. Although the handling, loading, and range obtained differ from those of the regular piece, the results obtained in elevating, traversing, sighting, and similar operations are adequate for instructional purposes.

b. **Description.** Subcaliber equipment consists of the 37-mm Gun M1916, complete with recoil mechanism and cradle, the 37-mm Subcaliber Mount M13A1, and organizational spare parts and accessories. The subcaliber gun and mount are mounted on the recoil mechanism of the 4.5-inch gun (fig. 148).



RA PD 31165

Figure 148—Subcaliber Equipment Mounted on 4.5-inch Gun

93. BREECHBLOCK AND BREECH MECHANISM.

a. **Description.**

(1) The breechblock is the Nordenfeld or eccentric type which screws into the breech ring and rotates through an angle of 156 degrees about its axis. The axis of the breech recess is below the axis

SUBCALIBER EQUIPMENT

of the bore. The breechblock is operated by the breechblock lever which, when moved to the left, causes the breechblock to rotate, thus carrying the eccentric opening in the breechblock to a position in line with the bore. This lever also indirectly operates the extractor, which extracts and ejects the cartridge case. When the lever is moved to the right, the breechblock closes, placing the firing pin in line with the percussion cap in the base of the cartridge case, and at the same time releases the safety bolt.

(2) The safety bolt is the device which prevents firing of the gun when the breechblock is not fully closed.

(3) The firing mechanism, which is housed in the breechblock, consists of the firing pin, firing pin spring, rocker, rocker pin, rocker pin latch, and rocker plunger. When the trigger crank lever is pressed down, the firing pin strikes the percussion cap, thus firing the gun.

b. Operation.

(1) To cock, place the palm of the hand against the cocking handle of the striker and push it forward until it latches. After the first shot the mechanism is automatically cocked. If the round is not to be fired, open the breechblock and remove the round from the gun. Do not uncock the piece while it is loaded, as the mechanism must be cocked before the breechblock can be opened.

(2) To open breech, rotate the breechblock lever to the left as far as it will go. If the firing mechanism has been tripped, however, it will be necessary to first cock the mechanism before the breech can be opened.

(3) To load, insert the round, pushing the cartridge case in as far as is allowed by the extractor.

(4) To close breech, grasp the breechblock lever and rotate it to the right as far as it will go. During the first part of the movement a ramp on the front of the breechblock pushes the cartridge case in flush with the face of the breechblock. The cartridge case is then pushed home by the forward movement of the breechblock in the breech ring threads.

c. Disassembly and Assembly.

(1) To dismount breechblock, cock the piece with the left hand by means of the cocking handle on the striker. Remove the breechblock lever with the right hand by grasping the handle with the fingers and pressing the breechblock lever release pin cap with the thumb. Take out the extractor pin by pressing the extractor pin latch toward the breech with the left forefinger and pulling it out to the right with the right hand. The extractor will drop down until its

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

heel clears the extractor cam. Then unscrew the breechblock to the left, grasping it firmly in the right hand and supporting it with the left hand.

(2) To replace breechblock, first see that the breech recess, extractor, and threads of the breechblock are thoroughly cleaned and lightly oiled. Then set the extractor in its seat but do not insert the extractor pin. Next, cock the mechanism, screw the breechblock home, and set the breechblock lever in place. Raise the extractor by pushing upward on its heel from under the block, and insert the extractor pin from the right until the extractor pin latch springs out and secures the pin. Uncock the mechanism by pressing down on the trigger lever with the right thumb while applying pressure against the cocking handle with the left hand, so as to prevent too fast a movement of the striker.

NOTE: Do not attempt to screw the breechblock in or out without first removing the extractor pin.

(3) To dismount the extractor, dismount the breechblock as directed in step (1), above. Withdraw the extractor by inserting the left forefinger in the mortise in the base of the breech ring, slightly raising the extractor and grasping it with thumb and finger of the right hand.

(4) To assemble extractor see step (2), above.

(5) To dismount firing mechanism, the gun should be cocked or the breechblock dismounted. The rocker pin is retained in its seat by the free end of the spring entering the groove in the outer end of the rocker pin. This spring may become stuck with paint, and should be freed by scraping the paint around the edge before attempting to remove the rocker pin. The head of the rocker pin projects at one side of the port. Place a small bronze drift against the projecting head, and, with light taps, drive the pin into the port. The rocker is then free and, when removed, exposes the firing pin which will be pushed out by its spring and the rocker plunger, all of which may then be taken out.

(6) To assemble the firing mechanism, first clean and lubricate all parts. Then insert the rocker plunger, firing pin spring, and firing pin. Hold the rocker pin down in its seat with the thumb until the rocker pin can be started through. Push the pin home and see that the rocker pin latch springs into the groove.

(7) To remove piston crosshead key, disengage the striker, press up on the piston crosshead key latch, and push out to the left.

(8) To assemble piston crosshead key, first examine, clean, and lubricate the parts. Push the key in place with the trigger crank lying in front of the long arm of the sear. See that the safety bolt

SUBCALIBER EQUIPMENT

properly engages the descending arm of the sear before the piston crosshead key is pushed fully home. Failure to have the safety bolt in the proper position will prevent the crosshead key from being fully pushed in, and an attempt to force it will cause damage to the sear.

(9) To disassemble striker mechanism, first remove the piston crosshead key. Draw the gun back about 8 inches and push the striker to its extreme forward position to loosen the striker rod nut set screw and unscrew the striker rod nut. Allow the spring to expand slowly and push the striker rod out. Clean all parts. Free height of the striker spring should be 6.81 inches. If it is as much as 0.5 inch less than this, replace it with a new spring.

(10) To assemble striker mechanism, first thoroughly slush the striker spring and striker rod with engine oil (SAE 10 or 30). Place the striker spring over the rod and insert both in the striker housing. Push the striker to the extreme forward position and turn the nut until the front edge of the nut is about flush with the front end of the striker rod, taking care that the striker rod nut set screw comes opposite its keyway in the striker housing. The stroke of the striker rod may be lengthened by unscrewing the striker rod nut a few turns. The set screw must not be omitted, and must be set so that it does not strike the bottom of the keyway.

94. RECOIL MECHANISM.

a. **Description.** The recoil mechanism is located in the cradle underneath the gun, and the gun slides over it during recoil and counterrecoil. It consists of the recoil mechanism, counterrecoil mechanism, and counterrecoil buffer.

b. The recoil mechanism is used for the purpose of controlling the force created by firing and to check movement of the gun in a gradual manner. The counterrecoil mechanism is used for the purpose of returning the gun into battery in order that it may be fired again. The counterrecoil buffer is used for the purpose of slowing down and stopping the counterrecoil action without injury to the system.

95. GUN AND CRADLE.

a. **Disassembly.** Release the striker and take out the piston crosshead key by pressing up its latch and pushing it out to left. Carefully draw the gun back off the cradle by grasping the muzzle with one hand and the breech with the other.

b. **Assembly.** See that the gun slides and the piston crosshead are thoroughly cleaned and lubricated. Insert the gun from rear, carefully maintaining alinement to avoid jamming the gun slides. Replace the piston crosshead key.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1****96. SUBCALIBER MOUNT M13A1.**

a. **Description.** The subcaliber mount consists of a bracket which is bolted to an extension, which in turn is fastened to the top of the recoil mechanism by means of two cap screws. The mount extension is 7 by 2½-inch standard channel, 33 inches long. It has two bosses at the front end on which the bracket is mounted, and two holes at the rear end, through which the cap screws pass to fix the subcaliber mount to the recoil mechanism.

b. The 37-mm gun and recoil mechanism is held in place on the mount by means of an adjusting collar at the front end and the trunnion brackets on the sides at the rear end. Several screws provide adjustment when alining the axis of the subcaliber gun bore with the axis of the 4.5-inch gun bore. Vertical adjustment is made by the screws in the front adjusting collar; and lateral adjustment, by means of the adjusting screws in the trunnion brackets.

97. MOUNTING SUBCALIBER EQUIPMENT.

a. To mount the subcaliber mount, aline the holes on the mount extension with the holes on the top of the rear end of the recoil mechanism, keeping the end of the extension with the bosses toward the front of the regular weapon. Fix the extension to the recoil mechanism with the two hexagon-head cap screws. Next aline the holes on the bottom of the main bracket of the mount with those in the bosses of the mount extension and fasten it in place with the two bolts.

b. To mount the subcaliber gun, loosen the adjusting screws in the front collar of the mount. Remove the right trunnion bracket by removing the cap screw which fixes it to the main bracket. Lift the recoil mechanism of the subcaliber gun into position on the bracket by placing the front end of the recoil mechanism in the front collar and the left trunnion in its bracket. Replace the right trunnion bracket over the gun trunnion and secure it to the main bracket. Be sure the cap screw is tight before tightening the trunnion adjusting screw.

98. DISMOUNTING SUBCALIBER EQUIPMENT.

a. To dismount subcaliber gun, remove the right trunnion bracket by removing the cap screw which fixes it to the main bracket. Loosen the adjusting screws in the front collar of the mount. Lift the subcaliber gun from the mount by slipping the front end of the recoil mechanism from the front collar and the left trunnion from its trunnion bracket. Replace the right trunnion bracket on the main bracket and secure it in place with its cap screw.

SUBCALIBER EQUIPMENT

b. To dismount subcaliber mount, remove the two bolts through the bottom of the main bracket of the mount and the bosses of the mount extension. Remove the two hexagon-head cap screws which hold the mount extension to the top of the rear of the recoil mechanism of the weapon. Lift off the subcaliber mount. Assemble all screws, nuts, and washers in their proper places to prevent their being lost.

99. CARE AND PRESERVATION.

a. **Gun.** The 37-mm gun should be kept in perfect condition and thoroughly cleaned and oiled. Only such cleaning and preserving materials as are issued for this purpose will be used. It is especially important that all parts of the gun be kept free from rust. The following instructions for cleaning these parts will be strictly observed:

(1) The bore and chamber of the subcaliber gun require particular attention and will be thoroughly cleaned within 1 hour after firing. Wash the bore until clean with a solution of $\frac{1}{2}$ pound of soda ash or 1 pound of sal soda per gallon of boiling water, rinse, then dry thoroughly, using burlap or cloths, inspect, then oil.

(2) The breechblock and the firing mechanism will be thoroughly cleaned with the same solution, rinsed, dried, inspected, and oiled. All parts, recesses, and breechblock threads will be lightly oiled.

(3) The trigger mechanism will be kept free from dust and foreign matter, and after use, all parts will be carefully wiped dry and a drop of oil put on the striker bearings, trigger bearings, and safety bolt.

(4) The gun slides will be cleaned and freely oiled.

b. **Recoil Mechanism.** Recoil mechanism adjustment by the using arms is prohibited. All maladjustments should be reported to Ordnance personnel. Refilling of the mechanism, however, is permitted.

c. **To Refill Recoil Mechanism.** An empty recoil mechanism requires $2\frac{3}{4}$ pints of oil, or 21 oil gun fills. Only special recoil oil is used for this purpose. The filling procedure is as follows:

(1) Raise rear end of cradle higher than front end.

(2) Fill oil gun.

(a) Unscrew nozzle of oil gun.

(b) Pull the plunger back.

(c) Fill oil gun with special recoil oil.

(d) Replace the nozzle.

(e) Push the plunger up gently to force out the air.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

- (3) Remove the filling plug in front of the cradle.
- (4) Screw the oil gun into the filling hole.
- (5) Remove the drain plug in the right rear side of the cradle.
- (6) Push the plunger of the oil gun in slowly, at the same time watching for the escape of oil from the drain hole. When oil runs out free of air bubbles, the recoil mechanism is full.
- (7) Remove the oil gun. Before replacing the filling and drain plugs let 2 teaspoonfuls of oil escape, then screw the two plugs in tightly. This is necessary as the expansion of oil during prolonged fire may interfere with the complete return of the gun to battery.

d. **Repairs.** The 37-mm subcaliber mount requires repairs that are minor in nature and involve only the removal of burs when necessary, and the replacement of some parts. When the subcaliber mount is disassembled, all screws, nuts, and washers should be assembled in their proper places.

e. **Lubrication.** Proper lubrication of the subcaliber equipment is necessary if the mechanism is to function smoothly and give long service. The 37-mm gun materiel has very few oilholes or special fittings, yet it requires frequent oiling of certain bearings. The following guide indicates where lubrication is necessary, the kind of lubricant, amount required, frequency, and method of application.

LUBRICATION GUIDE 37-MILLIMETER GUN MATERIEL, M1916

Part	Method	Kind	Remarks
Bore.	Slush.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	After firing or weekly. First clean bore. When not in use coat with COMPOUND, rust-preventive, light.
Breechblock.	Spread oil on threads.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	Daily. Unscrew breechblock.
Firing pin.	Drops at contact surfaces.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	*Daily. While breechblock is dismantled.
Extractor and extractor pin.	Drops at contact surfaces.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	*Daily. While breechblock is dismantled.
Safety bolt.	Drops at ends of bracket.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	*Daily. While breechblock is dismantled.
Striker rod.	Drops at ends of bracket.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	*Daily. While breechblock is dismantled.
Sear.	Drops at bearing surface.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	*Daily. While breechblock is dismantled.

*At low temperatures, clean with SOLENT, dry-cleaning, and lubricate with OIL, lubricating, for aircraft instruments and machine guns.

SUBCALIBER EQUIPMENT

Part	Method	Kind	Remarks
Piston cross-head key.	Drops at contact surfaces.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	At assembly.
Striker spring.	Slush.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	At assembly.
Gun slides.	Cover bearing surfaces.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	Dismount gun.
Trigger crank.	One drop at each end of bearing.	OIL, engine, SAE 10 (below 32°F), SAE 30 (above 32°F).	Once per week.

100. INSPECTION.

a. Careful and frequent inspection should be made of the materiel to discover any parts which need attention or adjustment. The following instructions should be scrupulously observed:

Parts To Be Inspected	Points To Observe
Gun and recoil mechanism as a unit.	General appearance. Condition of the paint. Try ejection with empty shell case.
Breechblock.	Rotate the breechblock from right to left and back several times, noting whether there is any stiffness or binding. Depress the breechblock lever release pin cap and pull out the breechblock lever. Remove the extractor pin. Rotate the breechblock in a counterclockwise direction until the threads on the breechblock are disengaged from the threads in the breech ring and examine the threads on both for burs and rough surfaces. Inspect the firing pin hole in the face of the breechblock, depress the rocker plunger, and note how far the firing pin protrudes. With the rocker plunger fully depressed, the firing pin should protrude approximately one-eighth inch. Remove the rocker pin, turn the breechblock over and allow the rocker plunger, firing pin and firing pin spring to drop out. Examine these parts for rust and burred surfaces. The free length of firing pin spring is twenty-five thirty-seconds inch. Test the tension of the breechblock lever latch spring.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

Parts To Be Inspected	Points To Observe
Firing mechanism.	Test the tension of the striker spring and sear plunger spring. Test the action of the trigger crank and trigger crank lever. The trigger crank plunger should have tension enough to hold the trigger crank in place. Examine the sear and sear notch for burs or worn surfaces.
Barrel.	Examine the threads in the breech recess for burs and rough surfaces. The chamber and bore should be free from pits and rust. Remove the piston cross-head key and slide the barrel back to insure that the jacket shoe and recoil ways are free from burs.
Recoil mechanism.	Remove the barrel assembly from the recoil mechanism and examine the front and rear caps for oil leaks, and for leaks at the piston rod packing washer. Check the quantity of oil in recoil mechanism. Perform a retraction test. A simple retraction test may be made by manually retracting the gun, blocking it with a piece of wood about 10 inches long, and then pulling out the block with a cord or wire. The gun should return to battery quickly, but without shock.

101. MALFUNCTIONS AND CORRECTIONS.

a. The gun may under certain conditions either fail to return completely to battery, or may return too suddenly with a shock which will tend to damage the weapon. The firing mechanism may jam, there may be a defective cartridge, or a failure to eject an empty cartridge case properly, or the breech may not open.

b. Incomplete return to battery is evident when the firing mechanism does not cock, or the cocking is not sufficient to fire the next round. This may be caused by weakened counterrecoil springs, scored or scratched jacket shoe guides, a dented recoil cylinder, or by an excess of oil in the recoil mechanism caused by the expansion of the oil from continued firing. In the latter case a little oil may be let out of the recoil mechanism by unscrewing the drain plug located on the rear right side of the cradle. If it is thought that the condition of the guides is causing the difficulty, the gun should be dismounted and the guides examined for traces of scratches, fouling, etc. These

SUBCALIBER EQUIPMENT

may be remedied by use of crocus cloth followed by a thorough cleaning and oiling. Test the operation of the gun in the slides before replacing the piston crosshead key.

c. Sudden return to battery with a jarring impact is caused by incomplete buffing at the end of counterrecoil, that is, insufficient oil in the recoil mechanism. Ordinarily, addition of a little oil will remedy this condition. To do this, refill by removing the filling plug at the front of the cradle and inject sufficient oil by means of the oil gun.

d. Trigger crank lever jamming, which prevents depression sufficient to operate the firing mechanism, can usually be attributed to incomplete closure of the breech, which causes the safety bolt to lock the sear. The cartridge case should be examined for damaged rim or other defects tending to prevent its insertion into the chamber. Another round may be tried. If the round is not the cause of the difficulty, examine the chamber for dirt, or fouling, and the trigger mechanism for broken or damaged parts and for foreign matter which may have become caught in the mechanism. Broken or damaged parts should be replaced.

e. Failure to fire is caused by a defective primer, a weakened striker spring, a worn or broken firing pin, or dirt in the firing pin recess. If two percussions are frequently necessary to produce discharge, the striker spring has either become weakened and should be replaced, or it is so clogged with dirt and hardened grease that it cannot function properly. If no defect can be found in the firing mechanism and the round does not fire after three percussions, wait for 2 minutes, and then replace it with another round as the primer is defective.

f. Defective extraction may occur when the cartridge case tends to stick in the chamber either because the chamber is burred or fouled with powder, or because the extractor is damaged or broken. A poor cartridge case may stick in the chamber because of expansion, in which case the hand extractor should be used to complete extraction. Careful use of crocus cloth will correct sticking caused by burs in the chamber. If the extractor is broken or damaged, it should be replaced.

g. Failure of the breech to open may be caused by the firing pin being stuck in the primer, or the gun may be uncocked. The former may be caused by a burred rocker, which can be corrected by careful use of crocus cloth, or a defective primer, which should be replaced by a new one. The gun may be uncocked because the cannoneer failed to release the trigger crank lever, because of a worn or broken sear, a defective sear plunger and spring, or a worn or broken shoulder on the striker rod.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

102. PRECAUTIONS.

a. Firing.

(1) Before firing, check to be sure that the bore is clean and dry, the recoil mechanism is correctly filled, the mount is securely fastened to the primary weapon, and both weapons are properly bore sighted. Also check to see that the spare parts set is complete, all moving parts are oiled, and that all parts are functioning properly. In addition, perform the retraction test.

(2) During firing, should a misfire occur, recock, relay, and make three attempts to fire. If failure continues, wait 2 minutes before opening breech. Always release the trigger crank promptly.

(3) After firing, clean the piece thoroughly within 1 hour, examining the cradle for worn, loose, or broken parts.

b. Handling.

(1) No attempt should be made to repair or disassemble the recoil mechanism except by Ordnance personnel. The using arms may only fill or drain it, as necessity requires.

(2) Avoid working the trigger mechanism when there is no cartridge in the chamber. Do not attempt to force the trigger crank lever when the breech is not completely closed. The sear is locked by the safety bolt, on the left side of breech ring, and cannot move with the breech open.

(3) The breechblock should not be opened unless the firing mechanism is cocked.

(4) The walls of the recoil cylinder and of the striker housing, attached to the cradle, are relatively thin. Dropping the cradle, therefore, may dent them and cause internal interferences.

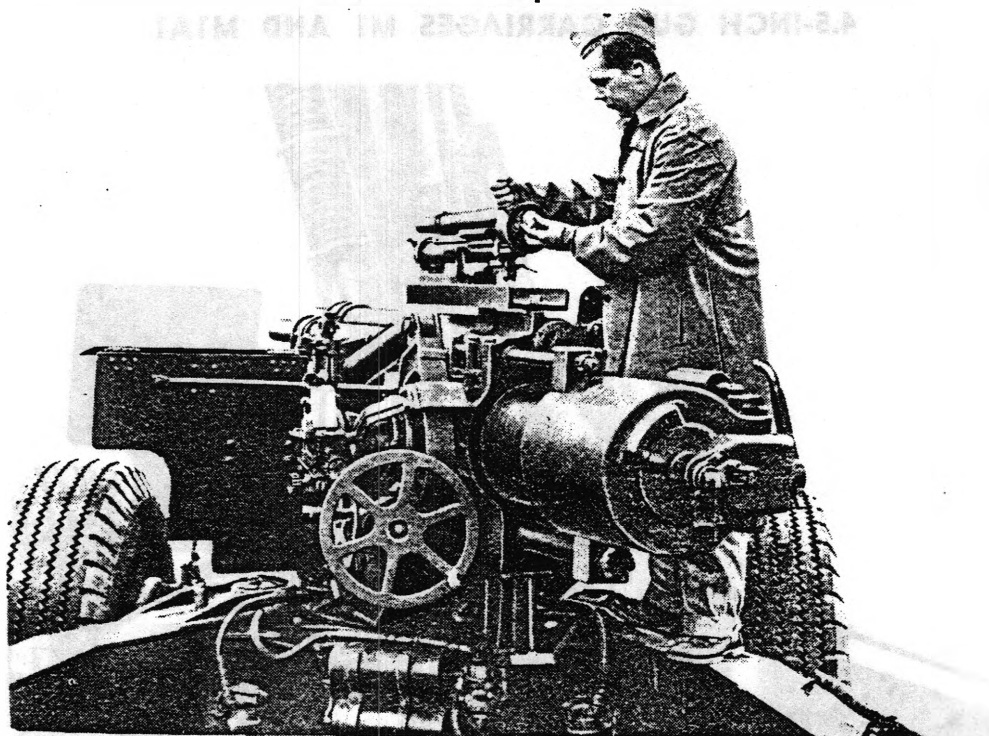
103. OPERATION.

a. The normal position for operating the subcaliber equipment is from the right side with gunner standing on the trails (fig. 149), or on a board placed across the trails and under the breech (fig. 150). At the higher elevations, however, the gun is serviced from the ground (fig. 151). The only need for caution is on the first round, or after a misfire, when the gunner is compelled to reach across the gun to cock the firing mechanism. Subsequent firing automatically cocks it.

104. BORE SIGHTING.

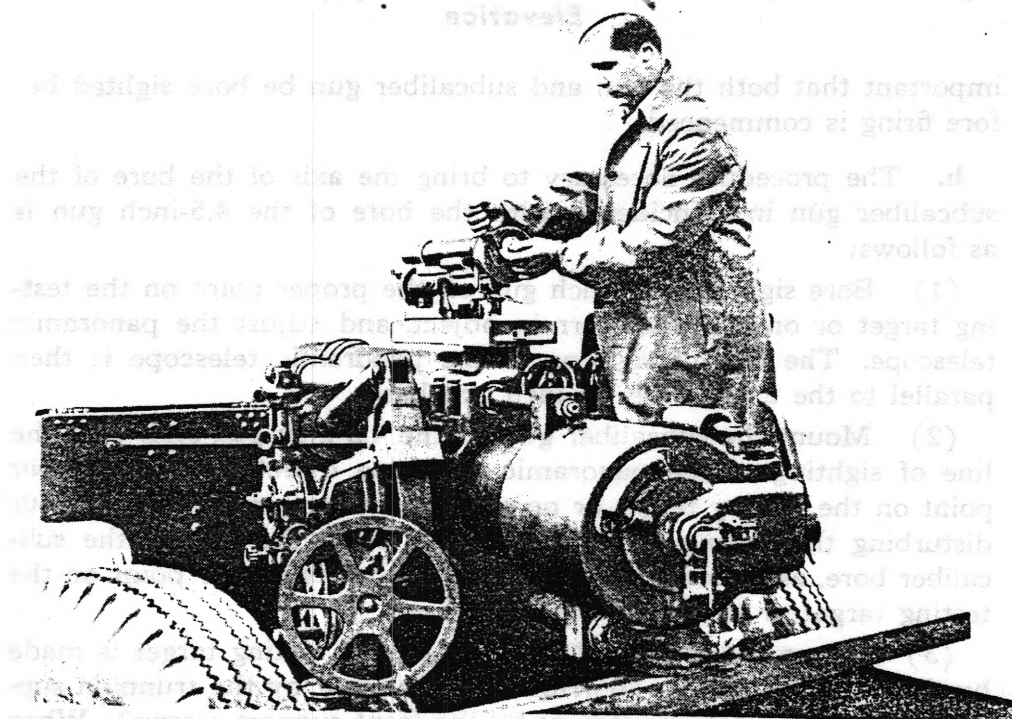
a. The subcaliber gun must be bore sighted before each period of firing and the alinement checked frequently during firing. It is

SUBCALIBER EQUIPMENT



RA PD 31166

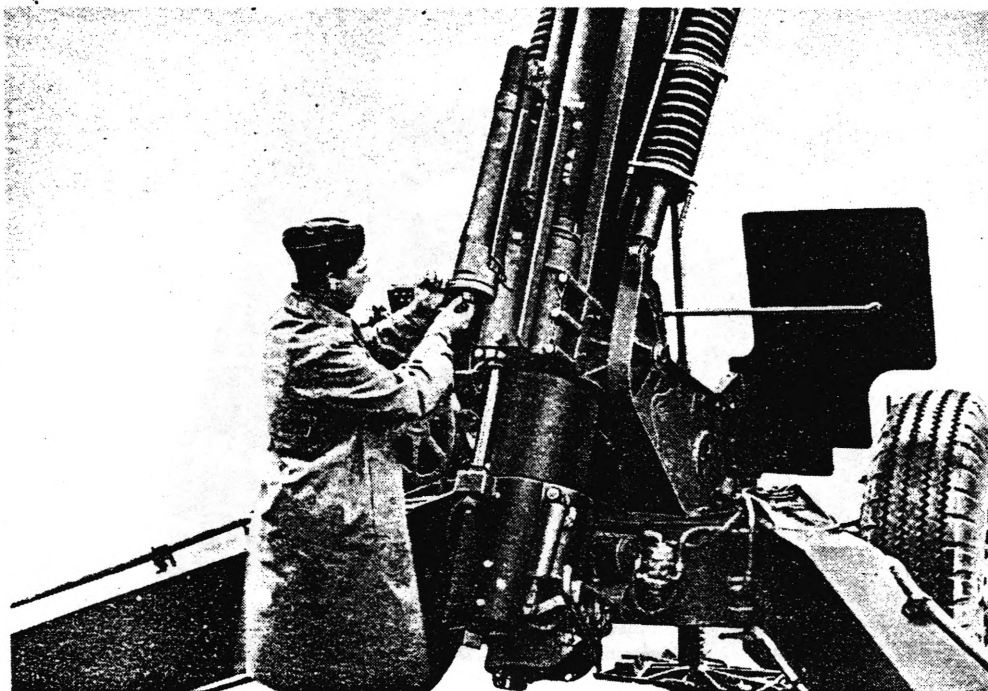
Figure 149—Operation of Subcaliber Equipment at 0° Elevation and Maximum Left Traverse



RA PD 31167

Figure 150—Operation of Subcaliber Equipment at 0° Elevation and Maximum Right Traverse

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**



RA PD 31168

Figure 151—Operation of Subcaliber Equipment at Maximum Elevation

important that both the gun and subcaliber gun be bore sighted before firing is commenced.

b. The procedure necessary to bring the axis of the bore of the subcaliber gun in coincidence with the bore of the 4.5-inch gun is as follows:

(1) Bore sight the 4.5-inch gun on the proper point on the testing target or on a distant terrain object, and adjust the panoramic telescope. The line of sighting of the panoramic telescope is then parallel to the axis of the 4.5-inch gun base.

(2) Mount the subcaliber gun on the 4.5-inch gun and, with the line of sighting of the panoramic telescope directed on its proper point on the testing target or on the distant terrain object (without disturbing the setting of the telescope), bring the axis of the subcaliber bore, as indicated by bore sighting, to its proper point on the testing target or to the terrain object.

(3) Alinement of the 37-mm gun on the testing target is made by the adjusting screws (horizontal adjustment by the trunnion support screws, vertical adjustment by the front support screws). When tightening the screws, care must be taken not to place strain on the recoil cylinder of the 37-mm gun recoil mechanism, as it may be dis-

SUBCALIBER EQUIPMENT

torted and so prevent the subcaliber gun from returning fully into battery. When the bore sights are properly alined, fit the jam nuts up tight by tightening them intermittently instead of completely tightening one at a time.

105. ORGANIZATIONAL SPARE PARTS AND ACCESSORIES.

a. Organizational Spare Parts. The only spare parts issued with the subcaliber equipment are those which are liable to fail and which may readily be replaced by the using arms. These parts are specified in "Organizational Spare Parts and Equipment" section, SNL C-38.

b. Accessories. The accessories provided for the subcaliber weapon are those required for the cleaning and preserving, as well as for keeping a complete record, of the equipment. They include a gun book, cartridge extractor, cleaning brush, oil gun, rammer, tool roll, etc.

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

CHAPTER 6

TOOLS, PARTS, AND ACCESSORIES

106. ORGANIZATIONAL SPARE PARTS.

a. A set of organizational spare parts is supplied to the using arms for field replacement of those parts most likely to become broken, worn, or otherwise unserviceable. The set will be kept complete by requisitioning new parts for those used. The parts (and their piece marks) comprising the set are listed below for information only; this list will not be used for requisitioning. The authority upon which requisitions are based is SNL C-38.

DISK	B163663	PLUG	A9585
GUIDE	A12256	PLUNGER	A25625
MECHANISM, firing		RING	A206739
M1, assembly	C70485	RING	B163614
NUT	A157225	RING	B163615
NUT	A233055	ROD	B163626
PAD	C70647	SCREW	A12260
PIN	BFAX2AB	SHOE	A12688
PIN	A12258	SPRING	A25626
PIN	BFDX1BN	SPRING	A12261
PIN	A25308	WHEEL, disk, and	
PLUG	A18495	rim, assembly,	—

b. Care of spare parts is covered in paragraph 50.

107. ACCESSORIES.

a. Accessories include the tools and equipment, required for such disassembling and assembling as the using arms are authorized to perform, and for the cleaning and preservation of the gun, carriage, sighting and fire control equipment, ammunition, etc. They also include chests, covers, tool rolls, and other items necessary to protect the materiel when it is not in use, or when traveling. Accessories should not be used for purposes other than as prescribed, and when not in use should be properly stored.

b. The accessories provided with each weapon are listed below. Those issued to the battery mechanic are listed in paragraph 108,

TOOLS, PARTS, AND ACCESSORIES

special organizational tools and equipment. If it becomes necessary to replace a broken or missing accessory, this list should be checked with SNL C-38, which is the authority for requisitioning.

Accessory	Piece Mark or Stock No.	Use
BAR, crow, pinch-pt., 3 lb.	41-B-167	_____
BELT, primer, M8	D7225490	_____
BOOK, Technical Manual 9-328	_____	_____
BRUSH, bore, M22	38-B-992-50	Cleaning and oiling bore of gun (par. 51).
BUCKET, water, glvd., 14 qt.	42-B-25520	_____
CHEST, metal, 28 $\frac{7}{8}$ x 13 $\frac{1}{4}$ x 11 $\frac{1}{16}$ in.	41-C-857-330	Fig. 153
COVER, bore brush	24-C-1058-825	_____
COVER, breech end, M224	24-C-1068-175	_____
COVER, firing jack, M528	24-C-1169-75	_____
COVER, firing jack, M532	24-C-1169-85	_____
COVER, muzzle, M326	D7158258	_____
COVER, muzzle end, M329	24-C-1851-625	_____
COVER, over-all, M104	D91433	Fig. 81
FORM, War Dept., Arty. Gun Book (O.O. Form 5825) (blank)	28-F-67990	Step c (1) below
FRAME, ammunition, M22	D54130	_____
FRAME, ammunition, M25	D54131	_____
GAGE, pressure, tire	8-G-357	_____
GUN, lubr., pressure, push- type, 5 oz.	41-G-1334	_____
HANDLE, socket wrench, $\frac{3}{4}$ in. diam., 20 in. long	41-H-1541	Fig. 124
HANDSPIKE	41-H-1522-100	To traverse gun by moving trail
HEAD, rammer, loading	41-H-1826-300	Fig. 74

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

Accessory	Piece Mark or Stock No.	Use
LANYARD, 4 ft.	21-L-123-725	For firing (fig. 78).
LIGHT-SYSTEM, black- out	8-L-818-53	Placed around muz- zle of gun when trav- eling (fig. 152).
LIGHT-SYSTEM, black- out	C93537	Placed around muz- zle of gun when trav- eling (fig. 152).
OILER, S., 1/3 pt.	13-O-1503	—
ORDER, (guide), lubr., War Dept. No. 77	—	Figs. 82 and 83
PAULIN, canvas, 12 x 12 ft.	24-P-29	—
RAMMER, cleaning and unloading, M6	C91880	Pars. 51 and 36
REAMER, cleaning, primer seat	41-R-501-80	Fig. 72
ROLL, tool, M4 w/con- tents, complete (Consisting of:	—	—
1 CHISEL	41-C-1124	—
1 DRIFT	41-D-1530	—
1 DRIFT	41-D-1533	—
1 FILE	41-F-1016	—
1 FILE	41-F-1572	—
1 HAMMER	41-H-524	—
2 HANDLE	41-H-1116	—
1 PLIERS	41-P-1977	—
1 PUNCH	41-P-3602	—
1 PUNCH	41-P-3606	—
1 ROLL, tool, M4	41-R-2705-5	—
1 SCREWDRIVER	41-S-1385	—
1 SCREWDRIVER	41-S-1101	—
1 SCREWDRIVER	41-S-1104	—
1 WRENCH)	41-W-2343	—
SLEDGE, blacksmith's, dble-face, 6 lb.	41-S-3722	—
SLEDGE, blacksmith's, dble-face, 10 lb.	41-S-3726	—
SPACER, adjusting, coun- terbalance	41-S-3868-160	Fig. 104
STAFF, cleaning, inter- mediate section	41-S-4658-120	Used with bore brush, rammer, and rammer head (fig. 21).

TOOLS, PARTS, AND ACCESSORIES

Accessory	Piece Mark or Stock No.	Use
TOOL, vent cleaning, drill bit type	41-T-3081-120	Fig. 71
TRAILER, 4-ton, 2-wheel, ammunition, M21	—	—
TRAY, loading	41-T-3851-260	Fig. 74
WRENCH, firing mecha- nism	41-W-3248-251	To unscrew firing pin housing (fig. 102).
WRENCH, fuze, M7A1	41-W-1596-50	Used for tightening and interchanging fuzes (fig. 73). Also used to set fuze to "DELAY" or "SU- PERQUICK"
WRENCH, socket	41-W-3843-10	For wheel stud nuts (fig. 124).
WRENCH, socket head set screw, 1/8 in. hex.	41-W-2450	Fig. 101
WRENCH, socket head set screw, 3/16 in. hex.	41-W-2452	—
WRENCH, spanner, face, adj., 4 in. cap	41-W-3247-500	Fig. 112

c. There are a number of accessories, the names or general characteristics of which indicate their use. The uses of others embodying special features or having special uses are illustrated and described in this manual. The uses of others are described in the following steps:

(1) ARTILLERY GUN BOOK WAR DEPARTMENT FORM.

(a) The Artillery Gun Book War Department form O.O. 5825 (28-F-67990) is used to keep 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; battery commander's daily gun record; inspector's record of examination; forms to be filled out in case of premature explosions. This book should be in the possession of the organization at all times, and its completeness of records and its whereabouts are the responsibility of the battery commander. It must also contain date of issuance of the materiel, by whom used, and the place where issued. If a new gun is installed on the carriage, all data recorded in the old book with reference to sights, mounts, etc. must be copied into the new book before the old book is relinquished. If a gun book is lost, it should be replaced at once and all entries brought up-to-date. Additional copies may be obtained by requisition to General Supply Department, Raritan Arsenal, Metuchen, New Jersey, on WD QMC Form No. 400.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

NOTE: Record of assignment data must be removed and destroyed prior to entering combat.

(b) Complete instructions on how to make entries in the Artillery Gun Book are contained therein. It is absolutely essential that the gun book entries be kept complete and up-to-date. In order to facilitate proper maintenance of the cannon and its related materiel (that is, carriage, recoil mechanism, and associated fire control equipment) and to avoid unnecessary duplication of repairs and maintenance, the following additional entries are to be made in the gun book:

1. A record of completed Modification Work Orders. This record should show the date completed and bear the initials of the officer or mechanic responsible for completion of the modification.

2. A record of seasonal changes of lubricants and recoil oil in sufficient detail to prevent duplication and afford proper identification by the inspector.

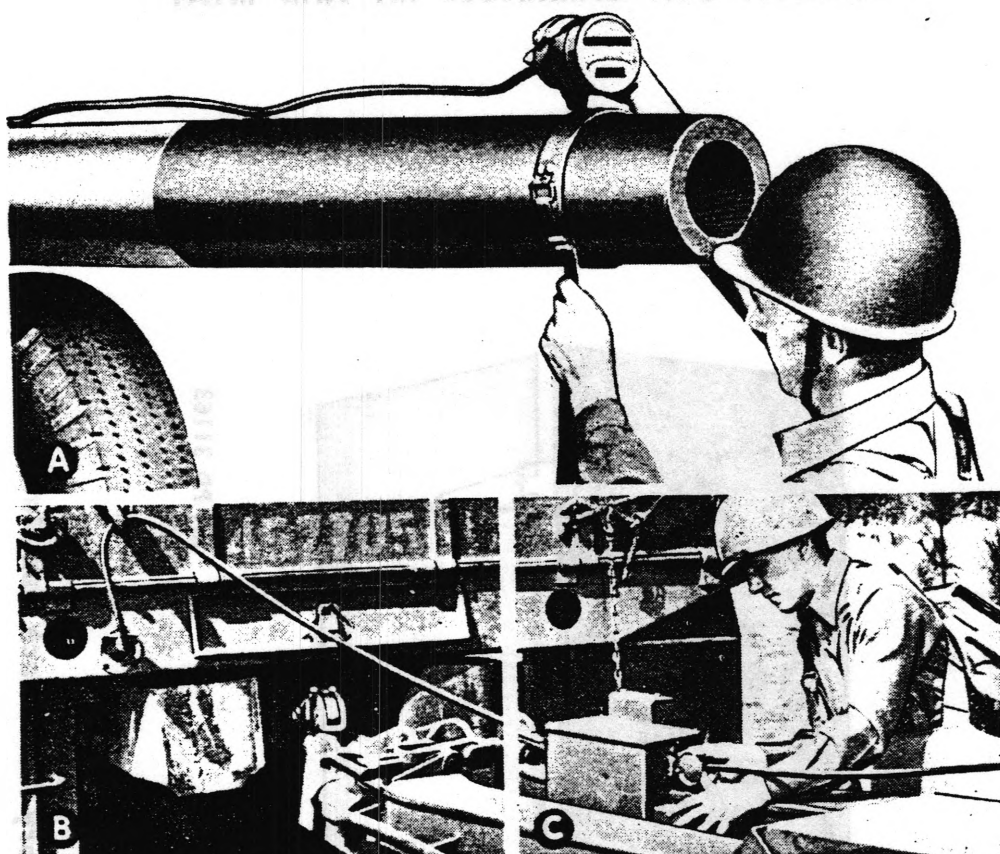
(c) The estimated accuracy life for cannon may be found in Changes No. 1 to TM 9-1860, Ordnance Maintenance: Star-gaging equipment, impression outfits and pressure gages, for making the entry in the blank space immediately under the inspector's record. The reference to OFSB 4-1 in instruction number 6 in the gun book should be corrected accordingly.

(2) BLACKOUT LIGHT-SYSTEM.

(a) The blackout light-system C93537 is furnished for the 4.5-inch Gun Materiel M1A1 (fig. 152) and the blackout light-system 8-L-818-53 is furnished for the 4.5-inch Gun Materiel M1. The principal difference between the two light-systems is that the cable for the M1A1 is 37 feet long and is plugged into a socket on the rear of the prime mover (fig. 152, B), while the cable for the M1 is 32 feet long and is plugged into a socket on the battery box on the left trail (fig. 152, C).

(b) In addition to the cable, each blackout light-system consists of a 6- to 8-volt lighting fixture attached to a flexible metal strap (fig. 152, A). It is strapped around the muzzle of the weapon by means of a web strap. The lighting fixture has both a red taillight and an amber stoplight. A coil spring is provided with the M1A1 system to keep the cable out of the way of the lunette of the carriage and the pintle of the prime mover.

TOOLS, PARTS, AND ACCESSORIES



RA PD 63385

Figure 152—Attaching Blackout Light-system

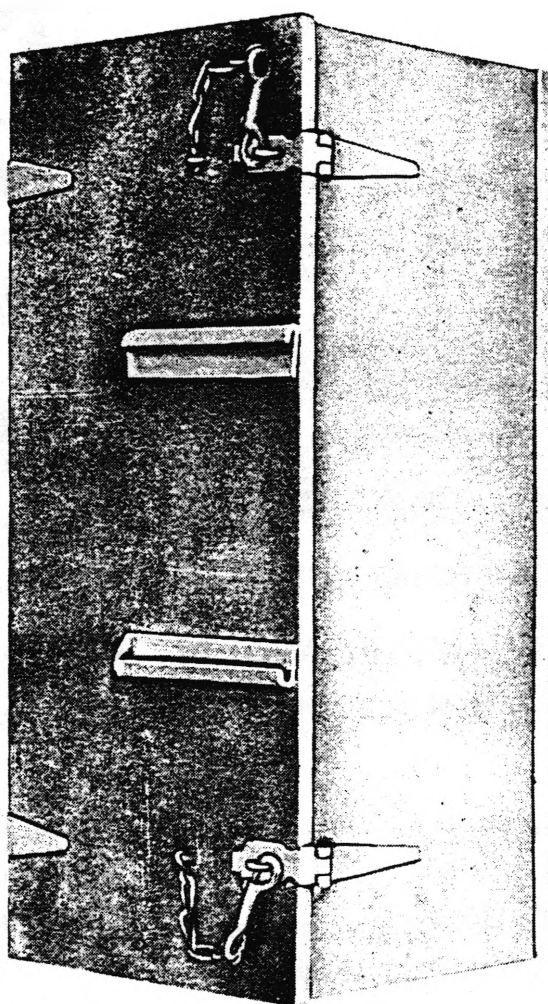
108. SPECIAL ORGANIZATIONAL TOOLS AND EQUIPMENT.

a. Following is a list of accessories issued per firing battery of 4.5-inch guns.

Accessory	Piece Mark or Stock No.	Figure No.
CHEST, grinder	41-C-738-300	3
CHEST, metal, 28 $\frac{7}{8}$ x 13 $\frac{1}{4}$ x 11 $\frac{1}{16}$ in.	41-C-857-330	1
CHEST, oil pump, w/contents, complete	—	2
CONTROL, electric brake, set	17-C-34129	—
GRINDER, bench, hand power, med. duty, 6 in., complete	41-G-873	3
HAMMER, hide-faced, 2 lb.	41-H-473	4
HOSE, air, 25 ft., assembly	33-H-986	—
WRENCH, socket, $\frac{1}{2}$ -in. sq-drive., set complete	—	4

TM 9-328
108

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

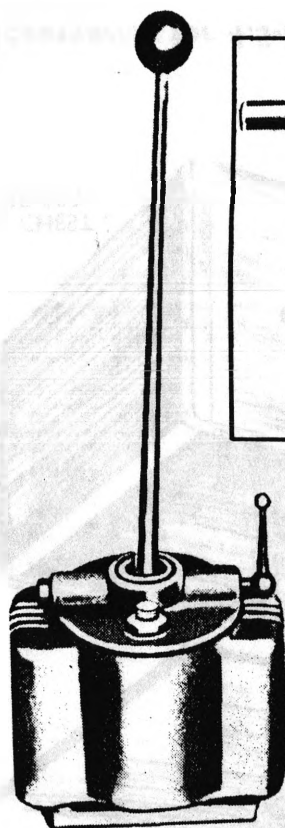
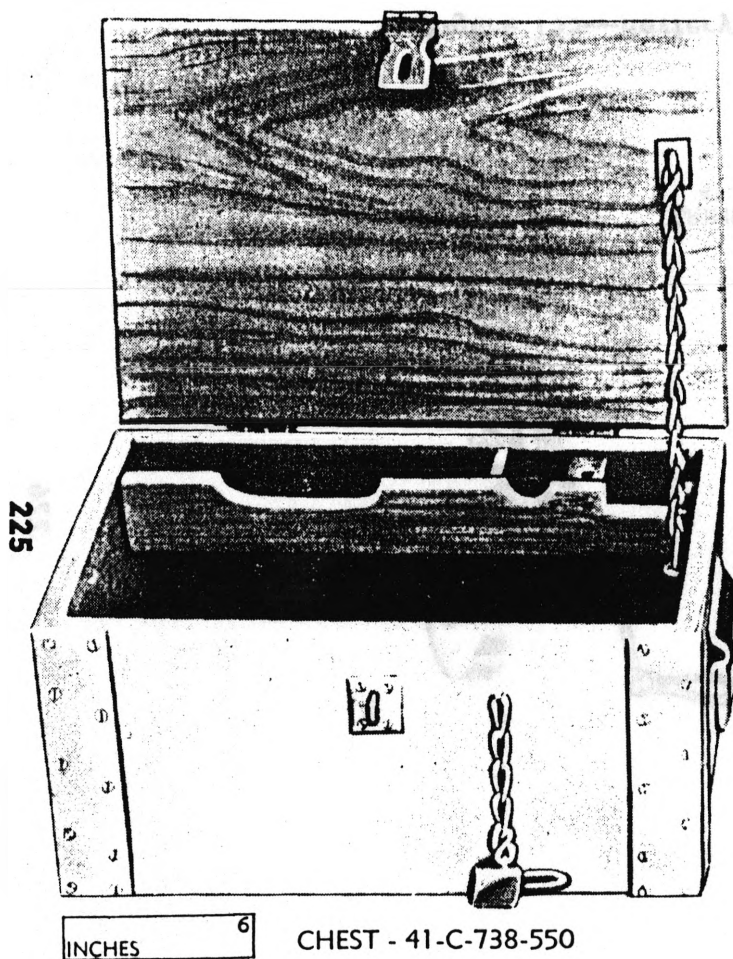


INCHES 1 2 3 4 5 6

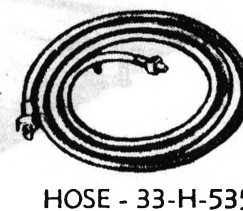
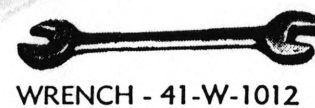
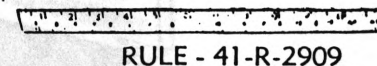
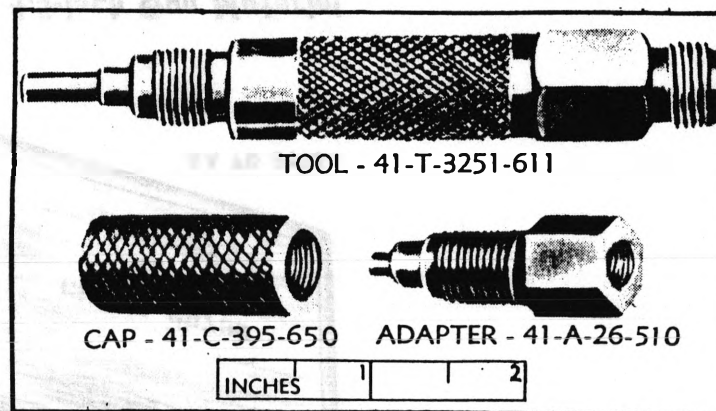
CHEST - 41-C-857-330

RA PD 31163

Figure 153—Battery Accessory for 4.5-inch Gun Materiel



CHEST, OIL PUMP, W/CONTENTS



RA PD 31149

TOOLS, PARTS, AND ACCESSORIES

TM 9-328
108

Figure 154—Battery Accessories for 4.5-inch Gun Materiel

4.5-INCH GUN MI AND
4.5-INCH GUN CARRIAGES MI AND M1A1

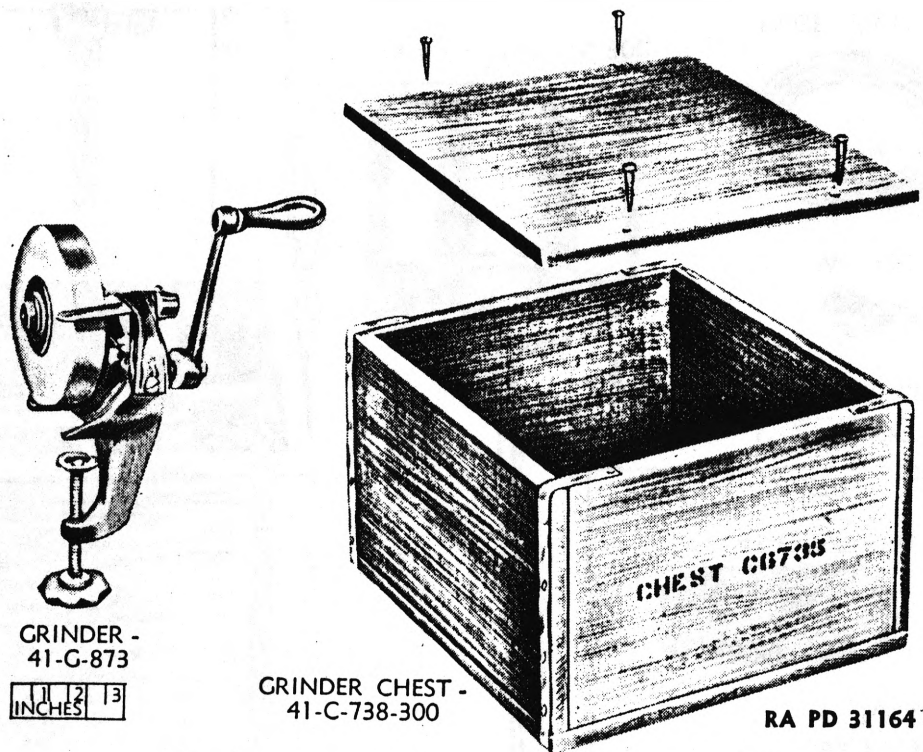
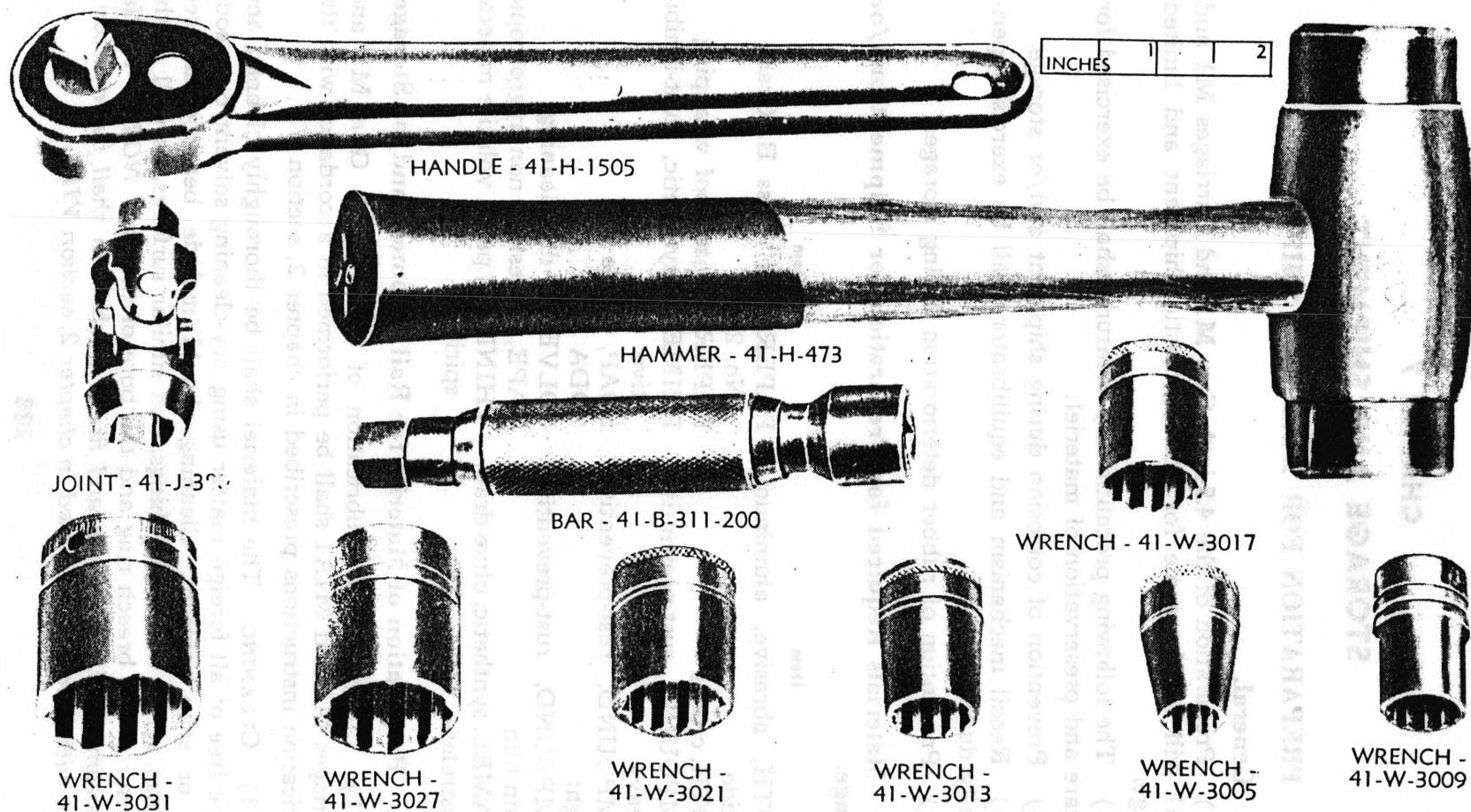


Figure 155—Battery Accessories for 4.5-inch Gun Materiel



TOOLS, PARTS, AND ACCESSORIES

TM 9-328
108

RA PD 31150

Figure 156—Battery Accessories for 4.5-inch Gun Materiel

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

CHAPTER 7

STORAGE AND SHIPMENT

109. PREPARATION FOR DOMESTIC SHIPMENT.

a. General.

(1) Preparation of the 4.5-inch Gun M1 and Carriages M1 and M1A1 will be the same for both domestic shipment and limited storage.

(2) The following precautionary measures shall be exercised for the care and preservation of materiel:

- (a) Prevention of corrosion during shipment and/or storage.
- (b) Recoil mechanism and equilibrator shall be exercised periodically during storage.
- (c) Prevention of rubber deterioration during storage.

b. Materials Required for Preparation for Shipment and/or Storage.

Item	Item
CLOTH, abrasive, aluminum-oxide	PAPER, flint, class B, Grade No. 2/0
CLOTH, crocus	PAPER, greaseproof wrapping
COMPOUND, rust-preventive, heavy	PRIMER, synthetic, rust-inhibitive
COMPOUND, rust-preventive, light	SOAP, castile
COMPOUND, rust-preventive, thin film	SODA ASH
ENAMEL, synthetic, olive-drab, lustreless	SOLVENT, dry-cleaning
	TAPE, adhesive, non-hygroscopic
	THINNER, paint, volatile mineral spirits

c. Preparation of Materiel for Rail Shipment and/or Storage.

(1) LUBRICATION. Lubrication of the 4.5-inch Gun M1 and Carriages M1 and M1A1 shall be performed in accordance with the lubrication instructions prescribed in chapter 2, section V.

(2) CLEANING. The materiel shall be thoroughly cleaned and made free of all foreign matter using dry-cleaning solvent or a soda ash or soap solution. Cleaning should include bearing surfaces, springs, screw threads, bushings, and similar surfaces, as well as the interior of the breech ring and the bore of the gun. *NOTE: Partial disassembly of the breech and firing mechanism shall be in accordance with procedure outlined in chapter 2, section VIII.*

STORAGE AND SHIPMENT

(a) Apply dry-cleaning solvent by scrubbing with a brush or wiping with a clean cloth. Dry thoroughly.

(b) Apply a warm soda ash or soap solution by vigorously brushing or scrubbing the surfaces thoroughly until all traces of contamination have been removed. The surfaces shall then be rinsed with clean, warm water and thoroughly dried.

1. Soda ash solution consists of $\frac{1}{2}$ pound of soda ash dissolved in 2 gallons of warm water.

2. Soap solution preparation consists of 1 pound of castile soap or issue soap in chip form dissolved in 4 gallons of hot water.

(c) Avoid contact of bare hands with cleaned surfaces.

(3) PAINTING. Painted surfaces that have become checked, pitted, or rusted must have the rust spots removed and the surfaces repainted.

(a) *Removing Rust Spots.* The following may be used in removing rust spots:

1. Use aluminum-oxide abrasive cloth for cleaning finished or unfinished external surfaces where wear of the parts cleaned will not affect the functioning of the mechanism.

2. Use crocus cloth for removing rust or stain and for polishing parts of the breechblock and firing mechanism and other finished surfaces of metal.

(b) *Application of Rust-inhibitive Synthetic Primer.* Apply a liberal coating of rust-inhibitive synthetic primer over the entire area of the cleaned surfaces to be repainted as follows:

1. *Brushing or Spraying.* The primer 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 volatile mineral spirits, paint thinner. For spraying, the primer may be thinned with not more than 15 percent by volume of volatile mineral spirits, paint thinner. Allow to dry thoroughly.

(c) *Sandpapering Surfaces.* Sandpaper the primed surfaces with grade No. 2/0, class B flint paper, and wipe all particles of dust from surfaces.

(d) *Application of Enamel.* Apply a coat of lustreless, olive-drab, synthetic enamel, and allow to dry thoroughly before the materiel is used.

(4) APPLICATION OF PRESERVATIVE. *NOTE: Application of preservatives should be accomplished immediately after cleaning and drying. Rust-preventive compounds, light and heavy, used herein shall be brought to the proper consistency by heating before application.*

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

(a) *Breech Mechanism.* Partial disassembly of the breech mechanism should be accomplished where possible, and parts dipped, sprayed, or brushed with light rust-preventive compound. After assembly of the breech, apply a coating of light rust-preventive compound to the exterior portion.

(b) *Gun Tube.* Thoroughly swab the bore of the gun with light rust-preventive compound.

(c) *Exterior Unpainted Surfaces.*

1. Use thin film rust-preventive compound on exterior unpainted surfaces that are not highly finished, machined, or operating and from which the preservative *need not be completely removed* before operation. This compound may be applied by brushing or spraying without heating or solvent dilution.

2. Use heavy rust-preventive compound on exterior unpainted, machined operating surfaces from which preservative *must be completely removed* before materiel is placed in operation.

(5) **SEALING.** Seal muzzle and breech with two layers of greaseproof wrapping paper and overwrap with waterproof wrapping paper. Tape securely with non-hygroscopic adhesive tape and brush or spray thin film rust-preventive compound over tape to act as a sealer. If greaseproof paper is not available, use canvas or burlap impregnated with thin film rust-preventive compound and tie or strap in place.

(6) **GUN BOOK.**

(a) During transfer or shipment, the gun book will be kept in a waterproof envelope securely fastened to the gun tube with waterproof tape.

(b) Under one of the wrappings of tape, one end of a small tab will be inserted, reading: "Gun book here."

(7) **TIRES.**

(a) Remove all stone and other foreign objects from the tire treads.

(b) Rubber equipment must be kept free from oils, greases, and preservatives.

110. LOADING AND BLOCKING MATERIEL ON RAILROAD CAR.

a. **General.** All loading and blocking instructions 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, containing "Rules Governing the Loading of Mechanized and Motorized Equipment, Transported by the Ground Armed Forces, also, Major Calibre Guns for the United States Army and Navy on Open Top Equipment."

STORAGE AND SHIPMENT

b. Instructions.

(1) **INSPECTION.** Railroad cars must be inspected to see that they are suitable to carry loads safely to destination. Cars should have good sound floors, and all loose nails or other projections, not an integral part of the car, should be removed. Nails, bolts, etc., necessary in car construction, when loose, should be made tight rather than 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, avoiding all unnecessary shocks.

(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, classification, 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) **BRAKE WHEEL CLEARANCE (A, fig. 157).** 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.

(7) **DISTRIBUTION OF LOAD.** Materiel 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. *NOTE: When loading railroad cars, materiel shall be 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.*

(8) **TYPES OF CAR.** Flat, box, or drop-end gondola cars may be used.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

(9) **MAXIMUM LOAD WEIGHTS.** 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 (Pounds)	Total Weight of Car and Load (Pounds)	Load Weight (Deduct Lt. Wt. of Car) (Pounds)
40,000	66,000	66,000
60,000	103,000	103,000
80,000	136,000	136,000
100,000	169,000	169,000
140,000	210,000	210,000
200,000	251,000	251,000

EXAMPLE

	Pounds
Capacity of car.....	100,000
Total weight of car and load.....	169,000
*Light weight of car (to be subtracted).....	37,000
Permissible weight of load.....	132,000

(10) **STAKES, BRACES, BLOCKS, CLEATS, WEDGES.** All blocking pieces must be of hardwood, fir, spruce, long leaf yellow pine, larch or hemlock, straight grained and free from strength impairing knots.

(11) **WIRE.** All wire used for securing loads should be No. 8 gage black annealed wire, or equivalent.

(12) **TIRES.** The tire pressure on all tires shall be increased to 10 pounds per square inch above normal pressure.

(13) **BRAKES.** After loading the materiel, set the hand brakes.

(14) **MUZZLE AND BREECH COVERS.** The muzzle and breech covers shall be placed in position and securely fastened.

(15) **TRAVELING LOCK.** Secure traveling lock to the bottom of the cylinder yoke by locking in position with traveling lock pin.

(16) **TRAILS.** Place trails in traveling position and secure with right trail retainer pin.

c. **Blocking 4.5-inch Gun M1 and Carriages M1 and M1A1 on Railroad Car.** The following blocking requirements are minimum. Additional blocking as required may be added at the discretion of the officer in charge or foreman supervising blocking of materiel. (All reference letters in the following paragraphs refer to the details and locations in figure 157.)

(1) **PATTERN 3, ITEM B (4 required).** Place one pattern 3 at the front and one at the rear of each wheel. The 45-degree portion of the block shall be placed next to the tire. Nail the heel of the

*This marking is stenciled on each side of car indicated as "LT. WT."

STORAGE AND SHIPMENT

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** (4 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** (2 required). Place one pattern 7 under the axle near the inside face of each wheel. Cut pattern according to height equal to the distance between car floor and axle plus one-quarter inch to partially relieve weight from the tires. Nail each pattern to the car floor with six 40-penny nails.

(4) **PATTERN 1, ITEMS G AND H** (5 required). Locate one cleat H against the outside face of each trail. Nail each cleat to car floor with three 40-penny nails. Locate two cleats G against each end of the trail on each side of the lunette. Nail to car floor with three 40-penny nails. Locate one cleat G crosswise to the cleats just described and over the lunette, and nail to cleats below with three 40-penny nails. See detail locking of trail, figure 157.

(5) **STAKES J** (2 required). Locate one-third the distance from end of trail to center of wheels. When cut lumber is used, it shall be 4 by 5 by 48 inches hardwood. If green saplings are used, they shall be 5 inches in diameter midway between top and bottom. Side stakes or sapling shall extend 4 inches below stake pocket. Drive one 40-penny nail into stake or sapling directly below and with head even with outside of stake pocket.

(6) **STRAPPING, ITEM S.**

(a) *Axle* (2 pieces required). Wrap wire consisting of six strands of No. 8 gage black annealed wire around axle near the inside face of each wheel and secure to car floor with anchor plates or blocking.

(b) *Trails* (2 pieces required). Secure trails by passing wire, consisting of six strands of No. 8 gage black annealed wire around and over top of the trails, and secure the wire to the stake pockets on each side of the car. Twist-tie with rod or bolt enough to remove slack. See detail blocking of trail, figure 157.

111. LIMITED STORAGE.

NOTE: Materiel in limited storage is that materiel which is temporarily out of service.

a. Preparation.

(1) Before being stored, materiel will be thoroughly cleaned, lubricated, preserved, and inspected as directed in paragraph 109.

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

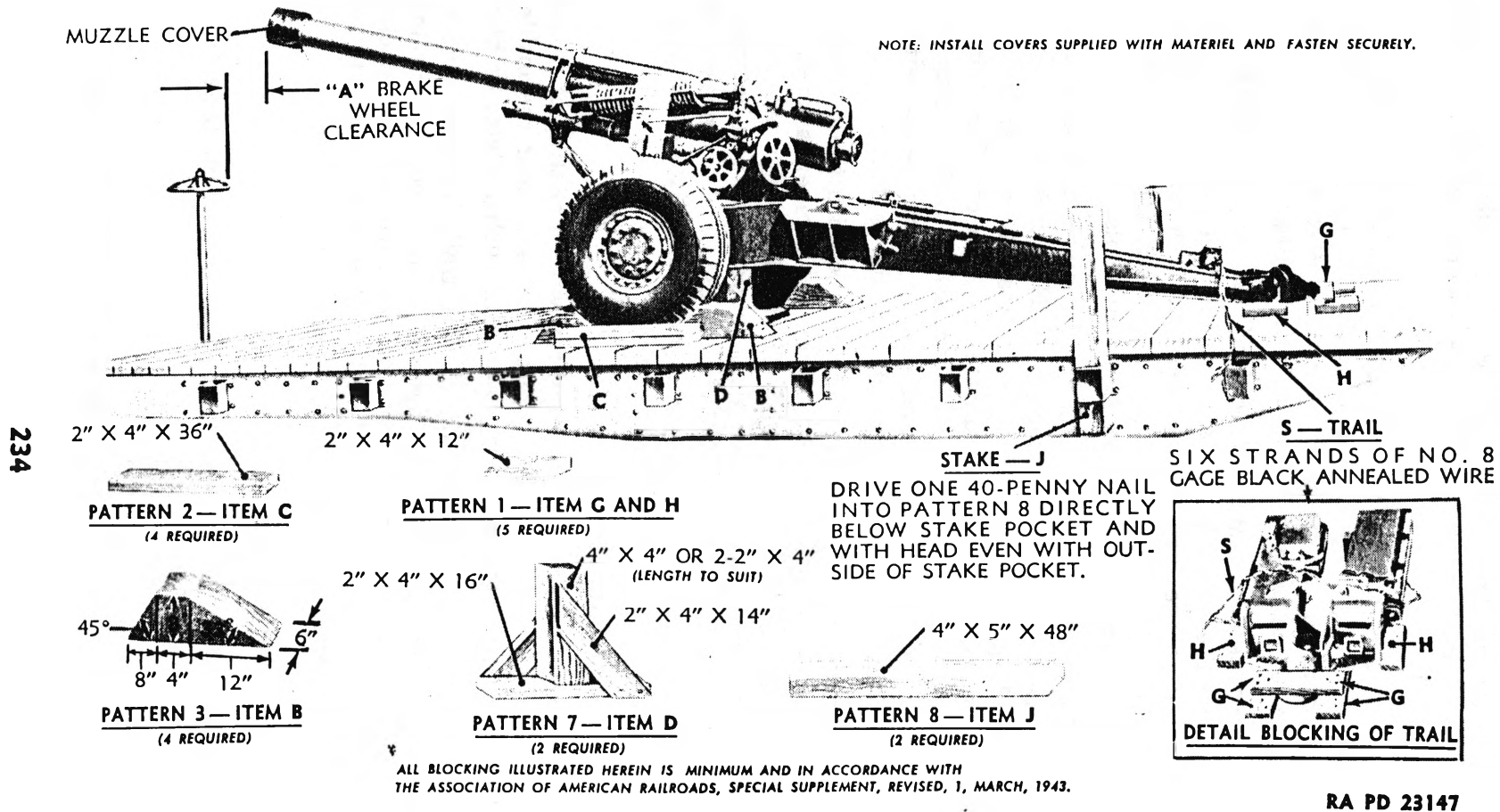


Figure 157—Method of Blocking 4.5-inch Gun M1 and Carriages M1 and M1A1 on Railroad Car

STORAGE AND SHIPMENT

(2) Install covers provided for the purpose at breech and at muzzle ends of gun and fasten securely.

(3) All missing or broken parts shall be promptly repaired and replaced. If repairs cannot be made prior to placing materiel in storage, a tag will be attached to materiel, specifying the repairs needed, and a written report of these items will be made to the officer in charge of the materiel.

b. **Tires.** All tires will be cleaned, inspected, and properly inflated. Tires requiring repairing or treading will be replaced with serviceable tires. Materiel will not be stored on floors, cinders, or other surfaces which are soaked with oil or grease. Any oil, grease, gasoline, or kerosene which comes in contact with tires under any circumstances will be washed off immediately.

c. **Inspections.**

(1) A visual inspection of the materiel will be made weekly to determine general appearance, and any parts found to be corroding will have the rust spots removed and will be treated with the proper preservative.

(2) Upon removal from storage, any items noted by a tag attached to materiel as still needing repair (step a (3), above), will be repaired. The materiel will be thoroughly cleaned and lubricated.

4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1

CHAPTER 8
OPERATION UNDER UNUSUAL CONDITIONS

112. GENERAL.

a. Because of the different climatic conditions under which this materiel may be expected to operate, special instructions are given in this chapter to cover operation under the unusual conditions that will be encountered in various regions.

b. In general, the instructions given in this manual apply to materiel operated in a temperate climate. When unusual operating conditions are encountered, the materiel must be prepared to meet these conditions if it is to perform in a satisfactory manner.

c. In cases of this nature, the instructions as to the classification of climate in which the materiel is operating is left to the judgment of the Ordnance officer. He is cautioned, however, that only extended, and not temporary, periods of climatic conditions govern the classification.

d. Manufacturing arsenals and plants should lubricate the materiel on assembly as prescribed in the Lubrication Orders (figs. 82 and 83). If the materiel is to be used in a climate other than temperate, the precautions in paragraphs 113 and 114 should be taken.

e. Materiel, previously lubricated for a colder climate than the one in which the materiel is to be used, should be relubricated with lubricants prescribed for use in the warmer climate.

f. Materiel, previously lubricated for a warmer climate than the one in which the materiel is to be used, should be completely cleaned of all lubricants, relubricated with the lubricants prescribed for the colder climate, and otherwise conditioned as directed in paragraph 114.

113. EXTREMELY HOT WEATHER.

a. The bore of the gun tube should be cleaned and oiled more frequently than usual when operating in hot climates. Temperature changes will cause condensation of moisture in the air on metal and cause rusting. If condensation occurs on other metal parts of the gun and carriage, wipe dry and coat with oil as required to prevent rusting.

b. Materiel should be inspected frequently when being operated in hot, moist areas. Cloth covers and other items which may deteri-

OPERATION UNDER UNUSUAL CONDITIONS

orate from mildew, or be attacked by insects or vermin should be aired and dried often.

c. **Lubrication.** Lubricate the materiel and check the levels of lubricants in gear cases more frequently when operating in hot climates. Heat will cause lubricants to thin out and deteriorate more rapidly; gear cases and other lubricant-retaining devices may leak when the lubricant is hot. Use the lubricants prescribed for temperatures over 32°F as prescribed in the Lubrication Orders (figs. 82 and 83).

d. **Tires.** Tires should be checked at frequent intervals to ascertain that the pressure is not above that which is prescribed, 95 pounds per square inch. Tires must be kept out of the direct rays of the sun as much as possible. They should be covered to protect them from prolonged exposure to the sun.

e. **Ammunition.** Ammunition should be kept cool and always out of the direct rays of the sun. Moisture-resistant seals should not be broken until ammunition is to be used.

NOTE: Extreme heat is often accompanied by other adverse conditions. Refer to paragraphs 115 and 116.

114. EXTREMELY COLD (SUB-ZERO) WEATHER.

a. Introduction.

(1) Operation of artillery materiel in cold weather presents problems that demand special precautions and careful servicing by both the using organizations and Ordnance maintenance personnel. Artillery materiel will operate efficiently in cold weather if properly serviced and properly maintained.

(2) The following instructions augment War Department Technical Manuals and Lubrication Orders, and apply when prevailing temperatures are consistently below 0°F and also for temperatures above 0°F when sluggish operation indicates the need for lighter lubricants.

b. **Effects of Cold Weather on Artillery Materiel.** The following results may be expected when artillery materiel is subjected to cold weather:

(1) Metal parts fail to withstand sudden shocks of impact when temperature is below 0°F.

(2) Painted surfaces crack very easily when exposed any great length of time.

(3) Metal contracts, causing considerably more friction between some moving parts, demand more care in lubrication.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

(4) Condensation, brought about by changes in temperature, necessitates more care to the tube and machined surfaces as a guard against corrosion.

(5) Recoil cycle time is lengthened by the recoil fluid thickening and creating a greater force resisting the motion of recoiling parts to the rear.

(6) Overlubrication of weapons causes parts to bind and freeze, resulting in the weapon being out of service.

(7) Handwheel effort is increased on both elevating and traversing mechanisms.

(8) Improperly packed wheel bearings freeze, hindering the mobility of the weapon.

(9) Most synthetic rubber becomes brittle and cracks when mishandled.

(10) Brakes fail to operate unless given special maintenance. Condensation, brought on by rises in temperature, freezes in air brake systems.

(11) Overlubrication and chilled lubricant causes power trains to require increased effort for operation.

(12) Overlubrication of the firing mechanism results in faulty firing from the firing pin striking the primer with insufficient force.

(13) Gas check pads deteriorate very rapidly and score up the gas check seat.

(14) Lubricants freeze and exposed surfaces collect dirt and other impurities from snow deposits. Inactive weapons must be kept covered.

(15) Exposed gears gather snow and other particles and spoil the lubricant very rapidly, necessitating strict and constant surveillance.

(16) Bores of tubes become coated with condensation brought on by rise in temperature and also by cooling after firing.

(17) Springs fail and break because of overlubrication.

(18) Ball and roller bearings freeze unless properly cleaned and lubricated.

(19) Leather straps crack unless properly treated with neat's-foot oil.

(20) Insulation around wire cables on the carriages may become brittle.

(21) Dry cell batteries fail after a few hours of exposure.

OPERATION UNDER UNUSUAL CONDITIONS

c. Mechanical Condition of Materiel.

(1) Since metals contract when the temperature decreases, and expand when the temperature increases, the clearances between bearing surfaces are considerably less in cold weather than at higher temperatures. In preparing artillery for cold weather operation, care must be taken to make certain that parts are alined properly and normal clearances exist. This applies not only to bearings but also to mechanisms employing packings around rotating or reciprocating shafts and rods. Lack of attention to this may result in binding which will make mechanisms stiff or inoperative regardless of the lubricant used. Scored or roughened bearings and other rubbing surfaces, such as cams and recoil slides also interfere with easy action and should be smoothed in preparing materiel for operation in cold weather.

(2) Cleanliness is imperative. Rust, dirt, and gummy oil and grease in bearing clearances reduced by low temperature, interfere with proper distribution of lubricant, thus causing stiff action, if not complete stoppage. In "winterizing" materiel, therefore, assemblies and mechanisms must be disassembled sufficiently to permit thorough removal of old oil, grease, and foreign matter. Cleaning is most efficiently done by washing with dry-cleaning solvent, employing brushes and scrapers where necessary. Care must be taken not to overlook cleaning small items that may appear insignificant. Field experience has proved that neglect in cleaning small linkages, bearings, and other similar parts may cause malfunctioning and stoppages in cold weather operation.

(3) Placing of materiel in proper mechanical condition requires time for necessary disassembly, repair, and cleaning, and must be carefully done. The approach of low temperatures must be anticipated far enough in advance to permit completion of the conditioning before the onset of cold weather.

d. Low Temperature Lubrication.

(1) Lubricating oils stiffen progressively as temperature falls, until a point is reached at which they solidify. As stiffness increases, the power required to move surfaces of bearings and gears in contact with the oil multiplies rapidly, until movement becomes impossible. When solidification occurs, the moving parts cut a channel through the oil, leaving the rubbing surfaces dry and unlubricated. Before friction can develop enough heat to liquefy the oil and re-establish an oil film, bearing and gear tooth surfaces may score and fail completely.

(2) Oils prescribed for use in artillery materiel at high temperatures must be designed to maintain adequate body at those temperatures, and, in most instances, they become too stiff at low temperatures to permit satisfactory operations. They must, therefore,

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

be completely replaced in cold weather with lighter oils which will remain fluid at the lowest expected operating temperatures.

(3) Grease is a combination of soap and oil in which the soap acts as a sponge to hold the oil in place, thus preventing leakage which might occur if oil alone were used. As temperature decreases, both oil and soap stiffen, and retard movement of parts. In cold weather, therefore, greases which cause minimum drag must be used.

(4) The presence of only a small quantity of warm weather grease will "freeze" bearings and prevent manipulation of the materiel at sub-zero temperatures. All normal temperature grease must be removed from bearings and gear cases, and replaced with suitable low temperature products when sub-zero temperatures are expected. Disassembly of materiel will be carried out to the extent necessary to do this. Once grease has solidified, it cannot be removed from bearings or gear cases without applying enough heat to melt it, or disassembling the unit and washing the parts with dry-cleaning solvent.

e. **Prescribed Lubricants.** The following materials will be used for the lubrication and preservation of all artillery and sighting and fire control materiel at temperatures below 0°F, and above 0°F where stiff action indicates their necessity. Refer to Product Guide OFSB 6-2 and SNL K-1 for specification designations and size of packages in which they are available through the Ordnance Provision System.

(1) OIL, Lubricating, preservative, light, or OIL, lubricating, preservative, special: For all bearings, gear cases, and mechanisms for which the prescribed oil at normal temperatures is engine oil; for firing pins and breech mechanisms; for miscellaneous hand oiling.

(a) *Purpose and Precautions.* Light or special preservative lubricating oil provide protection against corrosion and also lubricate moving parts. If either is to be used as a lubricant under cold weather conditions, it should be used sparingly. Overlubrication will result in sluggish action of moving parts and will also collect snow and result in a failure of the weapon. Whenever special or light preservative lubricating oil is used, it is necessary to inspect daily to determine the condition of the materiel. Whenever possible, seal or cover the parts so that there will be no direct contact with snow or water.

(b) *Method of Application.* The parts to be treated should be thoroughly free of all foreign material and cleaning agents. The most satisfactory method of application is by wiping with a cloth wetted with oil and then wrung out. The temperature of the metal should be slightly lower than the temperature of the preservative. Whenever possible, shelter the parts and provide enough warmth so the preservative may be applied evenly and easily.

OPERATION UNDER UNUSUAL CONDITIONS

(c) *Method of Removal.* Dry-cleaning solvent should be used to remove either of the oils. In cold weather, the use of dry-cleaning solvent will require considerable rubbing to remove all the preservative. Always dry thoroughly after using any cleaning agent. Strict inspection to assure removal of all foreign matter after cleaning is very important.

NOTE: Special preservative lubricating oil may be used as an alternate for light preservative lubricating oil. Means of application and removal are the same for all artillery materiel.

(2) OIL, lubricating, for aircraft instruments and machine guns: For oil-lubricated bearings, guides, and surfaces in directors, sighting instruments, and other fire control materiel.

(3) OIL, recoil, special: For all recoil cylinders where heavy recoil oil is prescribed above 0°F.

(4) LUBRICANT, gear, universal, Grade 75: Used in gear cases for which SAE 80 or SAE 90 are prescribed for above 0°F. Dilution is not required.

(5) GREASE, O. D. No. 00: For all bearings, gears and mechanisms at temperatures below +32°F where O. D. grease No. 0 is prescribed for temperatures above +32°F.

(6) GREASE, general purpose, No. 0: For lubrication of all parts at temperatures below +32°F where general purpose grease No. 1 is prescribed for temperatures above +32°F.

(7) GREASE, general purpose, No. 2: For wheel bearing lubrication at all temperatures.

(8) COMPOUND, antifreeze (ethylene glycol type): Used as an alternate for alcohol in bore sponging solution.

(9) SOLUTIONS, sponging: For cleaning gun bores after firing; Refer to subparagraph h below, for instructions on mixing and using.

(10) SOLVENT, dry-cleaning: For cleaning grease and oil from all mechanisms and parts.

f. **Cold Weather Lubricating Instructions.** To insure adequate lubrication and satisfactory performance of artillery materiel in cold weather, the following instructions must be followed when sub-zero temperatures are expected.

(1) **BEARINGS.**

(a) *Ball and Roller Bearings (Grease-lubricated).* It is impossible to replace warm weather grease in ball and roller bearings by forcing in the grease prescribed for low temperatures. Attempts to do this result in overloading of the bearings with unsuitable lubricant which will congeal at low temperatures and immobilize the moving parts. These bearings must be removed, washed thoroughly in dry-cleaning solvent to remove all traces of heavy grease, dried, and coated with

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

the prescribed lubricant (subpar. d above). The balls or rollers, races and cages should be thoroughly coated but the bearing housings are not to be packed full.

(b) *Ball and Roller Bearings (Oil-lubricated)*. Oil-lubricated ball and roller bearings will preferably be removed and cleaned. If this is impracticable, a thorough flushing with dry-cleaning solvent, followed by application of the prescribed oil (subpar. d above) will give generally satisfactory results. Oil sumps and reservoirs will be drained and filled with proper oil. The wicks of wick-fed bearings are to be removed, washed in dry-cleaning solvent, dried, and saturated with the specified low temperature oil before reassembling.

(c) *Plain Journal Bearings and Bushings*. It is preferable to disassemble these bearings, not only to remove thoroughly all heavy oil and grease, but also to smooth all roughness and to test for adequate clearances between shaft and bearings. Where disassembly is impracticable, heavy lubricant can usually be forced from the bearings by thorough flushing with the cold weather product. Reservoirs and wick feeds must be cleaned completely and refilled to prescribed level with the proper oil (subpar. d above).

(2) GEARS.

(a) *Gears Lubricated With Engine Oil (Above 0°F)*. Where gears are enclosed in oiltight cases filled with engine oil, all oil will be drained, flushed with dry-cleaning solvent, and the case refilled to proper level with light preservative lubricating oil. **CAUTION: Do not fill above prescribed level as the surplus oil will cause unnecessary drag on the movement of the gears.** Where no drain or level plug is provided, the gear case will be disassembled, the gears and bearings cleaned with dry-cleaning solvent slushed with oil, and reassembled in the case. Light preservative lubricating oil will then be added to the case until the lowest gears are dipping. In the case of gears enclosed in a cover which holds no oil, the cover will be removed, the gears thoroughly cleaned, and roughness removed before re-coating with oil and replacing cover.

(b) *Gears Lubricated With Universal Gear Lubricant (Above 0°F)*. Gear cases are to be thoroughly drained and refilled to the correct level with universal gear lubricant grade 75. If this product is not available, light preservative lubricating oil may be used as a temporary substitute. **CAUTION: Do not fill above prescribed level as the surplus oil will cause unnecessary drag on the gears.** Where no drain or level plug is provided, the gear case will be disassembled, the gears and bearings cleaned with dry-cleaning solvent, slushed with oil, and reassembled in the case. Universal gear lubricant grade 75 will then be added until the lowest gears are dipping.

OPERATION UNDER UNUSUAL CONDITIONS

(c) *Gears Lubricated With Grease (Above 0°F)*. Since it is practically impossible to wash heavy grease out of a gear case by flushing, grease-filled cases will be disassembled, the gears, case, and bearings washed clean with dry-cleaning solvent, and all parts coated with prescribed grade for operation below 0°F. In refilling the case, care must be taken to put in only enough grease for satisfactory lubrication. Overfilling will cause excessive drag.

g. Cold Weather Operating Instructions.

(1) **EMPLACING.** When emplacing a weapon, it is well to coat all metal parts coming in contact with the snow or ground with lubricant. This will prevent freezing to the ground and will facilitate moving the mount to the traveling position. Any lubricant is satisfactory. A good source of supply is the Automotive Section of Ordnance Units, procuring oil drained from crank cases, etc. Firmly rolled or compacted snow will provide a satisfactory emplacement. Driving of stakes in frozen terrain is practically impossible.

(2) **TRAVEL.** Before starting a road trip, a thorough inspection of the weapon should be made. Provide as much protection to all parts as possible. Assure all covers are properly assembled and securely lashed. If the cover is not adequate, cover exposed portion with available material. Burlap, under some conditions, is satisfactory. Remove and dry immediately, if it becomes wet. Improvisation of additional coverings is to be encouraged. Tires cannot be expected to take the abuse in extremely cold weather that they would under warmer conditions.

(3) **CARE.** All mechanisms should be exercised frequently. Traversing and elevating of the gun will be extremely helpful in reducing handwheel efforts. Periodic and frequent inspection to prevent snow and ice collecting on moving parts will result in keeping the weapon in service. Always use covers and shelter where possible to provide the maximum protection for the gun and carriage. These points cannot be overemphasized: clean all parts thoroughly; lubricate sparingly; guard against collection of snow and ice; leave no metal surfaces exposed without a protective film of lubricant; and if there is evidence that materiel is "sweating," dry thoroughly, clean, and renew lubricant film.

(4) **COVERS.** Whenever the weapon is to remain idle for a period of time, care should be taken to secure the covers for protection of the weapon. Wind will drive snow up under the covers unless they are securely fastened. This will result in formation of ice, rendering the weapon inoperative.

(5) **PAINTING OF WEAPONS.** Care must be exercised to maintain a good coat of enamel as a precaution against rusting of the weapon. Wherever painted surfaces become chipped, immediate care is neces-

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

sary. Remove all rust spots with CLOTH, crocus and clean with SOLVENT, dry-cleaning. Dry thoroughly and retouch the spots with ENAMEL, synthetic, olive-drab, lusterless, applying a light coat. Too heavy a coat will crack and chip off. Painting should always be done above freezing temperatures or enamel will not adhere to the metal.

h. Gun Tubes.

(1) CLEANING.

(a) Cleaning of a cold tube after firing cannot be accomplished in the normal manner at temperature below $+32^{\circ}\text{F}$. because the water will freeze in the tube. Cleaning seldom can be done with tube hot even when hot water is available and normal soap or SODA ASH solutions are used because ice forms before the work can be finished. It will be necessary to add alcohol, or as an emergency alternative, glycerine or COMPOUND, antifreeze (ethylene glycol type) to the solution. To 10 parts by volume of cleaning solution, add the number of parts of one of the antifreezes shown below:

Temperature, $^{\circ}\text{F}$.	Alcohol	Glycerine	Compound, Antifreeze
20	2	$2\frac{1}{2}$	2
10	4	5	$3\frac{1}{3}$
0	$6\frac{1}{2}$	$6\frac{1}{2}$	5
-15	9	10	$7\frac{1}{4}$
-30	16	13	10
-40	27	16	12

(b) In applying OIL, lubricating, preservative, light or special to the bore after cleaning, care must be taken to work the oil in well so that it will reach all surfaces of the lands and grooves. When the gun is brought into a heated shop, condensation will occur on all metal surfaces. After the gun reaches shop temperature, the tube and all other bright parts must be wiped dry and recoated with oil to prevent rusting.

(c) When materiel is protected with a canvas or other type cover, moisture will form on the metal surfaces. To prevent rusting, the cover must be removed at least weekly, all surfaces thoroughly dried and coated with OIL, lubricating, preservative, light or special.

(d) See OFSB 6-4, 22 November 1943 for detailed information on cleaning of gun and howitzer bores.

(2) BORE PLUGS. Do not seal up the muzzle or breech of the tube with wooden plugs as this will induce corrosion wherever the plug comes in contact with metal. This is caused by acids present in all lumber.

(3) STORAGE. Gun tubes should be thoroughly cleaned as outlined in OFSB 6-4, 22 November 1943. A careful inspection should

OPERATION UNDER UNUSUAL CONDITIONS

be made before applying preservative, making sure all surfaces are free of moisture, cleaning agent, and lubricant. Sweating must be completely finished before applying preservative. Periodic inspection must be made to determine the condition of the bore.

(4) LUBRICATION.

(a) During temporary inactive periods, coat the bore of the tube with OIL, lubricating, preservative, light, in sufficient quantity to assure thorough coverage.

NOTE: It must be kept in mind that less lubricant is used in cold weather than under normal conditions.

(b) OIL, lubricating, preservative, special will give protection directly in ratio to weather conditions. Therefore, if the weapon remains idle, daily inspection must be made to determine condition of the bore.

(c) Always remove the lubricant from the bore before firing.

i. Breech Assemblies.

(1) CLEANING AFTER FIRING—COLD WEATHER.

(a) Cold weather necessitates a very thorough cleaning of breech mechanism after firing.

CAUTION: *Be extremely sure all traces of snow and ice are removed.*

(b) Special care must be given to the breech mechanism. The entire breech mechanism, including the firing mechanism, obturator spindle, primer seat, primer vent, gas check pad disk, split rings (but not the gas check pad) should be disassembled immediately after firing and cleaned in the same solution used to clean the bore. All traces of powder fouling and primer residue should be carefully removed. After rinsing in clean water, dry thoroughly and coat with OIL, SAE 10 +32°F to 0°F, or light or special preservative lubricating oil below 0°F. Application to moving parts will be made by oilcan if oilholes are present, otherwise with a clean wiping cloth. Cleaning will be repeated daily until all traces of primer residue have been removed.

(c) During firing, whenever the rate of fire permits, remove powder fouling from the primer seat and primer vent.

(d) Daily, or at intervals prescribed by the officer in charge, disassemble parts and clean with SOLVENT, dry-cleaning. Dry thoroughly and coat parts with oil prescribed for prevailing temperature. Special precautions must be taken to apply only a light film to split rings. Be sure no solvent comes in contact with the gas check pad.

(2) LUBRICATION. A satisfactory result of any lubrication in cold weather is dependent upon all parts being thoroughly cleaned and the lubricant being used sparingly. Corrosion in cold weather is not

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

so large a factor as it is under humid conditions. Over-lubrication will result in sluggish action of breech mechanism, slowing the cyclic rate of fire and, in extreme cases, stopping the breech action entirely. This is especially true of firing mechanisms.

(3) **CARE DURING INACTIVE PERIODS.** Temporary inactive periods necessitate preservation of breech mechanism and also preparation for almost instant use. After cleaning the breech assembly as outlined in subparagraph (1) above, and while the mechanism is still disassembled, apply a light, thorough coat of OIL, lubricating, preservative, light. It must be kept in mind that less preservative is needed for protection against corrosion in cold weather than normally. A thorough coat of OIL, lubricating preservative, light will protect for an indefinite time, entirely dependent upon weather conditions and the amount of exposure of the breech mechanism. Daily inspections are mandatory.

(4) **GAS CHECK PADS.**

(a) Extreme care should be exercised in cleaning the gas check pad. After removal from the obturator spindle, the gas check pad will be wiped clean with a dry cloth, and then oiled lightly with a clean cloth wet with OIL, engine SAE 30 above $+32^{\circ}\text{F}$, or SAE 10 below $+32^{\circ}\text{F}$. Excess oil causes rapid deterioration, therefore, gas check pads will not be soaked in oil. Never clean the gas check pad with SOLVENT, dry-cleaning, or any other type of cleaning solution. *CAUTION: When cleaning the tube and breech assemblies, precaution should be taken that no SOLVENT, dry-cleaning, comes in contact with the gas check pad.*

(b) Brittleness of asbestos particles causes them to break away from the gas check pad. When inspection of gas check pad shows that ends of wire mesh are exposed and not properly covered by asbestos particles, the pad should be replaced. Rough ends of wire mesh will damage the gas check seat when the breech is closed if asbestos has broken out of the pad. Damage to the gas check seat cannot be repaired by stoning or polishing, therefore extreme care must be taken to inspect the pad frequently and to prevent over-lubrication.

j. **Recoil Mechanisms.**

(1) **GENERAL.**

(a) Care of the recoil mechanism will be for the most part the same as for normal conditions. Using units must maintain their careful check as prescribed by Ordnance publications. Should any difficulties arise, notify ordnance personnel immediately as delaying notification may lead to further difficulties.

OPERATION UNDER UNUSUAL CONDITIONS

(b) At times, the recoil mechanism may not function properly and the cycle of recoil may take longer than necessary. This is brought about by the oil becoming thick and not flowing as rapidly as it should. As further firing is conducted, the mechanism gradually heats up the recoil oil and thins it out so that a normal cycle time is then obtained. Do not condemn the recoil mechanism until definite proof of malfunction has been made. Should this condition arise notify the Ordnance personnel.

(2) RECOIL SLIDES.

(a) Friction between recoil slides and guides absorbs an appreciable portion of the energy of recoil. Thickened or congealed lubricant increases this friction, shortens recoil, and retards counterrecoil. It is vital to proper recoil and counterrecoil action that the slides be thoroughly cleaned of summer lubricant by disassembly, surfaces stoned smooth and relubricated sparingly with GREASE, O.D., No. 00, or OIL, lubricating, preservative, light, depending upon whether grease or oil is prescribed.

(b) Proper lubrication of the slides must be strictly adhered to or the weapon will hang out of battery if over-lubricated. At all times keep friction at minimum by careful lubrication and by excluding dirt and deposits of foreign matter.

(c) OIL, recoil, heavy, is unsatisfactory below 0°F. A change to OIL, recoil, special is therefore required. Reduction of gas pressure at low temperature as well as thickening of the recoil oil affect counterrecoil of these mechanisms. OIL, recoil, special, should be used in accordance with instructions in Ordnance Field Service Technical Bulletins. When OIL, recoil, special is used, it can be left in the cylinders of the recoil mechanisms, regardless of temperature. Make-up oil added subsequently should always be OIL, recoil, special.

(d) Hydropneumatic recoil mechanisms should never be repaired by any one but Ordnance personnel. Always notify the echelon of maintenance responsible for performing the work to be done.

k. Top Carriage.

(1) GEAR TRAINS.

(a) Extreme care should always be utilized when lubricating the gear trains of the elevating and traversing mechanisms. If care is not taken to follow lubrication instructions, malfunctions may require complete overhaul by Ordnance. Wherever there are oil fittings, lubricate with OIL, lubricating, preservative, light. Wherever there are grease fittings, use GREASE, O.D. No. 00.

(b) Condensation caused by rise in temperature must not be allowed to collect on shafts and bearings or it will result in the freezing of shafts where they enter the housing.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

CAUTION: *The importance of a light coat of lubricant on gear trains cannot be over-emphasized.*

(2) **BEARING SURFACE OF TOP CARRIAGE.** Winterizing the bearing surface of the top carriage requires complete disassembly and must be performed by Ordnance personnel. Through removal of all old lubricant from bearing surface should be performed with SOLVENT, dry-cleaning. Be sure that all old lubricant is removed before applying prescribed lubricant. Use a light coat, as over-lubrication will result in difficult traversing.

(3) **TRUNNION AND TRUNNION SEATS.** Trunnion and trunnion seats should be given special attention. Bearings that are inclosed should be thoroughly cleaned. Lubricate sparingly with GREASE, O.D. No. 00 as over-lubrication will result in difficult elevation.

(4) **ELEVATING AND TRAVERSING ARCS.** Elevating and traversing arcs should be lubricated very sparingly with OIL, lubricating, preservative, special or light. Snow will frequently collect on these parts. This will cake under pressure of the gears, forming ice which interferes with elevating and traversing. The snow must be removed by vigorous brushing with a stiff bristle or wire brush before manipulation of the piece is attempted. Elevating and traversing arcs are difficult problems in heavy snowstorms, and the importance of keeping them clean and protected as much as possible cannot be over-emphasized. At every opportunity during fire, the elevating and traversing arcs should be inspected and cleaned of any snow that may have accumulated. After use, elevating and traversing arcs should be thoroughly cleaned of oil and snow and relubricated.

(5) **INSPECTION OF TOP CARRIAGE.** Periods of lubrication must be determined by inspection. Because of the small amount of lubricant used, inspection should be made daily to assure all parts having a coat of lubricant. Failure to follow this procedure will result in an unserviceable weapon.

(6) **CARE OF TOP CARRIAGE DURING INACTIVE PERIODS.** To preserve the material of the top carriage, apply a satisfactory coat of lubricant. Seal all exposed openings against weather. For inactive periods, the lubricant should be applied with a heavier coat. Exposed metal surfaces, coat with Compound, rust-preventive, light.

1. **Wheel Bearings.** Packing of wheel bearings must be done with the utmost care. A tendency to over-pack them is predominant. This promotes freezing of wheels and prevents further travel of the weapon. When packing wheel bearings, make sure that they are thoroughly cleaned with SOLVENT, dry-cleaning. Dry thoroughly before repacking. At no time leave any of the old lubricant on the bearings or any of the dry-cleaning solvent at this

OPERATION UNDER UNUSUAL CONDITIONS

contaminates the new lubricant that is being applied. Pack the bearings sparingly with GREASE, general purpose, No. 2.

NOTE: Precaution must be taken not to handle the bearing with bare hands as the moisture from the skin will corrode the bearings.

m. Tires and Air Brake Hoses.

(1) Special care of tires must be maintained in cold weather. Check air pressure frequently and keep tires free of ice. Rubber becomes stiff in cold weather and is easy to damage. When a weapon is emplaced for a long time at the contact point, tires will develop a flat surface at the contact point with snow or frozen ground. Care should be maintained in traveling that the speed be held at a minimum until the tire has regained its original shape.

(2) To avoid tires developing flat surfaces, it is a good policy to have the weapon on its firing jack whenever it is inactive.

(3) Special care must also be maintained on those weapons using air brakes. Rubber air hoses become very brittle and careless handling causes them to break or crack. This must be avoided as complete failure of the brakes will result. Sharp bends should be avoided.

(4) Instructions regarding rubber hose hold true wherever rubber is used.

n. Trails and Spades. Trails used in hard frozen ground have a tendency to buckle. This can be overcome by embedding a log between the spade and the ground on some weapons. If dry sand is available, it may be substituted for the log when spades are constructed with a stiffening web.

o. Firing Jack.

(1) Winterization is accomplished by Ordnance units as complete disassembly is necessary. After cleaning, a careful inspection should be made to assure that all parts are serviceable. Special attention should be given to gears and bearings. Use GREASE, O.D. No. 00 on all surfaces, but do not pack grease within housing.

(2) **LUBRICATION.** Very little lubrication is necessary or feasible. Over-lubrication will greatly hamper operation. Extreme care should be exercised to see that all seals are tight and serviceable.

p. Brakes.

(1) **ELECTRIC BRAKES.** Dry cell batteries will not function properly where exposed to temperatures below -20°F . Therefore satisfactory operation of the break-away system cannot be expected even with a fully charged battery.

CAUTION: Handling of wire cables should be avoided in cold weather conditions as they become brittle and will break or crack.

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

(2) **AIR BRAKES.** Drain air tanks of the weapon after use. This will blow out moisture formed by compressed air and will prevent freezing of lines and brakes. If brakes are frozen, notify Ordnance personnel immediately.

CAUTION: Care should be maintained in connecting air hoses to prime mover to prevent cracking or breaking when bends are too sharp.

(3) **MECHANICAL BRAKES.** Care should be maintained that proper lubrication is applied to all connections and joints. Wheel chocks should be used in preference to setting brakes when the weapon is parked.

CAUTION: In lubricating brakes, keep lubricant away from inside of drum or shoes.

(4) **BRAKE SHOES.** Keep brake shoes as dry as possible. Make a thorough check of brake shoes whenever checking the wheel bearings.

q. Reports and Records.

(1) If instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, a report will be made to the Ordnance officer responsible for the maintenance of the materiel.

(2) A complete record of seasonal changes of lubricants and recoil oil will be kept in the Artillery Gun Book for the materiel.

r. Sighting and Fire Control Equipment.

(1) Sighting and fire control equipment is normally lubricated for operation over a wide range of temperatures. This equipment should be exercised frequently during periods of low temperature to insure proper functioning. If any equipment does not function properly, the Ordnance maintenance personnel should be notified.

(2) Optical surfaces should be cleaned in cold weather operation by using a PAPER, lens, tissue moistened with a few drops of ethyl alcohol. Alcohol should never be applied directly to the surfaces as it may injure the sealing compound. If alcohol is not available, a dry PAPER, lens, tissue will do the job (see SNL K-1). Never breathe on the lens in cold weather. This will only serve to aggravate conditions already present, and in extreme cases, may even break the lens.

(3) Optical instruments should not be brought from cold temperatures into warm inclosures. Sudden changes in temperature will cause optics to break, especially those under internal stress or an artificial strain set up by a tight retaining ring or tight adjusting screw. It is recommended that optical instruments be brought from cold up to normal temperature gradually. Heat from strongly con-

OPERATION UNDER UNUSUAL CONDITIONS

centrated sources should not be applied lest it cause unequal expansion of parts and result in breakage of optical parts or inaccuracies of observation.

(4) At temperatures below -20°F , small batteries used in night lighting devices often fail. Such batteries may be carried in an inside pocket to keep them warm until needed. It is recommended that a standard auto battery, wet, 6-volt, be used with extra long leads to light special night lighting devices. Tap off one cell (2-volts). Such batteries should be previously prepared for night lighting.

115. EXCESSIVELY MOIST OR SALTY ATMOSPHERE.

a. When the materiel is active, clean and relubricate the bore and exposed metal surfaces more frequently than is prescribed for normal service. Moist and salty atmospheres have a tendency to emulsify oils and greases and destroy their rust-preventive qualities. Inspect parts frequently for corrosion. Keep covers in place as much of the time as firing conditions permit.

b. Cloth 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, the unpainted parts should be covered with a film of COMPOUND, rust-preventive, heavy, and should be inspected daily for traces of the formation of rust. All covers should be in place.

116. EXCESSIVELY SANDY OR DUSTY CONDITIONS.

a. When the weapon is active in dusty or sandy areas, remove lubricants from the elevating and traversing arcs and from exposed sliding parts and bearing surfaces. Surface lubricant will pick up sand and dust, forming an abrasive which will cause rapid wear. Lubricate the parts after action.

b. Inspect and lubricate the materiel more frequently when operating in sandy or dusty areas. Exercise particular care to keep sand and dust out of the mechanisms and oil receptacles when carrying out inspecting and lubricating operations and when making adjustments and repairs. Keep all covers in place as much of the time as firing conditions permit. Shield parts from flying sand and dust with paulins or the over-all cover during disassembly and assembly operations.

c. Should the prescribed lubricant for the gun bore prove inadequate in preventing the formation of rust on bore surface, OIL, lubricating, preservative, medium, may be used for oiling the bore during periods of inactivity.

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

**CHAPTER 9
REFERENCES**

117. PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes or revisions of references given in this chapter 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 Ordnance personnel, OPSR, FSMWO's, BSD, S of SR's, OSSC's, and OFSB's, and including alphabetical listing of Ordnance 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, TR's, TB's, SB's, MWO's, WDLO's, and Firing Tables) 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

118. STANDARD NOMENCLATURE LISTS.

a. Ammunition.

Ammunition, fixed and semifixed, including subcaliber, for pack, light and medium field, aircraft, tank, and antitank artillery, including complete round data..... ORD 11
SNL R-1

Ammunition instruction material for pack, light and medium field, aircraft, tank, and antitank artillery ORD 11
SNL R-6

REFERENCES

- Projectiles and propelling charges, separate loading, for medium field artillery, including complete round data..... SNL R-2
- Service fuzes and primers for pack, light and medium field, aircraft, tank, and antitank artillery SNL R-3
- b. Cleaning, preserving and lubricating materials; recoil fluids, special oils, and miscellaneous related items SNL K-1
- c. Gun Materiel.
 - Gun, 4.5-in., M1; and Carriage, gun, 4.5-in., M1 and M1A1 SNL C-38
- d. Sighting and Fire Control Equipment.
 - Circle, aiming, M1 SNL F-160
 - Compass, M2 SNL F-219
 - Finder, range, 1-meter base, M1916 SNL F-26
 - Light, aiming post, M14; and Light, instrument, M16 SNL F-205
 - Mount, telescope, M25..... SNL F-216
 - Post, aiming, M1..... SNL F-35
 - Quadrant, gunner's, M1..... SNL F-140
 - Quadrant, gunner's, M1918..... SNL F-13
 - Table, firing, graphical..... SNL F-237
 - Telescope, B.C., M1915A1..... SNL F-9
 - Telescope, panoramic, M12..... SNL F-214

119. EXPLANATORY PUBLICATIONS.

- a. Ammunition, general TM 9-1900
- b. Army Regulations.
 - Qualifications in arms and ammunition training allowances AR 775-10
 - Range regulations for firing ammunition for training and target practice..... AR 750-10
- c. Chemicals.
 - Decontamination TM 3-220
 - Defense against chemical attack..... FM 21-40
- d. Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department..... TM 9-850

**4.5-INCH GUN M1 AND
4.5-INCH GUN CARRIAGES M1 AND M1A1**

e. Miscellaneous.

Artillery lubrication, general.....	OFSB 6-4
Auxiliary fire-control instruments (field glasses, eyeglasses, telescopes, and watches).....	TM 9-575
Cold weather lubrication and service of artillery materiel	OFSB 6-5
General instructions for recoil fluid light and medium artillery	OFSB 6-6
Maintenance and care of pneumatic tires and rubber treads	TM 31-200
Ordnance Maintenance: Star-gaging equipment, impression outfits and pressure gages	TM 9-1860
Ordnance service in the field.....	FM 9-5
Ordnance storage and shipment chart—group C—major items	OSSC C
Preparation of Ordnance materiel for deep water fording	TM 9-2853
Range Finder M9	TM 9-585

120. FIRING TABLES.

Current firing tables are as tabulated here. An up-to-date list of firing tables is maintained in	FM 21-6
Gun, 4.5-inch, M1; Shell, H.E., M65.....	FT 4.5-A-1

INDEX

A	Page		Page
Accessories		Bore sighting	
care and preservation.....	114	procedure for	181
identification and use	218	subcaliber gun	214
special accessories	223	Bottom carriage	
subcaliber equipment	217	description and functioning	48
Accidents, field report of.....	202	inspection and adjustment	142
Actuating mechanism, breechblock	16	Brakes	
Air filters (See Filters, air)		adjustment	
Air lines		air brakes	129
description and functioning....	61	hand brakes	134
replace hose and connections ..	130	application of	
test for air leakage	127	emergency brakes	67
Ammunition		service brakes	66
authorized rounds	188	care and preservation	131
care, handling, and preservation	187	cold-weather care	
classification and identification..	185	air brake hoses	249
field report of accidents	202	brake shoes	250
hot-weather operation	237	electric brakes	249
lot number	186	mechanical brakes	250
marking for shipment	200	description and functioning	
packing		air brake diaphragms	62
ammunition	200	air filters	8
subcaliber ammunition	202	air power brakes	60
painting and marking	186	brake mechanisms	
preparation for firing	189	air brakes	64
subcaliber ammunition	202	electric brakes	67
unloading	88, 89	electric brakes	67, 68
weight-zone markings	187	hand brakes	64, 70
Artillery gun book (O.O. 5825)	221, 250	differences among models	7
Assembly, general discussion of..	145	inspection	
Azimuth, laying for	178	air brakes	143
		brake drums	144
		electric brakes	144
		lubrication of bearings and pins	111
		malfunctions	
		air brakes	100
		electric brakes	101
		operation	91
		tests	
		air brakes	144
		air leakage	127
		automatic emergency braking	128
		to check current	132
		wheel clearance (shipment) ...	231
		Breech mechanism	
		assembly	
		breech mechanism	156, 205
		operating lever closing latch	162

Page

Breech mechanism (Contd.)	
care and preservation	117
cleaning after firing	
cold weather	245
usual conditions	115
cleaning and oiling	156
closing the breech	71
description	
breech mechanism	14, 204
operating lever closing latch..	21
disassembly	
breech mechanism	148, 205
operating lever closing latch..	162
functioning	
breech mechanism	26
operating lever closing latch..	21
lubrication of bearings	111
malfunctions	95
opening the breech	
first cycle	27
second cycle	29
operation	205
preparation for storage and	
shipment	230
Breech ring	
description and functioning	12
malfunction	95
Breechblock	
description and functioning	14, 204
inspection and adjustment	140, 211
malfunctions	95, 96
to dismount	205
to replace	206
Breechblock actuating mechanism	16
Breechblock carrier	
description and functioning	
adapter	23
carrier	16
counterbalance	21
hinge pin	19
inspection and adjustment..	140, 141
Breechblock driver roller, dis-	
assembly and assembly....	163
C	
Canvas covers, care and	
preservation	136

C

	Page
Care of materiel	112
Carriage	
care and preservation	122
characteristics	4
data	9
description and functioning	31
differences among models	7
inspection and adjustment	141
malfunctions	96
operation	70
serial number	139
Carrier (See Breechblock carrier)	
Cars, railroad, type of	231
Cleaners	113
Cleaning	
after firing	114
air filters	128
all parts	111
Cocking the gun	205
Counterbalance, breechblock carrier	21
Counterrecoil cylinder	
description and functioning	38
oil leaks	97
Counterrecoil head box	38
Counterrecoil rod, excessive oil dripping	97
Couplings, inspection and adjust- ment	144
Cradle	
description and functioning	34
disassembly and assembly	207
Cylinder yoke	34

D

Disassembly, general discussion of 145

E

Elevating arc, care in cold weather	248
Elevating mechanism	
care and preservation	123
description and functioning	44
inspection and adjustment	141
malfunctions	99
to elevate	81

INDEX

	Page		Page
Equilibrators		to fire	
care and preservation	124	subcaliber equipment	214
description and functioning	46	weapon	86
inspection and adjustment	141	to place in firing position	
Extractor, to assemble or dismount	206	carriages with air brakes	71
		carriages with electric brakes . .	73
F		Fuze setter	
Filters, air		care and preservation	183
cleaning	128	description and functioning	182
description and functioning	61	tests and adjustment	183
inspection and adjustment	143	Fuzes	
model differences	8	description	195, 198
test for air leakage	127	preparation for firing	189, 197, 198
to drain water from	127	subcaliber ammunition	202
Fire control equipment		to remove from shell	90
cold-weather operation	250		
description	171	G	
Firing jack		Gage, armature spacing	133
description and functioning	50	Gas-check pad	
differences among carriage		care and preservation	117
models	7	cold-weather care	246
Firing mechanism		Gas-check seat, care and	
assembly	148	preservation	117
care and preservation	117	Gear trains, care in cold weather . .	247
cleaning after firing	116	Gears, cold-weather lubrication . .	242
cleaning and oiling	148	Gun	
defective mechanism	94	care and preservation	
description and functioning		gun	116
firing mechanism	23, 31, 205	subcaliber equipment	209
housing	25	characteristics	4
M1 mechanism	25	data	8
safety latch	22	description and functioning	10
stop for block arm	7	differences among models	7
disassembly	146	disassembly and assembly	207
inspection and adjustment	140, 212	inspection	
lubrication of bearings	111	gun	137, 139
to dismount or assemble	206	subcaliber equipment	211
Firing tables	185	loading	82
Firing the weapon		malfunctions	93
cleaning after firing		operation	70
cold weather	245	serial number	139
usual conditions	114	to place in traveling position . . .	90
observation during firing	88	unloading	
operation prior to	81	dummy projectile	89
preparation for firing ammunition	189	service rounds	88
rates of fire	8	(See also Firing the weapon)	

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

G—(Contd.)

	Page
Gun tubes	
cleaning (cold-weather operation)	244
description and functioning	10

H

Handling	
ammunition	187
materiel for shipment or storage	231
subcaliber equipment	214
Hangfire	94
Hubs, wheel	57

I

Inspection	
general procedure	138
gun	139
on receipt of materiel	138
purpose of	137

J

Jack, firing	
care and preservation	125
cold-weather care	249
description and functioning	50
inspection and adjustment	142

L

Laying for elevation	177
Light M34, instrument	175
Light-system, blackout	222
Loading	
gun	82
projectile	83
propelling charge	86
Loading materiel for rail shipment	230
Loading tray retainers, differences among carriage models	8
Loads	
clearances	231
maximum weights	232
Lock, trail	56
Lock, traveling (See Traveling lock)	

Page

Lubricants, cold-weather operation	240
Lubrication	
by ordnance maintenance only ..	112
equipment	107
guide (37-mm gun materiel) ..	210
low temperatures	239
lubricating materials	113
order	107
points of application	111
reports and records	112
supplies	103

M

Marking ammunition	186
Misfire	93
Mount, subcaliber	
description	208
repairs and lubrication	210
Mount, telescope	
care and preservation	180
description	174
operation	177
Muzzle velocity	8

O

Obturating parts, breech mechanism	
description and functioning	14
inspection and adjustment	140
Oil, recoil	119
Oil index, recuperator	
description and functioning	40
differences among gun models ..	7
malfunctions	97
Oil reserve, recuperator	
to establish	121
to gage	80
Oil reserve, replenisher	
to establish	120
to gage	79
Oilcan points	111
Operating instructions, cold-weather	243
Operation under unusual conditions	
hot weather	236

INDEX

	Page	R	Page
Operation under unusual conditions (Cont'd.)		Rail shipment	
moist or salty atmosphere	251	blocking materiel	232
sandy or dusty conditions	251	loading materiel	230
sub-zero weather	237	preparation of materiel	228
Optical parts, care and preservation	173	Ramps (rail shipment)	231
		Range data	8
P		Recoil cam assembly, variable (See Variable recoil cam assembly)	
Packing		Recoil cylinder	35
ammunition	203	Recoil mechanism	
subcaliber ammunition	202	adjustments	141, 209
Painting		air in system	96
ammunition	186	care and preservation	
materiel	137	cold weather	246
Paints and related materials	114	subcaliber equipment	209
Percussion hammer	140	usual conditions	118
Percussion mechanism	24	data	9
Pintle, top carriage	49	description	33
Piston, replenisher		functioning	
to exercise	121	buffer action	43
to test operation of	120	counterrecoil action	43
Piston crosshead key, assembly		recoil action	40
and removal	206	recoil mechanism	33
Placarding, shipment	231	inspection	141
Preservation of materiel	112	recoil oil	119
Preservative, application of	229	serial number	139
Preserving materials	113	subcaliber equipment	207
Prime mover, data	9	to check liquid	79
Primers		to measure length of recoil	88
defective primer	94	to refill	209
description	199, 200	too great or little recoil	98
failure of	93	Recuperator	
preparation for firing	189	filling valve leaks	97
Projectiles		to establish oil reserve	121
description	190	Recuperator cylinder	
fuzing and loading	83	description and functioning	38
preparation for firing	83, 189, 190	to gage oil reserve	80
ramming	84	Replenisher	
unloading dummy projectile	89	air in system	96
Propelling charges		description and functioning	37
description	191	oil leaks	96
failure of	95	stuck piston	96
loading	86	test operation of piston	120
preparation for firing	84, 189, 194	to establish oil reserve	120

4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1 AND M1A1

R—(Contd.)

	Page
Replenisher (Contd.)	
to exercise piston	121
to gage oil reserve	79
Rust spots, removal	229

S

Safety bolt	205
Safety switch, electric brakes	69
Serial numbers	139
Shell, to remove fuze	90
Shields	44
Shipment	
preparation for	228
loading and blocking	230
marking ammunition for	200
Sighting equipment	
care and preservation	173
cold-weather operation	250
description	171
lubricants	174
test and adjustment	178
Slack adjusters (brakes)	63
Spades, trail	
cold-weather care	249
description and functioning	56
inspection and adjustment	142
Spare parts, organization	
care and preservation	114
description	217, 218
Spindle roller bearings, wheel	59
Spindles, wheel	57
Stakes, blocking materiel on car	233
Storage	
inspections	235
limited storage	233
preparation for	229
Strapping (axle and trails)	233
Striker mechanism, disassembly and assembly	207
Subcaliber equipment	
care and preservation	209
description	204
firing and handling	214

Page

inspection	211
malfunctions and corrections	212
mounting and dismounting	208
operation	214
repairs and lubrication	210

T

Tank, emergency reserve (air)	
description and functioning	62
filling the tank	66
to drain water from	127
Target, testing	181
Telescope, panoramic	
care and preservation	180
description	174
operation	177
preparation for travel	178
Telescope case, differences in carriage models	8
Testing target	181
Tires	
care and preservation	
cold weather	249
hot weather	236
usual conditions	126
description and functioning	60
excessive wear	99
inspection and adjustment	142
installation	170
limited storage	235
removal	169
Tools, organizational	
miscellaneous	114
special	223
Top carriage	
care in cold weather	247
description and functioning	
top carriage	43
traveling traversing locks	8
inspection and adjustment	142
Trails	
cold-weather care	249
description and functioning	54
inspection and adjustment	142
Traveling lock	54

INDEX

	Page		Page
Traveling position, to place gun in	90	Washing cautions	136
Traversing arc, care in cold weather	248	Wheels	
Traversing mechanism		adjustment of bearings	168
care and preservation	123	care and preservation	
description and functioning	46	bearings	126, 248
inspection and adjustment	142	wheels	131
malfunctions	99	data	9
to traverse	81	description and functioning	
Trunnion bearings, top carriage	44	hubs and spindles	57
Trunnions and seats, care in cold		spindle bearings	7, 59
weather	248	wheels	59
Tube, gun (See Gun tube)		inspection	142
Tube, tire, care and preservation	126	installation	
		bearings	167
		wheels	169
		lubrication of bearings	111, 167
		removal	
		bearings	164
		wheels	163
		Wires, shipment and storage	232
		Wiring, care of	131

V

Valve, relay-emergency	
description	62
functioning	66
test for air leakage	127
Variable recoil cam assembly	37

RESTRICTED

TECHNICAL MANUAL

**4.5-INCH GUN M1 AND 4.5-INCH GUN CARRIAGES M1
AND M1A1**

CHANGES }
No. 1 }

WAR DEPARTMENT
WASHINGTON 25, D. C., 17 March 1945

TM 9-328, 30 December 1943, is changed as follows:

Figure 29—Phantom view of recoil mechanism—weapon in counterrecoil.

Figure 28—Phantom view of recoil mechanism—weapon in recoil

23. WHEELS AND TIRES.

* * * *

b. Tires. The tires (fig. 44) * * * wheel tire beadlocks.

24. AIR POWER BRAKES.

* * * *

g. Air brake diaphragms.

* * * *

(2) Each air brake * * * the pressure side. When compressed air enters the pressure side through the inlet in the bottom of the unit, it forces the diaphragm and push rod plate toward the non-pressure side.

* * * *

42. MALFUNCTION OF CARRIAGE.

Cause

Remedy

* * * *

s. Excessive tire wear.

* * * *

Low tire inflation pressure.

Keep tires inflated to recommended pressure (par. 54 f).

54. CARRIAGE.

* * * *

f. Tires and tubes. The pressure to be maintained in the tires is 55 pounds per square inch. To obtain maximum * * * effect upon rubber.

* * * *

62. INSPECTION OF CARRIAGE.

Parts to be Inspected in Order of Inspection	Points to observe
* * *	* * *
Wheels and tires.	Check for any loose or missing nuts. Check the tires for correct pressure. Note the condition * * * and wheel alignment.

71. REMOVAL AND INSTALLATION OF TIRES.

* * *	* * *
b. Installation.	
* * *	* * *
(4) Install the valve core and inflate the tire. Screw on the	* * *
the carriage (par. 70 f).	

113. EXTREMELY HOT WEATHER.

* * *	* * *
d. Tires. Tires should be checked at frequent intervals to ascertain that the pressure is not above that which is prescribed. Tires must be	* * *
* * *	* * *

[AG 300.7 (3 Feb 45)]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:

J. A. ULIO
Major General
The Adjutant General

G. C. MARSHALL
Chief of Staff

DISTRIBUTION:

AAF (10); AGF (10); ASF (2); AAF Comds (2); Arm & Sv Bd (2); S Div ASF (1); Dept (10); Tech Sv (2); SvC (10); PC&S (1); PE (Ord O) (5); H & R (5); Dist O 9 (5); Dist Br O 9 (3); Reg O 9 (3); Establishments 9 (5); Decentralized Sub-O 9 (3); Gen & Sp Sv Sch (10); USMA (20); A (10); CHQ (10); D (2); AF (2). T/O and E 6-35 (2); 6-37 (3); 6-39 (3); 6-335 (2); 6-337 (3); 6-339 (3); 9-7 (3); 9-9 (3); 9-65 (2); 9-67 (3); 9-76 (2); 9-315 (2); 9-318 (3).

Refer to FM 21-6 for explanation of distribution formula.