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TM 9-335

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

8-INCH
HOWITZER M2
CARRIAGE M1,
MOUNT M17
AND
HEAVY CARRIAGE
LIMBER M5

REGRADED UNCLASSIFIED BY
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WAR DEPARTMENT TECHNICAL MANUAL

TM 9-335

This manual supersedes TM 9-335, 8-in. Howitzer Matériel M1, 25 September 1942, including C1, 16 January 1943; C2, 20 August 1943; C3, 12 November 1943; and C4, 3 December 1943; and TB 9-335-4, 10 August 1944. This manual also supersedes so much of TB ORD 65, 16 March 1944; TB ORD 76, 12 April 1944; TB ORD 113, 23 June 1944; TB ORD 135, 3 August 1944; TB ORD 193, 30 September 1944; TB ORD 206, 28 September 1944; TB ORD 251, 5 February 1945; TB ORD 263, 15 March 1945; TB ORD 280, 4 April 1945; TB ORD 285, 10 April 1945; TB ORD 309, 29 June 1945; TB ORD-FE9, 2 August 1944; TB ORD-FE10, 18 June 1943; and TB ORD-FE38, 23 April 1945, as pertain to the matériel covered in this manual.

8 - INCH
HOWITZER M2
CARRIAGE M1, MOUNT M17
AND
HEAVY CARRIAGE
LIMBER M5



WAR DEPARTMENT • MAY 1947

United States Government Printing Office

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WAR DEPARTMENT
Washington 25, D.C., 1 May 1947

TM 9-335, 8-inch Howitzer M2; Carriage M1; Mount M17; and Heavy Carriage Limber M5, is published for the information and guidance of all concerned.

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PART ONE

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual is published for the information of the using arms and services. It contains technical information required for the identification, use, and care of the 8-inch howitzer M2, carriage M1, heavy carriage limber M5, and mount M17, and of ammunition and accessory equipment.

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

2. Records

a. ARTILLERY GUN BOOK. (1) The Artillery Gun Book (O.O. Form 5825) is used to keep an accurate record of the matériel. It must always remain with the matériel regardless of where it may be sent. The book is divided as follows: record of assignment, battery commander's daily gun record; and inspector's record of examination. It must contain the date of issuance of the matériel, by whom used, and the place where issued.

(2) 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. If a new howitzer 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.

Note. Record of assignment data must be removed and destroyed prior to entering combat.

(3) When a gun book for a weapon has been lost and every effort to obtain the original gun book has been to no avail, the supporting ordnance maintenance unit will prepare a new gun book listing such information as they may be able to obtain from any source and estimate the number of rounds fired from the weapon. The number of rounds entered in the new gun book should be clearly indicated as an estimated number of rounds fired. Inquiries concerning lost gun books should also be forwarded to the Office, Chief of Ordnance, Field Service, Maintenance Division, Artillery Branch, Washington 25, D. C.

(4) When an Artillery Gun Book has become separated from the weapon to which it pertains and efforts to locate the weapon have failed, forward the gun book immediately to the Office, Chief of Ordnance, Field Service, Maintenance Division, Artillery Branch, Washington 25, D. C.

(5) 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 howitzer and its related matériel (that is, carriage, recoil mechanism, and associated fire control equipment) and to avoid unnecessary duplication of repairs and maintenance, make the following additional entries in the gun book:

(a) *A record of completed Modification Work Orders.* This record should show the date on which the modification was completed and bear the signature of the officer or mechanic responsible for the completion.

(b) *A record of seasonal changes of lubricants and recoil oil.* This record should be sufficiently detailed to prevent duplication and afford proper identification by the inspector.

b. **FIELD REPORT OF ACCIDENTS.** When an accident involving ammunition occurs during practice, the incident will be reported as prescribed in AR 750-10 by the ordnance officer under whose supervision the ammunition is maintained or issued.

c. **UNSATISFACTORY EQUIPMENT REPORT.** Suggestions for improvement in design, maintenance, safety, and efficiency of operation, prompted by chronic failure or malfunction of the weapon, spare parts, or equipment, should be reported on WD AGO Form 468 (Unsatisfactory Equipment Report) with all pertinent information necessary to initiate corrective action. Forward the report to the Office, Chief of Ordnance, Field Service, Maintenance Division, through technical channels in accordance with in-

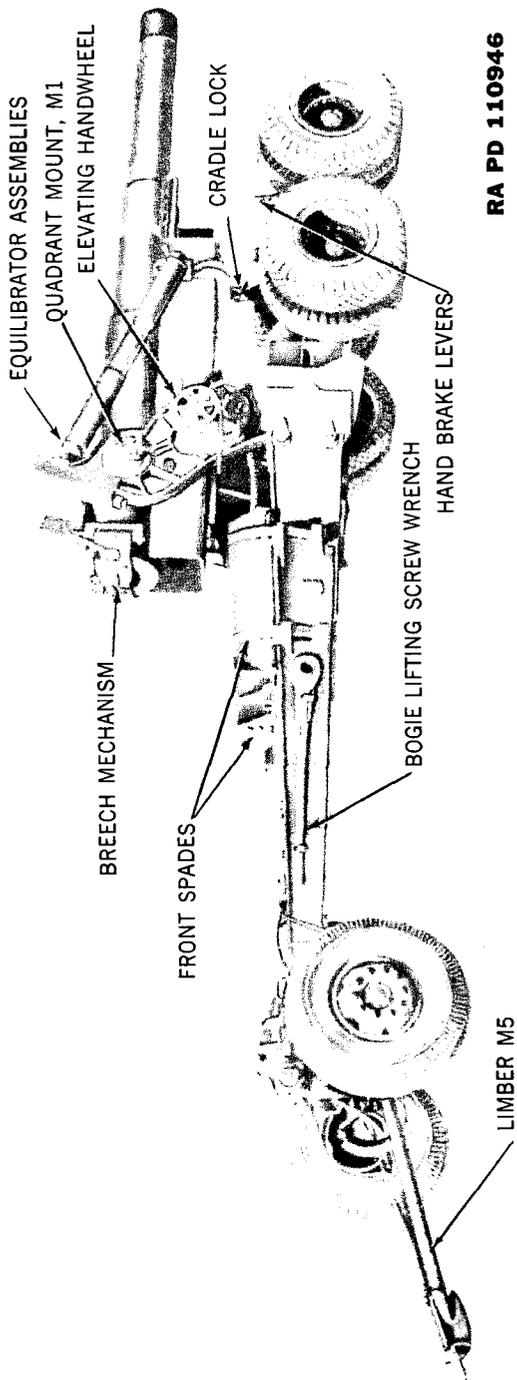
struction No. 7 on the form. If WD AGO Form 468 is not available, refer to TM 37-250 for list of data required on Unsatisfactory Equipment Report.

d. **REPORTS ON NEOPRENE GAS CHECK PADS.** Submit periodic reports on the operation, maintenance, serviceability, and malfunctioning of the Neoprene gas check pads through technical channels to Office, Chief of Ordnance, Attention: ORDFM.

Section II. DESCRIPTION AND DATA

3. General

a. The 8-inch howitzer M2 on carriage M1 is a heavy field weapon, utilizing the two-wheel, single-axle limber M5 and an eight-wheel, two-axle bogie for supporting the weight while traveling (fig. 1). The carriage is lowered to the ground and the bogie may be detached and rolled aside. When in traveling position, the trail ends of the carriage are attached to heavy carriage limber M5 (figs. 1 and 2), or it can be towed without a limber by means of a special prime mover with a goose-neck attachment. When emplaced, removable spades are installed on the carriage and on the rear ends of the trails (fig. 3). The recoil mechanism is of the hydropneumatic type with a variable recoil feature to effect different lengths of recoil at various degrees of elevation. Air brakes are provided for use during transit; the hand brakes on the front bogie wheels are applied when the weapon is parked (fig. 1). Separate-loading ammunition is used and is hand-rammed.

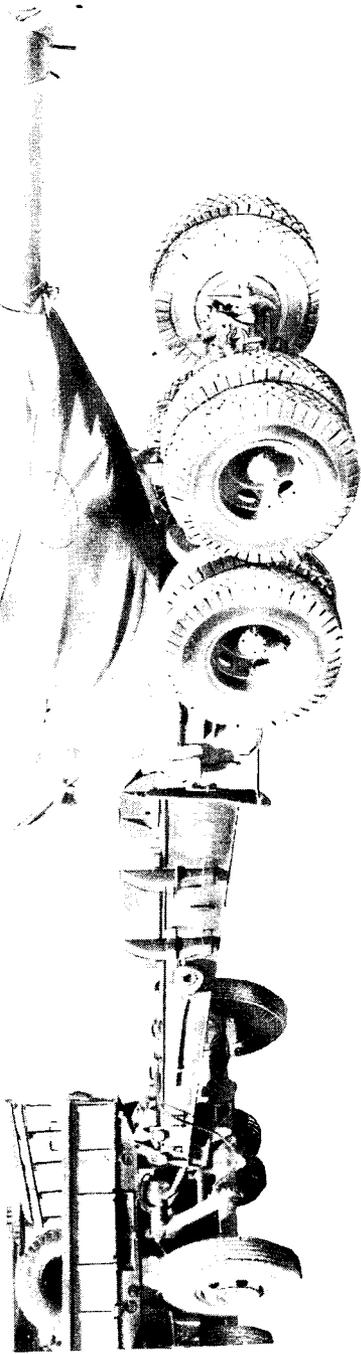


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Figure 1. 8-inch howitzer M2 and carriage M1—traveling position.

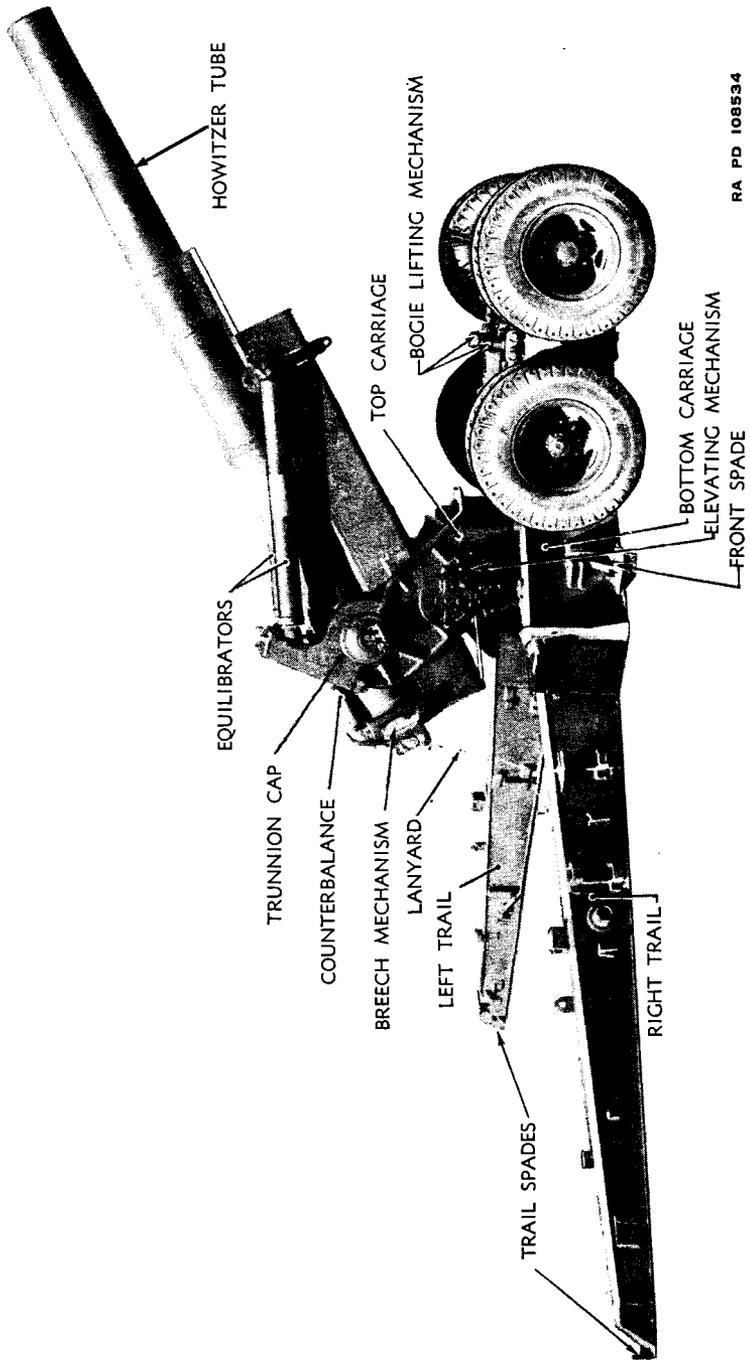
HOWITZER COVER (OVER-ALL) - D91403

MUZZLE COVER



RA PD 107698

Figure 2. 8-inch howitzer matériel—traveling position, with covers.



RA PD 108534

Figure 3. 8-inch howitzer matériel—firing position.

b. The 8-inch howitzer M2 on mount M17, mounted on the howitzer motor carriage M43 (figs. 4 and 5), is a self-propelled weapon employed against emplaced artillery and other ground objectives. The mount M17 is located in the fighting compartment of the howitzer motor carriage M43, and is tilted 5 degrees forward to permit the 5-degree angle of depression. A stop attached to the elevating arc limits the elevation. Stops are also added to the traversing arc to limit the traverse. The elevating mechanism clutch lever is fitted with a foot control lever assembly to release the elevating mechanism brake. The panoramic telescope mount M18A1 and the direct-fire telescope mount M75 are installed on the left trunnion. The elbow telescope mount M71 and the quadrant mount M1 are installed on the right trunnion. In other respects the top carriage of the mount is identical with that of the field carriage. The lower part of the mount is a pedestal in place of the bottom carriage on the field carriage.

4. Identification Information

a. SERIAL NUMBERS. The serial numbers listed below are required for records concerning the components of this matériel.

b. HOWITZER SERIAL NUMBER. This number is stamped on the breech ring (fig. 6).

c. RECOIL MECHANISM SERIAL NUMBER. This number appears on a brass plate on the right side of the recoil mechanism (fig. 7).

d. CARRIAGE (OR MOUNT) SERIAL NUMBER. This number appears on a brass plate on right side of top carriage, just below trunnion bearing (fig. 8).

e. EQUILIBRATOR SERIAL NUMBER. This number appears on front head of equilibrator (fig. 9).

f. LIMBER SERIAL NUMBER. This number appears on a name plate attached to limber lift bracket (fig. 10).

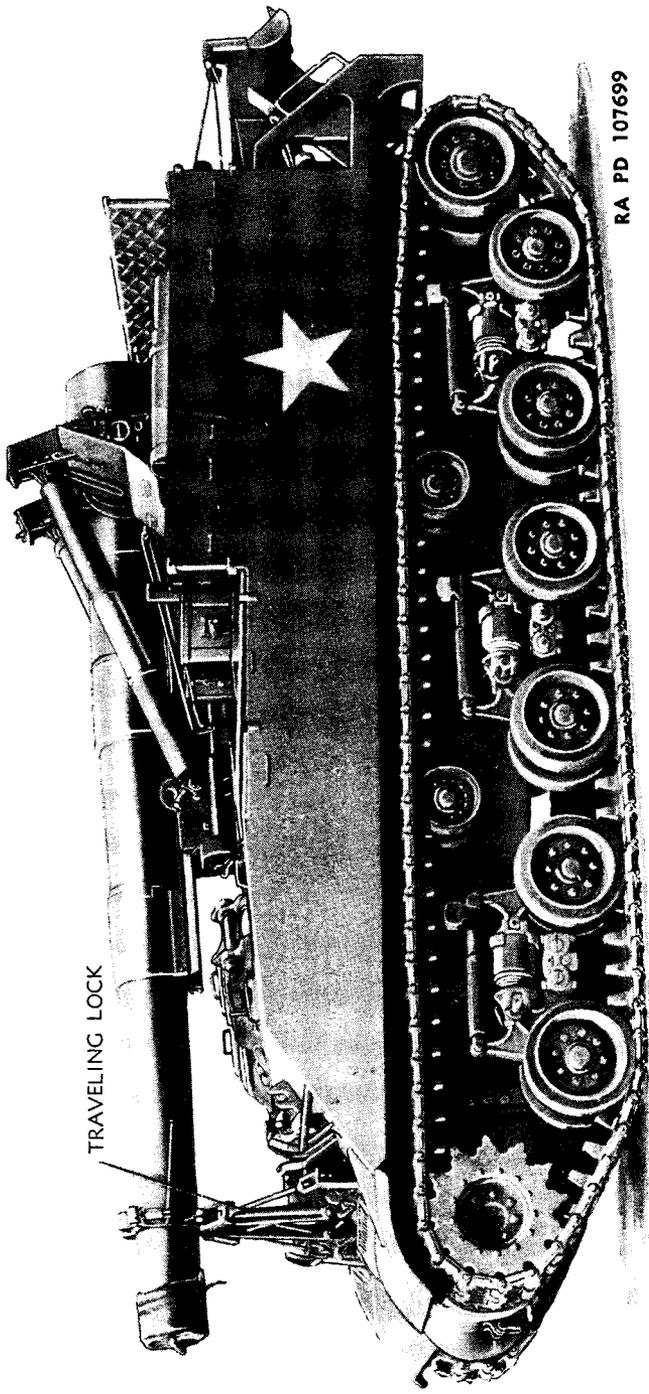
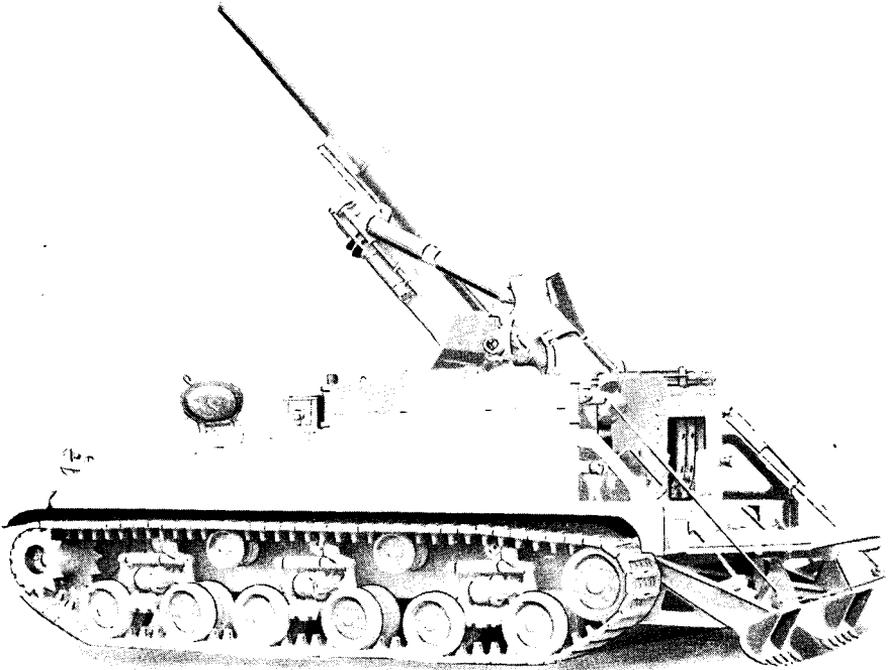
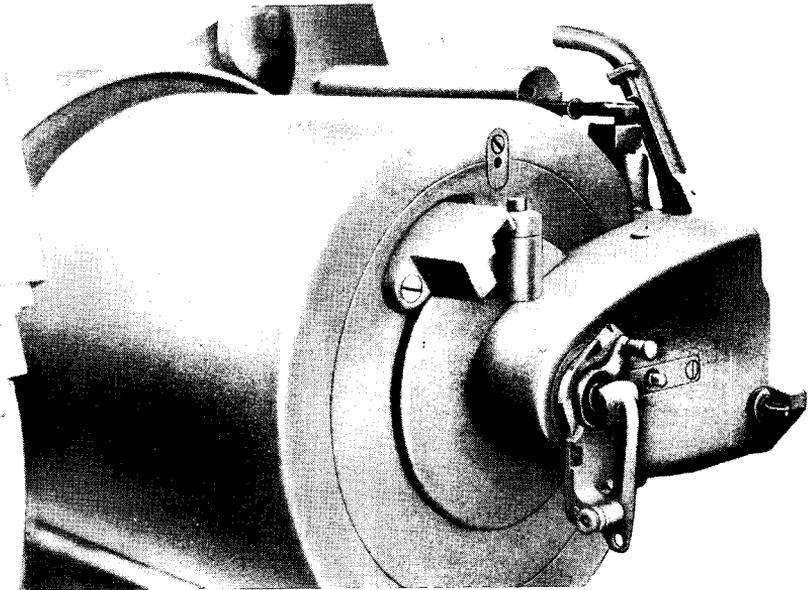


Figure 4. 8-inch howitzer motor carriage M43—traveling position—left view.



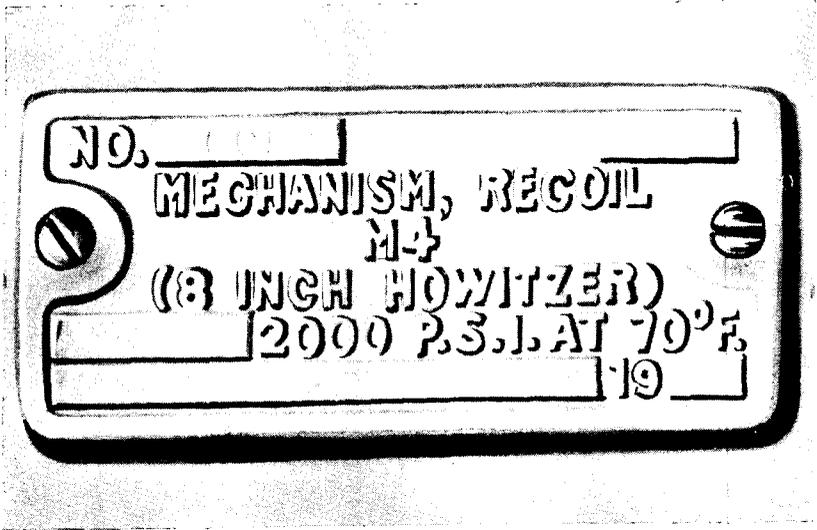
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*Figure 5. 8-inch howitzer motor carriage M43—firing position—
left rear view.*



RA PD 107981

Figure 6. Serial number of howitzer.



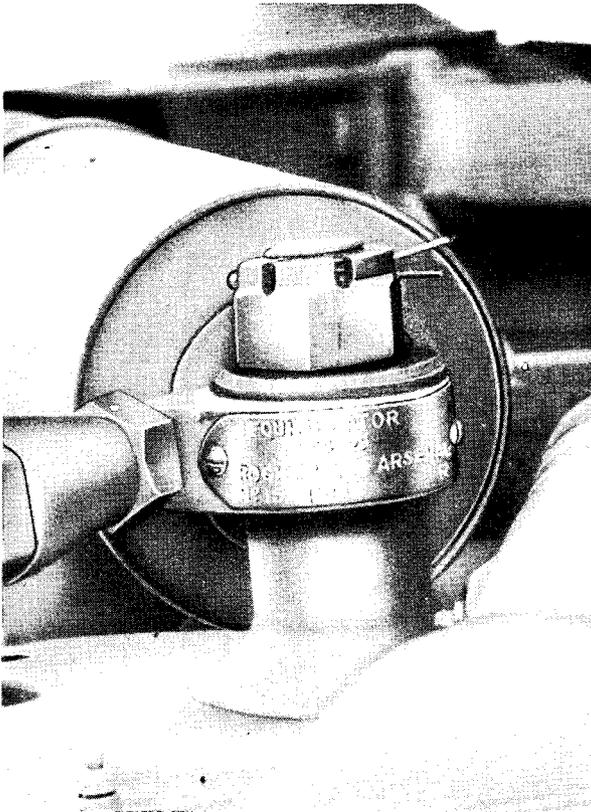
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Figure 7. Serial number of recoil mechanism.



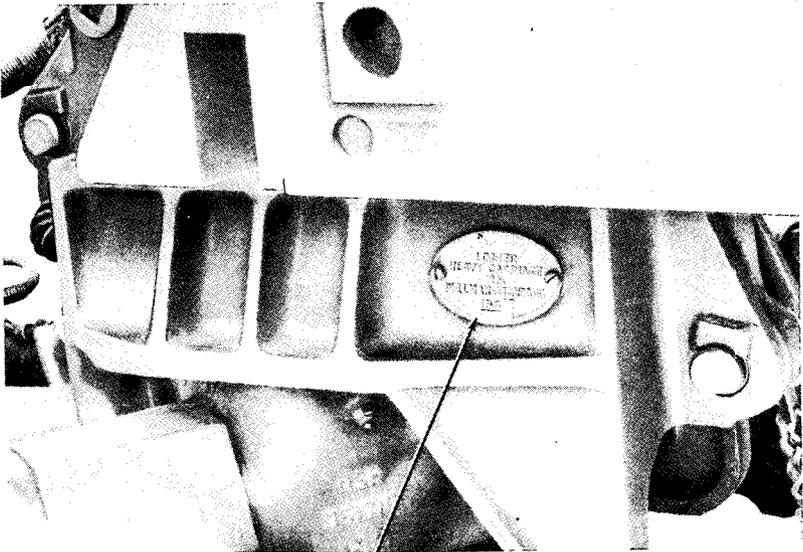
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Figure 8. Carriage (or mount) serial number.



RA PD 107984

Figure 9. Equilibrator serial number.



LIMBER NAMEPLATE

RA PD 102394

Figure 10. Serial number of heavy carriage limber M5.

5. Differences in Models

There are no differences among models which will affect troop use or care of the matériel. The only differences are between the recoil mechanism M4 (and M4A1) and M23. The lugs on the cradle front yoke of the recoil mechanism M4 have been removed and cradle traveling locks have been provided for use on the howitzer motor carriage M43. The recoil mechanism M23 cannot be used on the heavy field carriage. Conversely, the recoil mechanism M4 (and M4A1) cannot be used on the motor carriage.

6. Tabulated Data

a. DATA PERTAINING TO 8-INCH HOWITZER M2. (1) *General.*

Weight of:

Howitzer (complete with breech mechanism)	10,240 lb
Breech mechanism	405 lb
Tube assembly (barrel)	9,835 lb
Tipping parts (approx)	14,200 lb

Length of:

Howitzer	209.6 in.
Tube (muzzle to rear face of breech ring)	202.5 in.
Bore (200 in.)	25 cal.
Rifling	164.8 in.

Type of:

Breechblock	Interrupted screw
Firing mechanism	Percussion hammer
Ammunition.	For complete ammunition data, see section XXVII

(2) *Performance.*

Muzzle velocity (average velocity with a new howitzer):

Shell HE (maximum zone charge)	1,950 ft per sec
--	------------------

Range (maximum):

HE Shell	18,510 yd
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Rate of fire:

Normal	1 round per 2 min
Maximum	1 round per min
Maximum number of rounds which may be fired consecutively at maximum rate before cooling	30
Maximum powder pressure permitted	33,000 lb per sq in.
Average accuracy life	5,600 rounds

b. DATA PERTAINING TO CARRIAGE M1 AND MOUNT M17. (1)

General.

	<i>Carriage M1</i>	<i>Mount M17</i>
Time to emplace.....	1/2 to 6 hr	

Weights:

Howitzer and carriage or mount (firing position)	29,700 lb	83,000 lb
Howitzer and carriage, complete with accessories (traveling position)....	32,000 lb	83,000 lb
Bogie	5,375 lb	

Dimensions in traveling position (over-all) :

Length	(approx) 36 ft	24 ft
Width	98 7/8 in.	124 in.
Height	108 in.	130 in.
Minimum road clearance.....	12 1/2 in.	19 in.
Turning radius	37 ft	

Towed by:

With limber.....18-ton, high-speed tractor M4
 Without limber.....Semitrailed by 7 1/2-ton, 6 x 6 truck

Recoil mechanisms M4, M4A1, and M23:

Maximum allowable recoil.....70 in.
 Elevation at which maximum recoil occurs:
 Normal charge.....375 mils (approx)
 Supercharge.....300 to 425 mils
 Normal recoil at 375 mils (approx) elevation (normal charge)

	51 in.
Recoil at 300 to 425 mils elevation (supercharge)....	67 in.
Type of recoil mechanism	Hydropneumatic
Type of equilibrator	Pneumatic
Weight	(approx) 3,925 lb

Tires:

Type and size (tires)	11 x 20, standard
Type and size (tubes)	11 x 20, standard
Air pressure (bogie assembly tires).....	45 psi
Type of brakes.....	Mechanical, air or manually operated
Wheel base of bogie.....	47 in.

Tread:

Over-all width:

Center-to-center of inside bogie wheels.....	101 in.
Center-to-center of outside bogie wheels.....	89 in.

(2) *Performance.*

Limits of elevation:	<i>Carriage M1</i>	<i>Mount M17</i>
Maximum	65 deg or 1,156 mils	52 deg or 923 mils
Depression	Minus 2 deg or minus 35.5 mils	Minus 5 deg or minus 88.7 mils
Limits of traverse..	30 deg or 533 mils, right or left	18 deg or 319.5 mils right; 16 deg or 284 mils left
Elevation per turn of handwheel	13.10 mils	13.10 mils
Diameter of circle of emplacement	37 ft	
Traverse per turn of handwheel	10 mils	10 mils

(3) *Capacities of recoil mechanisms M4 and M23.*

Recoil oil:

Type	See WDLO 9-335
Oil required to fill recoil mechanism.	15 gal
Reserve in replenisher.	2 pt
Reserve in recuperator.	2 pt

c. DATA PERTAINING TO LIMBER M5.

Width (over-all)	98 in.
Width of tread, center-to-center of wheels.	83 in.
Height of lunette (limbered position)	21½ in.
Weight.	(approx) 2,300 lb

Tires:

Type and size (tires)	11 x 20, standard
Type and size (tubes)	11 x 20, standard
Pressure	65 lb

d. LIST OF SIGHTING EQUIPMENT.

- CHEST, lighting equipment, M21
- COVER, aiming post, M401
- LIGHT, aiming post, M14 (with green filter)
- LIGHT, aiming post, M14 (with red filter)
- LIGHT, instrument, M12 (for quadrant mount M1 and general lighting)
- LIGHT, instrument, M19 (for panoramic telescope M12)
- LIGHT, instrument, M33 (for telescope mount M75)
- LIGHT, instrument, M36 (for telescope mount M71)
- MOUNT, quadrant, M1
- MOUNT, telescope, M18A1 (for carriage M1 only)
- MOUNT, telescope, M71 (for mount M17 only)
- MOUNT, telescope, M75 (for mount M17 only)

PERISCOPE, M13 or M6 (substitute)
 POST, aiming, M1
 QUADRANT, gunner's, M1 (mils)
 SIGHT, bore, breech
 SIGHT, bore, muzzle
 TARGET, testing
 TELESCOPE, M69G (for mount M17 only)
 TELESCOPE, elbow, M16A1G (for mount M17 only)
 TELESCOPE, panoramic, M12

e. LIST OF FIRE CONTROL EQUIPMENT.

BINOCULAR, M13
 BOARD, plotting, M5
 BOARD, plotting, sound ranging, M1, complete
 CIRCLE, aiming, M1, complete
 CORRECTOR, wind, sound ranging, M1
 INSTRUMENT, azimuth, M1, complete

or

INSTRUMENT, spotting, M2
 SETTER, fuze, M14
 SETTER, fuze, hand, M23
 TABLE, firing, 8-K-1
 TABLE, firing, graphical, M8 (short range)
 TABLE, firing, graphical, M17 (long range)
 TABLE, firing, graphical, M33
 TELESCOPE, B.C., M65, complete
 TELESCOPE, observation, M13, complete
 THERMOMETER, powder temperature, M1, w/case complete
 WATCH, pocket, 15 or more jewel, complete
 WATCH, stop, type B, class 15
 WATCH, wrist, 7-jewel, complete

f. DATA PERTAINING TO SUBCALIBER EQUIPMENT (GUN M1916 AND MOUNT M10). (1) *General.*

Weight of gun and mount.....88 lb
 Length of bore.....29.13 in.
 Caliber37-mm
 Type of breechblockEccentric screw
 Type of firing mechanismTrigger
 Type of recoil mechanismHydrospring
 Maximum allowable recoil.....7 to 10 in.
 Ammunition..For complete ammunition data, see section XXVII

(2) *Performance.*

Maximum rate of fire.....35 rounds per min
 Range4,900 yd
 Muzzle velocity.....1,276 ft per sec

PART TWO

OPERATING INSTRUCTIONS

Section III. GENERAL

7. Scope

Part two contains information for the guidance of the personnel responsible for the operation of this equipment. It contains information on the operation of the equipment with the description and location of the controls and instruments.

Section IV. SERVICE UPON RECEIPT OF EQUIPMENT

8. General

a. Upon the receipt of new or used matériel, it is the responsibility of the officer in charge to ascertain whether it is complete and in sound operating condition. A record should be made of any missing parts and of any malfunctions, and any such conditions 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 matériel.

c. The matériel should be prepared for service in accordance with instructions given in paragraphs 9 or 10.

9. New Equipment

a. Disassemble the breech mechanism and soak the parts (except the gas check pad) in dry cleaning solvent while the bore and breech ring are being cleaned. Clean bore with a wooden scraper to remove most of the corrosion preventive before using dry cleaning solvent. After the bulk of the corrosion preventive has been removed from the bore, run cloths soaked in dry cleaning solvent through the bore until all the corrosion preventive has been removed. Clean the breech mechanism parts thoroughly and lubricate the tube and breech mechanism.

b. All lubricating fittings should be properly identified with red circles approximately $\frac{3}{4}$ inch in diameter, but the fittings, oil cups, and oilholes themselves should not be painted over. Bearing and sliding surfaces, hinged joints, latches, and other movable parts should be clean and free from rust and other foreign matter, and properly lubricated.

- c. Lubricate the matériel in accordance with section XI.
- d. Inspect for broken or missing parts.
- e. Open and close breech.
- f. The recoil mechanism filling plug should be painted green to indicate that the mechanism is filled with recoil oil (special).
- g. Inspect all operating parts for smoothness of operation.
- h. Check firing mechanism for proper functioning. If adjustment is necessary, refer to section XVI.
- i. Elevate and traverse the weapon throughout its complete range to determine smoothness of operation. Report binding, backlash in excess of $\frac{1}{2}$ inch, or looseness of mountings to ordnance maintenance personnel. If elevating or traversing mechanism may be moved without releasing elevating clutch or traversing brake, notify ordnance maintenance personnel.
- j. Examine the howitzer and mount for general appearance. If the paint has deteriorated or become damaged, leaving exposed portions of bare metal, the matériel should be repainted.
- k. Check operation of all sighting and fire control equipment.
- l. Check for missing spare parts and equipment, and replace shortages.

10. Used Equipment

The services required to insure that used matériel is in operating condition are identical with the services listed for new matériel in paragraph 9, except for the following additional points:

- a. During disassembly of the breech mechanism and the breech mechanism parts, examine all parts closely for signs of wear. If wear appears to be excessive, replace doubtful parts with new ones, or with parts that are declared usable by ordnance maintenance personnel.
- b. Examine the Artillery Gun Book (O.O. Form 5825) to make sure that this record has been kept up to date and that all entries have been properly made. Determine whether all War Department Modification Work Orders have been applied.

Section V. CONTROLS AND INSTRUMENTS

11. Elevating Mechanism

a. **ELEVATING HANDWHEEL.** The elevating handwheel, on the right side of the carriage or mount (fig. 11), elevates or depresses the weapon when rotated with the elevating mechanism clutch lever released.

b. **ELEVATING MECHANISM CLUTCH LEVER.** The purpose of the elevating mechanism clutch lever, on the right side of the carriage (fig. 11), is to release the brake which locks the elevating mechanism. The clutch lever is depressed to release the brake.

c. **CLUTCH LEVER PEDAL PLATE.** The elevating mechanism clutch lever pedal plate is connected to the clutch lever on the right side of the mount (fig. 12) and serves to release the brake which locks the elevating mechanism. The pedal plate is depressed to release the brake.

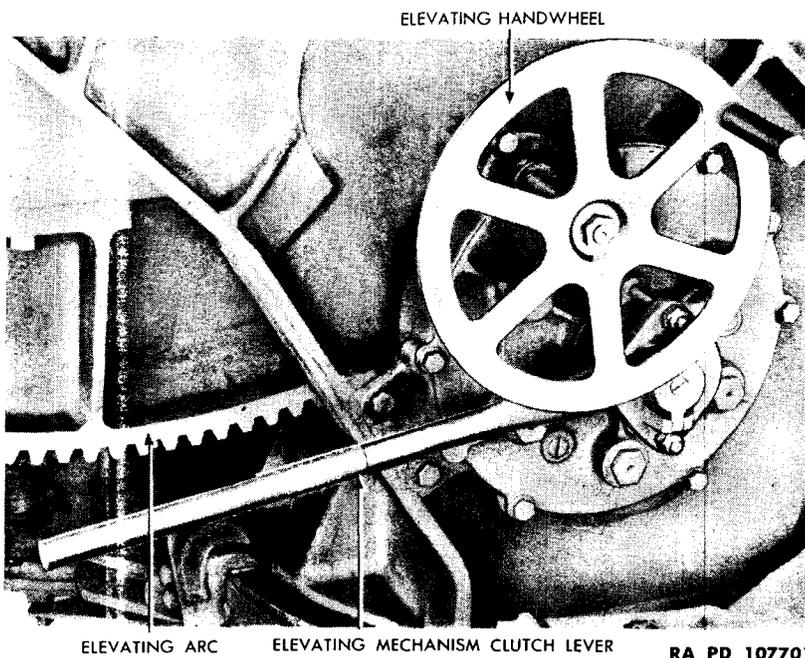
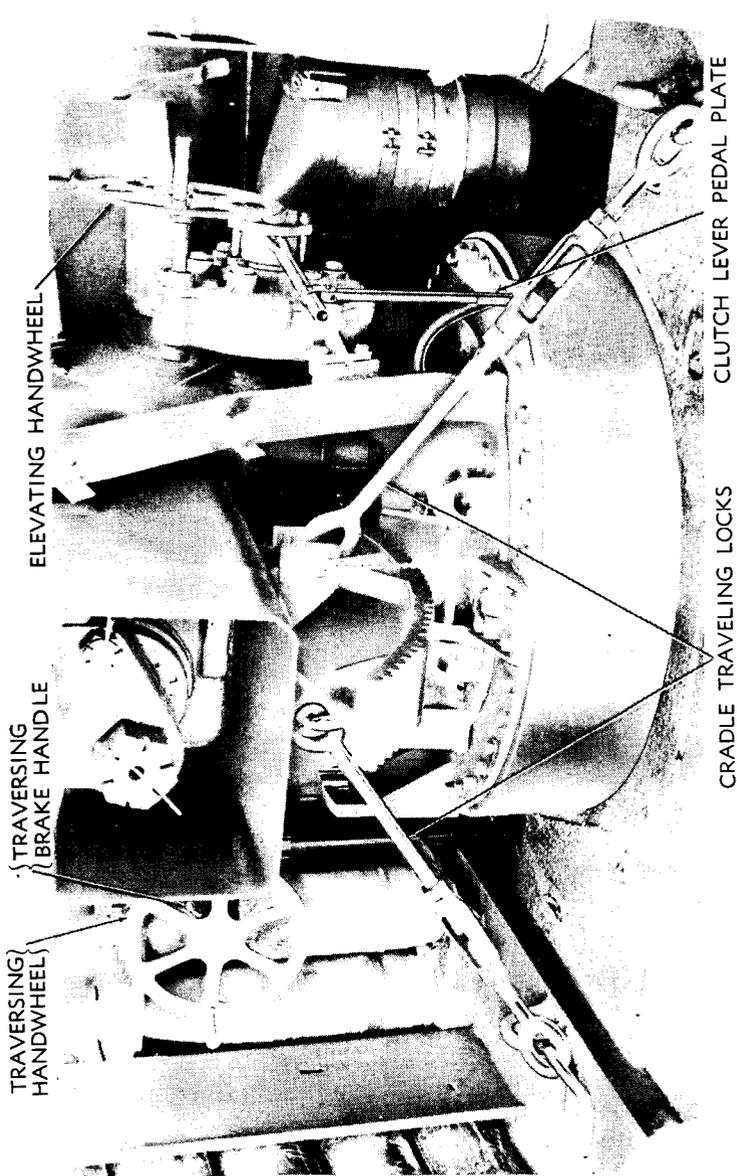


Figure 11. Elevating handwheel and clutch lever.



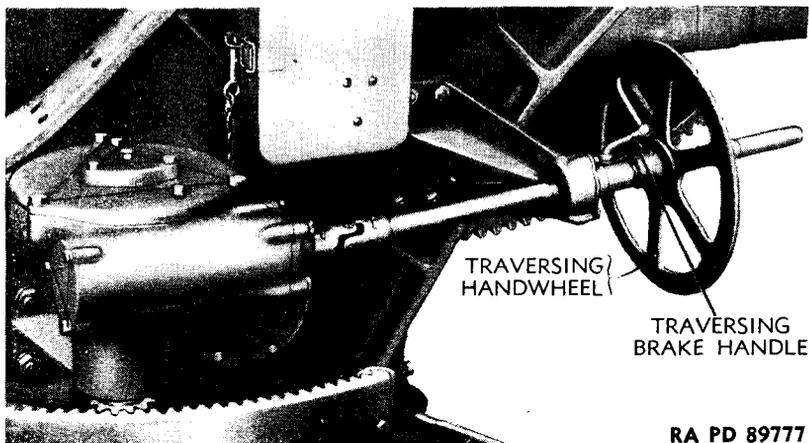
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Figure 12. Clutch lever pedal plate and cradle traveling locks.

12. Traversing Mechanism

a. **TRAVERSING HANDWHEEL.** The traversing handwheel, located on the left side of the carriage or mount (fig. 13), traverses the weapon. The handwheel is turned after the traversing mechanism has been released by loosening the traversing brake.

b. **TRAVERSING BRAKE HANDLE.** Rotating the traversing brake handle counterclockwise (fig. 13) releases the traversing mechanism.



RA PD 89777

Figure 13. Traversing handwheel and traversing brake handle.

13. Traveling Locks (Applies to Motor Carriage Only)

a. **HOWITZER TRAVELING LOCK.** The howitzer traveling lock is located in front of the hatches on top of the carriage hull (fig. 14) and serves to lock the howitzer in traveling position.

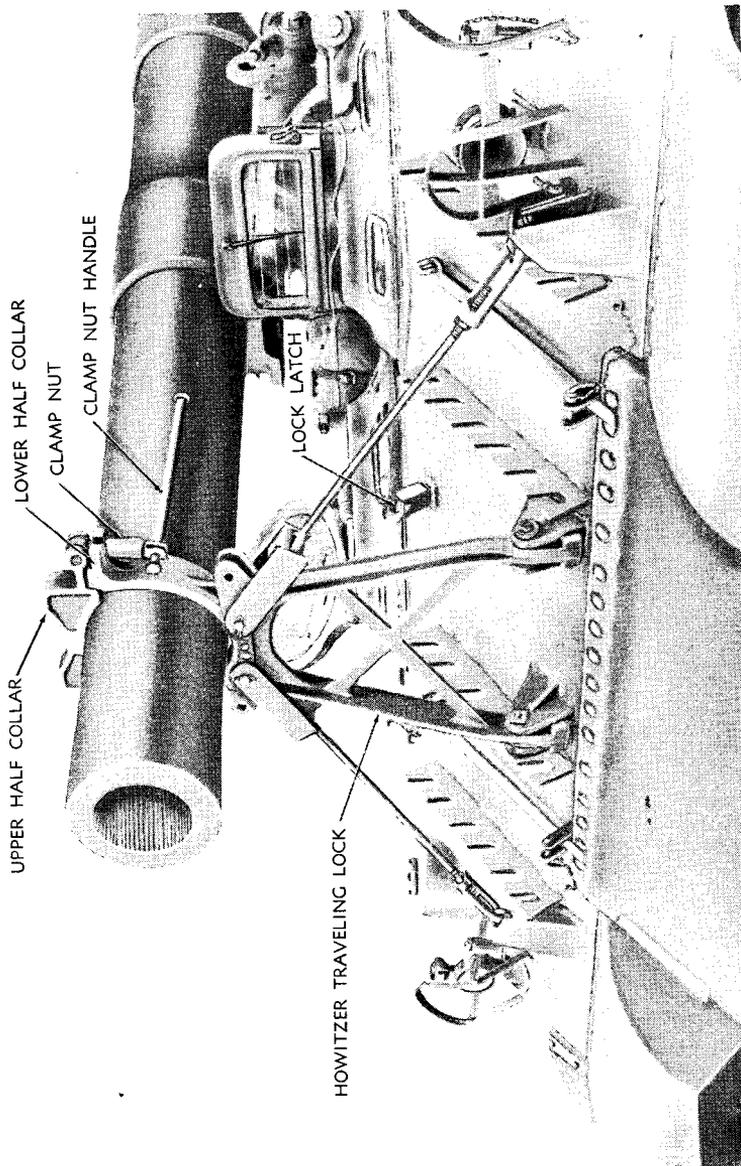
b. **CRADLE TRAVELING LOCKS.** The cradle traveling locks are located on the left and right sides of the platform (fig. 12) and serve to lock the cradle in traveling position.

c. **LOADING PLATFORM LOCKING PINS.** These lock pins are chained to the rear sides of the carriage, near the top (fig. 15) and serve to hold the platform in traveling position.

d. **SPADE SUPPORTING ARM LOCKING PINS.** These lock pins are chained to the rear sides of the carriage (fig. 15) and serve to hold the supporting arms and spade in traveling position.

e. **WINCH RATCHET CRANK.** This crank is located in left rear corner of carriage (fig. 16) and serves to release the spade without shock from the traveling position, or to raise it from firing position.

f. **CRANK BRAKE LEVER.** This lever is located near the crank (fig. 16) and serves to brake the winch ratchet mechanism when lowering the platform.



RA PD 107724

Figure 14. Howitzer traveling lock.

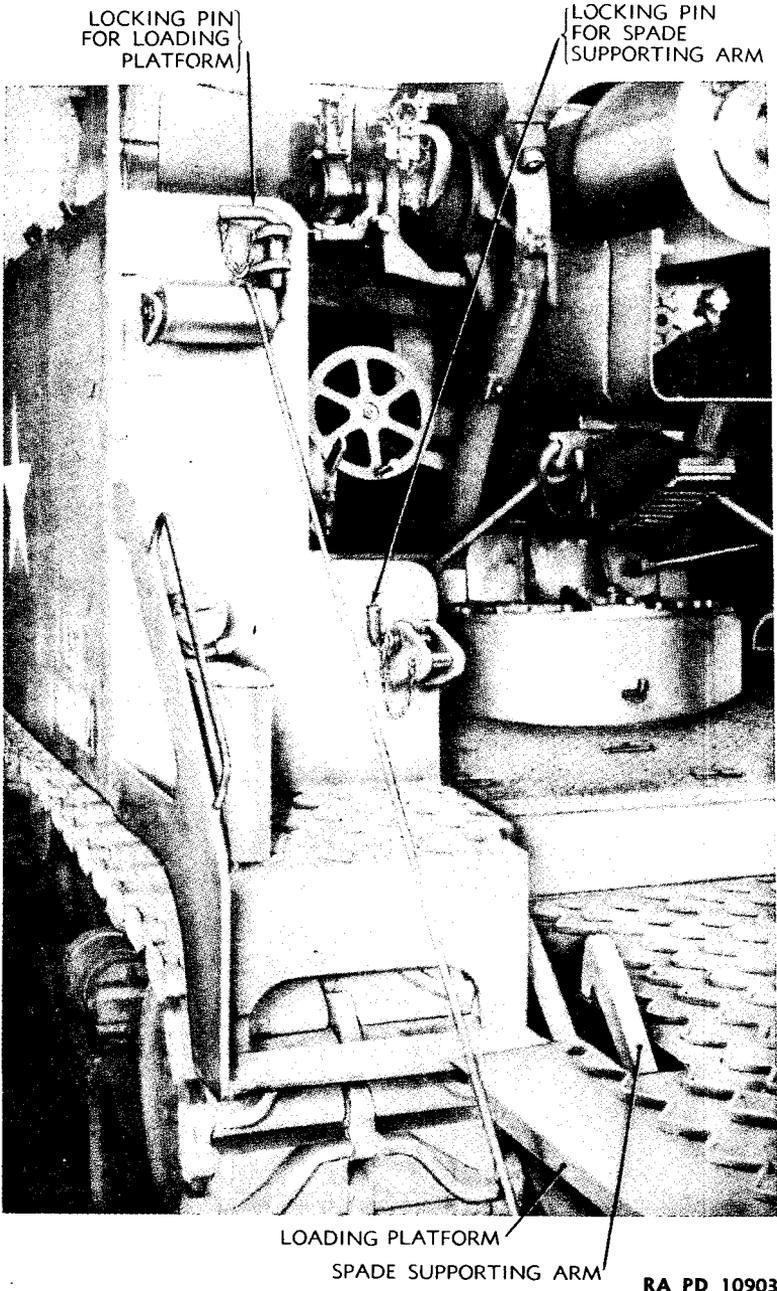
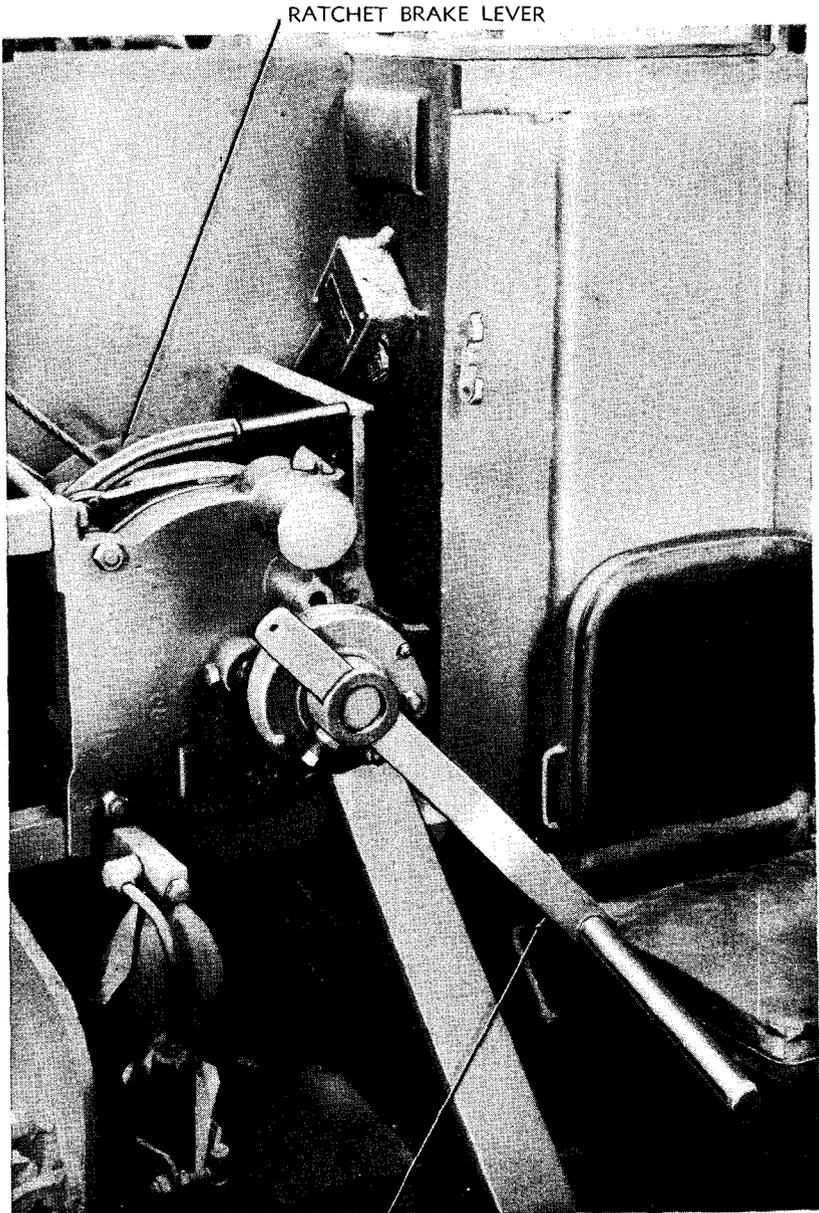


Figure 15. Locking pins for loading platform and spade supporting arms.



WINCH RATCHET CRANK

RA PD 109041

Figure 16. Winch ratchet crank and brake lever.

14. Brake Mechanism (Applies to Carriage M1 Only)

a. AIR BRAKES. The air brakes on all bogie wheels are actuated from the prime mover. In an emergency, the brakes are applied automatically, in the event of a break-away from the prime mover.

b. HAND BRAKES. Hand-operated levers (fig. 17) set the mechanical brakes on the bogie for parking.

- A—ARCH AXLE
- B—CRADLE LOCK
- C—TORQUE ROD
- D—BOGIE LIFTING SCREW LOCK
- E—BOGIE LIFTING SCREW
- F—HAND BRAKE LEVER
- G—BRAKE CHAMBER
- H—PINTLE

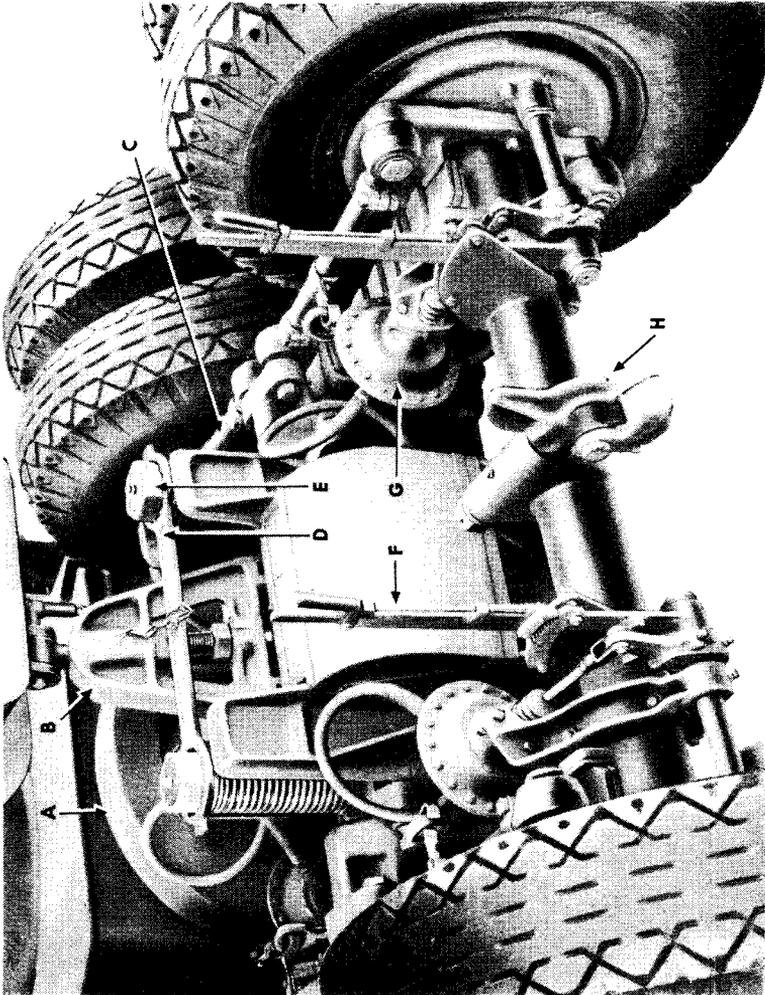
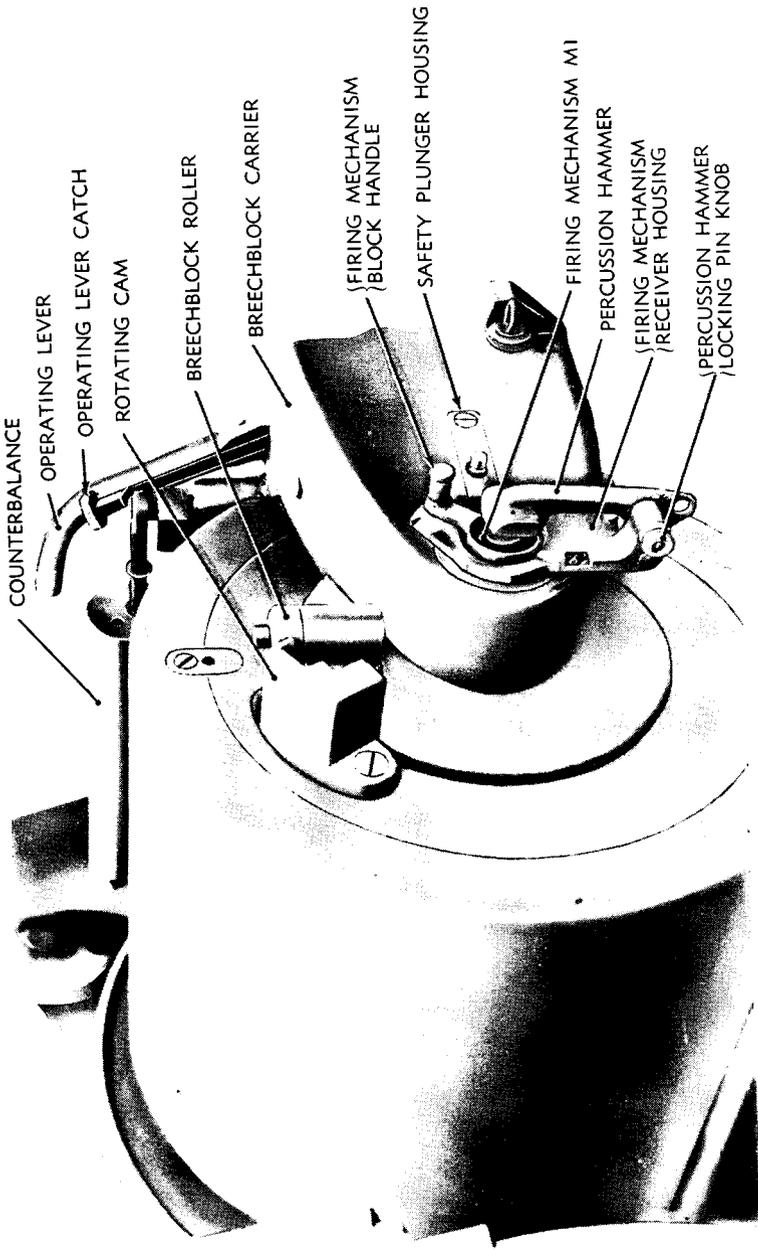


Figure 17. Controls on bogie.



RA PD 109039

Figure 18. Breech controls.

15. Breech Operating Lever

a. The breech operating lever (fig. 18) serves to open and close the breech. The breech is opened by pushing down the operating lever catch, pulling the lever rearward until breech thread sectors are cleared and then pulling lever to the right until spring counterbalance acts to hold breech mechanism in the open position.

b. The breech operating lever catch (fig. 18) locks the breech-lock when in the closed and firing position.

16. Lanyard

The purpose of the lanyard is to fire the weapon. This is done by a quick pull or snap of the lanyard which is attached to the hammer.

17. Instruments

a. TEMPERATURE ADJUSTMENT SCALE. The purpose of the temperature adjustment scale (fig. 19) is to provide a means of maintaining a uniform tension on the equilibrators at various temperatures. For satisfactory functioning, the temperature adjustment scale should be set for a temperature corresponding to the ambient temperature at the time of firing the gun. Further adjustment may be necessary if the equilibrator pressure is not normal.

b. OIL INDEX. The oil index (fig. 74) serves as a guide when establishing the proper oil reserve.

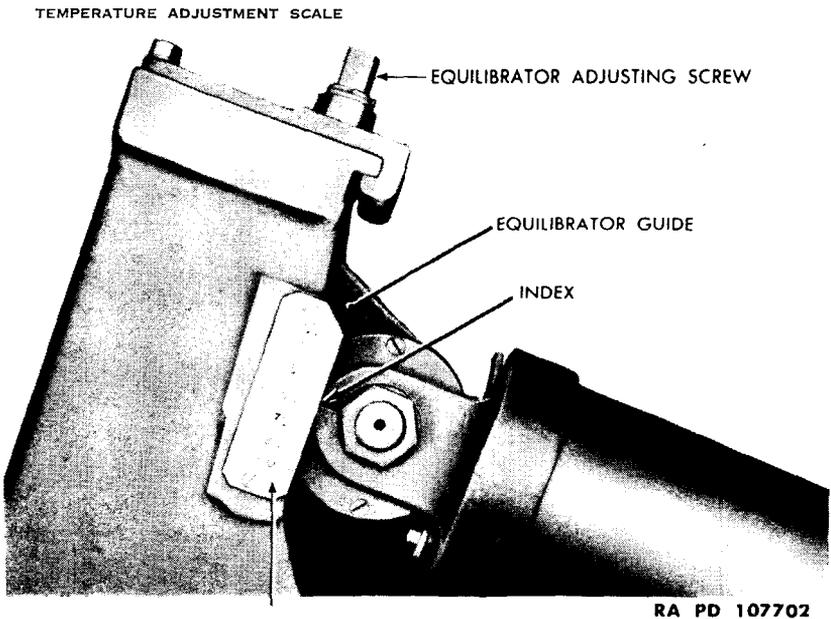
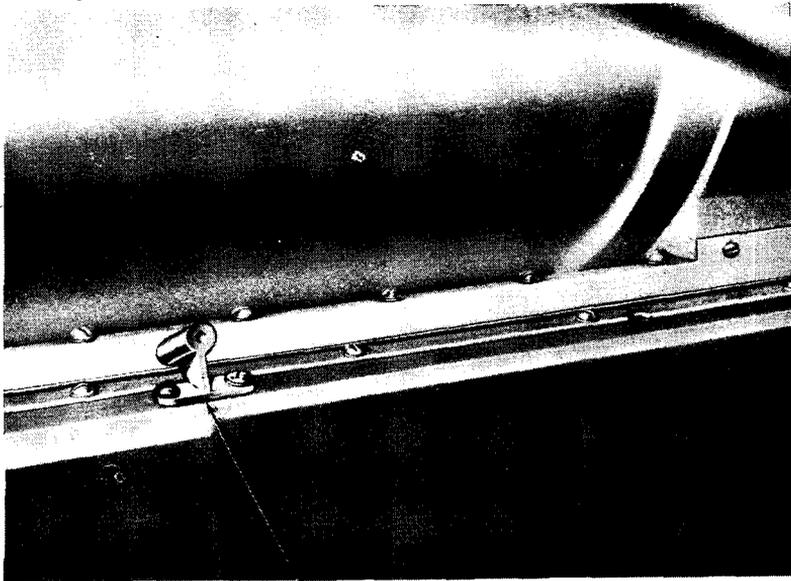


Figure 19. Equilibrator temperature adjustment scale.

c. **RECOIL INDICATOR.** The recoil indicator (fig. 20) inscribes the length of recoil of the howitzer upon the recoil mechanism, where it can be measured.

d. **REPLENISHER PISTON.** The position of the replenisher piston indicates the amount of oil in the recoil cylinder and replenisher. A scale is provided to measure the position of the piston (fig. 72).



RECOIL INDICATOR

RA PD 110948

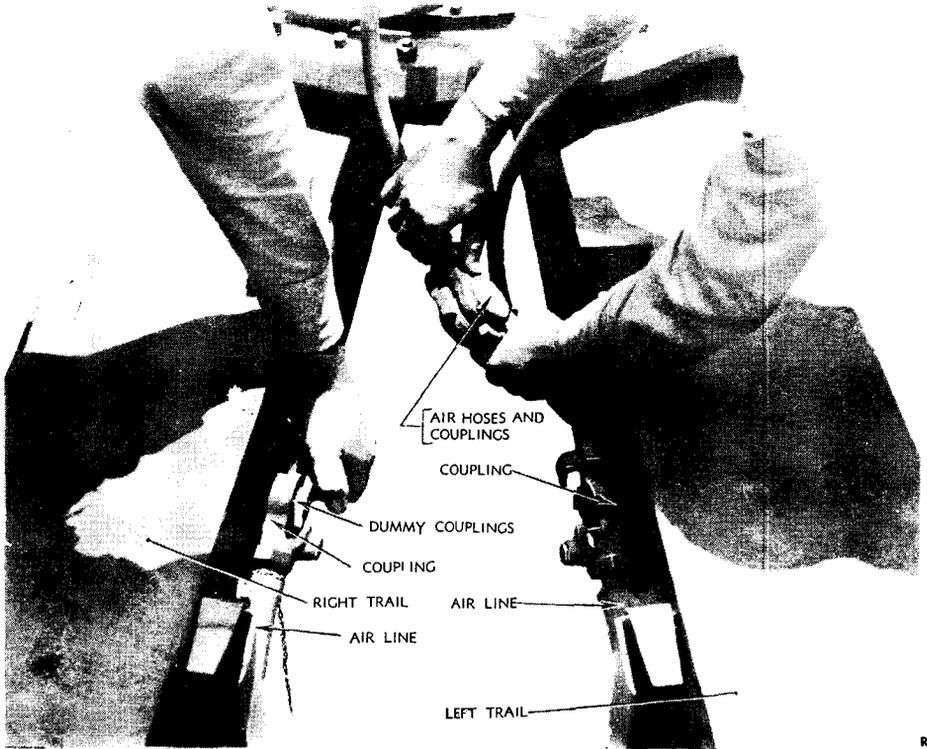
Figure 20. Recoil indicator.

Section VI. OPERATION UNDER USUAL CONDITIONS

18. To Place Weapon in Firing Position When Mounted on Carriage M1

a. Shut off the air pressure at the prime mover. Unless it is desired to apply the brakes on the weapon automatically, the air tank on the carriage should be bled. Use hand brakes for parking. Disconnect the air hose of the limber from the prime mover and from the spade end of the trails. Lock the ends of the hose together at the front of the M5 limber (fig. 23). Attach the dummy couplings to the ends of the air tubes on the trails (fig. 21).

Note. It is important to prevent dust, dirt, and other foreign matter from getting into the air lines since they cause malfunction of the brake mechanism.



RA PD

Figure 21. Locking air line hose and dummy couplings on trails.

b. Make certain that hand brakes on the howitzer carriage are set, and that the limber and prime mover are secured against undesired movement. Block limber and bogie wheels. Do not rely on parking brakes. Stand clear of the limber and trails. Remove the limber as follows: Attach prime mover winch cable to limber lifting sling and take up cable until there is a slight strain on it.

Caution: It is important to have this sling sufficiently tight to hold up the trails.

Remove cotter pin, wing nuts, and eyebolt spacer piece from eyebolt (fig. 29). Remove eyebolt hinge pin (fig. 30) and remove eyebolt from trail clamping bracket. Replace hinge pin. Pay out cable slowly from powered winch to allow a little slack. Use prime mover to pull limber forward slightly until the limber lift bracket assembly begins to rotate. Ease trails to the ground by means of winch (fig. 22). Remove trail coupling pin key from trail coupling hitch pin. Remove trail coupling hitch pin (fig. 22) and pull limber clear of the trails. Using powered winch, take in cable until the limber lift bracket assembly is rotated to approximately vertical position.

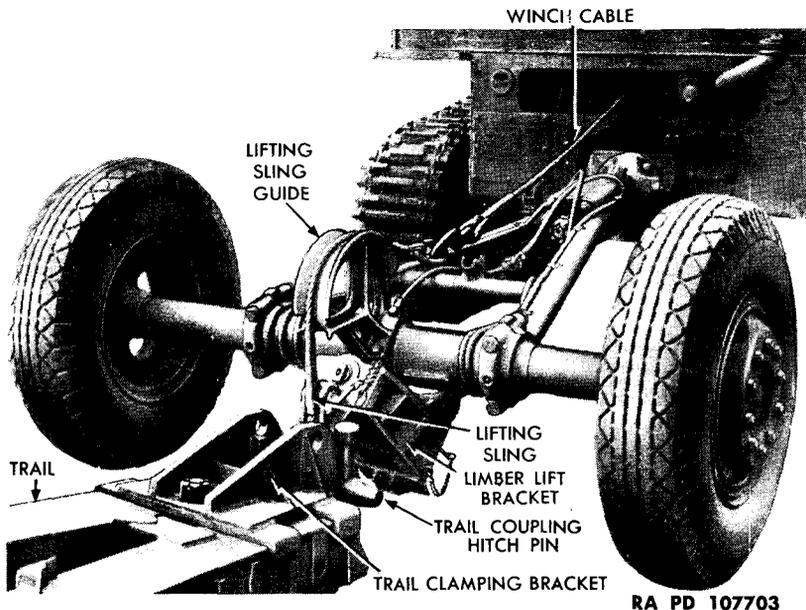


Figure 22. Removing heavy carriage limber M5.

Caution: Do not rotate past the vertical position. Attach eyebolt to lift bracket and to holding bracket on drawbar. One wing nut should be on each side of drawbar and eyebolt spacer seated in the groove on sling guide (fig. 23). This locks lift

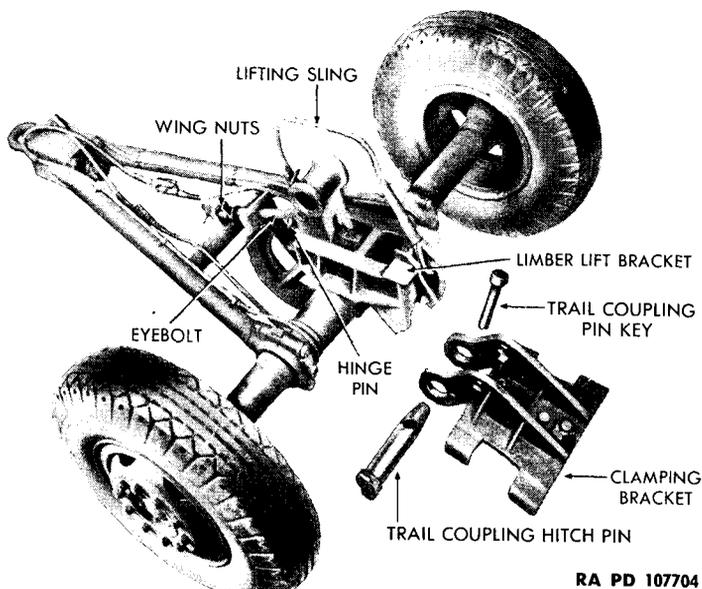


Figure 23. Heavy carriage limber M5—removed.

bracket assembly in upright (traveling) position. Disconnect lifting sling from winch cable and wind up cable. Attach running end of lifting sling to rear hinge pin. Remove safety pin and nuts from trail clamping bracket clamp bolts and remove trail clamping bracket. The T-bolt can be removed when trails are spread. All bolts and nuts should be assembled to trail clamping bracket after removal to prevent loss.

c. Remove the bogie lifting screw lock and covers (fig. 24). Remove the ends of the four wheel supporting cables from the torque rod hooks on the torque rods and attach them to the cross beam torque bracket bolts on the bogie cross beam (fig. 25). Release the cradle lock from the cradle (fig. 25). Remove loading tray from trails. Dig pits for front spades, then attach spades. Lower the carriage by operating the bogie lifting screws with the bogie lifting screw ratchet wrenches (fig. 26), and continue until the wheels are raised completely off the ground. Operate both screws in unison to prevent cramping of the mechanism. The wheel supporting cables provide support for the wheels when they are raised in firing position.

d. When the bearing strength of the soil is too low for more permanent emplacement of the matériel, embedded logs are used (railway ties may be used). These are placed behind the front and rear spades and dug in so as to distribute the force of recoil over a larger ground area and thus prevent movement of the weapon during firing.

e. Remove covers from breech and muzzle.

f. Install panoramic telescope in its mount.

g. Release traversing mechanism by rotating the traversing brake handle counterclockwise.

h. Place tools and equipment in proper position for firing.

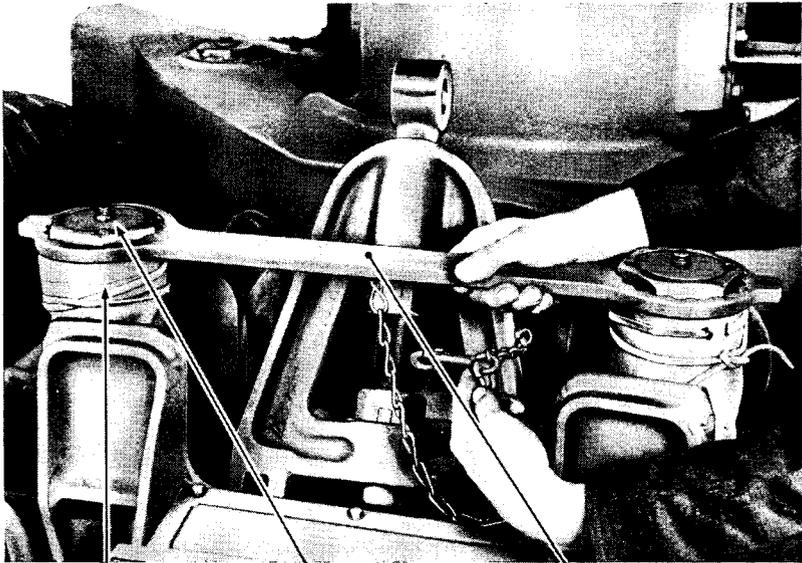
19. To Place Weapon in Firing Position When Mounted on Howitzer Motor Carriage M43

a. Remove the howitzer covers and store them out of the way in the place assigned for them; likewise store all the other equipment not required for operation of the weapon.

b. Unfasten cradle traveling locks from the cradle and place them out of the way.

c. Unlock the tube traveling lock by loosening the nut which secures the upper half of this lock. Rotate this upper half up and off the howitzer tube. Then elevate the howitzer slightly in order to push the traveling lock down in the latched position on the hull.

d. Remove the locking pins which hold the top support arms of the spade assembly. Release winch ratchet arm and brake, to lower spade to the ground. Then back up vehicle to force spade prongs



BOGIE LIFTING SCREW
COVER - D33759

OUTER BOGIE
LIFTING SCREW

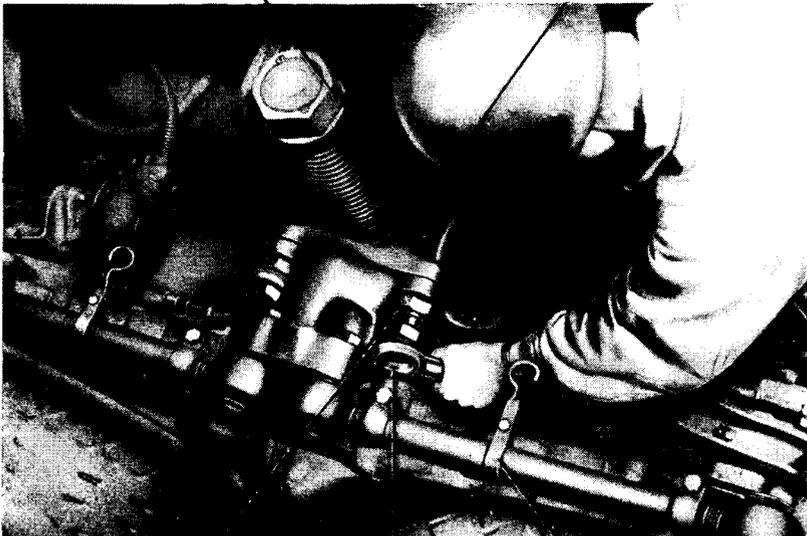
BOGIE LIFTING SCREW
LOCK - 41-L-1610-35

RA PD 107721

Figure 24. Removing bogie lifting screw lock.

BOGIE LIFTING SCREW

BOGIE CROSSBEAM



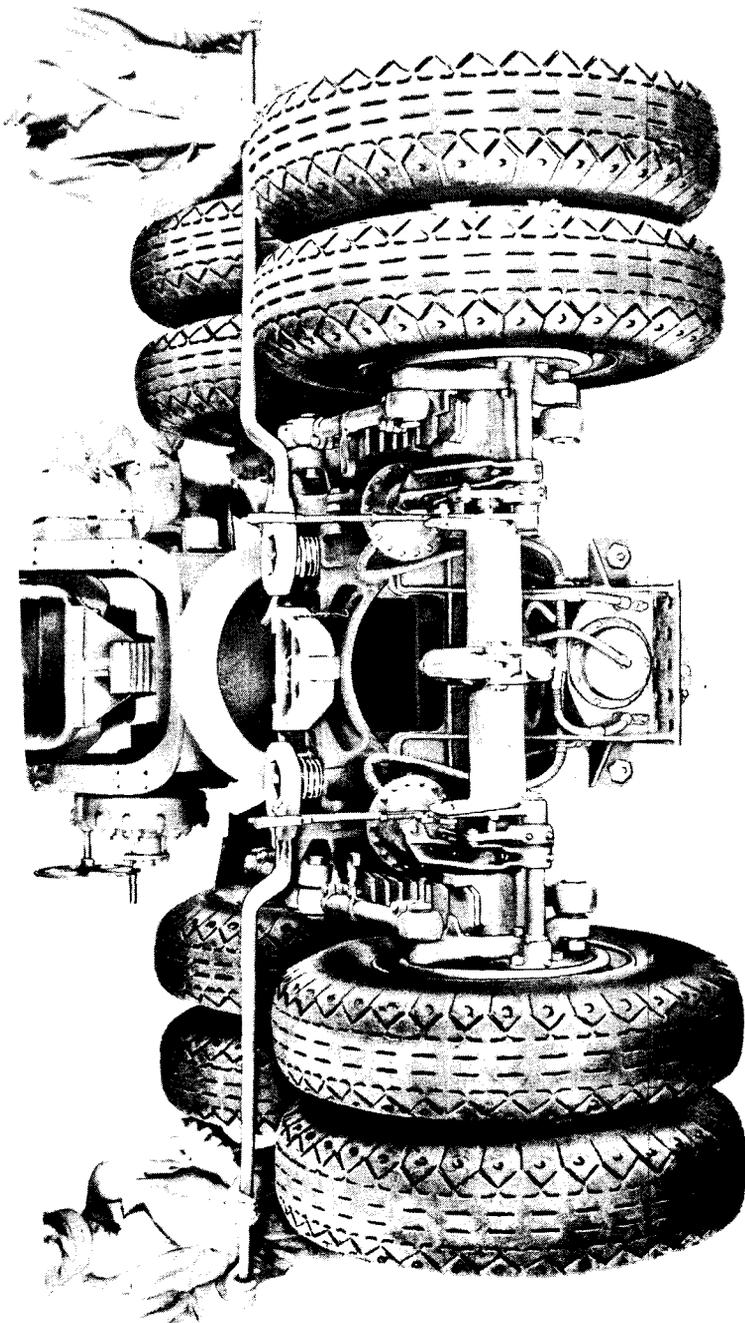
CROSSBEAM TORQUE
BRACKET BOLT

WHEEL SUPPORTING CABLE

TORQUE ROD HOOK

RA PD 107712

Figure 25. Attaching wheel supporting cables to the lugs on the bogie.



RA PD 86546

Figure 26. Lowering bottom carriage.

into the ground. When in its proper position, the spade must be flush with the ground and the spade stops seated against the hull of the vehicle. Apply the vehicle steering brakes and lock in position.

20. Loading the Howitzer

a. TO OPEN BREECH. Remove the firing mechanism M1 as follows:

(1) Pull the percussion hammer locking pin knob (fig. 27) to the left until the percussion hammer is free and the knob is free to rotate. Turn the knob until the small pin in the knob engages the shallow recess in the housing. The knob is left in this position during firing.

(2) Pull out the firing mechanism block handle, rotate the firing mechanism counterclockwise until the thread is disengaged, then withdraw the firing mechanism to the rear.

(3) Push down on the breechblock operating lever catch, and pull the breechblock operating lever down to a horizontal position. Swing the operating lever toward the muzzle of the howitzer.

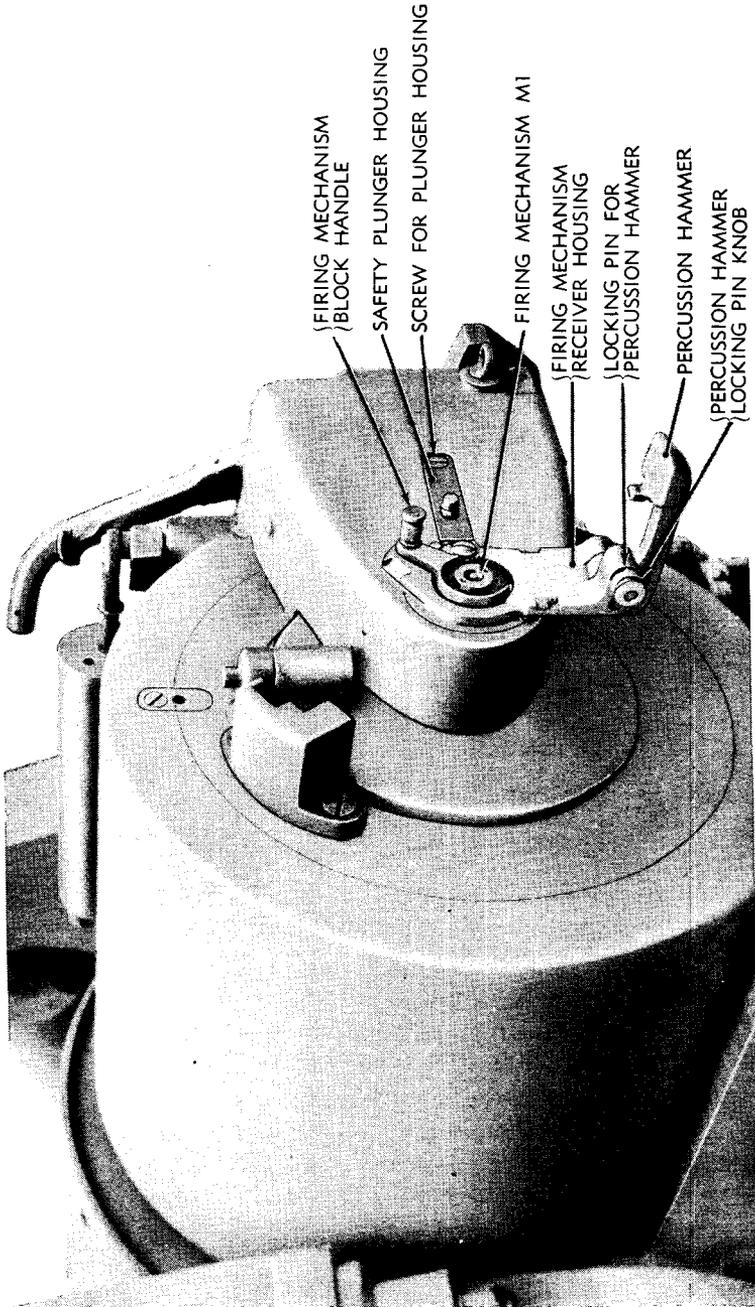
b. TO LOAD PROJECTILE. A loading tray (fig. 36) is furnished for howitzer and carriage M1, and a loading ramp (fig. 36) for howitzer and mount M17, both to provide for ease in loading and to protect the threads in the breech recess. When loading tray is used, the projectile is placed on the loading tray, the tray is then lifted by the gun crew, and the front of the tray so placed that the projecting brass lug rests in a blank portion of the interrupted breech thread. When the loading ramp is used, it is so placed that the projecting brass lug rests in a blank section of interrupted breech thread while the rear end of the ramp rests on the loading platform. The projectile is pushed clear of the loading tray (or ramp) by use of the rammer. Then the tray (or ramp) is removed and the projectile is rammed into position in the forcing cone. It is important that projectiles be rammed with a uniform force since variations in the ramming force will cause slight variations in the range. It is also important that the rotating bands of a projectile be not damaged, as such damage is likely to cause erratic firing. To avoid damage to rotating bands, the grommet should not be removed until the shell is prepared for loading.

c. TO LOAD PROPELLING CHARGE. It is not necessary to use the loading tray when placing the powder charge in the breech. Care must be taken to insure that the igniter end of the powder charge is located at the rear.

d. TO CLOSE THE BREECH. Pull the breech operating lever toward the breech and then push it to a vertical position.

e. TO LOAD PRIMER.

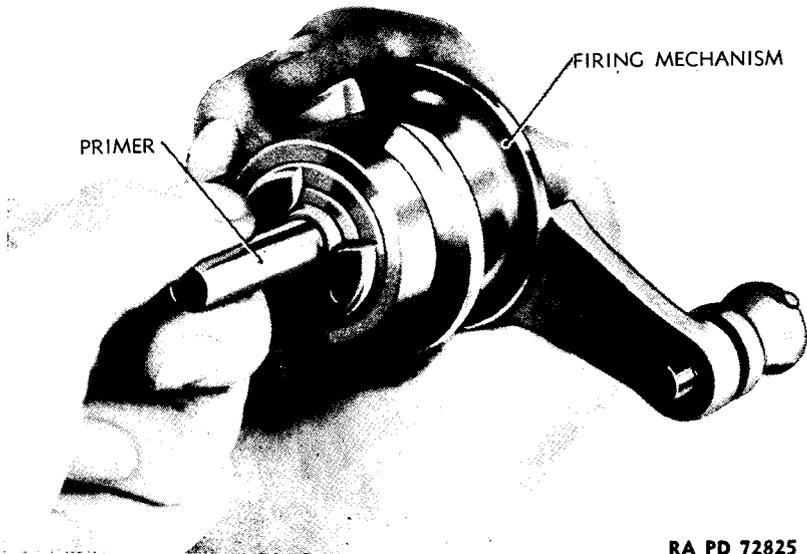
Caution: The breech must be closed before assembling the firing mechanism M1 to the breech.



RA PD 109042

Figure 27. Removal of firing mechanism.

Hold the firing mechanism M1 in one hand and slide the primer into the U-shaped groove (fig. 28). Place firing mechanism into breechblock and screw it all the way home.



RA PD 72825

Figure 28. Loading primer in firing mechanism M1.

21. Firing

- a. Lay the howitzer in elevation and traverse.
- b. Firing is accomplished by a quick pull or snap of the lanyard attached to the percussion hammer, which causes the hammer to strike the firing pin.
- c. When traveling, or for reasons of safety, the percussion hammer on firing mechanism M1 may be locked in a neutral position by the percussion hammer lock pin.
- d. In case of misfire, refer to paragraph 42.

22. To Place Weapon in Traveling Position

a. **RAISE CARRIAGE.** Detach the rear spades from the trails. Swing the trails together. Operate the bogie lifting mechanism to raise the carriage from the ground (fig. 26). Raise the carriage as high as the lifting mechanism will permit.

Caution: See that the pointer plates on the bottom carriage are alined with the indicator plates on the bogie cross beam (fig. 29). This is important since at times gravel, mud, dirt, or other foreign matter may lodge on the lower contact surface and, if not cleaned off before the carriage is raised and apparently up tight, will be shaken loose by the road vibration and the resulting clearance

may damage the lifting screws. Alinement of the plates indicates no foreign matter between the contact surfaces.

Detach the front spades. Place the front and rear spades in their respective carrying racks on the trails. Invert the loading tray and place on top of the trails, between the bottom carriage and the spades, with the front handles placed in the recess formed by the front spades mounted on the trails. The camouflage poles, when strapped to the trails over the handles, hold the tray in this position. Detach the wheel supporting cables from the bolts on the bogie cross beam (fig. 25) and hook the cable eyes on the brackets provided on the upper torque rods. Place the bogie elevating screw lock in position on top of the bogie elevating screws (fig. 17). Set the howitzer at zero-degree traverse and such elevation as will permit attaching the cradle lock on the bogie to the lug on the bottom of the cradle.

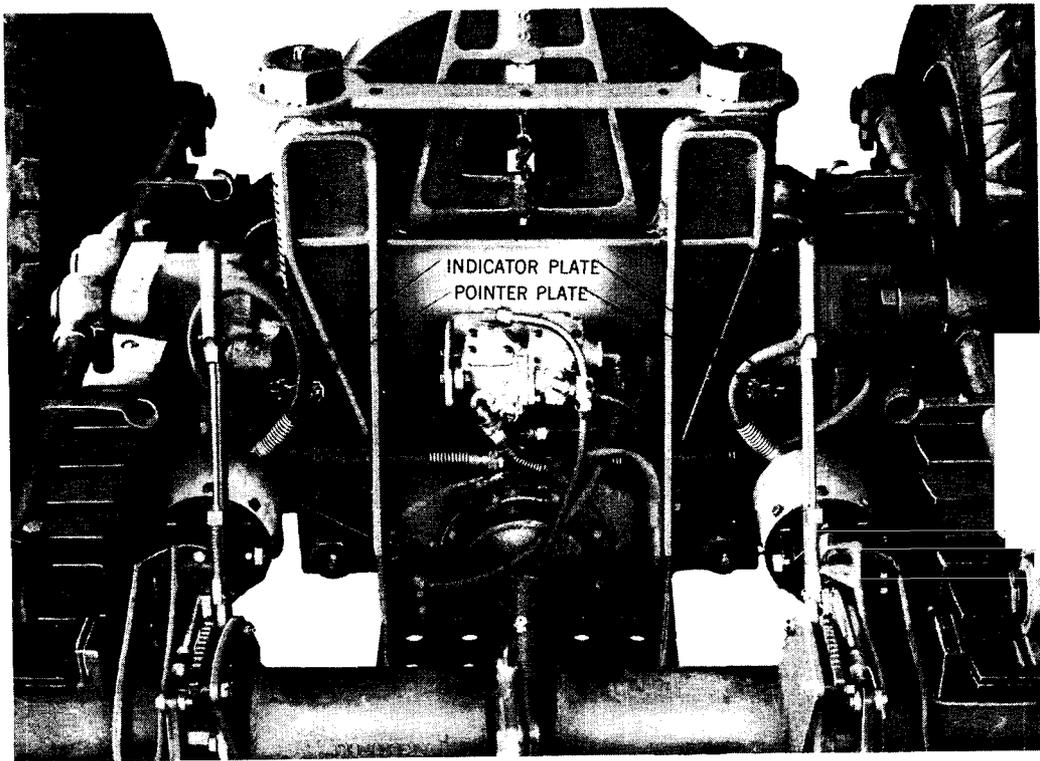


Figure 29. Alinement of indicator and pointer plates.

RA PD 111082

b. INSTALL HEAVY CARRIAGE LIMBER M5. (1) Place the trail clamping bracket T-bolt in the spade recess on the trails when closing the trails. Align the trail clamping bracket over the T-bolt and trails. Position the other trail clamping bracket bolt, and install nuts and tighten. Lock in place by inserting safety pins.

Caution: One or more threads should be showing above the nut.

(2) With the limber hooked to the prime mover, align the limber to the trail clamping bracket. Pay out the winch cable on the prime mover enough so that it can be connected to the lifting sling on the limber frame. Take up the slack until the cable and sling are taut. Make certain that the sling is in line with the lifting sling guide. Remove the eyebolt from its carrying position on the front of the limber by loosening the wing nuts and removing the hinge pin (fig. 23). Pay out cable from winch to allow the limber lift bracket assembly to rotate and swing down to the lifting position. Align the lift bracket with the trail clamping bracket (fig. 22). Insert the trail coupling hitch pin to connect the limber lift bracket to the trail clamping bracket. Insert and tighten the trail coupling pin key.

(3) Unlock brakes on howitzer carriage and, using powered winch, take in cable slowly. This will rotate the lifting bracket assembly and lift the trails to the traveling position. The carriage will move a few feet during this operation.

Caution: Personnel must stand clear of the limber and trails, and the operator of the prime mover winch should exercise care in powering the winch.

(4) Reset the hand brakes on the carriage. Keeping clear of the trails, place lifting and locking eyebolt down through trail clamping bracket between the trails (fig. 30). Lock in place with eyebolt hinge pin (fig. 31). Lay eyebolt spacer piece in position,

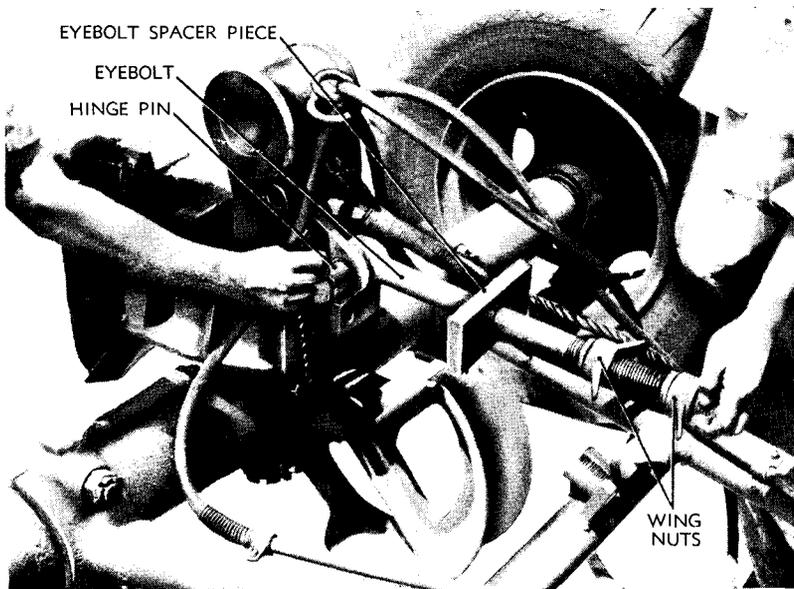
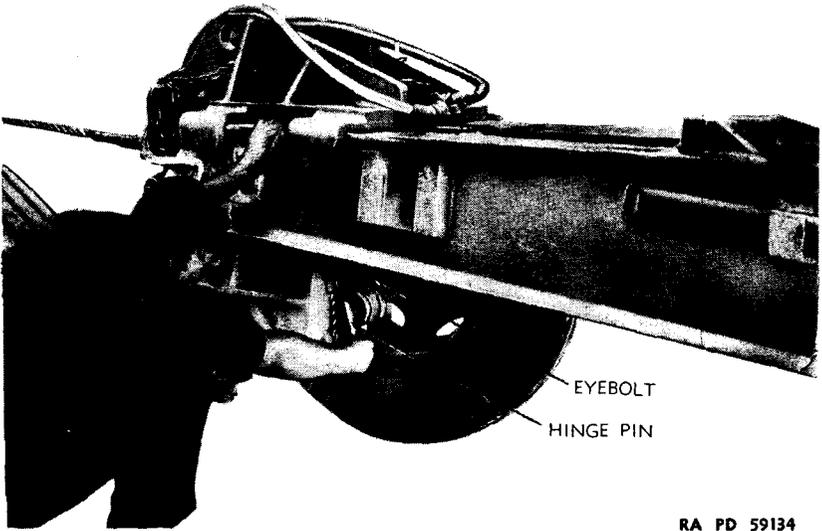


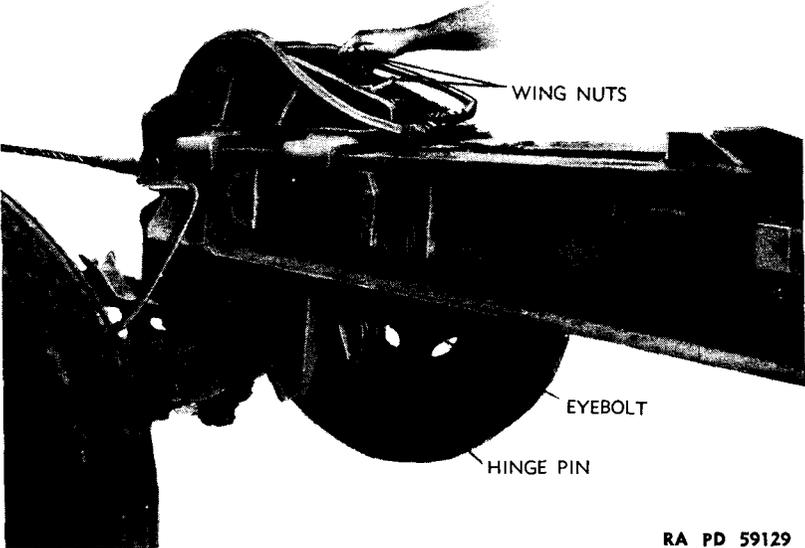
Figure 30. Installing or removing eyebolt.

RA PD 59126

start wing nuts (fig. 32), and tighten securely. Insert cotter pin. When eyebolt is securely in place, remove lifting sling from winch cable and attach sling to the hook on the trail (fig. 33). Wind up winch cable.

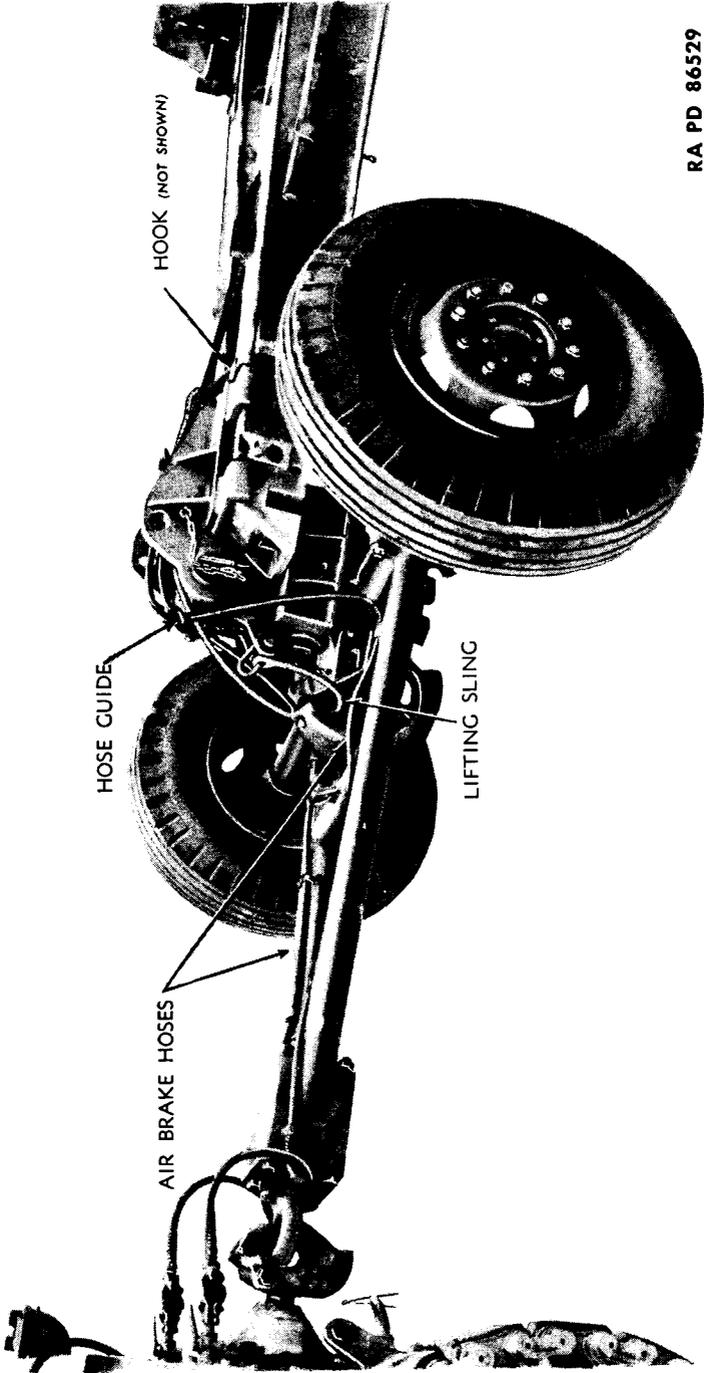


RA PD 59134
Figure 31. Inserting or removing hinge pin.



RA PD 59129
Figure 32. Installing or removing nuts on eyebolts.

c. **CONNECT AIR BRAKE HOSE.** Couple air brake hose together, passing them through hose guide. Hose are arranged for straight connections between limber and prime mover, and for cross connection between limber and trails (fig. 33).



RA PD 86529

Figure 33. Carriage limbered for traveling.

d. INSPECTION. A thorough inspection of the assembled limber should be made before moving. Points to be covered are:

(1) Trails must be seated properly on limber lifting bracket (limber M5).

(2) All nuts must be drawn up tight and locked with cotter pins.

(3) The eyebolt must be drawn up tight by the two wing nuts (limber M5).

(4) Air hose must be installed properly and be free to turn with the limber.

e. LOCKING MATERIAL FOR TRAVELING. (1) Connect cradle lock to the cradle.

(2) Lock traversing mechanism by rotating the traversing brake handle clockwise.

(3) Remove panoramic telescope from its mount.

(4) Replace breech and muzzle covers.

(5) Install blackout light on muzzle and connect.

23. To Place Weapon in Traveling Position When Mounted on Howitzer Motor Carriage

a. Unlatch and swing the howitzer traveling lock up to a vertical position. Depress the howitzer onto the traveling lock and clamp the upper half of the lock around the tube. Fasten by tightening the nut.

b. Fasten the cradle traveling locks to the cradle.

c. Install the howitzer covers.

d. Move the vehicle forward to free the spade from the ground. Lift the spade to traveling position by means of the spade winch. Insert spade support arms through the brackets and then insert the locking pins.

Section VII. OPERATION UNDER UNUSUAL CONDITIONS

24. General

When operating the matériel under unusual conditions such as extreme high or low temperature, severe dust or sand conditions, or locations near salt water, the precautions given in this section must be followed.

25. Extreme Cold

a. GENERAL. When prevailing temperatures below 0° F. are encountered, and when improper operation is experienced between 0° F. and 32° F., it is essential that the following points be observed:

(1) Keep all parts thoroughly clean.

(2) Leave no metal surfaces exposed without a protective film of lubricant.

(3) Do not let snow and ice collect on moving parts. Whenever the weapon is to remain idle for a period of time, secure the howitzer covers tightly. Wind will drive snow under loosely fitting covers, resulting in the formation of ice which may interfere with the operation of the weapon.

(4) Do not bring any matériel indoors unless it is absolutely necessary. It is best to leave it outdoors, but covered to protect it from the snow.

(5) If it is necessary to bring the howitzer, sighting and fire control equipment, parts, or assemblies indoors, after having been outside at low temperatures, vapor in the air will condense on the cold parts. If it is not dried off, this condensed moisture will cause rust and corrosion of the parts. Therefore, wipe the tube and all bright parts dry when the equipment reaches room temperature, and recoat with lubricant. Inclosed mechanisms (such as closed gear cases, etc.) may be damaged by condensation on the insides of the mechanisms. If the matériel is operated indoors while the moisture is present, the moisture will form an emulsion with the lubricants which will necessitate the removal of all grease and the relubrication of the matériel. If the matériel is taken outside with this moisture present, the parts will become covered with frost and may not function.

(6) All moving parts of the matériel should be exercised frequently. (Traversing and elevating the gun is helpful in reducing the effort required to turn the handwheels.) Intervals of exercise will depend upon the existing temperature—the lower the temperature, the more frequent the exercise.

(7) To prevent matériel from freezing to the ground, see that the equipment is coated with some substance to which the ice will not stick, or that a protective layer is placed on the ground for the matériel to rest on. Pedestals, trails, outriggers, skids of generating units, points of tripods, and other metal parts that rest on the ground, can be covered with grease to prevent them from freezing to the ground. Tires and packing or carrying cases, as well as the previously mentioned parts, may be placed on straw, hay, or waterproof paper such as tar or roofing paper.

(8) When matériel is protected with a canvas or other type of cover, moisture will form on the metal surfaces. To prevent rusting, remove covers at least once a week, and thoroughly dry and reoil all surfaces.

b. BORE CLEANING. (1) *Rifle bore cleaner.* When cleaning the bore with rifle bore cleaner at temperatures below 0° F., wipe

the bore dry and oil. Do not allow the rifle bore cleaner to remain in the bore, as freezing of the cleaner in the bore may make firing dangerous.

(2) *Care in oiling bore.* In applying oil 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.

c. **RECOIL MECHANISM.** (1) The care will be the same as for normal conditions with the exception that the recoil mechanism will be exercised more frequently. The frequency of exercising will depend upon the temperature—the lower the temperature the more frequently the recoil mechanism should be exercised.

(2) It can be expected that the cyclic rate of fire will be less under extreme cold weather conditions.

Caution: Do not remove recoil oil to increase the cyclic rate of fire. As firing continues, the oil will heat up until the normal rate of fire is obtained.

d. **TOP AND BOTTOM CARRIAGE.** Keep drain holes in top and bottom carriage open, and avoid accumulation of snow on carriage.

e. **ELEVATING AND TRAVERSING ARCS.** Brush ice and snow from traversing and elevating arcs with stiff bristle or wire brush before operation.

f. **TIRES.** (1) Special care must be given to tires during cold weather. Check air pressure frequently and keep the tires free of ice. When a weapon is emplaced for a long time, tires will develop a flat surface at the contact point with snow or frozen ground. Care should be taken, when traveling with the weapon, to keep the speed at a minimum until the tire has regained its original shape.

(2) To avoid developing flat surfaces, rest the weapon on its bottom carriage, with the bogie wheels raised, whenever it is inactive.

g. **BRAKES.** (1) *Air brakes.* Air brakes require special care during cold weather. Drain air reservoirs after use. This will blow out moisture formed by compressed air and will prevent freezing of lines and brakes.

Caution: Care should be exercised in connecting air hoses to prime mover to prevent cracking or breaking when bends are too sharp.

(2) *Hand brakes.* Apply proper lubrication to all joints and connections. Use wheel chocks in preference to setting brake when the howitzer is packed.

h. **FIRE CONTROL EQUIPMENT.** (1) When using optical instruments in cold weather, the operator should be careful not to breathe on the oculars. When the breath hits the lenses, the moisture in the warm breath condenses on the lenses and fogs them.

This moisture will then freeze, making it impossible to observe with the instrument.

(2) Optical surfaces should be cleaned in cold weather by rubbing gently with dry lens-tissue paper. To remove oil film, bring instrument into a warm inclosure and allow it to reach room temperature before applying liquid lens-cleaning soap.

26. Severe Dust or Sand Conditions

a. When the howitzer is active in sandy or dusty areas, clean and lubricate at frequent intervals, as the lubricant will pick up sand or dust, forming an abrasive mixture. Clean and lubricate after action.

b. Exercise particular care to keep sand and dust out of the mechanisms and oil receptacles when carrying out inspection and lubrication operations, adjustments, and repairs.

c. Keep the mount covered when practical. Cover the breech mechanism and muzzle as often as conditions permit.

27. High Humidity, Extreme Moisture, and Salt Water

a. The amount of moisture in the atmosphere determines the rate of corrosion and the rate of loss of protective quality by lubricant films used to prevent corrosion of metal surfaces, such as the howitzer bore, breech mechanism, etc., as the water will emulsify the lubricants and destroy their corrosion-preventive qualities. Inspect parts frequently for corrosion. The more moisture present, the greater the tendencies are for the matériel to corrode and deteriorate. Therefore, inspection, cleaning, and lubrication should be more frequently and carefully performed, depending upon the moisture present. Salt in the air, such as occurs near salt water areas, and high temperatures, add to the corrosive activity of moisture.

b. Keep the bore of the tube and the breech mechanism heavily oiled, and watch for signs of rust.

c. Coat exposed unpainted surfaces, such as the bore and the breech and firing mechanisms, as indicated in the War Department Lubrication Order.

d. In moist warm climates, covers and other items will deteriorate from mildew, etc., or may be attacked by vermin. Moisture under the covers also causes rusting of the parts. To prevent this, these items should be removed, aired, and dried daily.

Section VIII. DEMOLITION TO PREVENT ENEMY USE

28. General

a. The destruction of the matériel, subject to capture or abandonment in the combat zone, will be undertaken by the using arm

only on authority delegated by the division or higher commander as a command function when such action is deemed necessary as a final resort to keep the matériel from reaching enemy hands.

b. Adequate destruction of artillery matériel means damaging it in such a way that the enemy cannot restore it to usable condition in the combat zone either by repair or by cannibalization. Adequate destruction requires that:

(1) Enough parts essential to the operation of the matériel must be damaged.

(2) Parts must be damaged beyond repair in the combat zone.

(3) The same parts must be destroyed on all matériel, so that the enemy cannot make up one operating unit by assembling parts from several partly destroyed units.

c. The tube and breech are the most vital parts of any piece of artillery. These are the first things to damage. After the tube and breech, in the order of importance, come the recoil mechanism, sighting and fire control equipment, carriage, tires, gun book, and firing tables.

29. Methods

a. GENERAL. (1) The destruction procedures outlined are arranged in order of effectiveness. Destruction should be accomplished by method No. 1, if possible. If method No. 1 cannot be used, destruction should be accomplished by one of the other methods outlined, in the priority shown.

(2) Whichever method is used, the sequence outlined must be followed. Uniformity of destruction will then be obtained, whether or not the method is carried to completion.

(3) Certain of the methods outlined require special tools and materials, such as nitrostarch and incendiary grenades, which may not be items of issue normally. The issue of such special tools and matériel, the vehicles for which issued, and the conditions under which destruction will be effected, are command decisions in each case, according to the tactical situation.

(4) Detach all optical sights. If evacuation is possible, carry the sights; if evacuation is not possible, smash the sights completely.

b. METHOD NO. 1—DESTRUCTION OF TUBE, BREECH, AND RECOIL MECHANISM. (1) Open drain plug on recoil mechanism, allowing recoil fluid to drain out. It is not necessary to wait for the recoil fluid to drain completely before firing the howitzer (step (4) below).

(2) Place an armed (safety pin removed) high-explosive, anti-tank grenade M9A1, or armed (safety pin removed) antitank rocket M6 in the tube with the nose end toward the rear. The

grenade or rocket must be centered in the tube, using a wooden adapter. An alternate for the wooden adapter is the use of waste.

(3) Insert an unfuzed high-explosive shell with propelling charge into the howitzer and close the breech. Base-detonating, high-explosive shell cannot be used in this method.

(4) Fire the howitzer, using a lanyard at least 100 feet long. The man firing should be under cover to the rear of the piece and approximately 20° off the line of fire. Elapsed time: approximately 2 to 3 minutes.

(5) The danger zone is approximately 500 yards.

c. METHOD No. 2 (1) Insert TNT blocks into the bore near the muzzle, and in the firing chamber. Close the breechblock as far as possible without damaging the safety fuze. Plug the muzzle tightly with earth to a distance of approximately 3 calibers from the muzzle. Detonate the explosive charges simultaneously. Thirty to fifty ½-pound TNT blocks will be needed for effective demolition. If it is not possible to plug the bore, a larger number of blocks will be needed for effective demolition.

(2) Ram a high-explosive shell (without base fuze) into the forcing cone, and place TNT blocks behind it as specified above. Close the breechblock and detonate the TNT charge. A sufficient length of safety fuze should be used to permit personnel to reach safety zone or cover. The fuze may be routed through the primer hole in the spindle.

(3) The number of nitrostarch blocks to be used is an estimate only and has not been proved by tests.

d. METHOD No. 3. (1) Place unfuzed, incendiary grenades M14 on their sides, one on top of another, in the firing chamber. Close the breech. Equip another incendiary grenade with a 15-second safety fuze. Ignite and toss it in the muzzle. Quickly elevate the howitzer to its maximum elevation. Elapsed time: 3 to 5 minutes. Six to eight grenades are required per howitzer.

(2) The metal from the grenades will fuse with the interior of the breechblock, making it impossible to open the breech.

e. METHOD No. 4. (1) Fire adjacent guns at each other at point-blank range using high-explosive or armor-piercing shells. Two or more direct hits from a weapon of the same caliber, on a vital spot such as the breech mechanism, recoil mechanism, or tube, should adequately destroy the artillery piece. Fire from cover. Danger space is from 200 to 500 yards.

(2) Destroy the last gun and carriage by the best means available.

(3) Danger from cannibalization is inherent in this method.

f. AMMUNITION. Instructions for demolition of ammunition are contained in TM 9-1901.

PART THREE

MAINTENANCE INSTRUCTIONS

Section IX. GENERAL

30. Scope

Part three contains information for the guidance of the personnel of the using organizations responsible for the maintenance (first- and second-echelon) of this equipment. It contains information needed for the performance of the scheduled lubrication and preventive maintenance services, as well as descriptions of the major systems and units and their functions in relation to other components of the equipment.

31. Cleaners and Preservatives

The following cleaners and preservatives are required for use with this matériel. Additional information to that contained in this manual with regard to these materials is covered in TM 9-850.

ALCOHOL, denatured	PALM, sailmaker's
BRUSH, artist's camel's hair	PAPER, flint
BURLAP, jute, 8 oz.	PAPER, lens, tissue
CHALK, railroad, white	SOAP, issue (QM issue)
CLEANER, rifle bore	SOAP, liquid, lens-cleaning
CLOTH, abrasive, aluminum oxide	SOAP, saddle
CLOTH, crocus	SOLVENT, dry cleaning
CLOTH, wiping, cotton	SPONGES, cellulose
NEEDLE, sacking, steel, 4½ in.	TAPE, adhesive, non-hygroscopic, O.D.
OIL, neat's-foot	TWINE, jute
	WASTE, cotton (white or colored)

Section X.

ORGANIZATIONAL SPARE PARTS, TOOLS, AND EQUIPMENT

32. Organizational Spare Parts, Tools, and Equipment

a. SPARE PARTS. A set of organizational spare parts is supplied to the using arm for field replacement of those parts most likely to become worn, broken, or otherwise unserviceable.

b. TOOLS AND EQUIPMENT. A set of organizational tools and

equipment is supplied to the using arm for maintaining and using the matériel. This set contains items required for disassembly, assembly, cleaning, and preserving of the 8-inch howitzer matériel. Tools and equipment should not be used for purposes other than prescribed and, when not in use, should be properly stored in the chest and/or roll provided for them.

c. LIST OF SPARE PARTS, TOOLS, AND EQUIPMENT. Spare parts, tools, and equipment supplied for the 8-inch howitzer matériel are listed in WD Supply Catalogs ORD 7 SNL D-29 (for towed artillery) and ORD 7 SNL G-232 (for the 8-inch howitzer motor carriage M43) which are the authorities for requisitioning replacements.

33. Specially Designed Tools and Equipment

a. TOOLS AND EQUIPMENT. Certain tools and equipment listed in WD Supply Catalogs ORD 7 SNL D-29 and ORD 7 SNL G-232 are specially designed for maintenance, repair, and general use with the 8-inch howitzer matériel. These tools and equipment are listed below for information only. This list is not to be used for requisitioning replacements.

Item	Identifying number	References		Use ^a
		Fig	Par.	
<i>FOR HOWITZER, 8-IN., M2</i>				
BELT, primer, M8	D7225490	34		
BRUSH, bore, 8-in., M14	C73715	34	33 b	Cleaning and oiling bore of howitzer.
COVER, bore brush	C76919	34		
COVER, breech, M210	D6047	34		
COVER, muzzle, M328	C7225033			
FORM, govt., War Dept., Artillery Gun Book, 0.0 No. 5825 (blank)	28-F-67990	1		
GAGE, headspace (firing mechanism M1)	41-G-200-700	35		
HEAD, rammer, loading	B108585	34	33 c	To ram projectile home when loading.
LANYARD, firing, 6 ft., M12	B6780	34		To fire howitzer.
RAMP, loading (for use for Mount M17)		36		
R E A M E R, carb-S., hand, primer seat cleaning, spiral flute, w/wood handle, diam. small end 0.321 in., diam. large end 1.362 in., length overall 7 in.	41-R-501-80	35		To ream primer seat in obturator spindle plug.

* Where the use of an item is not indicated, the nomenclature is self-explanatory.

Item	Identifying number	References		Use*
		Fig.	Par.	
SIGHT, bore, breech	41-S-3640- 140	34	109	} To bore sight howitzer.
SIGHT, bore muzzle	41-S-3646- 340	34	109	
STAFF-SECTION (alumi- num, 46½ in. long) or	C7157648			
STAFF-SECTION (wood, 46½ in. long) (to be issued in lieu of Staff-Section C7157648 until present stock is exhausted)	C55199	34		Used with bore brush, ram- mer, and ram- mer head.
TARGET, testing, size 40 x 30 in.	C77511	113	109	Used with bore sights to bore sight weapon.
TOOL, cleaning vent, drill bit type, diam. of bit 0.206 in. . .	41-T-3081- 120	35		To clean obtu- rator spindle vent.
TRAY, loading, M2 (for use with Carriage M1)	D46204	36		
WRENCH, crankshaft nut. . .	41-W-3736- 150	35		
WRENCH, fuze, M7A1, carb- S. (to be issued in lieu of Wrench 41-W-1496-135 until supply is exhausted)	41-W-1596- 50	35		To change and tighten fuze; to set fuze to "Delay" or "Superquick."
WRENCH, fuze, M16 (T5) ..	41-W-1496- 115	35		
WRENCH, fuze, M18 (T12E1)	41-W-1496- 135	35		
WRENCH, firing mechanism.	41-W-3248- 251	35		
<i>FOR CARRIAGE, HOWIT- ZER, 8-IN., M1</i>				
CHEST, oil pump, wood, steel reinforced, w/contents	41-C-738-540			To fill recoil system.
(Consisting of:				
1 ADAPTER, S., plug oil filling, recoil mecha- nism, hex-hd., ¼ in., length overall 1-11/16 in., 16 mm-1.5 pitch, S. 1.3 male thread, ⅛-27NPT female thread	41-A-26-500	38		

* Where the use of an item is not indicated, the nomenclature is self-explanatory.

Item	Identifying number	References		Use*
		Fig.	Par.	
1 ADAPTER, S., plug, oil filling, recoil mechanism, hex-hd., $\frac{3}{4}$ in., length overall $1\frac{5}{8}$ in., $\frac{5}{8}$ -18NF-3 male thread, $\frac{1}{8}$ -27NPT female thread	41-A-26-510			
1 CAP, oil filler gun, thread 16 mm-1.5 pitch PX-3	41-C-395-625	38		For Adapter 41-A-26-500.
1 CAP, oil filler gun, $\frac{5}{8}$ -18NF-3 female thread	41-C-395-650			For Adapter 41-A-26-510.
1 CHEST, oil pump, wood, steel reinforced, w/o contents, M16 ..	41-C-738-550	38		
1 FUNNEL, copper, w/o strainer, cap. $\frac{1}{4}$ pt...	41-F-3580	38		
1 HOSE, oil, non-metallic, high temperature resisting, length 10 ft., complete w/couplings	33-H-535	38		
1 PUMP, hydraulic, oil..	11-P-576-300	38		
1 RULE, S., flexible, length 30 cm (grad. mm and 64ths)	41-R-2909	38		
1 WRENCH, engrs., angle 15 deg., dble-end., alloy-S., size of opngs. $\frac{3}{4}$ and $1\frac{3}{16}$ in.)	41-W-1012	38		
CHEST, tool, empty, metal, inside height $11\frac{1}{16}$ in., inside length $13\frac{1}{4}$ in., inside width $28\frac{3}{8}$ in.	41-C-857-335	37		
COVER, bogie lifting screw, M507	D33759	37		
COVER, canvas, over-all, M101A1	D7120197	2		
COVER, elevating brake cam, M514	C76352	37		
COVER, quadrant and telescope mount, M400	C66917			
GAGE, pressure, metal case, hydraulic, master assembly, size of dial $4\frac{1}{2}$ in., pressure 200 kg. (2,844 lb.) (grad. in lb. per sq. in. and kg. per sq. cm.)	45-G-285	39		

* Where the use of an item is not indicated, the nomenclature is self-explanatory.

Item	Identifying number	References		Use*
		Fig.	Par.	
HANDLE, wheel bearing adj. and wheel stud nut wrench, diam. $\frac{3}{4}$ in., length 20 in.	41-H-1541	43		Used with Wrenches 41-W-3727-43 and 41-W-2612-25.
HOIST, chain, rtc. lever type, cap. 1 $\frac{1}{2}$ -ton sgle. chain, convertible to 3-ton dble. chain	41-H-2115	42		
HOSE, tire inflating, complete w/sgle. foot chuck and air brake coupling, I.D. $\frac{1}{4}$ in., length 25 ft.	33-H-986	40		
LIGHT-SYSTEM, blackout, 6-8 v., 40 ft. cable, complete	C90891	41		Placed around muzzle of howitzer when traveling.
LOCK, bogie lifting screws . .	41-L-1610-35	43		To prevent the bogie lifting screws from turning during travel.
MANUAL, technical, 9-335 . .	TM 9-335			
ORDER, lubr., War Dept., LO 9-335	WDLO 9-335	48, 49	34	
RELEASE, filling and drain valve	45-R-3649	39		
RELEASE, filling and drain valve	45-R-3650	38		
ROLL, tool, canvas, empty, M4, size 26 x 30 in.	41-R-2705-5	43		
TUBE, air filling, complete . .	45-T-11442	39		Used when charging equilibrators.
TUBE, air filling, cop., flexible, complete w/couplings . .	45-T-11442-30	39		Used when charging equilibrators.
WRENCH, rtc., rvrs., hex. offset, size of opng. 3 $\frac{3}{4}$ in., length overall 63 in.	41-W-1989-600	42		To turn bogie lifting screws.
WRENCH, telescope, panoramic	41-W-3829	43		To adjust panoramic telescope indexes.
WRENCH, tubular, dble. end, hex., size of opngs. 3-1/16 and 3-3/16 in., length 9 in.	41-W-3727-43	43		
WRENCH, wheel bearing nut, dble-end., tubular, oct., size of opngs. 3-5/16 and 3 $\frac{7}{8}$ in., length 3 $\frac{7}{8}$ in.	41-W-2612-25	43		

* Where the use of an item is not indicated, the nomenclature is self-explanatory.

Item	Identifying number	References		Use*
		Fig.	Par.	
FOR MOUNT, HOWITZER, 8-IN., M17 (T20)				
CHEST, oil pump, wood, steel reinforced, w/contents	41-C-738-540			To fill recoil system.
(Consisting of:				
1 ADAPTER, S., plug, oil filling, recoil mechanism, hex-hd., $\frac{3}{4}$ in., length overall 1-11/16 in., 16 mm-1.5 pitch, S. 1.3 male thread, $\frac{1}{8}$ -27NPT female thread	41-A-26-500	38		
1 ADAPTER, S., plug, oil filling, recoil mechanism, hex-hd., $\frac{3}{4}$ in., length overall 1 $\frac{5}{8}$ in., $\frac{3}{8}$ -18NF-3 male thread, $\frac{1}{8}$ -27NPT female thread	41-A-26-510			
1 CAP, oil filler gun, thread 16 mm-1.5 pitch PX-3	41-C-395-625	38		For Adapter 41-A-26-500.
1 CAP, oil filler gun, $\frac{3}{8}$ -18NF-3 female thread	41-C-395-650			For Adapter 41-A-26-510.
1 CHEST, oil pump, wood, steel reinforced w/o contents, M16	41-C-738-550	38		
1 FUNNEL, copper, w/o strainer, cap. $\frac{1}{4}$ pt.	41-F-3580	38		
1 HOSE, oil, non-metallic, high temperature resisting, length 10 ft., complete w/coupling.	33-H-535	38		
1 PUMP, hydraulic, oil..	11-P-576-300	38		
1 R U L E, S., flexible, length 30 cm (grad. mm and 64ths)	41-R-2909	38		
1 W R E N C H, engrs., angle 15 deg., dble-end., alloy-S., size of opngs. $\frac{3}{4}$ and 13/16 in.)	41-W-1012	38		
COVER, elevating brake cam, M514	C76352	37		
COVER, quadrant and telescope mount, M400	C66917			

* Where the use of an item is not indicated, the nomenclature is self-explanatory.

Item	Identifying number	References		Use*
		Fig.	Par.	
GAGE, pressure, metal case, hydraulic, master assembly, size of dial 4½ in., pressure 200 kg. (2,844 lb.) (grad. in lb. per sq. in. and kg. per sq. cm.)	45-G-285	39		
RELEASE, filling and drain valve	45-R-3649	39		
RELEASE, filling and drain valve	45-R-3650	38		
ROLL, tool, canvas, empty, M4, size 26 x 30 in.	41-R-2705-5	43		
TUBE, air filling, complete..	45-T-11442	39		Used when charging equilibrators.
TUBE, air filling, cop., flexible, complete w/couplings..	45-T-11442-30	39		Used when charging equilibrators.
WRENCH, telescope, panoramic	41-W-3829	43		To adjust panoramic telescope indexes.
<i>FOR LIMBER, CARRIAGE HEAVY, M5</i>				
WRENCH, tubular, dble-end., hex., size of opngs. 3-1/16 and 3-3/16 in., length 9 in.	41-W-3727-43	43		For trail clamping bracket nut A7104681. For nuts A7104-606 on lunette and on limber pintle spindle.
<i>MISCELLANEOUS EQUIPMENT (T/O & E)</i>				
FRAME, amm., M18 (8 projectiles)	D39142	44		
FRAME, amm., M20 (10 projectiles)	D41050	45		

* Where the use of an item is not indicated, the nomenclature is self-explanatory.

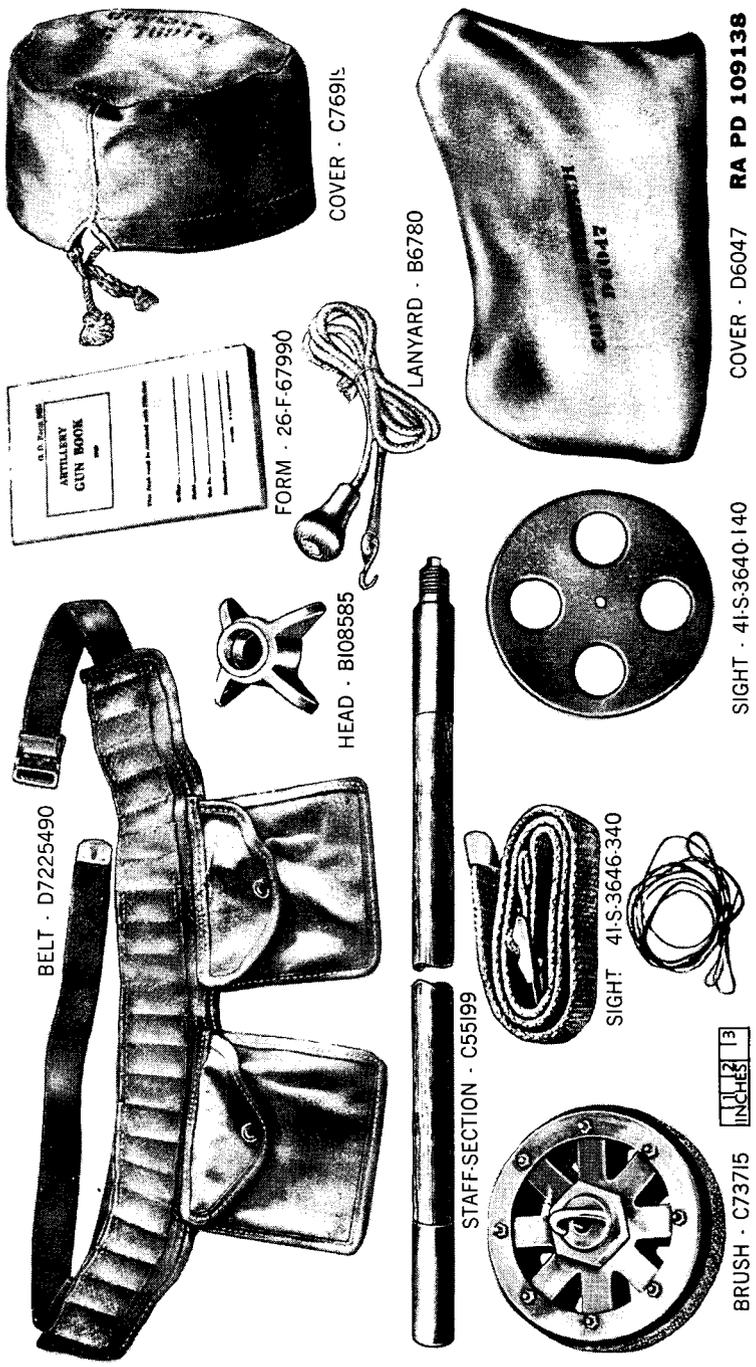


Figure 34. Equipment for howitzer.

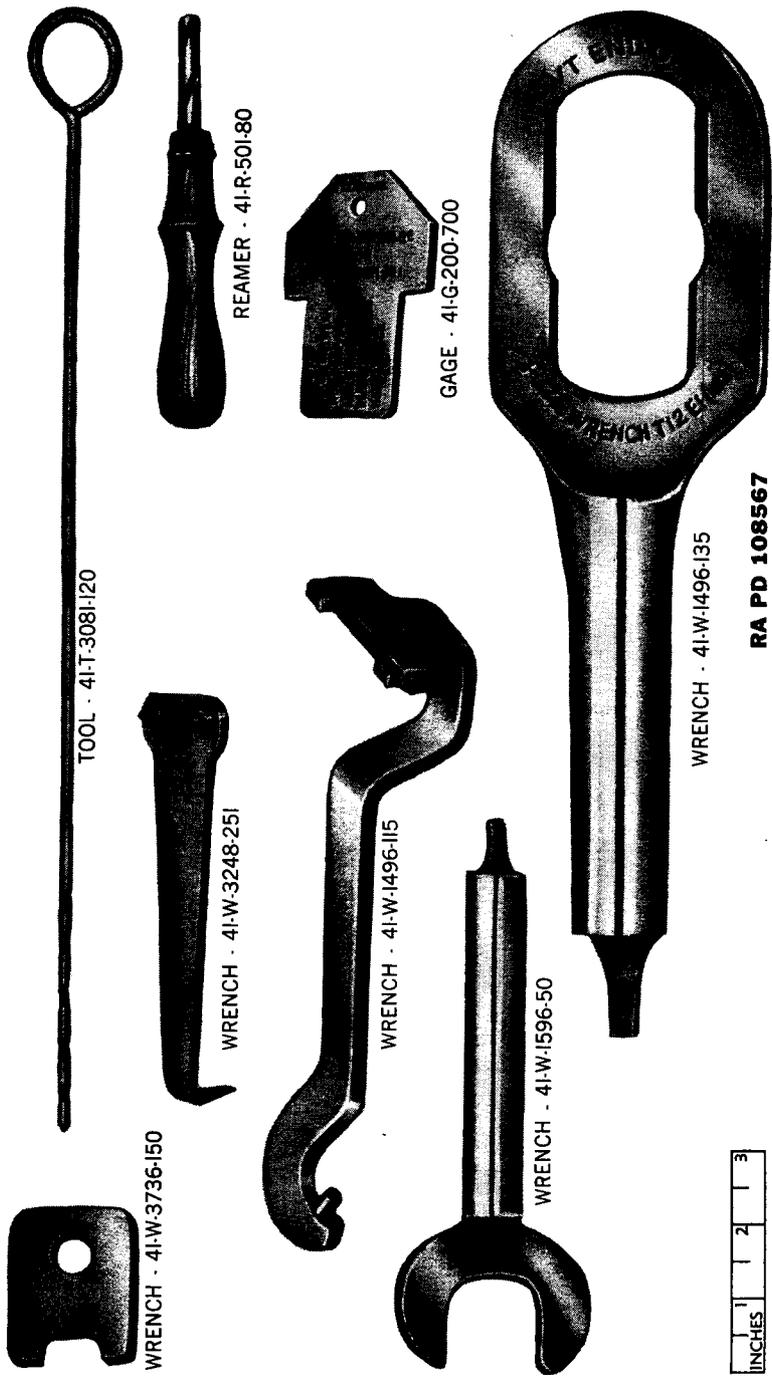


Figure 35. Tools for howitzer.

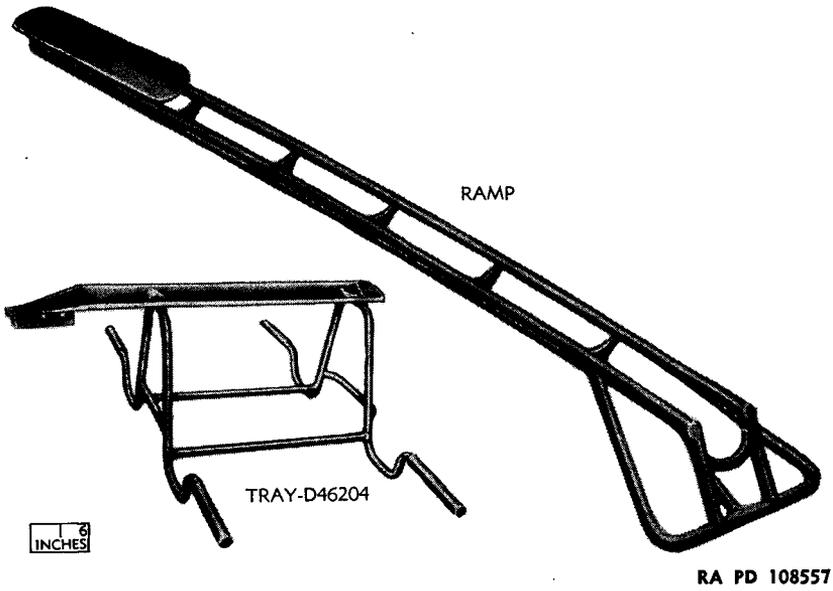


Figure 36. Equipment for howitzer.

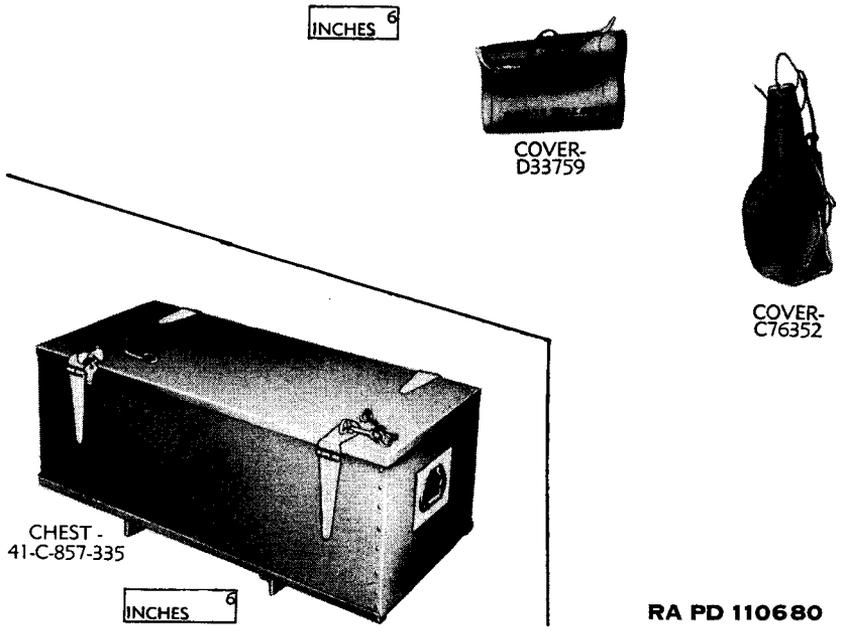


Figure 37. Equipment for carriage.

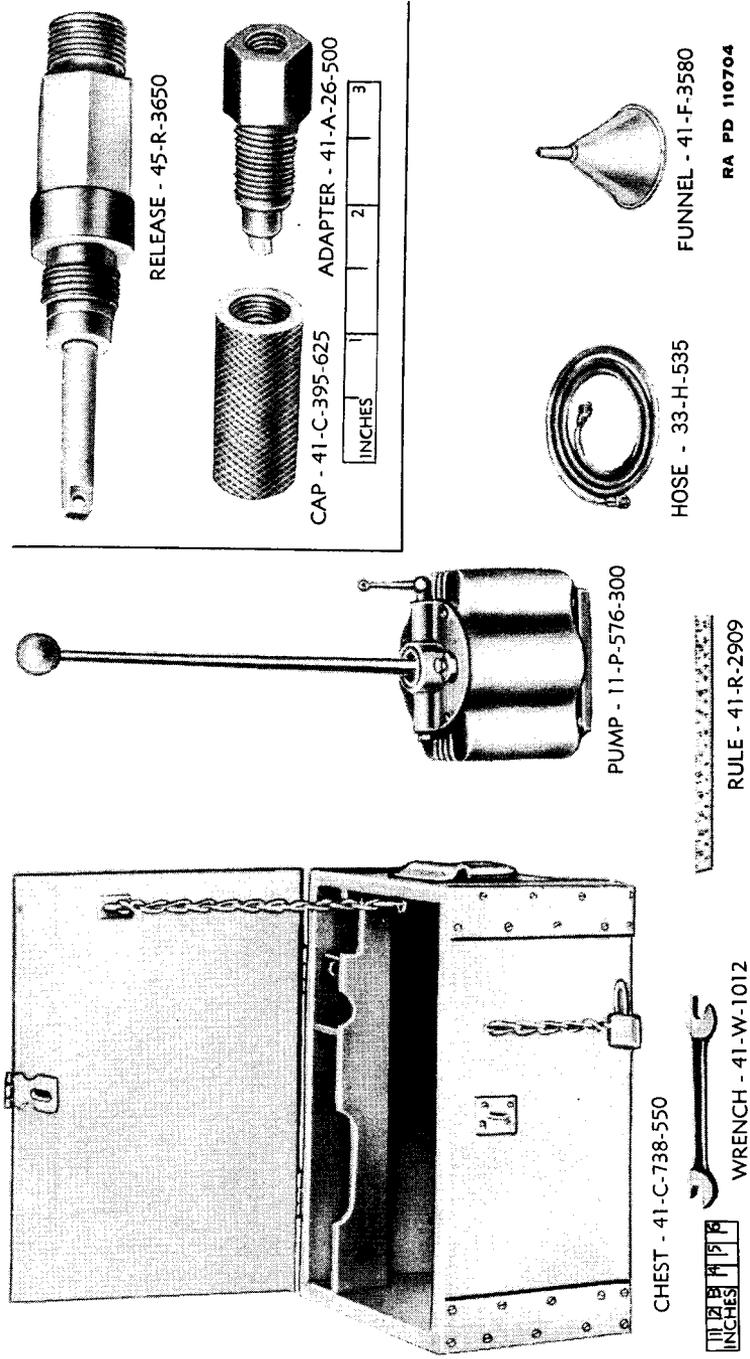


Figure 38. Equipment for carriage and mount.

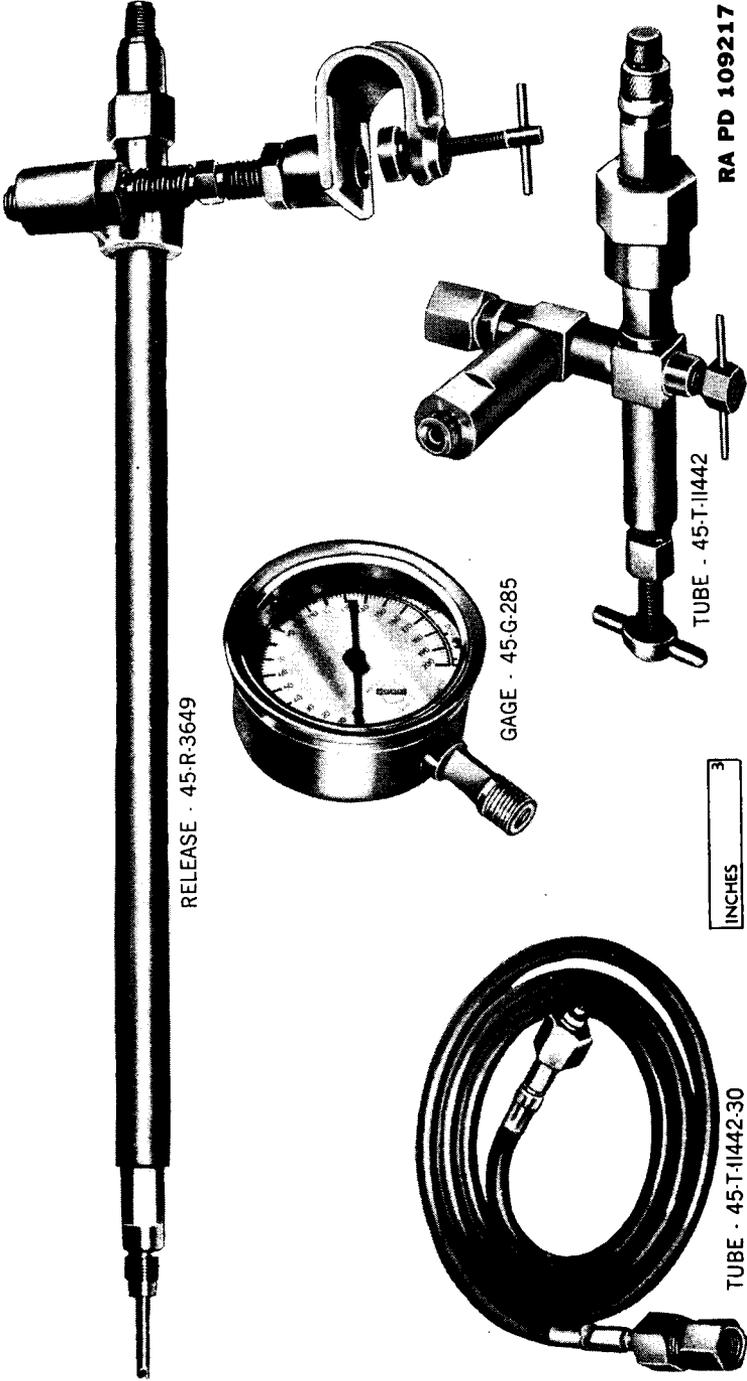


Figure 39. Equipment for carriage and mount.

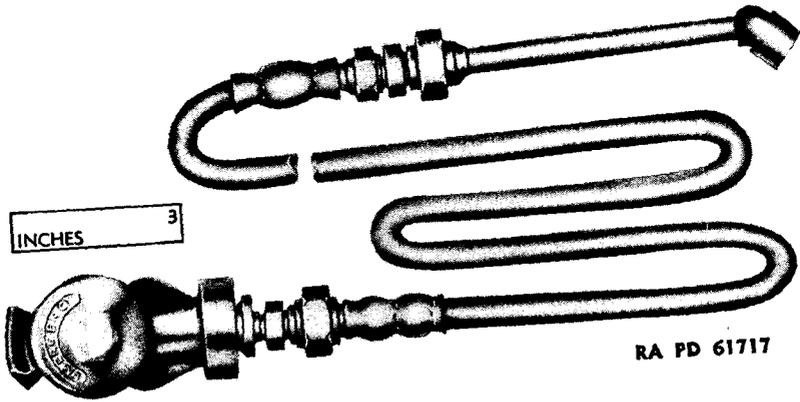


Figure 40. Equipment for carriage (tire inflating hose 33-H-986).

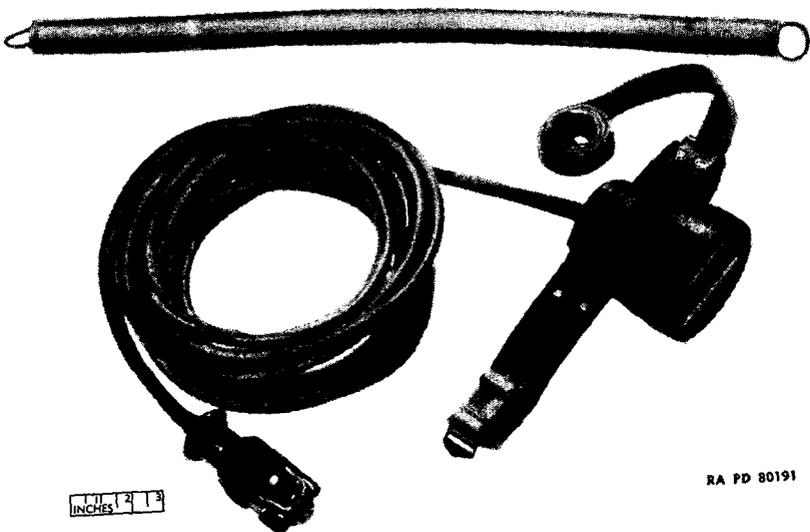
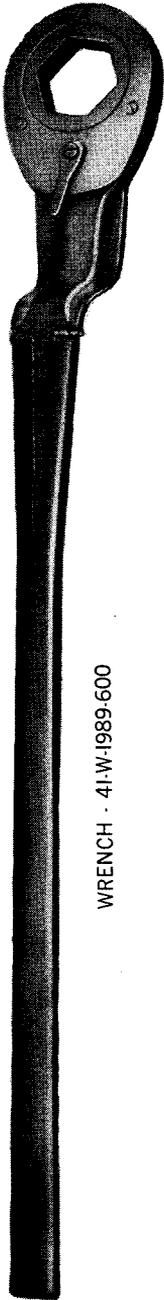
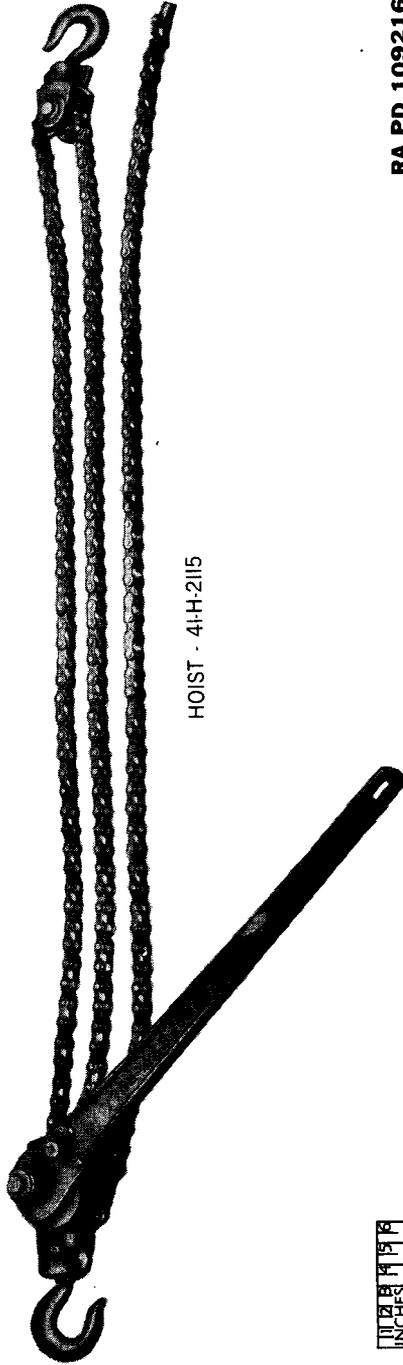


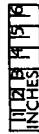
Figure 41. Equipment for carriage (light system C90891).



WRENCH · 4I-W-1989-600



HOIST · 4I-H-2115



RA PD 109216

Figure 42. Equipment for carriage.

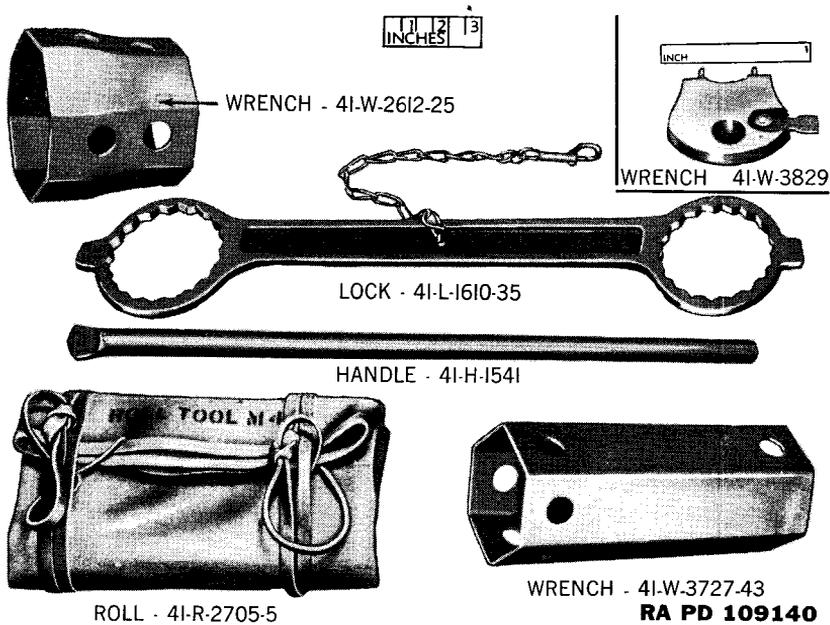


Figure 43. Equipment for carriage.

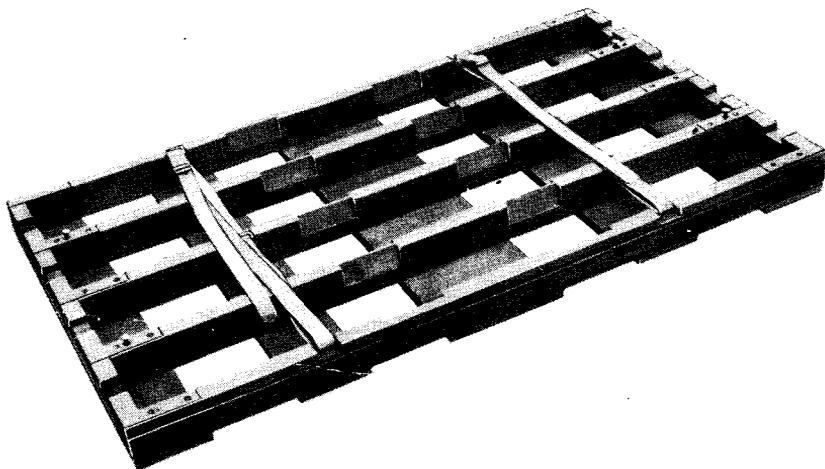
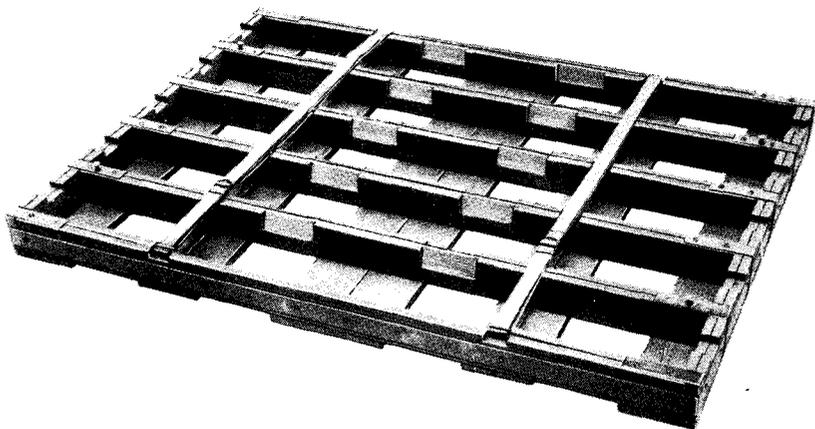


Figure 44. Ammunition frame M18.

RA PD 73822



RA PD 73825

Figure 45. Ammunition frame M20.

b. MODIFICATION OF BORE BRUSH M14. The cleaning characteristics and length of service of bore brush M14 can be improved by slight modification.

(1) Remove the nuts and lock washers from the front face of bore brush and, holding ring from brush body, remove brush insert.

(2) Separate the coils of the brush and, using a tinsmith's shears, trim the bristles off level with the channel on two full coils, one on each side of the middle coil, as shown in figure 46.

(3) Steel channel grip for bristles must not be cut or modified.

(4) Reassemble the parts in the reverse order of disassembly.

c. MODIFICATION OF LOADING RAMMER HEAD. (1) Due to the shortage of bronze, some of the loading rammers B108585 were made of malleable iron. This metal, being harder than bronze, scratches and otherwise damages the chamber, breech thread, and breech face of the howitzer. To eliminate or minimize this trouble, the loading rammer should be modified as indicated in figure 47. This modification consists of welding bronze on the four arms in such manner that the iron will not come in contact with the howitzer. After this welding process, the bronze should be machined, ground, or filed to give a smooth surface.

(2) This modification will be done by ordnance personnel.

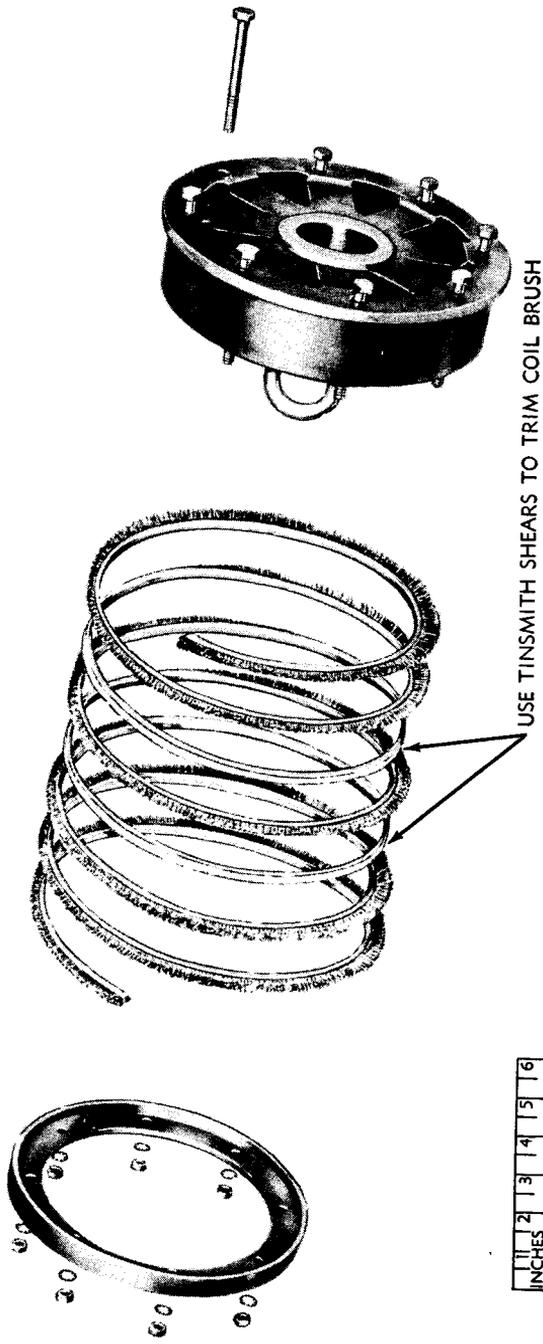


Figure 46. Modification of bore brush M14.

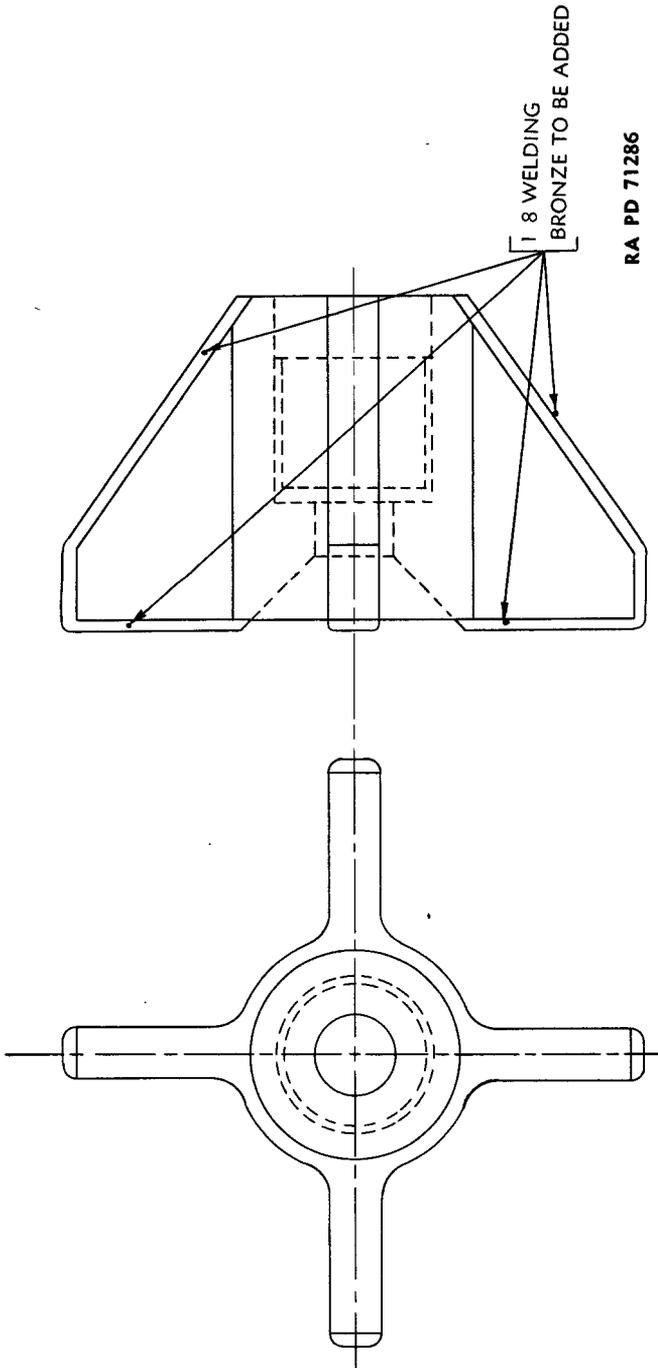


Figure 47. Modification of loading rammer head B108585.

Section XI. LUBRICATION

34. Lubrication Order

a. Reproduction of War Department Lubrication Order LO 9-335 (figs. 48 and 49) prescribes organizational (first- and second-echelon) lubrication maintenance. WDLO 9-747 which prescribes the lubrication of weapon mounted on the howitzer motor carriage M43 is not illustrated, as the lubrication of the weapon is the same as in WDLO 9-335.

LO 9-335

WAR DEPARTMENT LUBRICATION ORDER 1 Aug 1946 (Supersedes 18 Feb 1945)

**HOWITZER, 8-in., M2;
CARRIAGE, 8-in., M1;
LIMBER, CARRIAGE, HEAVY, M5.**

References: TM 9-335, ORD 7 SNL D-29

Intervals are minimum maintenance to be performed by using organization. Reduce to compatible for severe operating conditions. Clean fittings before lubricating. Relubricate after washing, loading or exposure to moisture. Clean parts with CLEANER, rifle bore. Dry before lubricating.

<p>12 Variable Recoil Control Mechanism Housing Bring howitzer to 0° elevation</p> <p>8 Variable Turning Rod, Exposed Surface Clean and oil</p> <p>Recoil Cylinder Replenisher Fill and Drain</p> <p>9 Variable Turning Rod, Bracket</p> <p>Recoil Mechanism Replenisher Opening Check weekly and before firing</p>	<p>Lubricant + Interval</p> <p>CG M</p> <p>PL W</p> <p>RS</p> <p>CG W</p> <p>W</p>		<p>W PL Howitzer Bore Wash clean before firing. See Note 3.</p> <p>W PL Exposed Recoil Slide Wash and before firing clean and oil both sides</p> <p>W PL Cradle Guide Both sides, 2 of tops</p> <p>W PL Equilibrator Case and Plunger Both sides. See Note 2</p> <p>W PL Equilibrator Exposed Finished Surface Freshen Surface. Clean and oil</p> <p>W CG Cradle Slide Both sides (6 fittings)</p> <p>W PL Equilibrator Temperature Guide Slides Both sides</p> <p>W PL Equilibrator Temperature Adjusting Screw Clean and oil. Both sides</p> <p>RS Recuperator Cylinder Reserve Oil Filling Valve</p> <p>W Recuperator Cylinder Oil Index Check weekly and before firing</p> <p>W PL Breech Hinge Pin</p> <p>W PL Breech Cranks shaft Bearing</p> <p>W PL Breech and Firing Mechanism See Note 1</p> <p>W PL Obturator Spindle</p>
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—NOTES—

1. BREECH AND FIRING MECHANISM
After firing and on 3 consecutive days thereafter, disassemble the gas check pad from the obturator spindle. Clean all parts except the gas check pad with CLEANER, rifle bore, wipe dry and oil. Wipe the gas check pad with a dry cloth (do not oil or clean with CLEANER, rifle bore or bore cleaning solutions).

2. EQUILIBRATOR CASE AND PLUNGER
With howitzer at 0° elevation, unscrew cover from front of equalizer and slide to rear. Wipe moisture from all surfaces and apply a thin film of lubricant to all exposed parts including outer surface of both plunger and case.

3. HOWITZER BORE
After firing and on 3 consecutive days thereafter, clean with CLEANER, rifle bore. After 4th cleaning wipe dry and oil if the howitzer will not be fired within the next 24 hours. Weekly clean with CLEANER, rifle bore wipe dry and reed.

—KEY—

LUBRICANTS	EXPECTED TEMPERATURES			INTERVALS
	above +32° F. ; +32° F. to 0° F. ; below 0° F.			
	PL—Medium	PL—Medium	PL—Special	
	CG—1	CG—0	CG—0	W—Weekly
PL—OIL, lubricating, preservative				M—Monthly
CG—GREASE, general purpose				3M—3 Months
WB—GREASE, general purpose, No. 2—all temperatures				S—6 Months
RS—OIL, recoil, special—all temperatures				

RA PD 110950

Figure 48. Lubrication order LO 9-335—front.

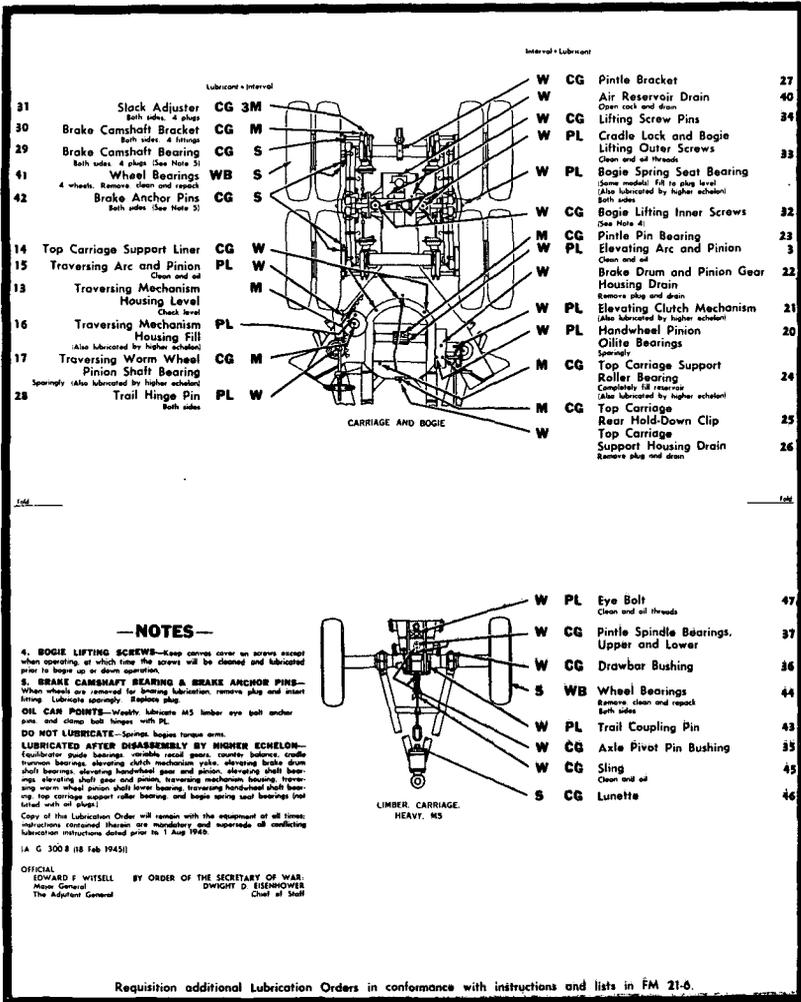
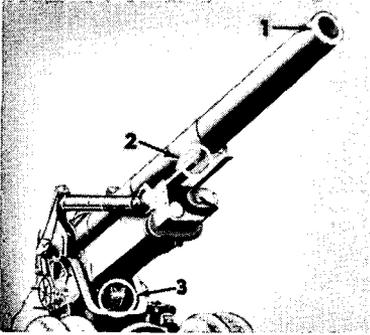
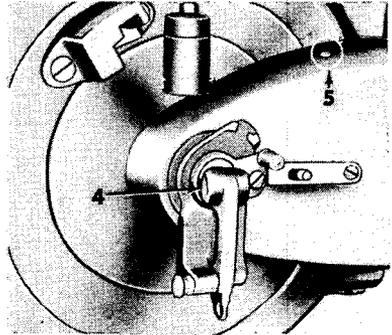


Figure 49. Lubrication order LO 9-335—back.

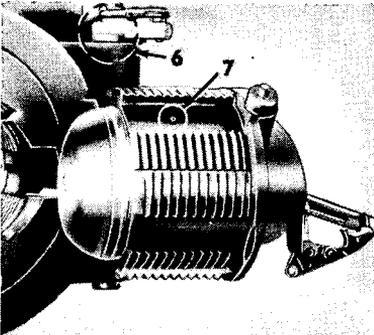
b. The points of application indicated on the Lubrication Order are illustrated in figures 50 to 54 showing their location on the matériel. The fittings shown in the figures may be identified on the order by the key numbers around the border.



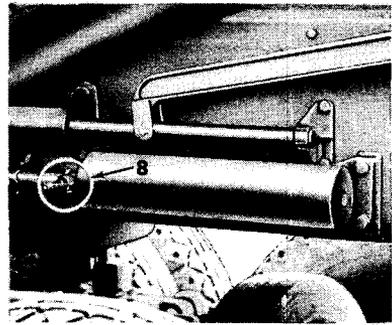
1 — HOWITZER BORE
 2 — EXPOSED RECOIL SLIDE
 3 — ELEVATING ARC AND PINION



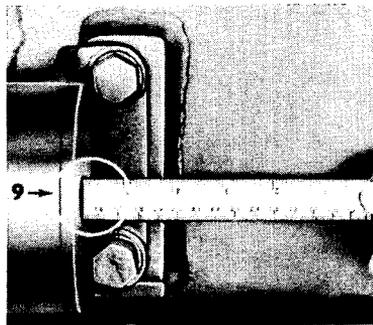
4 — BREECH AND FIRING MECHANISM
 5 — BREECH CAMSHAFT BEARING



6 — BREECH HINGE PIN
 7 — OBTURATOR SPINDLE



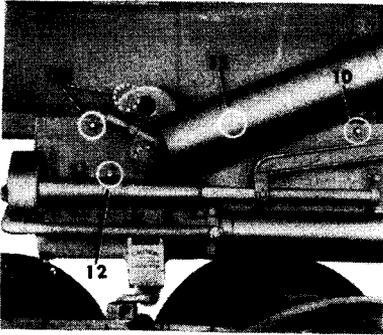
8 — RECOIL MECHANISM REPLENISHER FILL AND DRAIN



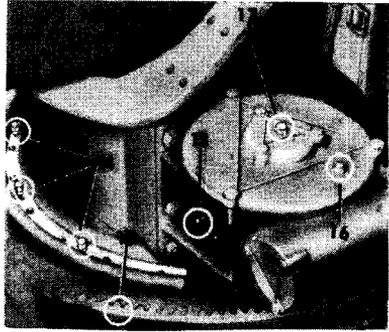
9 — RECOIL MECHANISM REPLENISHER LEVEL OPENING

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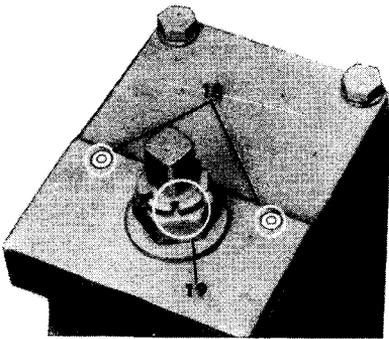
Figure 50. Lubricating points.



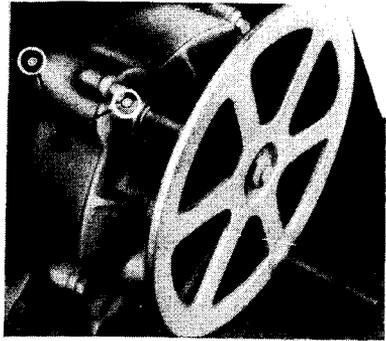
- 10 — RECOIL SLIDE
- 11 — EQUILBRATOR CASE AND PLUNGER
- 12 — VARIABLE RECOIL CONTROL SHAFT



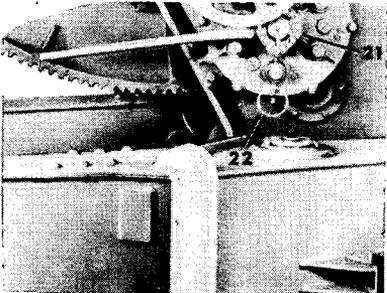
- 13 — TRAVERSING MECHANISM HOUSING LEVEL
- 14 — TOP CARRIAGE SUPPORT LINER
- 15 — TRAVERSING ARC AND PINION
- 16 — TRAVERSING MECHANISM HOUSING FILL
- 17 — TRAVERSING WORM WHEEL PINION SHAFT BEARING



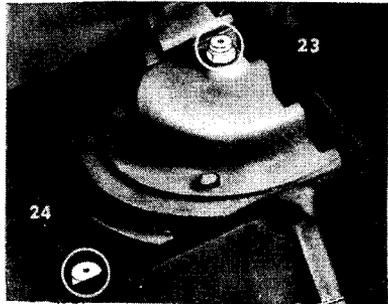
- 18 — EQUILBRATOR GUIDE SLIDES
- 19 — EQUILBRATOR GUIDE ADJUSTING SCREW



- 20 — HANDWHEEL PINION BEARINGS



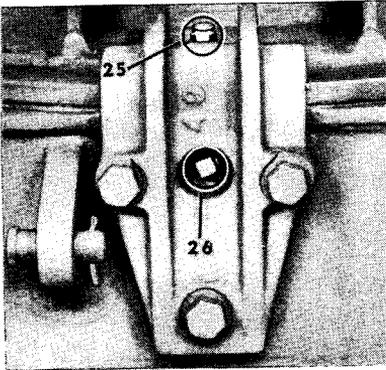
- 21 — ELEVATING CLUTCH MECHANISM
- 22 — BRAKE DRUM AND PINION GEAR HOUSING DRAIN



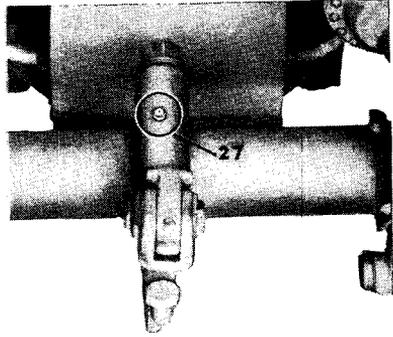
- 23 — PINTLE PIN BEARING
- 24 — TOP CARRIAGE SUPPORT ROLLER BEARING

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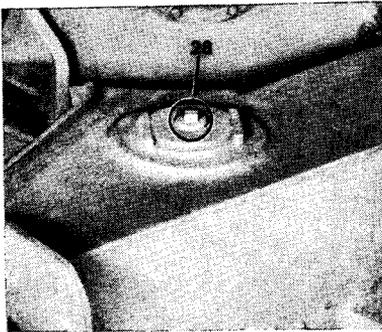
Figure 51. Lubricating points.



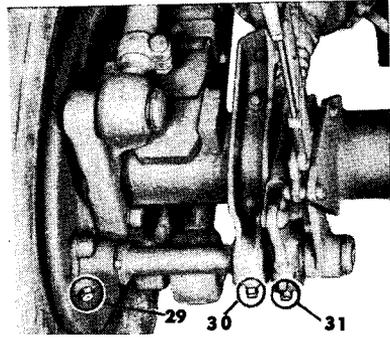
25 — TOP CARRIAGE REAR HOLD-DOWN CLIP
26 — TOP CARRIAGE SUPPORT HOUSING DRAIN



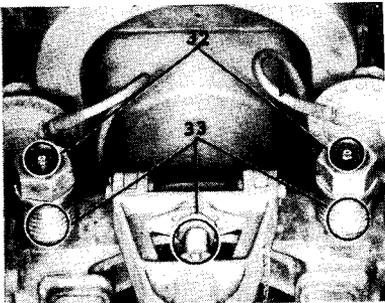
27 — PINTLE BRACKET



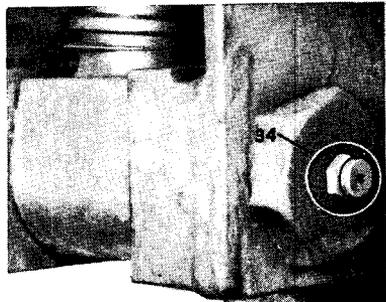
28 — TRAIL HINGE PIN



29 — BRAKE CAMSHAFT BEARING
30 — BRAKE CAMSHAFT BRACKET
31 — SLACK ADJUSTER



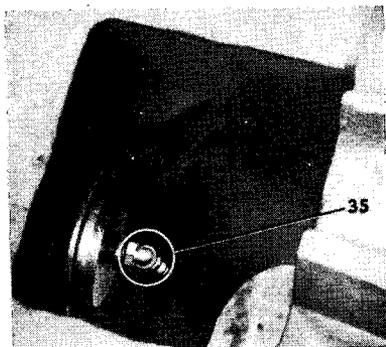
32 — BOGIE LIFTING INNER SCREWS
33 — CRADLE LOCK AND BOGIE LIFTING OUTER SCREWS



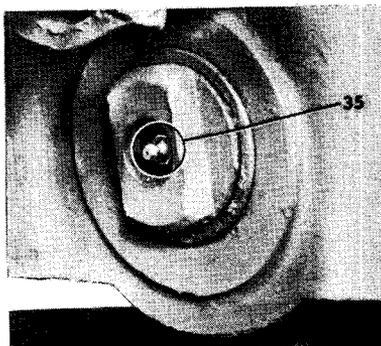
34 — LIFTING SCREW PINS

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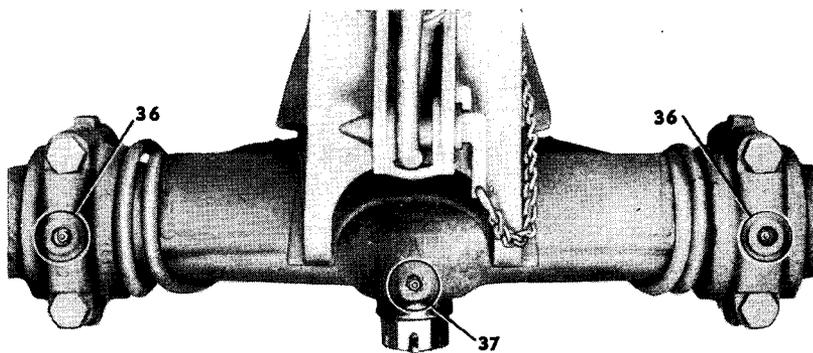
Figure 52. Lubricating points.



35 — ROCKER PIN BUSHING



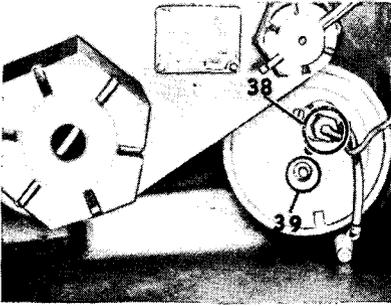
35 — ROCKER PIN BUSHING



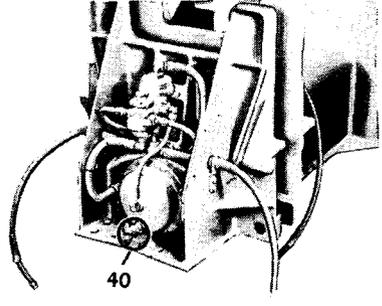
36 — DRAWBAR BEARING
37 — SPINDLE BEARINGS, UPPER AND LOWER

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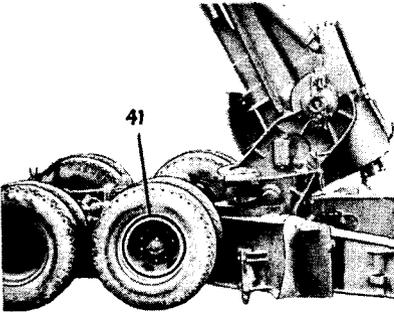
Figure 53. Lubricating points.



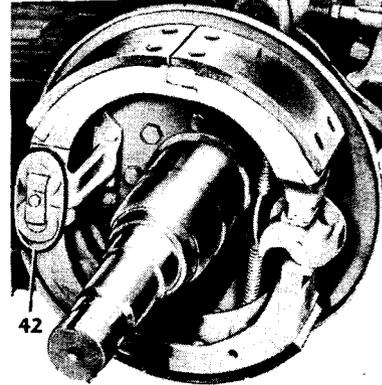
38 — RECUPERATOR CYLINDER
RESERVE OIL FILLING VALVE
39 — RECUPERATOR CYLINDER OIL
INDEX



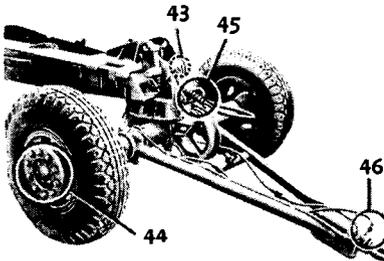
40 — AIR RESERVOIR DRAIN



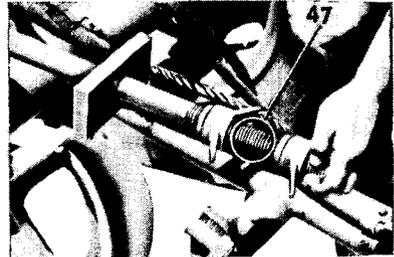
41 — WHEEL BEARINGS



42 — BRAKE ANCHOR PINS



43 — YOKE BLOCK PIN
44 — WHEEL BEARINGS
45 — SLING
46 — LUNETTE



47 — EYE BOLT

RA PD 107710

Figure 54. Lubricating points.

c. A War Department Lubrication Order is placed on, or is issued with, each item of matériel, and is to be carried with it at all times. In the event the matériel is received without an order, a replacement should be immediately requisitioned (see lists in FM 21-6).

35. General Lubrication Instructions

a. TEMPERATURE RANGES. Lubricants are prescribed in the "KEY" on the Lubrication Order in accordance with three temperature ranges: "above + 32° F.," "from + 32° F. to 0° F.," and "below 0° F." The time to change to lubricants prescribed for a different range is determined by maintaining a close check on operation of the matériel during the approach to prolonged periods when temperatures will be consistently higher or lower. Because of the time element involved in preparing for operation at lower prevailing temperatures, a change to lubricants prescribed for the next lower range will be undertaken the moment operation becomes sluggish. Ordinarily, it will be necessary to change lubricants *only when expected air temperatures will be consistently in the next higher or lower range.*

b. INTERVALS. Service intervals specified are based on normal operating conditions and continuous use of the matériel with frequent firing. Reduce these intervals under extreme conditions such as excessively high air temperatures, prolonged periods of traveling or firing, operation in sand or dust, immersion in water, or exposure to moisture. Any one of these conditions may quickly destroy the protective qualities of the lubricant, and require servicing in order to prevent malfunctioning or damage to the matériel.

c. LUBRICATING EQUIPMENT. (1) Clean lubricating equipment both before and after use. Operate lubricating guns carefully and in such manner as to insure proper distribution of the lubricant. If lubricating fitting valves stick and prevent the entrance of lubricant, remove the fitting and determine and eliminate the cause. Replace broken or damaged lubricators. If lubricator cannot be replaced immediately, cover hole with tape, as a temporary expedient to prevent the entrance of dirt. If oil lines become clogged, disassemble the lines and remove the obstruction.

(2) Lubricating fittings, grease cups, oilers, oilholes, and fill, level, and drain plugs are marked with a red circle $\frac{3}{4}$ inch in diameter, for ready identification. Do not paint fittings. Exceptions are the recoil mechanism filler plugs, which are painted green when the mechanisms are filled with recoil oil (special).

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

d. CLEANING. (1) Use rifle bore cleaner to clean or wash all

metal parts, whenever partial or total disassembly is undertaken, or when renewing the protective lubricant film on exposed metal surfaces. Use of gasoline for cleaning is prohibited. Dry all parts thoroughly before lubricating. Flushing of gear cases and bearing housings will not be undertaken by the using arm.

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

e. **METHODS OF LUBRICATION.** Methods of lubrication are outlined in the respective maintenance paragraphs of each major unit or assembly. Lubricants, quantities, and intervals will be found on War Department Lubrication Order 9-335.

36. Lubrication under Severe Conditions

a. **SUBZERO TEMPERATURES.** (1) *General.* Operation at below 0° F. presents problems that demand special precautions and careful servicing to prevent malfunction or mechanical failure. Cleanliness is imperative and all assemblies and mechanisms will be disassembled to the extent necessary to remove all old lubricants, rust, dirt, and other foreign matter. Ordnance maintenance personnel will disassemble, clean, and lubricate those assemblies which the using arm is not authorized to disassemble.

(2) *Lubrication of surfaces.* Surfaces lubricated manually at prescribed intervals with oil or grease will receive only a very thin film of lubricant. Excessive oil or grease on such parts will thicken and cause sluggish action at extremely low temperatures.

(3) *Cradle and howitzer slides.* The cradle and howitzer slides should be cleaned thoroughly of all summer lubricant and surfaces stoned smooth. Relubricate as indicated on lubrication order (figs. 48 and 49).

(4) *Breech assemblies.* (a) Lubricate in accordance with instructions in WDLO 9-335.

(b) During temporary inactive periods, in cold weather, an excessive amount of oil is not necessary, for less preservative is needed for protection against corrosion than in warmer weather. A thorough coating of oil while disassembled as in step (a) above, will protect for an indefinite period of time, depending upon weather conditions and the amount of exposure of the breech mechanism.

(5) *Equilibrators.* Lubricate as prescribed in the lubrication order (figs. 48 and 49).

(6) *Gear trains.* (a) Gear trains on the top carriage will be the most critical problem of lubrication during subzero operation.

Winterization must be done by ordnance units, as complete disassembly is required. The lubrication orders should be consulted for lubricant to be used. When gear trains are winterized, only the gears and bearings should be coated; additional lubrication must be sparing. Overlubrication will result in increasing hand-wheel effort to the point where operation will be hindered.

(b) Extreme care should always be utilized when lubricating the gear trains of the elevating and traversing mechanisms. If lubrication instructions are not followed, malfunctions may result which will require complete overhaul by ordnance maintenance personnel.

(7) *Bearing surface of top carriage.* Use a light coating of lubricant, as overlubrication will result in difficult traverse. The lubrication order prescribes the lubricant to be used.

(8) *Elevating and traversing arcs.* (a) The elevating and traversing arcs should be lubricated very sparingly with the lubricant prescribed in the lubrication order.

(b) Intervals must be determined by inspection. Because of the small amount of lubricant used, inspect daily to make sure that all parts have sufficient lubricant. Failure to follow this procedure may result in an unserviceable weapon.

(9) *Wheel bearings.* Packing of wheel bearings must be done with the utmost care. A tendency to overpack them is predominant. This promotes freezing of the wheels and prevents further travel of the weapon. When packing wheel bearings, make sure that they are first thoroughly cleaned with dry cleaning solvent. Dry thoroughly before repacking. Pack by kneading the grease into the rollers, rotating the bearing at the same time. At no time shall any of the old lubricant or any of the dry cleaning solvent be left on the bearings, as this contaminates the new lubricant that is being applied.

Note. Care must be taken not to handle the bearings with the bare hands as the moisture from the skin will corrode the bearings.

(10) *Mechanical brakes.* It is important that proper lubrication be applied to the brake camshaft bearing, and also to the brake anchor pins. When the wheels are removed for bearing lubrication, remove plug and insert fitting. Lubricate sparingly and then replace plug. The lubrication order prescribes the proper lubricant.

Caution: When lubricating the brake parts, keep lubricant away from inside of brake drum or shoes.

b. HIGH TEMPERATURES. (1) Special lubrication servicing will not ordinarily be required as lubricants prescribed for temperatures above 32° F. provide adequate protection at extremely high temperatures. It may be necessary, however, to reduce

service intervals and lubricate more frequently during prolonged periods of firing.

(2) The quantities of oil in the replenisher and counterrecoil systems of the recoil mechanism should be checked as described in paragraph 72*e* and *f*.

c. SEVERE DUST OR SAND CONDITIONS. (1) If considerable dust or sand is present, the traversing and elevating arcs must be cleaned and lubricated at frequent intervals.

(2) Clean thoroughly when firing is over, and then relubricate.

d. HIGH HUMIDITY, MOISTURE, AND SALT AIR CONDITIONS. The bore of the tube, and the breech mechanism, should be kept heavily oiled and should be inspected daily for traces of rust.

Section XII. PREVENTIVE MAINTENANCE SERVICE

37. General

a. Preventive maintenance services prescribed by Army Regulations are a function of using organization echelons of maintenance. This section contains schedules of preventive maintenance service allocated to crew (first-echelon) and to organizational (second-echelon) maintenance.

b. Incidents of wear, breakage, cleaning, and inspection make necessary the occasional disassembly of various parts of the howitzer and carriage. The battery personnel may, in general, do such dismounting as is required for the assembling of battery spare parts and for the maintenance prescribed herein. Any difficulty which cannot be overcome by the prescribed method must be brought to the attention of ordnance maintenance personnel. The battery personnel will not attempt to disassemble any part of the matériel not authorized in this manual.

38. Common Procedures

a. The following general preventive maintenance will be observed in addition to that referred to in the schedules below.

b. Avoid getting dry cleaning solvent or lubricants on tires, rubber hose, or electric wire insulations, as petroleum products are extremely injurious to rubber. Any solvent or lubricant which comes into contact with rubber parts will be removed immediately.

c. Wash rubber parts and equipment with soap solution ($\frac{1}{4}$ pound of soap chips to a gallon of water) or with water alone.

d. The use of tools which do not fit snugly on the parts must be avoided. They will not only fail to tighten the part properly, but will damage the parts being tightened, and there is the danger of rendering them useless.

e. Loose parts will be kept tightened, broken parts replaced, paint kept in good condition, etc.

f. Rust, dirt, grit, gummed oil, and water cause rapid deterioration of internal mechanisms and outer unpainted surfaces. Particular care must be taken to keep all bearing surfaces clean and properly lubricated. Wiping cloths and dry cleaning solvent are furnished for this purpose. Rust is an enemy of iron and steel. All traces of it must be removed from unpainted surfaces with crocus or abrasive cloth.

g. If burs on bearing surfaces of mechanisms cannot be removed with crocus or abrasive cloth, report to ordnance maintenance personnel.

h. Water from a high-pressure hose must not be played on any part of the gun or carriage. Wash with a sponge and water. Carefully dry parts which have become wet during washing, and then oil the parts in the manner prescribed in section XI. Before washing, take off removable sighting equipment from the matériel to be cleaned. In cases where it is not removable, cover the parts properly.

i. Sighting and fire control equipment will not be painted by the using arm.

j. In disassembly, assembly, and inspection, extreme care must be exercised to prevent dust, dirt, and other foreign matter from entering mechanisms of the gun and carriage. Keep the matériel clean. Clean parts such as bearings, slide surfaces, threads, etc., thoroughly, and lubricate before assembling. Never use a steel hammer on any part of the gun or carriage. If a copper, rawhide, or lead hammer is not available, use a block of wood as a buffer.

k. The breech and muzzle covers will be used when the howitzer is not in service. When the howitzer is inactive for a considerable time, prepare for storage as in paragraph 120.

l. Repair without delay any loose grommets or rips in canvas covers; failure to make immediate repairs may allow a minor defect to develop into major damage. To prevent formation of damaging mildew, shake out and air the canvas covers for several hours at frequent intervals. Mildewed canvas is best cleaned by scrubbing with a dry brush. If mildew has been present, examine fabric carefully by stretching and pulling for evidence of rotting or weakening of fabric where mildew has been. If fabric shows indication of loss of tensile strength, it is probably not worth retreatment. Oil and grease can be removed by scrubbing with issue soap and warm water. Rinse well with clean water and dry.

Caution: At no time is gasoline or solvent to be used to remove oil or grease spots from canvas.

For waterproofing of canvas, see TM 9-850.

- m.* Check for lights that are out or flickering. Check entire wiring system for serviceable condition and for tight connections, including jumper cables, coupling sockets, and lamp brackets. See that ground connections are tight and free from corrosion.
- n.* Lettering on name plates and direction plates must be kept legible and will not be painted over.
- o.* See paragraph 2*a* for gun book.

39. Organizational (First-Echelon) Maintenance Schedules

a. WEEKLY SERVICE.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
	Lubricate.	WDLO 9-335.
Gun tube.	Clean gun bore. Note condition of leveling plates.	Par. 56. Par. 60 <i>h</i> . Remove rust from leveling plates with crocus cloth.
Firing mechanism.	Examine the mechanism closely for signs of rust, as the highly finished surfaces of the firing mechanism rust very easily.	Par. 66.
Breech mechanism as a unit.	Note smoothness of operation of the breech mechanism in opening and closing. If the mechanism binds or does not operate smoothly, disassemble, clean, examine the parts for wear or breakage, and replace unserviceable parts. Lubricate and reassemble. If it is still difficult to operate, notify ordnance maintenance personnel.	Par. 58.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
Breechblock.	Examine the breechblock and breech recess for burs, indentations on the threads, rust, pitting, and other evidence of corrosion.	Par. 60d.
Breechblock carrier assembly.	Examine the breechblock carrier assembly, the machined surface on which the breechblock rotates, and hinge pin for roughened or scored condition.	Par. 60e.
Obturator spindle.	Clean the face of the obturator spindle and ream the obturator spindle venthole. Examine obturator spindle for burs. Examine the split rings for burs or cracks. Replace the defective rings.	Par. 60g.
Gas check pad.	Examine gas check pad for bruises or torn covering. Replace defective pad.	Par. 60f.
Counterbalance assembly.	Test the mechanism to see that it functions properly at different degrees of elevation.	If out of adjustment, notify ordnance maintenance personnel.
Recoil and counterrecoil piston rod nuts.	Make certain the recoil and counterrecoil piston rod nuts are fully engaged and fastened with cotter pins.	Par 72a.
Recoil mechanism.	Inspect for leakage at recoil rod and counterrecoil rod stuffing boxes.	Par. 52.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
Recoil slides and guides.	Inspect closely for scores, bruises, or pitting.	
Recoil replenisher piston.	Check position.	Par. 53 and 72e.
Recoil cylinder oil index.	Check position.	Par. 72b and f.
Wipers.	See that the front gun rail wipers and upper and lower rear gun rail wipers are in good condition so that they will prevent dust or sand from entering the slides of the recoil mechanism.	
Variable recoil rod (exposed surfaces).	Clean and oil.	
Elevating clutch mechanism.	Inspect for proper functioning.	Par. 11b and c.
Brake air reservoir.	Drain.	Par. 87e.
Brake air filter.	Drain.	Par. 87b.
Tires.	Check air pressure. Check for cuts and breaks. Check tread for foreign bodies (nails, stones, etc.).	Par. 6 and 84f.
Locating surfaces (as quadrant seats) and external unpainted metal surfaces (all sighting and fire control equipment).	Wipe clean and oil. When there is evidence of corrosion or gummy deposits, clean with dry cleaning solvent.	Apply film of preservative lubricating oil (special).
Exposed surfaces of lenses.	Clean.	Par. 103c.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
Gun, carriage, and limber as a unit.	<p>Make over-all inspection for general appearance and cleanliness, and condition of paint. Check for tightness of all fastenings.</p> <p>Examine all exposed unpainted surfaces for signs of rust.</p> <p>Make over-all check for cracked, damaged, or missing or distorted parts.</p>	

b. BEFORE FIRING.

Gun tube.	Wipe off excess lubricant from exposed gun tube.	
Gun bore.	Wipe the bore dry with clean, dry burlap or wiping cloth.	
Breech mechanism.	Check for proper functioning.	Open and close several times and note ease of operation.
Firing mechanism.	Check for proper functioning.	Sec. XVI.
Recoil and counterrecoil piston rod nuts.	Note that these nuts are fully engaged and fastened with cotter pins.	Par. 72a.
Recoil mechanism replenisher.	Check position of piston.	Pars. 53 and 72e.
Recoil cylinder.	Check position of index.	Par. 72b and f.
Elevating mechanism.	Check for proper functioning.	Par. 11. Elevate and depress several times, noting backlash and action of equilibrators.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
Equilibrator.	Check setting of equilibrator temperature adjusting scale.	Par. 74a.
Traversing mechanism.	Check for proper functioning.	Par. 78. Traverse several times throughout entire range. If traverse is hard, clean; if action is still hard, notify battery mechanic.
Carriage, trails, and spades.	After the weapon is in firing position, but before firing, make certain that the carriage is emplaced firmly, that the trails are properly spread, and that the spades set securely in position.	Sec. VI.

c. DURING FIRING.

Gun bore.	Whenever the rate of fire permits, examine the bore for powder fouling. Swab powder chamber with water and dry. Clean with bore brush if necessary.	Par. 56.
Firing mechanism.	Check between rounds for proper functioning.	Sec. XVI.
Breech mechanism.	Whenever the rate of fire permits, remove powder fouling from the primer seat and primer vent. Wash powder fouling from the face of the obturator spindle. Check for proper functioning.	Sec. XV.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
Recoil indicator.	Measure the length of recoil after the first few rounds, and at regular intervals when practicable.	Par. 17c and figs. 70 and 71. If the length of recoil does not fall within the desired limits when the gun is operated at normal temperatures notify ordnance maintenance personnel.
Recoil cylinder.	Check position of index at frequent intervals.	Par. 72b and f.
Recoil mechanism replenisher.	Check position of piston at frequent intervals.	Pars. 53 and 72e.
Carriage, trails, and spades.	Make certain that the carriage is firmly emplaced at all times, and that the spades and trails are absorbing the shock of recoil properly.	Sec. VI.
 <i>d. AFTER FIRING.</i>		
Recoil mechanism.	Make over-all inspection.	Sec. XVIII.
Recoil cylinder.	Check position of index and reestablish reserve if necessary.	Par. 72b and f.
Obturator spindle.	Swab head of spindle. Clean primer vent. Ream primer seat with reamer. Check erosion of primer seat with unfired primer.	Par. 60g.
Recoil mechanism replenisher.	Check position of piston.	Pars. 53 and 72e.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
Elevating mechanism.	Inspect over-all and check for proper functioning.	Par. 76.
Traversing mechanism.	Inspect over-all and check for proper functioning.	Par. 78.
Carriage.	Clean carriage thoroughly. Inspect for condition. When damaged, notify ordnance maintenance personnel.	
Brakes.	Inspect.	Par. 87.
Wheels and tires.	Inspect.	Par. 85.

e. BEFORE TRAVELING.

Gun bore.	Open the breech and make certain the gun bore is clear; close the breech.	
Traveling locks.	On the field carriage M1, make certain that the cradle lock and the traversing mechanism lock are locked. On the howitzer motor carriage M43, make certain that the tube is clamped by the howitzer traveling lock and that the cradle traveling tie rods are installed and tight.	Pars. 22 <i>e</i> and 23 <i>a</i> and <i>b</i> .
Front spades.	Make certain the front spades are inserted in their proper positions on the trails for traveling and that the spade keys are put in place.	Par. 22 <i>a</i> .
Trails.	Make sure the trails are raised and properly clamped to the limber for traveling.	Par. 22 <i>b</i> .
Tires.	Check for proper inflation.	Par 6.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
Air brakes.	Check connections between carriage, limber, and prime mover. A rapid inspection of the functioning of the system should be made before the unit is moved in convoy.	Tow the load slowly and apply the service brake, and observe whether or not the towed load opposed the movement imparted on the prime mover.
	Check break-away emergency action.	Disconnect the couplings in the emergency line after closing the cut-out cock. The brakes should apply immediately.
Air brake hose.	Hose couplings must be clean, dry, free from grit, and properly seated. Hose should be fastened in such manner as to be clear between the prime mover and the towed load to prevent damage to the hose in movement.	Par. 87d.
On-carriage accessories.	Inspect and make certain that all accessories and equipment that have provisions for being carried "on-carriage" when traveling, are in place and fastened properly.	

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
Drawbar.	Inspect connections between the lunette on the limber and the pintle of the prime mover. Make certain that the lunette is securely engaged and hooked in the pintle.	

Brake air reservoir.	Drain.	Par. 87e.
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f. MONTHLY SERVICE. Perform all weekly services as listed above and, in addition, the following:

Slack adjuster.	Inspect and adjust.	Par. 87a.
Brake air filters.	Remove and clean.	Par. 87b.
Eyeshields of telescopes.	Clean and dust.	Clean with soap and water, dry, then dust with talc. Wipe clean and apply a drop of lubricating oil.

Threads of clamping thumbscrews on telescope mounts and instrument lights.	Clean and oil.	
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g. QUARTERLY SERVICE. Perform all weekly and monthly services as listed above and, in addition, the following:

Lubricating fittings of telescope mount M18A1 and mount quadrant M1.	Clean and grease.	Apply lubricating grease (special).
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<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
h. SEMIANNUAL SERVICE.		
Gun, carriage, and limber.	Check to see that all authorized modifications have been applied.	A list of current Modification Work Orders is published in FM 21-6. If a modification has not been applied, notify the local ordnance officer. No alteration or modification which will affect the moving parts will be made by the using personnel except as authorized by the Ordnance Department.
Wheel and bearing.	Clean and grease.	WDLO 9-335.

40. Organizational (Second-Echelon) Maintenance Schedules

a. WEEKLY.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
Recoil mechanism.	Check oil index.	Par. 72 <i>b</i> and <i>f</i> . If there is excessive leakage around oil index, filling plug, or recoil stuffing box head, notify ordnance maintenance personnel.

<i>Point</i>	<i>Preventive maintenance</i>	<i>Detailed instructions</i>
b. BEFORE FIRING.		
Breech mechanism and firing mechanism.	Check breech mechanism and firing mechanism for broken or worn parts.	Replace broken or worn parts. Secs. XV and XVI.
Recoil mechanism.	Reestablish oil reserve. Check functioning of oil index.	Par. 72 <i>b</i> and <i>e</i> .

c. DURING FIRING.

Recoil mechanism.	Check functioning of oil index. If the oil index is stuck, firing may be continued in an emergency by draining off all the reserve oil and refilling with approximately 2 pints of oil.	Par. 72 <i>b</i> and <i>e</i> .
	Continue firing until the howitzer returns to battery with a shock. This indicates a surplus of reserve oil. Drain off and reestablish reserve. When the howitzer fails to return or is slow in returning to battery, insufficient reserve oil is indicated. Add oil until reserve has been reestablished.	Sec. XVIII.

Note. The oil pump should be calibrated with relation to the number of strokes per pint of oil.

Section XIII. MALFUNCTIONS AND CORRECTIONS

41. General

A malfunction is an improper or faulty action of some part, or parts, of the weapon that may result in a stoppage or failure to fire.

42. Failure to Fire

a. FAILURE OF FIRING MECHANISM. (1) If the gun fails to fire, make two more attempts to fire. After the last attempt, wait at least 60 seconds, then make sure that the firing mechanism is screwed in as far beyond the latch as possible. If it is, and if the primer is struck solidly, replace the primer and continue firing. If the percussion element of the primer is struck lightly, the trouble may be that the lanyard was not pulled hard enough; replace the primer and pull the lanyard with considerable snap.

(2) Disassemble the firing mechanism and replace the firing pin if deformed. If firing pin is not deformed, clean all the parts with dry cleaning solvent. Dry thoroughly and relubricate lightly.

b. GUN FAILS TO FIRE AFTER PRIMER HAS DISCHARGED. (1) If the primer is heard to fire and gun does not fire, the venthole through the obturator spindle may be fouled or damp. Wait at least 60 seconds and remove the primer. Clean the venthole.

(2) The charge may be damp. Remove the propelling charge and replace.

(3) The propelling charge may be wrongly inserted in the chamber. Examine the charge and make sure that the igniter end (red end) of the charge is facing the breechblock.

c. PRIMER DOES NOT DISCHARGE. If the primer does not discharge, it is due to one of the following reasons:

(1) *Weak pull on the lanyard.* Pull the lanyard with considerable snap.

(2) *Firing mechanism M1 not screwed home.* Adjust the firing mechanism so that the primer seats properly.

(3) *Broken, bent, or fouled firing pin.* Remove firing mechanism and disassemble. Wash all parts free from dirt or gummed oil with rifle bore cleaner. Dry thoroughly and lubricate with seasonal grade engine oil. Replace broken parts.

(4) *Defective primer.* Insert new primer and continue firing.

43. Excessive Blowback

Remove the primer. If primer is split or ruptured, it indicates an excessively eroded primer seat in the obturator spindle plug. Replace plug as directed in paragraph 60g.

44. Breech Mechanism Does Not Operate Freely

a. If the breech mechanism does not operate freely, disassemble breech mechanism. Clean all parts thoroughly and relubricate lightly. If the breechblock and breech recess threads have burrs and scores, notify ordnance maintenance personnel.

b. If the breechblock closes hard at high angles of firing, notify ordnance maintenance personnel.

c. If the breechblock does not open (seized breechblock), tap the rear of the breechblock with brass hammer and, at the same time, have a man exert a reasonable pull on the breech operating lever. If this fails, insert a long 4- x 4-inch timber (wrapped with burlap to protect the bore) down the muzzle end of the tube so that pressure can be applied to the breechblock from the inside, while a man exerts a reasonable pull on the breech operating lever. If this fails to relieve the seized breechblock, notify ordnance maintenance personnel. If the breechblock seizes when the weapon is loaded, do not use the timber, but notify ordnance maintenance personnel.

45. Gun Returns to Battery with Too Great a Shock

a. The return of the gun into battery with too great a shock may be caused by insufficient oil in the replenisher, excess oil in the counterrecoil mechanism, change of viscosity of oil due to rapid firing, or a broken replenisher spring.

b. Refill the replenisher (par. 72e) and drain the reserve oil off and refill to normal (par. 72f). Allow mechanism to cool before continuing firing. If this malfunction is not then corrected, notify ordnance maintenance personnel.

46. Gun Overrecoils

a. Overrecoiling of the gun (figs. 74 and 75) may be caused by insufficient oil in the recoil cylinder, insufficient gas pressure in the recuperator, or by malfunction of the variable recoil mechanism.

b. Refill the replenisher (par. 72e). If action is not normal, then notify ordnance maintenance personnel.

47. Gun Underrecoils

a. If the gun underrecoils, the recoil mechanism may not be warmed up and the oil may be too thick. If the gun does not recoil normally after a few rounds, notify ordnance maintenance personnel.

b. Clean and lubricate the tube bearing surface. If the bearing surface is scored, notify ordnance maintenance personnel.

48. Gun Will Not Return to Battery

a. When the gun does not return to battery, it may be that there is insufficient oil in the counterrecoil system or insufficient gas pressure.

b. Drain off and refill the oil reserve. If this does not correct the action, notify ordnance maintenance personnel.

49. Gun Slow to Return to Battery When Oil Indication Is Normal

This condition is caused by insufficient gas pressure or excess friction in the packings and cannot be corrected in the field; notify ordnance maintenance personnel.

50. Uneven or Jerky Recoil Action

a. This condition may be caused by air having been admitted into the oil, lack of lubrication, or scoring on the gun slides and cradle guides. Evidence of air present is noticeable by foaming or frothing of the oil when it is bled from the recoil cylinder.

b. If there is evidence of air in recoil cylinder, notify ordnance maintenance personnel. Inspect, clean, and lubricate the gun slides and cradle guides.

51. No Sound of Air Escaping from Relief Valve in Counterrecoil Head During Counterrecoil

The air relief valve in the counterrecoil cylinder front head may become rusted shut, may have collected foreign matter under the seat preventing closing, or may have a broken valve spring or scored seat. Remove setscrew. Remove the guide, valve spring, valve, and valve housing from the counterrecoil cylinder front head. Clean parts and replace if broken or damaged. Reassemble the relief valve back in the head, taking care to assemble parts in their proper order. The counterrecoil cylinder front head should not be removed to clean or repair the relief valve.

52. Oil Leakage

a. OIL LEAKS AROUND RECOIL ROD OR STUFFING BOXES. Oil may be observed to leak from around the recoil rod or counterrecoil rod stuffing boxes. Reestablish the correct amount of oil in the replenisher (par. 72*e*) and drain and reestablish the proper oil reserve (par. 72*f*). If oil has to be replaced in the replenisher and if the oil reserve has to be reestablished so often that it interferes with the normal function of the weapon, notify ordnance maintenance personnel.

b. OIL LEAKS FROM REAR OF REPLENISHER. Whether or not a serious leak exists must be determined by the position of the replenisher piston and the frequency of refilling required in the recoil system. There is no cause for alarm should the oil drip rapidly from the rear of the replenisher when the gun is elevated, provided the cradle has been at a minimum elevation on the carriage for some time previously. If oil continues to drip, notify ordnance maintenance personnel.

c. OIL LEAKS FROM FORWARD END OF COUNTERRECOIL CYLINDER. Black oil appearing in front of the counterrecoil piston is a normal condition due to lubrication. Clear oil is an indication of a leak. Report leak of clear oil to ordnance maintenance personnel.

d. EXCESSIVE LEAKS FROM RECUPERATOR AND RECOIL FILLING AND DRAIN VALVE. This may be caused by sticking of valve or defective packing. Report to ordnance maintenance personnel.

53. Position of Replenisher Piston Does Not Change During Continued Firing

When replenisher piston is stuck, drain oil from replenisher through filling and drain valve release. Remove plug at breech end of replenisher. Insert a block of hardwood in the rear of the replenisher against the piston end, and tap with a hammer. Refill the replenisher. (If piston does not move as oil is pumped in, notify ordnance maintenance personnel.) Drain oil again. If piston moves toward muzzle end of replenisher, fill until piston is $5\frac{3}{4}$ inches from rear face (par. 72e). If piston does not move, notify ordnance maintenance personnel. If a howitzer in the hands of the using arms is not being fired, the replenisher should be exercised, as described above, at least once a month. There are two 0.08-inch (2-mm) holes in the replenisher piston guide and one 0.12-inch (3-mm) hole in the replenisher cylinder, which are for the purpose of draining the cylinder of accumulated oil that has passed the replenisher piston, and of providing for the circulation of air through the replenisher. The two holes in the piston guide are in the center of the face spanner wrench holes. The cylinder hole is in the under side of the replenisher about $1\frac{1}{4}$ inches from the rear end. It is very important that these holes be kept open. They can be cleaned with a small copper wire. The walls of a replenisher should never be struck with a hammer or any other article. If the replenisher cylinder becomes dented in any way, report the fact to ordnance maintenance personnel.

54. Malfunction of Brakes

a. BRAKES FAIL TO OPERATE. (1) Source of air supply may

be shut off at prime mover. Open output cocks in air lines at rear of prime mover.

(2) Reservoir drain cock may be open. Close drain cock on reservoir.

(3) Dirt in the air lines may lodge in the diaphragm seats and obstruct proper seating, causing leakage of air from the relay emergency valve exhaust parts. Air is exhausted from these parts only when the brake pedal of the prime mover is being moved. Serious leakage of air from these parts can be heard; small leakage can be detected by smearing soapsuds over the parts. Refer to ordnance maintenance personnel.

(4) The air line hose couplings may be loose or damaged or the air lines may leak. Tighten loose couplings. Test for leaks with soapsuds. If damage is discovered in air line tube, hose, or couplings, refer to ordnance maintenance personnel.

b. BRAKE RUNS HOT. (1) The slack adjuster may be improperly adjusted. Adjust brakes (par. 87*a*).

(2) Brake parts may be broken or deformed. Refer to ordnance maintenance personnel.

(3) Dirt or rust on linkage may cause air brake to drag and run hot. Clean and lubricate air brake linkage.

c. SLOW BRAKE APPLICATION OR SLOW RELEASE. (1) The slack adjuster may be out of adjustment causing travel of chamber push rod. Adjust brakes (par. 87*a*).

(2) The air filters may be dirty. Clean air filters (par. 87*b*).

(3) The air tubing may be dented or the air hose may be kinked. Straighten kinked air hose but, if air tubing or hose is damaged, refer to ordnance maintenance personnel.

(4) Dirt or rust on linkage may retard action of the air brake. Clean and lubricate air brake linkage.

d. WEAK BRAKING ACTION. (1) The brake lining may be worn, glazed, or greasy. Refer to ordnance maintenance personnel.

(2) The slack adjuster may be improperly adjusted. Adjust brakes (par. 87*a*).

(3) The air lines between the air reservoir and the brake push rod diaphragm chamber may be restricted. Refer to ordnance maintenance personnel.

e. INTERMITTENT BRAKING. (1) Overlubrication of anchor pins, camshaft, or wheel bearings may cause the brake lining to become greasy. Refer to ordnance maintenance personnel.

(2) Slack adjuster may be improperly adjusted. Adjust brakes (par. 87*a*).

(3) The brake drum may be scored. Refer to ordnance maintenance personnel.

(4) The wheel bearings may have excessive bearing play. Refer to ordnance maintenance personnel.

f. BRAKES DO NOT RELEASE. (1) The air line hose may be improperly connected to the prime mover. Connect the hose coupling marked "SERVICE" to the service (left) air line coupling on the prime mover, and the hose coupling marked "EMERGENCY" to the emergency (right) air line coupling on the prime mover.

(2) Cut-out cocks in the air lines at the rear of the prime mover may be closed. Open the cut-out cocks.

(3) Air line tubing or hose may be restricted. Check all tubing and hose. If damaged tubing or hose is discovered, refer to ordnance maintenance personnel.

(4) Dirt or rust on linkage may cause failure of air brake to release. Clean and lubricate air brake linkage.

g. DRAGGING BRAKES. (1) Slack adjuster may be improperly adjusted. Adjust brakes (par. 87*a*).

(2) The brake push rod diaphragm springs may be defective. Refer to ordnance maintenance personnel.

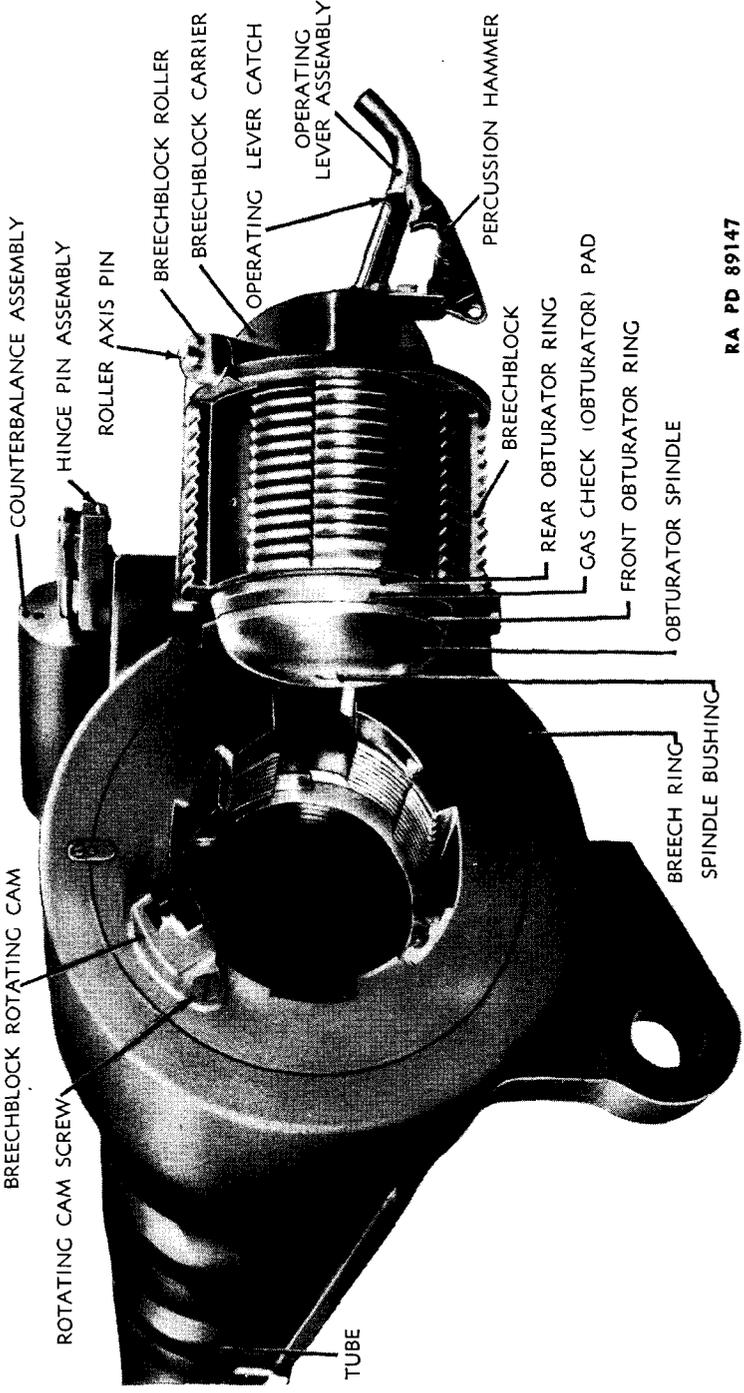
(3) Dirt and rust may cause air brake to drag. Clean and lubricate the air brake linkage.

Section XIV. TUBE AND BREECH RING

55. General

a. The 8-inch howitzer M2 consists of a tube screwed into an internal thread in the breech ring, and locked in place by three screws. Bearing surface for support and alinement on the carriage is provided by smoothly finished longitudinal rails. The breech ring carries lugs on the side for support of the breechblock carrier and on the bottom for attachment of the recoil mechanism (fig. 55).

b. The inner rear portion of the breech ring forms the breech recess, which is divided into eight threaded and four plain sectors mating with those of the breechblock. Two leveling plates are inlaid in the top surface of the breech ring.



RA PD 89147

Figure 55. Tube and breech ring assembly—rear view.

56. Maintenance

a. The bore should be cleaned as soon as possible after firing. The purpose of cleaning after firing is to remove all powder fouling, and all traces of residue and primer salts which cause corrosion. The purpose of cleaning on subsequent days is to remove all evidence of sweating. A clean bore has a uniform gray appearance; do not attempt to obtain a bright, polished finish. Do not try to remove copper fouling. Swab the bore with one of the solutions mentioned below, and in order of preference as listed. Use swab of burlap wound around the end of the bore cleaning brush.

(1) *Rifle bore cleaner.* (a) Thoroughly clean after firing, when the tube has cooled sufficiently to touch with the bare hand, and for 3 consecutive days thereafter, with undiluted cleaner. Make sure all surfaces, including the rifling, are well coated, but do not wipe dry. On the third day after firing, clean the bore again with rifle bore cleaner. If the weapon will probably be fired within the next 24 hours, do not wipe dry; but, if it will not be fired within that time, wipe dry and coat with the prescribed oil.

(b) When the piece is not being fired, clean the bore weekly with rifle bore cleaner, wipe dry, and reoil.

(2) *Hot water.* As a temporary measure after firing, the bore may be cleaned by swabbing with quantities of hot water while the bore is still hot. Dry the bore thoroughly after cleaning and coat with oil immediately to prevent rusting. As swabbing with hot water may not remove all the primer salts or powder residue, clean the bore with rifle bore cleaner as soon as possible thereafter.

b. Inspect for erosion at origin of rifling, bruises in the gas check seat, and burs or roughness on the leveling plates. Clean with bore brush. If the gas check seat is bruised or the leveling plates are rough or burred, notify ordnance maintenance personnel.

Section XV. BREECH MECHANISM

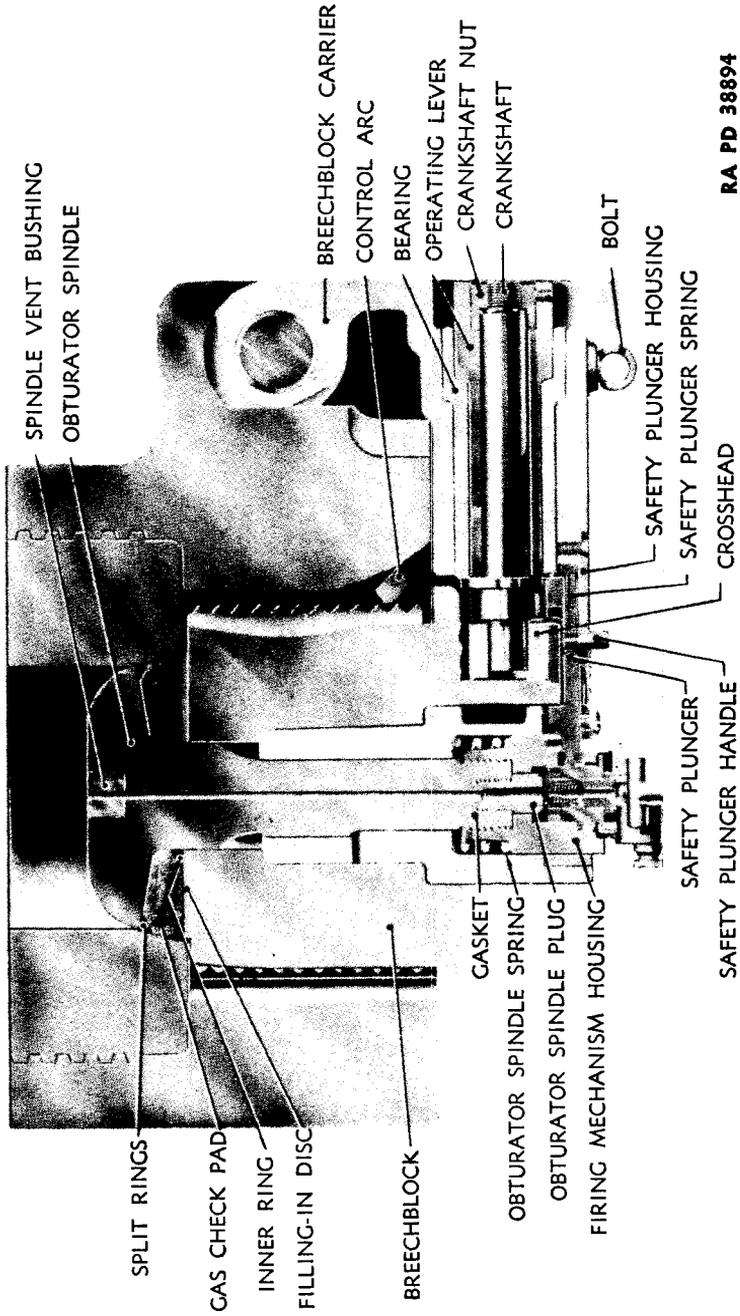
57. General

a. The breech mechanism is composed of the breechblock carrier assembly, breechblock assembly, counterbalance assembly, obturator group, and operating lever assembly.

b. The breechblock is of the interrupted screw (Welin type), carrier-supported, 2-cycle type. An operating lever (figs. 18 and 55) is provided which rotates the breechblock, and swings the

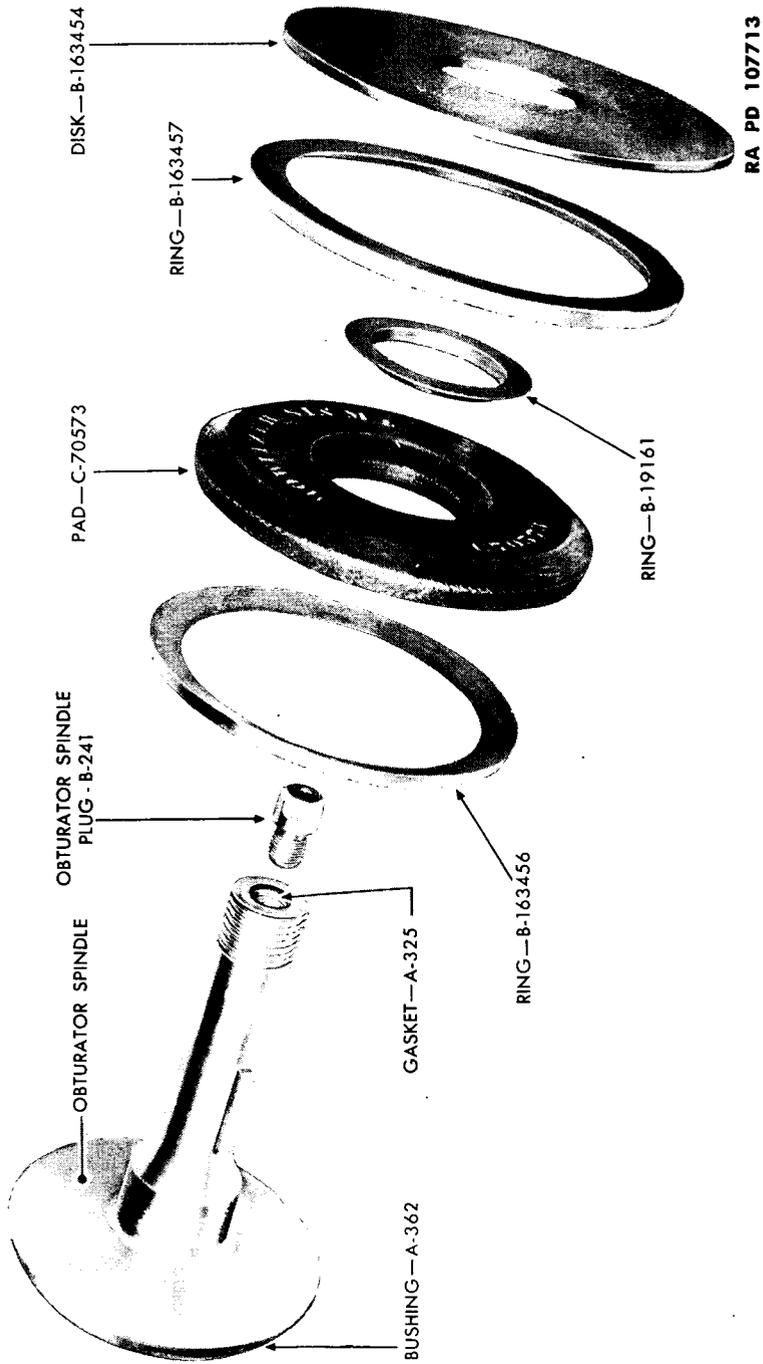
breechblock into open or closed position. When withdrawn from the breech, the breechblock is supported by a breechblock carrier (fig. 55) hinged to the right side of the breech ring. Motion of the breechblock operating lever rotates the crankshaft on which it is mounted. A crank on the end of this crankshaft actuates a crosshead which operates in a recess in the breechblock, rotating the breechblock for opening or closing the breech. A roller on the rear face of the breechblock and a cam on the breech end of the breech ring (figs. 18 and 55) give a properly timed initial turning movement to the breechblock in closing. The breechblock operating lever is held in the closed position by a catch (fig. 18) which engages a plate attached to the carrier.

c. The obturator spindle group (fig. 57) consists of a mushroom-headed spindle assembly, a front split ring, a gas check pad, a rear split ring, an inner ring, and a filling-in disk. A through axial hole in the spindle provides for the passage of hot primer gases into the powder chamber. This group is held in position against the breechblock by a helical spring and the firing mechanism housing (fig. 56). As the powder charge is ignited, the pressure against the spindle head compresses the gas check pad, expanding it and the split rings to seal effectively the powder chamber.



RA PD 38894

Figure 56. Breech mechanism with firing mechanism M1—sectional view.



RA PD 107713

EXPLODED VIEW OF OBTURATOR SPINDLE GROUP

Figure 57. Obturator spindle group used with firing mechanism M1—exploded view.

58. Disassembly of Breech Mechanism

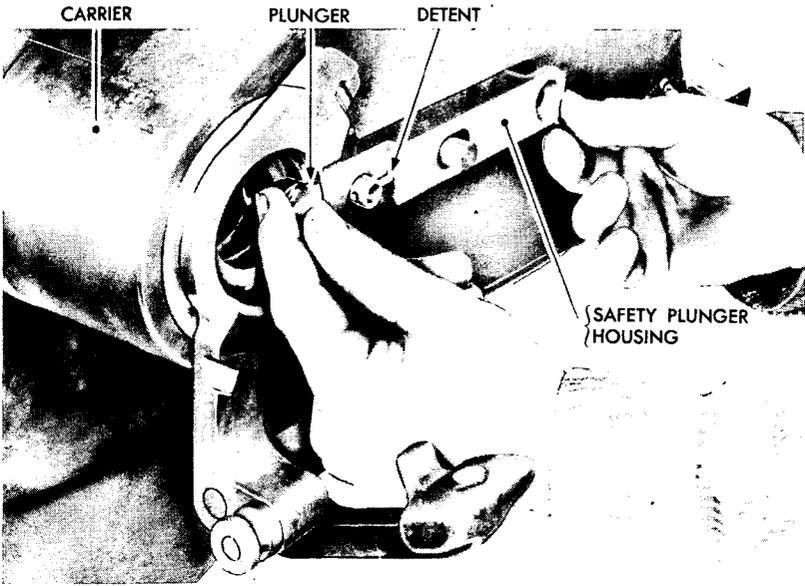
a. PRECAUTIONS. (1) Under no circumstances should an attempt be made to disassemble the breech mechanism with the breech in closed position. Failure to observe this rule may result in the displacement of the split rings and the gas check pad, and the dropping of the rings into the threads of the breech recess. This probably would cause serious damage to the rings and threads and prevent either the swinging of the breechblock out of the breech recess or the 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 (par. 68) and remove the hinge pin (*k* below). The complete breechblock carrier and breechblock should be carefully removed rearward from the weapon, by several men, leaving the obstructing parts in the recess for removal.

b. REMOVE THE FIRING MECHANISM. See paragraph 20*a*.

c. REMOVE THE COUNTERBALANCE. Open the breech as described in paragraph 20*a* and detach the counterbalance as described in paragraph 68.

d. REMOVE FIRING MECHANISM SAFETY PLUNGER HOUSING ASSEMBLY (fig. 58). Turn the firing mechanism safety housing lock one-quarter turn with the aid of a screwdriver blade. Unscrew the $\frac{3}{8}$ -inch flathead machine screw which holds the right end of firing mechanism safety plunger housing to the breechblock carrier. Unscrew the firing mechanism safety plunger housing lock screw. Remove the safety plunger housing lock screw washer, lock, lock detent, and detent spring from the safety plunger housing. The detent should be held inward against the spring pressure as the lock is removed to prevent the detent and spring from flying out. Unscrew the safety plunger handle and remove the safety plunger from the housing, while retaining the safety plunger spring with the hand to prevent its flying out (fig. 59).



RA PD 95139

Figure 58. Removing firing mechanism safety plunger housing assembly.

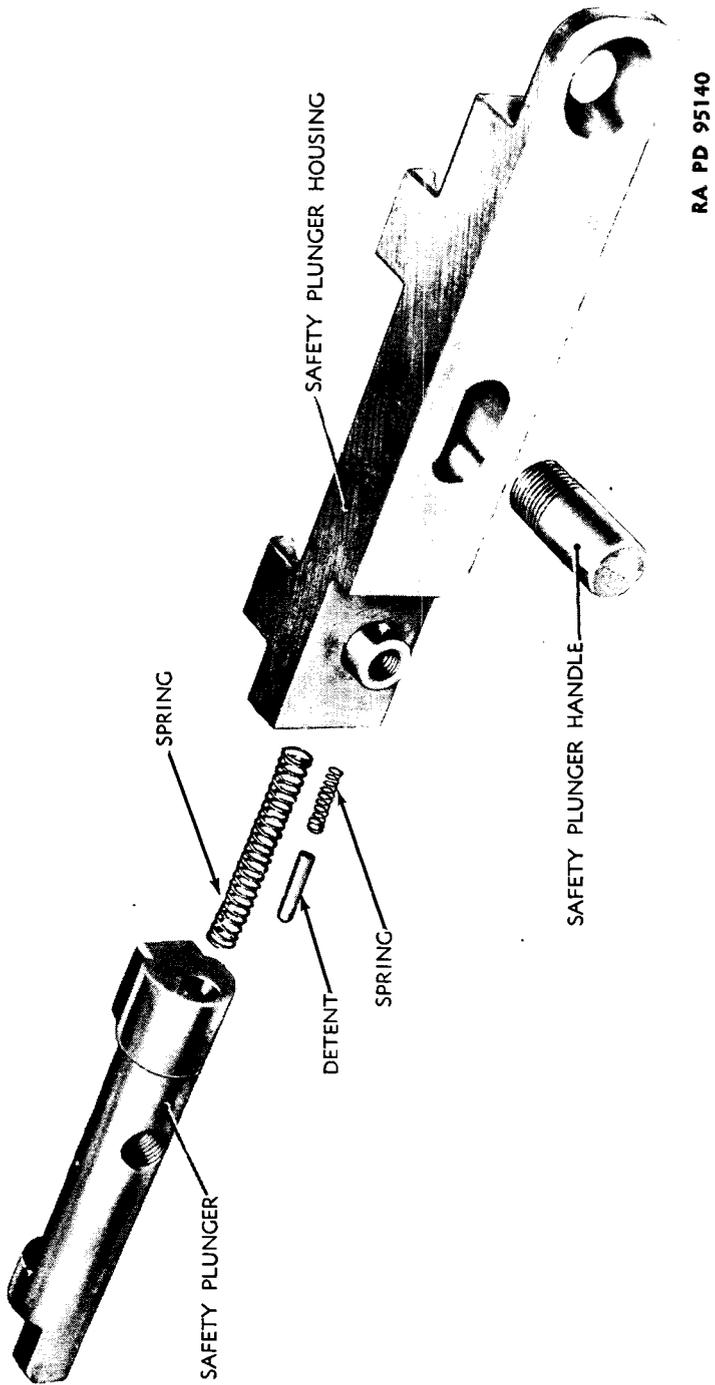


Figure 59. Safety plunger housing group used with firing mechanism M1.

e. REMOVE FIRING MECHANISM RECEIVER HOUSING ASSEMBLY, AND OBTURATOR SPINDLE GROUP. Unscrew the firing mechanism receiver housing while holding mushroom head against the spindle.

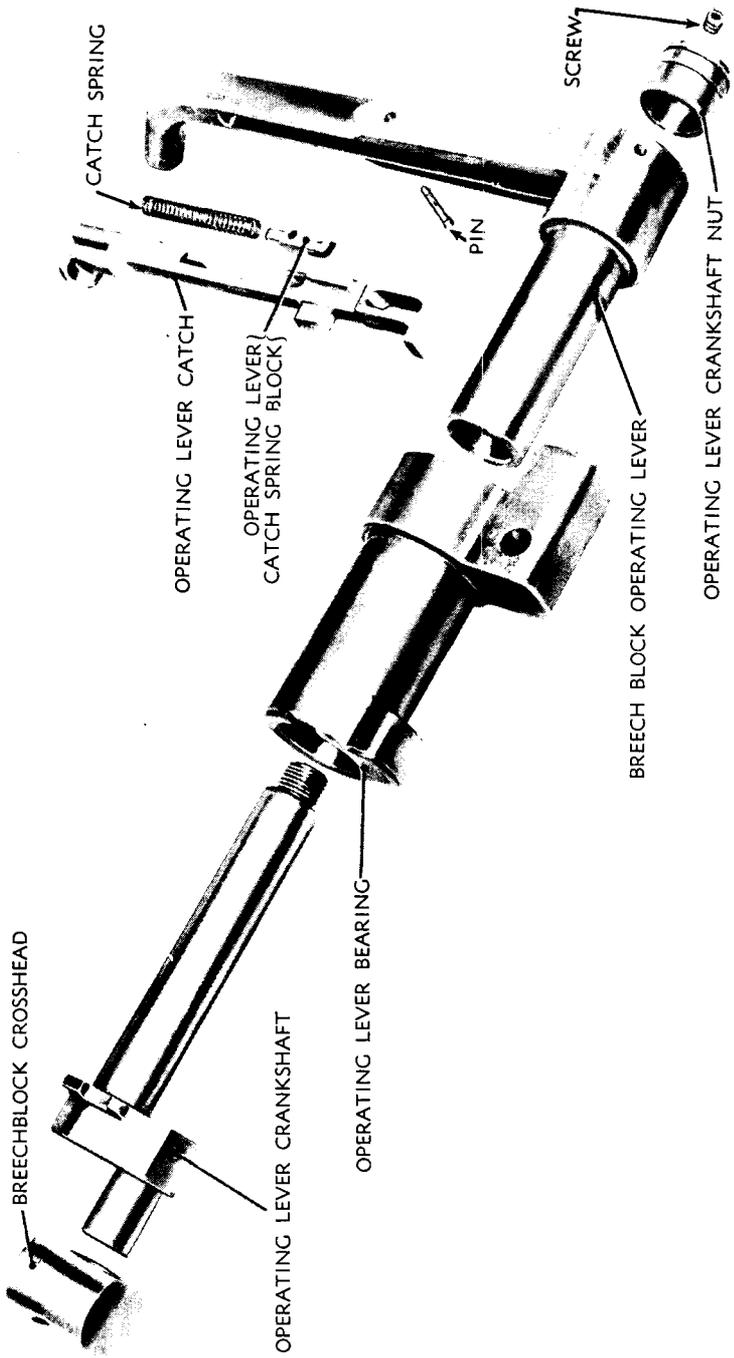
Caution: Never unscrew receiver housing from obturator spindle until breech has been opened.

Remove the housing and the obturator spindle spring. Withdraw the obturator spindle assembly, split rings, inner ring, gas check pad, and filling-in disk from the front of the breechblock, taking care not to damage any of the parts.

f. REMOVE BREECHBLOCK CONTROL ARC. Remove breechblock control arc screw from the front face of the breech ring. Withdraw the control arc.

g. REMOVE BREECHBLOCK ASSEMBLY. Insert the end of the wood pole, $1\frac{3}{4}$ inches in diameter, through the breechblock onto the carrier, and slide the breechblock off the carrier pintle onto the pole. Remove breechblock and pole. Withdraw the cotter pin from the breechblock roller axis pin and remove the pin and breechblock roller from the upper lug on the rear of the breechblock.

h. REMOVE BREECHBLOCK OPERATING LEVER ASSEMBLY. Remove the cotter pin from the breechblock operating lever bearing retaining bolt and withdraw the bolt. Slip the crosshead from the left end of the crankshaft. With the lever in closed position, withdraw the breechblock operating lever, the operating lever bearing, and crankshaft from the carrier (fig. 60).



RA PD 107714

Figure 60. Breechblock operating lever group—exploded view.

i. REMOVE OPERATING LEVER CATCH. Remove the socket-head setscrew from the crankshaft nut and then remove the nut with the bar spanner wrench. Slide crankshaft out of operating lever and withdraw operating lever from operating bearing. Drive out the catch spring block retaining pin with a 3/16-inch punch. The operating lever catch should be pushed down and lifted out of the operating lever. Remove the spring and spring block from the operating lever catch (fig. 60).

j. REMOVE OPERATING LEVER CATCH PLATE. Unscrew the breechblock operating lever catch plate screw and remove the operating lever catch plate from the carrier.

k. REMOVE BREECHBLOCK CARRIER HINGE PIN ASSEMBLY. Remove the cotter pin from the bottom of the hinge pin assembly. Draw the hinge pin assembly upward and out while supporting the breechblock carrier to prevent its slipping from the breech ring hinge lugs. (One man should support the carrier while a second withdraws the hinge pin.) Remove the carrier from the lugs. The breechblock carrier bearing washer may now be removed from the lower hinge lug of the breech ring.

l. REPLACEMENT OF DAMAGED AND WORN PARTS. Replace all damaged and worn parts which are authorized for replacement by first and second echelon, and refer to higher authority for replacement of other damaged or worn parts. Clean and lubricate as outlined in section XI.

59. Assembly of Breech Mechanism

a. INSTALL HINGE PIN ASSEMBLY, OPERATING LEVER CATCH PLATE, AND OPERATING LEVER CATCH. Place the breechblock carrier bearing washer in position on the top surface of the lower hinge lug of the breech ring. Place the breechblock carrier in position between the hinge lugs on the breech ring. Insert the hinge pin assembly downward through the vertical bore in the breech ring lugs and the carrier, fitting the keyway of the hinge pin to the key in the carrier. (One man should support the carrier while a second man inserts the hinge pin assembly.) Replace the cotter pin in the bottom of the hinge pin body. Place the operating lever catch plate in the U-shaped slot in the right side of the carrier and fasten it with the catch plate screw. Assemble spring and spring block to the operating lever catch and assemble in the operating lever. Insert the crankshaft, crank end to the left, into the breechblock operating lever bearing, and place the operating lever on the end of the crankshaft. Assemble the crankshaft nut on the crankshaft using the bar spanner wrench, and lock the nut with the setscrew.

b. **INSTALL BREECHBLOCK OPERATING LEVER ASSEMBLY, AND BREECHBLOCK ASSEMBLY.** Replace the breechblock roller on roller axis pin and press pin into recess on the rear of the breechblock. Put the cotter pin in place on the roller axis pin. Insert the cross head into the cross head groove of the breechblock with the flat side out. Place the breechblock on heavy wood pole, insert pole into carrier hole, and slide breechblock onto the carrier pintle. Insert the operating lever assembly almost fully into the transverse bore of the carrier. Aline cross head with the crankshaft and push operating lever assembly into proper position. Insert the operating lever bearing retaining bolt and pin it in place with the cotter pin.

c. **INSTALL BREECHBLOCK CONTROL ARC.** With the operating lever in the down position, replace the control arc to the front face of the breech ring and install breechblock control arc screws.

d. **INSTALL OBTURATOR SPINDLE GROUP, AND FIRING MECHANISM RECEIVER HOUSING ASSEMBLY.** Place the obturator front split ring, gas check pad, rear split ring, inner ring, and filling-in disk on the stem of the obturator spindle assembly in that order. Insert the threaded end of the obturator spindle assembly through the spindle opening of the breechblock and breechblock carrier. Assemble the obturator spindle spring over the threaded end of the obturator spindle. Insert the firing mechanism receiver housing into the rear of the carrier, and pressing forward on the housing to compress the spring, screw the housing home on the rear end of the obturator spindle. Make sure that the gas check pad and split rings are in proper position, concentric with the spindle. Screw the receiver housing in until it seats against the spindle (approximately seven full turns).

e. **HEAD SPACE ADJUSTMENT.** Back off the firing mechanism receiver housing assembly slightly to the nearest position where the slot in the housing will aline with the firing mechanism safety plunger recess in the carrier, to allow the safety plunger to enter the slot freely. Assembly in this manner assures proper head space. To check proper head space, use the head space gage. Insert gage into the firing mechanism receiver housing (fig. 61).

(1) A space between the shoulder of the gage and the housing (figs. 61 and 62), indicates proper assembly and head space.

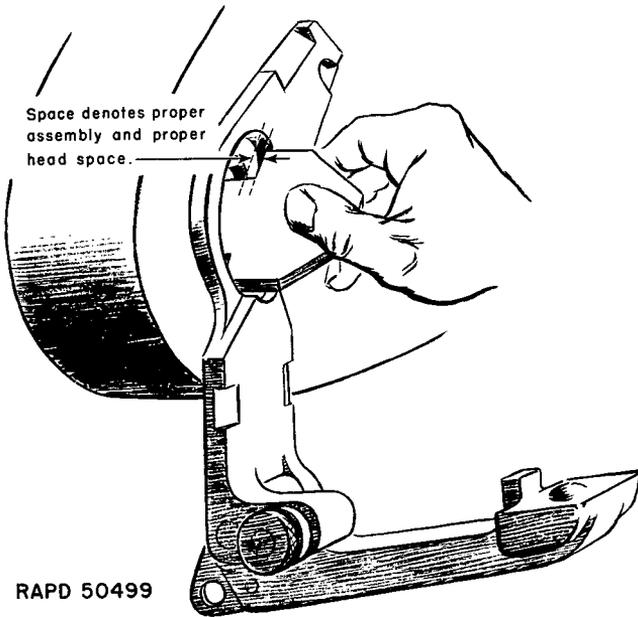
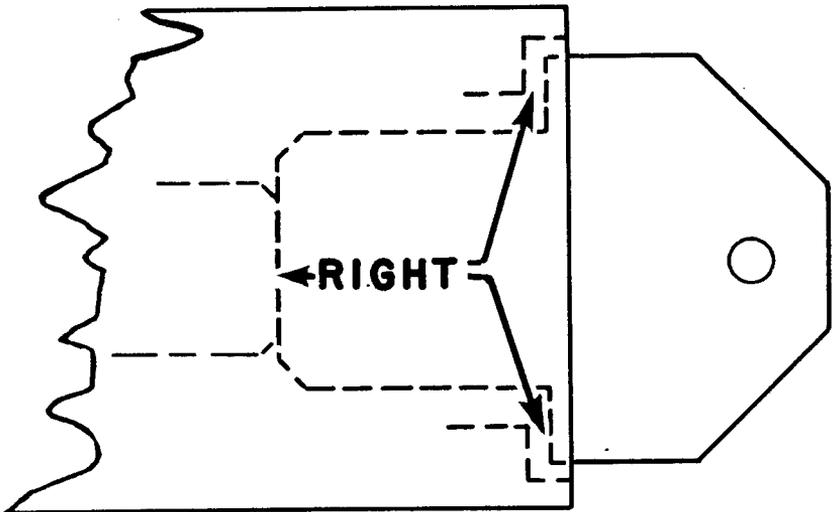


Figure 61. Checking head space with head space gage.



RAPD 50501

Figure 62. Correct head space.

(2) If the shoulder rests on the housing (fig. 63) improper assembly and head space is indicated. Screw housing one or two additional complete turns on the obturator spindle and recheck the head space.

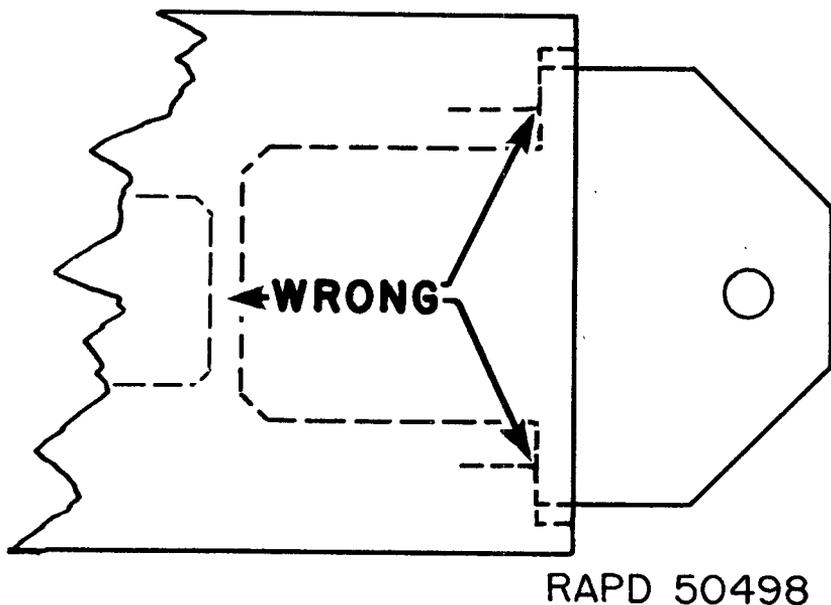


Figure 63. Incorrect head space.

f. INSTALL FIRING MECHANISM SAFETY PLUNGER HOUSING ASSEMBLY. Place the firing mechanism safety plunger spring in its hole in the safety plunger, then slide them into their position on the safety plunger housing. Screw the safety plunger handle into the safety plunger. Place safety plunger housing lock detent spring and detent in the hole in the left side of the safety plunger housing. While retaining the lock detent and its spring in position, fasten the safety plunger housing lock to the housing by screwing in the housing lock screw behind the housing lock screw washer. Turn the housing lock so that the housing can be placed in the recess in the rear of the carrier, slipping the left end through the flanges of the breechblock carrier retainer ring. Rotate the lock 90° to secure the housing in position. Insert the flathead machine screw through the hole in the right end of the housing into the carrier and fasten.

g. INSTALL THE COUNTERBALANCE. Attach the counterbalance to the carrier and bracket as described in paragraph 69.

h. INSTALL THE FIRING MECHANISM M1. Place firing mechanism into breechblock and screw it all the way home.

60. Maintenance of Breech Mechanism

a. **GENERAL.** Weekly, when the howitzer is not being fired, the breech mechanism (except the gas check pad) must be cleaned with dry cleaning solvent or rifle bore cleaner, dried, and lubricated as prescribed in War Department Lubrication Order 9-335. Application to moving parts will be by oilcan if oilholes are provided; otherwise, use a clean wiping cloth. Disassembly will be undertaken to the extent necessary to insure complete lubrication of all moving parts.

b. **CARE OF BREECH MECHANISM.** The entire breech mechanism including the firing mechanism, obturator spindle, primer seat, primer vent, filling-in disks, split rings, etc., should be disassembled and, with the exception of the gas check pad, cleaned immediately after firing in the same solution used to clean the bore. All traces of powder fouling and primer residue are to be carefully removed. After rinsing in clean water, dry thoroughly, and lubricate as prescribed on War Department Lubrication Order 9-335. Application to moving parts will be by oilcan if oilholes are present; otherwise, use a clean wiping cloth. Cleaning will be repeated daily, for at least 3 consecutive days, until all traces of primer residue have been removed.

c. **INSPECTION AND REPLACEMENT OF BREECH PARTS.** Examine all parts for wear and breakage and replace unserviceable parts. Reassemble and test operation; if difficult to operate, notify ordnance maintenance personnel.

d. **BREECHBLOCK AND BREECH RECESS.** Examine the breechblock and breech recess for burs, indentations on the threads, rust, pitting, and other evidences of corrosion. If not possible to smooth or clean with crocus cloth, notify ordnance maintenance personnel. Do not use any other abrasive.

e. **BREECHBLOCK CARRIER ASSEMBLY.** Examine the breechblock carrier assembly, the machined surface on which the breechblock rotates, and hinge pin, for a roughened or scored condition. Remove roughness or scores with crocus cloth.

f. **GAS CHECK PAD.** (1) Extreme care should be exercised in cleaning these gas check pads which are covered with wire mesh and asbestos. After removal from the obturator spindle, the gas check pad will be wiped clean with a dry cloth. A film of oil will not be applied. Oil causes rapid deterioration; therefore, gas check pads will always be replaced dry at assembly. Never clean the gas check pad with dry cleaning solvent or any other type of cleaning solvent.

Caution: When cleaning the breech assemblies, precaution should be taken that no bore swabbing or dry cleaning solvent comes into contact with the gas check pad.

(2) The gas check pad should be examined for bruises or torn covering. Replace defective pad. Damage to gas check seat cannot be repaired by stoning or polishing; therefore, extreme care must be taken to inspect the pad.

(3) Quantities of a new Neoprene gas check pad are being issued for extensive service tests. Each pad is issued in a box, properly marked with cannon name and model designation. These gas check pads are the same size and shape as the pads which have been issued with the weapons to date. The new pads are solid Neoprene rubber containing no metal or asbestos covering. Removal from, or assembly to, the obturator spindle is the same as for the old-type pads. They are not affected as much as rubber by oil, dry cleaning solvents, rifle bore cleaner, or water, nor are they seriously damaged if dropped to the ground or by moderately rough handling. Neoprene will expand (or swell) if immersed in gasoline or solvent. The Neoprene gas check pads develop chafing from the openings in the split rings, but chafing does not seriously affect the proper functioning or serviceability of these pads. Periodic reports on operation, maintenance, serviceability, and malfunctioning of the Neoprene gas check pads should be submitted through technical channels to Office, Chief of Ordnance, Attention: ORDFM.

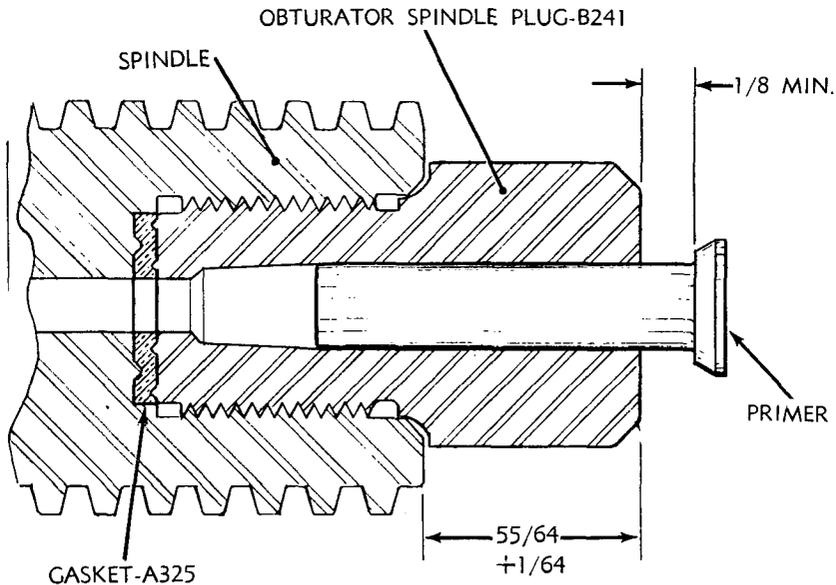
g. OBTURATOR SPINDLE AND PLUG. (1) Examine the obturator spindle for burrs and, if possible, smooth the spindle, using crocus or abrasive cloth; if not possible, notify ordnance maintenance personnel. Examine split rings for burrs or cracks and replace if necessary.

(2) Check erosion of primer seat. When the head of an unfired primer, inserted into the plug with thumb pressure, is less than $\frac{1}{8}$ inch from rear face of plug (fig. 64), replace obturator spindle plug as described below. Plug will not be removed from obturator spindle except for replacement. A new gasket will be installed when plug is replaced as follows:

(a) Place the obturator spindle in a vise with copper jaws or a special holding fixture which may be made locally. Remove the obturator spindle plug by using a wrench approximately 18 inches long with a $\frac{7}{8}$ -inch opening.

(b) To remove the copper gasket, peen around its hole, thus reducing the diameter of the hole. Insert a $\frac{3}{16}$ -inch rod through front of the obturator spindle to contact the gasket, then tap the rod with a hammer.

(c) Insert a new gasket and plug, and tighten until the distance between rear face of spindle and face of plug is $\frac{55}{64}$ inch plus $\frac{1}{64}$ inch (fig. 64). Ream hole in gasket with vent-cleaning tool.



RA PD 104247

Figure 64. Installation of obturator spindle plug.

h. **LEVELING PLATES.** The leveling plates should be protected at all times. Tools or other articles will not be placed upon them at any time. In case of damage, repair must be made by ordnance maintenance personnel.

Section XVI.

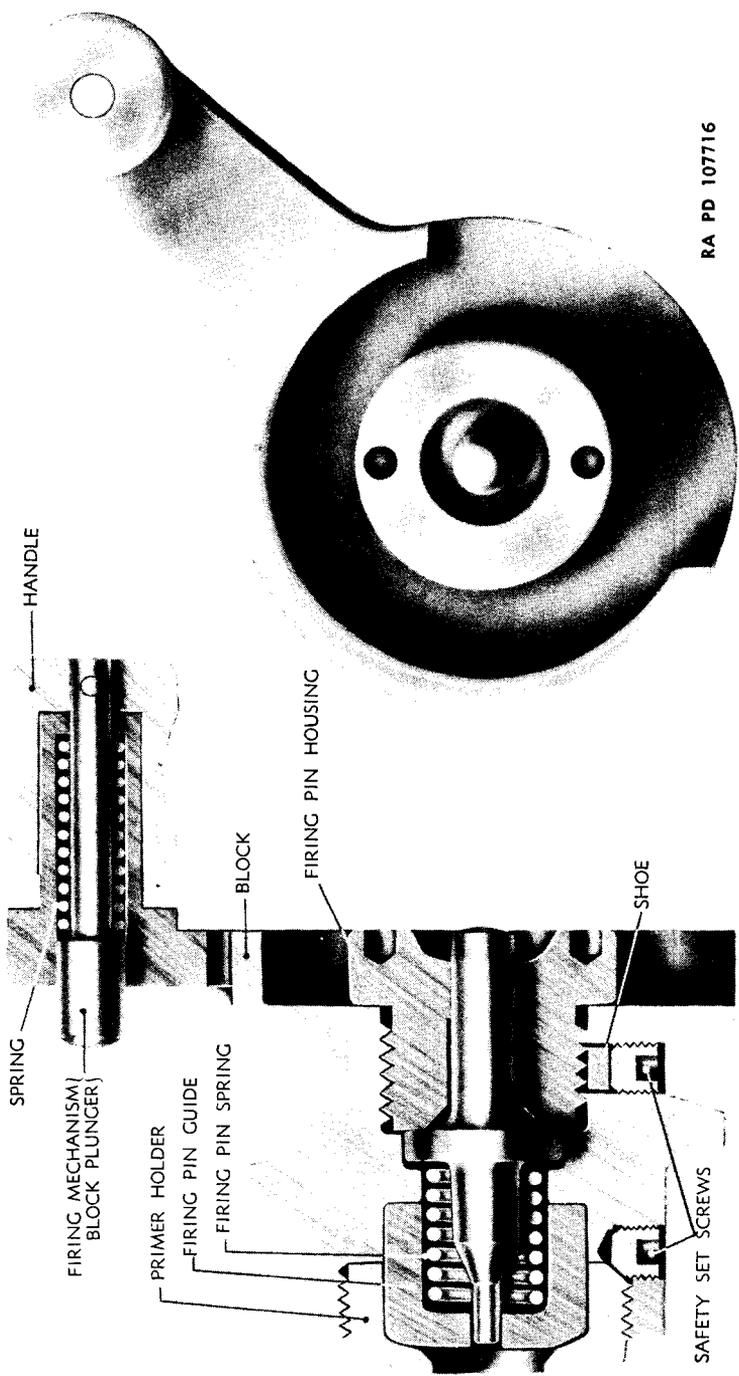
FIRING MECHANISM M1 AND PERCUSSION MECHANISM

61. General

a. **FIRING MECHANISM.** (1) The exterior of the firing mechanism block has a large single thread for screwing into the firing mechanism receiver housing.

(2) The primer holder (fig. 65) has a left-hand thread to prevent it from becoming loose when the firing mechanism is inserted in its receiver housing. The firing pin is guided by the firing pin housing at the rear end and the firing pin guide at the front end. The pin is held rearward by the firing pin spring. The setscrews secure the primer holder and the firing pin housing (fig. 65).

(3) The front of the primer holder has a U-shaped slot which engages the rim of the primer. The primer is retained in position by the pressure of the firing pin spring bearing against the firing pin guide.



RA PD 107716

Figure 65. Firing mechanism M1—sectional view.

(4) A projecting rim on the rear of the block is a safety feature against firing until the firing mechanism has been screwed all the way into the firing mechanism housing and locked by the firing mechanism block plunger.

b. **PERCUSSION MECHANISM** (fig. 67). (1) The percussion mechanism consists of the percussion hammer and hinge pin, and the percussion hammer locking pin. These are mounted on the lower arm of the firing mechanism receiver housing assembly. When the lanyard is attached to the percussion hammer and pulled, the hammer swings in an arc, and strikes the firing pin of the firing mechanism M1, firing the piece.

(2) When the percussion hammer 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.

62. Disassembly of Firing Mechanism M1

a. Secure the firing mechanism block in a soft-jawed vise and remove the socket-head setscrews. Using the spanner-type firing mechanism wrench, unscrew the firing pin housing from the rear end of the block to release the firing pin and its spring. Remove the firing mechanism shoe from the rear setscrew hole. Using the firing mechanism wrench, unscrew and remove the primer holder from the front of the block to release the firing pin guide (fig. 66).

b. Do not disassemble the firing mechanism block handle, block plunger, and spring, except to replace unserviceable parts or to correct functioning. To disassemble, chip out the staking, and drive the straight pin from the rear end of the handle and plunger. The plunger should be held inward against spring pressure as the pin is removed so that the plunger is not thrown out (fig. 66).

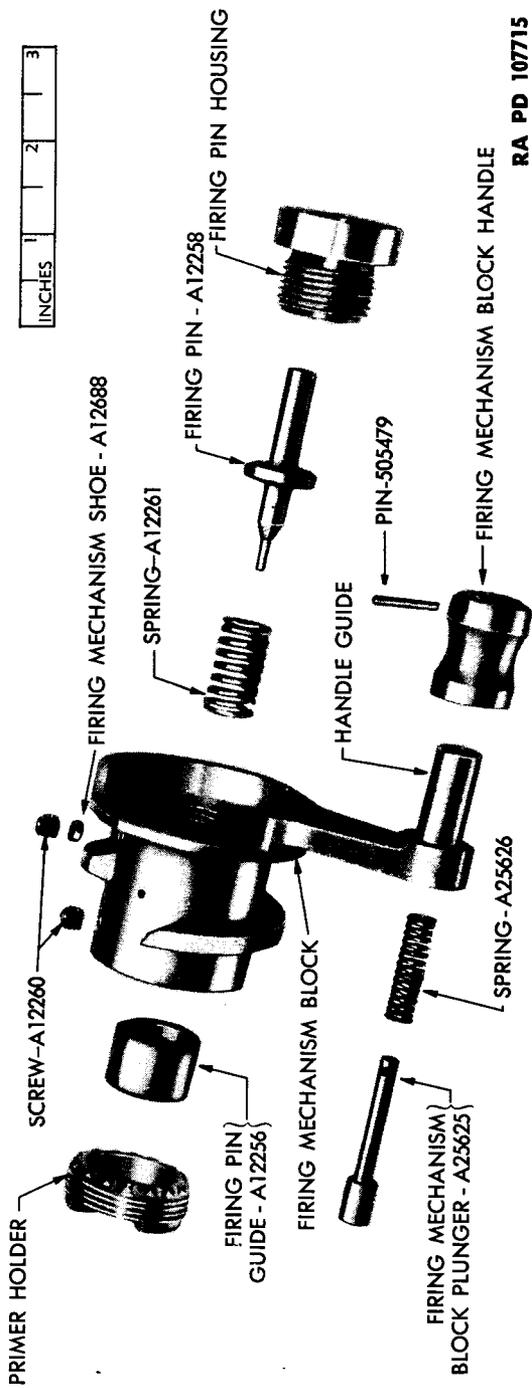


Figure 66. Firing mechanism M1—exploded view.

63. Assembly of Firing Mechanism M1

a. Place the firing pin guide in the forward end of the firing mechanism block, counterbored end inward. Screw the primer holder into the block outside the firing pin guide. Tighten the holder against the internal shoulder of the block with the firing mechanism wrench, and align the nearest notch with the setscrew hole. Insert the socket-head setscrew and tighten it. Place the firing pin spring into the firing pin guide through the rear of the block. Insert the rear end of the firing pin into the firing pin housing and screw the housing into the block, using the firing mechanism wrench. Make sure that the firing pin point properly enters its hole in the center of the guide. When the rear shoulder of the housing is seated firmly against the rear of the block, insert the copper shoe into the rear setscrew hole, then screw in and tighten the socket-head setscrew (fig. 65). Both setscrews must be flush with, or below the surface of, the block.

b. If the firing mechanism block handle has been removed, reassemble as follows: Place the firing mechanism block plunger spring on the body of the firing mechanism block plunger and insert into the bore of the firing mechanism block handle guide. Compress the spring until the smaller end of the plunger projects through the outer end of the guide. Place the firing mechanism block handle over the guide. Align the pinholes in handle and plunger and drive in the 3/32-inch diameter straight pin. Stake the pin at the ends to prevent loosening (fig. 66).

64. Disassembly of Percussion Mechanism

Disassemble the percussion mechanism, starting with the positioning pin located in the knob (fig. 67), then remove the pin in the locking pin knob to release the spring and percussion hammer locking pin. Remove pin in forked end of firing mechanism receiver housing to release hinge pin, then remove the percussion hammer.

65. Assembly of Percussion Mechanism

a. Install the percussion hammer in forked end of receiver housing, insert hinge pin through housing and percussion hammer, and secure it in place with pin. Install locking pin and spring, and secure knob to locking pin with pin. Install positioning pin in knob.

b. When the present stock of the percussion hammer locking pin A25308 (fig. 67) is exhausted, pin A7226288 will be issued. The percussion hammer B7226289 is being supplied for use with this new pin.

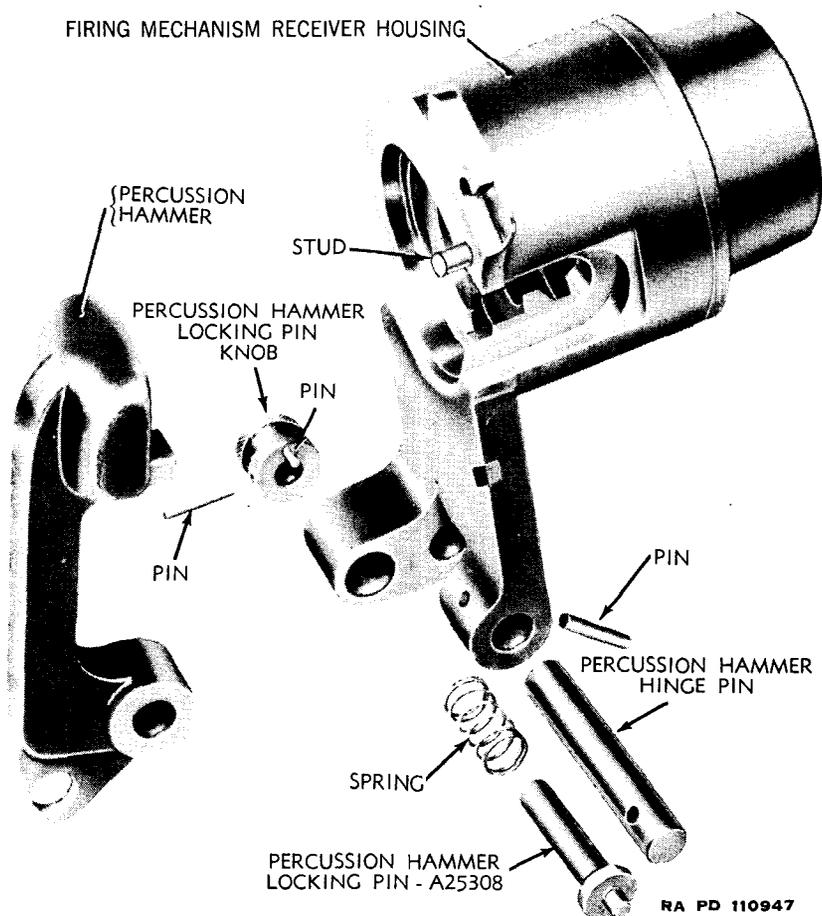
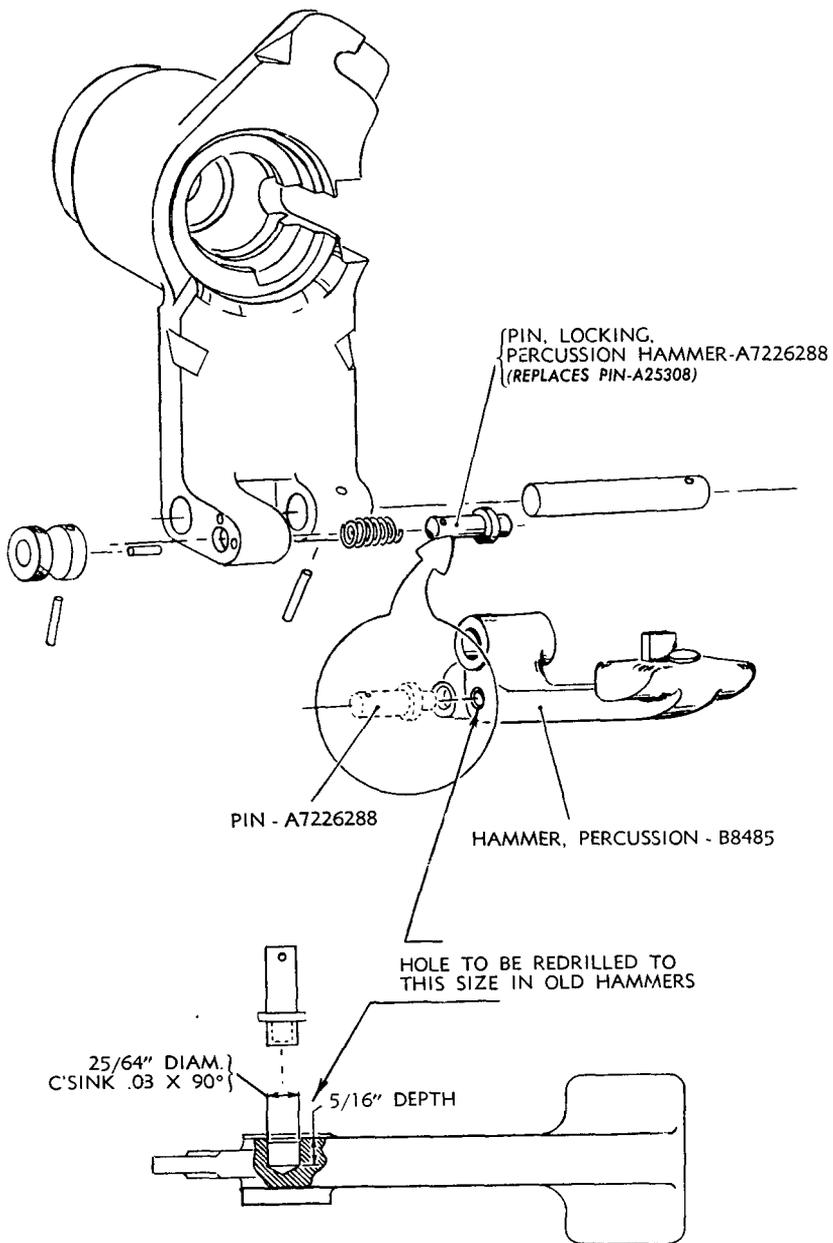


Figure 67. Firing mechanism receiver housing assembly—exploded view.

(1) Pin A25308 may be used with hammer B7226289 without modification.

(2) Pin A7226288 may be used with old hammer B8485, subject to the following modification:

(a) The recess in the hammer into which the pin seats to lock the hammer in the traveling position has been changed from $\frac{1}{4}$ -inch diameter by $\frac{1}{4}$ -inch hole in hammer B8485, to $\frac{25}{64}$ -inch diameter by $\frac{5}{16}$ -inch hole in hammer B7226289 (fig. 68).



RA PD 107718

Figure 68. Percussion hammer and new percussion hammer locking pin—exploded view.

(b) The present stock of pins and hammers will be used up before stock is replenished with the new pins and hammers. When a new pin is supplied on a requisition calling for pin A25308, the old hammer will be modified to the dimensions given above. When the old hammer is drilled, the 25/64-inch diameter by 5/16-inch hole will be given a 0.03-inch by 90° countersink. All other dimensions on the hammers remain the same.

66. Maintenance

a. Test firing mechanism by firing two primers. The primers should extend more than 1/8-inch out of the obturator spindle plug when pressed in hard with finger or thumb. Ream out the primer seat if necessary.

b. Note the action of the firing mechanism by pulling on the lanyard. It may be necessary to repair or replace parts which are worn or broken.

c. Clean all parts of the firing mechanism M1 with rifle bore cleaner or dry cleaning solvent, rinse with clean water, dry thoroughly, and lubricate as prescribed on War Department Lubrication Order 9-335.

Section XVII. COUNTERBALANCE ASSEMBLY

67. General

The counterbalance mechanism (figs. 18 and 55) is provided to facilitate opening of the breech, and to offset the retarding force of gravity on closing the breech, particularly at greater angles of elevation. This assembly is supported and hinged on the counterbalance bracket mounted on the forward right side of the breech ring, and attached to the arm of the hinge pin assembly. The spring assists in swinging the carrier when closing the breech and resists the opening movement until it is nearly completed. As the carrier approaches full-open position, the counterbalance rod and hinge pin arm pass dead-center position, and the spring tension then tends to hold the carrier in open position.

68. Removal of Counterbalance Assembly

a. Rotate the breechblock carrier until the standard spacer counterbalance (or a similar U-shaped metal device) and small block can be placed over the counterbalance piston rod, between the shoulder on the rod and the counterbalance cylinder rear head. The blocks must be of such size as to hold the piston rod shoulder 2 3/4 inches from the head.

b. With the spacer and small block in place on the piston rod, swing the breechblock carrier toward the closed position until the larger hole in the piston rod will allow removal of the piston rod over the head of the hinge pin when the keyhole end of the counterbalance cylinder is lifted upward.

c. Remove the counterbalance bracket collar detent and collar from the upright stud on the counterbalance bracket. Lift the counterbalance assembly from its supports.

69. Installation of Counterbalance Assembly

a. Rotate the breechblock carrier until the large hole in the end of the counterbalance piston rod will slip over the head of the hinge pin at the same time that the drilled lug on the counterbalance cylinder head slips over the stud on the counterbalance bracket.

b. With the counterbalance in place, put the counterbalance bracket collar on the bracket stud and secure it with the counterbalance bracket collar detent. See that the detent is slightly bent before insertion.

c. Rotate the breechblock carrier toward open position until the standard spacer and small block holding the counterbalance piston rod spring in compression can be removed.

70. Maintenance of Counterbalance Assembly

Test the mechanism to see that it functions properly at different degrees of elevation. If it does not function properly, notify ordnance maintenance personnel because disassembly of the counterbalance requires special tools.

Section XVIII. RECOIL MECHANISM AND CRADLE

71. Functioning

a. **GENERAL.** The 8-inch howitzer recoil mechanism M4 (M4A1 or M23) is of the hydropneumatic (variable) recoil type. It is composed essentially of the recoil cylinder, counterrecoil cylinder, and recuperator cylinder which are assembled within the cradle. The replenisher cylinder is mounted on the outside of the cradle at the left front end. The recoil mechanism controls the forces created by firing and checks the movement of the recoiling parts gradually to avoid displacement of the carriage. It also returns the recoiling parts into battery so that the howitzer is ready to fire again. A recoil indicator, attached to the right side of the cradle, indicates the length of recoil. The cradle is mounted in the

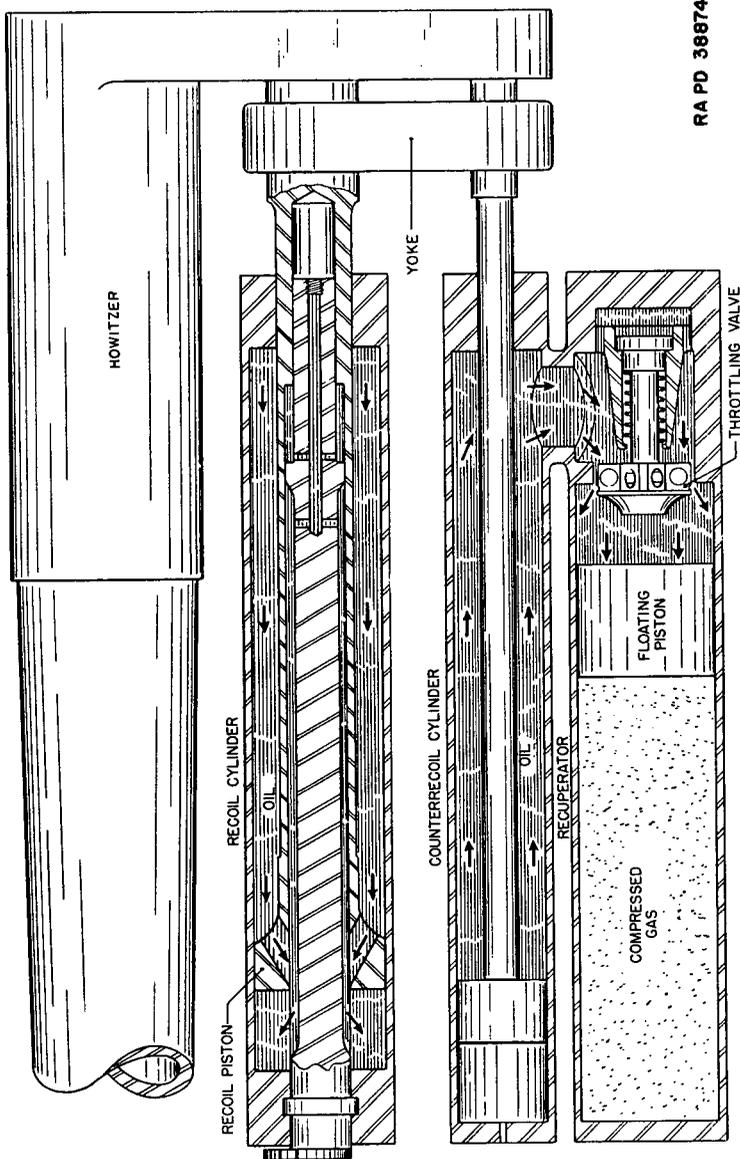
trunnion bearings on the top carriage. It houses the recoil mechanism. The replenisher and the variable recoil mechanism are assembled to the left side and front end of the cradle. The cradle trunnions form the fulcrum for the movement of the howitzer in elevation. Each of the two equilibrators is secured to the cradle near its front end and the equilibrator guides in the trunnion cap on the top carriage. The elevating arc, which is engaged by the pinion of the elevating mechanism, is held in correct alinement on the bottom of the cradle by a projection fitting a mating groove in the cradle. The howitzer moves in recoil and counterrecoil in the guides formed in the top of the cradle. The guides are provided with rail wipers at front and rear.

b. RECOIL. (1) The operation of the recoil and counterrecoil sections of the recoil mechanism can be seen from the schematic drawing (fig. 69). The recoil and counterrecoil piston rods are connected to the breech end of the howitzer, and move with the howitzer in recoil and counterrecoil. The recoil portion of the recoil mechanism absorbs and dissipates part of the recoil energy. The counterrecoil and recuperator portions of the recoil mechanism store the remainder of the recoil energy. Upon completion of recoil, this stored energy is utilized to return the howitzer to the in-battery, or firing position.

(2) During recoil, oil in the recoil cylinder is throttled through openings past the recoil piston so that recoil energy is absorbed and the howitzer motion is slowed to a stop. The recoil control rod, housed in the recoil piston rod, remains stationary during recoil. Rotation of the control rod controls the groove dimensions through which the oil is forced past the piston, and thus provides a variable recoil. Elevating the howitzer reduces the length and size of the grooves through which the oil is throttled and shortens the length of recoil. The segment of a gear on the forward end of the control rod matches the cam gear segment of the variable recoil mechanism. Rotation of this cam in this mechanism gives a rotating motion to the gear segment and control rod, as the howitzer is elevated or depressed.

(3) The rear end of the control rod acts as a buffer at the end of the counterrecoil motion, throttling a small amount of the recoil oil through throttling grooves and into the recoil cylinder, and slowing down the counterrecoil action so that the howitzer is eased into battery position.

(4) The replenisher serves as a reservoir for excess oil when increased atmospheric temperature, or heat developed during firing, expands the oil, and keeps the recoil cylinder filled when the oil contracts because of falling temperature. A filling and drain plug is provided on the forward end of the replenisher.



RA PD 38874

Figure 69. Recoil mechanism M4—schematic view.

c. **COUNTERRECOIL.** The counterrecoil parts of the recoil mechanism are contained in the recuperator and counterrecoil cylinders. These cylinders are connected near the rear ends. A regulator valve, which is open during recoil and closed during counterrecoil, is mounted near this connection in the breech end of the recuperator cylinder. During recoil, the motion of the counterrecoil piston forces oil from the recoil cylinder to open the regulator valve for the easy passage of oil into the recuperator cylinder, and forces the floating piston in the recuperator cylinder forward to compress further the nitrogen in the forward end of the recuperator cylinder (fig. 69). This absorbs some of the energy of recoil and stores it for the counterrecoil action. When the recoil action ceases, the counterrecoil action starts. The oil in the rear of the recuperator is throttled through the regulator valve in returning to the counterrecoil cylinder and forces the counterrecoil piston and the howitzer back into battery position.

72. Maintenance

a. **GENERAL.** (1) Examine recoil mechanism for general condition and loose or damaged parts. Examine condition of wipers; these must be in good condition to prevent dust or sand from entering the slides of the recoil mechanism. Damaged or deteriorated wipers must be replaced. Check for dirt or rust on slides. Remove rust and clean the surfaces.

(2) Check whether recoil and counterrecoil piston rod nuts are in position and held with cotter pins. Tighten nuts, if necessary, and replace cotter pins.

(3) When the howitzer is fired, see that the air vent in the counterrecoil front head is functioning properly and allowing the air trapped in the cylinder to escape. If the air vent is not functioning properly, notify ordnance maintenance personnel.

b. **OIL INDEX.** The amount of oil in reserve is indicated by a small rod which extends through the cylinder head. If there is a full reservoir, the oil index will project 5 millimeters or approximately 0.20 inch beyond the face of the oil index housing. If there is insufficient reserve, the oil index will project less than 5 millimeters, and may recede below the face of the index housing. Whenever the oil index projects less than 5 millimeters, it is necessary to drain completely and refill the oil reservoir as described in *f* below. If the oil index is stuck, notify ordnance maintenance personnel.

c. **VARIABLE RECOIL.** The variable recoil cam is linked to the top carriage by the variable recoil connecting rod. As the howitzer is elevated or depressed, the connecting rod moves forward or

backward. This movement rotates the variable recoil cam which, by means of gear segments, rotates the control rod. The position of the control rod determines the length and size of the grooves for the oil passage in the recoil mechanism and thereby determines the length of recoil. The recoil is shortened as the howitzer is elevated. Figures 70 and 71 show the limits of allowable recoil of the howitzer at all elevations for muzzle velocities of 1,380 feet per second and 1,950 feet per second when operated at normal temperatures of the recoil oil (70° F.). For the first few rounds fired, and at temperatures other than normal, the length of recoil may not be within the limits shown in the illustrations. If this condition continues to exist after firing several rounds, or when the recoil oil is at normal temperature, ordnance maintenance personnel should be notified.

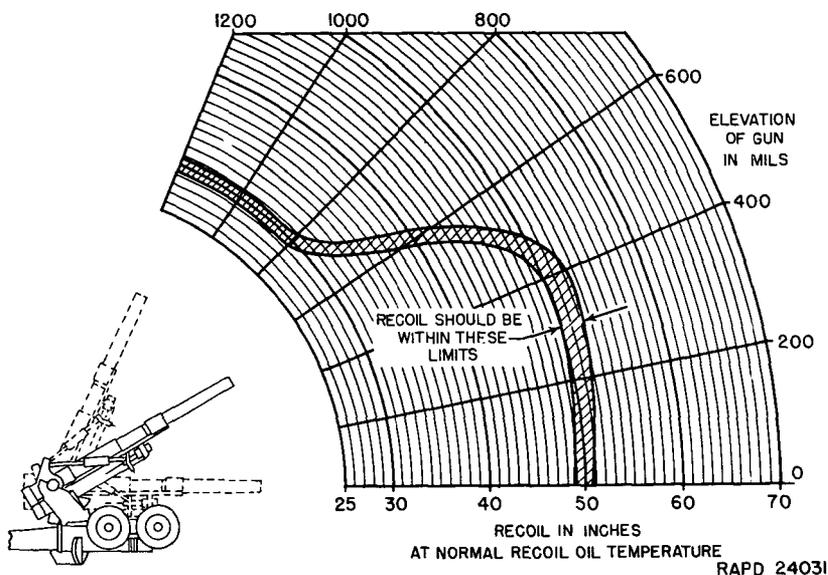


Figure 70. Limits of length of recoil—normal charge.

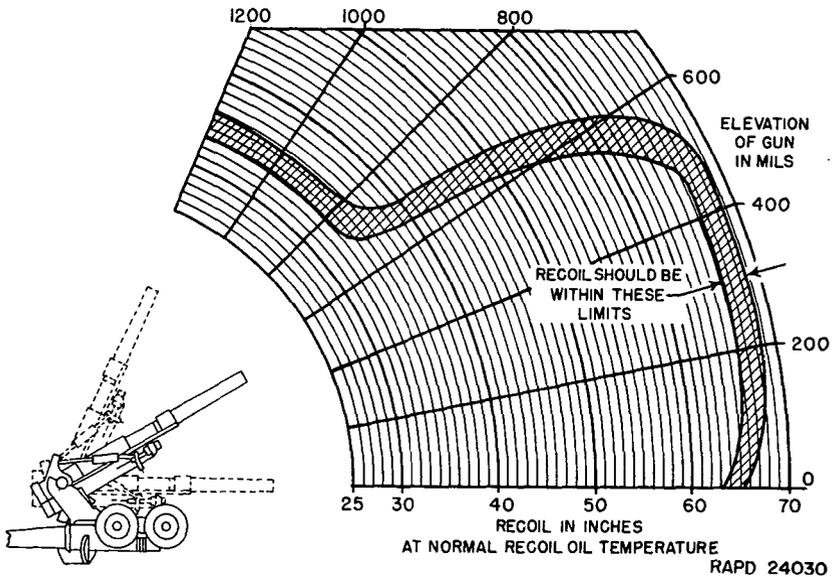


Figure 71. Limits of length of recoil—supercharge.

d. CARE OF RECOIL OIL. (1) Use only the recoil oil prescribed by War Department Lubrication Order 9-335.

(2) Water must not be allowed to enter the recoil mechanism at any time.

(3) Avoid exposure of recoil oil in an open can as it may result in the accumulation of moisture or dust. Condensation in container partly filled with recoil oil may be carried along with the oil into the recoil mechanism.

(4) It is advisable to test recoil oil for water. Fill a clean glass bottle with recoil oil. Place the bottle in a warm place and allow the oil to settle. If water is present, it will sink to the bottom. If the bottle is tilted slightly, drops or bubbles will form in the lower position. Invert the bottle and hold it to the light. Drops or bubbles of water, if present, may be seen slowly sinking in the oil. Cloudiness may also be ascribed to particles of water.

(5) If the above tests show the presence of water, the recoil oil should be turned in.

(6) Recoil oil must not be transferred to a container not marked with the name of the oil, as it may result in the wrong oil getting

into recoil mechanisms, or in the use of recoil oil for lubricating purposes. The following should also be observed: recoil oils should not be left in open containers, nor subjected to excessive heat. Take care to exclude moisture and dirt. In the event an emergency arises which requires reuse of recoil oils, strain through clean cloth before filling recoil mechanism. Do not mix recoil oils with any other type of oil.

e. FILLING RECOIL CYLINDER WITH OIL. (1) The recoil mechanism must be purged after the recoil cylinder is filled with oil. Purging means removing all the air which has been introduced when forcing in the oil. This is accomplished by pumping in oil, until no air is forced out of the purge hole.

(2) The recoil cylinder is filled through the replenisher with the oil pump M3. The position of the replenisher piston governs the filling of the recoil cylinder (fig. 72). The normal position of the replenisher piston is $5\frac{3}{4}$ inches (150 millimeters) from the rear face of the replenisher cylinder. This position indicates a full cylinder and sufficient reserve in the replenisher. Check the position of the replenisher piston, and when it is at a point 4 inches (100 millimeters) or less from the rear face of the replenisher, remove oil from the replenisher before firing is continued. The removal of oil is accomplished by means of the filling and drain valve release. When the replenisher piston has moved in to a point $7\frac{7}{8}$ inches (200 millimeters) or more from the rear face of the replenisher, add oil. If the replenisher piston does not function properly, notify ordnance maintenance personnel.

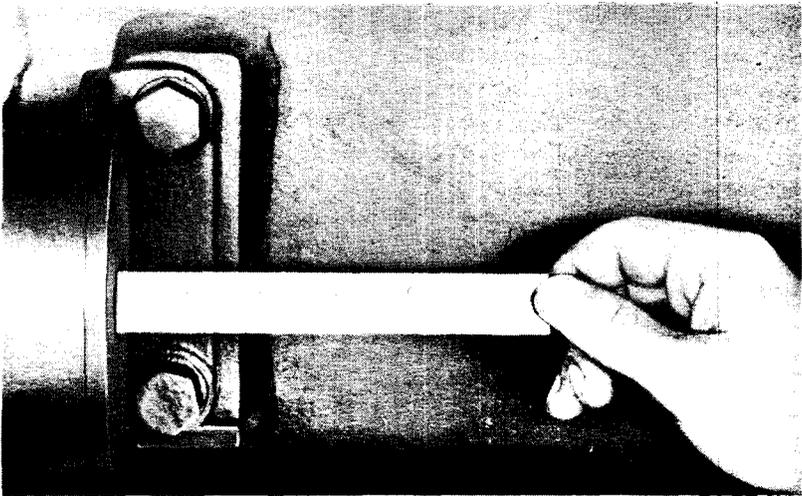
f. FILLING RECUPERATOR CYLINDER WITH OIL. The following instructions as to the number of strokes, apply only to the oil pump M3.

(1) The position of the oil index (fig. 74), which is below the filling and drain plug, should not be used as an absolute guide for determining whether the counterrecoil system contains the proper amount of oil. The normal position of the oil index in the counterrecoil system is 5 millimeters (0.20 inch) out from the rear face of the recuperator cylinder, but this position is not a definite indication of the amount of oil in the system. If the index extends out less than 5 millimeters, it is a definite indication that there is not sufficient oil. However, it may extend out 5 millimeters without sufficient reserve in the system. Fill the system to be sure that it has sufficient reserve.

(2) When the howitzer does not return to battery, or the position of the oil index indicates that there is too little oil in the recuperator, drain off the reserve oil before refilling. This is accomplished by removing the plug from the filling and drain valve located on the breech end of the recuperator. Screw in the

filling and drain valve release, and allow oil to drain until the flow ceases. Then remove the filling and drain valve release. It will be noted that the oil index should recede 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 stuck. If it still does not move, notify ordnance maintenance personnel. Purge the oil pump, clean the union of the pump tubing, and screw the union loosely into the filling and drain hole (fig. 74). Work the pump a few times until the oil is forced out through the connection, thereby excluding all air. The pump must be kept filled during operation, to a level sufficient to avoid running dry. If air should get into the tubing, it will be necessary to purge the line again. Tighten the union sufficiently to prevent further escape of oil through the connection as the pump is operated. To establish a correct reserve, pump in sufficient oil to bring the oil index to its extended position. Count the number of strokes and then add twice this amount of oil. (For example, if it requires 150 strokes to bring out the oil index, then add *another* 300 strokes of oil. One stroke is considered one complete cycle of the pump handle.) This quantity of oil is considered the correct reserve.

(3) Before filling the replenisher with oil, test the operation of the replenisher piston by inserting a scale through the opening of the replenisher piston guide and against the replenisher piston, after removing plug (fig. 72). Then release oil from the replenisher by means of the filling and drain valve release screwed into the filling and drain valve on the side of the replenisher (fig. 73). If movement of the replenisher piston takes place, proceed with the filling of the recoil cylinder as follows:



RA PD 86544

Figure 72. Measuring position of replenisher piston.

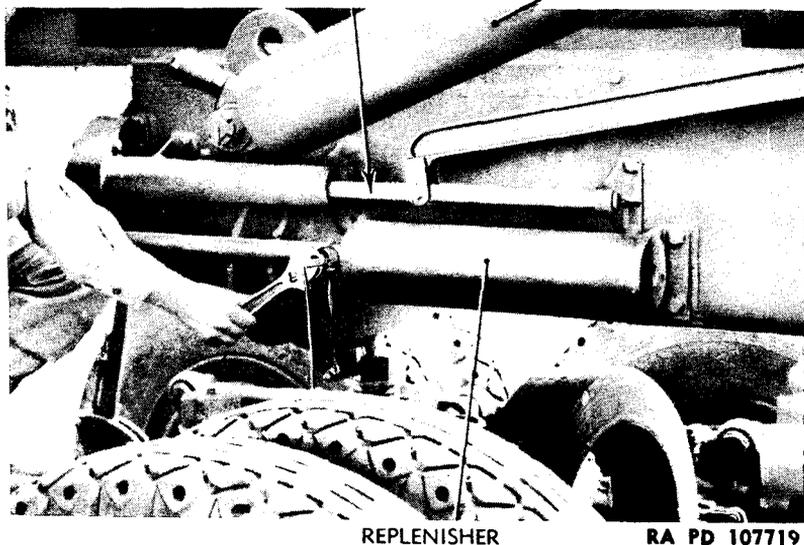


Figure 73. Draining oil from the replenisher.

(a) Unscrew the filling and drain valve release from the replenisher filling and drain valve.

(b) Screw oil filling adapter loosely into oil filling and drain valve, and attach oil filling hose from pump, handtight. Pump oil until all air is purged from hose (fig. 74). Then only, tighten connection with wrench, just enough to prevent oil from leaking. Take care not to tighten too much, as excessive pressure may damage the threads of the filling valve assembly, and thus put the entire recoil system out of action.

(c) After tightening the union, continue pumping oil until the rear end of the replenisher piston is $5\frac{3}{4}$ inches (150 millimeters) from the rear face of the replenisher.

(d) Remove the oil pump connections and replace the filling and drain plug.

(4) The allowable range of operation of the replenisher is from $7\frac{7}{8}$ inches to zero. Zero measurement is obtained when the rear face of the replenisher piston is flush with the rear face of the replenisher. When the replenisher piston approaches zero measurement, drain oil from the replenisher until the normal reading of $5\frac{3}{4}$ inches is obtained.

Caution: Be sure to fill replenisher at the end of the firing mission to allow for the contraction of oil which occurs when the system cools off. Never allow the replenisher to go beyond the zero measurement.

g. EXERCISING THE RECOIL MECHANISM. (1) The primary

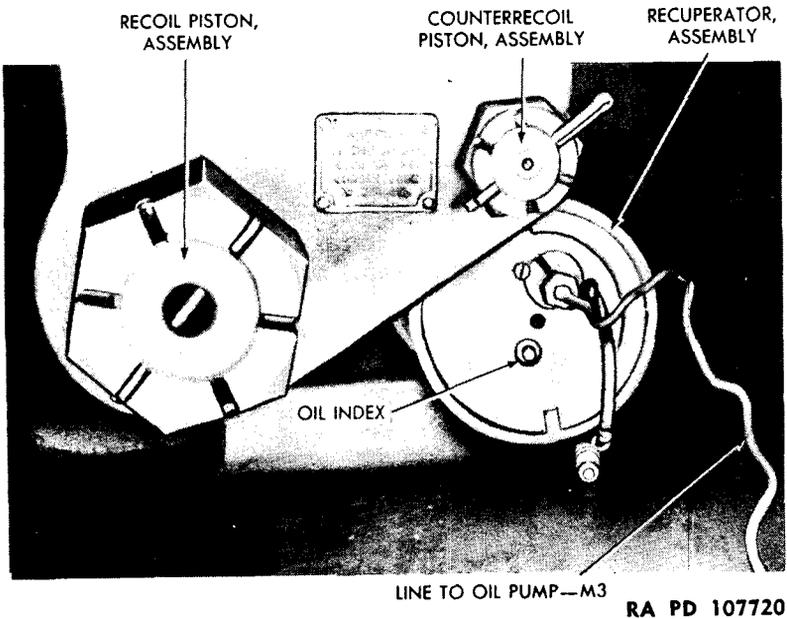


Figure 74. Pumping oil into recuperator cylinder.

purpose of exercising is to obtain a new film of oil around the piston rods and between the packings, and to move the floating piston in the counterrecoil mechanism.

(2) Firing of the weapon is one of the best means of exercising. If firing is not practicable, the use of the winch on the prime mover is suggested. Exercising in this case consists of withdrawing the recoil and counterrecoil piston rods approximately 16 to 18 inches.

(3) Ordnance personnel should be contacted for further instructions on exercising or until battery personnel become familiar with the process.

Section XIX. EQUILIBRATORS

73. General

Two equilibrators of the pneumatic type are provided to balance the weight of the howitzer muzzle and reduce the manual effort required to elevate the howitzer through the lower elevations. They consist primarily of cylindrical cases and plungers, filled with nitrogen gas under pressure and equipped with appropriate grease seals to retain the gas. The equilibrators assume a nearly closed position at the maximum elevation of the howitzer. If the howitzer is depressed, the plunger, sliding in a stationary grease seal, is retracted. This motion draws the plunger ahead toward

the stationary grease seal and further compresses the nitrogen in the equilibrator.

Note. The equilibrators are not to be disassembled except by ordnance maintenance personnel.

74. Maintenance

a. TEMPERATURE ADJUSTMENT SCALE. Temperature adjustment scales are located on both trunnion bearing caps of the howitzer to provide for an adjustment of the tension of the equilibrators for various temperatures. For satisfactory functioning, the equilibrators should be set for a temperature corresponding to the atmospheric temperature at the time of firing the howitzer. Below 0° F. it will be necessary to reverse the nitrogen pressure and above 110° F. it will be necessary to reduce the nitrogen pressure, in order to establish satisfactory handwheel loads. The adjustment may be made by trial since the scale is not correct if the equilibrator pressure is not normal. Operation of the equilibrator guide adjusting screw raises or lowers the guide and index along the temperature scale (fig. 19). If the handwheel effort required to move the howitzer in elevating is excessive, it is probably that there is low nitrogen pressure in one or both of the equilibrators.

b. MEASURING THE NITROGEN PRESSURE.

Caution: Normal gas pressure in the equilibrators is 1,355 pounds per square inch at 70° F. Hence, every caution in the following subparagraphs on opening valves and plugs slowly must be observed.

It is not advisable to check the nitrogen pressure unless it is evident that the equilibrators are not functioning properly. One grain of dust under the air filling valve will render an equilibrator unserviceable. To measure the nitrogen pressure proceed as follows:

(1) With the carriage approximately level, bring the howitzer to zero elevation.

(2) Remove the filling valve plug from the gas filling valve assembly in one equilibrator.

Caution: Remove the plug gradually to allow the escape of gas which, due to a faulty valve, may have built up a pressure against the plug.

(3) Be sure that the air release valve and the tee cap on the air filling tube are closed, and that the valve opener has been unscrewed until the point has been withdrawn into the body of the tube.

(4) Screw the pressure gage in place in the air filling tube.

(5) Screw the air filling tube and gage into the plug opening of the gas filling valve assembly of the equilibrator. Before tightening the large nut on the filling device body, swing the body into such position that the tee cap will be readily accessible and the gage easily read (fig. 75).

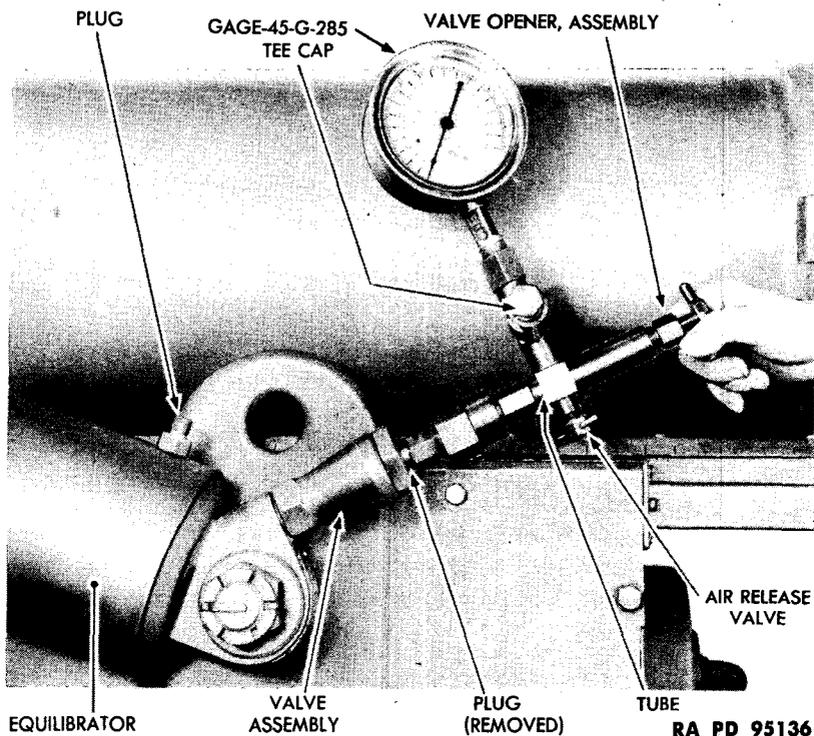


Figure 75. Checking equilibrator pressure.

(6) Force open the gas filling valve in the equilibrator by screwing in the valve opener. Tap the gage lightly to avoid error due to sticking of the hand.

(7) The pressure in the equilibrator will now be indicated on the gage. The gage reading should approximate the pressure specified in the table below for the atmospheric temperature. The allowable variation is from 89 pounds above the specified pressure to 56 pounds below the pressure. About 15 pounds of pressure will be lost during each test.

(8) If the pressure is outside these limits, proceed as in *c* below.

*Approximate equilibrator nitrogen pressure at different temperatures
(gage pressure in pounds per square inch)*

Howitzer at zero-degree elevation
(equilibrator extended)

<i>Temperature (deg F.)</i>	<i>Gage pressure (lb per sq in.)</i>
0	1,174
10	1,200
20	1,226
30	1,252
40	1,278
50	1,304
60	1,330
70	1,355
80	1,381
90	1,407
100	1,433
110	1,459

c. REMOVING NITROGEN FROM THE EQUILIBRATORS. (1) If the gage reading is more than 89 pounds in excess of the proper pressure, partially open the air release valve (fig. 75) and allow a slow escape of gas while tapping the gage lightly until the proper pressure is indicated. Close the air release valve.

(2) When the pressure is between the limits given in b(7) above, unscrew the valve opener enough to close the gas filling valve. Open the air release valve slowly to let the nitrogen out of the air filling tube and allow the pointer to go back to zero gradually. Remove air filling device and gage. Install plug and gasket. Tighten plug.

d. ADDING NITROGEN TO THE EQUILIBRATORS.

Caution: Only nitrogen gas will be used in charging hydro-pneumatic recoil mechanism and equilibrators.

If the pressure is more than 56 pounds below the desired pressure, the pressure gage should be left in place and then proceed as follows:

(1) Unscrew the valve opener enough to close the gas filling valve. Open the air release valve slowly and allow the pointer to go back gradually to zero.

(2) Remove the cap from the nitrogen cylinder. Use special cap removing tool or insert a metal bar in the slot in the cap. Connect one end of the flexible filling tube to the tee on the air filling tube and the other end to the nitrogen cylinder valve. Close the air release valve. Open the cylinder valve slowly, tapping the gage lightly until it registers. The pressure of the nitrogen cylinder registered on the gage should exceed the desired pressure in the equilibrator.

(3) Close the cylinder valve. Screw in the valve opener, just far enough to allow the gage to register the pressure in the equilibrator. Tapping the gage lightly, slowly open the nitrogen cylinder valve to allow nitrogen to enter the equilibrator.

(4) When the pressure gage indicates a pressure slightly in excess (10 to 40 pounds) of the desired pressure as specified in the table, close the nitrogen cylinder valve.

(5) Unscrew the valve opener enough to close the gas filling valve on the equilibrator. Open the air release valve slowly. Remove the flexible filling tube assembly from the air filling tube. Close the air release valve and replace the tee cap on the air filling tube. Remove the air filling device and put in the gas filling plug, noting that the gasket is in good condition.

(6) Remove the pressure gage from the air filling tube. Remove the flexible filling tube from the nitrogen cylinder. Make sure that the nitrogen cylinder valve is entirely closed and replace the cylinder cap.

(7) Proceed in the manner described in step (2) above, to measure the nitrogen pressure in the other equilibrator and, if necessary, to replenish the equilibrator. If an equilibrator has a slow leak, it may be replenished as necessary. If the equilibrator has a leak so large that it is impractical to keep the nitrogen in the equilibrator at the proper pressure, report to ordnance maintenance personnel for correction.

e. RELIEVING ACCUMULATED NITROGEN IN HEAD. (1) With the gun at zero elevation, gradually unscrew the lower one of the two screw plugs in rear head of equilibrator.

Caution: The plug should be unscrewed slowly to allow any accumulated gas to escape gradually and to avoid the danger of gas rushing out and causing damage.

(2) Elevate the howitzer to maximum elevation and replace plug. Be sure that the plug is tight.

Section XX. ELEVATING MECHANISM

75. General

a. The elevating mechanism is mounted on the right side of the top carriage and moves the cradle and howitzer in elevation about the trunnions as an axis. Motion of the handwheel is transmitted through a series of gears to the pinion portion of the elevating gear shaft and this, in turn, moves the elevating arc attached to the cradle. The gear train, with the exception of the elevating mechanism pinion, is mounted on antifriction bearings. Seals and oil retainers are provided to make the mechanism oiltight. The mechanism is enclosed by a cover to keep out dust and dirt.

b. The elevating mechanism is equipped with a brake which is engaged at all times and must be released in order to operate the elevating handwheel. The brake is released by pressing down on

the brake lever. After the adjustment of howitzer in elevation is made, the lever is released, thus automatically engaging the brake through action of springs and lugs within the brake housing.

76. Maintenance

a. Operate the elevating mechanism to determine smoothness of operation, and whether there is any backlash, or play, in the mechanism. If backlash exceeds one-sixth of a turn of the handwheel, notify ordnance maintenance personnel.

b. Inspect for defective or broken parts. If replacement is necessary, notify ordnance maintenance personnel.

c. Examine for proper lubrication, and lubricate if necessary.

d. Note the movement of the brake to see if it functions properly.

e. Note whether the nut which retains the handwheel is in place. Tighten if necessary.

Section XXI. TRAVERSING MECHANISM

77. General

The traversing mechanism is mounted on the left side of the top carriage and rotates the howitzer in azimuth by means of a pinion which meshes with the traversing rack. The traversing rack is secured to the bottom carriage. The traversing handwheel shaft is connected, through flexible joint, to a worm which drives a worm wheel connected to the pinion. This pinion meshes with the traversing rack. The worm and worm wheel operate on anti-friction bearings in a housing which is sealed to retain the lubricant and exclude dust and dirt.

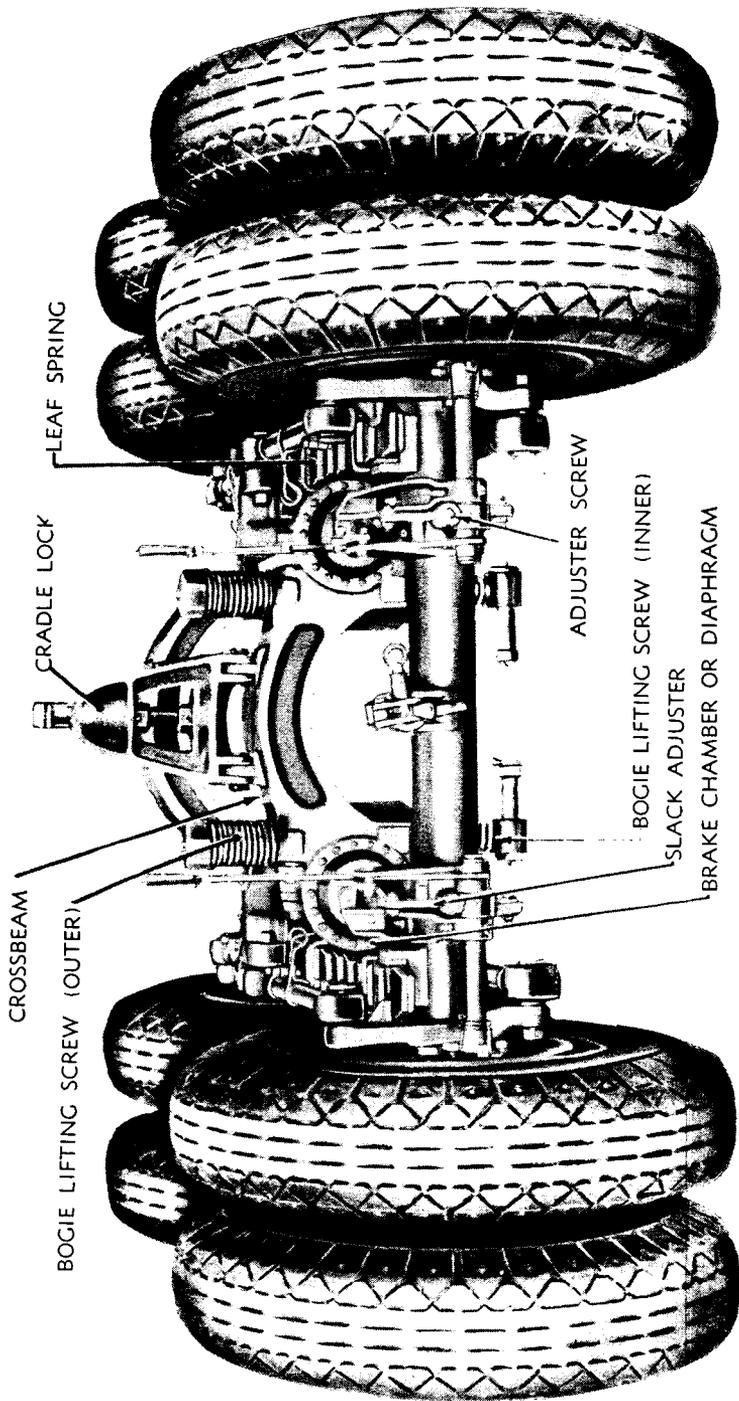
78. Maintenance

a. Operate the traversing mechanism to determine smoothness of operation and whether there is any backlash, or play, in the mechanism. If backlash exceeds one-sixth of a turn of the handwheel, notify ordnance maintenance personnel.

b. Inspect for defective or broken parts. If replacement is necessary, notify ordnance maintenance personnel.

c. Examine for proper lubrication, and lubricate if necessary.

d. Test the clearance between the front and rear clamps that transmit the tipping loads from the top carriage to the bottom carriage. A piece of very thin tin or heavy paper may be used for this purpose. The clearance should be between 0.003 and 0.010 inch.



RA PD 95146

Figure 76. 8-inch howitzer bogie M1.

Section XXII. BOGIE

79. General

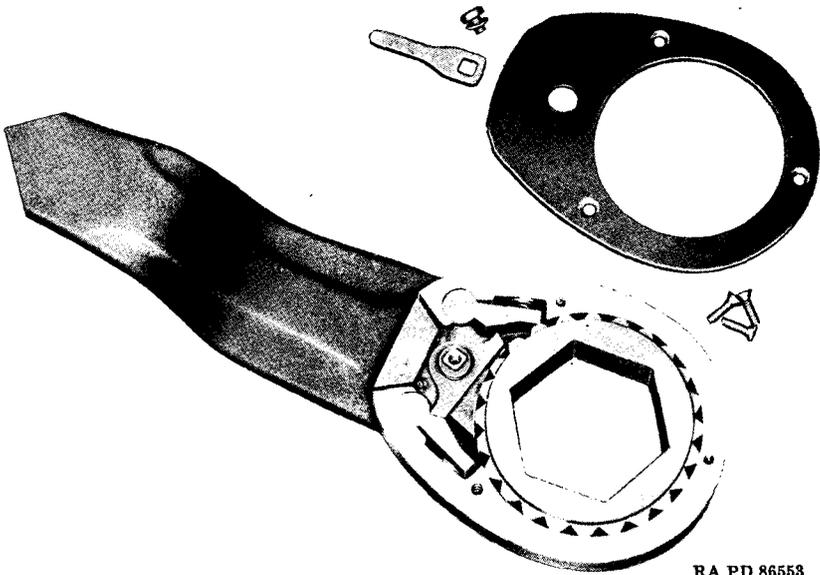
a. The two-axle, dual-tired bogie supports most of the weight of the howitzer and carriage when traveling. The arched and the straight axles are held in position by torque rods. The bogie is equipped with a mechanism to lower or raise the carriage into firing or traveling position.

b. Compound screws, with external right-hand threads, are screwed into the cross beam (fig. 76). The internal threads of the compound screws are left-hand and are assembled with pins which fit in holes on the front end of the bottom carriage. To raise or lower the carriage, turn the screws by means of reversible ratchet wrenches applied to the hexagonal end of the screw.

Note. The canvas covers are to be kept on the bogie lifting screws except when operating these screws.

c. The two wrenches furnished are secured by clips to the outside of the trails (fig. 1). The mechanism consists of two spring-loaded dogs underneath the cover, which are actuated by a lever (fig. 77). A latch on the outside of the cover operates the lever to engage one of the dogs with a geared nut, thus changing the direction of rotation.

d. Periodically remove the cover and clean any dirt which may have accumulated in the interior of the wrench.



RA PD 86553

Figure 77. Bogie lifting screw ratchet wrench—cover removed.

Section XXIII. WHEELS AND TIRES

80. Removal of Wheels and Hubs

a. GENERAL. Raise the wheels clear of the ground, either by means of the jack provided, or by lowering the carriage to the ground and raising the bogie wheels with the lifting mechanism.

b. REMOVE OUTSIDE WHEELS. Remove cap nuts (fig. 78). Note right-hand and left-hand thread feature of the nuts.

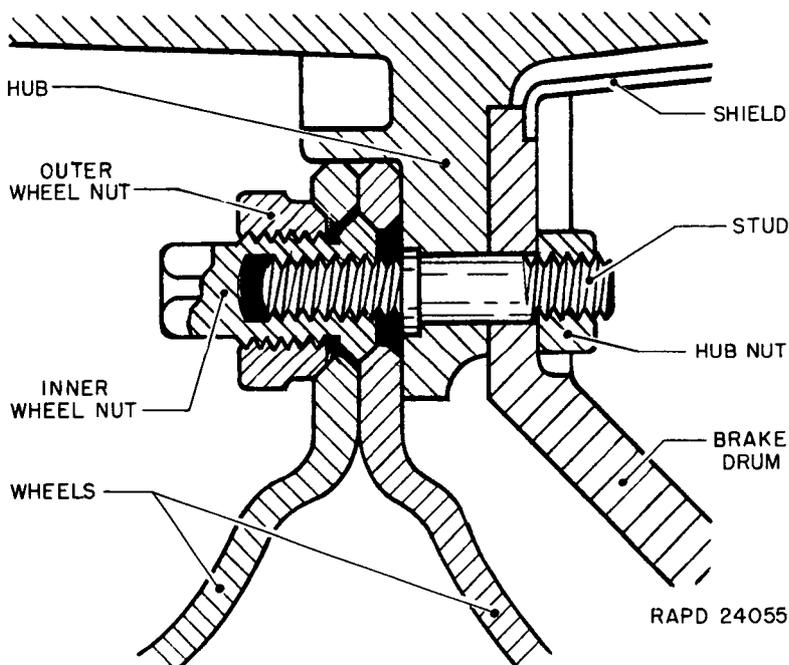


Figure 78. Dual wheel mounting—diagrammatic sketch.

c. REMOVE INSIDE WHEELS. Remove outside wheels as described above. Remove cap nuts (fig. 78). Note left-hand and right-hand thread feature of the nuts.

d. REMOVE HUBS. Remove wheels as described above. Remove the hub cap and its gasket by removing the six cap screws securing them to the hub. Remove the axle end nut, the axle washer, and the axle nut and dowel. Withdraw the taper roller bearing. Remove the hub and brake drum, taking care not to damage the large taper roller bearing or the oil retainer at the inner end of the hub (fig. 79).

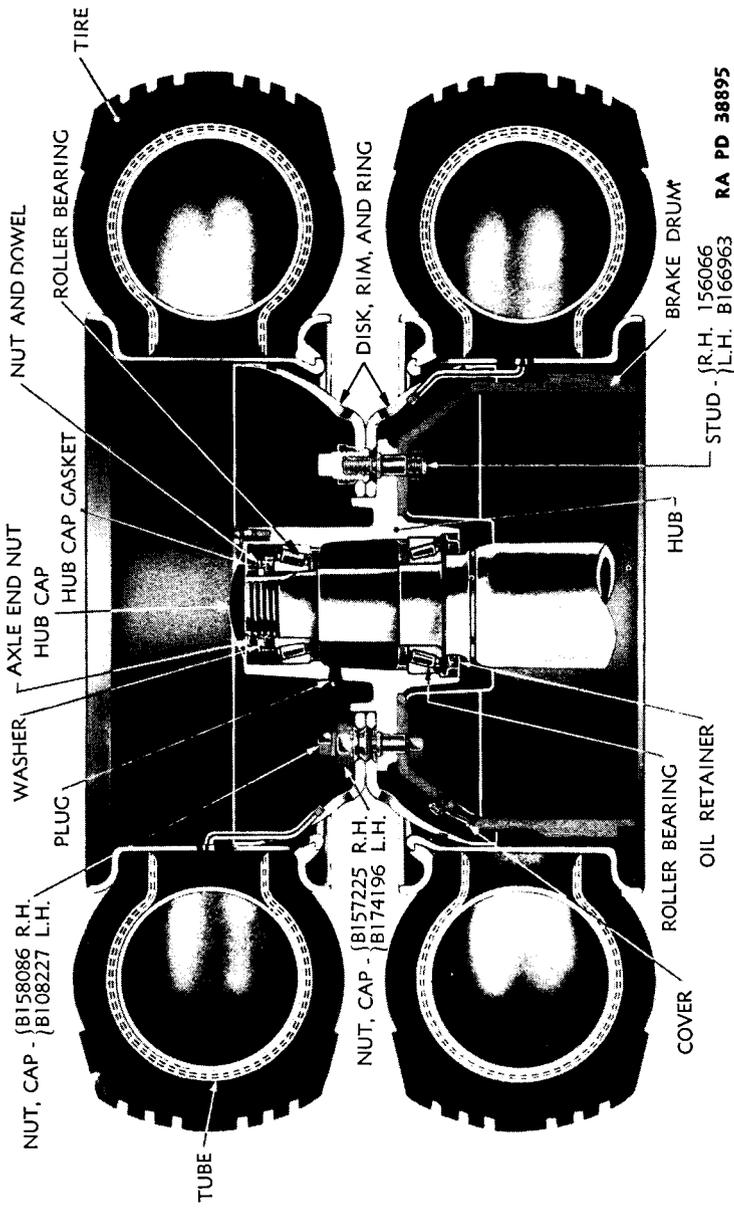


Figure 79. Dual wheel—phantom view.

81. Maintenance

a. WHEEL BEARINGS. Remove bearing cone assemblies from the hub. Wash bearings, cones, spindle, and inside of hub and dry thoroughly. *Do not use compressed air.* Inspect bearing races for serviceability, and notify ordnance maintenance if replacement is necessary. Coat the spindle, and the inside of hub and hub cap, with the grade of lubricant as prescribed on War Department Lubrication Order 9-335 to a maximum thickness of 1/16 inch for the purpose of retarding the formation of rust. Lubricate the bearings with the same grade of grease with a packer, or by hand, kneading the grease into all spaces in the bearing. Use extreme care to protect the bearings from dirt, and reassemble immediately. Do not fill hub, or hub cap, as any excess grease might result in leakage into the brake drum. The grease in the bearing is sufficient to provide lubrication until the next service period.

b. BRAKE CAMSHAFT BEARINGS, AND BRAKE ANCHOR PINS. When wheels are removed for bearing lubrication, remove plug and insert fitting so that lubrication can be accomplished as prescribed on War Department Lubrication Order 9-335.

82. Assembly of Wheels and Hubs

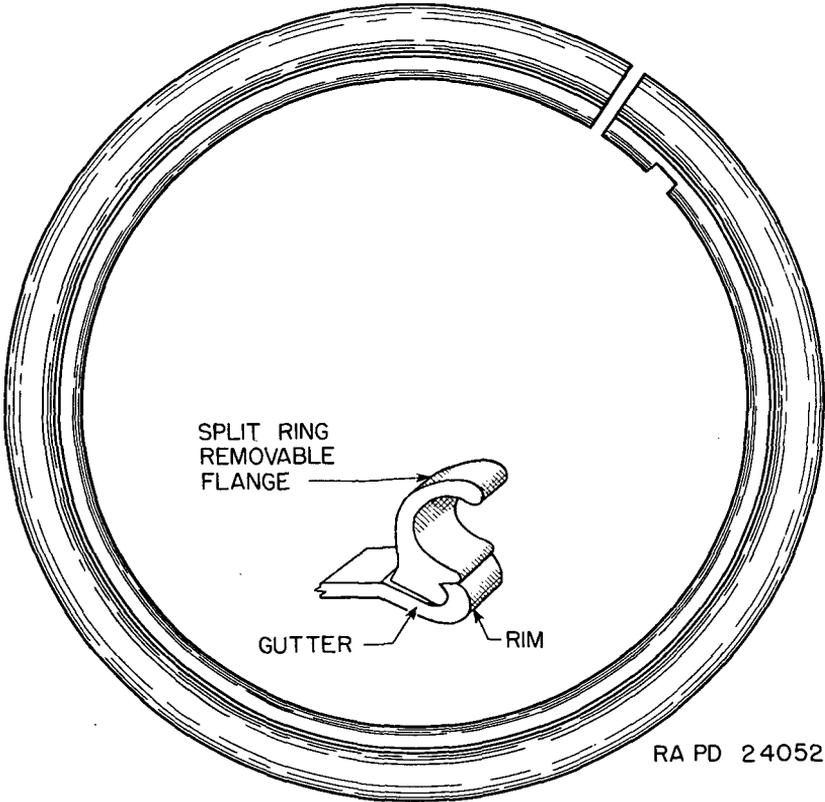
Place the large roller bearing cone and roller in its cup in the inner end of the hub. Place the oil retainer in the inner end of the hub with the lip of the sealing member towards the roller bearing. Carefully place the hub and bearing over the axle end. After lubricating, put the smaller taper roller bearing cone and roller on the axle end, following it with the axle nut and dowel. Adjust the nut and dowel until the hub rotates freely, but with no play. Place the axle washer in the keyway of the axle end and make any necessary slight adjustment of nut and dowel so that the dowel engages one of the holes in the washer, thereby locking the nut. Assemble and tighten the axle end nut against the axle washer. Put the hub cap and gasket back on the hub. Assemble the wheels to the hub (fig. 79).

83. Removal of Tires and Tubes

a. DEFLATE TIRE. Remove the wheels (par. 80). Deflate the tire by removing the valve core, to permit the tire locking ring to be removed.

b. REMOVE TIRE LOCKING RING. Figure 80 shows the tire locking ring and how it is locked in place. Force the locking ring down far enough to unlock it. Then with the ring tool in the

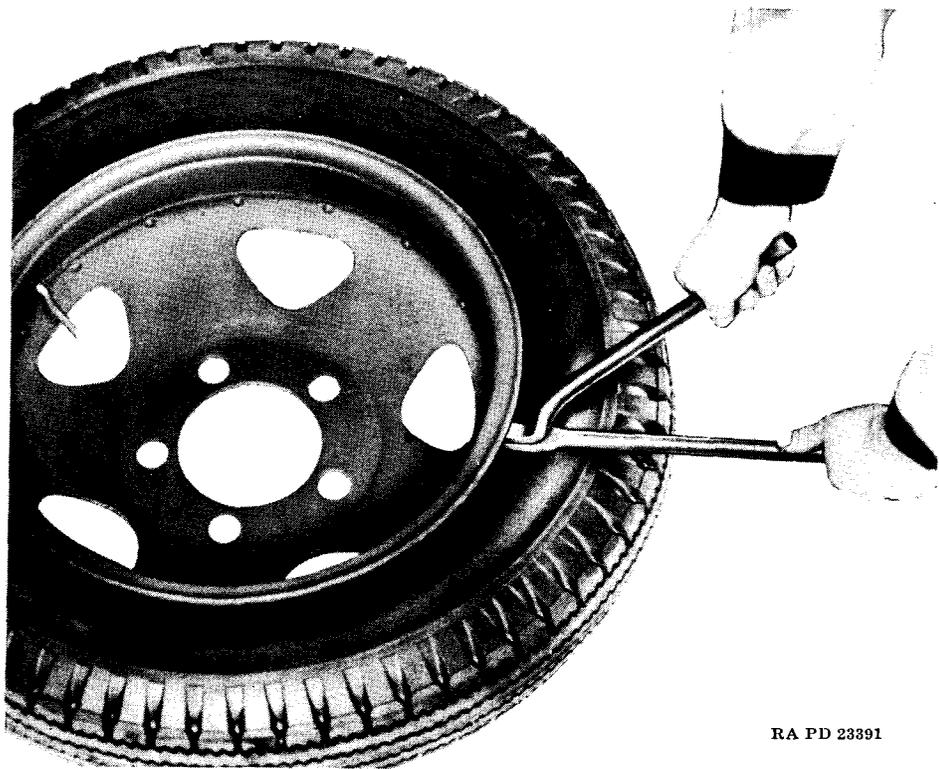
breaking notch, pry the ring out over the rim flange. To avoid twisting the ring, pry only enough to clear the rim flange. Follow around with a tire iron until the ring can be lifted off.



RA PD 24052

Figure 80. Tire locking ring.

c. LOOSEN TIRE FROM WHEEL. Turn the wheel and tire over and force the tire bead away from the rim flange, using a tire releasing tool (fig. 81) or a blunt wedge and mallet.



RA PD 23391

Figure 81. Loosening tire from wheel.

d. REMOVE TIRE FROM WHEEL. Place blocks under the wheel and push tire down off rim. If the tire is loose on the rim, it may be removed by hand with the wheel in a vertical position.

e. REMOVE INNER TUBE. Spread the casing with a tire spreader, to permit removing the tube. If a tire spreader is not available, wooden blocks may be used to hold the casing open while taking out the tube (fig. 82). If bullet-resisting tubes are used, they should be removed in a similar manner. Because of their heavier construction, however, it will be more difficult to remove them from the tire. Do not pull on the valve stem, as this may cause leakage of the valve. Do not use sharp objects to pry the tube out of the tire. A tool without sharp edges may be used after removal has been started by hand. Bullet-resisting tubes should be partially inflated immediately after removing from the tire to prevent the inside surfaces from sticking and sealing together.

84. Installation of Tires and Tubes

a. INSPECT AND REPLACE PARTS. Inspect the wheel and locking ring to see if they are bent or otherwise damaged, excessively

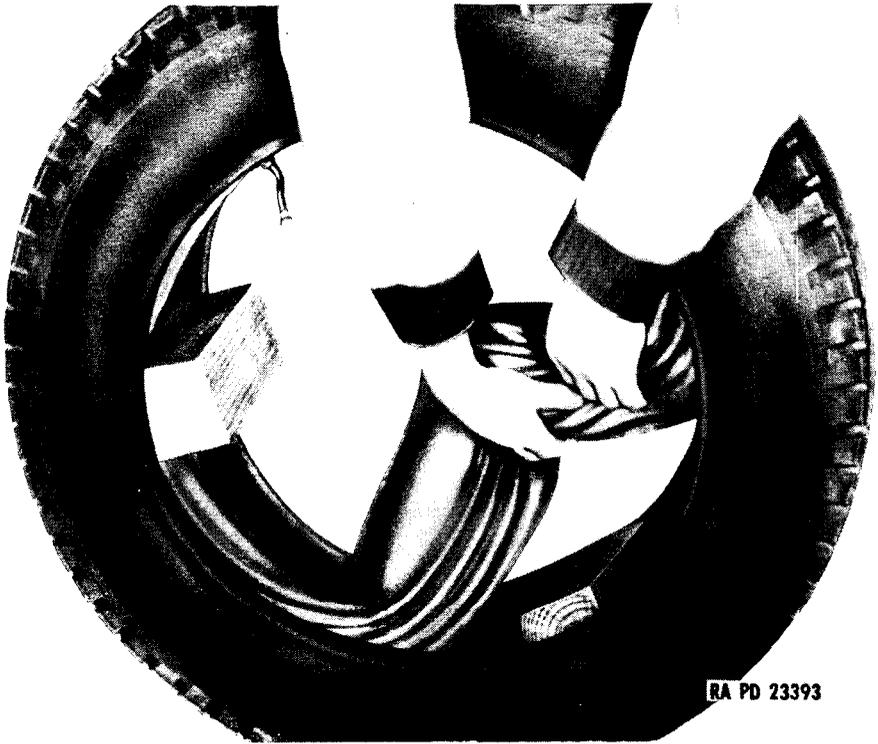


Figure 82. Removing tube from tire

worn, or unfit for service. Damaged tires, in many cases, can be repaired, while excessively worn tires and damaged inner tubes should be replaced.

b. INSTALL INNER TUBE. Spread the tire casing with the tire spreader or wooden blocks to permit installation of the inner tube (fig. 82). Deflate the inner tube and install it in the tire with the valve stem opposite the red dot on the side wall of the tire. Bullet-resisting tubes will be installed in a similar manner. Because of their heavier weight and greater thickness, they are more difficult to handle.

Note. After installing the tube, partially inflate and deflate several times to remove all kinks and folds.

c. MOUNT TIRE ON WHEEL. (1) Insert the valve stem in the wheel slot, working the tire into position on the wheel. Soap or a soap solution may be used as a lubricant to aid in slipping the tire onto the wheel.

(2) Lay the tire and wheel on a flat surface (gutter side of the rim up) with suitable blocking under the wheel to raise the tire just clear of the floor. Place the locking ring in approximate

position above the rim gutter. Pry the locking ring into the rim gutter, a little at a time, locking the notched end last.

d. PARTIALLY INFLATE TIRE. Partially inflate the tire and, at the same time, tap the locking ring at points around the rim to seat it properly. Do not overinflate the tire at this time; just a few pounds of pressure is enough to seat the locking ring in position.

e. INFLATE TIRE. Place tire in normal vertical position and inflate from the side opposite the tire locking ring.

Caution: Stand on the side of the assembly, away from the tire locking ring, to avoid injury in case improper installation causes the locking ring to blow off.

f. ALLOWABLE VARIATION OF TIRE PRESSURE. The prescribed tire pressures for the carriage may be reduced or increased by 20 percent (10 percent for heavy carriage limber M5) depending upon conditions under which used. The prescribed pressures refer to pressures when tires are cold. For this reason air should never be let out of tire when the air pressure exceeds the authorized maximum inflation during or immediately after operation.

85. Maintenance

a. WHEELS. (1) Check for any loose or missing nuts. Tighten or replace as necessary.

(2) Check for proper lubrication of the wheel bearings. Lubricate if necessary (par. 81*a*).

(3) Jack up the wheels and rotate them to test for drag, bearing adjustment, and trueness of wheel. Correct drag and bearing adjustment (par. 82). If wheel is not true, notify ordnance maintenance personnel.

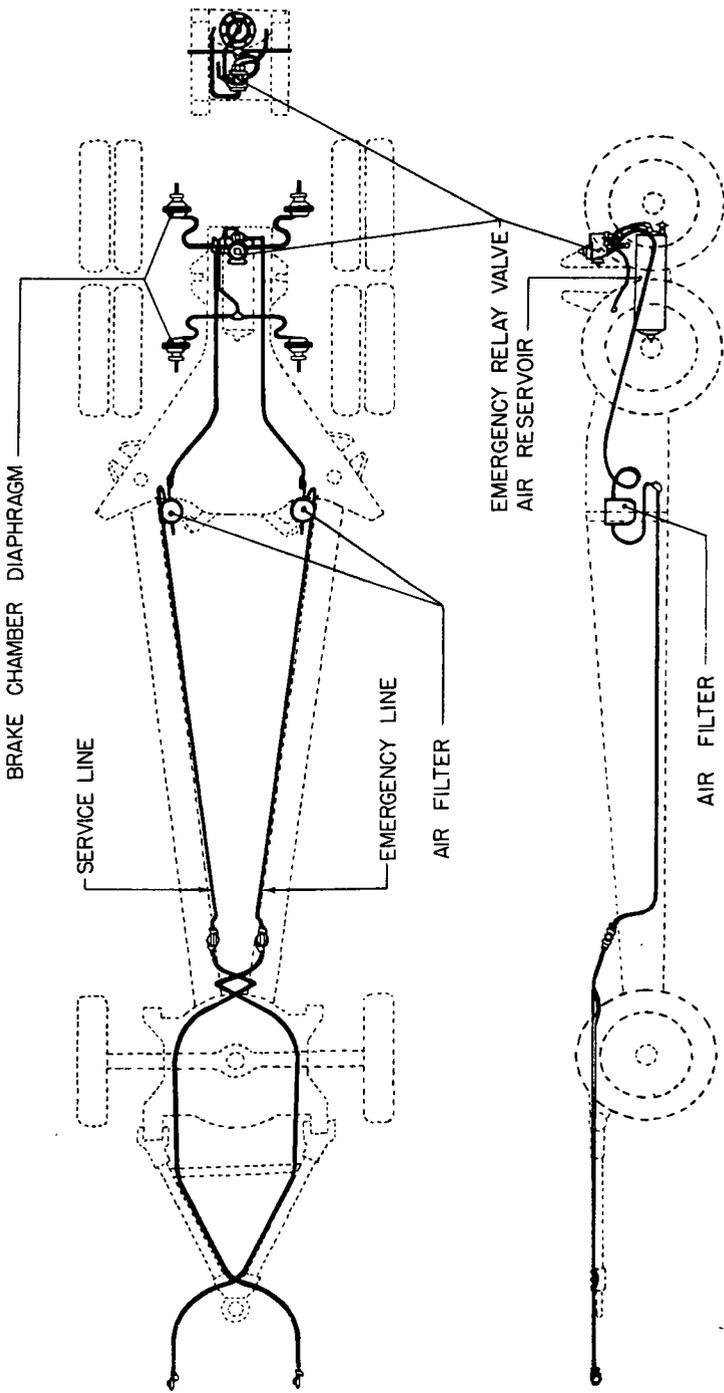
b. TIRES. (1) Check the tires for correct pressure (par. 6).

(2) Note the condition of the tires to see whether the treads are wearing evenly. Look also for torn strips and embedded stones. Interchange the tires if necessary, and remove any embedded stones.

Section XXIV. BRAKES

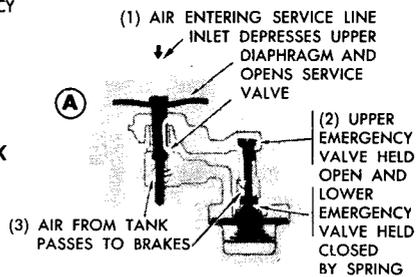
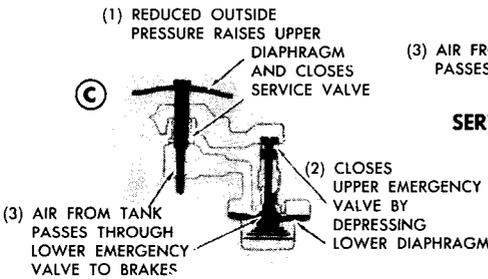
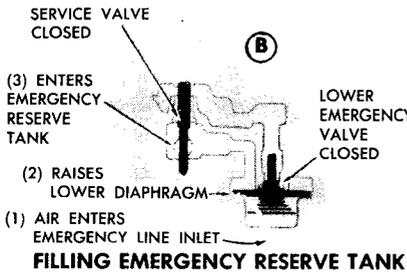
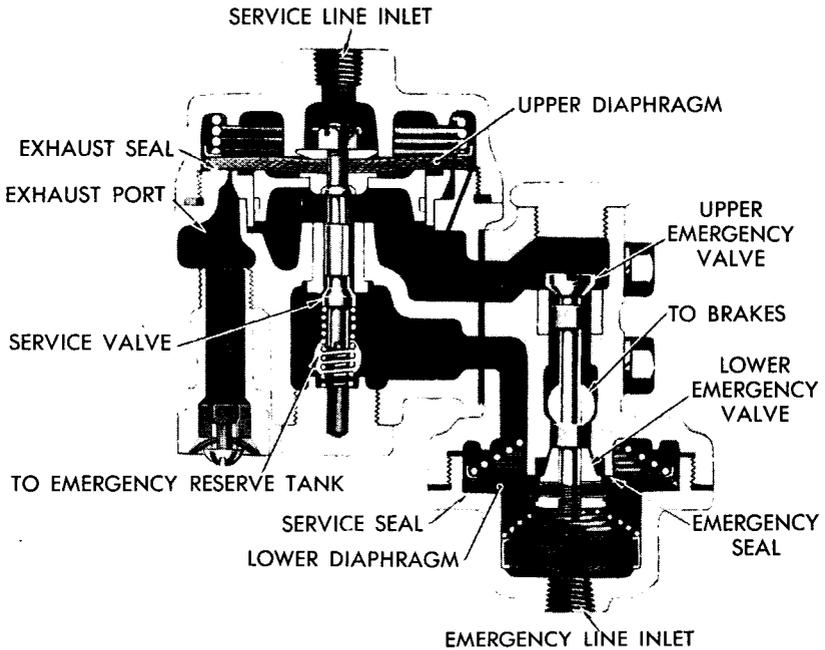
86. General

a. DESCRIPTION. The air brake system (fig. 83) includes the brakes, relay emergency valve, and the air lines. Two air line filters are mounted on the inside plate of the forward ends of the trails and serve to prevent dirt from entering the relay-emergency valve. One of these is connected to the service line and the other to the emergency line.



RA PD 24058

Figure 83. Diagram of air brake system.



RA PD 107722

Figure 84. Relay-emergency valve—cross-sectional view.

b. **FUNCTIONING.** (1) When the driver of the prime mover applies the brakes, air pressure, controlled by the brake valve on the prime mover, flows through the service line into an air filter, and from the air filter to the relay-emergency valve (fig. 84). As the air pressure enters the service line inlet of the relay-emergency valve, it depresses the upper diaphragm and opens the service valve (A, fig. 84). The air then flows through the upper emergency valve (A, fig. 84) (upper valve is held open and lower valve held closed by spring) to the brake operating chamber on each wheel where it forces a piston rod to rotate a brake operating cam which actuates the brake shoes (fig. 85).

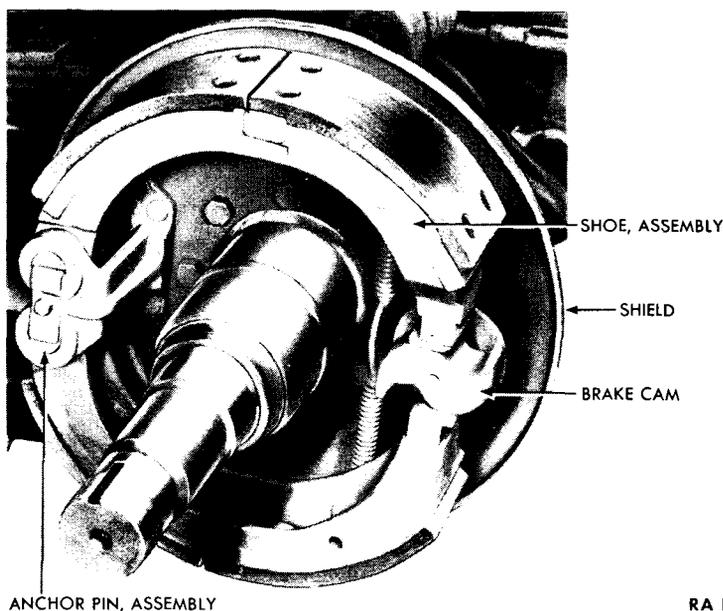


Figure 85. Brake shoes.

(2) Although the air pressure can flow through the service line only when the driver applies the brakes, it always flows through an emergency line to the relay-emergency valve. The air pressure flows through an air filter in the emergency line into the emergency line inlet where it raises the lower diaphragm and enters the emergency reserve tank (B, fig. 84).

(3) In the event that the carriage breaks away from the prime mover, the air pressure in emergency reserve tank, being greater than the outside air pressure, will raise the upper diaphragm, and close the service valve, thus preventing air escape through the service line inlet (C, fig. 84). At the same time, the air pressure

from the reserve tank will depress the lower diaphragm, closing the upper emergency valve and opening the lower emergency valve. Thus, the air pressure will flow through the opened lower emergency valve into the brake chambers where it is converted into mechanical energy necessary to apply the brakes.

(4) When emergency application of the brakes has occurred it will be necessary to release the brakes. This may be accomplished by one of the two following methods:

(a) The recommended method is to repair and reconnect the air brakes so that all connection lines and equipment are in their original condition, and then to operate the air compressor on the prime mover to build up the air pressure. As this pressure in the pilot reserve cavities in the relay-emergency valve is equalized, it forces the emergency diaphragm in the relay-emergency valve upward so that the emergency valve resumes its normal operating position. In this position the diaphragm, pressed against its seat, seals the lower end of the cavity against the pressure in the upper part of the cavity and holds the emergency valve off its seat. This opens the brake chambers for the admission of air.

(b) The other method is to drain the air pressure from the air reservoir on the carriage by means of the drain cock at the bottom of the reservoir.

87. Brake Maintenance

a. BRAKE ADJUSTMENT. Adjustment of the brakes is accomplished by means of a slack adjuster at each wheel (fig. 86). Check the push rod travel by measuring the push rod with the brakes released, and then with the brakes applied. If the push rod travel is in excess of $\frac{7}{8}$ inch, adjustment is required. The most efficient brake action is obtained when the slack adjuster arm travel is held to a minimum so that the full length of the lever is used. This adjustment is accomplished by jacking up each wheel and tightening the adjusting screws of the slack adjusters (fig. 86) until the brakes drag, and then loosening them until the wheel just turns freely.

b. AIR FILTERS (fig. 87). (1) The drain plugs should be removed at any time the presence of moisture is suspected.

(2) Clean the strainer assembly as follows:

(a) Detach the strainer assembly by removing screws, chamber, support, and gasket and take strainer out by pulling it slightly downward.

(b) Clean the strainer by brushing off accumulated foreign matter, washing with dry cleaning solvent, and allowing to dry. Remove any rust or foreign matter from the interior of the body.

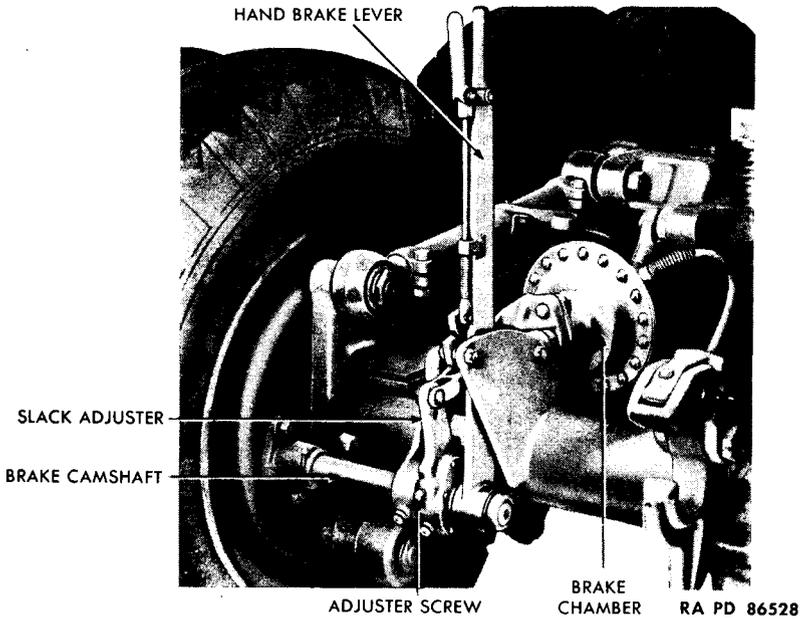


Figure 86. Slack adjuster.

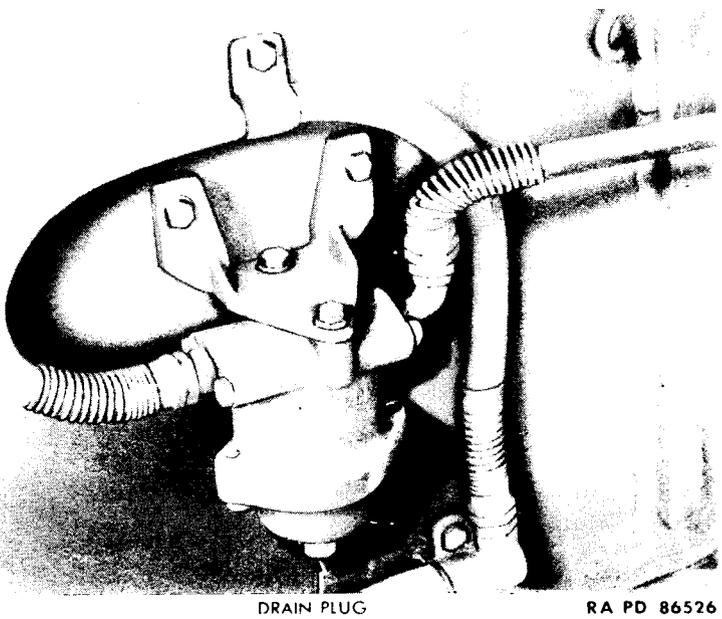


Figure 87. Air filter.

c. **BRAKE DRUMS.** In order to prevent damage to the brake shoes, all accumulated dirt should be removed, and the drums cleaned thoroughly with dry cleaning solvent, whenever the wheel bearings are repacked.

d. **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. Air lines should be connected to the dummy couplings immediately upon disconnection from the prime mover (fig. 21). If the couplings 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.

e. **AIR RESERVOIR DRAIN COCK.** An air reservoir drain cock is located at the bottom of the reservoir to permit the draining of accumulated condensation. The reservoir should be drained at least once a week or before traveling, and after each 8 hours of traveling.

Section XXV. HEAVY CARRIAGE LIMBER M5

88. General

a. The heavy carriage limber M5 (fig. 1) is used with the 8-inch howitzer M2. It is a two-wheeled, pneumatic-tired vehicle that secures the spade ends of the trails, and provides a means by which the howitzer carriage can be towed.

b. The principal parts of the limber M5 are the axle and the trail clamping bracket, the limber lifting bracket, and the drawbar with spring-loaded lunette.

c. The limber lift bracket is mounted on the axle and forms a seat for the trail ends.

d. The trail clamping bracket secures the trail ends together and also to the limber lift bracket. It is hinged to the lift bracket by means of a coupling pin at its forward end.

e. Air brake hose are provided for coupling to the air hose of the prime mover and of the howitzer carriage. The couplings are connected together when the limber is disconnected from prime mover or carriage.

89. Removal and Installation of Limber

Removal and installation of this limber are discussed in paragraphs 18*b* and 22*b*.

PART FOUR

AUXILIARY EQUIPMENT

Section XXVI. GENERAL

90. Scope

Part four contains information for the guidance of the personnel responsible for the operation of this equipment. It contains only the information necessary to using personnel properly to identify, connect, and protect such auxiliary equipment while being used or transported with the main equipment. Detailed instructions pertaining to auxiliary equipment are contained in other Technical Manuals listed in appendix II.

Section XXVII. AMMUNITION

91. General

Ammunition for the 8-inch howitzer M2 is of the separate-loading type. The loading of each complete round into the cannon requires three separate operations: loading the projectile, the propelling charge, and the primer. The components of a complete round, projectile, propelling charge, primer, and fuze are shipped separately. The fuze is assembled to the high-explosive projectile just prior to firing.

92. Firing Tables

Firing data for the ammunition fired in the 8-inch howitzer M2 is provided in FT 8-J-1 and FT 8-K-1. Firing data for the ammunition fired in the 37-mm subcaliber gun M1916 is provided in FT 37-BA-2 (abridged) and FT 37-BJ-2 (abridged). An index of firing tables is maintained in FM 21-6.

93. Classification

Dependent upon the type of projectile, ammunition for this howitzer is classified as high-explosive and dummy. The high-explosive projectiles have comparatively thin walls and contain a high-explosive bursting charge. They are intended principally for fragmentation or mining effect. The dummy (drill) projectiles, which are completely inert, are intended for practice in loading and handling.

94. Identification

a. GENERAL. The various rounds may be identified as follows:

Table I. Color scheme

Type of projectile	Kind of filler	Color of body	Color of markings	Other distinguishing characteristics
HE	TNT*	Olive Drab	Yellow	None.
Dummy	None	Black	None	One red band painted around body of projectile at center of gravity.

* TNT—trinitrotoluene.

b. AMMUNITION LOT NUMBER. A lot number is assigned to all ammunition at the time of manufacture. This lot number is stamped or marked on each of the components unless the item is too small, and on all packing containers. It is required for all purposes of record, including reports on condition, functioning, and accidents in which the ammunition is involved. All components in any one lot of separate-loading ammunition are manufactured under as nearly identical conditions as possible to insure uniform functioning. Consequently, to obtain the greatest accuracy in firing, successive rounds should consist of projectiles of one lot number, fuzes of one lot number, and propelling charges of one lot number.

c. WEIGHT-ZONE MARKINGS. It is not practicable to manufacture projectiles within the narrow weight limits required for accuracy of fire. Therefore, they are grouped into weight zones, and appropriate ballistic corrections are given in the Firing Tables for the variation in weight. The weight zone of the projectile is indicated thereon by placing on the projectile yellow squares, with a prick-punch mark in the center of each. There are one, two, three, four, or more squares with punch marks appearing on each projectile, depending upon its weight.

95. Care, Handling and Preservation

a. Ammunition components are packed to withstand conditions ordinarily encountered in the field. All unfuzed projectiles for the 8-inch howitzer M2 are fitted with an eyebolt lifting plug and a grommet. Therefore, a shipping crate is not required. Dummy projectiles are shipped in wooden crates. Charges are packed in cartridge storage cases, fuzes and primers in metal cans. Since explosives are adversely affected by moisture and high temper-

ature, due consideration should be given to the following :

(1) Do not break moisture-resistant seal until the ammunition is to be used.

(2) Protect ammunition, particularly fuzes, from high temperature, including the direct rays of the sun. More uniform firing is obtained if the rounds are at the same temperature.

b. Do not attempt to disassemble any fuze.

c. Do not remove protective or safety devices from fuzes until just before use.

d. Before loading into the howitzer, each of the components should be cleaned of foreign matter (sand, mud, moisture, grease, etc.).

e. **AMMUNITION, OR COMPONENTS CONTAINING EXPLOSIVE, 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. 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.

g. Primers must always be stored in a dry place. Prolonged exposure to moisture or dampness may cause malfunctioning.

h. Components of rounds prepared for firing but not fired will be returned to their original condition and packings and appropriately marked. Such components will be fired first in subsequent firings, in order that stocks of opened packings may be kept at a minimum.

i. The following precautions should be applied to the handling of VT fuzes :

(1) Precautions applying to other packed ammunition also apply to VT fuzes. In addition, storage temperature limits should be held within -20° and $+130^{\circ}$ F. Storage outside these limits for any length of time will result in permanent damage. The direct rays of the sun on VT fuze containers may cause the temperature inside the container to exceed 130° F. and must be avoided.

(2) VT fuzes must be protected against dampness. Although the fuzes are nearly waterproof, any exposure to dampness may increase the number of duds. Contact with rain or immersion in water will hasten deterioration. Particularly in tropical climates, the storage time of unpacked fuzes should be kept to a minimum. In other climates, fuzes can be safely used after 2 months' storage outside of their packing containers but should be stored in the original sealed metal containers so far as practicable.

(3) VT fuzes will withstand normal handling without danger of detonation or damage when in their original packing containers or when assembled to projectiles. However, care should be taken not to strike or drop fuzes or fuzed rounds as these actions may increase the number of duds. A drop of 4 feet in certain positions may cause the electrolyte vial in the fuze battery to break, creating a dud. Excessively rough handling will not decrease fuze safety but may increase the number of duds.

(4) VT-fuzed ammunition may be safely transported short distances with normal care in handling. However, when such ammunition is to be transported considerable distances it may be advisable to remove the fuze from the shell and return the fuze to its original marked container. The supplementary charge and original fuze or closing plug (with gasket and spacer) should be reassembled to the shell, making certain that the supplementary charge is inserted properly (felt-pad end innermost).

(5) Fuzes and supplementary charges which have been removed from the shell will be packed in the containers from which VT fuzes have been removed. The containers should be properly marked and returned to ordnance personnel for disposition.

(6) When rounds on which fuzes have been changed are returned to their containers, care must be taken to change markings on the containers and boxes to conform with the change in ammunition.

(7) Rounds fuzed with VT fuzes must be specially padded when returned to their fiber containers. The U-shaped support which engages the wrench slots of time or impact fuzes will not fit the slots in VT fuzes and must, therefore, be omitted. The play that results is taken up by placing extra corrugated board pads under the base end of the projectile before closing the container.

96. Authorized Rounds

The ammunition authorized for use in the 8-inch howitzer M2 is listed in table II. The components are illustrated in figures 88 to 98.

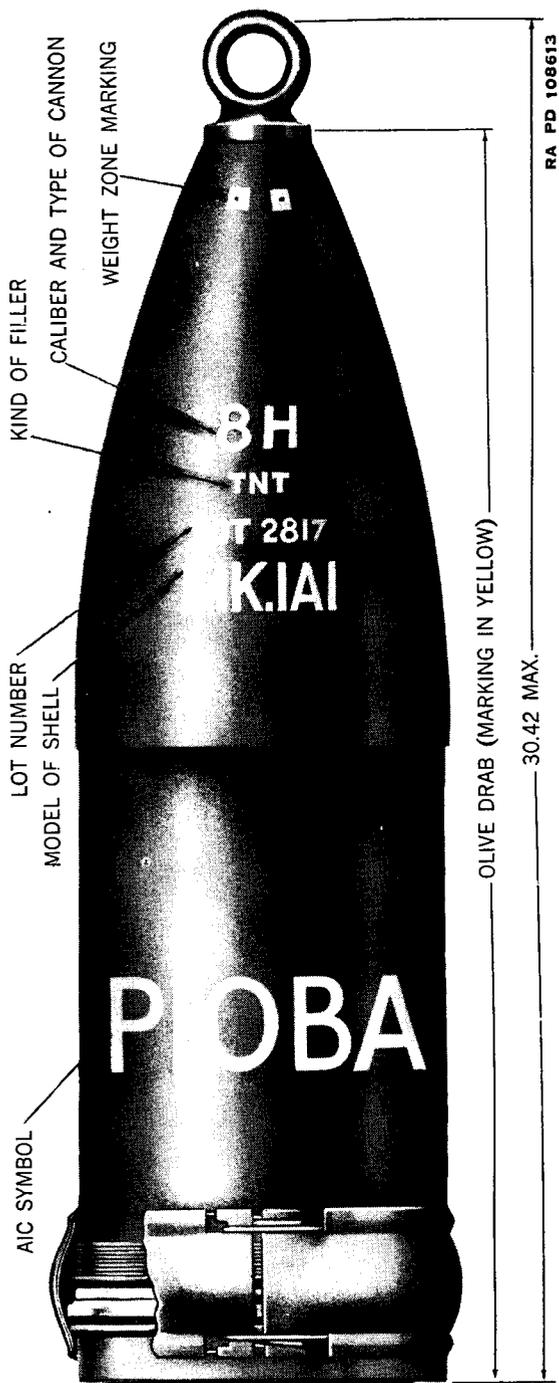


Figure 88. HE shell Mk 1A1 for 8-inch howitzer M2.

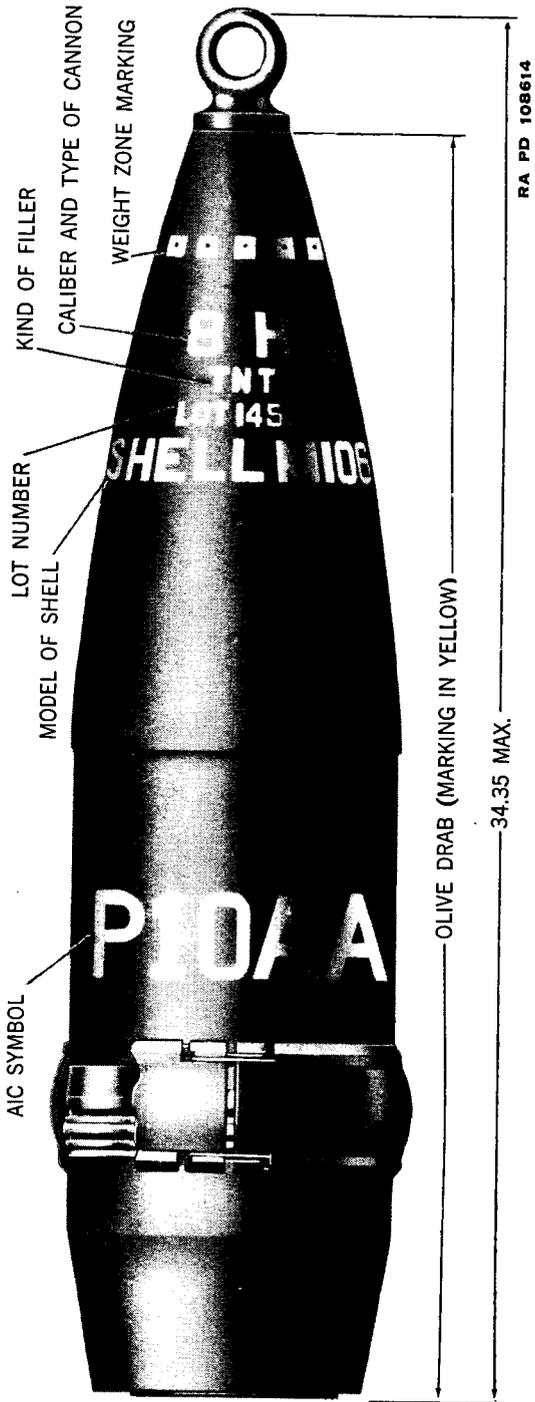
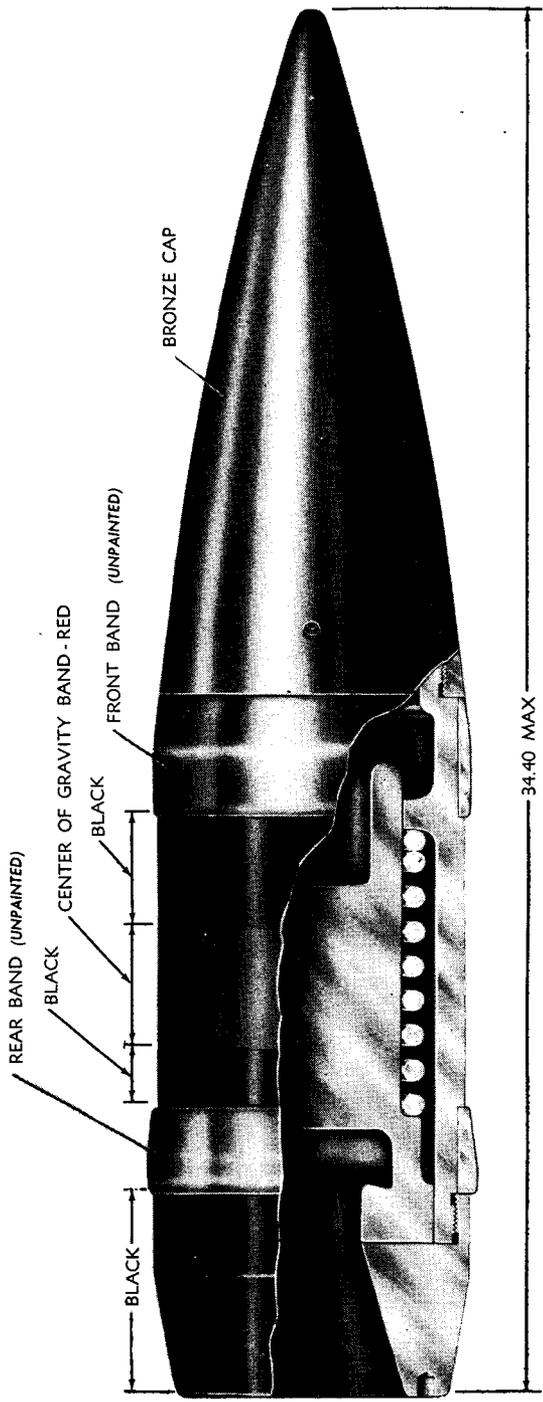
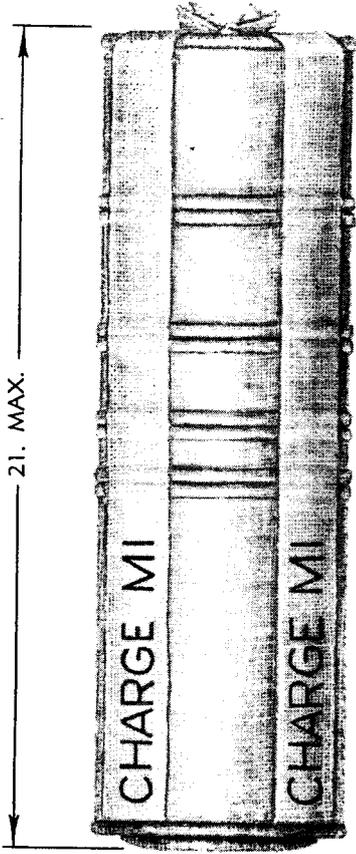


Figure 89. HE shell M106 for 8-inch howitzer M2.



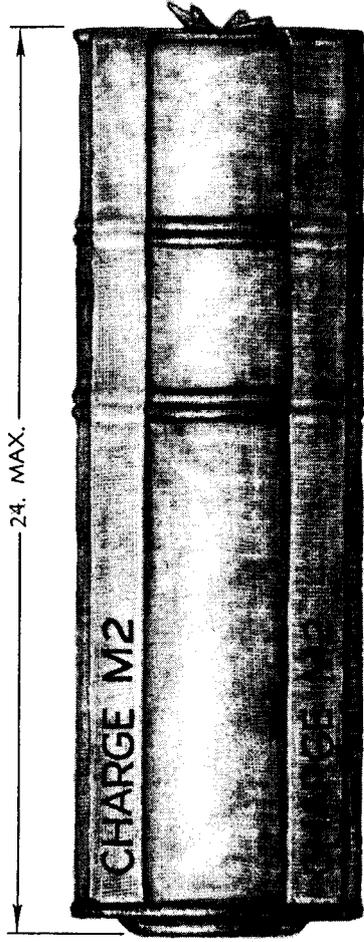
RA PD 97684

Figure 90. Dummy projectile M14 for 8-inch howitzer.



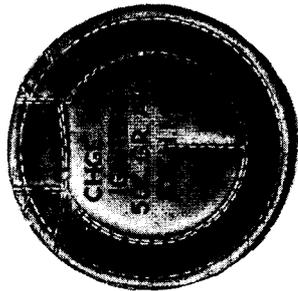
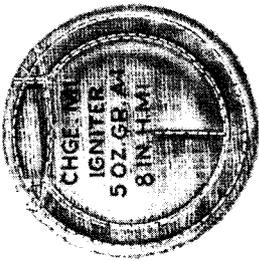
RA PD 2115

Figure 91. Propelling charge M1 (green bag) for 8-inch howitzer.



RA PD 2116

Figure 92. Propelling charge M2 (white bag) for 8-inch howitzer.





RA PD 108216

Figure 93. Flash reducer T3.

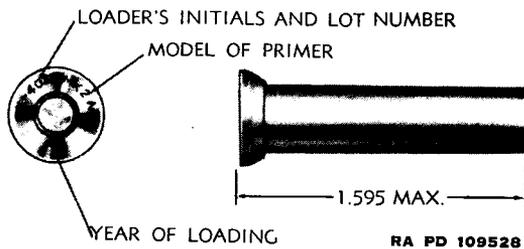


Figure 94. 17-grain percussion primer Mk 2A4.

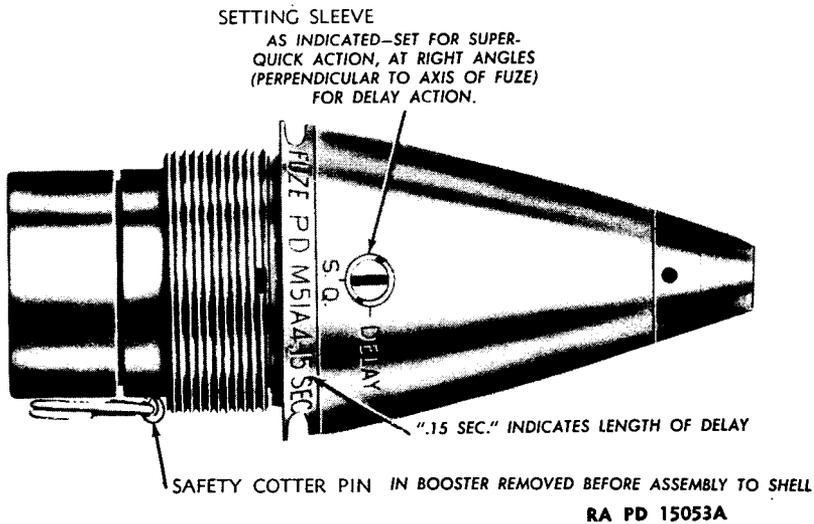
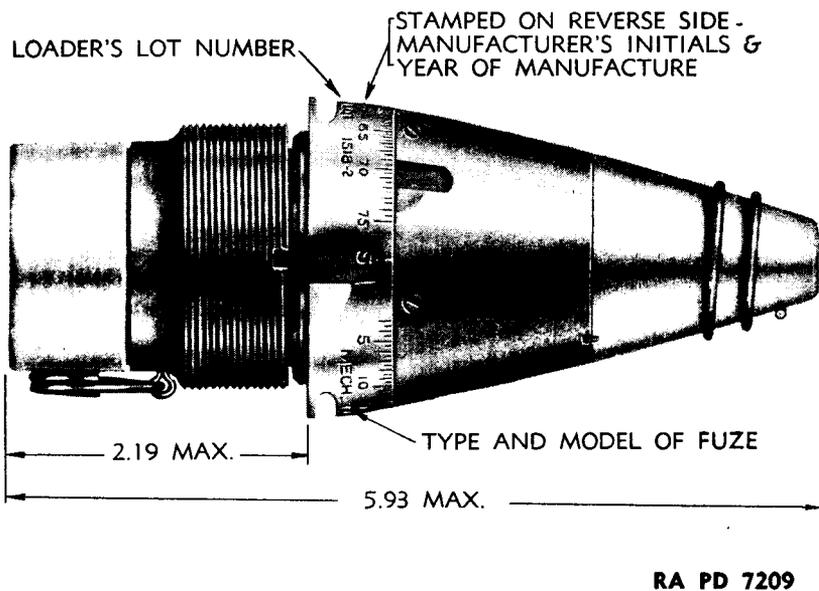


Figure 95. PD fuze M51A4.



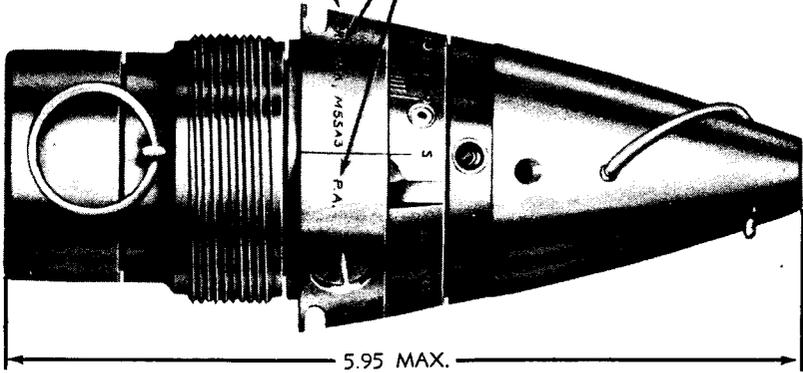
RA PD 7209

Figure 96. Mechanical time fuze M67A3.

STAMPED ON REVERSE SIDE:
LOADER'S LOT NUMBER
LOADER'S INITIALS AND
MONTH AND YEAR LOADED.

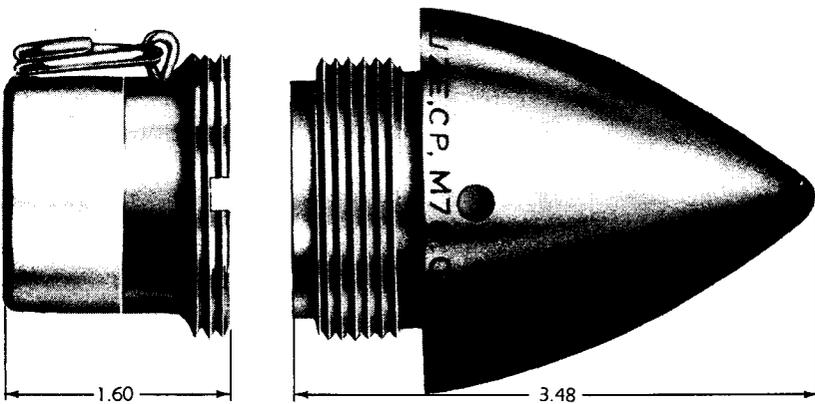
TYPE AND MODEL OF FUZE

MANUFACTURER'S INITIALS



RA PD 97727

Figure 97. TSQ fuze M55A3.



RA PD 104830

Figure 98. Booster M25 and CP fuze M78, .025-sec delay.

Table II. Authorized rounds

Projectile	Fuze for which adapted	Propelling charge	Primer
<i>Service Ammunition:</i>			
SHELL, HE, M106, for 8-in. how. M2.	FUZE, PD, M51 series, ¹		
SHELL, HE, Mk 1A1, for 8-in. how. M2.	FUZE, TSQ, M55 series, ²	CHARGE, propelling, M1, for 8-in. how. ³	PRIMER, percussion, Mk 2A4 ⁴ .
SHELL, HE, M106, w/supplementary charge, for 8-in. how. M2 ⁷ .	FUZE, time, mechanical, M67 series, ⁵	CHARGE, propelling, M2, for 8-in. how. ³	
	FUZE, CP, M78, ⁶ w/BOOSTER, M25.		
SHELL, HE, M106, for VT fuze, for 8-in. how. M2 ⁶	FUZE, VT, M96		

Dummy Ammunition:

PROJECTILE, dummy, M14, for 8-in. how. M2.			
PROJECTILE, dummy, Mk 1, for 8-in. guns or how.		CHARGE, propelling, dummy, M4, for 8-in. how.	PRIMER, percussion, Mk 2A4 ⁹ .
PROJECTILE, dummy, Mk 1A1, for 8-in. guns or how.			

CP—Concrete piercing.

TSQ—Time and superquick.

HE—High explosive.

PD—Point detonating.

¹ FUZE, PD, M51A3, or M51A4. An appreciable percentage of duds may be expected when firing FUZE, PD, M51A3 in zones 1 and 2 of the 8-inch howitzers. This is due to the nonarming of BOOSTER, M21A2 at the low velocities in these zones.

² FUZE, TSQ, M55, M55A1, M55A2, or M55A3 for emergency use in the absence of FUZE, time, mechanical, M67 series. The fuze setter M22 is required for use with this fuze.

³ The M1 charge is characterized by green cloth—the M2 charge by white cloth.

⁴ Earlier modifications of this primer may be used if PRIMER, percussion, Mk 2A4 is not available.

⁵ FUZE, time, mechanical, M67, M67A1, M67A2, or M67A3.

⁶ This fuze is issued with either an 0.025-sec delay pellet or nondelay.

⁷ Without supplementary charge, this projectile is adapted for FUZE, VT, M96.

⁸ When fitted with supplementary charge, this shell is adapted for FUZE, PD, M51 series; FUZE, time, mechanical, M67 series; or FUZE, CP, M78, w/BOOSTER, M25.

⁹ A fired service primer is used with dummy (drill) ammunition.

97. Preparation for Firing

The separate components are prepared for firing, after removal of any packing material, as follows:

a. PROJECTILE—OTHER THAN DEEP CAVITY. The grommet and eyebolt lifting plug are removed and the appropriate fuze is assembled to the projectile.

b. PROJECTILE—“W/SUPPLEMENTARY CHARGE” OR “FOR VT FUZE.” (1) To prepare projectiles in this category for VT fuze:

(a) Remove lifting plug, spacer, and supplementary charge if one is present.

(b) Inspect the fuze cavity.

(c) Screw in VT fuze by hand. If binding occurs, reinspect the fuze cavity, and threads of both fuze and shell. Reject whichever is at fault.

(d) Tighten the fuze to the shell with the special fuze wrench issued with boxes of VT fuzes. Use only such force as can be applied by hand to the fuze wrench handle. If the fuze cannot be tightened to form a good seat between shell and fuze, reject the component which is at fault. *Do not hammer on the wrench handle or use an extension handle. Do not stake the fuze to the shell under any circumstances.*

(2) To prepare projectiles marked “FOR VT FUZE” for firing with time or impact fuze:

(a) Remove lifting plug.

(b) Inspect fuze cavity.

(c) Properly insert supplementary charge (felt-pad end innermost).

(d) Assemble fuze to shell in usual manner.

c. PROPELLING CHARGE. The igniter protector cap must be removed prior to using the propelling charge, and when required, the charge is adjusted for the appropriate zone of fire. The charge must be loaded into the weapon with the igniter end (cloth dyed red) toward the breech. When firing CHARGE, propelling, M2 (white bag), there are conditions wherein the weapon will flash. To remove this undesirable action, REDUCER, flash, T3 (fig. 93) is provided. To prepare CHARGE, propelling, M2 for night firing, insert one flash reducer at forward end of the charge under the tie straps. The flash reducer is used only with CHARGE, propelling, M2 (charges 5, 6, or 7). CHARGE, propelling, M1 (green bag) is considered flashless under all conditions. The flash reducer increases the quantity of smoke and should not be used in daylight firing.

d. FUZE. The fuzes are set as described in paragraph 98. VT fuzes do not require preparation for firing.

e. PRIMER. Primers are ready for firing as shipped and need only to be inserted into the firing mechanism of the cannon.

98. Fuzes

a. FUZE, PD, M51A3 AND M51A4.* (1) *General.* The fuzes and boosters making up this series of assemblies are similar in principle, but differ, due to modifications of either the fuze or the booster. FUZE, PD, M51 and M51A1 differ from the FUZE, PD, M51A3 and M51A4 in that they use a shorter plunger housing, resulting in a less rigid plunger. BOOSTER, M21A2 is a modification of earlier boosters of this series; however, a set-back pin is used for additional insurance against premature or accidental functioning. BOOSTER, M21A4 is a further modification of BOOSTER, M21A2.

(2) *Description.* The booster is permanently attached to all M51 series fuzes at the time of manufacture as shown in figure 95. Therefore the assembly is handled as a unit. The fuze may be set to function either superquick or delay. When the fuze is set "DELAY," the interrupter is locked in a closed position preventing superquick action by closing the upper flash hole thus permitting the fuze to function only with delayed action. It should be noted that if the fuze is set for superquick action and "SQ" malfunction occurs the fuze will automatically function with delayed 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 delayed action it is only necessary to turn the setting sleeve so that its slot is alined with "DELAY." A 0.15-second delay black powder pellet is incorporated in the delay plunger assembly to provide for the delayed action. Earlier models used a 0.05-second delay pellet. The setting may be changed at will with a screw driver 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 the rotor assembly from becoming alined with the flash hole during shipment. This is a safety feature to prevent a premature explosion in the event one of the detonators should fire during transportation or handling. This cotter pin is to be withdrawn just prior to assembling the fuze to the projectile.

(3) *Preparation for firing.* To fuze the projectile, proceed as follows:

(a) Remove eyebolt lifting plug from projectile.

* The following limitations apply to the FUZE, PD, M51A3: An appreciable percentage of duds may be expected when firing FUZE, PD, M51A3 in zones 1 and 2 of the 8-inch howitzer. This is due to the nonarming of BOOSTER, M21A2 at the low velocities in these zones.

(b) Inspect fuze cavity and threads. They should be free of foreign matter which would interfere with the proper assembly of the fuze.

(c) Remove cotter pin from booster.

(d) Screw fuze assembly into projectile by hand. Tighten with fuze wrench.

(e) Set fuze. If delay action is required, aline slot in setting sleeve with "DELAY"; if superquick, aline slot with "SQ" setting. Fuze may be reset as required.

Caution: When this fuze is set for superquick action, premature air bursts of rounds may occur, though very rarely, during extremely heavy rainfall. If necessary to continue firing under such conditions, set the fuze on "DELAY" action to prevent such an occurrence.

b. FUZE, TIME, MECHANICAL, M67, M67A1, M67A2, AND M67A3.

(1) *Description.* The fuze M67 and its modifications (fig. 96) are essentially alike, and are intended to provide a means of high-burst adjustment at longer ranges when firing the high-explosive shell. The primary differences occur in booster modifications as described in subparagraph *a* above. The fuze is of the mechanical time (clockwork) type, and is similar to the M43 type of fuze in contour and in design except that the escapement mechanism has been modified to give a longer running 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 counter-clockwise 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 alinement with the safety line "S" on 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 arming of the rotor assembly during shipment. The booster is assembled to the fuze at the time of manufacture and handled thereafter in shipment and assembly to the projectile as a single unit with the fuze. 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 assembly into the projectile by hand. Tighten with the fuze wrench.

(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 counter-clockwise direction as viewed from the point of the fuze. The torque required to set the fuze is between 80 and 100 inch-pounds.

c. FUZE, TSQ, M55, M55A1, M55A2, AND M55A3. (1) *Description.* These fuzes (fig. 97) are provided for emergency use in the absence of M67-series fuzes. The fuze is a combination time and superquick type. A safety pull wire extends through the fuze to secure the plunger assembly during shipment. The fuze may be made to function with superquick or some predetermined time. The superquick action is always operative and will function on impact unless prior functioning has been caused by time action. Therefore, to set the fuze for superquick action, it is necessary that the fuze be set at safe (S) or for a time longer than the expected time of flight. The time ring is graduated for 25 seconds. To prevent premature functioning of the fuze, an internal safety feature does not permit the time action to function should the fuze be set for 0.4/second or less. For reliable functioning, the fuze should be set for at least 0.8 second. The fuze as shipped is set "SAFE." The boosters fitted to the M55-series fuzes are of the M21 series described in *a* above.

(2) *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.

(c) Remove cotter pin from booster.

(d) Screw fuze assembly into projectile by hand. Tighten with fuze wrench.

(e) Remove safety pull wire. To do this, pull lower end of wire from the hole and slide the wire off the end of the fuze.

(f) If superquick action is desired, leave the fuze as shipped (set at safe) or set the time ring for a time greater than the expected time of flight.

(g) If time action is desired, the time ring is set to the required time by means of the fuze setter M22.

Note. If, after setting the fuze preparatory to firing, the round is not fired, the fuze will be reset at safe (S), the safety pull wire replaced, and cotter pin replaced in booster, before the round is returned to its packing.

d. FUZE, CP, M78 (T105) AND BOOSTER, M25 (T1E1). (1) *Description.* The concrete-piercing fuze M78 (T105) and booster M25 (T1E1) (fig. 98) are used to convert SHELL, HE, M106 or Mk 1A1 into a shell capable of penetrating concrete or other heavy targets. In this case both the fuze and booster are shipped in the same container, but as separate components. The fuze is a solid hardened steel nose plug which contains a detonator and delay plunger assembly in its base. It is shorter and heavier than the fuzes described in paragraphs above. FUZE, CP, M78 is fitted with a nonadjustable 0.025-second delay or nondelay plunger assembly; the delay is indicated by the stamping on the fuze. To make the identification of the fuze easy (after removal from the packing container), the nondelay fuze has a white tip which extends approximately 1 inch from the tip toward the base of the fuze.

Note. All FUZES, CP, T105 were assembled with 0.05-second delay plunger assemblies during the early development of this fuze.

FUZE, CP, M78 is not issued with this delay. Nondelay fuzes are designed primarily for spotting purposes. Fuzes with 0.025-second delay plunger assemblies are designed to be used when firing for effect. The BOOSTER, M25 (T1E1) is a modified BOOSTER, M21A2 containing approximately three rather than six external threads. A cotter pin with pull ring is located in the booster body, and must be removed prior to assembly of the booster to the shell. This booster is intended for use only with the FUZE, CP, M78 (T105).

(2) *Preparation for firing.* After removal of lifting plug from projectile, proceed as follows:

(a) Remove the cotter pin from BOOSTER, M25 and screw the booster into the shell. Tighten firmly with the wrench provided (fig. 99). Formerly this wrench was issued with each box of fuzes. After the present supply of wrenches has been used, future issue will be made as part of the equipment for the howitzer. Boosters which are issued without safety pins should not be used.

(b) Screw the FUZE, CP, M78 into the fuze cavity and tighten securely with fuze end of wrench. Be sure that the fuze shoulder seats firmly against the nose of the shell—there should be no space between the fuze shoulder and the shell. Do not stake fuze to the shell.

e. FUZE, M96 (T76E6). (1) *Description.* The M96 is an automatic time fuze without impact element, and is provided for

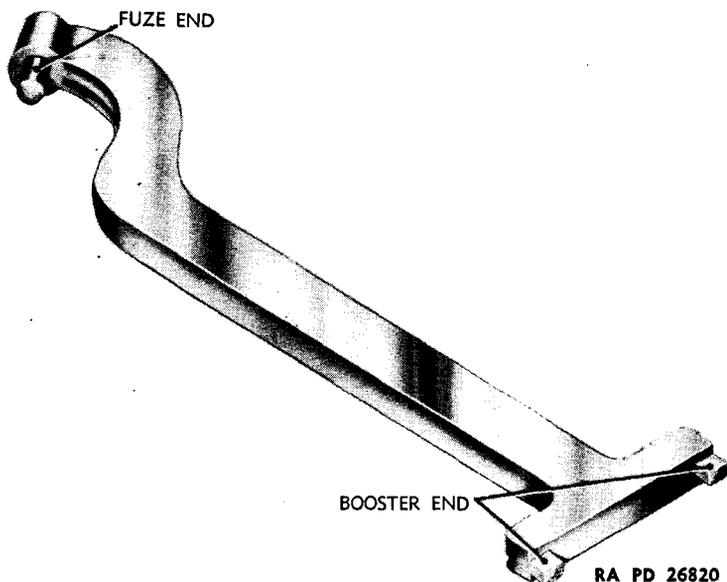


Figure 99. Wrench for CP fuze M78 and booster M25.

use in terrestrial fire with deep-cavity high-explosive shell (without supplementary charge). It is essentially a self-powered radio transmitting and receiving unit. In flight, the armed fuze broadcasts radio waves. When any part of the radio wave front is reflected back from the target, it interacts with the transmitted wave. When the ripple or beat of this interaction reaches a predetermined intensity, it trips a switch which closes an electric circuit and initiates detonation of the fuze explosive train. Bore-safety is provided by an arming switch which delays arming of the fuze for approximately 5 seconds. When armed, the fuze will function on close approach to any object capable of reflecting the transmitted waves.

(2) *Preparation for firing.* Since all functioning within the fuze is automatic, no adjustment in preparation for firing is required. It should be noted that the fuze will function properly only at temperatures within 0° and 120° F., and should not be used outside these limits. Also, if the fuzed round is loaded into the chamber of a hot gun and not fired before 30 seconds, the fuze probably will cause either an early burst or a dud.

99. Packing

Complete packing data covering box dimensions, volume, and weight of the various components of ammunition described herein are published in ORD 11 SNL's P-1, P-2, and P-8. Ammunition

for subcaliber guns are published in SNL's R-1 and R-3. Although weight of individual projectiles varies somewhat, dependent upon type and model—propelling charges likewise are dependent upon the particular powder charge—the following data are representative for estimating weight and volume requirements:

<i>Projectiles</i>	<i>Weight (pounds)</i>	<i>Volume (cubic feet)</i>
SHELL, HE, M106, as shipped	201	1.5
Over-all dimensions (inches): 34 $\frac{3}{8}$ by 8 $\frac{3}{4}$ diameter.*		
SHELL, HE, Mk 1A1, as shipped	200	1.4
Over-all dimensions (inches): 30 $\frac{1}{2}$ by 8 $\frac{3}{4}$ diameter.*		

Dummy projectiles are packed and shipped in wooden crates.

<i>Propelling Charges</i>	<i>Weight (pounds)</i>	<i>Volume (cubic feet)</i>
CHARGE, propelling, M1 (green bag): Packed—1 per cartridge storage case M18	31.2	0.98
Over-all dimensions (inches): 26 $\frac{3}{8}$ by 8 $\frac{1}{8}$ diameter.		
CHARGE, propelling, M2 (white bag): Packed—1 per cartridge storage case M19	51.9	1.52
Over-all dimensions (inches): 29 $\frac{3}{8}$ by 9 $\frac{1}{2}$ diameter.		

Dummy propelling charges are packed and shipped in wooden boxes as required; however, these charges may be packed in cartridge storage cases when they are available.

Fuzes

FUZE, PD, M51 series; FUZE, time, mechanical, M67 series; or FUZE, TSQ, M55 series:

Packed—1 per metal container, 15 per wooden box	50.0	0.84
Over-all dimensions (inches): 16 $\frac{11}{16}$ by 9 $\frac{3}{4}$ by 9 $\frac{9}{32}$.		

* Diameter shown is for projectile with grommet.

FUZE, CP, M78 and BOOSTER, M25:
 Packed—1 fuze and 1 booster per metal
 container, 20 containers per box.... 77.0 0.95

Primers

PRIMER, percussion:
 Packed 48 primers per metal container,
 48 containers (1400 primers) per
 box 2.0
 Over-all dimensions (inches):
 23³/₄ by 14 by 10³/₈.

100. Subcaliber Ammunition

a. GENERAL. SHELL, fixed, practice (TP), M92, w/FUZE, PD, M74, for 37-mm subcaliber guns (fig. 100) and SHELL, fixed, TP, M63 Mod. 1, for 37-mm subcaliber guns are authorized for use in the 37-mm subcaliber gun M1916 as standard and substitute standard, respectively. This ammunition is issued in the form of fixed complete rounds, with a low-explosive filler of black powder for spotting purposes. The cartridge case may be of brass or steel. SHELL, M63, Mod. 1 is fitted with the FUZE, base-detonating (BD), M58, practice.

b. FUZES. (1) *FUZE, BD, M58, practice.* This fuze consists of a brass or steel body containing a detonator and a direct-action firing pin. Since the flash of the detonator is sufficient to ignite the black powder spotting charge, no booster is required or fitted to this fuze. There are no boresafety features incorporated in the design. Prior to firing, the firing pin is held in an unarmed position by means of a spring and resistance ring. Upon firing, setback force arms the fuze. Upon impact, the firing pin, acting against a spring, travels forward, strikes, and initiates the detonator.

(2) *FUZE, PD, M74.* FUZE, PD, M74 is a point-detonating fuze containing a direct-action firing pin and a Semple-type rotor which acts as the interrupter. This fuze is shown fitted to shell M92 in figure 100. 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.

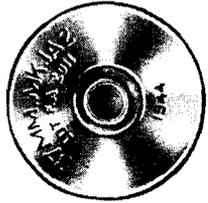
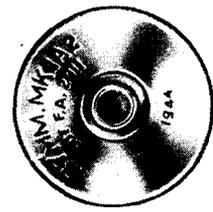
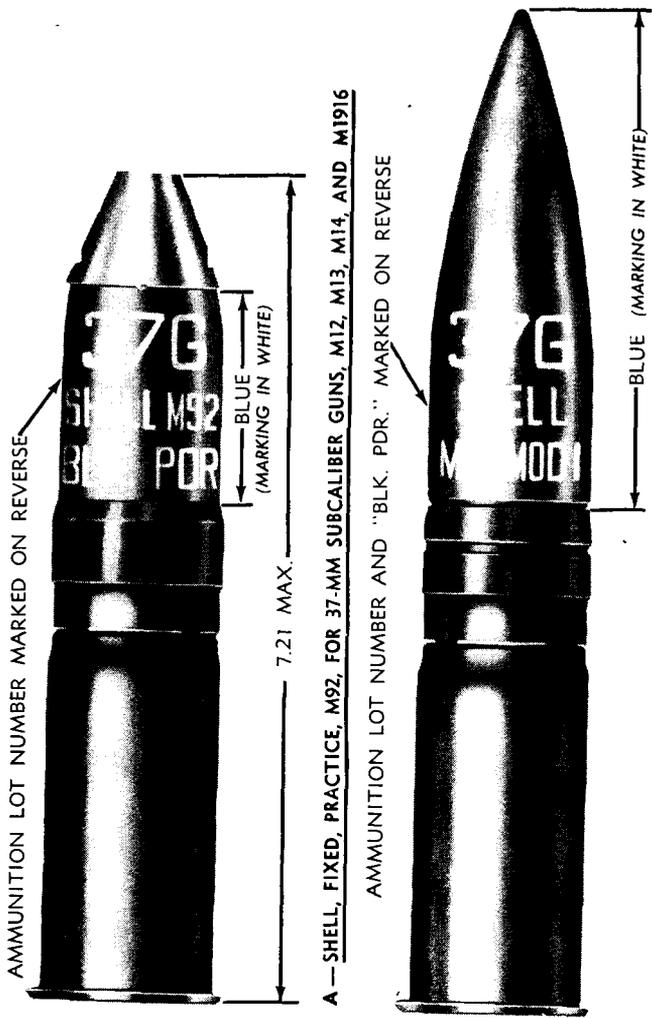


Figure 100. Ammunition for 37-mm subcaliber guns M12, M13, M14, M15, M16, and M1916.

A — SHELL, FIXED, PRACTICE, M92, FOR 37-MM SUBCALIBER GUNS, M12, M13, M14, AND M1916

B — SHELL, FIXED, PRACTICE, M63 — MOD 1, FOR 37-MM SUBCALIBER GUNS, M12, M13, M1916

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c. PACKING. The following packing data are representative for estimating weight and volume requirements:

	<i>Weight</i> (pounds)	<i>Volume</i> (cubic feet)
SHELL, fixed, practice, M92, w/FUZE, PD, M74 for 37-mm subcaliber gun without packing material	2.01	
Packed—1 round per fiber container M126A1, 40 containers (40 rounds) per box	93.3	1.5
Over-all dimensions of box (inches): 19 $\frac{5}{8}$ by 12 by 10 $\frac{7}{8}$.		
SHELL, fixed, practice, M63, Mod. 1, for 37-mm subcaliber guns:		
Packed—1 round per fiber container M127A1, 40 containers (40 rounds) per box	75.7	1.2
Over-all dimensions of box (inches): 18 $\frac{1}{8}$ by 11 $\frac{7}{8}$ by 11.		

Section XXVIII.

SIGHTING AND FIRE CONTROL EQUIPMENT

101. General

This section contains information on the arrangement of the sighting and fire control equipment. It includes instructions for operation and maintenance of each item of on-carriage equipment. Instructions covering off-carriage equipment are not included in this manual, but a list of this equipment is contained in paragraph 6. The off-carriage equipment is covered in other Technical Manuals (appendix II).

102. Arrangement and Use

a. 8-INCH HOWITZER CARRIAGE M1. (1) The sighting and fire control equipment for the 8-inch howitzer matériel is designed for a two-man, two-sight system for indirect fire.

(2) The telescope mount M18A1 supports the panoramic telescope M12, and the two instruments are used together for laying the howitzer in azimuth. Illumination of the instruments for night operation is provided for by the instrument light M19.

(3) The quadrant mount M1 is used in conjunction with a

gunner's quadrant for laying the howitzer in elevation. Illumination of the instrument for night operation is provided for by the instrument light M12.

(4) The fuze setter M23 is used to manually set the mechanical time fuzes.

b. 8-INCH HOWITZER MOUNT M17. (1) The sighting and fire control equipment for the 8-inch howitzer mount M17 used in howitzer motor carriage M43 is designed for both direct and indirect fire. The howitzer is aimed for direct fire by a two-man, two-sight system, and is laid in indirect fire in the same manner as the howitzer carriage M1.

(2) The telescope mount M75 supports the telescope M69G and the panoramic telescope M12. The telescope M69G is used for aiming the howitzer in azimuth for direct fire. Illumination of the M69G telescope reticle for night operation is provided for by the instrument light M33.

(3) The telescope mount M71 supports the elbow telescope M16A1G. This telescope is used for aiming the howitzer in elevation for direct fire. Illumination of the elbow telescope M16A1G reticle for night operation is provided for by the instrument light M36.

(4) The telescope mount M75 with panoramic telescope M12 and quadrant mount M1 are used for laying the howitzer in azimuth and elevation for indirect fire in the same manner as for the carriage M1.

(5) The fuze setters M14 and M23 are used for setting the mechanical time fuzes.

103. Maintenance

a. GENERAL. Interval for servicing sighting and fire control equipment will be found in the preventive maintenance schedule (par. 39). Important care of the instrument follows:

b. CARE IN HANDLING SIGHTING AND FIRE CONTROL EQUIPMENT. (1) Sighting and fire control instruments are, in general, rugged and suited for the designed purpose. They will not, however, stand rough handling or abuse. Inaccuracy or malfunctioning will result from mistreatment.

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

(3) Stops are provided on instruments to limit the travel of the moving parts. Do not attempt to force the rotation of any knob beyond the stop limit.

(4) Keep the instruments as dry as possible. If an instrument is wet, dry it carefully before placing it in its carrying case.

(5) When not in use, keep the instruments in the carrying cases provided, or covered and protected from dust and moisture.

(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 by ordnance personnel. The authorized tests and adjustments are those for which tools and parts have been provided. Adjustments other than those expressly authorized are not the responsibility of the using arm personnel.

(7) No painting of sighting or fire control equipment by the using personnel is permitted.

(8) When disengaging the azimuth mechanism of the panoramic telescope M12, push the azimuth worm throwout lever outward as far as it will go to insure complete disengagement of the internal worm and worm gear. Do not allow the worm to drag over the worm gear teeth as this will result in unnecessary wear of the parts.

(9) Do not point telescope directly at the sun unless a filter is used, as the heat of the focused rays may damage optical elements.

(10) Leveling and clamping screws must not be tightened beyond a snug contact. Excessive wear of threads and other damage to the instruments are thereby eliminated.

(11) The testing targets should be protected at all times against moisture, to prevent shrinkage.

c. 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 and etching of the surface of the glass which interfere with vision can be prevented or greatly retarded by keeping the glass clean and dry.

(2) Under no circumstances should polishing liquids, pastes, or abrasives be used for polishing lenses and windows.

(3) For wiping optical parts, use only clean lens tissue paper especially intended for cleaning optical glass. Use of cleaning cloths in the field is not permitted. To remove dust, brush the glass lightly with a clean artist's 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.

(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 liquid lens-cleaning soap with a tuft of lens tissue paper, and wipe gently with clean lens tissue paper. If this liquid is not available, breathe heavily on the glass and wipe off with clean lens tissue paper. Repeat this operation until clean.

(5) Below freezing temperature, optics will be cleaned as described in paragraph 25h.

(6) Moisture, due to condensation, may collect 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 to optical parts and inaccuracies of observation.

d. BATTERIES. (1) Batteries used in the instrument lights should habitually be removed whenever the lights are not in use. Chemical reaction set up in an exhausted battery will damage the battery tube.

(2) To replace batteries, remove the cap on the battery tube. The cap is secured by bayonet pins and is removed by pressing the cap inward and then turning slightly until free. When replacing the batteries, be sure that they go back into the tube in the same position as when removed. See that the bayonet pins on the cap engage the slots in the tube to insure a tight contact between the battery terminals.

e. LUBRICATION. (1) Where lubrication with oil is indicated, use preservative lubricating oil (special).

(2) Where lubrication with grease is indicated, use lubricating grease (special).

(3) Lubricants for sighting and fire control instruments function also as rust preventives. It is important that they be applied carefully and effectively. Extreme care should be taken not to apply lubricants excessively. Excessive lubrication of certain parts may be as damaging as the absence of any lubricant.

(4) Excessive lubricants should be wiped off to prevent the accumulation of dust and dirt.

(5) Fittings are provided for lubrication of the principal bearings in the telescope mount (fig. 101). Lubricate with lubricating grease (special). Do not lubricate more often than every 3 weeks.

104. Telescope Mount M18A1, Panoramic Telescope M12, and Instrument Light M19

a. DESCRIPTION. (1) *Telescope mount M18A1.* (a) The telescope mount M18A1 is of the azimuth-compensating type which mechanically calculates azimuth correction when the howitzer is elevated with the trunnions out of level.

(b) The azimuth correction is actuated by turning the cross leveling knob until the bubble in the cross level vial is centered,

and then keeping it centered continuously during operations.

(c) The longitudinal level in conjunction with the cross level is used to determine when the panoramic telescope is positioned in a true horizontal plane, thereby insuring accurate measurements of azimuth angles.

(d) Turn the longitudinal leveling knob on the mount to center the bubble in the longitudinal level vial; keep the mount leveled continuously during operations.

(e) With all level bubbles kept centered during operations, the azimuth correction is automatically applied when the gun or howitzer tube is traversed until the telescope's vertical line of sight intersects the target or aiming point.

(f) Rotate the covers on the levels to protect the vials when the instrument is not in use.

(2) *Panoramic telescope M12.* (a) The panoramic telescope M12 (fig. 102) is a four-power instrument having a field of view of 10° . The eyepiece is offset 45 degrees to permit the observer to stand clear of the gun. The reticle pattern seen through the eyepiece is shown in figure 103. The pattern consists of a vertical cross line for sighting the instrument on the aiming point, and a deflection scale graduated in 5-mil intervals and numbered at 50-mil intervals for estimating small deflection angles.

(b) The azimuth scale is graduated in 100-mil intervals and numbered progressively from 0 to 32 in two consecutive semi-circles. The azimuth scale reads zero when the eyepiece is offset 800 mils from the rotating head. The graduations on the azimuth micrometer are at 1-mil intervals. Turn the azimuth worm knob to set values on the scale and micrometer. The micrometer index is part of an assembly called "gunner's aid." This consists of a ratchet and detent mechanism and a deflection scale. When the index (gunner's aid) is rotated, the detent will click at each mil graduation. Rotation of the micrometer index is read as deflection right (R) or left (L) on the deflection scale. If deflection has been introduced, turn the azimuth worm knob to reset the original value on the micrometer.

(c) Depress the azimuth worm throwout lever (fig. 102) to its limit and hold in this position while turning the azimuth scale. As the desired value on the scale is reached, release the lever with caution to prevent damage to interior parts by snapping the spring, and refine the setting with the azimuth micrometer knob.

(d) Turn the elevation knob on the panoramic telescope (fig. 102) whenever it is necessary to elevate or depress the line of sight in order to bring the aiming point into the field of view. Coarse and fine index graduations indicate the normal (zero

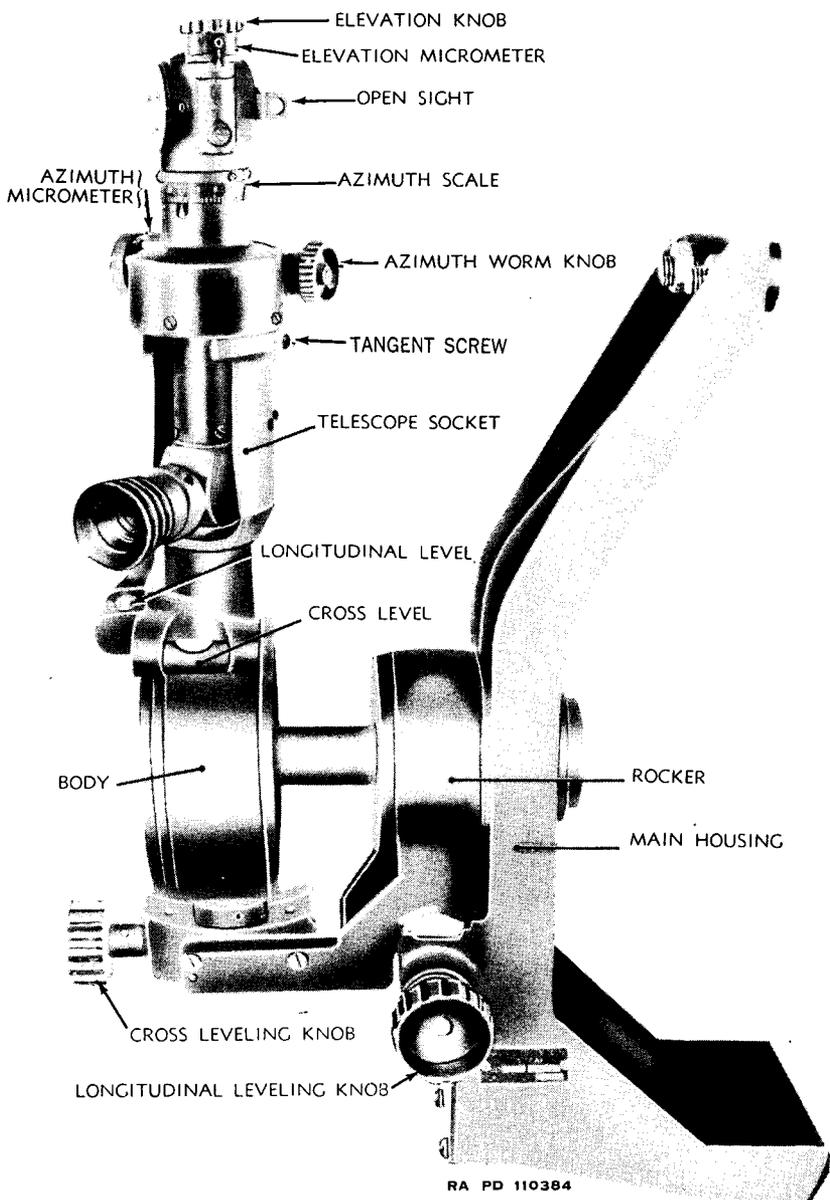
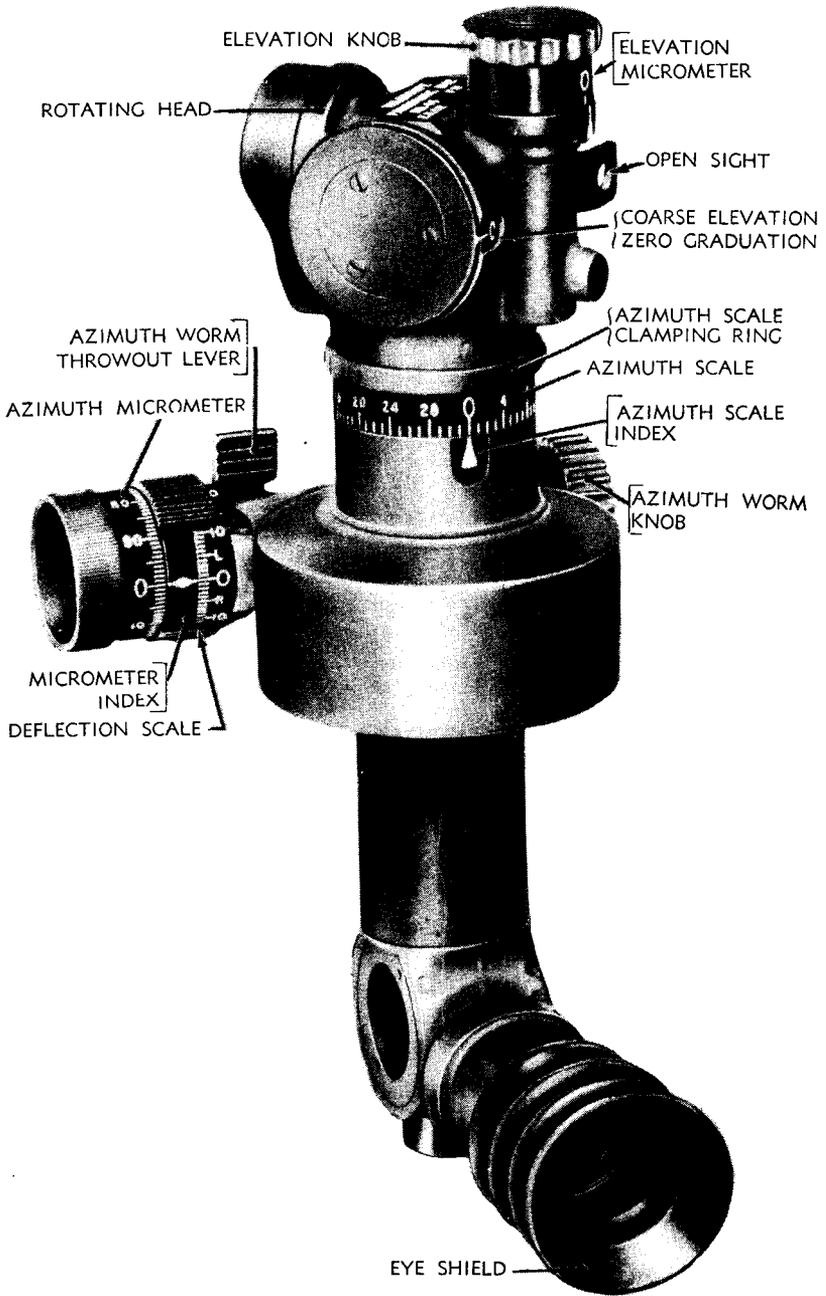


Figure 101. Telescope mount M18A1 with panoramic telescope M12.



RA PD 96179

Figure 102. Panoramic telescope M12.

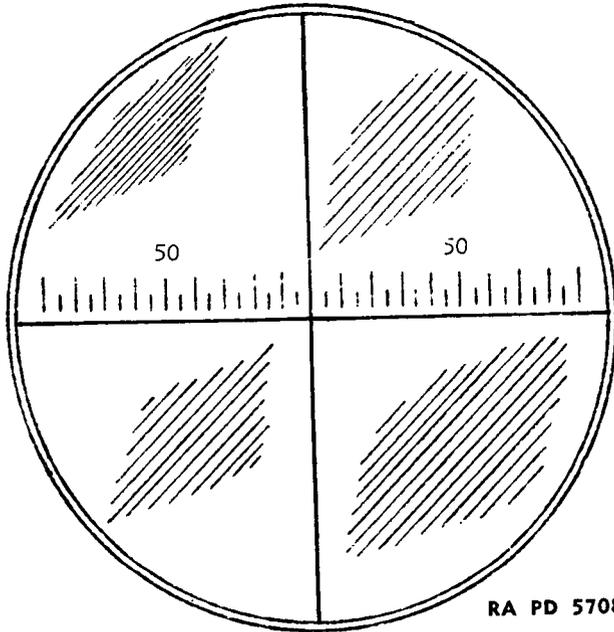


Figure 103. Reticle pattern for panoramic telescope M12.

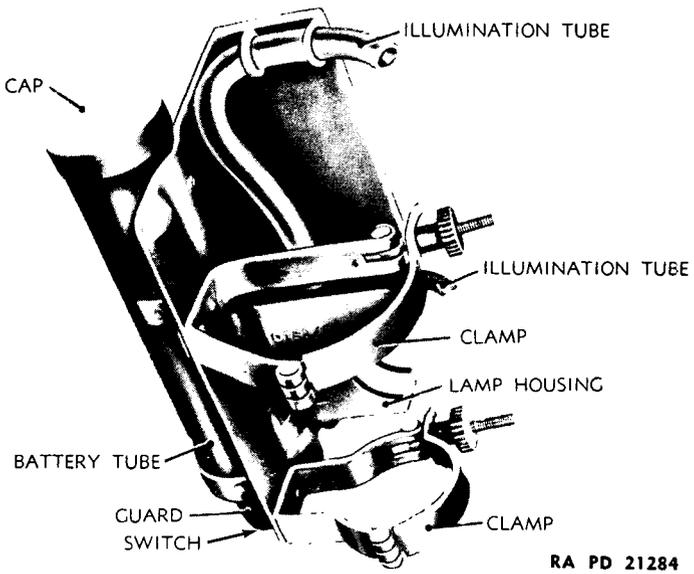


Figure 104. Instrument light M19.

elevation) position of the line of sight. Use the open sight to pick up the aiming point.

(3) *Instrument light M19.* The instrument light M19 (fig. 104) is secured to the telescope socket of the telescope mount M18A1 with two clamps, and associated eyebolts and thumbnuts. A 3-volt electric lamp and two flashlight batteries furnish the illumination for the reticle, azimuth scale and micrometer, and the level vials on the mount. The light is turned on and off by a toggle switch. The built-in switches and electrical fittings of the telescope mount are not used when employing the instrument light M19. The lamp is replaced by unscrewing the lamp socket and then unscrewing the lamp from the socket.

b. **SETTING UP.** (1) The panoramic telescope is properly set up when it is secured in the telescope mount socket. To place the panoramic telescope in the socket, turn the wing knob on the socket against spring pressure, and carefully insert the shaft of the telescope so that the lug on the telescope is centered between the two tangent screws in the socket. Make sure that the telescope is fully seated by exerting a slight downward pressure, and then release the wing knob to secure the telescope in position.

(2) Position the instrument light over the reticle window of the panoramic telescope and clamp the light to the telescope mount socket.

c. **TESTS AND ADJUSTMENTS.** (1) *Preliminary settings.* Level the howitzer and carriage transversely (axis of cradle trunnions) and longitudinally (axis of bore). Place the testing target in position, alining it with the bore by means of the bore sights. Center the bubbles in the cross and longitudinal level vials. Set the scales and micrometers of the panoramic telescope to their zero positions. These settings will then apply for all subsequent operations.

(2) *Verification of cross level and longitudinal level.* Remove the panoramic telescope from the telescope mount. Use the gunner's quadrant set for zero elevation, with the correction, if any, applied as a test level, placing it on a machined steel plate or a piece of plate glass which rests on the locating surface of the telescope socket. Place the quadrant parallel to the respective level axes of the telescope mount. The gunner's quadrant should show the surface to be level along both axes. An error not in excess of one division on the telescope mount level vial is acceptable. If the error along either axis is beyond this limit, it will be necessary to adjust the corresponding level vial. The adjustment is to be performed only by authorized ordnance personnel.

(3) *Verification and adjustment of panoramic telescope.* Replace the panoramic telescope in the telescope mount and observe the position of the reticle lines with respect to the corresponding marker on the testing target. If the reticle lines do not coincide, it will be necessary to adjust in the following manner:

(a) *Micrometer adjustment.* The telescope's elevation coarse scale and micrometer need no adjustment normally. If, however, due to previous misadjustment, the micrometer is obviously out of adjustment, turn the elevation knob on the telescope until the horizontal reticle line coincides with the horizontal line on the target. Loosen the screws in the end of the knob and, holding the knob, slip the elevation micrometer until the zero graduation lines up with its index; then tighten the screws, being careful not to disturb the setting.

(b) *Zeroing of micrometer scales.* Micrometers and their corresponding coarse scales should be set to read zero, simultaneously, particularly after bore sighting. If the coarse scale's zero is appreciably off its index, qualified ordnance personnel should be notified.

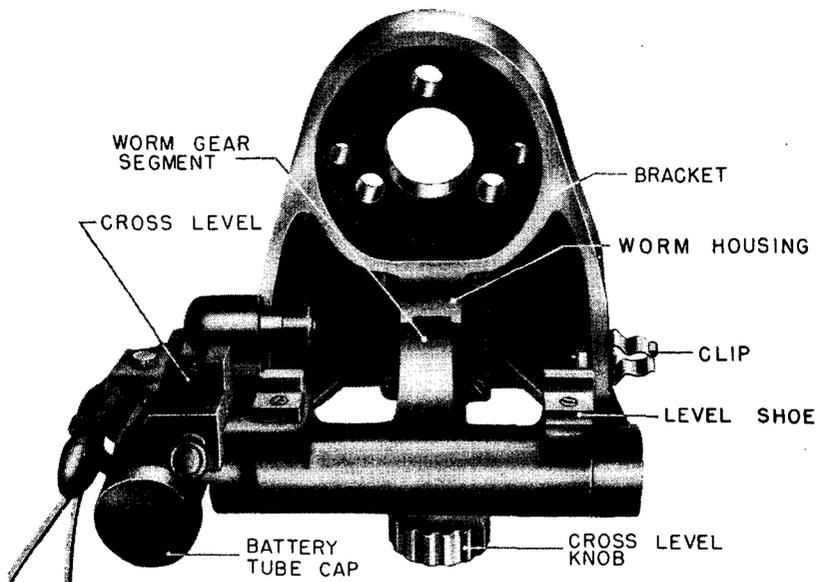
(c) *Final bore-sighting adjustments.* The telescope socket is provided with tangent and locking screws (fig. 101) for the explicit function of alining the telescope's vertical line of sight with the bore of the gun. Loosen both locking screws and adjust both tangent screws until the telescope's vertical reticle line is accurately alined on the target. Tighten the two locking screws. If the limits of this adjustment are inadequate, further adjustment may be made by use of the azimuth micrometer knob. Turn the knob until the vertical reticle line is alined on the target, loosen the three screws in the knob's face and carefully slip the micrometer back to zero its index. Tighten the screws and verify all alinements. If the azimuth coarse scale is too far from zero, notify ordnance personnel.

(d) **OTHER ADJUSTMENTS.** The adjustments described above are the only adjustments the using arm personnel are permitted to make. For other adjustments, notify ordnance personnel.

105. Quadrant Mount M1 and Instrument Light M12

a. **DESCRIPTION.** (1) *Quadrant mount M1.* The quadrant mount M1 (fig. 105) is provided with two level shoes for seating the gunner's quadrant, and cross leveling mechanism and a cross level for keeping the shoes cross-leveled. Cross-leveling the shoes by turning the cross level knob until the bubble in the cross level vial is centered insures that elevation and depression angles will be measured in a true vertical plane.

(2) *Instrument light M12.* The instrument light M12 (fig. 105) is a device for illuminating the cross level vial, and includes a hand light for illuminating the gunner's quadrant and for general use around the mount. Two 3-volt electric lamps and a flashlight battery, type BA-30, furnish the illumination. The power is turned on and off by a toggle switch. The instrument light is attached to the mount, as shown in figure 105, by slipping the bracket over the cross level and the lug adjacent to the level. It is secured by tightening the thumbscrew in the end of the bracket.



RA PD 6825

Figure 105. Quadrant mount M1 and instrument light M12.

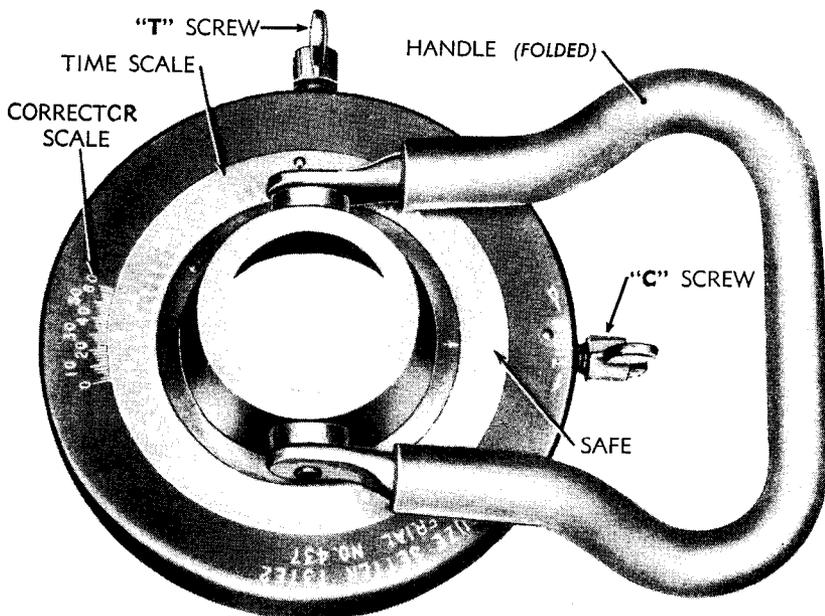
b. **SETTING UP.** The quadrant mount is pinned and bolted to the right cradle trunnion so that the only setting up that is required is the installation of the instrument light M12.

c. **TESTS AND ADJUSTMENTS.** No adjustment of the quadrant mount M1 should be necessary. If any adjustments or repairs are required, notify ordnance maintenance personnel.

106. Fuze Setter M23

a. **DESCRIPTION.** (1) The fuze setter M23 (fig. 106) is a hand-operated, dialed instrument for setting the mechanical time fuze M67. A time scale and corrector scale with corresponding indexes record the fuze number corresponding to the firing table figure for the desired time of flight of the shell. (Fuze numbers or fuze seconds are angular measurements and are not directly

proportional to the time of flight.) The setting is locked with two wing screws so that any number of fuzes may be set, even in darkness, until a new setting is required. The fuze setter is contoured to fit over the point of the fuze, after the fuze safety pin has been removed.



RA PD 96182

Figure 106. Fuze setter M23.

(2) The time scale is graduated in 1.2-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 when the corrector scale is set to 30 (normal).

(3) The graduations on the corrector scale are called points. The scale is graduated in 2-point (0.2-second) intervals from 0 to 60 points with 30 as normal. The graduations represent corrections in time from 0 to 3 seconds either side of normal for increasing or decreasing the time of burst from the time indicated on the time scale.

(4) To insure accuracy in setting the scales, look squarely at the graduations and indexes.

(5) The wing screws which lock the time scale and correction scale settings are marked "T" and "C," respectively. Tighten the "C" screw and loosen the "T" screw when setting time values; turn the handle until the time scale index alines with the desired

graduation; and tighten the "T" screw. To set corrector values, loosen the "C" screw and turn the corrector scale until the corrector scale index aligns with the desired graduation; tighten the "C" screw.

(6) The handle which was used to set time values is also used to turn the fuze setter when setting the fuze.

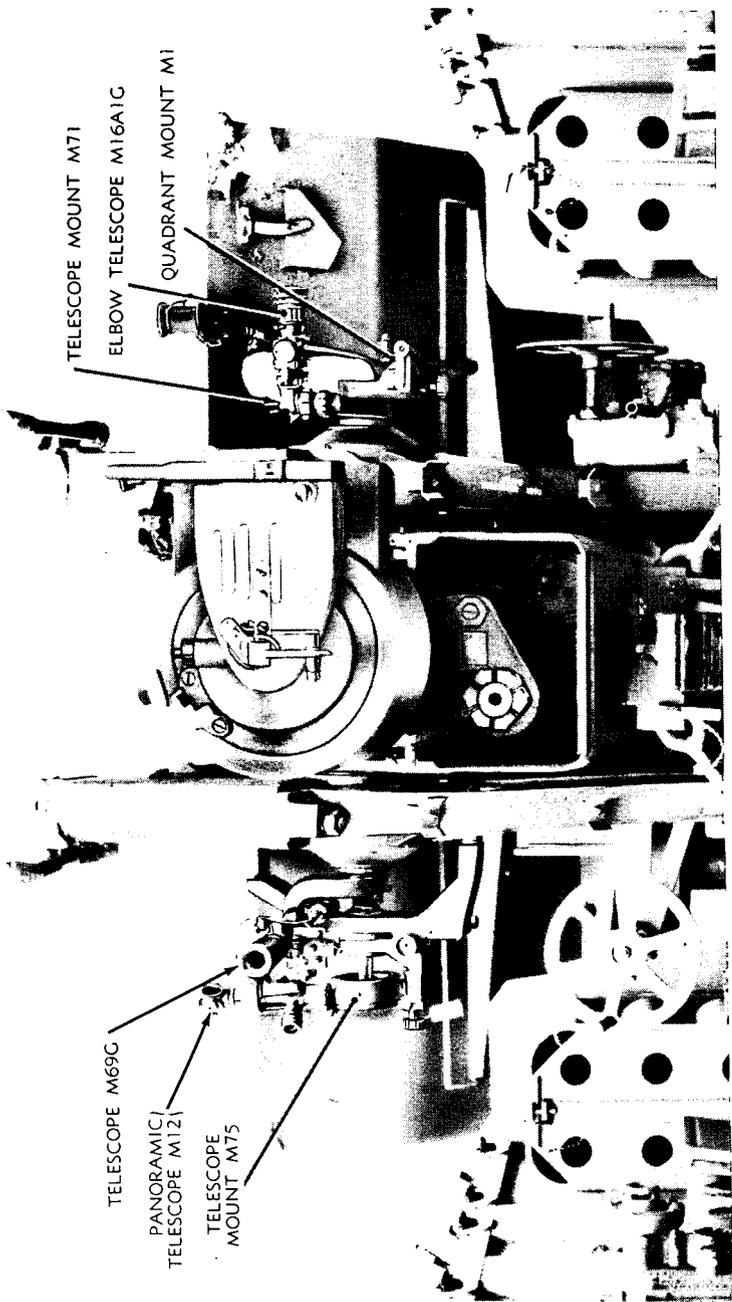
b. TO SET A FUZE. (1) Place the fuze setter, with the scales set to the desired values over the point of the fuze. Press down firmly on the fuze setter, and at the same time rotate the fuze setter clockwise until the lug engages the fuze ring. Continue rotation until the pawl seats in the fuze body. The setting is complete when further rotation becomes impossible.

(2) If it is desired to reset a fuze to the SAFE position, set the time scale to "S" and the corrector scale to 30 (a(2) above) and proceed as above.

Caution: Before setting a fuze, make sure that the "T" and "C" screws are tight to prevent any slipping of the scale indexes when the handle of the fuze setter is rotated. When setting fuzes, always rotate the fuze setter in a clockwise direction. When removing the fuze setter from the fuze, lift it straight off without rotating it, to prevent disturbing the setting of the fuze.

c. TESTS AND ADJUSTMENTS. Test the fuze setter M23 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. If the settings do not agree, 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. No adjustments by the using personnel are permitted.

Caution: Where a live fuze is used, the precautions 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 the fuze setter 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 TM 9-1900.



RA PD 107583

Figure 107. Arrangement of sighting and fire control equipment—8-inch howitzer motor carriage M43.

107. Telescope Mount M75 with Telescope M69G and Instrument Light M33, and Panoramic Telescope M12

a. DESCRIPTION. (1) *Telescope mount M75.* (a) The telescope mount M75 is mounted on the left trunnion of the top carriage (fig. 107) and moves with the howitzer. The mount supports the telescope M69G and the panoramic telescope M12. The telescope M69G is supported in a mounting which holds the front and rear of the telescope. The front holder, which is fixed, contains a spring-loaded plunger for securing the forward end of the telescope. The rear holder, which is adjustable, has a locating slot for positioning the telescope and a clamp and eyebolt with associated nuts for securing the rear end of the telescope.

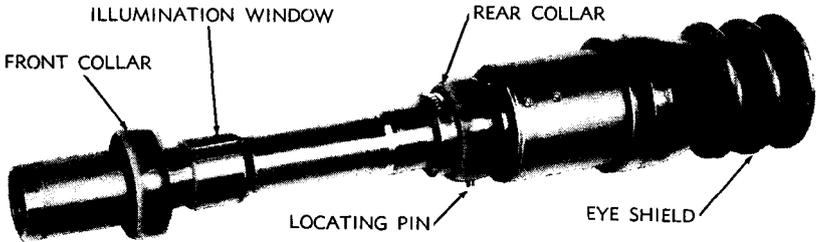
(b) Lateral and vertical adjusting mechanisms for the telescope M69G move the rear holder when performing the bore sighting adjustment. The lateral motion is controlled by a lateral adjustment micrometer, and two gib adjusting bolts for locking the adjustment. The vertical motion is controlled by a vertical adjustment micrometer and a holder clamping bolt.

(c) The amount of the adjustment is registered on scales and micrometers which are graduated in reference units approximating mils. The lateral scale is graduated from 0 to 20 either side of zero, and marked "0," "10," "20." Arrows and the letters "L" and "R" (left and right) indicate the direction of the adjustment. The graduations on the lateral micrometer are marked "0," "1," "2," "3," "4" in both directions. Arrows and the letters "L" and "R" indicate the direction of the adjustment. The sum of the scale and micrometer readings give the amount of the adjustment in reference units. The elevation scale and micrometer are graduated in the same manner as the lateral scale and micrometer with the exception that the direction of the adjustment is indicated by the letters "EL" and "DEP" (elevation and depression). No means are provided for setting deflection or elevation angles; this is accomplished with the graduated reticle in the telescope.

(2) *Telescope M69G.* (a) The telescope M69G (fig. 108) has a front and rear collar which form the locating surfaces for seating the instrument in the mount. A locating pin on the rear collar engages a corresponding slot in the rear holder of the telescope for positioning the telescope.

(b) The telescope is a 3-power instrument having a field of view of 10 degrees, 24 minutes.

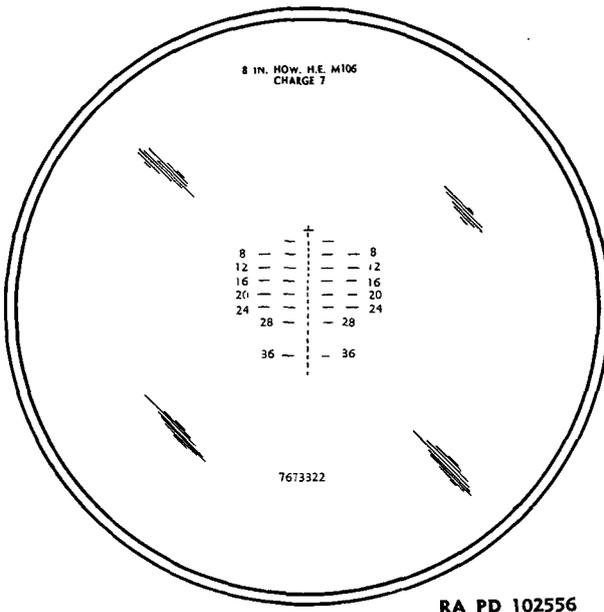
(c) The reticle pattern of telescope M69G (fig. 109) is based upon the data from Firing Table 8-J-1, part 2G: HE SHELL M106 fired with a muzzle velocity of 1,950 feet per second; charge 7; plus 1.2 mils jump. The cross in the pattern represents zero



RA PD 102555

Figure 108. Telescope M69G.

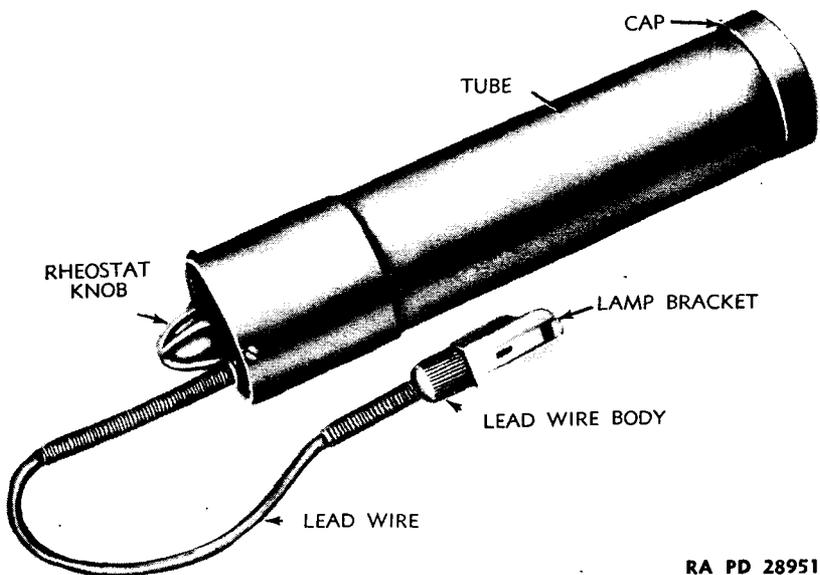
range and zero deflection. The cross is used for bore sighting. Each part of the broken vertical line represents an interval of 100 yards' range, and serves as a guide for estimating range settings when the range falls within a 400-yard interval. The broken horizontal lines below the cross represent 400; 800; 1,200; 1,600; 2,000; 2,400; 2,800; and 3,600 yards' range, indicated by range marks 8, 12, 16, 20, 24, 28, and 36. The bottom of the broken vertical line represents 4,100 yards' range. Each horizontal line and each horizontal space represents a deflection of 5 mils. The inscription "8 IN. HOW. H.E. M106, CHARGE 7" at the upper edge of the reticle indicates the ammunition. The number 7673322 at the lower edge of the reticle is the part number of the reticle. When aiming, elevate and traverse the howitzer with the handwheels until the target appears at the desired point on the reticle pattern. A window in the telescope provides for illumination of the reticle.



RA PD 102556

Figure 109. Reticle pattern of telescope M69G.

(3) *Instrument light M33.* The instrument light M33 (fig. 110) is a device for illuminating the reticle. It consists principally of two flashlight batteries, a rheostat, and a 3-volt electric lamp. The batteries are contained in a body tube, and are held in position by a bayonet-type cap and spring which fits over one end of the tube. Press inward on the cap and turn slightly to release the cap when removing batteries. The rheostat is mounted in the other end of the body tube. Rotate the rheostat knob to turn the electric power on and off and to regulate the intensity of the illumination. The electric lamp is mounted in a lead wire body to which is screwed a lamp bracket. The lamp bracket has a dovetail-formed base which contains a window and detent device. The lamp bracket is positioned in a telescope bracket which has corresponding mating surfaces and is attached to the telescope over the reticle window. To replace an electric lamp, remove the lamp bracket from the telescope bracket, and unscrew it from the lead wire body. Unscrew the lamp from its socket. A block or slide on the side of the body tube provides for holding the lamp bracket when not attached to the telescope.



RA PD 28951

Figure 110. Instrument light M33.

(4) *Panoramic telescope M12.* The panoramic telescope M12 is retained in a mounting which is similar to the telescope mount M18A1 and has similar adjustments (par. 104).

b. **SETTING UP.** (1) Unlock the wing nut on the rear holder of the telescope mount and loosen the round nut so that the eyebolt can be lowered, and the clamp opened. Remove the telescope from its carrying case, and insert the front end of the telescope in the front holder on the mount. Aline the locating pin on the rear collar of the telescope with the slot in the rear holder. Exert a slight forward pressure on the telescope to overcome the action of the spring-loaded plunger and to shove the telescope into position in the mount. Close the clamp and tighten the nuts.

(2) Install the body of the instrument light in the bracket on the mount, and slide the lamp bracket into position on the telescope.

c. **TESTS AND ADJUSTMENTS.** The line of sight is adjusted parallel to the axis of the howitzer bore at the time the telescope mount is installed on the carriage. The adjustment should be checked occasionally by the bore-sighting procedure (par. 109). If the cross of the reticle pattern is not on its aiming point, put it on in the following manner:

(1) Loosen the two gib adjusting bolts and turn the lateral adjustment micrometer until the cross alines with the aiming point. Tighten the bolts.

(2) Loosen the holder clamping bolt and turn the vertical adjustment micrometer until the cross alines with the aiming point. Tighten the bolt. If for any reason the cross has now moved laterally off the aiming point, repeat the above adjustment until coincidence is obtained in both directions. The adjustment may be read on the scales and micrometers and recorded for future reference.

(3) All other adjustments and repairs are to be performed by ordnance maintenance personnel.

(4) Description, setting up, tests, and adjustments of panoramic telescope M12 are covered in paragraph 104.

108. Telescope Mount M71 with Elbow Telescope M16A1G and Instrument Light M36

a. **DESCRIPTION.** (1) *Telescope mount M71.* The telescope mount M71 (fig. 111) is attached to the right side of the motor carriage, and moves with the howitzer in elevation. The mount supports the elbow telescope on locating surfaces and secures it in position with a clamp and associated eyebolt. Provision is made for rotating the elbow telescope about its objective axis in order to place the range lines of the reticle in a horizontal position. Vertical and lateral adjusting mechanisms are provided for bore sighting. The pilot model T124 of the mount is shown in figure

111. The mounts are identical with the exception of the positioning of the instrument light bracket and the arrangement of the telescope holder in relation to the bracket.

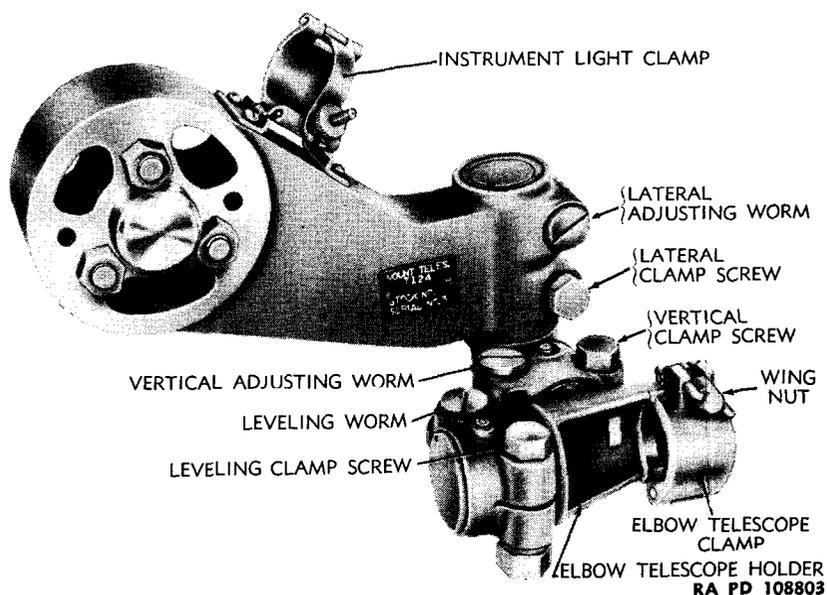


Figure 111. Telescope mount T124 (M71)—right side view.

(2) *Elbow telescope M16A1G.* Elbow telescope M16A1G (fig. 112) is a 3-power instrument having a field of view of 13 degrees, 20 minutes. The reticle pattern (fig. 109) is identical to the reticle pattern of telescope M69G except for the reticle part number and the graduations which have been compensated for a plus 1.4-mil jump instead of a plus 1.2-mil jump. Elevate and traverse the howitzer with the handwheels until the target appears at the desired range line. A window in the elbow telescope provides for illumination of the reticle.

(3) *Instrument light M36.* Identical to the instrument light M33 (fig. 110) except for the length of lead wire.

b. SETTING UP. The elbow telescope is properly set up in the telescope mount when it is fully seated on the locating surfaces, the reticle range lines are in a horizontal position, and the telescope is securely clamped in position with the eyebolt.

c. TESTS AND ADJUSTMENTS. (1) *Leveling the range lines.* The reticle range lines are leveled by turning the reticle rotation worm (fig. 111). The observer's sense of balance determines when the lines are level. Clip the instrument light bracket to the elbow telescope if illumination of the reticle is desired.

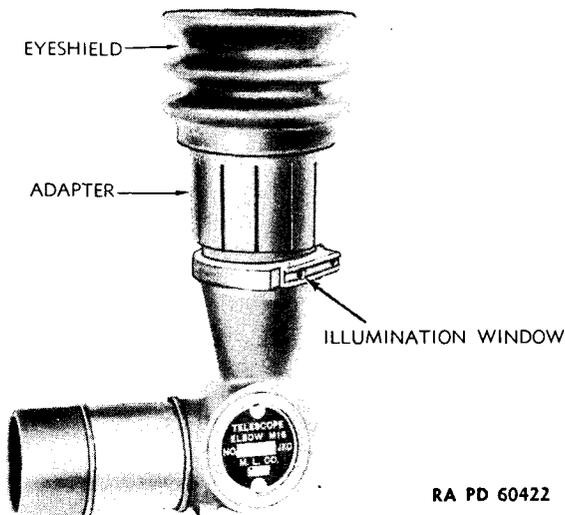


Figure 112. Elbow telescope M16A1G.

(2) *Bore-sighting adjustments.* Bore-sight the howitzer on a distant aiming point (par. 109). If the cross on the reticle does not fall on the aiming point, proceed as follows:

(a) For vertical adjustment, loosen the vertical adjustment clamping bolt, and turn the vertical adjusting worm until the cross falls on the distant aiming point. Tighten the bolt.

(b) For lateral adjustment, loosen the lateral adjustment clamping bolt (above the lateral adjusting worm) (fig. 111), and turn the lateral adjusting worm until the cross falls on the distant aiming point. Tighten the bolt.

109. Bore Sighting

a. **GENERAL.** This paragraph contains instructions for setting up the matériel for testing the alinement of the sighting equipment with the bore. Instructions for adjusting the instruments are covered in paragraphs 104c, 107c, and 108c. A general description of the purpose and principles of bore sighting is contained in TM 9-575.

b. **SELECTION OF TARGET.** The target for bore sighting may be a distant target 1,500 yards or more from the weapon, or a testing target placed at a minimum distance of 50 yards from the muzzle of the howitzer tube. The choice of target will depend on time and facilities available. A suitable distant aiming point is a celestial body such as a star, a point of the crescent moon, or the leading edge of the sun; if using the sun, interpose a filter of smoked glass or darkened photographic negative to prevent damage to the instruments and to reduce glare.

c. **IMPROVISING TESTING TARGET.** If a testing target is not available, construct one out of cardboard or some other suitable material. Use the dimensions shown in figure 113 for constructing the testing target for the 8-inch howitzer carriage M1. Mark the top of the target "TOP," to avoid accidentally positioning the target in an inverted position, and identify the aiming points.

Note. The targets for use with the different telescopes are not interchangeable and care should be taken that the correct target is used.

d. **PROCEDURE.** (1) Insert the breech bore sight in the chamber of the tube and attach the muzzle bore sight, stretching the linen cord tightly across the score marks on the muzzle, and hold in place by the strap.

(2) Level the carriage transversely. It is absolutely necessary that the axis of the cradle trunnions be level. The trunnions will be level when the top carriage is level. Check with a gunner's quadrant.

(3) Bring the howitzer tube to near center traverse.

(4) The testing target (fig. 113) must be leveled horizontally and tilted vertically, so that its face is at right angles to (square with) the line of sight through the bore of the howitzer. If shrinkage of the testing target is suspected, check the dimensions with a scale or ruler before using the target.

(5) When using the testing target, bring the howitzer to zero degrees elevation and check the longitudinal level with a gunner's quadrant. Then move the target until the bore aiming point is centered, as seen through the bore sights in the howitzer bore.

(6) When using a distant target, select an aiming point as near to zero elevation as practicable and sight the bore accurately on the point. If bore sighting the 8-inch howitzer carriage M1, determine the exact howitzer angle of elevation by use of the gunner's quadrant and adjust the sighting equipment to the same angle.

(7) Once this alinement has been obtained, do not shift the howitzer carriage or the testing target, until the tests and adjustments in paragraphs 104c, 107c, and 108c have been completed. When using celestial bodies as targets, the bore-sighting operation must be performed rapidly to minimize errors arising from the normal motion of these bodies.

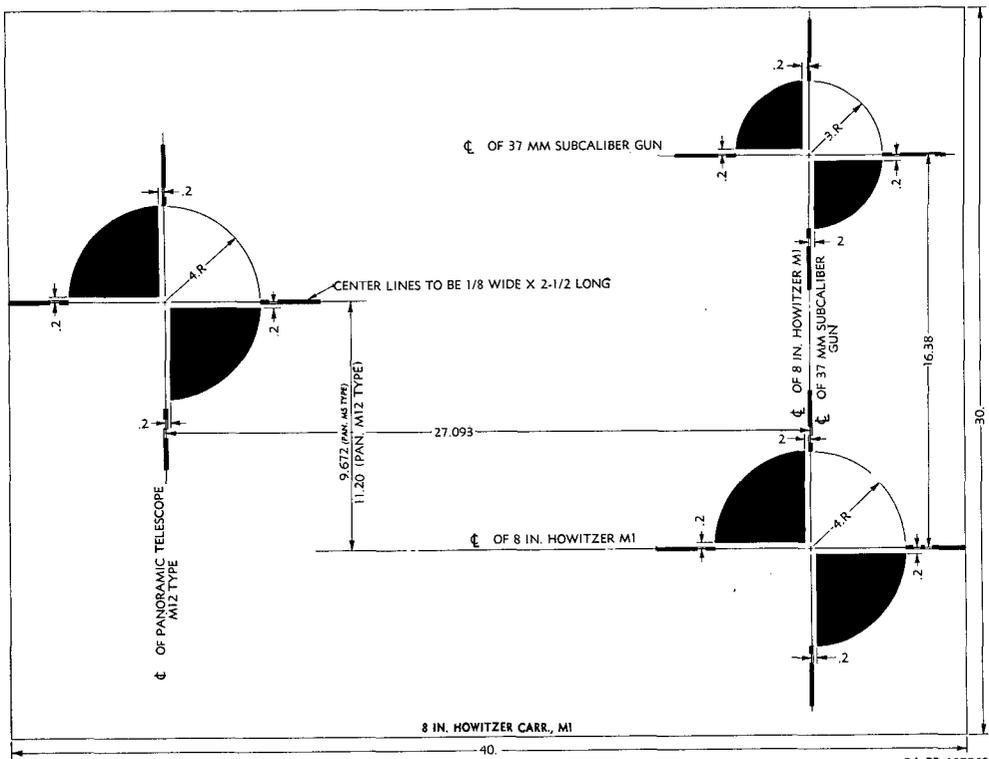


Figure 113. Testing target for 8-inch howitzer.

Section XXIX. SUBCALIBER EQUIPMENT

110. Purpose

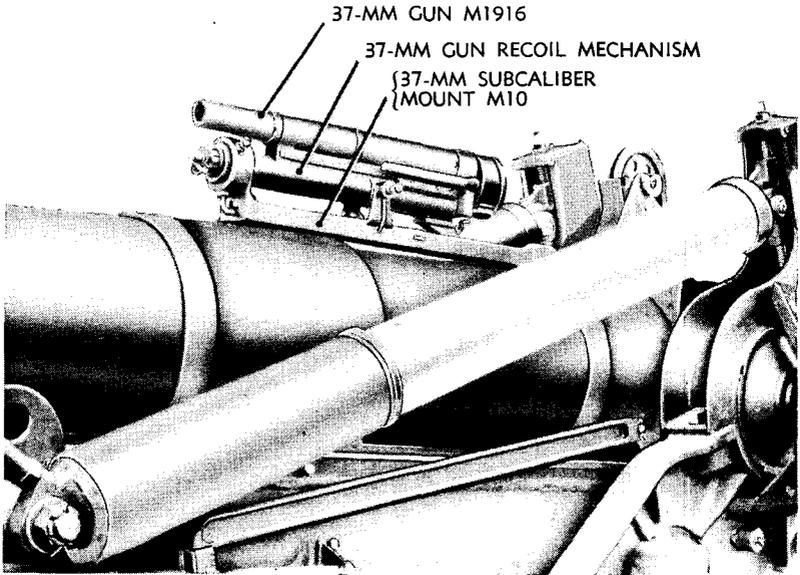
Subcaliber equipment, which is used for training purposes only, and is not taken into the theater of operations, consists of the following:

- 37-mm gun and recoil mechanism M1916
- 37-mm subcaliber mount M10
- Caliber .22-.30 rifle adapter M17
- Caliber .22 rifle M2
- Caliber .30 rifle M1903

The subcaliber equipment is used to provide practice in laying and firing the 8-inch howitzer matériel M2. The use of smaller bore ammunition prevents wear on the regular piece and is less costly. The actual handling, loading, and range obtained are different.

111. General

- a. For tabulated data, see paragraph 6.
- b. The 37-mm gun M1916 (figs. 114 and 115) is a single-shot, hand-loaded weapon with a manually operated, eccentric-screw type breechblock.

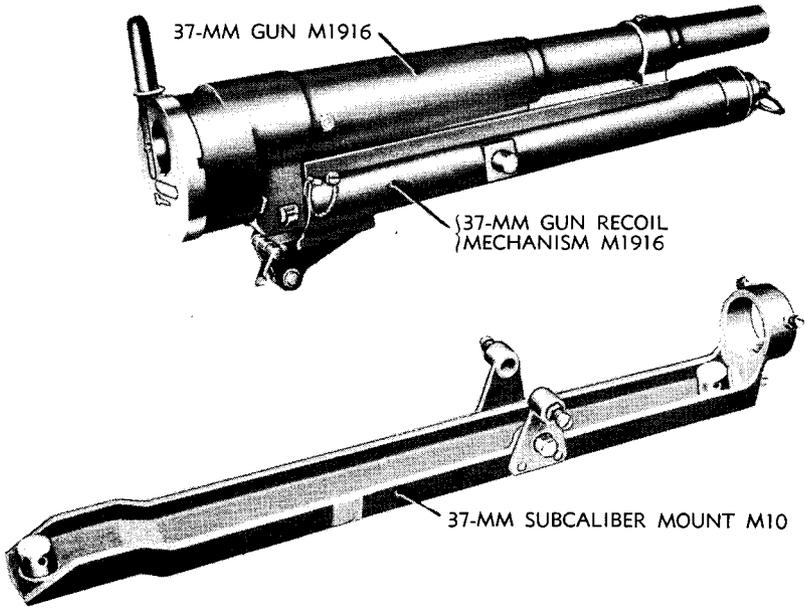


RA PD 102058

Figure 114. 37-mm subcaliber equipment mounted on howitzer.

c. The 37-mm gun recoil mechanism M1916 (figs. 114 and 115) is a hydrospring type and consists of the recoil mechanism, counterrecoil mechanism, and counterrecoil buffer, contained in a single cylinder. The recoil mechanism controls the force created by firing and retards the rearward movement of the gun in a gradual manner. The counterrecoil mechanism returns the gun into battery in order that it may be fired again. The counterrecoil buffer functions at the end of counterrecoil by slowing down and stopping the counterrecoil action without injury to the system.

d. The 37-mm subcaliber mount M10 (fig. 115) consists of a cradle mounting bracket to which the detachable right cradle trunnion bearing bracket is fastened. The left cradle trunnion bearing is cast as an integral part of the cradle mounting bracket. Both trunnion bearings are equipped with cap screws and jam nuts which not only retain the gun cradle in position, but also provide a means of lateral adjustment. The collar at the front end of the cradle mounting bracket houses three screws and jam nuts which retain the front end of the recoil cylinder and also provide a means of vertical adjustment.

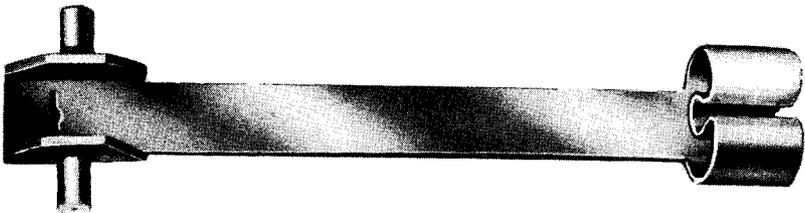


RA PD 102059

Figure 115. 37-mm subcaliber equipment.

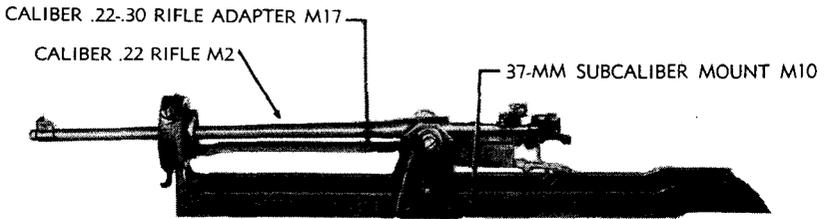
e. The caliber .22-.30 rifle adapter M17 (fig. 116) is positioned in the 37-mm subcaliber mount M10 as shown on figures 117 and 118. The rifle adapter mounts either the caliber .22 rifle M2 or the caliber .30 rifle M1903 with the stock removed.

f. The caliber .22 rifle M2 and caliber .30 rifle M1903 are fully described in TM 9-280 and TM 9-270, respectively.



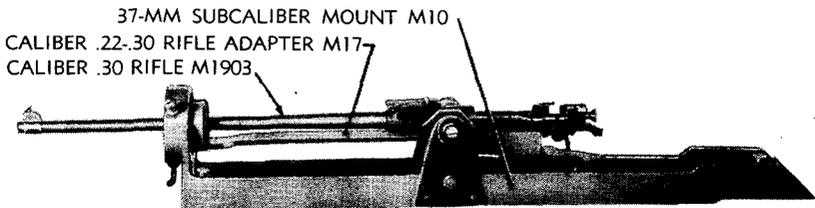
RA PD 106892

Figure 116. Caliber .22-.30 rifle adapter M17.



RA PD 108519

Figure 117. Caliber .22 subcaliber equipment.



RA PD 108520

Figure 118. Caliber .30 subcaliber equipment.

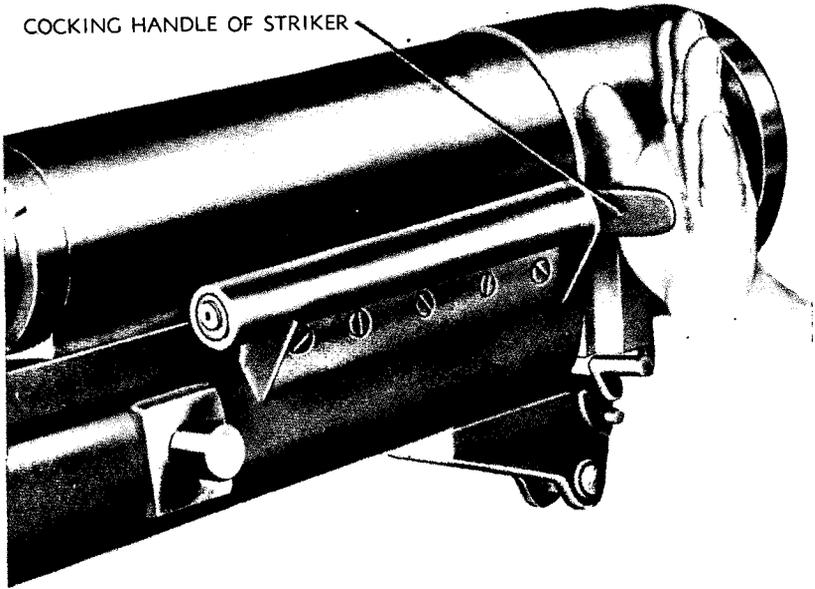
112. Operation of Subcaliber Gun and Mount

a. PRECAUTIONS. (1) Before firing, check to be sure that the bore is clean and dry, that the recoil mechanism is properly filled (*e* below), that the mount is securely fastened to the 8-inch howitzer, and that both weapons are properly bore sighted. Also check to see that all moving parts are oiled and that all parts are functioning properly.

(2) Avoid working the trigger mechanism when there is no round 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 and cannot move when the breech is open.

(3) The breechblock cannot be opened unless the firing mechanism is cocked. Caution is required on the first round or after a misfire when the gunner has to reach across the gun to cock the firing mechanism. Subsequent firing automatically recocks it.

b. COCKING. To cock, place the palm of the hand against the cocking handle of the striker and push it forward until it latches (fig. 119).



RA PD 102061

Figure 119. Cocking the 37-mm gun.

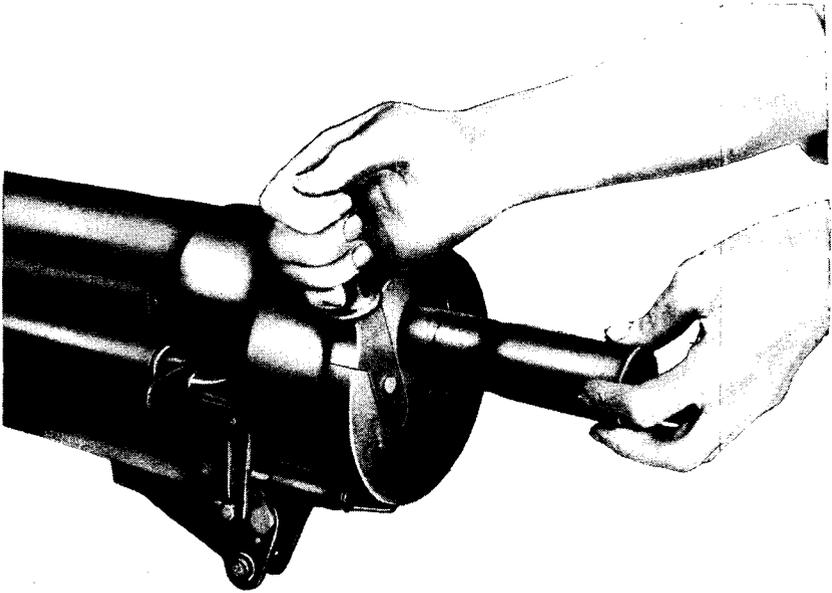
c. OPERATING THE BREECH MECHANISM. To open the breech, rotate the breechblock lever to the left as far as it will go in order to rotate the breechblock and position the eccentric opening in the breechblock in line with the bore (fig. 120). This action operates the extractor, which extracts and ejects the cartridge case. When the breechblock lever is moved to the right, the breechblock closes the breech, forcing the cartridge home; places 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.

Note. The breech cannot be opened if the firing mechanism is not cocked.

d. OPERATION. (1) The normal position for operating the 37-mm gun is from the right side.

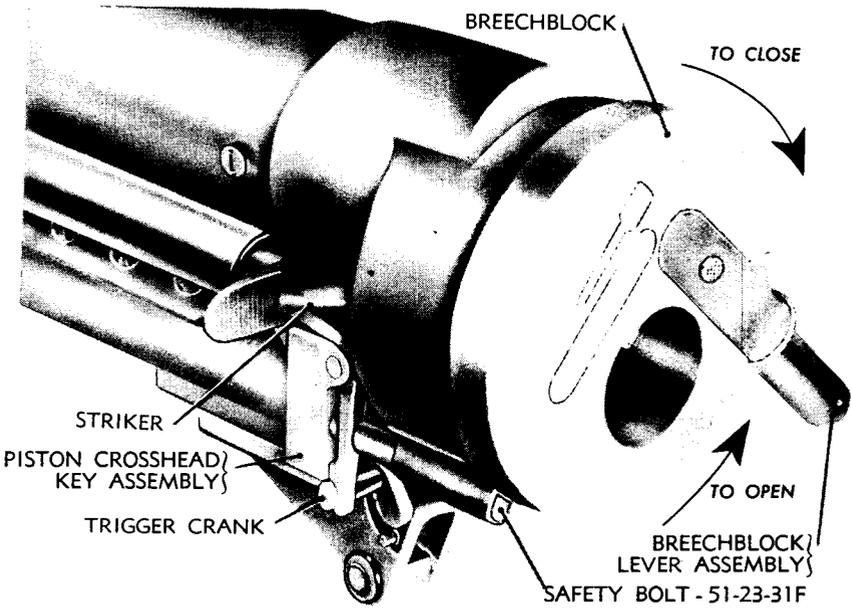
(2) First cock the gun (if not already automatically recocked) and then open the breech.

(3) Place round in breech opening (fig. 120) and push it forward as far as allowed by the extractor. Rotate the breechblock lever to the right until the breech is fully closed (fig. 121). The gun is now ready to fire.



RA PD 102063

Figure 120. Loading the 37-mm gun.



RA PD 108530

Figure 121. 37-mm gun—breech closed.

(4) Firing is accomplished by pressing the trigger crank actuating lever (fig. 122) and then releasing it promptly. During firing, should a misfire occur, recock, relay, and make another attempt to fire. If failure continues after three attempts to fire, wait 2 minutes before opening breech.

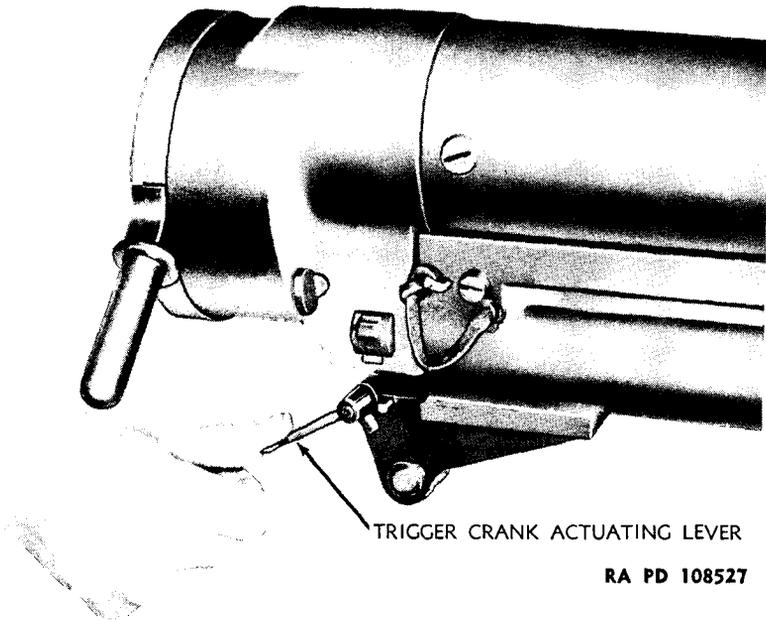


Figure 122. Firing the 37-mm gun.

(5) The maximum elevation at which the 37-mm gun can be served, without depressing the primary weapon to load, is 65 degrees. At the lower elevations, the gun is served by standing on the trails or bogie. At the higher elevations, the gun is served by standing on a board placed across the trails under the breechblock.

e. FILLING THE RECOIL MECHANISM. The recoil mechanism requires $2\frac{3}{4}$ pints of oil or 21 oil gun fills. Only recoil oil (special) is used for this purpose. The filling procedure is as follows:

(1) Raise the rear end of the recoil mechanism higher than the front end (fig. 123).

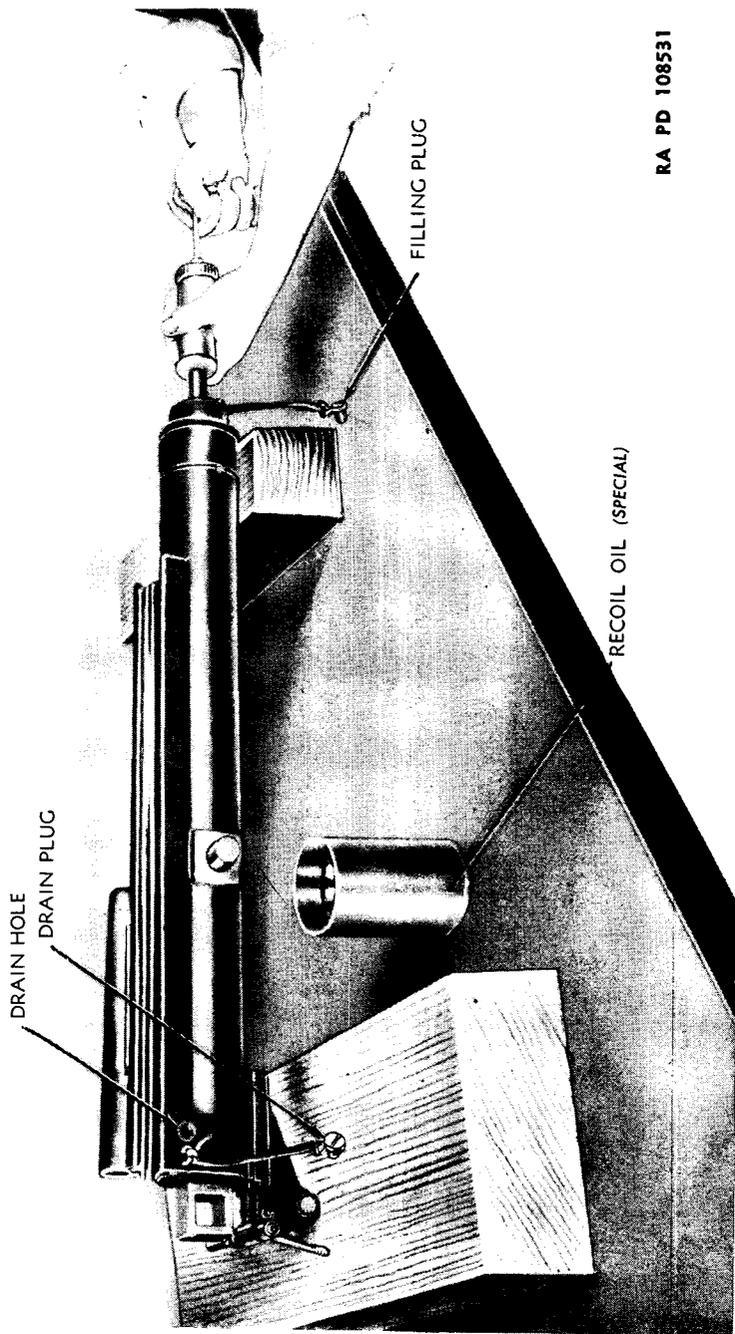


Figure 123. Filling the recoil mechanism.

(2) Fill oil gun. To fill oil gun, unscrew the nozzle of the oil gun and pull the plunger back. Fill with recoil oil (special). Replace the nozzle and push the plunger up gently to force out the air.

(3) Remove the filling plug in the front of the cradle.

(4) Screw the oil gun into the filling hole.

(5) Remove the drain plug in the right 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 the 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 about 2 teaspoonfuls of oil escape, then screw the two plugs in tightly. This is necessary because the expansion of oil during prolonged fire may interfere with the complete return of the gun to battery.

f. BORE SIGHTING. (1) As the 37-mm gun is to be laid with the regular sighting and laying mechanism of the 8-inch howitzer, the bores of the two weapons should be parallel. Bore sighting is the method by which this is accomplished. It is essential that both the subcaliber gun and the howitzer be bore-sighted before firing is commenced, and the alinement checked frequently during firing.

(2) The procedure necessary to bring the axis of the bore of the subcaliber gun parallel to that of the howitzer is as follows:

(a) Insert the breech and muzzle bore sights in the subcaliber gun and howitzer.

(b) Make a testing target by wrapping two pieces of black tape of equal width around the aiming post, with the bottom edges of each exactly 16.38 inches apart. By the use of the aiming post as a testing target, it will not be necessary to level the 8-inch howitzer, as the post can be canted to conform to the angle of the primary weapon. Thus, the vertical line of the howitzer will be parallel to the aiming post. The testing target should then be placed about 50 yards in front of the howitzer. The more distant the target, the less will be the error produced by inaccuracies in constructing the target.

(c) Aline the bore of the howitzer with the bottom edge of the lower tape on the target.

(d) Aline the bore of the gun with the bottom edge of the top tape on the target.

(e) All the adjustments of the 37-mm gun are made by adjusting the screws in the collar of the subcaliber mount that encircles the recoil cylinder and by adjusting the screws in the trunnion bearing brackets. When tightening the screws, care must be taken not to place a strain on the recoil cylinder as it may become

distorted and so prevent the subcaliber gun from returning fully into battery. After the bore of the 37-mm gun is properly alined, fit the jam nuts up tight by tightening them intermittently.

113. Preventive Maintenance Schedules for the 37-mm Gun Materiel.

The following table contains instructions designed to insure proper functioning of the 37-mm gun matériel at all times. These instructions must be scrupulously observed.

Item	Preventive maintenance	Instructions
<i>Before firing</i> Gun, recoil mechanism, and mount as a unit.	General inspection.	General—see paragraphs 9 or 10. Check to see that mount is securely fastened to primary weapon, and that both weapons are properly bore-sighted (par. 112f). Try ejection with empty shell case.
Gun barrel	Inspect, clean, and dry.	General—see paragraph 56. Remove the piston cross head key and slide the gun back to insure that the jacket shoe and recoil ways are free from burrs.
Piston cross head key	Inspect, clean, and lubricate.	If the sear, sear spring or sear plunger becomes worn, entire key should be replaced.
Breechblock	Inspect and check for proper functioning.	General—see paragraph 60. 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 $\frac{1}{8}$ inch. Remove the firing mechanism. Examine the parts for rust and burred surfaces. The free length of firing pin spring is $\frac{25}{32}$ inch. Test the tension of the breechblock lever latch spring. Replace all worn parts with new ones, or with parts that are declared usable by ordnance personnel.

Item	Preventive maintenance	Instructions
Recoil mechanism	...Check for leaks and proper functioning.	Examine the front and rear cradle 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.
Striker and trigger mechanisms.	Inspect and check for proper functioning.	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 burrs or worn surfaces.
<i>During firing</i>		
Gun barrelExamine bore for powder fouling.	Clean with bore brush if necessary.
Recoil mechanismCheck for proper functioning.	The length of recoil should be measured for the first few rounds and then at regular intervals. Normal length of recoil is 7 to 10 inches (maximum).
<i>After firing</i>		
Gun barrelClean and lubricate...	See paragraph 56.
Breechblock, and striker and trigger mechanisms.	Clean and lubricate...	Disassemble, clean, and re-lubricate.
Recoil mechanismGeneral inspectionExamine for worn, loose, or broken parts.

114. Disassembly and Assembly of Subcaliber Equipment

a. MOUNTING SUBCALIBER EQUIPMENT. (1) To mount the subcaliber mount, aline the holes on the bottom of the cradle mounting bracket with those on the 8-inch howitzer tube and secure the bracket with the two mount clamping bolts provided (fig. 114).

(2) To mount the subcaliber gun, loosen the adjusting screws in the front collar of the mount. Remove the cradle trunnion bracket from the right side of the cradle mounting bracket by removing the cap screw and washer which retain it in position. Lift the 37-mm gun with recoil mechanism to the top of the 8-inch howitzer and insert the front end of the recoil cylinder through the front collar of the mount, meanwhile placing the trunnion of the recoil mechanism in the trunnion bearing on the left side of the cradle mounting bracket. Assemble the cradle trunnion bracket to the cradle mounting bracket, and secure it with the cap screw and washer. Tighten cap screws in the trunnion bearings and those in the front collar just enough to retain the 37-mm gun in position.

b. 37-MM GUN. (1) To remove the gun, first release the striker by pressing down on the trigger crank actuating lever with the right thumb while applying pressure against the cocking handle with the left hand, thus preventing too fast a movement of the striker. Remove the piston crosshead key by pressing its latch upward and pushing the key out to the left. Grasp the muzzle with one hand and the breech with the other, and carefully draw the gun to the rear and off the cradle.

(2) To replace the gun, first clean and lubricate the gun slides and the piston crosshead. Insert the gun from the rear, carefully maintaining alinement to avoid jamming the gun slides. Replace the piston crosshead key.

c. BREECH MECHANISM (figs. 124 and 125). (1) To dismount the 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 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 the breechblock, first see that the breech recess, the extractor, and the 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

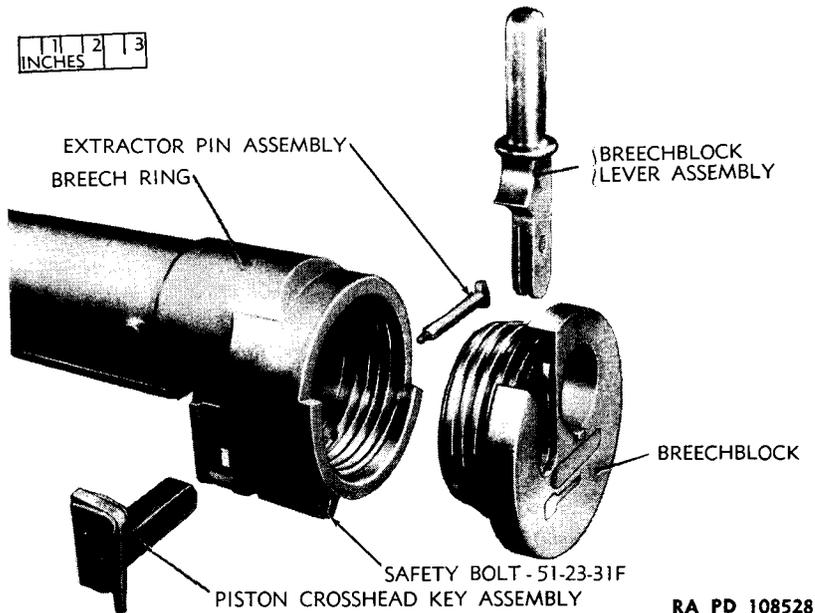


Figure 124. Breech mechanism—exploded view.

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 pins.

(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 replace the extractor, see step (2) above.

(5) To dismount the 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 grooves 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

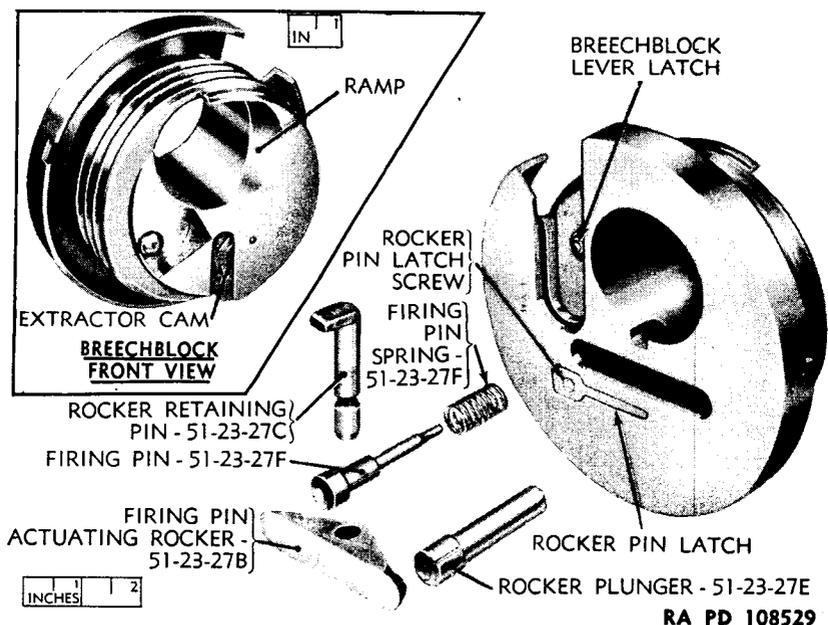


Figure 125. Breechblock—exploded view.

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 the piston crosshead key, disengage the striker, press up on the piston crosshead key latch, and push out to the left.

(8) To assemble the piston crosshead key, first examine and lubricate the parts. Push the key in place with the trigger crank lying in front of the long arm of sear. See that the safety bolt 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 the 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 setscrew 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 the striker mechanism, first oil the striker spring and striker rod. 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 setscrew 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 setscrew must not be omitted, and must be set so that it does not strike the bottom of the keyway.

d. RECOIL MECHANISM. Disassembly of the recoil mechanism by the using arm is not permitted. The using arm may only fill or drain it as necessity requires.

115. Maintenance of Subcaliber Equipment

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.

a. 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 dismantled and the guides examined for traces of scratches, fouling, etc. These 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.

b. Sudden return to battery, with a jarring impact, is caused by incomplete buffer action 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.

c. Trigger crank lever jamming, which prevents sufficient depression 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.

d. 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 2 minutes, and then replace it with another round, as the primer is defective.

e. 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.

f. Failure of the breech to open may be caused by the fact that the gun is uncocked. The gun may be uncocked because the cannoneer failed to release the trigger crank lever, or because of a worn or broken sear, a defective sear plunger and spring, or a worn or broken shoulder on the striker rod.

116. Lubrication of Subcaliber Equipment

The 37-mm gun materiel has very few oilholes or special fittings, yet it requires regular oiling of certain bearings. The following lubrication guide indicates where lubrication is necessary, the amount and frequency required, and the method of application required in active service. Preservative lubricating oil, medium, will be used at temperatures above 0° F.; preservative lubricating oil, special, at temperatures below 0° F.

*Lubrication guide,
37-millimeter gun matériel M1916*

Part	Method	Remarks
Bore	Swab with bore brush. Dry and apply oil with jute burlap.	Clean and lubricate in the same manner as the 8- inch howitzer (par. 56).
Breechblock	Apply oil to threads.....	Weekly. Unscrew breech- block (par. 114c).
Firing pin	Drops at contact surfaces.	Weekly. While breechblock is dismantled (par 114c).
Extractor and extractor pin	Drops at contact surfaces.	Weekly. While breechblock is dismantled (par 114c).
Safety bolt	Drops at ends of bracket.	Weekly. While breechblock is dismantled (par 114c).
Striker rod	Drops at ends of bracket.	Weekly. While breechblock is dismantled (par 114c).
Sear	Drops at bearing surface.	Weekly. While breechblock is dismantled (par 114c).
Piston crosshead key..	Drops at contact surfaces.	At assembly.
Striker spring	Slush	At assembly.
Gun slides	Cover bearing surfaces...	Dismount gun.
Trigger crank	One drop at each end of bearing.	Weekly.

117. Ammunition

The ammunition issued for use with the 37-mm gun M1916 is described in paragraph 100.

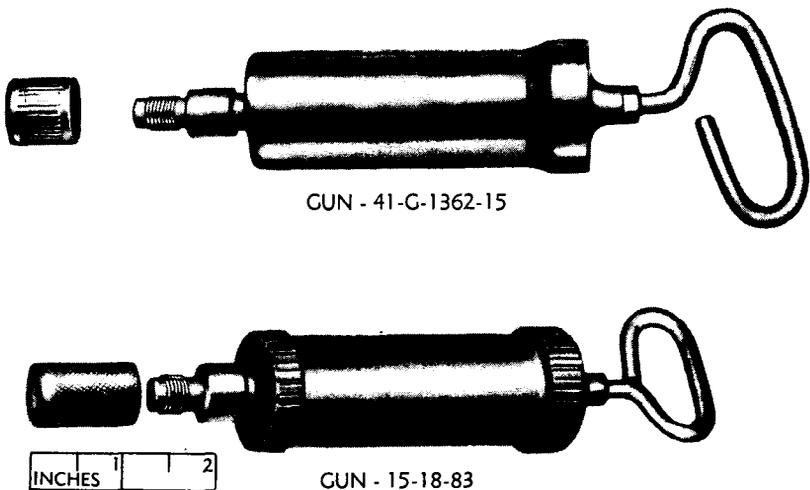
118. Organizational Spare Parts, Tools, and Equipment

a. SPARE PARTS. A set of organizational spare parts is supplied to the using arm for field replacement of those parts most likely to become worn, broken, or otherwise unserviceable.

b. TOOLS AND EQUIPMENT. A set of organizational tools and equipment is supplied to the using arm for maintaining and using the matériel. This set contains items required for disassembly, assembly, cleaning, and preserving the 37-mm gun matériel. Tools and equipment should not be used for purposes other than prescribed and, when not in use, should be properly stored in the chest and/or roll provided for them.

c. LIST OF SPARE PARTS, TOOLS, AND EQUIPMENT. Spare parts, tools, and equipment supplied for the 37-mm gun materiel are listed in WD Supply Catalog ORD 7 SNL C-33, Section 13, which is the authority for requisitioning replacements. There are no spare parts, tools, or equipment supplied for the 37-mm subcaliber mount M10.

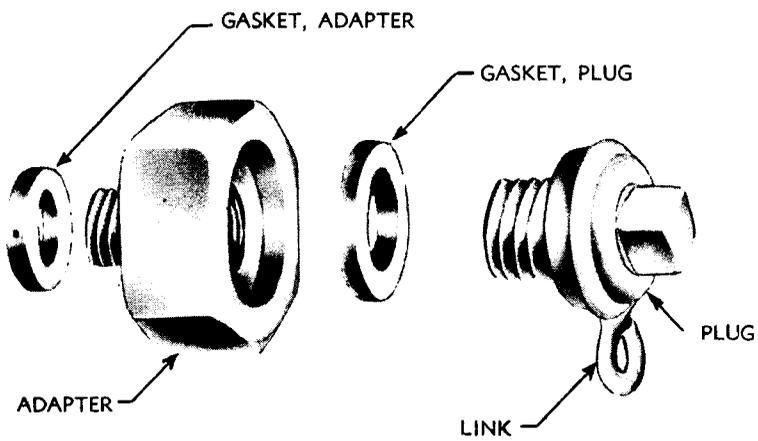
d. RECOIL OIL GUNS. (1) Recoil oil gun 41-G-1362-15 (CLAX7A) will be issued for use in filling the recoil mechanism of the 37-mm gun M1916 in lieu of oil gun 15-18-83, which is no longer being produced (fig. 126).



RA PD 108526

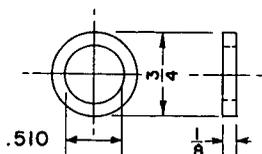
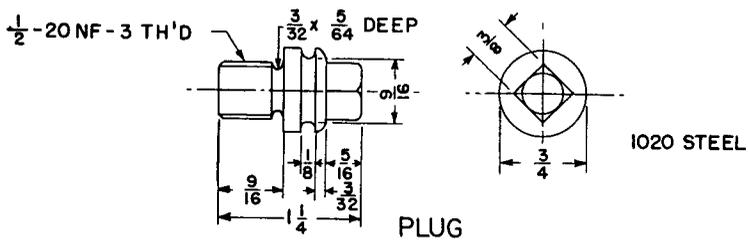
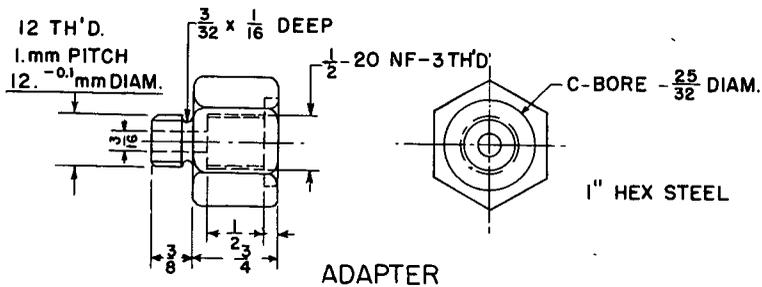
Figure 126. Recoil oil guns.

(2) The oil gun 41-G-1362-15 is not adapted for the recoil mechanism M1916 because the nozzle of the gun is $\frac{1}{2}$ inch in diameter with standard thread, whereas the end cap of the recoil mechanism is adapted for a metric-threaded nozzle of 12-mm diameter. To use this substitute oil gun, an adapter, two gaskets, plug, and link must be manufactured locally as shown in figures 127 and 128. The adapter must be assembled to the recoil mechanism and cap whenever it becomes necessary to replace the oil gun 15-18-83 with the gun 41-G-1362-15.

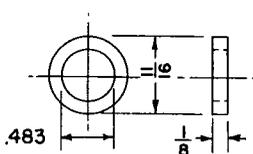


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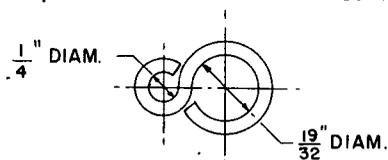
Figure 127. Adapter and components—exploded view.



GASKET, PLUG
COPPER, SOFT



GASKET, ADAPTER
COPPER, SOFT



LINK
WD 1020 STEEL WIRE
.120 (NO.11) DIAM.

RA PD 102119

Figure 128. Adapter and components—dimensions.

APPENDIX I

STORAGE AND SHIPMENT

1. Preparation of Materiel for Shipment

a. Preparation of the 8-inch howitzer and carriage M1, for shipment for the classifications listed below, will be accomplished as directed in WD SB 9-4.

(1) Class I—Processing for all shipments to destinations within continental U. S., *except* directly to ports of embarkation.

(2) Class II—Processing supplementing class I, for shipments directly to ports of embarkation.

(3) Class III—Processing to be performed by ports of embarkation for all shipments except combat loaded.

b. If during the course of shipment, operations embrace deep water fording, prepare matériel in accordance with TM 9-2853.

2. Preparation of Materiel for Storage

a. GENERAL. (1) Matériel received for storage already processed for domestic shipment as indicated on "Vehicle Processing Record Tag" for classifications I, II, or III, will not be reprocessed unless the inspection preparatory to or during storage reveals corrosion, deterioration, etc.

(2) Completely process matériel before storage (*b* through *l* below), if it is determined from the previous storage processing recorded on the tag that such has been rendered ineffective by operation, use, or damage to the matériel, or upon receipt of matériel direct from manufacturing facilities.

b. MATERIALS REQUIRED. The required materials listed for preparation of matériel for storage are in addition to those listed in paragraph 31.

ACID, phosphoric, metal conditioner, concentrated, wipe-off type, type II	COMPOUND, rust-preventive, thin film
BARRIER, waterproof (type E-2)	COMPOUND, sealing, tape
COMPOUND, rust-preventive, light	SOAP, issue
COMPOUND, rust-preventive, medium	WRAPPING, greaseproof (type I, grade C)

c. RECEIVING INSPECTIONS. (1) When matériel is out of use, it must be turned over to ordnance personnel or placed in a storage status for periods not to exceed 90 days. Storage of matériel for periods in excess of 90 days will normally be handled by *ordnance personnel only*.

(2) Immediately upon receipt of matériel for storage, it must be inspected and serviced as prescribed in section IV. Make a systematic inspection and replace or repair all missing or broken parts. If repairs cannot be made prior to placing matériel in storage, attach a tag to the matériel specifying the repairs needed and make a written report of these items to the *officer-in-charge* of the matériel.

d. CLEANING. Prior to the application of preservatives and protective wrapping, thoroughly clean the howitzer and carriage as described below. Give special attention to bearing surfaces, revolving parts, springs, screw threads, gear teeth, and exterior surfaces, as well as the interior of the breech ring and the bore of the howitzer. Do not use dry cleaning solvent to clean the bore of howitzer.

Note. Make the partial disassembly of the breech and firing mechanisms in accordance with the procedure outlined in sections XV and XVI.

(1) *Cleaning nonrusted surfaces.* (a) *Rifle bore cleaner* is first preference for cleaning matériel.

1. The standard bore brushes and cleaning equipment supplied with matériel are satisfactory for cleaning.
2. The cleaner is most efficient when used undiluted. When necessary to conserve supply, dilute rifle bore cleaner up to 50 percent with water provided prevailing temperatures are above +32° F. When temperatures are below +32° F. dilute the cleaner with a solution of grade II denatured alcohol and water in the proportions prescribed in TM 9-850, table I, "Guide for Preparing Fresh Anti-Freeze Solutions."

Caution: Grade II denatured alcohol is the only authorized solution that may be used as any other anti-freeze compound will tend to "gum up" the bore of the howitzer and cause severe damage to the weapon.

(b) *Dry cleaning solvent* is second preference for cleaning matériel. Apply dry cleaning solvent by scrubbing with a brush or wiping with a clean, saturated cloth. Repeat application with clean solvent and cloths until all traces of foreign matter have been removed.

(c) *Soap solution* may be used if rifle bore cleaner or dry cleaning solvent is unavailable. Dissolve 1 pound of issue soap in

chip form in 4 gallons of hot water. The efficiency of soap solutions is accelerated more by raising the temperature of the solutions than by increasing the amount of soap. Maximum results are obtained with a temperature of $+180^{\circ}$ F. to $+200^{\circ}$ F.

Note. When soap solutions are used, thoroughly rinse materiel immediately in clear hot water, to remove all traces of the solution which may promote corrosion or deterioration of the finish. Under no circumstances use a hose, either normal or high-pressure, in cleaning any sighting equipment or any fire control instruments. Before washing, take off removable sighting equipment from the materiel to be cleaned. In cases where it is not removable, take care to cover the parts properly.

(2) *Cleaning rusted surfaces.* Clean all metal surfaces that have become rusted or pitted as follows:

(a) *Unpainted metal surfaces.*

1. Use crocus cloth for removing rust from finished surfaces.
2. Use aluminum-oxide abrasive cloth for removing rust from unfinished surfaces where slight removal of metal will not affect the functioning of the part.
3. Use type II, wipe-off type, concentrated, metal conditioner, phosphoric acid for removal of rust from unfinished surfaces where pits are too deep to be removed with aluminum-oxide abrasive cloth.

(b) *Painted metal surfaces.*

1. Remove paint from rusted area using flint paper (sandpaper) grade 0 to grade 3.
2. Remove rust as prescribed in (a) above and repaint.

e. **LUBRICATION.** The materiel will be completely lubricated before rail shipment or storage in accordance with War Department Lubrication Order 9-335 (figs. 48 and 49).

f. **APPLICATION OF PRESERVATIVES AND PROTECTIVE WRAPPINGS.** Apply preservatives immediately after cleaning and drying, as a rust stain will form if materiel is handled between operations. Apply rust-preventive compound (light) and (medium) hot, in order to obtain sufficient fluidity to adhere to the metal surfaces. This is best accomplished by placing the compound container in a vessel of water and heating.

Note. The maximum temperature to which rust preventive compound (light) may be heated is 150° F. and rust-preventive compound (medium) may be heated to not more than 180° F.

Application of a flame directly to the compound container must be avoided, as overheating will destroy the protective qualities of the compound and may create a fire hazard. For description of preservatives used herein and method of application, refer to TM 9-850.

(1) *Howitzer tube.* (a) Swab the howitzer bore thoroughly using a ramrod and clean cloths soaked in heated rust preventive compound (medium).

(b) Cover the muzzle with type I, grade C greaseproof wrapping material and secure with nonhygroscopic adhesive tape (fig. 129). Place a corrugated paper disk over the muzzle end and position a plywood disk against the corrugated paper disk. Secure with nonhygroscopic adhesive tape. Inclose the entire muzzle end with type E-2 waterproof barrier material, and thoroughly secure to the howitzer with nonhygroscopic adhesive tape. Apply tape sealing compound over tape to protect it against the elements. Rust-preventive compound (thin film) may be used as a substitute for tape sealing compound.

(2) *Breech mechanism.* (a) Apply heated rust-preventive compound (light) to the interior parts of the breech mechanism, and assemble to the howitzer in accordance with assembly procedure outlined in section XV. Before closing the breech, make a thorough inspection to insure that all unpainted metal surfaces are coated with rust-preventive compound (light). Seal the assembled breech mechanism in the breech ring with rust-preventive compound (medium).

(b) Thoroughly inspect the exterior of the breech to insure that all exposed unpainted metal surfaces have been coated with rust-preventive compound (medium). Seal the breech with two layers of type I, grade C greaseproof wrapping material. Secure with nonhygroscopic adhesive tape and apply the tape sealing compound over tape.

(3) *Exterior unpainted metal surfaces.* Apply a coating of rust-preventive compound (medium) to any mechanical or finished unpainted surfaces of the howitzer and carriage not already preserved.

g. COVERS. Install all covers provided with the matériel and securely fasten.

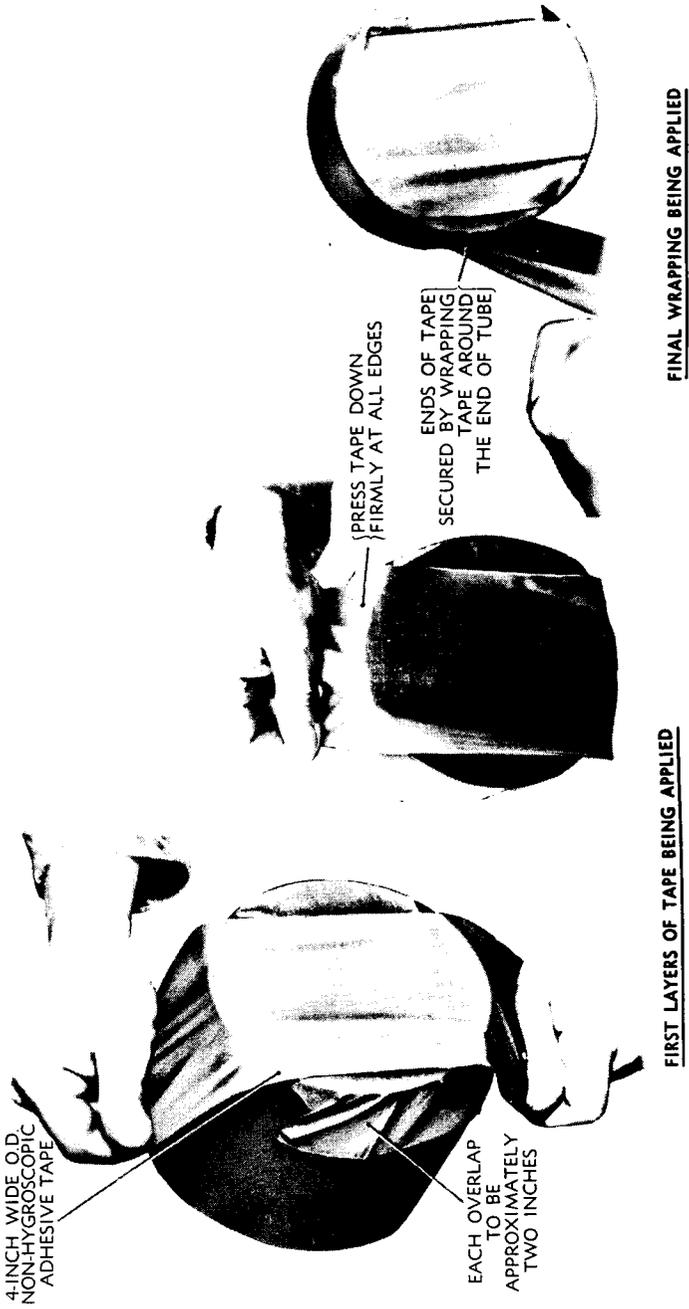
h. GUN BOOK. (1) During transfer or shipment, keep the gun book in a waterproof envelope securely fastened to the howitzer with nonhygroscopic adhesive tape.

(2) Under one of the wrappings of tape, insert one end of a small tab reading: "Gun book here."

i. TIRES. (1) Remove all stones or other foreign objects from the tire treads.

(2) Keep rubber equipment free from oils, greases, and preservatives.

Note. If corrosion preventives are applied by spraying, remove rubber tires or cover with greaseproof wrapping material or tape.



4-INCH WIDE O.D.
NON-HYGROSCOPIC
ADHESIVE TAPE

PRESS TAPE DOWN
FIRMLY AT ALL EDGES

ENDS OF TAPE
SECURED BY WRAPPING
TAPE AROUND
THE END OF TUBE

EACH OVERLAP
TO BE
APPROXIMATELY
TWO INCHES

FIRST LAYERS OF TAPE BEING APPLIED

FINAL WRAPPING BEING APPLIED

RA PD 90439

Figure 129. Method of sealing muzzle.

j. **PREFERRED STORAGE.** The preferred type of storage for this matériel is in closed dry warehouses or sheds. Where it is found necessary to store matériel in the open, cover with tarpaulins. (See WD SB 9-47.)

k. **INSPECTIONS.** (1) Before placing matériel in storage, make a systematic inspection as outlined in *c* above.

(2) Make a visual inspection periodically to determine general condition. If corrosion is found on any part, remove the rust spots, clean and treat with the prescribed preservatives.

(3) Clean, inspect, and properly inflate all tires. Replace tires requiring repairing or retreading with serviceable tires. Matériel must not be stored on floors, cinders, or other surfaces, which are soaked with oil or grease. Wash off immediately any oil, grease, gasoline, or solvent which comes in contact with tires under any circumstances.

l. **REMOVAL FROM LIMITED STORAGE.** (1) If the matériel is not shipped or issued upon expiration of the limited storage period, further treat matériel for stand-by storage (matériel out of use for periods in excess of 90 days up to 3 years).

(2) If matériel to be shipped will reach its destination within the scope of the limited storage period, it need not be reprocessed upon removal from storage unless inspection reveals it necessary.

(3) Deprocess matériel when it has been ascertained that it is to be placed into immediate service. Remove all rust-preventive compounds and thoroughly lubricate as prescribed in section XI. Thoroughly inspect matériel and service as prescribed in section IV.

3. Loading and Blocking Materiel on Railroad Car

a. **LOADING RULES.** (1) *Inspection.* Inspect railroad cars to see that they are suitable to carry loads to destinations. Floors must be sound and all loose nails or other projections not an integral part of the car must be removed.

(2) *Permanent ramps.* Use permanent ramps for loading the matériel when available. When such ramps are unavailable, use improvised ramps constructed of rail ties and/or other available lumber.

(3) *Handling.* (a) Cars loaded in accordance with specifications given herein must not be handled in hump switching.

(b) Do not cut off cars while in motion. Couple cars carefully and avoid unnecessary shocks.

(c) Place cars in yards or sidings so that they will be subjected to as little handling as possible. Designate separate track or

tracks, when available, at terminals and classification or receiving yards for such cars. Cars must be coupled at all times during such holding, and hand brakes set.

(4) *Clearance limits* of the railroads over which matériel is to be moved will govern the height and width of load. Army and railroad officials must check all clearances prior to each move.

(5) *Maximum load weights.* (a) In determining the maximum weight of load, the weights in table III will govern, except where load weight limit has been reduced by the car owner.

(b) For example, table III gives the capacity of the car as 100,000 pounds (Col. 1) and the total weight of car and load as 169,000 pounds (Col. 2). The permissible weight of load can be computed by subtracting the light weight of car, 37,000 pounds (stenciled on each side of car as "Lt. Wt.") from the total weight of car and load, 169,000 pounds (Col. 2). This gives a permissible weight of load of 132,000 pounds.

Table III. *Maximum load weights*

(Col. 1) Marked capacity of car (lbs)	(Col. 2) Total weight of car and load ¹ (lbs)
40,000	66,000
60,000	103,000
80,000	136,000
100,000	169,000
140,000	210,000
200,000	251,000

¹ The light weight of car, stenciled on each side of railroad car as "Lt. Wt.," must be subtracted from the figures in this column to obtain the permissible weight of load.

(6) *Brake wheel clearance* must be at least 4 inches below and 6 inches above, behind and to each side of the wheel (see A, fig. 130). Increase brake wheel clearance as much as is consistent with proper location of load.

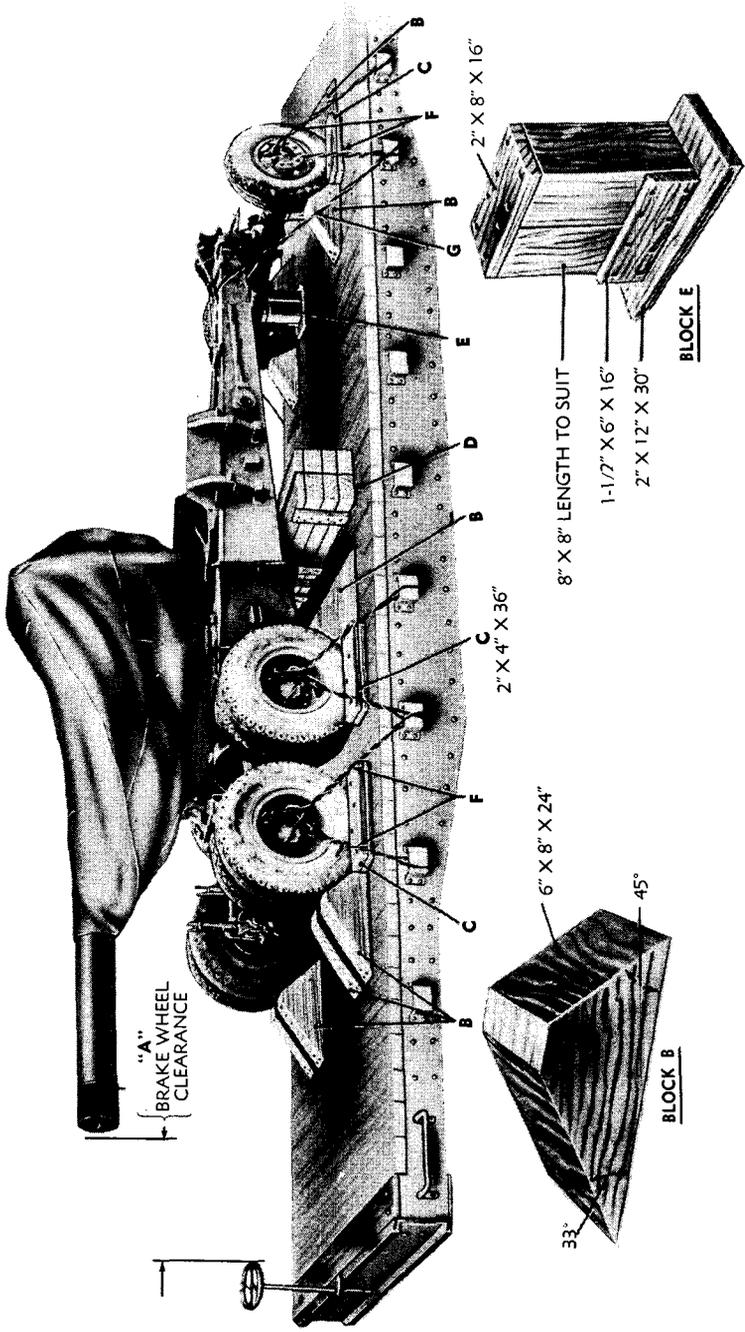
(7) *Distribution of load.* Place load on the car so that there will not be more weight on one side of the car than on the other. One truck of the carrying car must not carry more than one-half of the load weight.

Note. Various types of matériel having common destinations may be loaded on the same car to require the use of a minimum number of cars.

(8) *Tire pressure.* Increase pressure to 10 pounds per square inch above normal for shipment by rail.

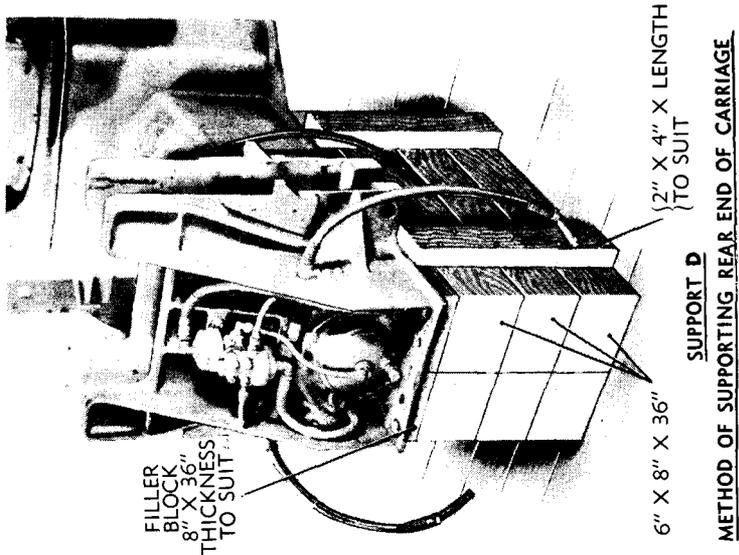
(9) *Type of car.* Use a flat or drop-end gondola car.

(10) *Hand brakes.* Set brakes after loading the matériel.

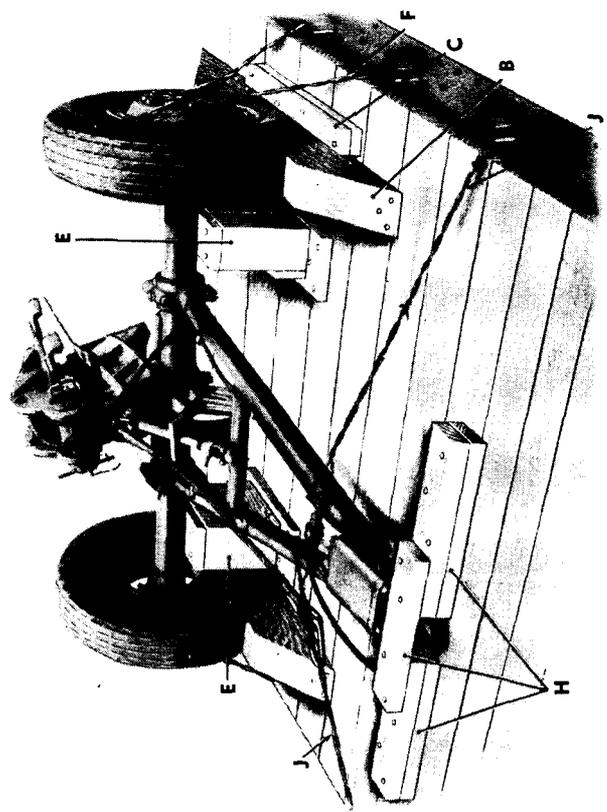


RA PD 102959

Figure 130. Method of blocking 8-inch howitzer and carriage M1.



METHOD OF SUPPORTING REAR END OF CARRIAGE



METHOD OF BLOCKING LIMBER

RA PD 82333

Figure.131. Details of blocking the 8-inch howitzer and carriage M1.

(11) *Materials used in blocking.* Use hardwood, fir, spruce, long leaf yellow pine, larch, or hemlock, straight-grained and free from strength-impairing knots.

b. BLOCKING MATERIEL ON RAILROAD CAR. (1) *General.* All blocking instructions specified herein are minimum and are in accordance with Special Supplement No. 1 of Association of American Railroads, "Loading of Commodities on Open Top Cars." Add additional blocking as required at the discretion of the officer-in-charge. All item reference letters given below refer to the details and locations in figures 130 and 131.

(2) *Brake wheel clearance.* See *a*(6) above.

(3) *Blocks B* (Pattern 3, twelve required). Locate the 45° portion of the blocks against the front and rear of the limber wheels, in front of the intermediate bogie wheels, and in back of the rear bogie wheels. Nail heel of block to car floor with three forty-penny cement-coated nails, and toenail one side of the block to the car floor with two forty-penny cement-coated nails before cleats *C* are applied.

(4) *Cleats C* (Pattern 2, twelve required, 2 in. x 4 in. x 36 in. cleats). Locate two cleats against the face of the outside wheels. Nail lower cleat to car floor with four thirty-penny cement-coated nails, and top cleat to the lower cleat and car floor with four thirty-penny cement-coated nails.

(5) *Supports D* (three required). Place one support under each side of trail crosswise of car and one under the rear end of howitzer carriage lengthwise of car. The height of the support should be slightly higher than the distance between the matériel and car floor partially to relieve weight on tires. Toenail the support to the car floor with four forty-penny cement-coated nails on each side.

(6) *Blocks E* (two required). Place supports under the limber axle lengthwise of car close to each wheel. Height will be $\frac{1}{4}$ inch higher than distance between the axle and car floor partially to relieve weight on tires. Nail support to the car floor using ten forty-penny cement-coated nails.

(7) *Strapping.* Each to consist of four strands of No. 8 gage, black annealed wire or wires of equivalent strength.

(a) *Wheel strapping F* (twelve pieces are required).

1. Pass one wire through two openings in wheel (top and adjacent hole) and through stake pocket. Bring ends of wire together and twist taut with rod or bolt to remove slack.

8. Pass other wire through top and adjacent hole (opposite step 1 above) and through stake pocket. (Wires must cross each other near center of wheel.) Bring ends of wire together and twist taut with rod or bolt to remove slack.

(b) *Trail strapping G* (two pieces are required). Pass one wire around one side of trail and through stake pocket. Bring ends together and twist taut enough with rod or bolt to remove slack. Repeat operation on other side of trail.

(c) *Drawbar strapping J* (one required). Pass one wire around drawbar and through stake pockets on each side of car. Bring ends together and twist taut with rod or bolt just enough to remove slack.

(8) *Cleats H* (five required, 2 in. x 4 in. x 24 in. cleats). Locate two cleats on each side of the lunette. Nail lower cleats to car floor with four thirtypenny cement-coated nails, and top cleat to the lower cleat and car floor with four thirtypenny cement-coated nails. Center one cleat above lunette ring and nail each end to the side cleats with four thirtypenny cement-coated nails.

4. Methods of Slinging 8-inch Howitzer and Carriage M1

a. GENERAL. (1) These instructions prescribe procedures, methods, and practices to be followed when uncrated matériel is hoisted in or out of vessels, and describe the proper attachment points for slings to permit the matériel to be hoisted in its normal traveling position.

(2) Install covers supplied with matériel and securely fasten.

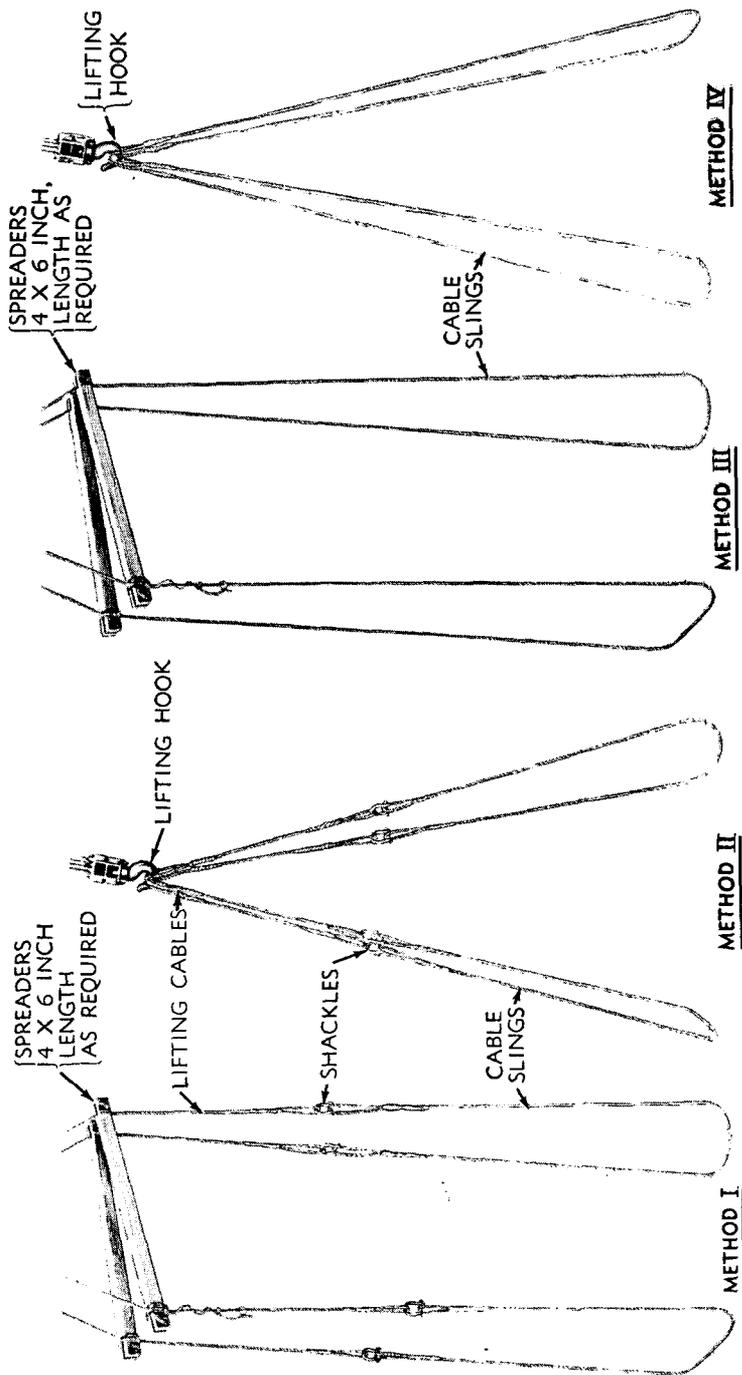
(3) If operations embrace deep water fording, prepare matériel in accordance with TM 9-2853.

(4) For methods in stevedoring, refer to TM 55-310.

b. SLING METHODS. (1) *Hoisting unboxed matériel in and out of vessels*. Due to varying conditions encountered in the field, use any of the following procedures where applicable (see fig. 132).

(a) *Method 1* employs the following materials:

1. Cable slings (2) (heavy enough to support matériel)
2. Shackles (4) (placed between lifting cables and slings).
3. Lifting cables (4).
4. Lifting hook (1).
5. Cargo runners (cable running through head and heel block and fastened to winch).



RA PD 96035

Figure 132. Sling methods used in hoisting artillery matériel.

6. Spreaders (2) (4 in. x 6 in., length as required). Use spreaders between cables to obtain a better balance and to provide clearance between slings and matériel, preventing damage when hoisted. Spreaders consist of two pieces of oak or other hardwood with open ends as shown in figure 132. Position on the cables leading from the lifting hook at a point which will provide clearance between slings and matériel. (The angle of the cable above the spreader must not exceed 45 degrees from the vertical.) Slings are to be placed around matériel at the proper points of balance and attached to the shackles on the lifting cables.

(b) *Method II* requires special care to see that proper clearance for fire control brackets, gears, and operating surfaces is maintained when matériel is hoisted clear of ground. Method II employs the following materials:

1. Cable slings (2) (heavy enough to support matériel).
2. Shackles (4) (placed between lifting cables and slings).
3. Lifting cables (4).
4. Lifting hook (1).
5. Cargo runners (cable running through head and heel block and fastened to winch).

(c) *Method III* employs the following materials:

1. Cable slings (2) (heavy enough to support matériel).
2. Lifting hook (1).
3. Cargo runners (cable running through head and heel block and fastened to winch).
4. Spreaders (2) (4 in. x 6 in., length as required).

(d) *Method IV* requires special care to see that proper clearance for fire control brackets, gears, and operating surfaces is maintained when matériel is hoisted clear of ground. Method IV employs the following materials:

1. Cable slings (2) (heavy enough to support matériel).
2. Lifting hook (1).
3. Cargo runners (cable running through head and heel block and fastened to winch).

(2) *Cautions during hoisting of matériel.* (a) Before attempting to hoist matériel, examine hoisting cables to determine their condition. If strands of cable are broken at any point, substitute a new cable. Cables that are kinked and will not straighten out without damage *must not* be used.

(b) Under no circumstances must matériel be hoisted when it is found that all weight is balanced on one sling (other sling being loose). Lower matériel to the ground and place slings in the proper position.

(c) Do not place slings around howitzer tubes for hoisting purposes.

(d) Remove and securely stow all damageable instruments such as fire control equipment, gun sights, etc. *It is imperative that all stowage boxes, tires, or other loose equipment be securely strapped to matériel prior to movement.*

(e) If the underside of matériel has sharp edges at the points where slings are placed, insert dunnage consisting of wood blocks, sacking, clean cloths, or similar material between the slings and matériel in order to prevent cable strands from cutting or slipping (fig. 133).

(f) Attach guy lines to matériel before lifting. Guide matériel during hoisting to prevent damage caused by striking any nearby object or structure.

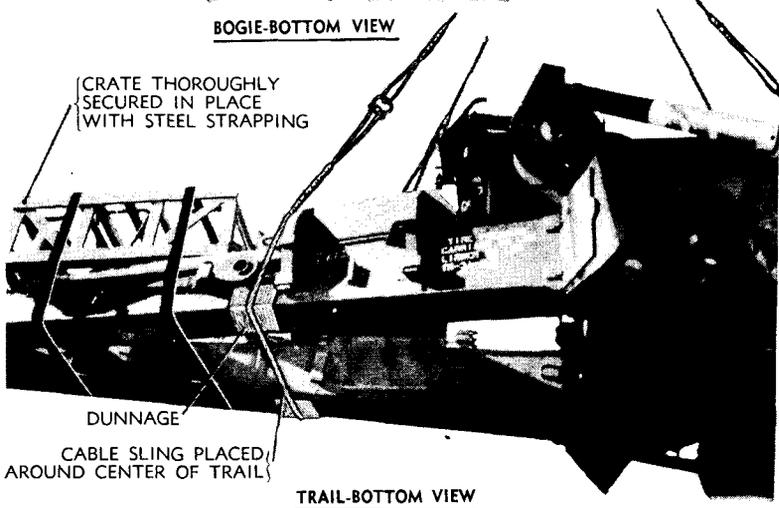
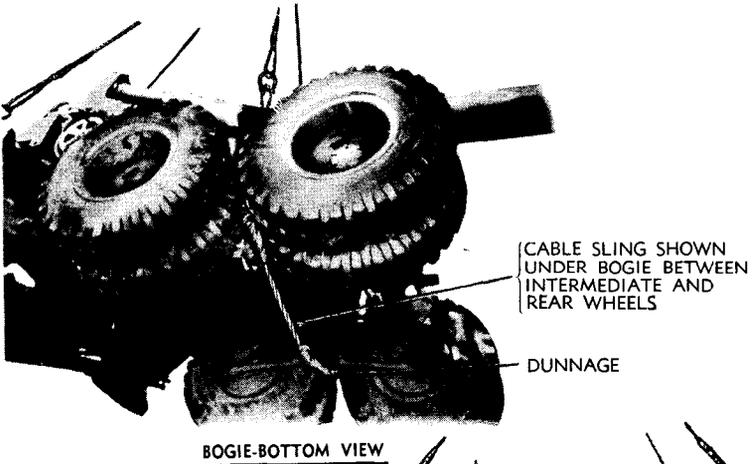
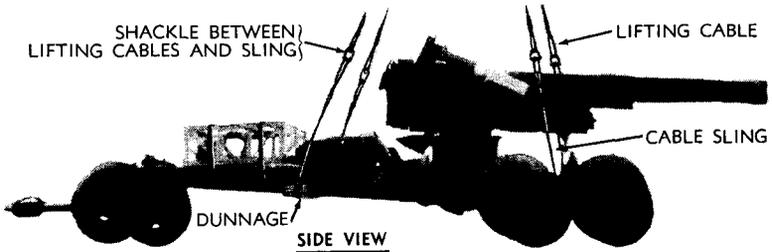
(3) *Method of slinging 8-inch howitzer and carriage M1 (figs. 132 and 133).* (a) Detach one end of cable slings from shackles on lifting cables.

(b) Place detached end of one cable sling under bogie between the intermediate and the rear wheels across width of carriage, and attach to shackle.

(c) Place detached end of other cable sling around center of trails and attach to shackle.

(d) Locate dunnage as described in step (2) (e) above.

(e) Attach guy lines (step (2) (f) above), and hoist matériel slowly, observing proper balance (step (2) (b) above).



- NOTE 1 — SUITABLE DUNNAGE WILL BE PLACED BETWEEN CABLE AND MATERIEL.
 2 — ATTACH GUY LINES TO MATERIEL BEFORE LIFTING. GUIDE MATERIEL DURING HOISTING TO PREVENT DAMAGE CAUSED BY STRIKING ANY NEARBY OBJECT OR STRUCTURE.

RA PD 102952

Figure 133. Method of slinging 8-inch howitzer and carriage M1.

APPENDIX II

REFERENCES

1. Publications Indexes

The following publications indexes should be consulted frequently for latest changes or revisions of references given in this section and for new publications relating to matériel covered in this manual:

- a. Ordnance Supply Catalog Index...WD Supply Cat ORD 2
- b. Ordnance Major Items and Combinations, and Pertinent PublicationsSB 9-1
- c. List and Index of War Department Publications...FM 21-6
- d. List of War Department Films, Film Strips, and Recognition Film Slides.....FM 21-7
- e. Military Training Aids.....FM 21-8

2. Standard Nomenclature Lists

a. AMMUNITION.

- Ammunition, fixed and semifixed, including sub-caliber, for pack, light and medium field, aircraft, tank, and antitank artillery, including complete round dataWD Supply Cat ORD 11 SNL R-1
- Ammunition instruction material for antiaircraft, harbor defense, heavy field, and railway artillery, including complete round data
WD Supply Cat ORD 11 SNL P-8
- Charges, propelling, separate loading, 6-in., 155-mm, 8-in. and 240-mm, for harbor defense, heavy field, and railway artillery.....WD Supply Cat ORD 11 SNL P-2
- Fuzes, primers, blank ammunition, and miscellaneous items for antiaircraft, harbor defense, heavy field, and railway artillery...WD Supply Cat ORD 11 SNL P-7
- Projectiles, separate loading, 6-in., 155-mm, 8-in., and 240-mm, for harbor defense, heavy field, and railway artillery including complete round data
WD Supply Cat ORD 11 SNL P-1
- Service fuzes and primers for pack, light and medium field, aircraft, tank, and antitank artilleryWD Supply Cat ORD 11 SNL R-3

b. CLEANING AND PRESERVATION.

Cleaning, preserving and lubricating materials;
recoil fluids, special oils, and miscellaneous related
items WD Supply Cat ORD 3 SNL K-1

c. HOWITZER MATERIEL.

Gun, 37-mm, M1916.. WD Supply Cat ORD (*) SNL C-33, Sec. 13
Howitzer, 8-in., M2; Carriage, howitzer, 8-in., M1;
Limber, carriage, heavy, M5; Mount, howitzer,
8-in., M17 (T20)..... WD Supply Cat ORD (*) SNL D-29
Major items of heavy field artillery

WD Supply Cat ORD 3 SNL D-1

Mount, subcaliber, 37-mm, M10

WD Supply Cat ORD (*) SNL D-41, Sec. 2

d. SIGHTING AND FIRE CONTROL EQUIPMENT.

Circle, aiming, M1..... WD Supply Cat ORD (*) SNL F-160
Light, aiming post and instrument

WD Supply Cat ORD (*) SNL F-205

Mount, telescope, M18A1 and M75 (T122) and

Mount, quadrant, M1.... WD Supply Cat ORD (*) SNL F-180

Mount, telescope, M71..... WD Supply Cat ORD (*) SNL F-224

Post, aiming, M1..... WD Supply Cat ORD (*) SNL F-35

Quadrant, elevation, M1.... WD Supply Cat ORD (*) SNL F-204

Quadrant, gunner's, M1 (mils)

WD Supply Cat ORD (*) SNL F-140

Quadrant, gunner's, M1918 (mils)

WD Supply Cat ORD (*) SNL F-13

Setter, fuze, M23..... WD Supply Cat ORD (*) SNL F-293

Telescope, B.C., M1915A1.. WD Supply Cat ORD (*) SNL F-9

Telescope, M69 type..... WD Supply Cat ORD (*) SNL F-235

Telescope, panoramic, M12. WD Supply Cat ORD (*) SNL F-214

3. Other Publications

a. AMMUNITION.

Ammunition, General TM 9-1900

Ammunition Inspection Guide..... TM 9-1904

Artillery Ammunition TM 9-1901

Ballistic Data, Performance of Ammunition..... TM 9-1907

b. CARE AND SERVICE.

Cleaning, Preserving, Sealing, Lubricating and Related

Materials Issued for Ordnance Matériel..... TM 9-850

(*) See WD Supply Catalog ORD 2 Index for published pamphlets of the Ordnance Supply Catalog.

- Service of the Piece, 8-in. Howitzer, M1.....FM 6-91
 Service of the Piece, Gun Howitzer Motor Carriage
 —155-mm Gun or 8-inch Howitzer.....FM 6-87

c. MAINTENANCE AND REPAIR.

- Basic Maintenance Manual.....TM 38-650
 DecontaminationTM 3-220
 Defense Against Chemical Attack.....FM 21-40
 Ordnance Maintenance: 155-mm Guns M1 and M1A1
 and Carriage M1; 8-inch Howitzer M1 and Carriage
 M1; Heavy Carriage Limber M2.....TM 9-1350

d. MISCELLANEOUS.

- 155-mm Gun Motor Carriage T83 and 8-inch Howitzer
 Motor Carriage T89.....TM 9-747
 Caliber .22 Rifles, All Types.....TM 9-280
 Dictionary of United States Army Terms.....TM 20-205
 GunneryFM 4-10
 Instruction Guide: Ordnance Packaging and Shipping
 (Posts, Camps, and Stations).....TM 9-2854
 Maintenance and Care of Pneumatic Tires and Rub-
 ber TreadsTM 31-200
 Preparation of Ordnance Matériel for Deep Water
 FordingTM 9-2853
 Preparation of Unboxed Ordnance Matériel for Ship-
 mentSB 9-4
 Protection of Ordnance Matériel in Open Storage.WD SB 9-47
 U. S. Rifle, Cal. .30, M1903A4 (Sniper's) Character-
 istics and Operation; and Use of Telescopic Sight...TM 9-270
 StevedoringTM 55-310

e. SIGHTING AND FIRE CONTROL EQUIPMENT.

- Auxiliary Fire-control Instruments (Field Glasses,
 Eyeglasses, Telescopes, and Watches).....TM 9-575
 Field Artillery Fire-control Instruments.....TM 6-220
 Graphical Firing Table.....TM 9-526
 Meteorology for Artillery.....TM 20-240

4. Firing Tables

a. GUN, 37-MM, SUBCALIBER, M1916.

- Shell, fixed, practice, M63 (mod. 1).....FT 37-BA-2
 Shell, fixed, practice, M92FT 37-BJ-2

b. HOWITZER, 8-IN., M1 OR M2.

Shell, H.E., 200-lb., M106FT 8-J-1
Shell, H.E., 200-lb., Mk. 1A1FT 8-K-1

5. Army Regulations

Qualification in Arms and Ammunition Training Al-
lowancesAR 775-10
Range Regulations for Firing Ammunition for Train-
ing and Target Practice.....AR 750-10

6. List of Forms

Artillery Gun Book.....O.O. Form 5825
Unsatisfactory Equipment Report.....WD AGO Form 468

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