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DOCUMENT SECTION

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Reference

TM 9-350

WAR DEPARTMENT TECHNICAL MANUAL

U.S. ARMY MILITARY HISTORY INSTITUTE
CARLISLE BARRACKS, PA 17013-5008

155-MM GUN M2; CARRIAGE M1 AND M1A1; GUN MOUNT M13; HEAVY CARRIAGE LIMBER M2 AND M5; AND FIRING PLATFORM M1

DECLASSIFIED
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WAR DEPARTMENT
WASHINGTON, D.C.

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WAR DEPARTMENT TECHNICAL MANUAL

TM 9-350

This TM supersedes TM 9-350, dated 11 May 1942; Changes No. 1, dated 31 Jul 42; Changes No. 2, dated 29 Oct 42; Changes No. 3, dated 19 Aug 43; Changes No. 4, dated 9 Nov 43; Changes No. 5, dated 20 Apr 44; OFSTB 350-1, dated 11 Jun 43; WDTB 9-350-4, dated 19 Jan 44; WDTB 9-350-5, dated 7 Mar 44; WDTB 9-350-6, dated 10 Aug 44. This TM supersedes portions of OFSTB 350-3, dated 26 Aug 43; WDTB ORD FE9, dated 2 Aug 44; WDTB ORD FE10, dated 18 Jun 43; WDTB ORD 65, dated 16 Mar 44; WDTB ORD 113, dated 23 Jun 44; WDTB ORD 135, dated 3 Aug 44; WDTB ORD 206, dated 28 Sep 44; which apply to the materiel covered in this TM; however, these TB's remain in force until incorporated in all other affected TM's or specifically rescinded.

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WAR DEPARTMENT,
Washington 25, D. C., 7 MAY 1945.

TM 9-350, 155-mm Gun M2; Carriage M1 and M1A1; Gun Mount M13; Heavy Carriage Limber M2 and M5; and Firing Platform M1, is published for the information and guidance of all concerned.

[A.G. 300.7 (8 Apr 44)
O.O. 300.7/3556]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

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

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

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PART ONE – INTRODUCTION

Section I

GENERAL

1. SCOPE.

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

b. In addition to a description of the 155-mm gun M2; carriage M1 and M1A1; heavy carriage limber M2 and M5, firing platform M1, and gun motor mount M13, this manual contains technical information required for the identification, use, and care of the weapon, ammunition, and accessory equipment.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope or facilities of the unit, the responsible ordnance service should be informed 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 for the purpose of keeping an accurate record of the materiel. It must always remain with the materiel regardless of where it may be sent. The book is divided as follows: Record of assignment; battery commander's daily gun record; inspector's record of examination. This book should be in the possession of the organization at all times, and its completeness of record and its whereabouts are the responsibility of the battery commander. It must also contain date of issuance of the materiel, by whom used, and the place where issued. If a new gun is installed on the carriage, all data recorded in the old book with references to sights, mounts, etc., must be copied into the new book before the old book is relinquished. If the gun book is lost, it should be replaced at once and all entries brought up to date. NOTE: *Record of assignment data must be removed and destroyed prior to entering combat.*

(2) The Artillery Gun Book which has become separated from the weapon to which it pertains and for which efforts to locate the weapon have failed, should be forwarded immediately to the Office, Chief of Ordnance, Field Service, Maintenance Division, Artillery Branch, Washington 25, D. C. Inquiries concerning a lost gun book should also be forwarded to the same office. All available information concerning the weapon and its past history should be forwarded with the inquiry. If the lost book is not turned in, any additional information available will be furnished for use in preparing a duplicate book.

(3) Complete instructions on how to make entries in the artillery gun book are contained therein. It is absolutely essential that the gun book entries be kept complete and up to date. In order to facilitate proper maintenance of the cannon and its related materiel (that is, carriage, recoil mechanism, and associated fire control equipment) and to avoid unnecessary duplication of repairs and maintenance, the following additional entries are to be made in the gun book.

(a) A record of completed modification work orders. This record should show the date completed and bear the signature of the officer or mechanic responsible for completion of the modification.

(b) A record of seasonal change of lubricants and change of recoil oil in sufficient detail to prevent duplication and afford proper identification by the inspector.

(4) The estimated accuracy life of this cannon is 1,500 rounds.

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 ordnance officer under whose supervision ammunition is maintained or issued. Where practicable, reports covering malfunctions of ammunition in combat will be made to the Chief of Ordnance, giving the type of malfunction, type of ammunition, the lot number of complete rounds or separate loading components, and condition under which fired.

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 No. 468, Unsatisfactory Equipment Report, with all pertinent information necessary to initiate corrective action. The report should be forwarded to the Office, Chief of Ordnance, Field Service Division, Maintenance Branch, through command channels in accordance with instruction No. 7 on the form. Such suggestions are encouraged in order that other organizations may benefit. If WD AGO Form No. 468 is not available, refer to TM 37-250 for list of data required on Unsatisfactory Equipment Report.

Section II

DESCRIPTION AND DATA

3. GENERAL.

a. The 155-mm gun M2 is used as a heavy field weapon and is also classed as secondary armament for seacoast defense. The 155-mm gun M2 is mounted on three types of mounts, namely; the heavy field carriage M1 or M1A1 (figs. 1, 2, and 3), gun motor carriage T83 (figs. 4 and 5) and the firing platform M1 (fig. 6).

b. The 155-mm gun carriages M1 and M1A1 are heavy field carriages and are equipped with a bogie assembly at the front of the carriage, which is used to lower the carriage to the firing position and also to raise the carriage to the traveling position. The carriage is limbered by either the heavy limbers M2 or M5, or it can be towed without the use of the limber by being semi-trailed. When emplaced, removable spades are installed on the carriage and on the rear ends of the trails. Air brakes are provided for use during transit, and hand brakes are applied on the front bogie wheels when the weapon is parked.

c. The firing platform M1 is a circular platform designed to enable all-around fire. When mounted on the firing platform M1, the same materiel is used that is used with the heavy gun carriage M1 and M1A1. The weapon is rolled up into place and anchored on the bolster in the center of the platform (fig. 6).

d. The gun motor carriage M40 provides a highly mobile heavy artillery unit. When mounted on the 155-mm gun mount M13 for mounting on the gun motor carriage, only the gun, recoiling parts and top carriage of heavy field materiel are used (figs. 4 and 5).

e. The recoil mechanism is a hydro-pneumatic type with a variable recoil feature to offset differences of recoil at various degrees of elevation.

f. The 155-mm gun M2 may be equipped with either the firing mechanism M1 or the firing lock M17.

g. Separate loading ammunition is used, which is loaded and rammed into the gun by hand.

4. IDENTIFICATION INFORMATION.

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

b. Gun serial number. This number is stamped on the breech ring (fig. 7).

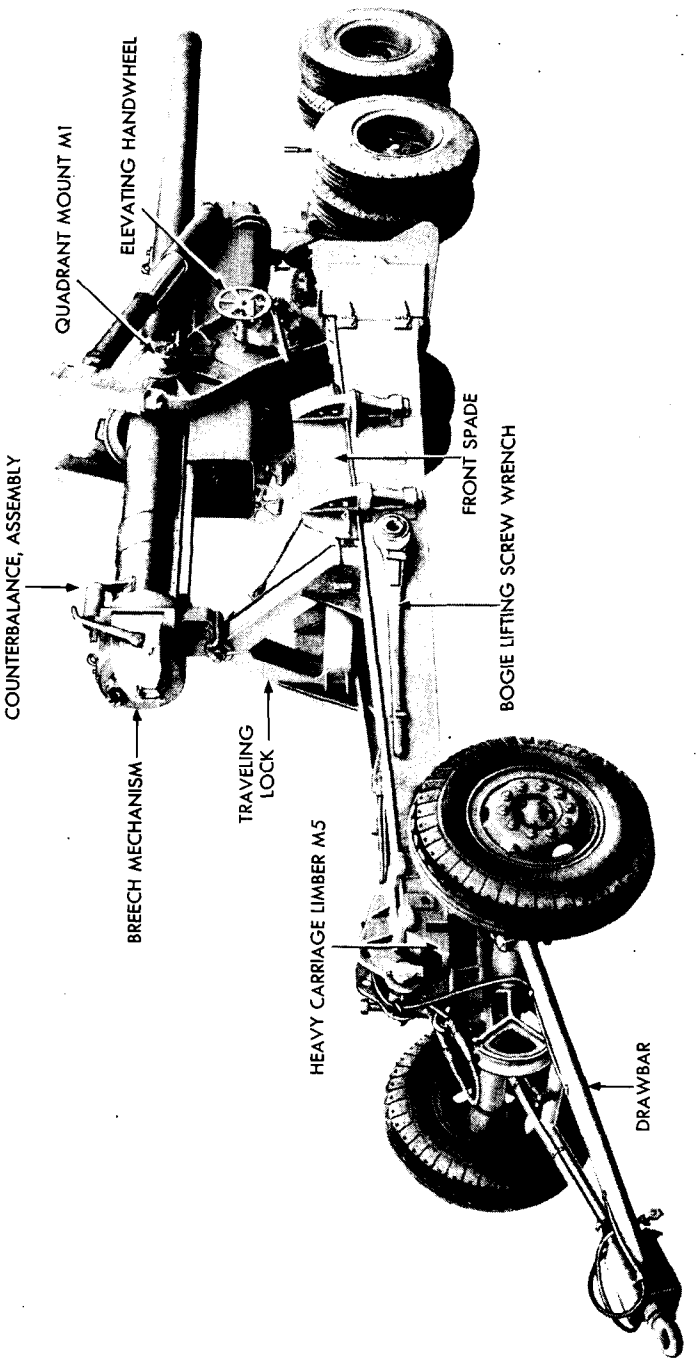

Figure 1 — 155-mm Gun — Right Rear View

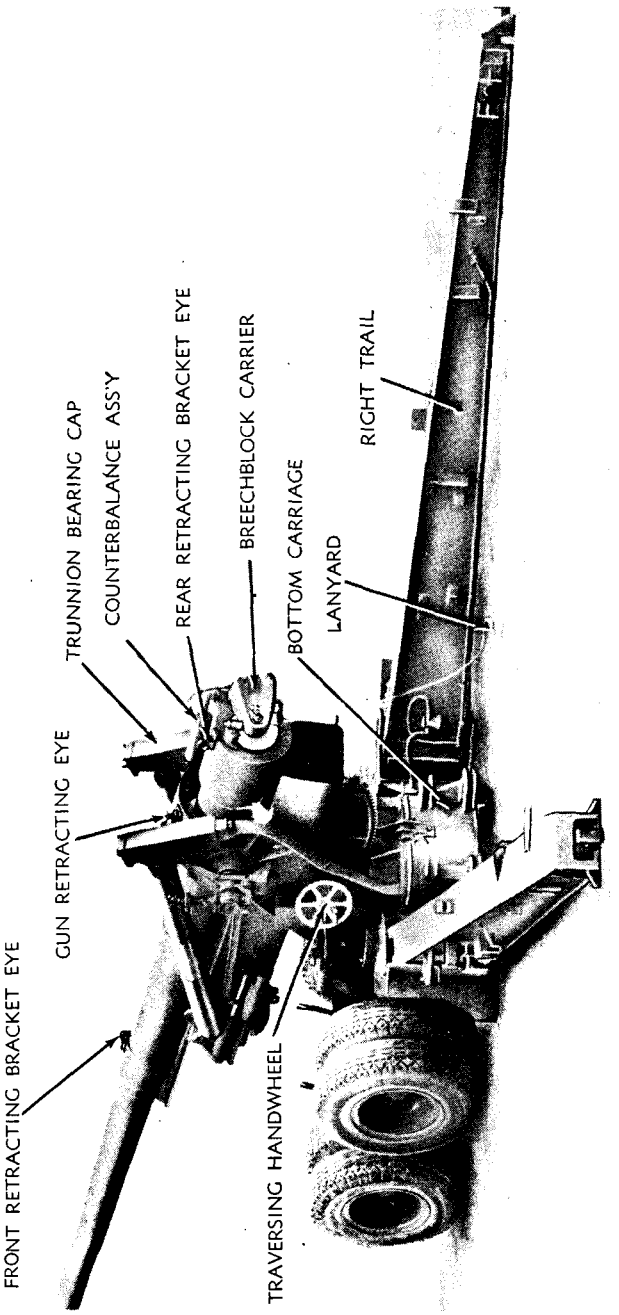

Figure 2 — 155-mm Gun in Firing Position — Left Rear View

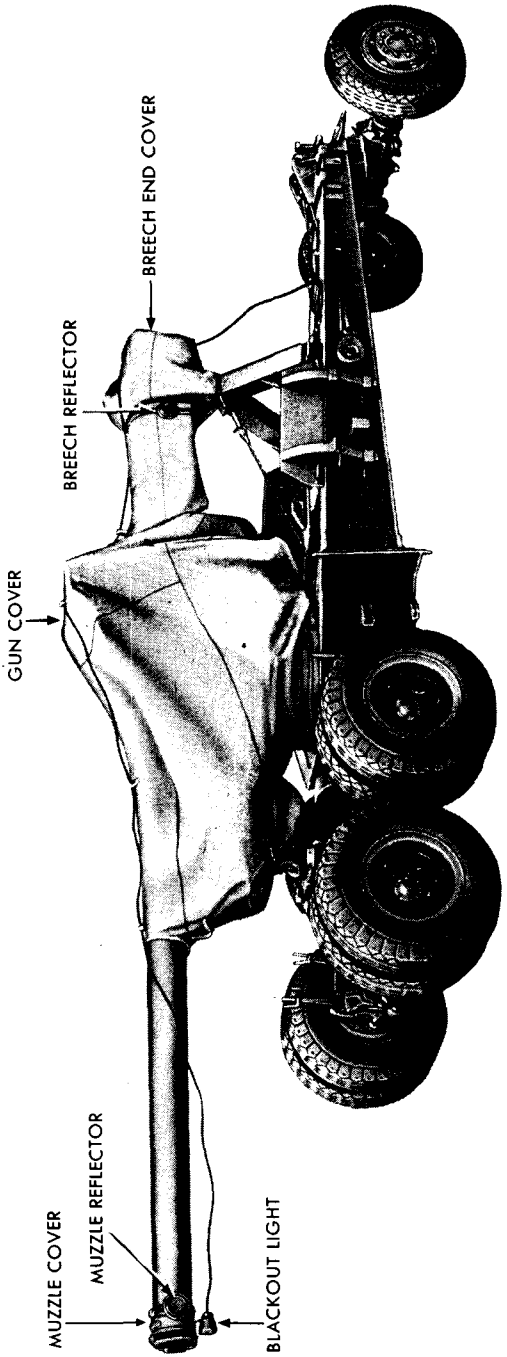

Figure 3 — 155-mm Gun — Left Front View — With Covers Installed

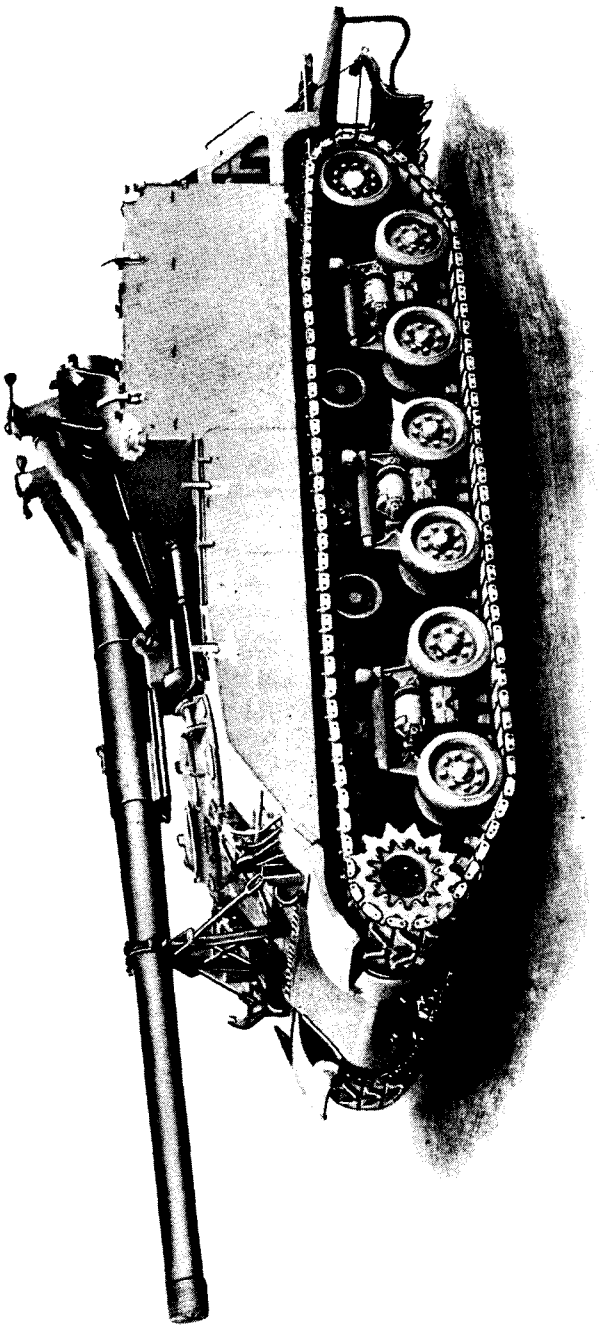

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Figure 4 — 155-mm Gun on Gun Mount M13 on Gun Motor Carriage M40 — Side View

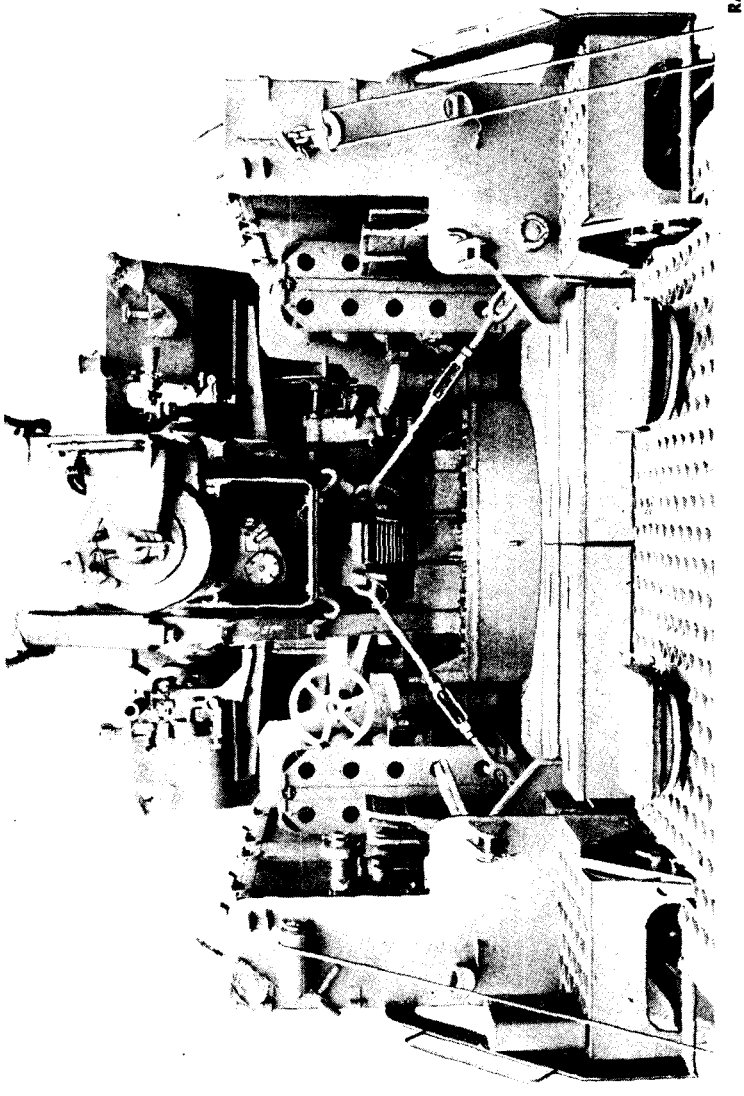

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Figure 5 — 155-mm Gun on Gun Mount M13 on Gun Motor Carriage M40 — Rear View

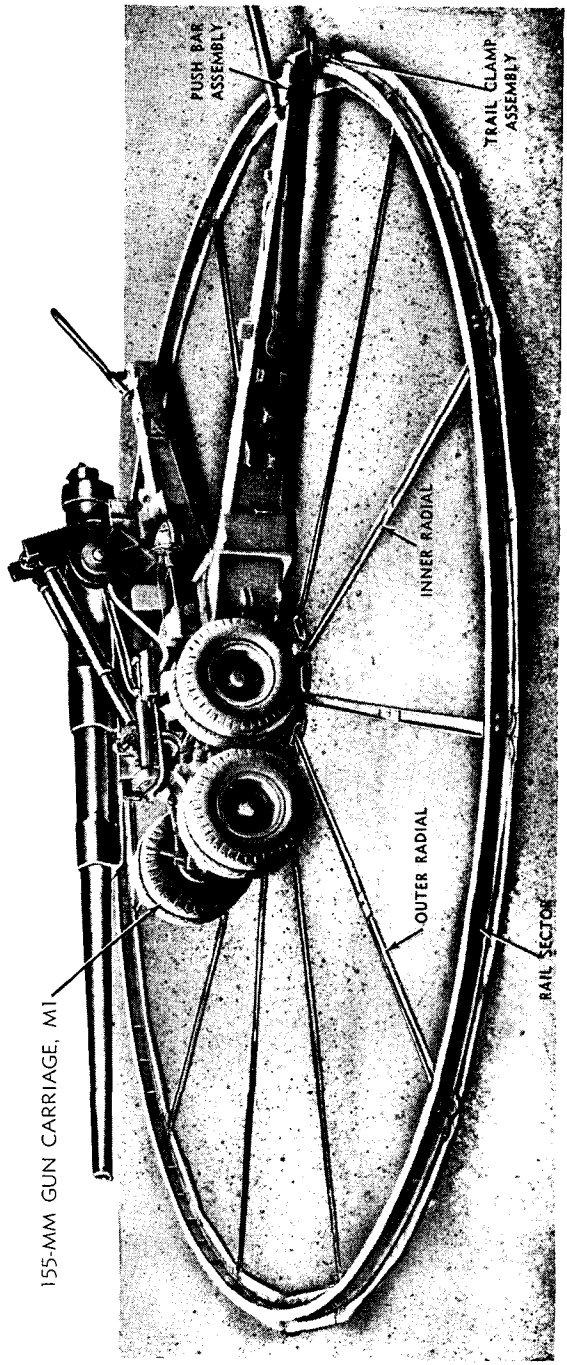

Figure 6 — Firing Platform

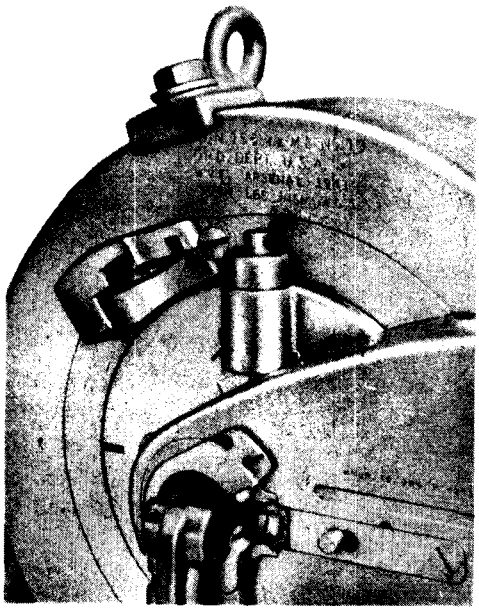

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Figure 7 — Gun Serial Number

c. Recoil mechanism serial number. This number appears on a plate on right side of recoil mechanism (fig. 8).

d. Carriage serial number. This number appears on a plate on the right side of the top carriage (fig. 8).

e. Equilibrator serial number. The number appears on a plate screwed to the front head of the equilibrator (fig. 9).

f. Limber serial number (heavy carriage limber M2). This number appears on a name plate attached to the limber lift bracket (fig. 10).

g. Limber serial number (heavy carriage limber M5). This number appears on a nameplate attached to the limber lift bracket (fig. 11).

5. DIFFERENCE IN MODELS.

a. The 155-mm guns M1, M1A1, and M2 can be mounted on either the M1 or M1A1 gun carriages.

(1) The 155-mm guns M1 and M1A1 are identical with one exception, as follows:

(a) The 155-mm gun M1 has a breech ring bushing inserted in the breech ring. The breech mechanism female threads are cut in the breech bushing.

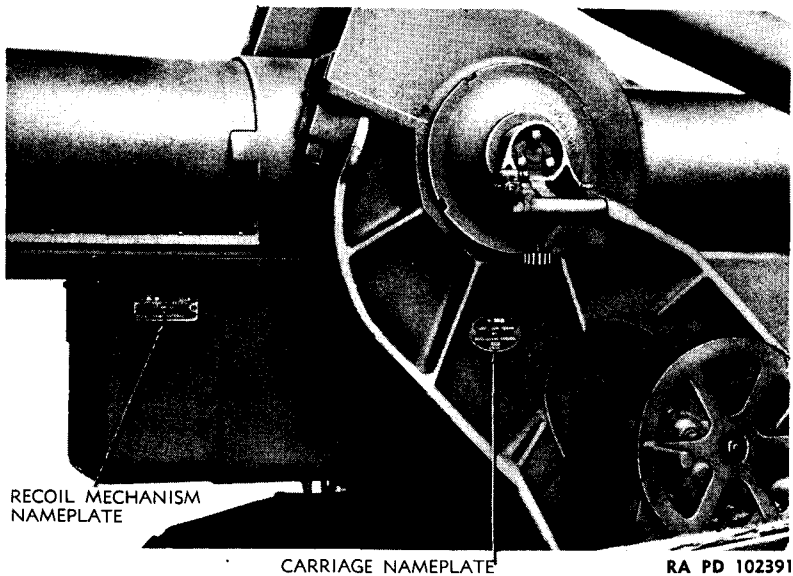

Figure 8 — Recoil Serial Number and Carriage Serial Number

(b) The 155-mm gun M1A1 does not have a breech ring bushing; the breech mechanism female threads being cut directly in the breech ring.

(c) The 155-mm gun M2 is similar in construction to the 155-mm gun M1, i.e., the breech ring is fitted with a breech ring bushing and the breech mechanism female threads are cut in the breech ring bushing. In addition the 155-mm gun M2 has a slightly larger powder chamber than the guns M1 or M1A1.

b. The 155-mm gun carriage M1 is the standard carriage for these guns. The M1A1 carriages were the original test models reworked to be practically identical with the M1 carriage. Differences that remain between these two models are manufacturing details.

c. Recoil mechanism. The recoil mechanism M21 (formerly T54) used when mounting the 155-mm guns on the gun motor carriage M40 is the same as the recoil mechanism M3A1 used with the 155-mm guns on the heavy field carriage, with the exception that the cradle lock support, traveling lock boss and part of the supporting ribs have been removed to obtain required depression of the weapon. The recoil mechanism M21, cannot be used on the heavy field carriage.

d. Limbers. The heavy carriage limbers M2 and M5 are entirely different in design and operation (see pars. 85 and 86).

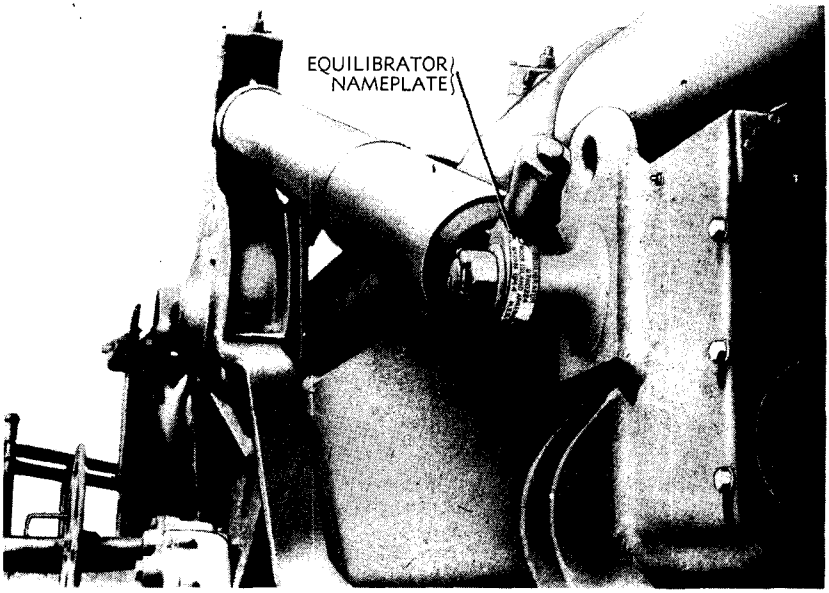

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Figure 9 — Equilibrator Serial Number

6. TABULATED DATA.

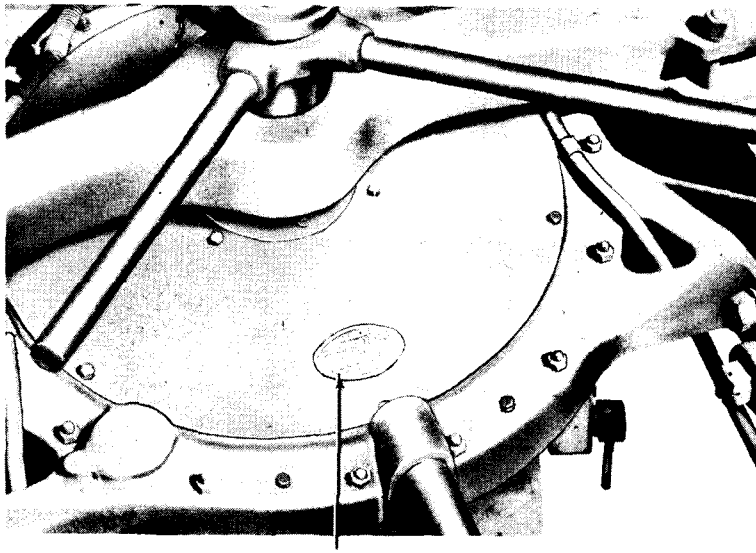
a. Data pertaining to 155-mm gun M2.

(1) GENERAL.

Weight of gun (complete with breech mechanism) ..... 9,595 lb
Weight of tube assembly (barrel) ..... 9,190 lb
Length of tube ..... 277.37 in.
Length of bore ..... cal. .45
Length of rifling ..... 230.57 in.
Powder pressure (normal pressure with maximum charge in a new gun) lb per square in. 40,000
Type of breecblock ..... Interrupted screw
Weight of breech mechanism ..... 405 lb.
Type of firing mechanism ..... continuous pull percussion hammer
Ammunition ..... For complete ammunition data see section XXVII.

(2) PERFORMANCE.

Muzzle velocity (average velocity with a new gun in feet per second):
Shell AP (Maximum zone charge) ..... 2,745 fps
Shell HE (Maximum zone charge) ..... 2,800 fps
Range: (Maximum)
AP Shell ..... 24,075 yd
HE Shell ..... 25,715 yd



RA PD 102395

Figure 10 — Serial Number — Heavy Carriage Limber M2

Rate of fire:
Normal ..... round 1 (per 2 minutes)

b. Data pertaining to carriage M1 or M1A1.

(1) GENERAL.

Weights:
Gun and carriage (firing position) ..... 27,700 lb
Gun and carriage (complete with accessories, traveling position)
(M2 limber) ..... 29,900 lb
(M5 limber) ..... 30,100 lb
Bogie ..... 5,375 lb
Dimensions in traveling position, over-all: (with heavy carriage limber M2)
Length ..... 34 3/8 ft
Width ..... 98 7/8 in.
Height ..... 102 1/4 in.
Dimensions in traveling position, over-all: (with heavy carriage limber M5)
Length ..... 36 5/8 in.
Width ..... 98 7/8 in.
Height ..... 107 in.

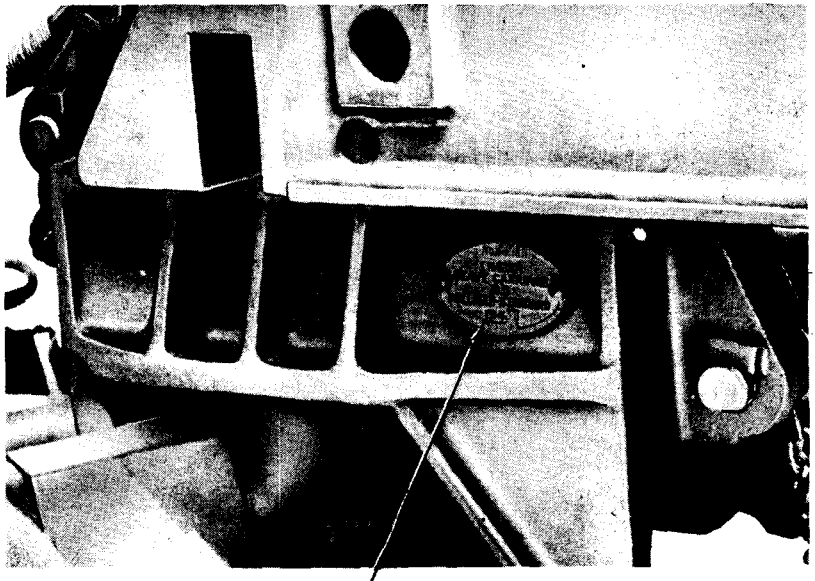


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Figure 11 — Serial Number — Heavy Carriage Limber M5

Towed by (with limber) ..... M4 tractor, 18-ton, high speed
(without limber) semi-trailed..... Truck, 7½ ton, 6 x 6, with semi-trailer

Recoil mechanism:
- Model M3A1
- Maximum allowable recoil (approx) ..... 70 in.
- Type of recoil mechanism ..... Hydraulic
- Type of counterrecoil mechanism ..... Hydropneumatic
- Weight ..... 3,890 lb

Type of equilibrator ..... Pneumatic

Tires:
- Type and size ..... 11 x 20 std
- Type and size tubes ..... 10 x 20 std
- Air pressure: bogie assembly tires (normal: see par. 83).... 45 psi
- Air pressure: limber assembly tires (normal: see par. 83).... 65 psi

Brakes, type ..... mechanical, air or manually operated

Wheel base of bogie ..... 47 in.

Tread (center-to-center of inside bogie wheels)..... 62 in.
(center-to-center of outside bogie wheels)..... 88½ in.

(2) PERFORMANCE.

Limits of elevation:
- Maximum ..... 63 deg 20 min
- Depression ..... minus 1 deg 50 min

Limits of traverse in degrees right or left ..... 30 deg
Elevation per turn of handwheel in mils ..... 13.10 mils
Diameter of circle of emplacement ..... 37 ft
Traverse per turn of handwheel ..... 10 mils

(3) CAPACITIES.

Recoil oil:
- Reserve in replenisher (recoil) (normal) ..... 1⅕ pt
- Reserve in recuperator (counterrecoil) ..... 2 pt

c. Data pertaining to 155-mm gun mount M13 (T14).

(1) GENERAL.

Mounted on gun motor carriage M40
Recoil Mechanism M21

(2) PERFORMANCE.

Limits of elevation.
- Maximum ..... 45 deg
- Depression ..... minus 5 deg

Limits of traverse.
- Right ..... 18 deg
- Left ..... 18 deg
- Total traverse ..... 36 deg

(Complete data will be supplied when available)

d. Data pertaining to limbers M2 and M5.

	M2	M5
Width, over-all	95¾ in.	95 in.
Weight	2,000 lb	2,200 lb
Tires:		
Type and size	11 x 20 std	11 x 20 std
Type and size tubes	11 x 20 std	11 x 20 std

e. Data pertaining to sighting equipment.

Aiming post M1
Aiming post light M14
Gunner's quadrant M1 or M1918
Panoramic telescope M12 or M5A5
Telescope mount M18A1
Quadrant mount M1
Instrument light M5
Instrument light M12
Instrument light M19

f. Data pertaining to fire control equipment.

Aiming circle M1
Battery commander's telescope M65

g. Data pertaining to firing platform M1.

Total weight	8,332 lb
Diameter across rails	37 ft
Diameter of base ring	5 ft 7 in.
Diameter of pit	10 ft
Depth of pit	18 in.

h. Data pertaining to subcaliber equipment.

(1) GENERAL.

Model of gun	M1916
Model of mount	M10
Weight of gun and mount	88 lb
Length of bore	29.13 in.
Caliber	37-mm
Type of breecblock	Eccentric screw
Type of firing mechanism	Trigger
Recoil mechanism:	
Type of recoil	Hydrospring
Type of counterrecoil	Spring
Maximum allowable recoil	7 to 10 in.

Ammunition—For complete ammunition data, see section XXVII.

(2) PERFORMANCE.

Maximum rate of fire	35 rds per min.
Range	4,900 yd
Muzzle velocity	1,276 fps

Section III

TOOLS, PARTS, AND ACCESSORIES

7. ORGANIZATIONAL SPARE PARTS. A set of organizational spare parts is supplied to the using arms for field replacement of those parts most likely to become broken, worn, or otherwise unserviceable. The set will be kept complete by requisitioning new parts for those used. The parts comprising the set are listed below for information only; this list will not be used for requisitioning. The authority upon which requisitions are based is SNL D-24.

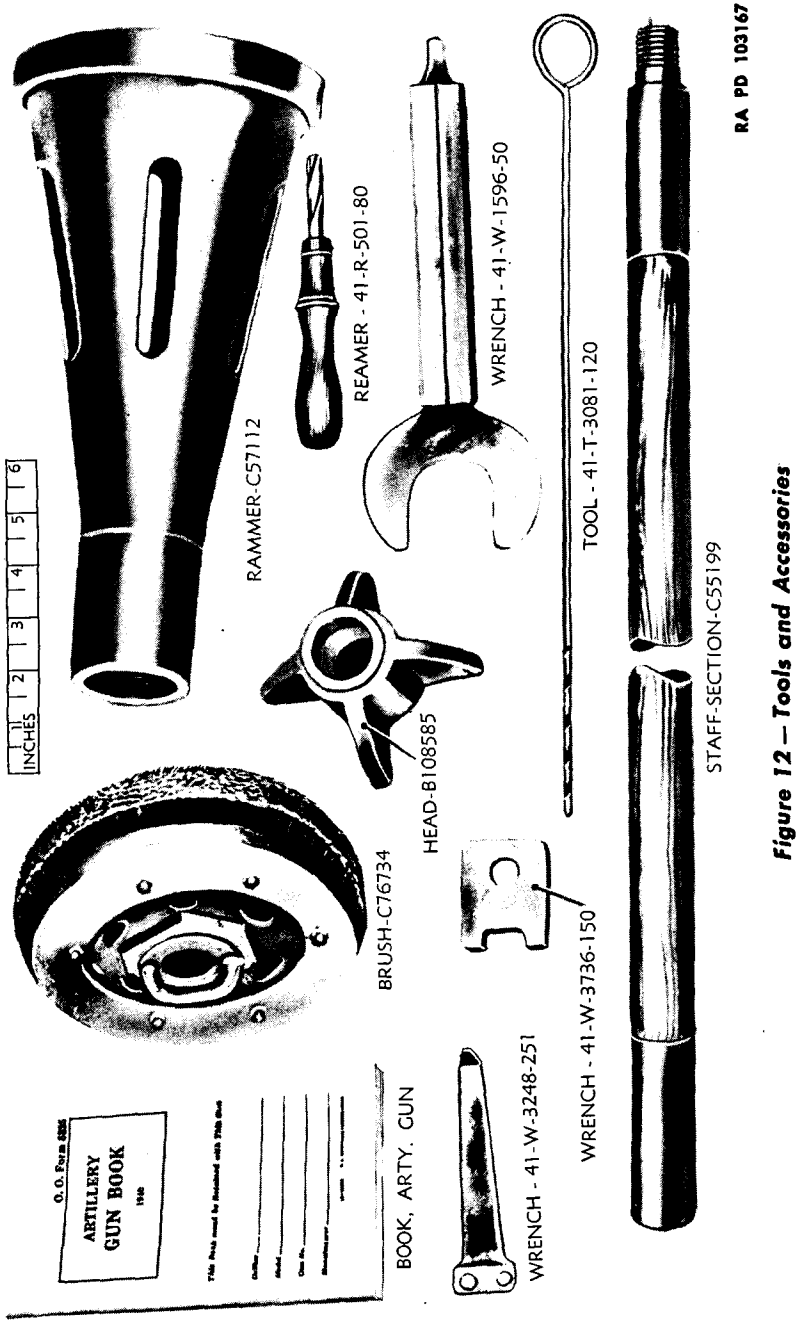


Figure 12 — Tools and Accessories

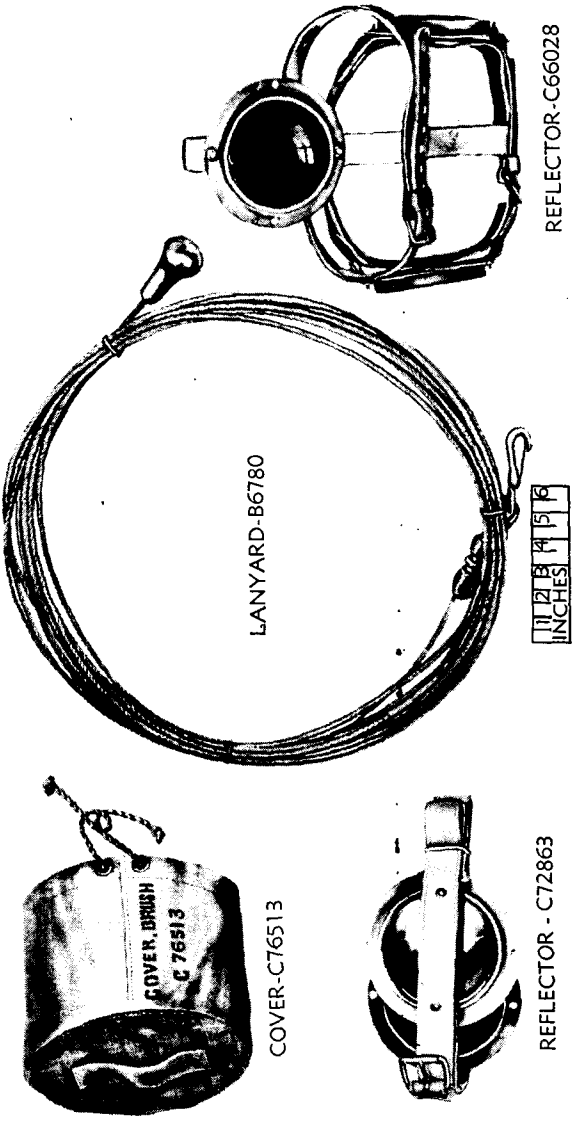
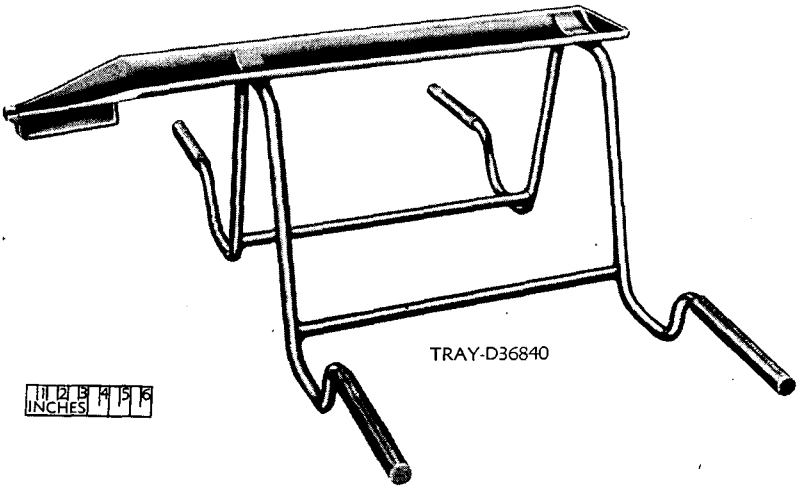


Figure 13 — Tools and Accessories

Spare Part	Piece Mark	Figure No.
FOR GUN, 155-MM, M2		
GASKET, obturator spindle plug	A325	81
MECHANISM, firing, M1	C70485	86
PAD, gas check, obturator	C70484	81
PLUG, obturator spindle	B241	81
RING, inner, obturator	B19161	81
RING, split, front, obturator	B163356	81
RING, split, rear, obturator	B163357	81
FOR CARRIAGE, GUN, 155-MM, M1		
GASKET, wheel hub cap	B159927	102
WHEEL, assembly	C7107154	102
FOR MOUNT, GUN, 155-MM, T14		
None authorized.		
FOR LIMBER, CARRIAGE, HEAVY, M2		
None authorized.		
FOR LIMBER, CARRIAGE, HEAVY, M5		
PIN, safety, clamp bolt nut	A7104680	—
FOR MECHANISM, RECOIL, 155-MM GUN, M3 AND M3A1		
None authorized.		
FOR PLATFORM, FIRING, 155-MM GUN, M1		
BASE, trail clamp	B7201657	57
BOLT, special hinge w/shoulder, 1¼-7NC-2	B7159424	—
NUT, hex., semi-fin., ⅝-11NC-2	220080	—
NUT, hex., semi-fin., 1-8NC-2	220083	—
NUT, hex., semi-fin., 1¼-7NC-2	220090	—
PLANK, support, inner	A7201734	—
PLANK, support, intermediate	A7201735	—
PLANK, support, outer	A7201733	—
PLATE, rubbing, base, trail clamp	B7159428	—
SCREW, base timber support	A7201700	—
SCREW, cap, hex-hd., ⅝-11NC-2	202816	—
SCREW, cap, hex-hd., 1-8NC-2 x 2	D7201293	—
WASHER, beveled	A7201741	—
WASHER, lock, ¾ x ¼ x 3/16	103326	—
WASHER, lock, reg., ⅝ x 13/64 x 5/32	103325	—
WASHER, lock, reg., ¾ x ¼ x 3/16	103326	—
WASHER, lock, reg., 1 x 5/16 x ¼	121326	—
WASHER, lock, reg., 1¼ x 7/16 x ¼	131035	—
WASHER, plain, ⅝	106267	—
FOR LOCK, FIRING, M17		
HAMMER, firing	B290426	91
PIN, face plate retaining	A7157504	91
PIN, firing	A338246	91
PLATE, face	B7157505	91
SPRING, firing	A338262	91
SPRING, firing pin return	A338222	91
SPRING, pull rod	A7157544	91
TRIPPER, firing hammer	B290433	—



RA PD 22825

Figure 14 — Loading Tray

Spare Part	Piece Mark	Figure No.
FOR MECHANISM, FIRING, M1		
GUIDE, firing pin	A12256	87
HOLDER, primer	B8058	87
PIN, firing	A12258	87
PLUNGER, firing mechanism locking	A25625	87
SCREW, set, safety, ¼-20NC-3	A12260	87
SHOE, firing pin housing set screw	A12268	87
SPRING, firing pin	A12261	87
SPRING, firing mechanism locking plunger	A25626	87

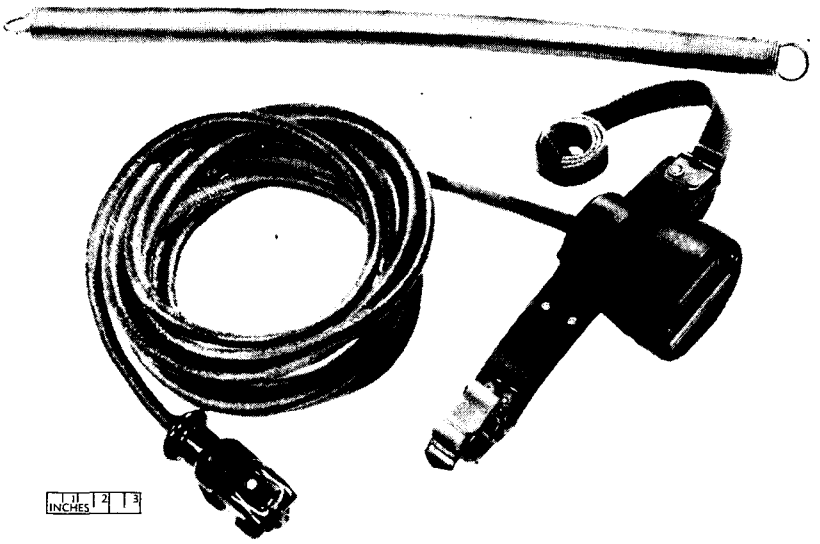
8. ACCESSORIES.

a. Accessories include the tools and equipment required for such disassembling and assembling as the using arm is authorized to perform, and for the cleaning and preservation of the gun, carriage, mount, limbers, firing platform, sighting and fire control equipment, ammunition, etc. They also include chests, covers, tool rolls, and other items necessary to protect the materiel when it is not in use, or when traveling. Accessories should not be used for purposes other than as prescribed, and when not in use should be properly stored.

b. The accessories provided with each weapon are listed below; those issued to the battery mechanic are listed in section XII, Special Organizational Tools and Equipment. If it becomes necessary to replace a broken or missing accessory, this list should be checked with SNL D-24, which is the authority for requisitioning.

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR GUN, 155-MM, M1A2			
BELT, primer, M8		D7225490	—
BOOK, Arty. Gun, O.O. Form 5825 (blank)	12	—	To keep records.
BRUSH, bore, M13	12	C73734	Used with cleaning staff to clean and oil bore or gun (see par. 9.)
COVER, bore brush	13	C76513	—
COVER, breech end, M211		D40786	—
COVER, gun book, M539		C7228906	—
COVER, muzzle, M314		D40555	—
GAGE, headspace, firing mechanism, M1		41-G-200-700	Check headspace between firing mechanism and obturator spindle plug.
HEAD, rammer, loading	12	B108585	—
LANYARD, firing, 6 ft., M12	13	B6780	To fire gun.
RAMMER, cleaning and unloading, M7	12	C57112	—
REAMER, carb-S., hand, primer seat cleaning, spiral, flute, w/wood handle, diam. small end 0.321 in., diam. large end 0.362 in., length over-all 7 in.	12	41-R-501-80	—
REFLECTOR, breech	13	C72863	—
REFLECTOR, muzzle	13	C66028	—
SIGHT, bore, breech		41-S-3636-220	—
SIGHT, bore, muzzle		41-S-3646-100	—
STAFF-SECTION (46½ in. long)	12	C55199	Used with bore brush, rammer, and rammer head.
TARGET, testing, 155-mm gun carriage M1, size 36 x 26 in.		1-T-283-375	—
TECHNICAL MANUAL 9-350		—	—
TOOL, cleaning, vent, drill bit type, diam. of bit 0.206 in.	12	41-T-3081-120	To clean obturator spindle vent.
TRAY, loading, M1	14	D36840	—
WRENCH, open end, stght., hdle., stght. opng. sgle-hd., w/pick on other end, size of opng. 2.05 in.	12	41-W-1596-50	For interchanging and tightening fuze. Also used to set fuze to "DELAY" or "SUPERQUICK."
WRENCH, spanner, face, Ordnance design, type 2-pin, c. to c. of pins 0.875 in.	12	41-W-3248-251	To disassemble firing mechanism.
WRENCH, tubular, pronged, sgle. end, O.D. 1 3/16 in., length 2.25 in., No. of prongs 2	12	41-W-3736-150	For crankshaft nut.

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.



RA PD 80191

Figure 15 — Blackout Light-system

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR CARRIAGE, GUN, 155-MM, M1 AND M1A1			
BAR, crow, pinch-point, size ¾ x 30 in.	16	41-B-168	—
BAR, crow, pinch-pt., diam. of stock 1¼ in., length 60 in.	16	41-B-175	—
BUCKET, metal, galv., heavy weight, cap. 14 qts., gage 14	16	42-B-25520	—
CHEST, tool, empty, metal, height 11 1/16 in., length 13¼ in., width 28⅞ in.		41-C-857-335	—
COVER, bogie lifting screw, M507	18	D33759	—
COVER, cam, elevating brake, M514	18	C76352	—
COVER, (over-all), M102		D91382	—
EXTRACTOR, cotter pin, lgth. 7 in.	19	41-E-525	—
FILLER, cradle guide		D39001	Clamped in cradle guides when gun is retracted to prevent dirt from accumulating on cradle guide when traveling.
GUIDE, War Dept., lubr., No. 10		—	

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

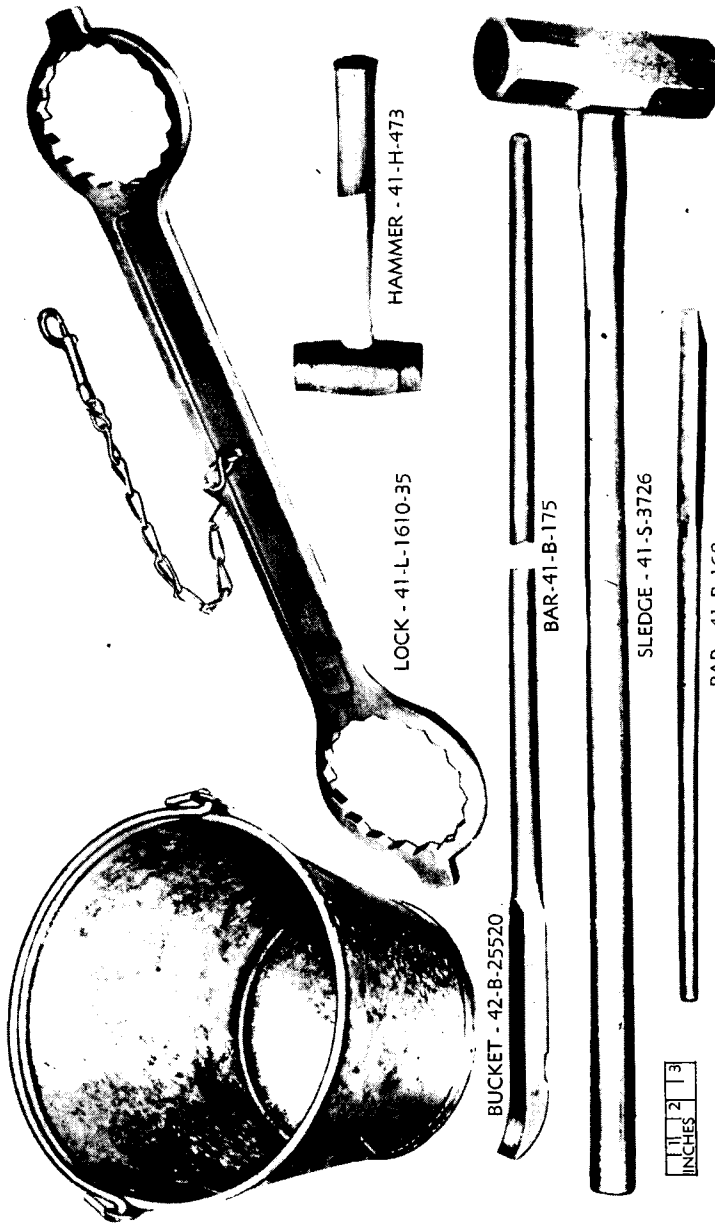
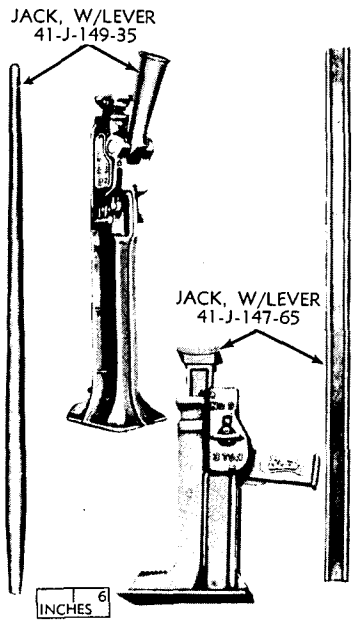
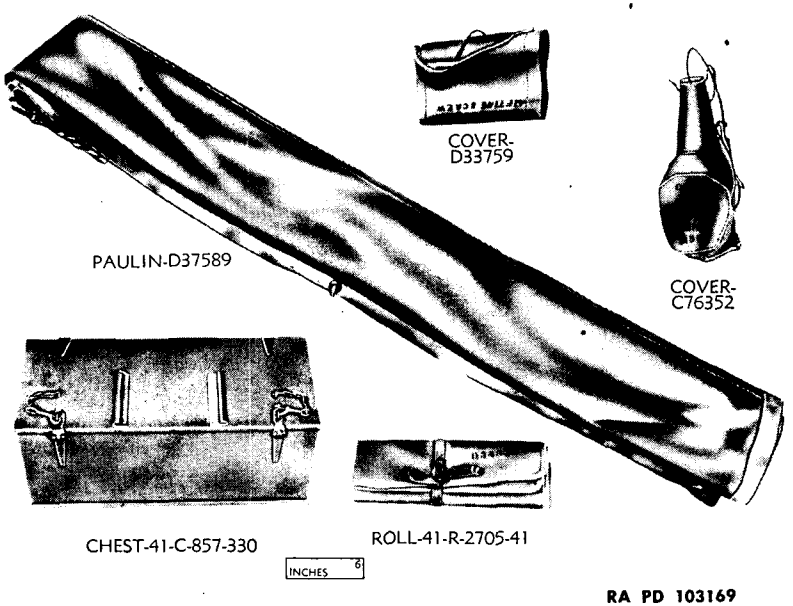


Figure 16 — Tools and Accessories



RA PD 57526

Figure 17 — Jacks, w/Levers



RA PD 103169

Figure 18 — Tools and Accessories

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR CARRIAGE, GUN, 155-MM, M1, AND M1A1 (Contd.)			
GUN, lubr., push-type, hydraulic, 7 oz. cap., M2, complete (Artillery)	21	41-G-1344	—
OR			
GUN, lubr., hand operating, push type, M1, complete w/extension (41-E-485)		41-G-1341-8	—
HAMMER, machs., ball peen, weight 1¼ lb.	20	41-H-524	—
HOIST, chain, rtc., lever type, cap. 1½ to 3 tons		41-H-2115	To retract the gun from and restore it to traveling position.
JACK, rtc. lever, automatic, cap 15 tons, closed height 35 in., rise 24½ in.	17	41-J-149-35	—
JACK, rtc. lever, automatic, 3 tons, w/lever	17	41-J-147-65	—
LIGHT - SYSTEM, blackout, 6-8 v., 45 ft. cable, compete..	15	C90802	Placed around muzzle end of gun when traveling.
LOCK, bogie lifting screw	16	41-L-1610-35	To prevent the two bogie lifting screws from turning during travel.
OILER, S., stght. spout, push bottom, cap. ⅓ pt., length of spout 4 in.	21	13-O-1503	—
PAULIN, canvas, size 12 x 12 ft.	18	D37589	—
PLIERS, side cutting, flat nose, length over-all 8 in.	20	41-P-1977	—
ROLL, tool, canvas, empty, M4, size 26 x 30 in.	20	41-R-2705-5	—
SCREWDRIVER, common, normal duty, sgle. grip, length of blade 6 in., width of blade 5/16 in.	20	41-W-1104	—
SCREWDRIVER, jewelers', wood handle, length of blade 2 in.,width of blade 0.125 in...	20	41-S-1339	—
SCREWDRIVER, machs., extra heavy duty, wood insert handle, length of blade 5 in., width of blade ½ in.	20	41-S-1385	—
SLEDGE, blacksmiths', dble. faced, weight 10 lb.	16	41-S-3726	—
STRAP, webbing, width 1¼, length 64 in.		QADX1DK	—
WRENCH, adj., crescent, type, sgle-end., length 8 in., jaw opng. 15/16 in.		41-W-486	—
WRENCH, adj., crescent type, sgle-end., length 15 in., jaw opng. 1 1/16 in.		41-W-489	—

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

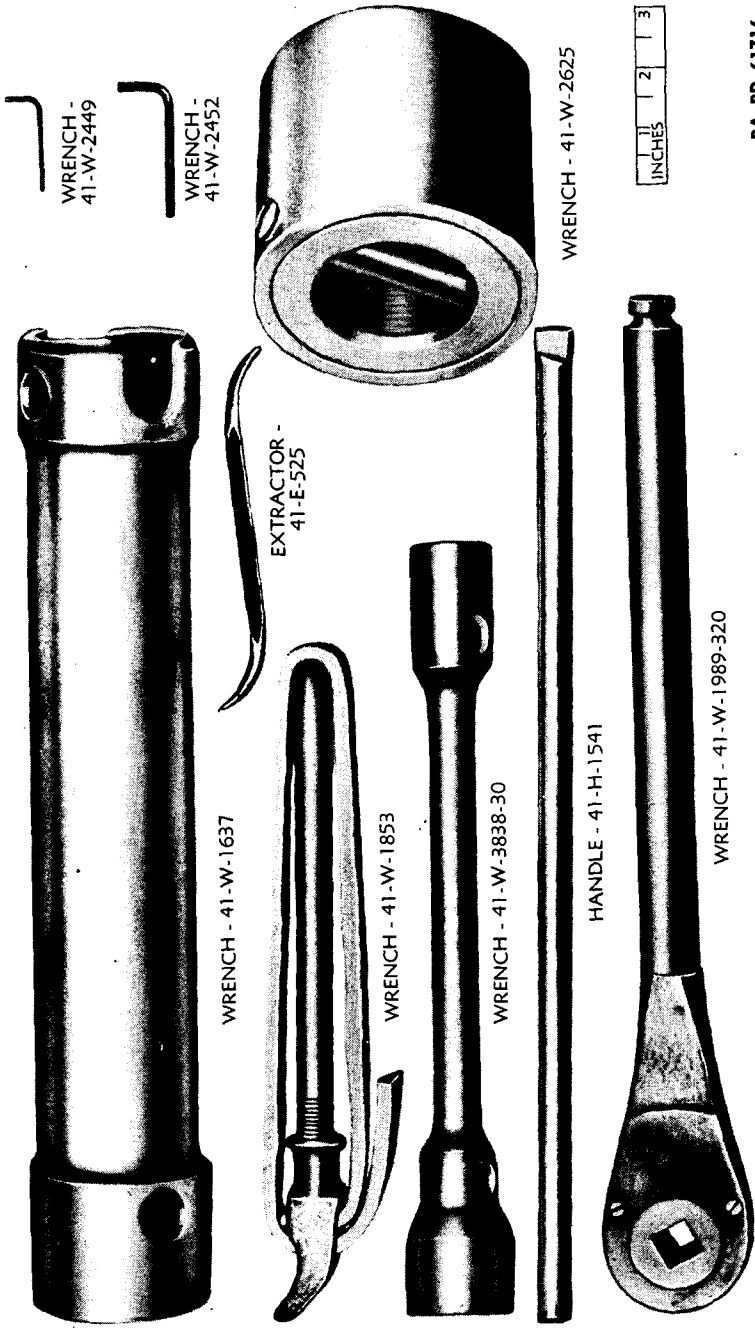


Figure 19 — Tools and Accessories

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR CARRIAGE, GUN, 155-MM, M1, AND M1A1 (Contd.)			
WRENCH, pintle bolt nut, hex. opng. 2 13/16 in.	19	41-W-1637	—
WRENCH, rtc., reversible, offset handle, hex., opng., size of opng. 4 in., length 62 1/2 in.	23	41-W-1989-600	Two of these wrenches are provided to turn the bogie lifting screws to raise or lower the bottom carriage. They are secured by clips to the outside of the trails. Two spring-loaded dogs underneath the cover are actuated by a lever. 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. Periodically remove the cover and clean any dirt which may have accumulated in the interior of the wrench.
WRENCH, rtc., reversible, sq-opng., size 3/4 in., length 18 in.	19	41-W-1989-320	—
(Composed of:			
1 GEAR, wrench, rtc., reversible, sq-opng., flat type, size 3/4 in. (41-G-586-40)			
1 HANDLE, wrench, rtc., reversible, length 18 in. (41-H-1548-400))			
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam., 3/32 in., screw size set No. 10, cap No. 5-6	19	41-W-2449	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. 1/8 in., screw size No. 1/4 in., cap No. 8, socket No. 10 flat		41-W-2450	—
WRENCH, set or cap screw (hollow head), hex., plug type, regular short arm series, hex. diam. 3/16 in., screw size set 3/8 in., cap 1/4 in.	19	41-W-2452	—

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

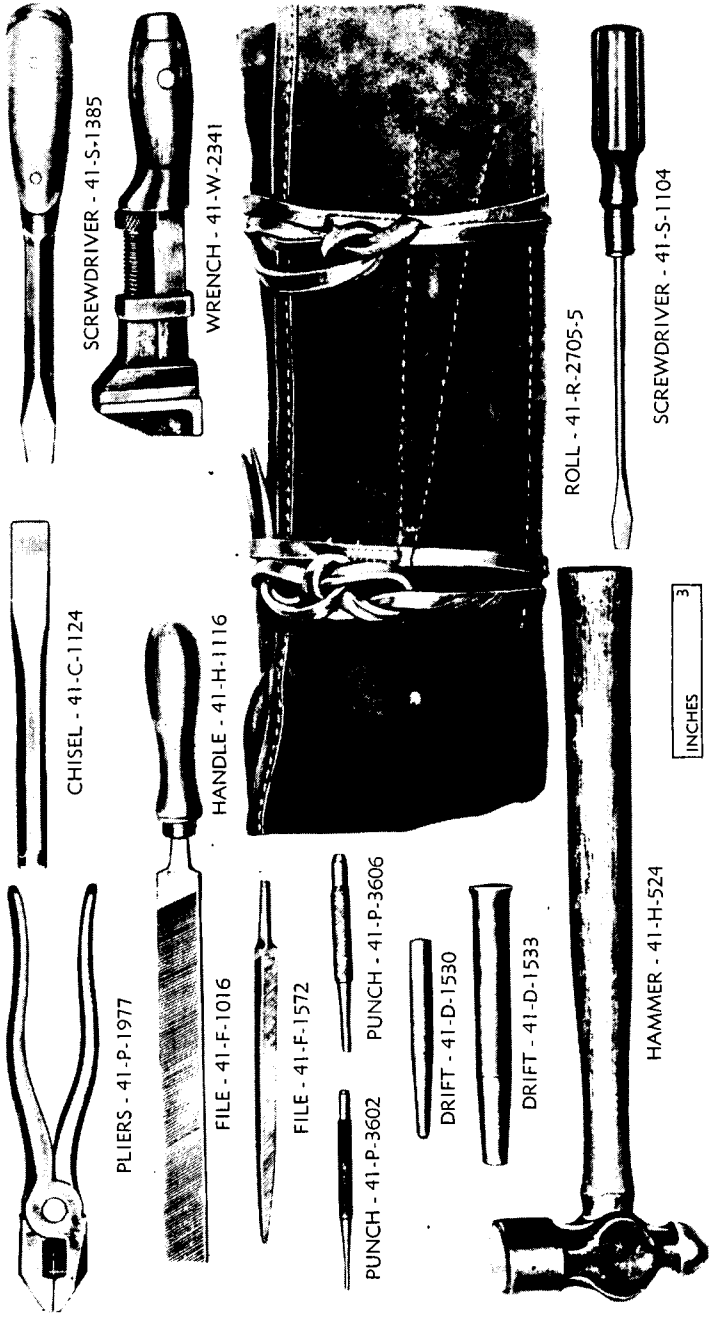
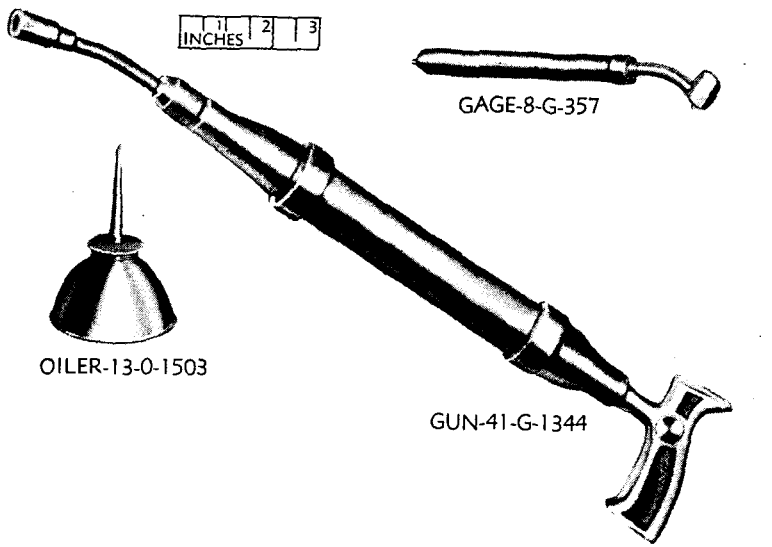


Figure 20 — Tools and Accessories

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR CARRIAGE, GUN, 155-MM, M1, AND M1A1 (Contd.)			
WRENCH, socket, recoil rod nut, hex. opng., size 4½ in.....	19	41-W-2625	—
WRENCH, wheel bearing nut, dble.-end., octagon opngs., size of opngs. 3 5/16 in. and 3⅞ in.		41-W-2612-25	To adjust wheel bearing outer jam nuts and the nut and dowel assemblies.
FOR MOUNT, GUN, 155-MM, M13			
ADAPTER, S. (plug), oil filling, recoil mechanism, diam. hex. head ¾ in., over-all length 1 11/16 in.	70	41-A-26-500	—
BAR, crow, pinch point, size ¾ x 30 in.	16	41-B-168	—
CAP, oil screw filler (gun).....	70	41-C-395-625	—
CHEST, oil pump M16, w/basic contents		—	For filling recoil system.
(Composed of:			
1 CHEST, oil pump, wood, S. reinforced, w/o contents, M16 (41-C-738-550)	70		
1 FUNNEL, copper, w/o strainer, cap. ¼ pt. (41-F-3580)	70		
1 HOSE, gasoline and oil, non-metallic, high temp. resisting complete w/couplings, length 120 in., ends threaded ¼ in., ends threaded ¼ in.-18NPT and ⅛-27NPT (33-H-535)	70		
1 PUMP, hydraulic, oil, M3 (11-P-576-300).....	70		
1 RULE S., flexible, length 30 cm, grad. one edge mm, other 64ths (41-R-2909)	70		
1 WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of opng. ¾ x 13/16 in. (41-W-1012))	70		

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.



RA PD 103170

Figure 21 — Tools and Accessories

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR MOUNT, GUN, 155-MM. M13 (Contd.)			
COVER, cam, elevating brake, M514		C76352	—
COVER, gun, over-all, M102 complete		D91382	—
CYLINDER, gas filled, compressed gas, M1, O.D. 9/16 in., length 56 9/16 in.		51-C-2255	For adjusting equilibrator pressure.
GUIDE, War Dept., lubr., No. 10		—	—
GUN, lubr., push type, hydraulic, 7 oz. cap., M2, complete (Artillery)	21	41-G-1344	—
OR			
GUN, lubr., hand operating, push type, M1, complete w/extension (41-E-485)		41-G-1341-8	—
OILER, S., stght. spout, push bottom, cap. 1/3 pt., length of spout 4 in.	21	13-O-1503	—
RELEASE, gage, pressure, filling and drain valve	70	45-R-3650	—

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR MOUNT, GUN, 155-MM, M13 (Contd.)			
ROLL, tool, canvas, empty, M4, size 26 x 30 in.	20	41-R-2705-5	—
SCREWDRIVER, common, normal duty, sgle. grip, length of blade 6 in., width of blade $\frac{5}{16}$ in.	20	41-S-1104	—
SCREWDRIVER, machs., extra heavy duty, wood insert handle, length of blade 5 in., width of blade $\frac{1}{2}$ in.	20	41-S-1385	—
WRENCH, adj., crescent type, sgle-end., length 8 in. jaw opng. $1\frac{5}{16}$ in.		41-W-486	—
WRENCH, adj., crescent type, sgle-end., length 15 in., jaw opng. $1\frac{11}{16}$ in.		41-W-489	—
WRENCH, rtc., reversible, sq-opng., size $1\frac{1}{8}$ in., length 24 in.		41-W-1989-440	—
(Composed of:			
1 GEAR, wrench, rtc., reversible, sq-opng., flat type (41-G-586-160)			
1 HANDLE, wrench, rtc., reversible, length 24 in. (41-H-1548-600))			
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. $\frac{3}{32}$ in., screw size set No. 10, screw size cap No. 5 and No. 6	19	41-W-2449	—
WRENCH, set or cap screw (hollow head), hex., plug type, regular short arm series, hex. diam. $\frac{1}{8}$ in., screw size set $\frac{1}{4}$ in., cap No. 8 socket No. 10 flat		41-W-2450	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex., diam. $\frac{3}{16}$ in., screw size set $\frac{3}{8}$ in., screw size cap $\frac{1}{4}$ in.	19	41-W-2452	—
WRENCH, socket, recoil rod nut, hex. opng., size $4\frac{1}{2}$ in.	19	41-W-2625	—
FOR LIMBER, CARRIAGE, HEAVY, M2			
None authorized.			

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

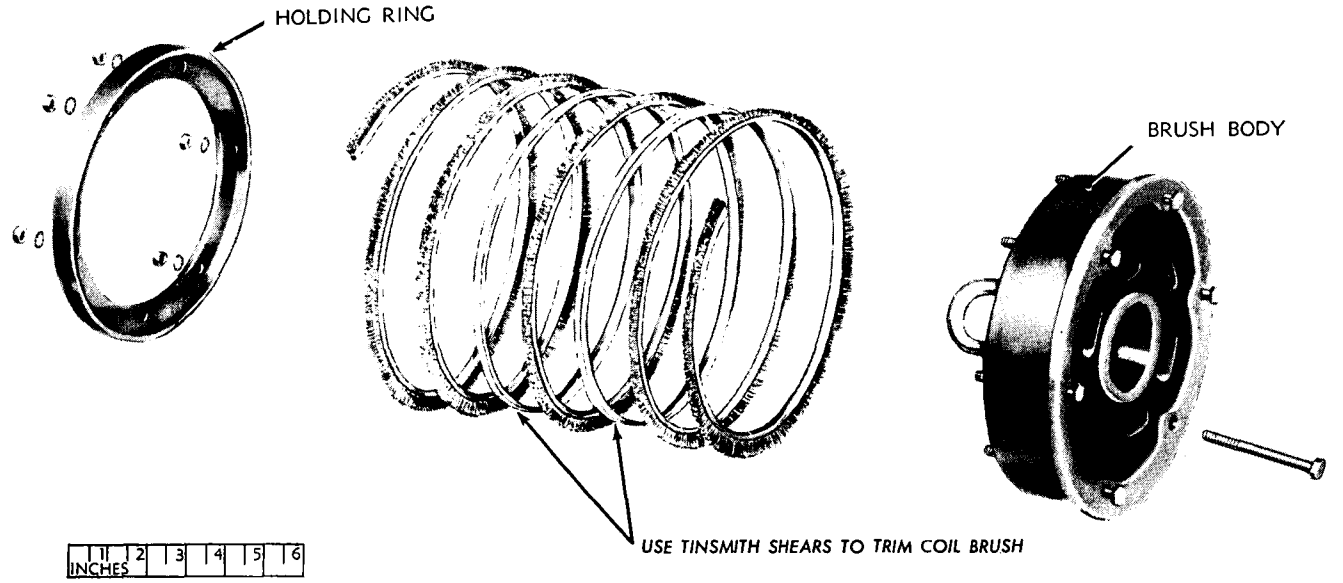


Figure 22 — Modification of Bore Brush M13

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR LIMBER, CARRIAGE, HEAVY, M5			
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of opngs. 1 and 5/16 in.		41-W-1024-2	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, carb-S., size of opngs. 1⅛ and 1½ in.		41-W-1065-40	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, carb-S., size of opngs. 1 11/16 and 1⅞ in.		41-W-1065-220	—
WRENCH, tubular, dble. end, hex opngs. 3 1/16 and 3 3/16 in., length 9 in.		41-W-3727-43	—
FOR PLATFORM, FIRING, 155-MM GUN, M1			
CHEST, tool, empty, metal, Ordnance design, w/o partitions, inside height, in. 11 1/16, inside width, in. 13¼, inside length, in. 28⅞, material S...	18	41-C-857-330	—
FILE, A.S., mill, type A, cut bast., length point to shoulder 10 in.	18	41-F-1157	—
FILE, A.S., three sq., cut bast., length point to shoulder 8 in...		41-F-1553	—
HANDLE, sledge, length 36 in...		41-H-1489	—
PLIERS, side-cutt., flat-nose, over-all, 8 in.	20	41-P-1977	—
SCREWDRIVER, common, normal duty, sgle. grip, length of blade 6 in., width of blade 5/16 in.	20	41-S-1104	—
SLEDGE, blacksmiths', double-faced, weight 10 lbs.	16	41-S-3726	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of openings ⅞ and 1 in.		41-W-1019-50	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of openings 1⅛ and 1 5/16 in.		41-W-1028	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of openings 1½ and 1⅝ in.		41-W-1036-5	—
WRENCH, engrs., angle 15°, sgle. head, open end, normal duty, alloy-S., size of openings 1⅞ in.		41-W-1314	—

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

RA PD 86553

Figure 23 — Bogie Lifting Screw Wrench

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR PLATFORM, FIRING, 155-MM GUN, M1 (Contd.)			
WRENCH, engrs., angle 15°, sgle. head, open end, normal duty, carb-S., size of opening 3¾ in.		41-W-1430	—
WRENCH, screw, monkey, metal handle, jaw opng. size 12 in.		41-W-2353	—

9. MODIFICATION OF BORE BRUSH M13. The cleaning characteristics and length of service of the bore brush M13 can be improved by slight modification.

a. Remove nuts and lock washers from the front face of bore brush, and the holding ring from the brush body; then remove the coiled brush insert.

b. Separate the coil of the brush and, using a pair of tinsmith 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 22.

c. The steel channels grip for bristles must not be cut or modified.

d. Reassemble the parts in reverse order of disassembly.

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

PART TWO – OPERATING INSTRUCTIONS

Section IV

GENERAL

10. 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 V

SERVICE UPON RECEIPT OF MATERIEL

11. GENERAL.

a. Upon the receipt of new or used materiel, it is the responsibility of the officer in charge to ascertain whether or not 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 materiel.

c. The materiel should be prepared for service in accordance with instructions given in paragraphs 12 and13.

12. NEW EQUIPMENT.

a. The following steps are suggested as a guide which can be followed to determine the serviceability of the materiel:

(1) Check the gun book for proper entries as outlined in section I.

(2) Remove all corrosion-preventive from the weapon.

(3) Inspect all operating parts for smoothness of operation.

(4) Check the gun and carriage for general appearance and condition of paint; make certain all lubrication fittings are properly painted (par. 40). Review part three, for detailed inspection and adjustment procedure.

(5) Disassemble and clean breech and firing mechanisms (sections XVII, XVIII, and XIX).

(6) The materiel should be lubricated in accordance with War Department Lubrication Order, section XIII.

(7) Check spare parts and accessories with the OSP&E of SNL D-24.

(8) Inspect tools and accessories, section III.

13. USED EQUIPMENT

a. Repeat the steps outlined in paragraph 12.

b. When checking the gun book as outlined in section I, be sure that all War Department Modification Work Orders have been taken care of. If not, proper procedure should be followed to have this done.

c. Check all the materiel for signs of excessive wear, damage, and missing parts (par. 11).

Section VI

CONTROLS AND INSTRUMENTS

14. GENERAL. The controls and instruments used to operate the gun throughout the cycle of loading, firing, and reloading for continuous firing, are located and described in this section. For location and description of sighting controls and instruments used in laying the gun see section XXVIII.

15. CONTROLS.

a. Elevating controls.

(1) ELEVATING MECHANISM CLUTCH LEVER. The elevating mechanism clutch lever is located on the right side of the top carriage adjacent to the elevating handwheel (fig. 24). The purpose of this lever is to control the elevating brake which locks the gun at any desired angle of elevation. To release the elevating brake, depress the elevating mechanism clutch lever. To set the brake, raise the lever.

(2) ELEVATING HANDWHEEL. The elevating handwheel located on the right side of the top carriage (fig. 24) controls the movement of the gun throughout its range of elevation and depression after the elevating mechanism clutch lever has been released. To elevate the gun, depress the elevating mechanism clutch lever and rotate the elevating handwheel clockwise. To depress, rotate the elevating handwheel counterclockwise.

b. Traversing controls.

(1) TRAVERSING BRAKE HANDLE. The traversing brake handle is located on the traversing handwheel shaft at the left side of the top carriage (fig. 25). This handle locks the traversing handwheel shaft, preventing rotation of the traversing handwheel and the traversing of the weapon. Rotating the traversing handwheel counterclockwise releases the traversing mechanism.

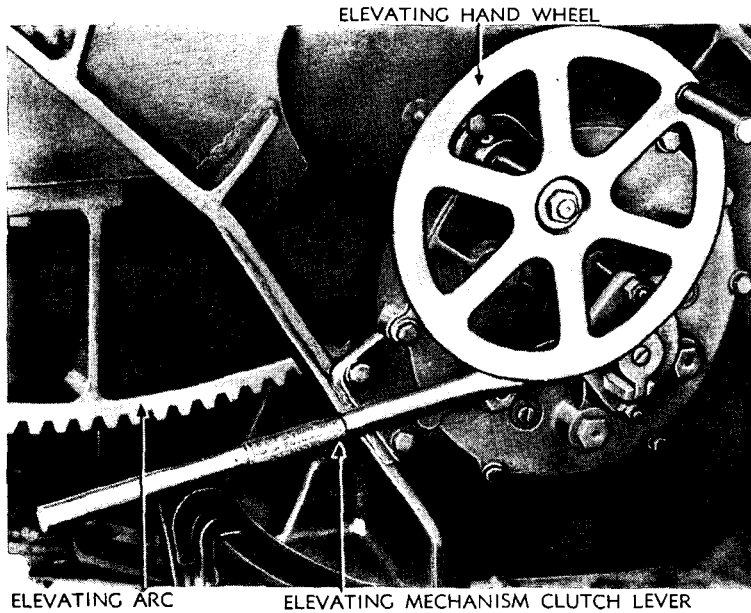


Figure 24 — Elevating Controls

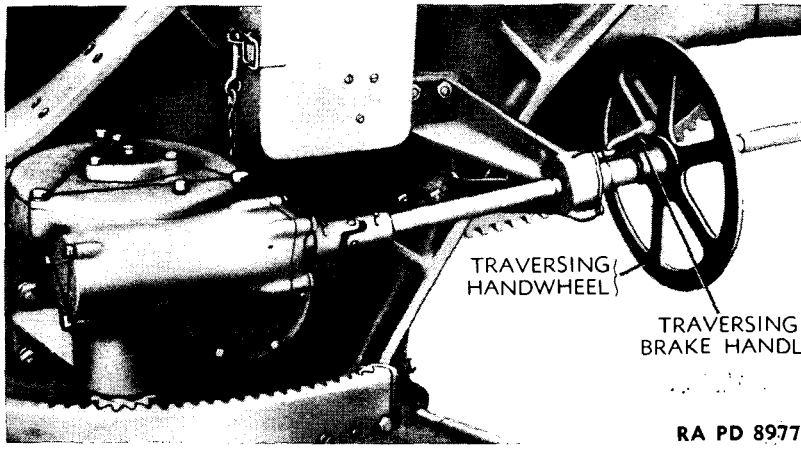


Figure 25 — Traversing Controls

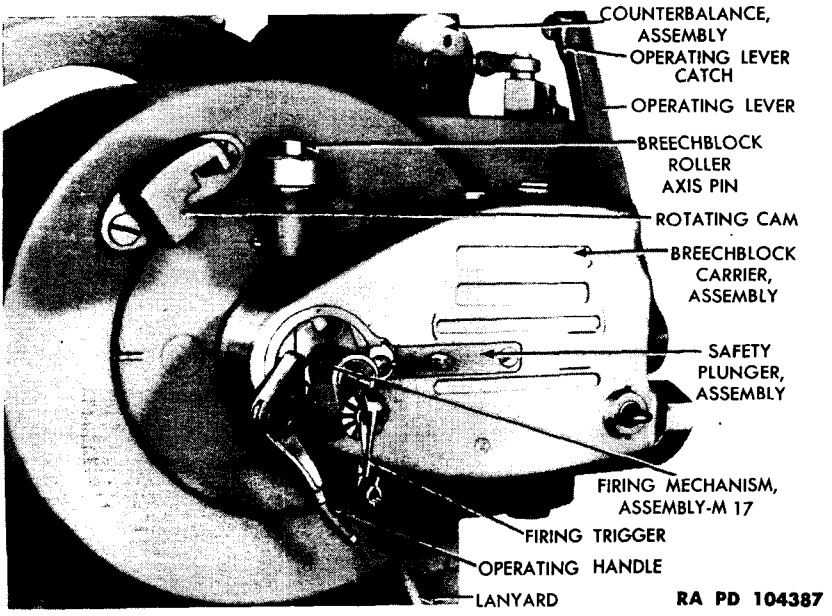


Figure 26 — Breech and Firing Mechanism Controls — Breech Closed

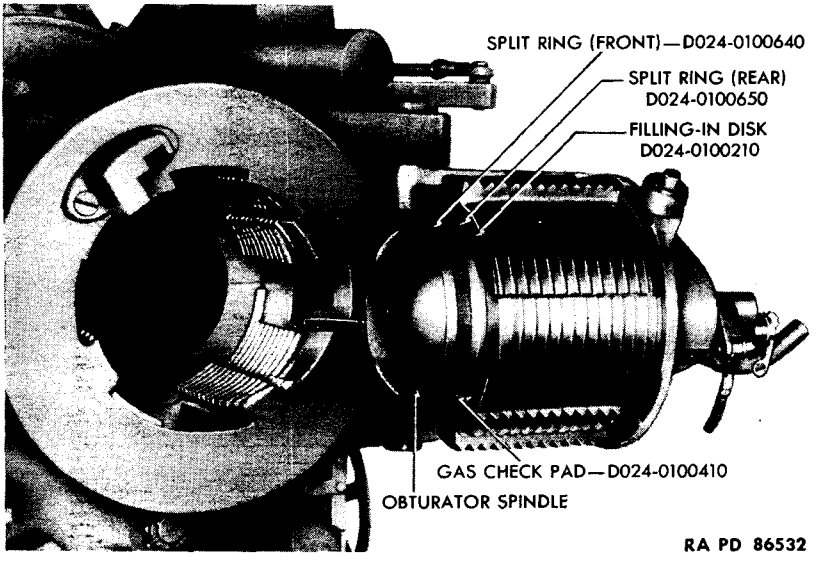


Figure 27 — Breech and Firing Mechanism Controls — Breech Open

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

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Figure 28 — Bogie in Traveling Position

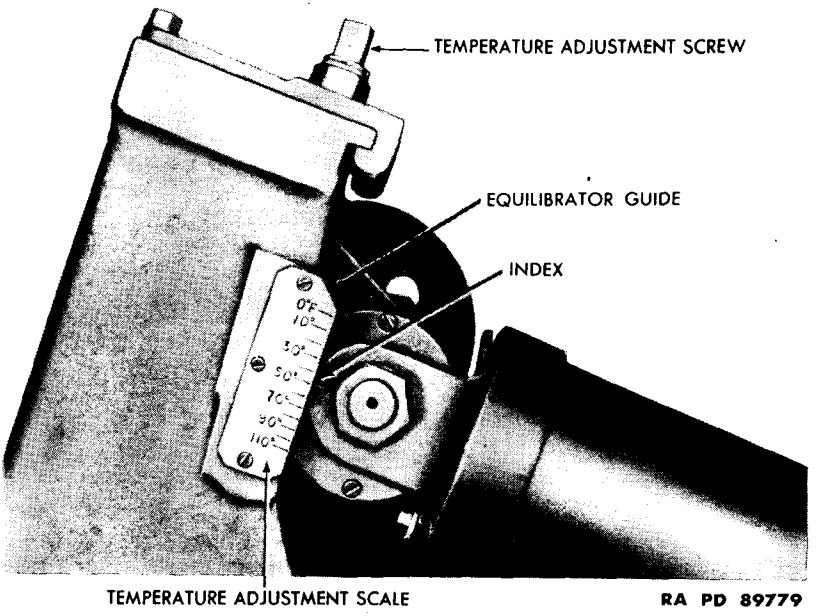

Figure 29 — Temperature Adjustment Scale

(2) TRAVERSING HANDWHEEL. The traversing handwheel located on the left side of the top carriage (fig. 25) controls the movement of the gun throughout its range of traverse after the traversing brake has been released. To traverse the gun release the traversing brake handle and rotate the traversing handwheel clockwise at right traverse and counterclockwise for left traverse.

c. Breech operating controls. The purpose of the breech operating lever, attached at the right side of the breechblock carrier, (figs. 26 and 27) is to provide a means to open or close the breech. This lever can be operated only after the firing mechanism M1 has been removed or the firing lock M17 opened (see subpar. **d** (1) and (4), below). This is done by grasping the lever, pushing the operating lever catch (fig. 26) down, and pulling and swinging the operating lever to the right.

d. Firing controls. (see par. 3 f).

(1) OPERATING HANDLE. The firing lock M17 is opened for loading and closed for firing by means of the operating handle (fig. 26).

(2) FIRING TRIGGER. The firing lock M17 fires the gun manually by means of the lanyard-operated firing trigger (fig. 26).

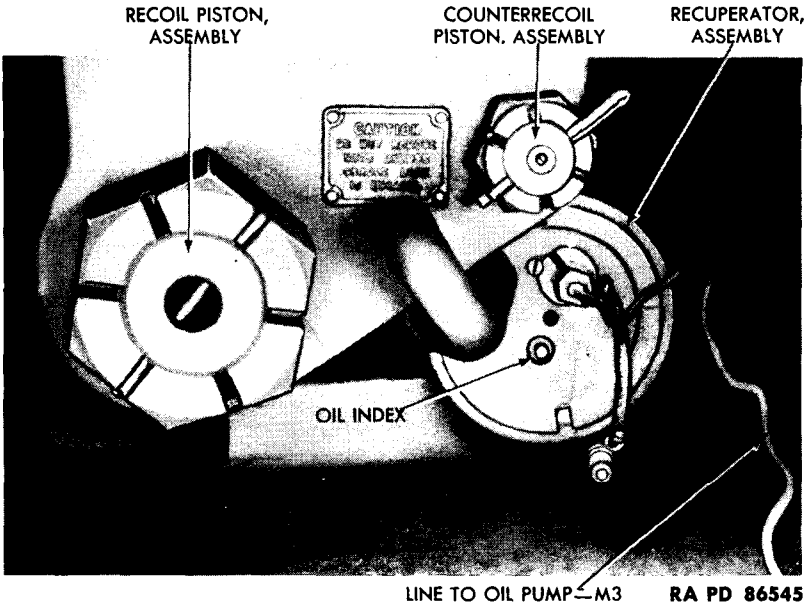

Figure 30 — Oil Index

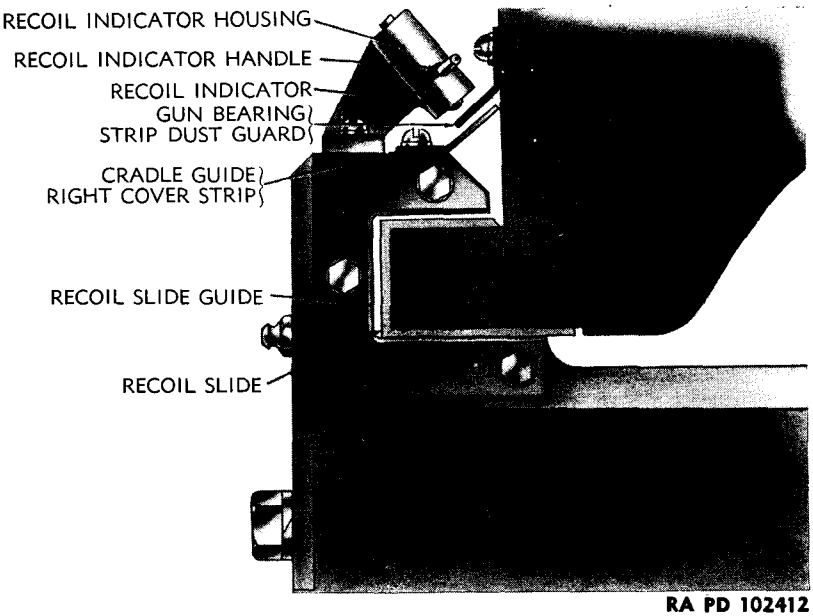

Figure 31 — Recoil Indicator

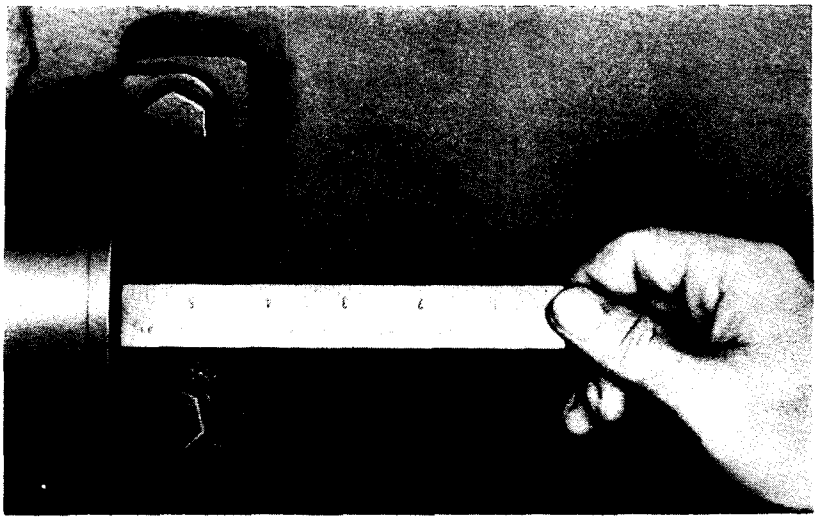

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Figure 32 — Replenisher Piston

(3) PERCUSSION HAMMER. The firing mechanism M1 fires the gun manually by means of the lanyard-operated percussion hammer (fig. 50).

(4) FIRING MECHANISM HANDLE. The firing mechanism M1 is inserted and locked in the firing mechanism receiver housing and unlocked and withdrawn by means of the firing mechanism handle (fig. 49).

(5) LANYARD. The purpose of the lanyard is to provide a means to fire the gun from a distance, sufficient to give the gunner protection from the recoiling parts.

(a) The lanyard is attached to the trigger on the firing lock M17 (fig. 26).

(b) The lanyard is attached to the percussion hammer on the firing mechanism M1 (fig. 50).

e. Brake mechanism controls.

(1) AIR BRAKES. The air brakes on all bogie wheels are actuated from the prime mover.

(2) HAND BRAKES. Hand-operated levers (fig. 28) are to set the mechanical brakes on the bogie for parking.

16. INSTRUMENTS.

a. Temperature adjustment scale. The purpose of the temperature adjustment scale (fig. 29) is to provide an adjustment of equilibrator tension for various temperatures.

b. Oil index. The oil index (fig. 30) indicates whether or not there is sufficient reserve oil in the recoil mechanism system to fire the gun without damage.

c. Recoil indicator The recoil indicator (fig. 31) is used to measure directly the length of recoil of the gun during firing.

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. 32).

Section VII

OPERATION UNDER USUAL CONDITIONS

17. TO PLACE THE GUN AND HEAVY FIELD CARRIAGE IN FIRING POSITION.

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 and rear of the limber. Place the dummy couplings on the ends of the air tubes on the trails. 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.*

b. Remove the loading tray. When the carriage is in traveling position, the prescribed location for the loading tray is on top of the trails between the bottom carriage and the spades. The tray is inverted, and the front handles are placed in the recess formed by the front spades mounted on the trails. The tray is held in this position by the camouflage poles strapped to both trails over the handles of the loading tray.

c. Make certain that hand brakes on gun carriage are set, and that limber and prime mover are secured against undesired movement. CAUTION: *Using personnel should chock the limber and bogie wheels at the rear with wood blocks, sand bags, or other suitable and efficient blocking, whenever the materiel is disconnected from the prime mover and particularly when unlimbered on sloping terrain. The parking brakes alone should not always be relied on to hold the materiel stationary.* Stand clear of limber and trails. Remove the limber as follows:

(1) REMOVING HEAVY CARRIAGE LIMBER M5 (figs. 33 to 37). 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 trails.* Remove cotter

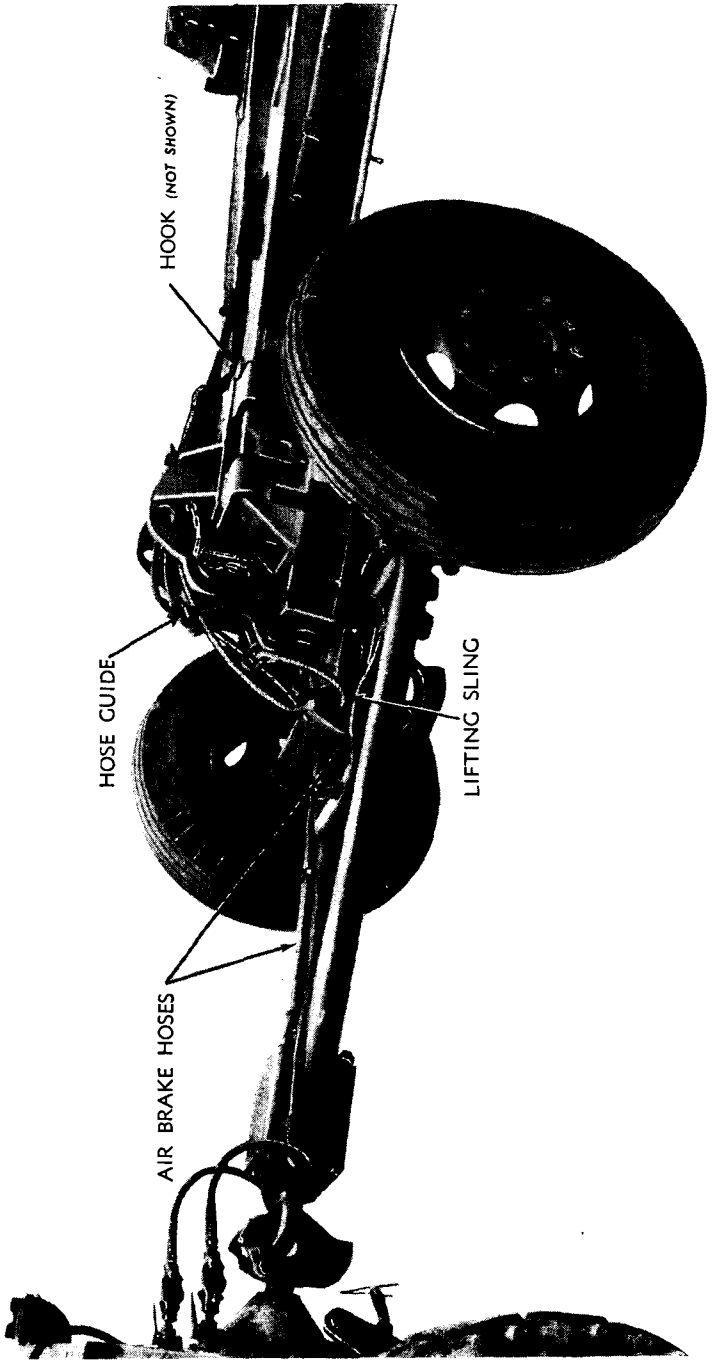

Figure 33 — Carriage Limbered for Traveling (Heavy Carriage Limber M5)

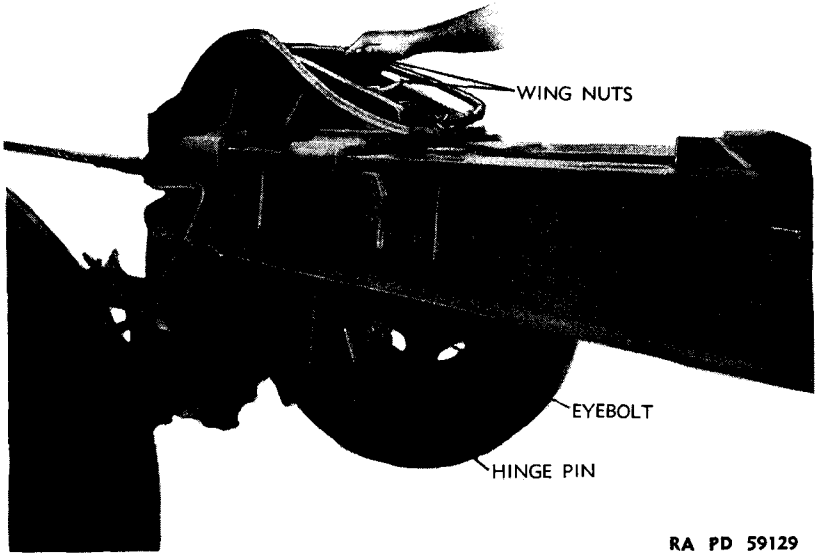

Figure 34 — Unlimbering the Trails — Step 1

pin, wing nuts, and eyebolt spacer piece from eyebolt (figs. 34 to 36). Remove eyebolt hinge pin 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 limber lifting bracket assembly begins to rotate. Ease trails to the ground by means of winch. Remove bar wing nut from trail coupling pin and screw on bronze assembling nose. Remove trail coupling pin and pull limber clear of trails. Using powered winch, take in cable until the limber lifting bracket assembly is rotated to approximately vertical position. CAUTION: *Do not rotate past vertical.* Attach eyebolt to lifting 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. This locks lifting 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 pins and nuts from trail 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.

(2) REMOVING HEAVY CARRIAGE LIMBER M2. Remove locking pin and lift off lock. Lock the drawbar to the limber lifting mechanism base by inserting the drawbar locking pin in the limber lifting

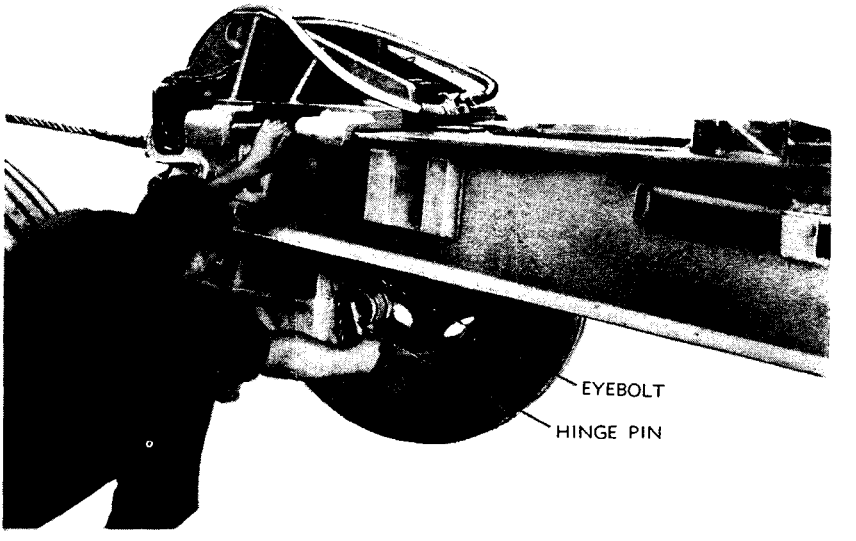

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Figure 35 — Unlimbering the Trails — Step 2

mechanism tube. Remove pin and swing prop up under drawbar. Secure by placing snap in handle. Release the two locking pins on the limber which bear against the outside of the trails. Turn the limber lifting mechanism handle and lower the trails.

d. Remove the lock pin to disconnect the gun from the traveling lock.

e. Install the cable from the prime mover winch over and around the sheave on the top carriage, over the top of the breech ring (breechblock open), and attach it to the hook under the breech ring. A guard can be used over the breech ring. Operate the winch to pull the gun up to firing position. Secure the gun to the piston rods by installing the two piston rod nuts. NOTE: *It is necessary to allow a slight floating of the piston rod in the gun lug to prevent excessive wear on the stuffing boxes which might be caused by a slight irregularity in alinement of the recoil mechanism.* The nuts should be drawn tight and then backed off enough to allow approximately 0.005 inch end play between the gun and the piston rod socket. CAUTION: *The two piston rod nuts must always be installed before disengaging the cradle lock over the bogie.*

f. A modification work order provides that the sheave bracket assembly be replaced by a retracting eye. To place the gun in firing position, couple the hoist to the eye nearest the breech ring and to the yoke of the cradle, and jack the gun into battery position (fig. 38).

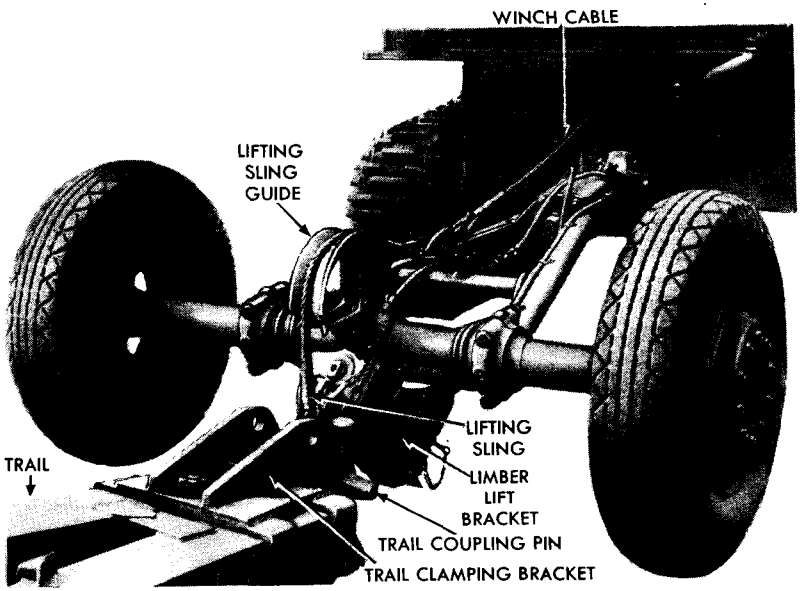

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Figure 36 — Trails Unlimbered

To place the gun in traveling position, couple the hoist to the eye nearest the muzzle and the yoke of the cradle, and jack the gun until it is properly engaged by the tube traveling lock.

g. Remove the traveling lock and spread the trails. Locate the holes for the rear spades and dig sufficiently deep to permit assembly of the spades to the trails.

h. Remove the bogie lifting screw lock (fig. 39). Remove bogie lifting screw covers (fig. 40). Remove the ends of the four wheel supporting cables from their brackets on the torque arms and attach them to the wheel supporting bolts on the bogie cross beam (fig. 41). Release the cradle lock from the cradle. Dig pits for front spades, then attach spades. Lower the carriage by operation of the bogie lifting screws with the bogie lifting screw wrenches (fig. 42), and continue operating the bogie lifting mechanism until the bogie wheels are raised completely off the ground. Operate both screws in unison to prevent cramping of the mechanism. Cables are attached to the brackets and axles to provide a support for the wheels when they are raised from the ground in firing position.

i. If the bearing strength of the soil is too low for more permanent emplacement of the materiel, embedded logs are used (railway ties may be used). These are placed behind the front and rear spades

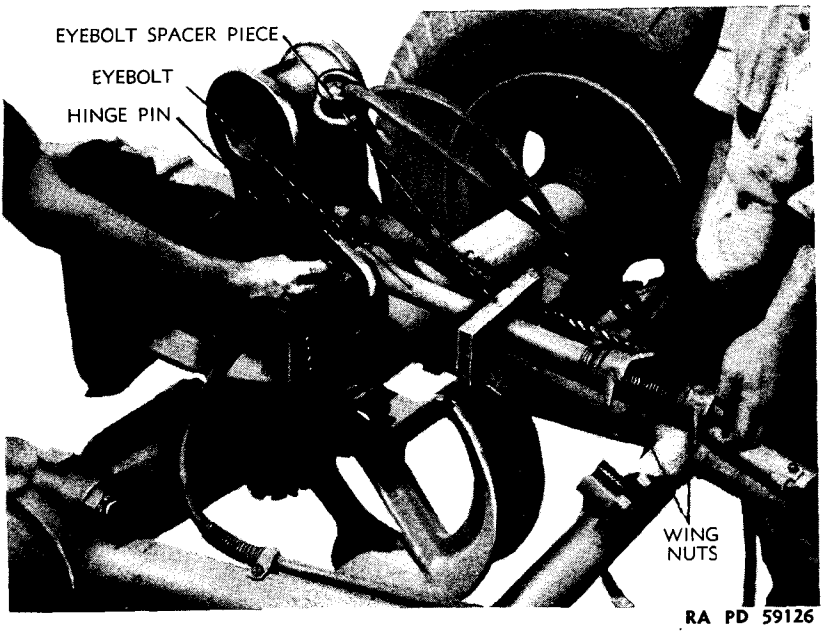


Figure 37 — Eyebolt in Carrying Position

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.

j. Remove covers from breech and muzzle.

k. Install panoramic telescope in its mount.

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

m. Place tools and accessories in proper position for firing.

18. TO PLACE THE GUN AND HEAVY FIELD CARRIAGE IN FIRING POSITION ON THE FIRING PLATFORM M1.

a. For emplacing the firing platform, see paragraph 27.

b. Procedure.

(1) The lower front spade supports must fit over the studs on the bolster, and permit the pivot blocks to be placed in position. Lower carriage on the bolster by raising bogie. During the operation of lowering the carriage, the gun and carriage may have to be maneuvered slightly to properly aline the bolster and bottom carriage. When bottom carriage is in position on the bolster, lower the trails from the limber. Place bolster clamps on bolster, and bolt in place (fig. 47).

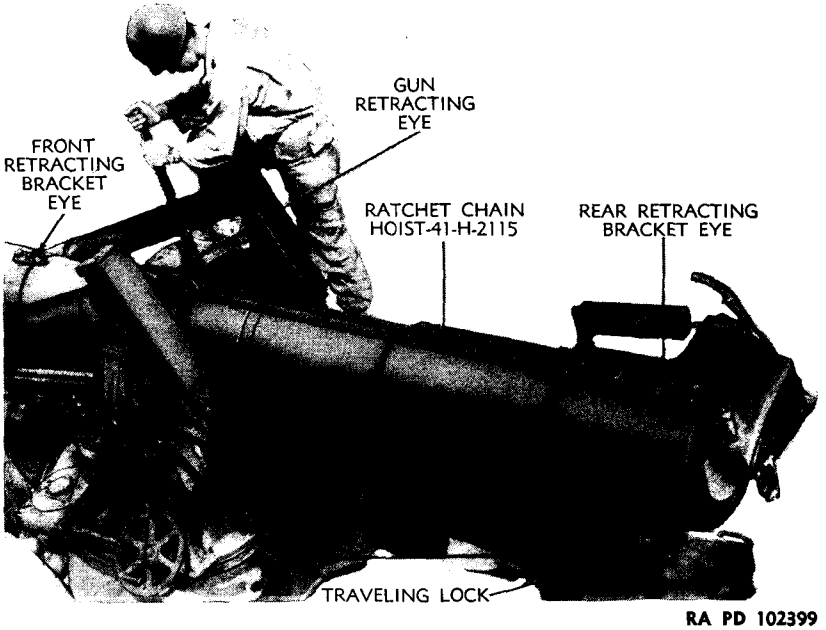


Figure 38 — Pulling the Gun Forward Into Firing Position With Ratchet Chain Hoist

Drop yoke bar over bottom carriage and tighten locking nuts (fig. 46). Place pivot blocks in position in bottom front spade supports. Place bolster frame clamp over spade supports and lock with two nuts (fig. 46).

(2) Assemble remaining rail sections and attach remaining radial. Assemble trail clamps and rubbing plates on rail sectors with hooked bolt on outside of rail. Slide trail clamps into the trail spade seats. Fasten with trail spade key (fig. 57).

(3) Assemble trail brace, and hook the trail brace clevises over the top front spade supports. Tighten up clevis nuts, making sure that the support ends engage the trails properly. Assemble push bar assembly on end of trails. The push bar assemblies must have the clamp gib on the outside of the trails (fig. 57). Drive stakes around the outside of the rail sectors.

c. After the gun has been mounted and clamped on the bolster, further procedure to bring the weapon into firing position is the same as detailed in placing the heavy field carriage in firing position, paragraph 17.

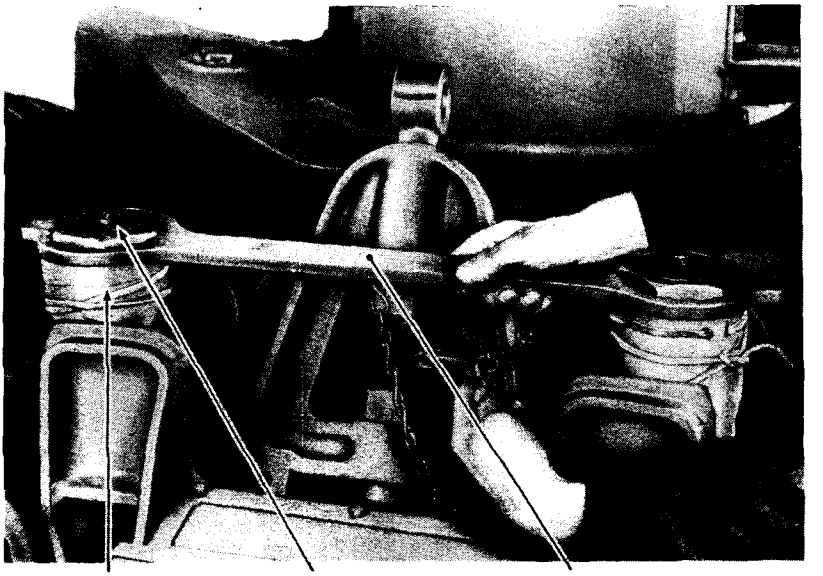


Figure 39 — Removing Bogie Lifting Screw Lock

19. TO PLACE THE GUN IN FIRING POSITION ON THE GUN MOUNT M13.

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

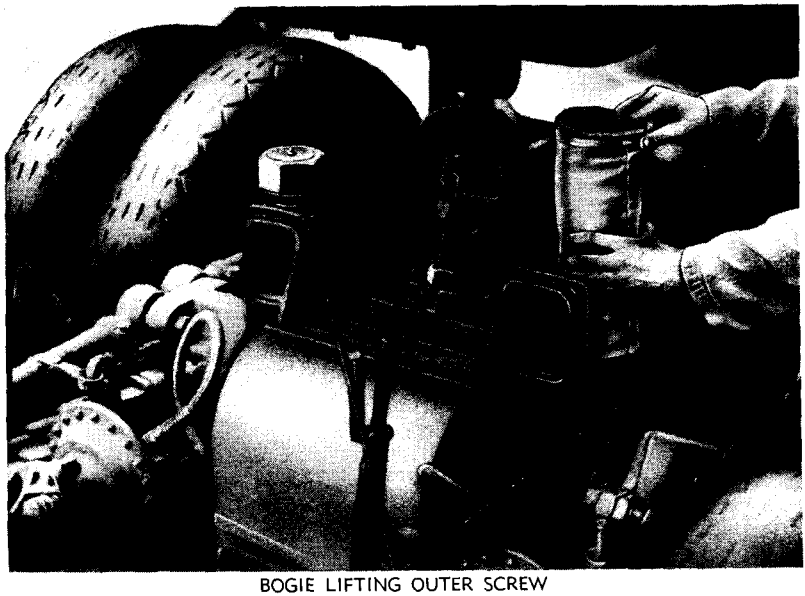
b. Unlock the tube front traveling lock (fig. 44) by loosening the nut which secures the upper half of the traveling lock, and unlock the rear traveling lock (fig. 43). Rotate the upper half up and off the tube; then elevate tube slightly in order to push traveling lock down in latched position on the hull.

c. Place spade in firing position. Free the top support arms of the spade assembly by removing the locking pins. Release winch ratchet arm and brake to lower spade to ground. Back up vehicle to force spade prongs into ground. When in its proper position, the spade must be flush with the ground and the spade stops seated against the hull. Apply vehicle steering brakes and lock in position.

20. LOADING THE GUN.

a. Loading angle. Bring the gun to approximately 15 degrees elevation.

b. To open the breech. Remove the firing mechanism M1 or open the firing lock M17. Push down on the breechblock operating



BOGIE LIFTING OUTER SCREW

RA PD 102393

Figure 40 — Removing Bogie Lifting Screw Cover

lever catch, and pull the breechblock operating lever down to a horizontal position. Then swing the operating lever toward the muzzle of the gun.

c. Powder chamber. In between rounds of fire, immediately upon opening the breech, the powder chamber, including the forcing cone, should be swabbed out with the sponge. The bore should then be examined to make certain that there are no burnt fragments of powder bags or other objects remaining in the bore before reloading.

d. Projectile. A loading tray (fig. 48) is furnished both to provide for ease in loading and to protect the threads in the breech recess. The projectile is placed on the loading tray, the tray is lifted by the gun crew, and the front of the tray placed so that the brass projecting lug rests in a blank portion of the interrupted breech. The projectile is pushed clear of the loading tray by use of the rammer. Then the tray 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 and bourrelet on a projectile are 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 being prepared for loading.

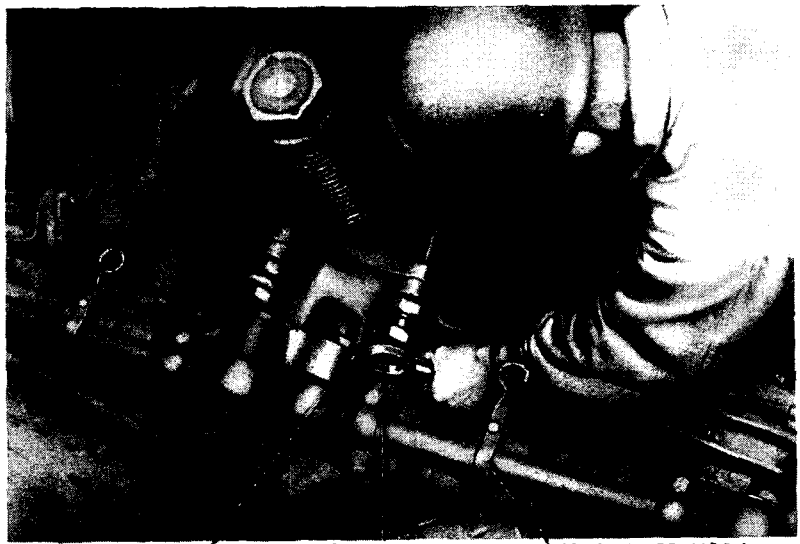


Figure 41 — Attaching Wheel Supporting Cables to the Lugs on the Bogie

e. Propelling charge. It is not necessary to use the loading tray for 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.

f. To close the breech. Pull the breech operating lever toward the breech and then push it to a vertical position.

21. FIRING.

a. Release the elevating and traversing handwheel brakes and lay the gun in elevation and traverse. Operation of sighting and fire control equipment is covered in section XXVIII.

b. Insert primer. NOTE: *The breechblock must be closed before assembling the firing mechanism M1, and the firing mechanism M1 must be removed, or the firing lock M17 opened, before the breechblock can be opened.*

c. Make sure the firing mechanism is properly latched and then release hammer locking pin (when firing mechanism M1 is used).

d. On firing mechanism M1 installation, attach lanyard to hammer, keeping one hand between hammer and firing pin as an added safety precaution. On firing lock M17 installation, attach lanyard to the trigger and adjust trigger to position best suited for pulling

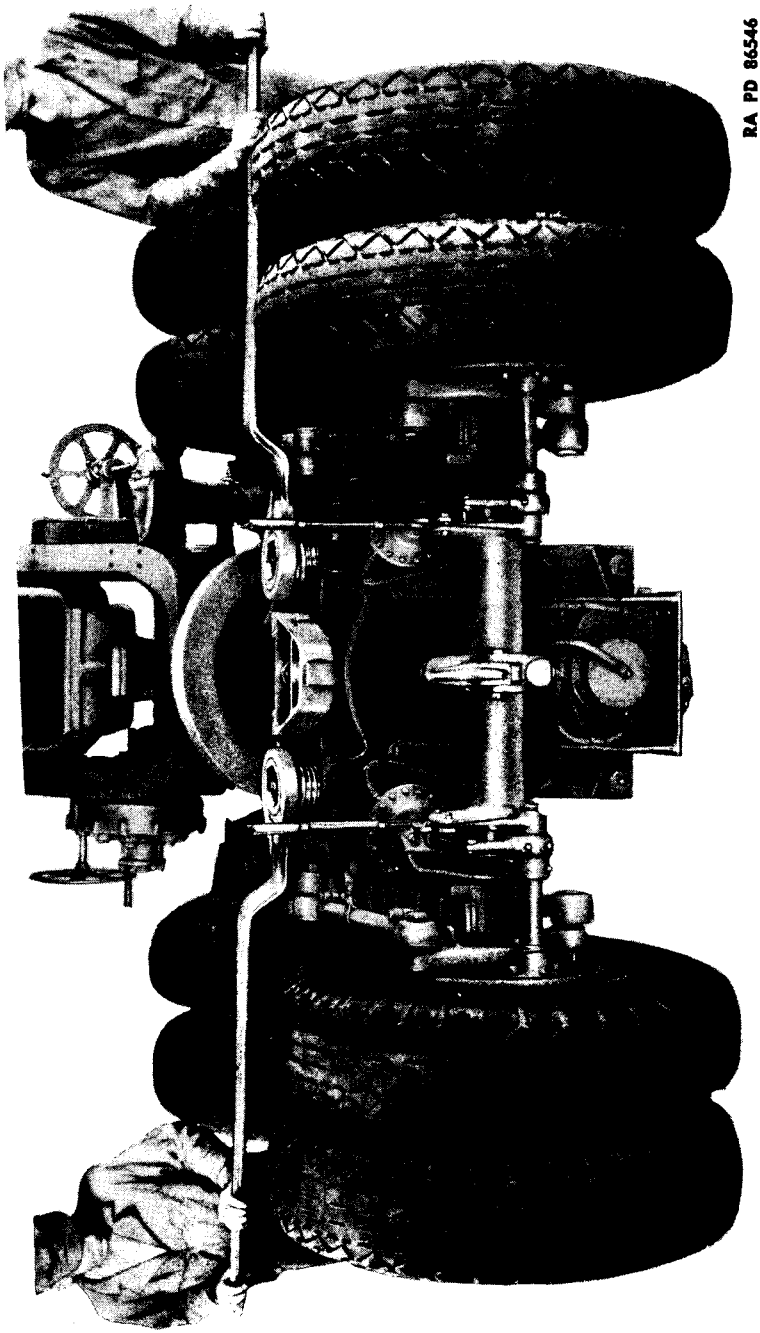


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Figure 42 — Lowering Bottom Carriage

lanyard (figs. 26 and 86). This adjustment is made by pushing the longer arm of the trigger forward, which disengages the shorter arm from the notches in the selector. Then rotate the trigger to the desired location. The release of the lanyard permits the trigger to reengage the firing hammer and the lock is ready for the next firing. To eject the primer, move the operating handle smartly to the left. This movement can best be obtained by striking the handle with the palm of the hand.

e. Allow slack in lanyard.

f. Pull lanyard sharply and with force, to fire with firing mechanism M1. Apply a steady pull to lanyard, to fire with firing lock M17.

g. In case of a misfire, refer to paragraph 45.

22. TO UNLOAD. The piece will be unloaded only upon the specific orders and under the direct supervision of an officer. Remove the firing mechanism. Bring the gun to a horizontal position. Open the breech and remove the powder charge. Place the loading tray in position in the breech recess. Inspect the unloading rammer head to see that it is thoroughly clean and of a type containing a suitable recess for inclosing the fuze. Insert the rammer head into the bore from the muzzle end and push it carefully until it incloses the fuze and comes into contact with the ogive of the projectile. Push the projectile back slowly onto the loading tray. It may be necessary to tap the end of the rammer staff with a wooden block in order to dislodge the projectile from its seat in the bore. Hold an extra rammer, if available, otherwise a pickax handle, firmly against the base of the projectile and steady its backward movement until it comes to rest in the loading tray.

23. TO PLACE THE GUN AND HEAVY FIELD CARRIAGE IN TRAVELING POSITION.

a. Raise carriage. Detach the rear spades from the trails. Operate the bogie lifting mechanism to raise the carriage from the ground. Swing the trails together. Raise the carriage as high as the lifting mechanism will permit. Detach the front spades. Place the front and rear spades in their carrying racks on the trails. Detach the wheel supporting cables from the bolts on the bogie cross beam 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.

b. Install limber.

(1) INSTALL HEAVY CARRIAGE LIMBER M5.

(a) Place the trail clamping bracket T-bolt in the spade recess on the trails when closing the trails. Aline the trail clamping bracket over the T-bolt and trails. Position the trail clamping bracket bolt

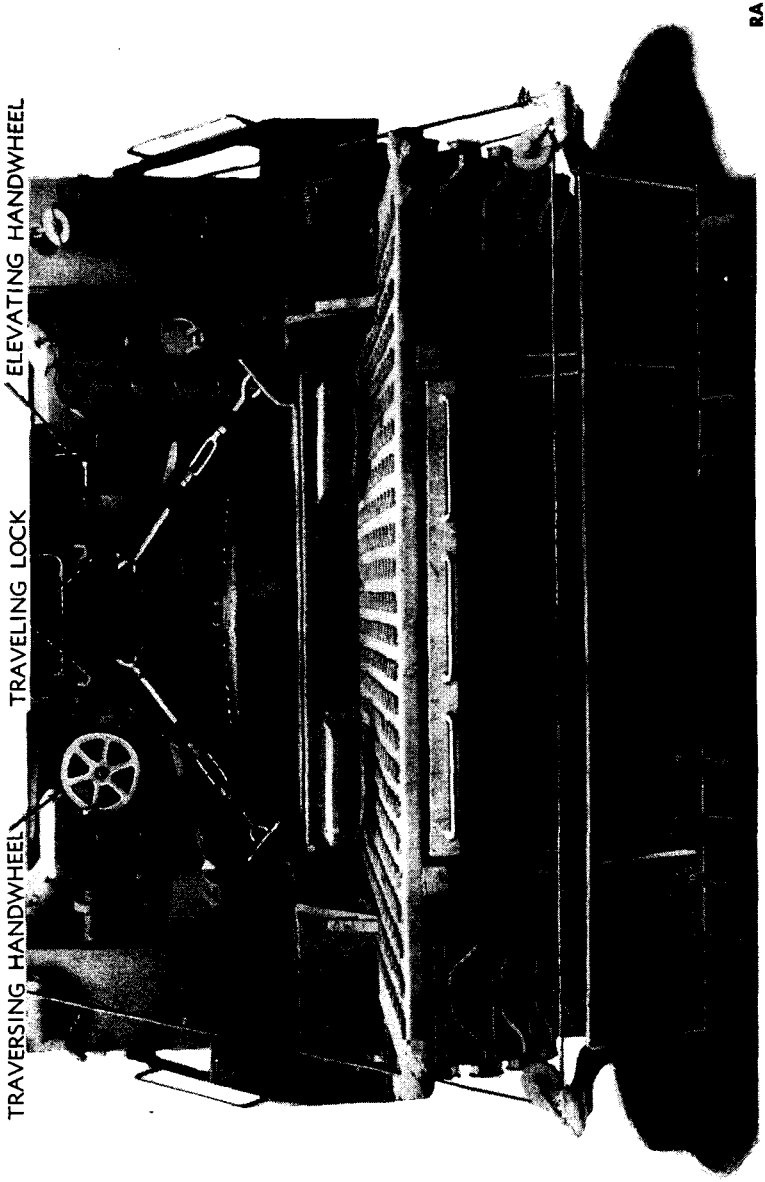

Figure 43 — Gun Motor Carriage Traveling Lock

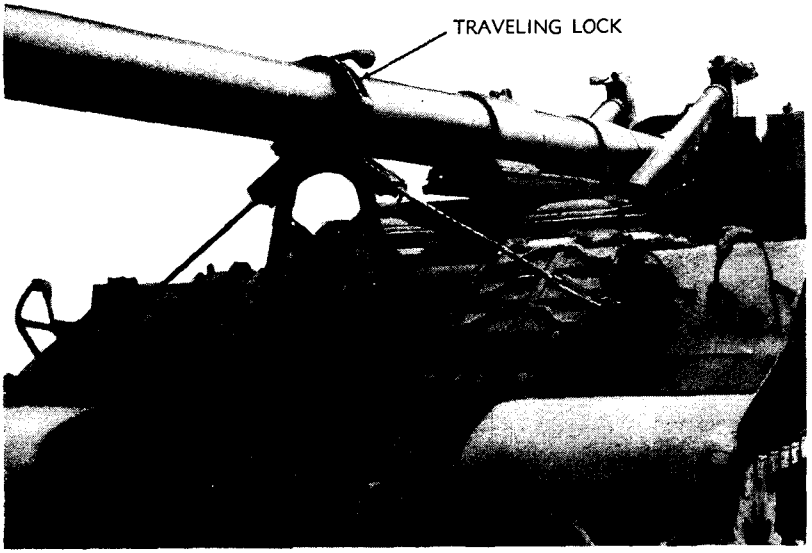

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Figure 44 — Gun Motor Carriage Front Traveling Lock

and install nuts on the bolts. Tighten with the double-headed box wrench issued with the limber. Lock in place by inserting the safety pins (fig. 35). CAUTION: *One or more threads should be showing above the nut.*

(b) With the limber hooked to the prime mover, aline the limber with 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 in the front of the limber by loosening the wing nuts and removing the hinge pin (fig. 37). Pay out cable from winch to allow the lifting bracket assembly to rotate and swing down to the lifting position. Aline the lifting bracket with the trail clamping bracket. Screw assembling nose onto the trail coupling pin and insert pin to connect the limber lifting bracket to the trail clamping bracket. Limbers equipped with coupling pins that are secured by means of a tapered key do not require this assembling nose. Remove the nose from the trail coupling pin, and screw on the bar wing nut. Insert the trail coupling lock pin.

(c) Unlock brakes on gun carriage, and, using powered winch, take in cable slowly. This will rotate the lifting bracket assembly and lift the trails to the traveling position. CAUTION: *Personnel must stand clear of the limber and trails and the operator of the prime*

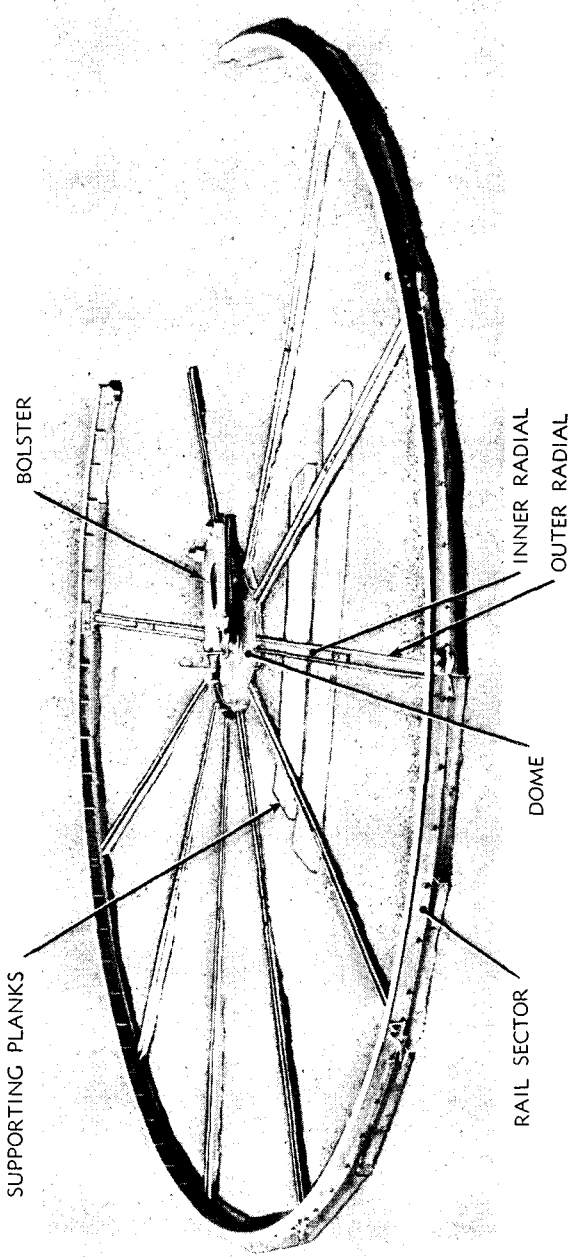

Figure 45 — Firing Platform — Assembled for Mounting Carriage

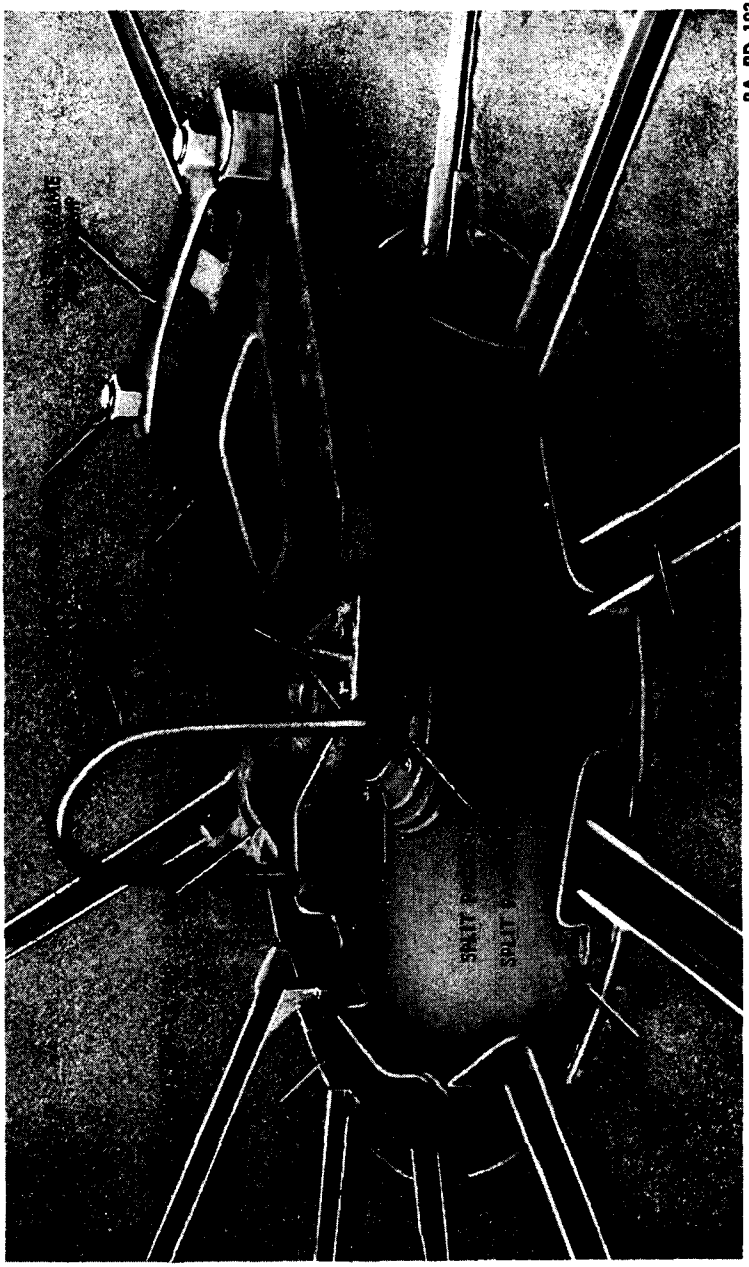

Figure 46 — Firing Platform — Bolster in Position

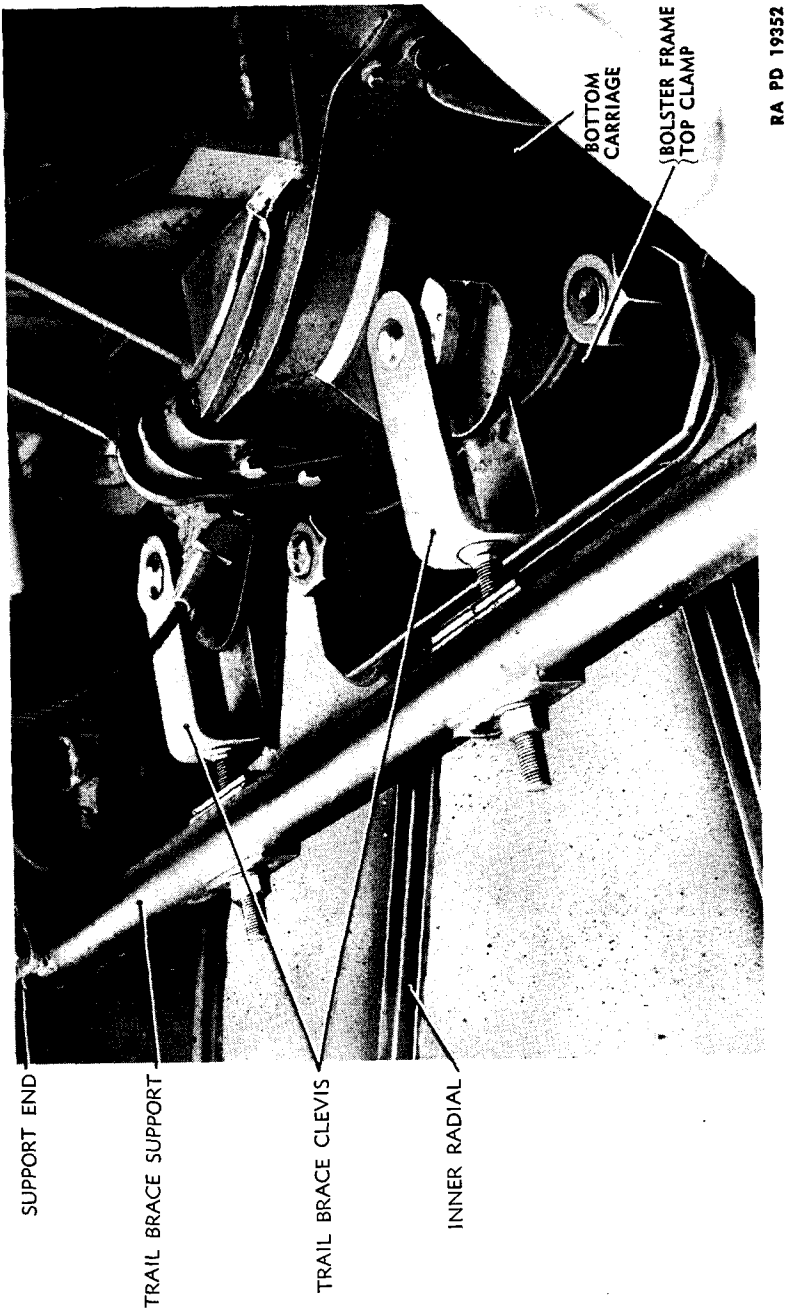

Figure 47 — Trail Brace in Position

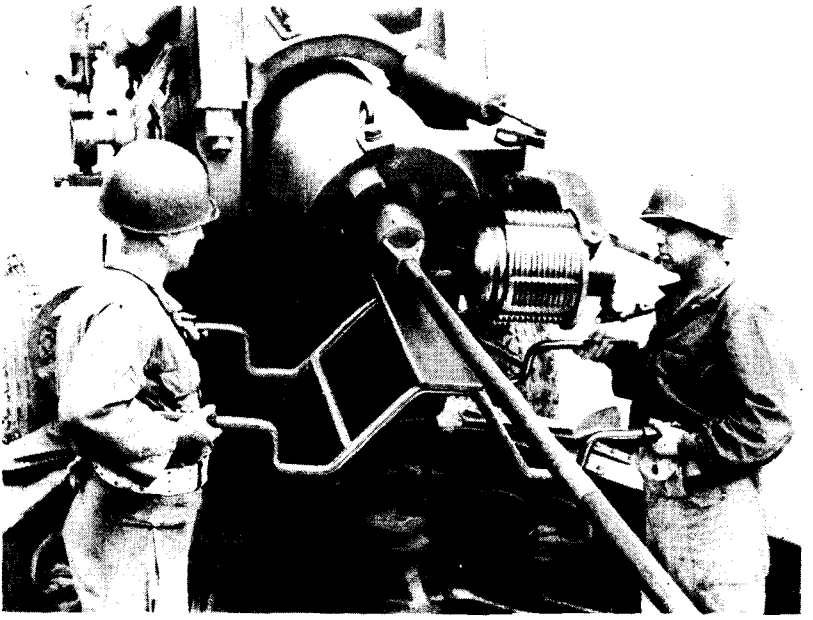

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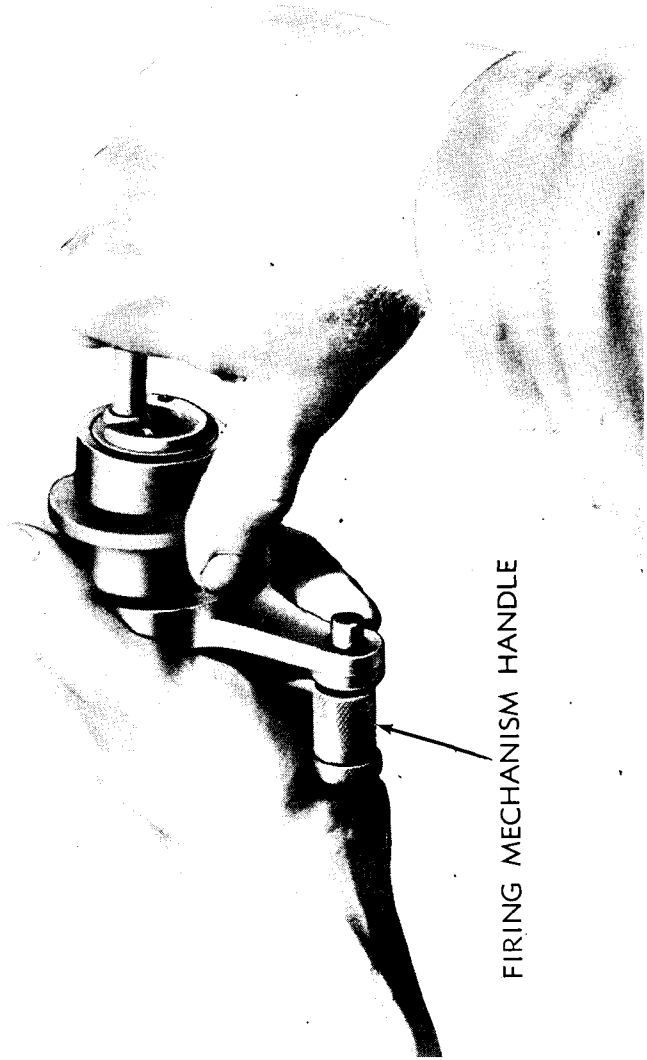
Figure 48 — Loading Projectile

mover winch should exercise care in powering the winch. The carriage will move forward a few feet during this operation.

(d) 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. Lock in place with eyebolt hinge pin (fig. 35). Lay eyebolt spacer piece in position, start wing nuts (fig. 34) and tighten securely, using a rawhide or copper hammer. Insert cotter pin. When eyebolt is securely in place, remove lifting sling from winch cable and attach sling to hook on the trail (fig. 33). Wind up winch cable.

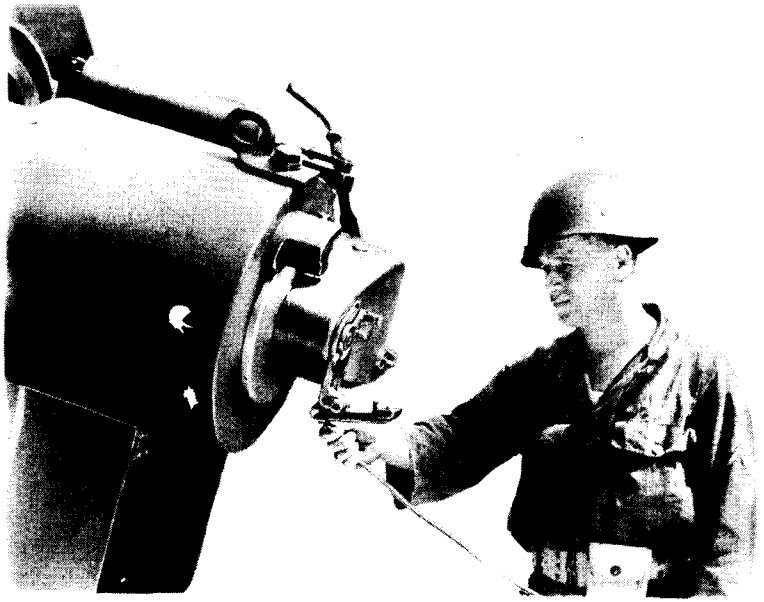
(2) INSTALL HEAVY CARRIAGE LIMBER M2. Move limber assembly into position at rear of trails with limber lifting mechanism screw between lock plates on trails. Run the limber lifting screw down by turning handle of limber lifting mechanism until guide arms are in guides. The elevating screw is then operated to raise the trails until they are in position in the spring supported seat and clamped there by lifting screw. Replace the lifting screw cover. Fasten the trail locking pins.

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 104388

Figure 49 — Sliding Primer Into Place in Firing Mechanism M1



RA PD 102386

Figure 50 — Attaching Lanyard to Percussion Hammer

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). Trails must be locked properly by trail locking pins (limber M2).

(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).

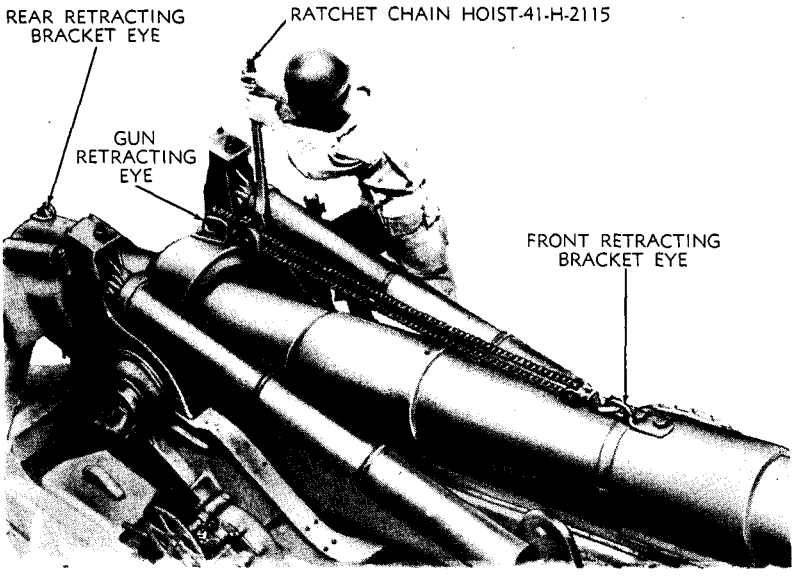
(4) Air hose must be installed properly and be free to turn with the limber.

e. Retracting the tube (fig. 51).

(1) Connect cradle lock to the cradle.

(2) Place gun traveling lock in position over brackets on trails. Lock in position. Attach traveling lock cable clevis to bracket on rear of bottom carriage. Secure clevis pin with cotter pin.

(3) Remove cotter pins, and nuts from counterrecoil and recoil piston rod ends. Pull barrel assembly to rear and lock it securely in place on traveling lock with locking pin. CAUTION: *The piston rod nuts must not be removed until cradle lock and traveling lock are in postion.* Replace the nuts and cotter pins on the recoil and counterrecoil rod ends.



RA PD 102398

Figure 51 — Retracting the Gun Into Traveling Position

f. Lock traversing mechanism by rotating the traversing brake handle clockwise.

g. Remove panoramic telescope from its mount and replace it in its carrying case.

h. Replace breech and muzzle covers.

24. TO PLACE THE GUN AND HEAVY FIELD CARRIAGE IN TRAVELING POSITION WITH THE FIRING PLATFORM M1.

a. For emplacing, dismantling, and storing the firing platform, see paragraph 27.

b. Remove push bar assembly. Remove yoke bar and bolster clamp from the bolster. Remove two nuts from rear bolster and remove the carriage clamp. Remove two rail sectors in order that the gun may be rolled out. Place gun in traveling position and tow away from firing platform. Remove bolts holding rail sectors together, and remove bolts that hold the outer radials to the rail sector. Remove rail sectors.

c. After the gun has been unclamped and dismounted from the bolster, further procedure for limbering up preparatory to travel and towing is the same as prescribed for the heavy field carriage (see par. 23).

25. TO PLACE THE GUN IN TRAVELING POSITION ON THE GUN MOUNT M13.

a. Fix tube position. Bring the weapon to a horizontal position in the center of traverse.

b. Clean and oil gun. Clean, thoroughly dry, and cover the bore, powder chamber, breech recess, breechblock, and firing mechanism with a thin coat of light oil; oil the top and bottom carriages. Lock the percussion hammer in traveling position.

c. Stow tools, equipment, and ammunition. Return sighting equipment, firing tools, and accessory equipment to their proper stowage position in chests, in brackets, and in clips on the vehicle. Store the ammunition, and close and store the powder containers.

d. Install gun covers. Install the breech, muzzle, and sight mount covers.

e. Fasten traveling lock. Unlatch and swing traveling lock up to a vertical position. Clamp upper half of lock around tube. Tighten nut. Tighten cradle traveling tie rods.

f. Raise spade. Move the vehicle forward to free the spade from the earth. Crank up spade winch, and lift spade to traveling position. Insert spade support arms through brackets and insert locking pins.

Section VIII

OPERATION OF AUXILIARY EQUIPMENT

26. GENERAL. Operation of sighting and fire control equipment is covered in section XXVIII.

27. FIRING PLATFORM M1.

a. General. The operation of the firing platform M1 consists of: emplacing the platform preparatory to mounting the gun and heavy field weapon in firing position upon it; dismantling the platform after weapon has been pulled off of it and stowing the platform for traveling.

b. Emplacement.

(1) Select a position for firing that is fairly level within a 37-foot diameter. Dig a circular pit 10 feet in diameter and 18 inches deep. Place long 8- by 8-inch timber support in approximate center of hole (figs. 52 and 53). Assemble saddle over timber and bolt short timber supports in place. Lower base ring in place over supports. Raise supports and aline bolt holes in timbers with holes in base ring. Bolt in place. To increase flotation in soft or sandy soil, place planks

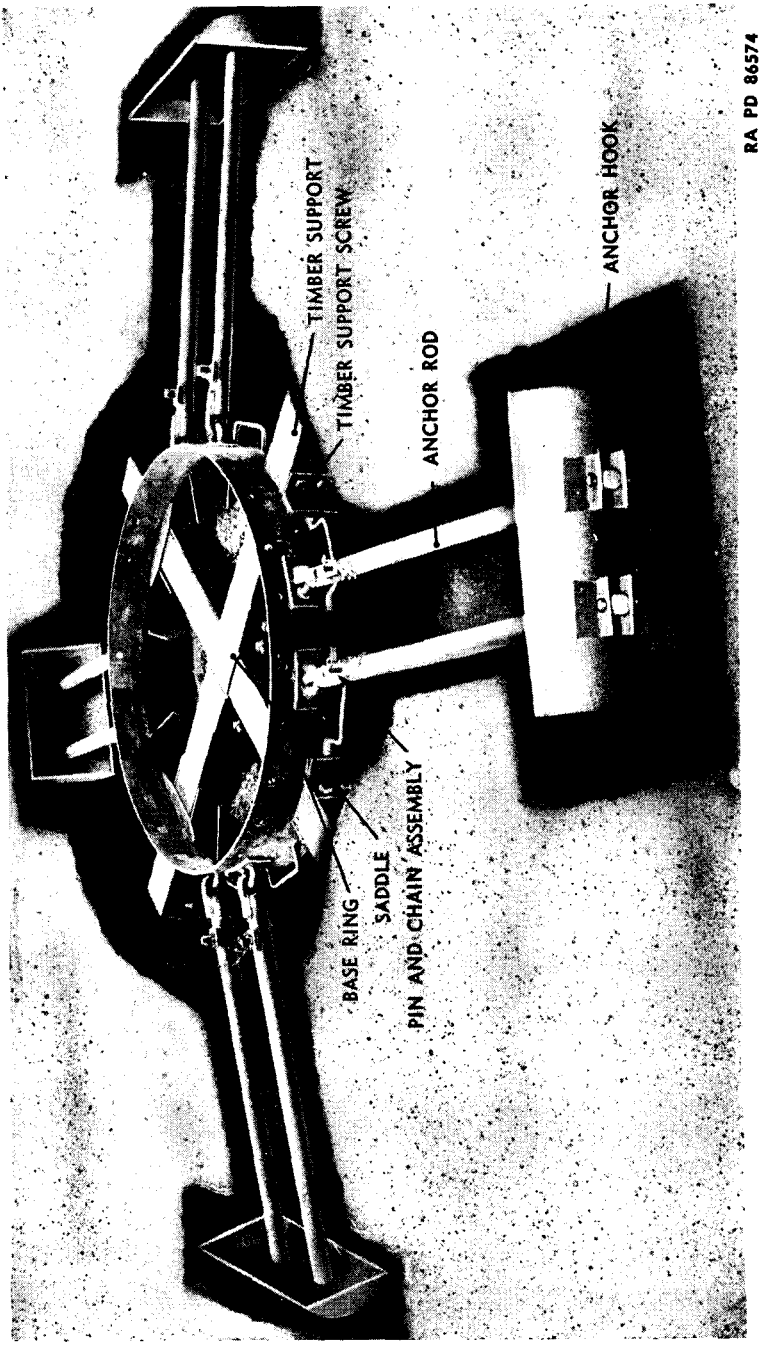


Figure 52 — Base Assembly

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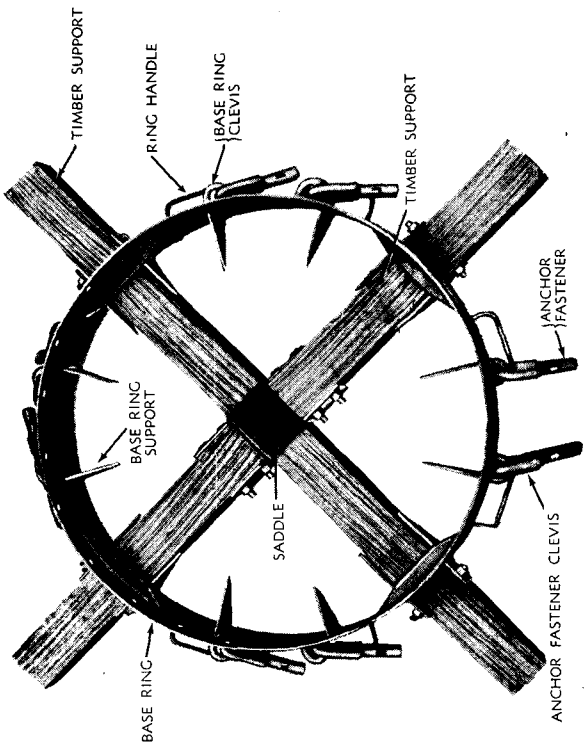
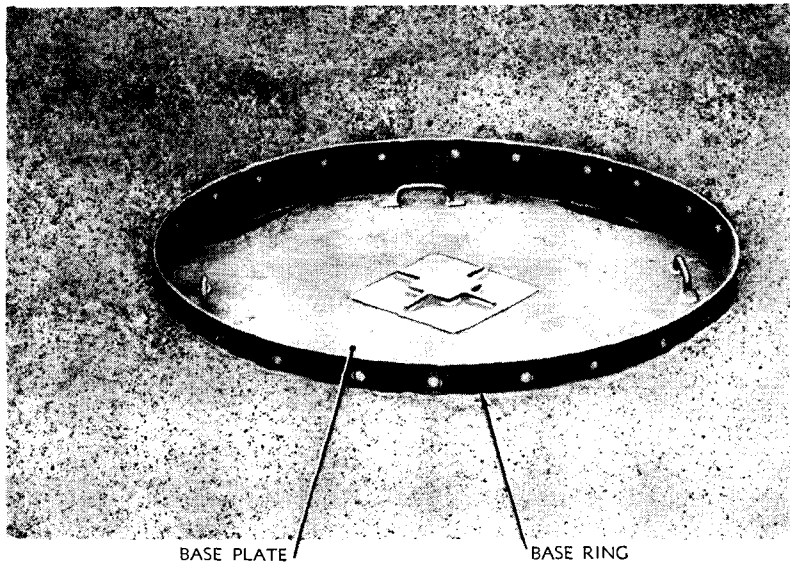


Figure 53 — Base Ring and Supports



RA PD 19347

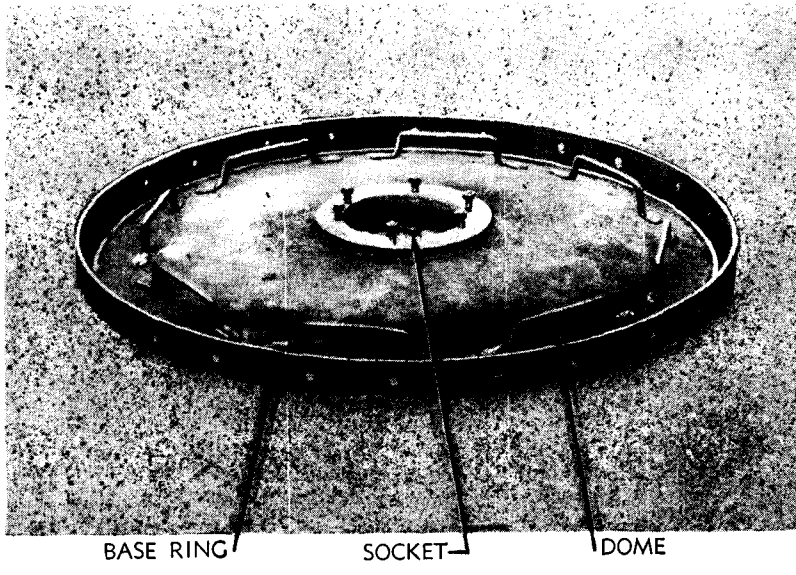
Figure 54 — Base Plate in Position

under the ends of the timber supports. Fill under the supports with dirt and tamp in solid. Fill in ring with dirt to the top level of the base ring supports and tamp level.

(2) Dig out four pits, large enough for the anchor hooks, 30 inches deep (fig. 52). Assemble anchor rods and anchor hooks. Assemble anchor rods to the anchor rod fasteners on the base ring. Insert pin and tap in place. Fill in around the outside of the base ring, and over the anchors with dirt and tamp until firm (fig. 54). Do not fill dirt in even with top of base ring. Room must be left for planks to fit under the inner radials.

(3) Lower base plate in position in base ring. Make sure the plate sits firmly on the timber supports. Place the dome assembly on top of the base ring (fig. 55). Lay planks around outside of base ring. Attach inner radials to top of base ring and bolt in place. The radials must rest on top of the planks. Remove the socket cover plate.

(4) Assemble the large split ring over the bolster ball (fig. 60). Place the split packing and packing ring on large split ring, and bolt in place. Lower bolster (fig. 61) into dome socket. Aline the holes in the split ring with the studs on the dome. Set the bolster ball completely in the socket. Fasten in place by tightening nuts on dome studs.



RA PD 19348

Figure 55 — Dome in Position

(5) Attach outer radials to inner radials (fig. 63) and bolt in place. Lay the rail sectors (fig. 66) in position and fasten together. Attach outer radials to rail sectors at point where sectors join (fig. 56).

(6) With two rail sector assemblies removed to permit entrance of carriage, back carriage into position and aline bottom carriage directly over bolster (fig. 45). The lower front spade supports must fit over the studs on the bolster, and permit the pivot blocks to be placed in position. Lower carriage on the bolster by raising bogie. During the operation of lowering the carriage, the gun and carriage may have to be maneuvered slightly to properly aline the bolster and bottom carriage. When bottom carriage is in position on the bolster, lower the trails from the limber. Place bolster clamps on bolster, and bolt in place. Drop yoke bar over bottom carriage and tighten locking nuts. Place pivot blocks in position in bottom front spade supports. Place bolster frame clamp over spade supports and lock with two nuts.

(7) Assemble remaining rail sections and attach remaining radial. Assemble trail clamps (fig. 62) and rubbing plates on rail sectors with hooked bolt on outside of rail. Slide trail clamps into the trail spade seats. Fasten with trail spade key.

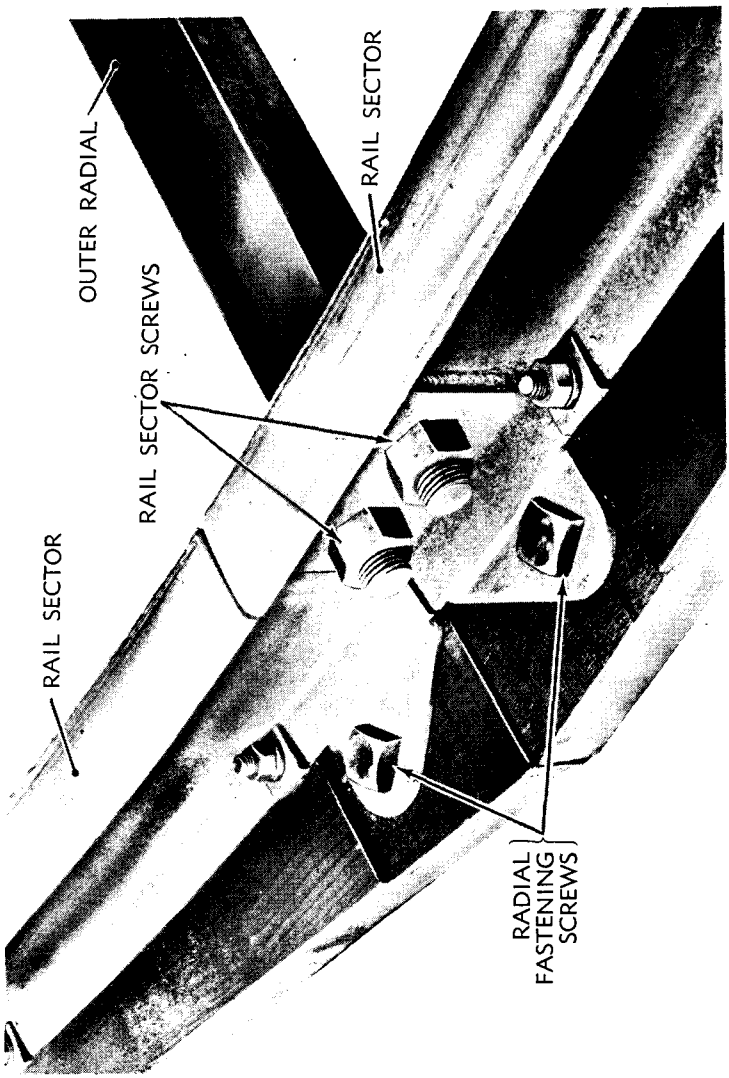


Figure 56 — Method of Attaching Radials

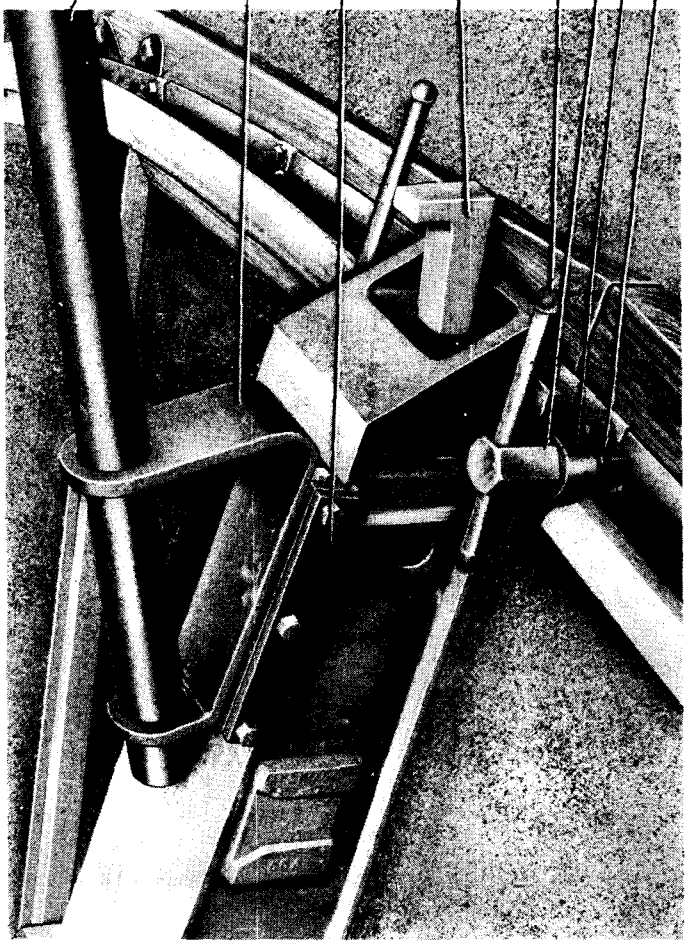


Figure 57 — Trail Clamp and Push Bar

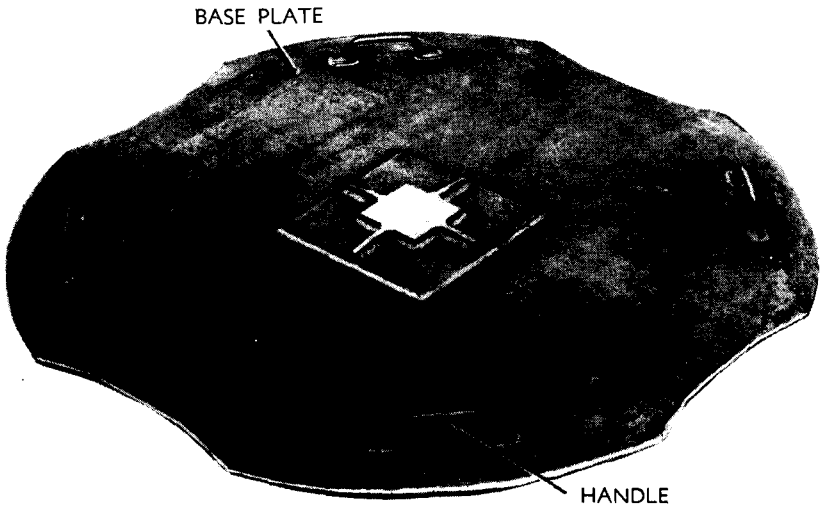


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Figure 58 — Base Plate

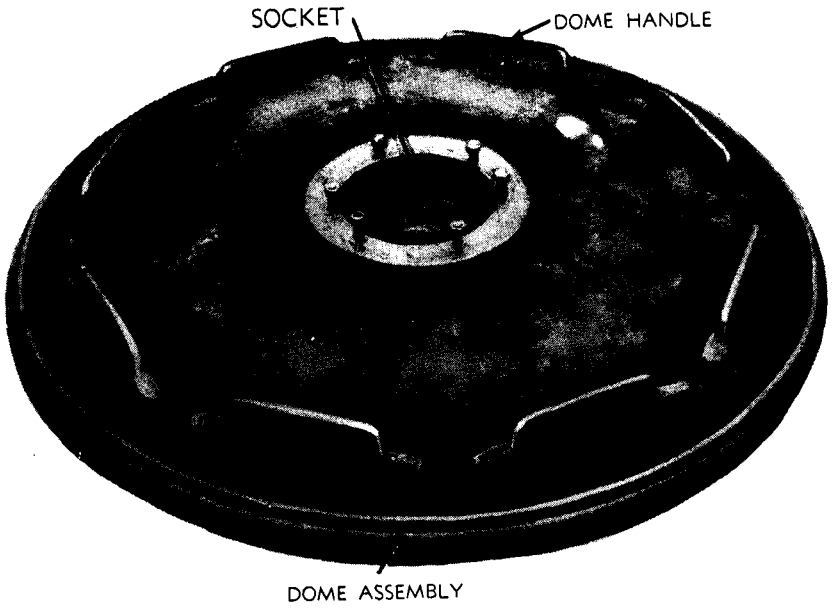

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Figure 59 — Dome Assembly

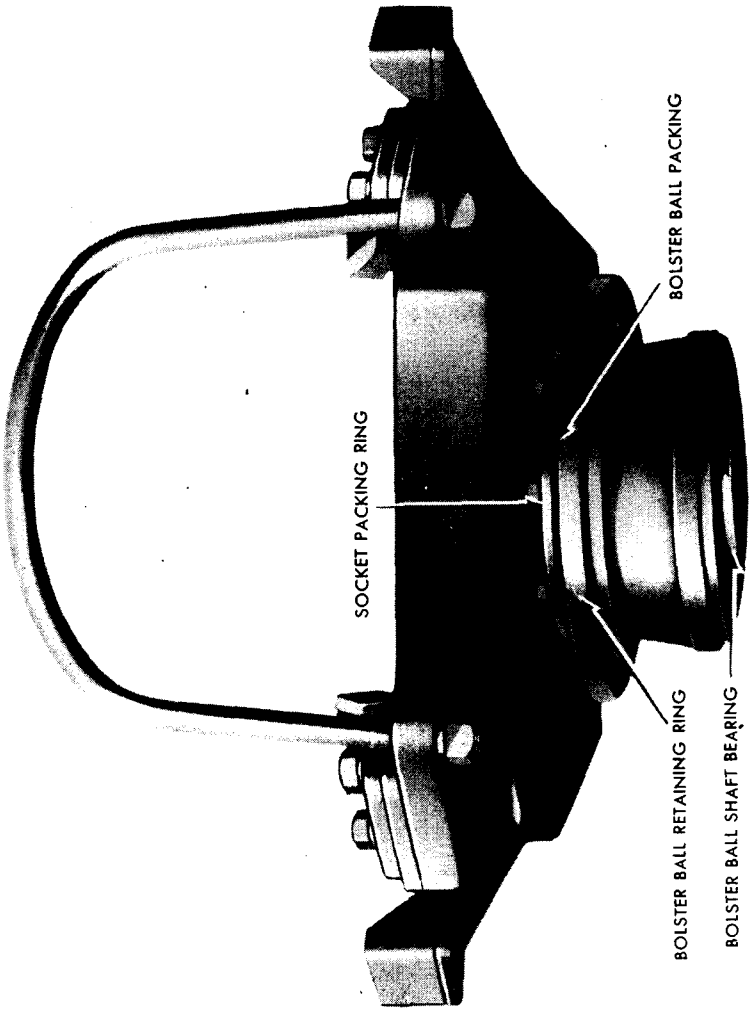
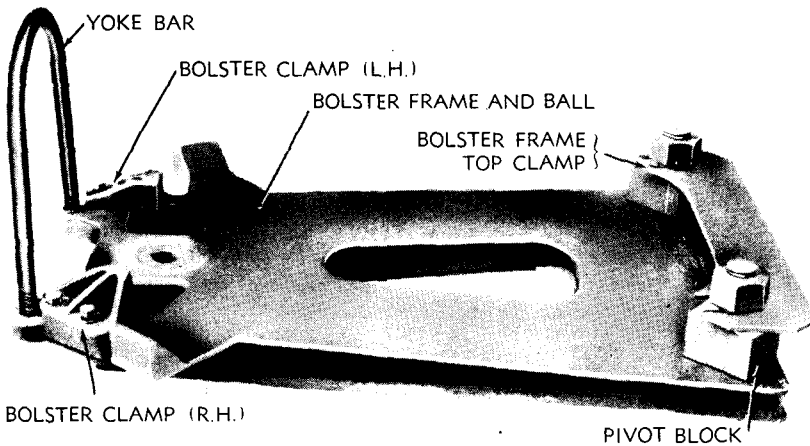


Figure 60 — Bolster and Bolster Ball Retaining Ring — Front View



RA PD 86547

Figure 61 — Bolster Assembly

(8) Assemble trail brace (fig. 64), and hook the trail brace clevises over the top front spade supports. Tighten up clevis nuts, making sure that the support ends engage the trails properly. Assemble push bar assembly (fig. 65) on end of trails. The push bar assemblies must have the clamp gib on the outside of the trails. Drive stakes around the outside of the rail sectors.

c. For mounting the gun and the carriage upon the platform, see paragraph 24.

d. Dismantling.

(1) Remove trail base locking nut and remove trail brace. Withdraw trail spade key. Loosen trail clamp assembly and slide out of trail spade seats.

(2) Remove push bar assembly. Remove yoke bar and bolster clamp from the bolster. Remove two nuts from rear bolster and remove the carriage clamp. Remove two rail sectors in order that the gun may be rolled out. Place gun in traveling position and tow away from firing platform. Remove bolts holding rail sectors together, and remove bolts that hold the outer radials to the rail sector. Remove rail sectors.

(3) Disconnect inner and outer radials. Remove inner radials from the base ring. Remove planks that support inner radials. Remove nuts from the dome studs that hold the large split ring in position. Remove screws from the large split ring, and remove the small split ring and split packing. Lift out bolster. Lift dome assembly out of base ring (fig. 59). Lift out base plate (fig. 58).

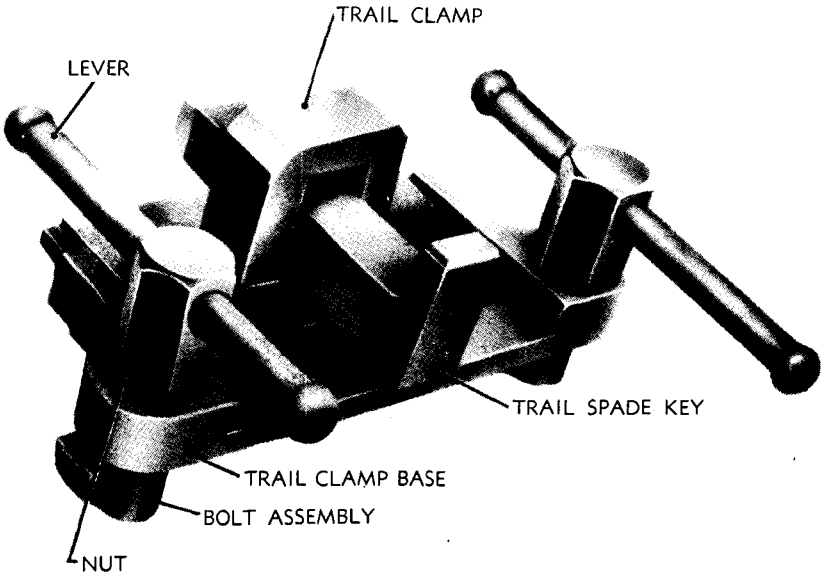


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Figure 62 — Trail Clamp Assembly

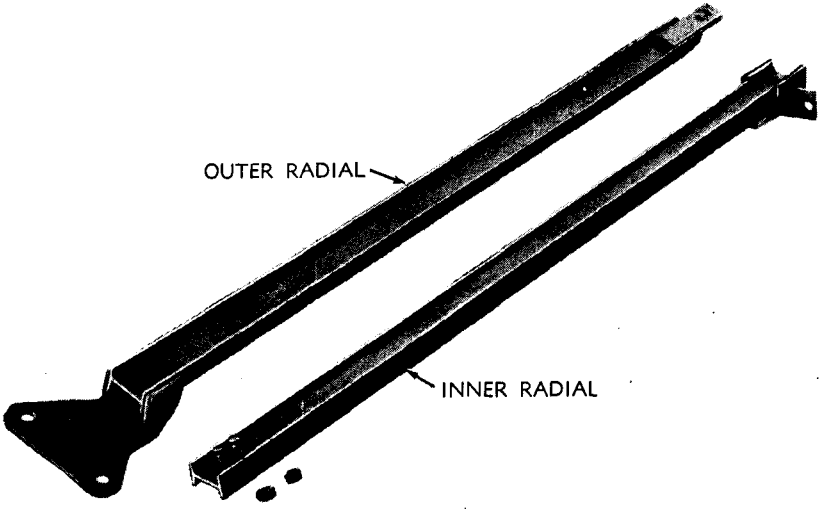

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Figure 63 — Radials

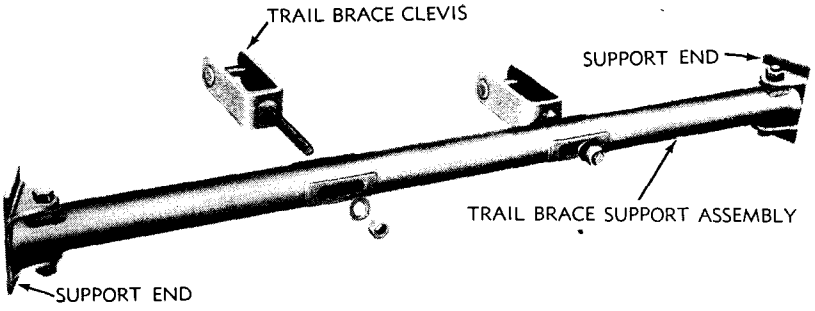

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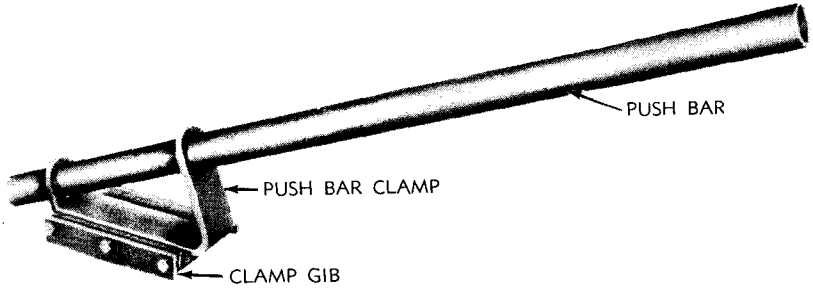
Figure 64 — Trail Brace Assembly — Exploded View



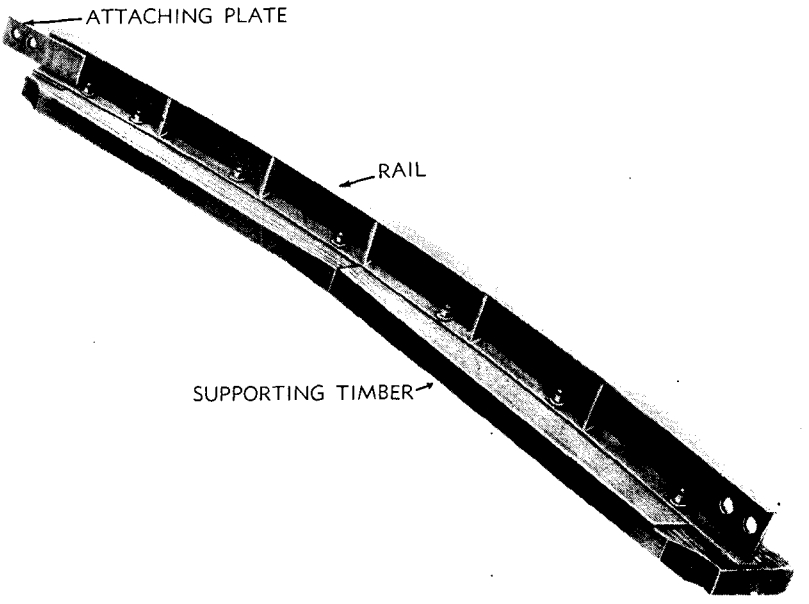
RA PD 19349

Figure 65 — Push Bar Assembly

(4) Dig out anchor rods, anchors, and timber supports. Withdraw anchor rod locking key and remove anchor rods and hooks. Remove timber support screws in base ring and lift base ring off the timbers. Unbolt short timbers from the saddle. Remove timbers and saddle. Remove long timber support.

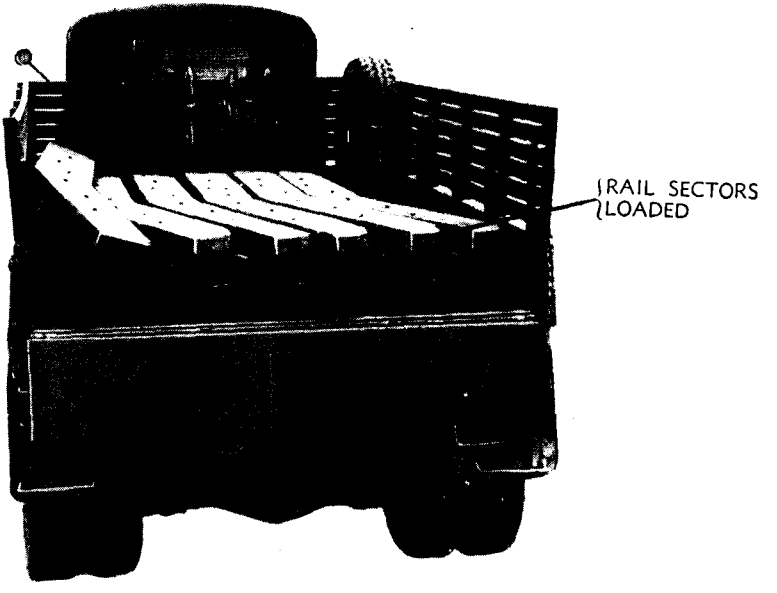
e. Stowage.

(1) The following illustrations (figs. 67 and 68) show a method of stowing the materiel on a 6-ton, 6 by 6 truck. The Mack 7½-ton, 6 by 6 is normally used as the prime mover and the load may be spread out more, due to a larger load capacity. The tail gate should be closed before traveling is attempted, to prevent the load from working out. No dunnage is required with the exception of planks under the base ring to keep the ring from bearing on the rail sector. The platform stowage as shown on figures 67 and 68 is satisfactory for primary and secondary roads. Greater care should be taken to prevent damage to the base ring when cross-country travel is attempted. A 4-ton, 6 by 6 cargo carrier can also accommodate the firing platform M1 with the truck trail gate closed.



RA PD 19339

Figure 66 — Rail Section



RA PD 22425

Figure 67 — Rail Assembly Loaded (6-ton, 6 x 6)

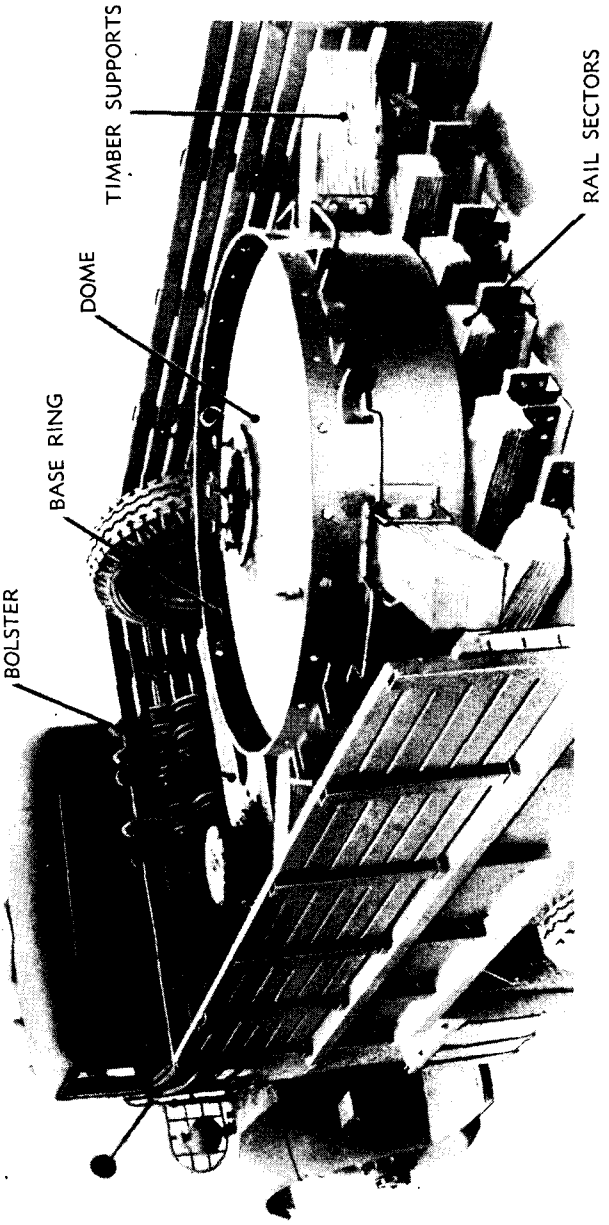


Figure 68 — Dome and Bolster Assembly Loaded (6-ton, 6 x 6)

(2) Storage of the anchor rods, anchor hooks, radials, push bar assemblies, and trail clamps are not shown. These parts may be stowed in any manner to prevent shifting or bouncing during transit. Proper procedure is left to discretion of personnel responsible for transporting materiel.

Section IX

OPERATION UNDER UNUSUAL CONDITIONS

28. GENERAL. When operating the materiel under unusual conditions such as extreme high temperatures, extreme low temperatures, severe dust, sand, or near salt water, the precautions given in this section must be followed. For lubrication instructions see section XIII.

29. COLD WEATHER.

a. General.

(1) Operation of the 155-mm materiel at subzero temperature presents problems that demand special precautions and careful servicing by using organizations and maintenance personnel to avoid poor performance and/or total functional failure, and, in some instances, damage to both materiel and personnel.

(2) Artillery will operate efficiently if the instructions contained herein are following when temperatures below 0° F prevail or when sluggish or stiff operation of materiel indicates the advisability of adopting them at higher temperatures.

b. Mechanical condition of materiel.

(1) Since metals contract when the temperature decreases, and expand when the temperature increases, the clearance between bearing surfaces is considerably less at subzero than at higher temperatures. In preparing artillery for subzero temperature operation, care must be taken to make certain that parts are alined properly and normal clearances exist, not only in bearings but also in mechanisms employing packings around rotating or reciprocating shafts and rods. Lack of attention to this may result in binding which will make mechanisms stiff or inoperative regardless of the lubricant used. Scored or roughened bearings and other rubbing surfaces, such as cams and recoil slides also interfere with easy action and should be smoothed in preparing artillery and fire control materiel for low temperature operation.

(2) Cleanliness is imperative. Rust, dirt, gummy oil, and grease in bearing clearances reduced by low temperature, interferes with proper distribution of lubricant, thus causing stiff action, if not complete stoppage. In "winterizing" materiel, therefore, assemblies and

mechanisms must be disassembled sufficiently to permit thorough removal of oil, grease, and foreign matter. Cleaning is most efficiently done by washing with dry-cleaning solvent, employing brushes and scrapers where necessary. Care must be taken not to overlook cleaning small items that may appear insignificant. Field experience has proved that neglect in cleaning small linkages, bearings, and other similar parts often causes malfunctioning and stoppages in subzero weather.

(3) Placing of materiel in proper mechanical condition requires time for necessary disassembly, repair, and cleaning and must be carefully done. The approach of low temperatures must be anticipated far enough in advance to permit ordnance maintenance personnel sufficient time to make necessary disassembly and assembly and to complete conditioning before onset of subzero temperatures.

c. Low temperature lubrication.

(1) Lubricating oils stiffen progressively, as temperature falls, until a point is reached at which they solidify. As stiffness increases, the power required to move surfaces of bearings and gears in contact with the oil multiplies rapidly, until movement becomes impossible. When solidification occurs, the moving parts cut a channel through the oil, leaving the rubbing surfaces dry and unlubricated. Before friction can develop sufficient heat to liquefy the oil and reestablish an oil film, bearing and gear tooth surfaces may score and cause complete failure of the mechanism. Similar action takes place where rubbing surfaces are fed by an oil pump. The stiffened oil flows too slowly, or not at all, to the pump inlet, and the oil already in the feed lines cannot be forced to the bearings. Oils prescribed for use in artillery materiel at high temperatures must be designed to maintain adequate body at those temperatures and, in most instances, they become too stiff at low temperatures to permit satisfactory operation. Oils must therefore be completely replaced in cold weather with lighter oils which will remain fluid at the lowest expected operating temperatures.

(2) The proper lubricants to be used for cold weather operation are prescribed in the lubrication orders, figures 72 and 73.

d. Low temperature operating instructions.

(1) EMPLACING. When emplacing a weapon, it is well to coat all metal parts which come in contact with the snow or ground with a film of grease. This will prevent freezing to the ground and will facilitate moving the mount to the traveling position. Firmly rolled or compacted snow will provide a satisfactory emplacement. Digging of the recoil and spade pits will be difficult. It may require chopping of the frozen ground to get started.

(2) TRAVEL. Before starting a road trip, a thorough inspection of the weapon should be made. Provide as much protection to all

parts as possible. Be sure all covers are properly assembled and securely lashed. If the gun cover is not adequate, cover exposed portion with available materiel. Suspension assemblies will be stiff, therefore, more care than normal should be emphasized when traveling over rough terrain. Tires cannot be expected to take the abuse in extremely cold weather that they would under former conditions.

(3) CARE. All mechanisms should be exercised frequently. Traversing and elevating of the gun will be extremely helpful in reducing handwheel efforts. Exercising of the suspension systems will help to keep those parts from freezing. Periodic and frequent inspection to prevent snow and ice collecting on moving parts will result in keeping the gun in service. Always use gun covers and shelter, where possible, to provide the maximum protection for the gun and mount. These points cannot be overemphasized: clean all parts thoroughly, lubricate sparingly, guard against collection of snow and ice, leave no metal surfaces exposed without a protective film of lubricant, and if there is evidence that materiel is "sweating," dry thoroughly, clean, and renew lubricant film.

(4) GUN COVERS. Whenever the weapon is to remain idle for a period of time, care should be taken to secure the gun covers for protection of the weapon. Wind will drive the snow up under the gun covers unless they are securely fastened. This will result in formation of ice, which renders the gun inoperative.

e. Gun bore cleaning.

(1) If the tube can be cleaned while hot, rifle bore cleaner may be used in the normal manner as prescribed in paragraph 58, or if this cleaner is not available, normal soda-ash or soap solutions may be used. Cleaning a cold tube below a temperature of +32° F cannot be accomplished in the normal manner, due to freezing of the cleaner in the tube. Under such conditions cleaning should be done with the normal soda-ash or soap solutions which are prevented from freezing by the addition of alcohol, or as an emergency alternative, glycerine or antifreeze compound (ethylene glycol type). To 10 parts by volume of soda-ash or soap solution add the number of parts of one of the antifreezes shown below:

CAUTION: *Do not add these antifreezes to rifle bore cleaner.*

Temperature, °F	Alcohol	Glycerine	Antifreeze Compound
20	2	2½	2
10	4	5	3⅓
0	6½	6½	5
–15	9	10	7¼
–30	16	13	10
–40	27	16	12

(2) 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. When gun is brought into a heated shop, condensation will occur on all metal surfaces. After the gun reaches shop temperature, the tube and all other bright parts must be wiped dry and recoated with oil to prevent rusting.

(3) When materiel is protected with a canvas or other type cover, moisture will form on the metal surfaces. To prevent rusting, the cover must be removed at least weekly and all surfaces thoroughly dried and coated with oil.

f. Breech assemblies.

(1) CLEANING AFTER FIRING—COLD WEATHER.

(a) Cold weather necessitates a very thorough cleaning of breech mechanism after firing. CAUTION: *Be extremely sure all traces of snow and ice are removed.*

(b) Care during inactive periods. Temporary inactive periods necessitate preservation of breech mechanism and also preparation for almost instant use. After cleaning the breech assembly and while the mechanism is still disassembled, apply a light, thorough coat of oil. It must be kept in mind that less preservative is needed for protection against corrosion in cold weather than normally. A thin film of oil is adequate. Daily inspections are mandatory.

g. Recoil mechanisms.

(1) Care of recoil mechanisms will be for the most part the same as for normal conditions. Using units must maintain their careful check as prescribed for ordnance publications. Should any difficulties arise, notify ordnance maintenance personnel immediately, as delaying notification may lead to further difficulties. At times the recoil mechanism may not function properly and the cycle of recoil may take longer than necessary. This is brought about by the oil becoming thick and not flowing as rapidly. As further firing is conducted, the mechanism gradually heats up the recoil oil and thins it out so that a normal cycle of time is then obtained. Do not condemn the recoil mechanism until definite proof of malfunction has been made. Should this condition arise, notify the ordnance maintenance personnel.

(2) CRADLE AND GUN SLIDES. Thickened or congealed lubricant increases this friction, shortens recoil, and retards counterrecoil. Heavy or congealed lubricants will be removed from all exposed parts of the rails and slides when the gun is retracted.

h. Equilibrators. Lubricate as prescribed in War Department Lubrication Order (fig. 72). The piston rod should be kept well lubricated to prevent formation of ice which would freeze it in posi-

tion. It may be necessary to adjust nitrogen pressures to provide sufficient equalizing action. Upon return to temperatures above 0° F, gas pressure should be adjusted to the prescribed value.

i. Care and maintenance of top and bottom carriage.

(1) GEAR TRAINS.

(a) Extreme care should always be observed when lubricating the gear trains of the elevating and traversing mechanism. If care is not taken to follow lubrication instructions, malfunctions may require complete overhaul by ordnance.

(b) Condensation caused by rise in temperature must not be allowed to collect on shafts and bearings or it will result in the freezing of shafts where they enter the housing. CAUTION: *The importance of a light coat of lubricant on gear trains cannot be overemphasized.*

(c) Gear trains on all top carriages will be the most critical problem in lubrication. Winterization must be done by ordnance units as complete disassembly is required. Lubrication orders should be consulted for correct lubricant. When gear trains are winterized, only the bearings should be repacked and the gears coated. Additional lubrication must be sparing. Overlubrication will result in increasing handwheel effort to the point where operations will be hindered.

(2) BEARING SURFACE OF TOP CARRIAGE.

(a) Winterizing the bearing surface of the top carriage requires complete disassembly. Thorough removal of all old lubricant from bearing surface should be performed with dry-cleaning solvent. Be sure that all old lubricant is removed before applying prescribed lubricant. Use a light coat as overlubrication will result in difficult traversing.

(b) Trunnion and trunnion seats. Trunnion and trunnion seats should be given special attention. Bearings that are enclosed should be thoroughly cleaned. Lubricate sparingly, as overlubrication will result in difficult elevation.

(c) Make certain that drain holes provided in top and bottom carriage are kept open and that ice or snow is not permitted to gather inside the carriages.

j. Elevating and traversing arcs.

(1) Elevating and traversing arcs should be lubricated very sparingly. Snow will frequently collect on these parts. This will cake under pressure of the gears, forming ice which interferes with elevating and traversing. The snow must be removed by vigorous brushing with a stiff-bristle or wire brush before manipulation of the piece is attempted. Elevating and traversing arcs are difficult problems in heavy snowstorms. The importance of keeping them clean and protected as much as possible cannot be overemphasized.

(2) At every opportunity during fire, the elevating rack should be inspected and cleaned of any snow that may have accumulated. After use, elevating rack should be thoroughly cleaned of oil and snow and relubricated.

(3) INSPECTION OF TOP AND BOTTOM CARRIAGE. Because of the small amount of lubricant used, inspection may be made daily to assure all parts having a coat of lubricant. Failure to follow this procedure will result in an unserviceable weapon.

k. Care and maintenance of bogie and limbers.

(1) WHEEL BEARINGS. Packing of wheel bearings must be done with the utmost care. A tendency to overpack them is predominant. This promotes freezing of 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. At no time leave any of the old lubricant on the bearings or any of the dry-cleaning solvent, as this contaminates the new lubricant that is being applied. NOTE: *Precaution must be taken not to handle the bearing with bare hands, as the moisture from the skin will corrode the bearings.*

(2) CARE AND MAINTENANCE OF TIRES.

(a) Special care of tires must be maintained in cold weather at all times. Check air pressure frequently and keep tread free of ice. Rubber becomes stiff in cold weather and is easy to damage. When a weapon is emplaced for a long time, tires will develop a flat surface at the point of contact with snow or frozen ground. Care should be maintained in traveling with the weapon that the speed be held at a minimum until the tire has regained its original shape.

(b) To avoid tires developing flat surfaces, it is a good policy to have the weapon bearing on its bottom carriage with the bogie wheels raised whenever it is inactive.

(c) Special care must also be maintained with air brakes. Rubber air hose becomes very brittle and careless handling causes them to break or crack. This must be avoided, as complete failure of the brakes will result. Sharp bends should be avoided.

(3) CARE AND MAINTENANCE OF BRAKES.

(a) Air Brakes. Drain air tanks of the weapon after use. This will blow out moisture formed by compressed air and will prevent freezing of lines and brakes. If brakes are frozen, notify ordnance maintenance personnel immediately. CAUTION: *Care should be maintained in connecting air hose to prime mover to prevent cracking or breaking when bends are too sharp.*

(b) Mechanical brakes. Care should be maintained that proper lubrication is applied to all connections and joints. Wheel chocks

should be used in preference to setting brakes when the gun is parked. CAUTION: *When lubricating brake parts, keep lubricant away from inside of drums or shoes.*

(c) Brake shoes. Keep brake shoes as dry as possible. Make a thorough check of brake shoes whenever checking the wheel bearings.

30. HOT DRY CLIMATES.

a. In hot dry climates, inspect, clean, and lubricate more frequently than prescribed under normal operating conditions.

b. Clean and lubricate as soon as possible after firing or if there is any reason to expect corrosion to start.

31. SEVERE DUST OR SAND CONDITIONS.

a. If considerable dust or sand is present when the gun is operated, all lubricants on the traversing and elevating arcs and pinions should be removed. Lubricants contaminated with dust or sand are more harmful than no lubricant at all.

b. Clean thoroughly when firing is over, and relubricate.

32. HIGH HUMIDITY, EXTREME MOISTURE, AND SALT WATER.

a. Preservative lubricating oil (medium) will be used in lieu of engine oil at all temperatures above 0° F for application to all external unpainted metal surfaces, including the bore and breech and firing mechanism, on which a film of lubricant is maintained by manual application. Preservative lubricating oil (medium) will also be used for lubrication of oil can points for which engine oil is prescribed.

b. The bore of the tube and the breech mechanism should be kept heavily oiled and should be inspected daily for traces of rust.

c. In excessively salty conditions, the bore and breech mechanism should be inspected daily for traces of rust, and the oil should be changed often as the salt has a tendency to emulsify the oil and destroy its rust-preventive qualities.

33. REPORTS AND RECORDS.

a. Reports. If instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, a report will be made to the ordnance officer responsible for the maintenance of the materiel.

b. Records. A complete record of seasonal changes of lubricants and recoil oil will be kept in the Artillery Gun Book for the materiel.

Section X

DEMOLITION TO PREVENT ENEMY USE

34. GENERAL.

a. The destruction of the materiel, 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 materiel from reaching enemy hands.

b. Adequate destruction of artillery materiel 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 materiel must be damaged.

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

(3) The same parts must be destroyed on all materiel, 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 importance come the recoil mechanism, sighting and fire control equipment, carriage, tires, gun book, and firing tables.

35. 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 material, 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) SIGHTS. Detach all optical sights. If evacuation is possible, carry the sights; if evacuation is not possible, thoroughly smash the sights.

b. Method No. 1 — destruction of tube, breech, and recoil mechanism.

(1) Open drain plug on recoil mechanism, allowing recoil fluid to drain. It is not necessary to wait for the recoil fluid to drain completely before firing the cannon in step (4), below.

(2) Place an armed (safety pin removed) antitank grenade M9A1, HE, 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 HE complete round or HE shell with propelling charge into the cannon and close the breech. Base-detonating HE shell cannot be used in this method.

(4) Fire the cannon, using a lanyard at least 100 feet long. The person firing should be under cover to the rear of the piece and approximately 20 degrees 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 in the bore, near the muzzle and in the chamber of the cannon. Close the breechblock as far as possible without damaging the safety fuse. Plug the muzzle tightly with earth to a distance of approximately 3 calibers from muzzle. Detonate the TNT charges simultaneously. Thirty to fifty half-pound blocks will be needed for effective demolition. If it is not possible to plug the bore, a larger number of TNT blocks will be needed for effective demolition.

(2) Ram an HE 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 fuse should be used to permit personnel to reach safety zone or cover. The fuse may be routed through the primer hole in the spindle.

(3) Attention is invited to the fact that, for the larger calibers, the number of blocks to be used is an estimate not proved by tests.

d. Method No. 3.

(1) Place unfuzed incendiary grenades M14, on their sides, one on top of another, in the chamber. Close the breech. Equip another incendiary grenade with a 15-second safety fuse, ignite, and toss it in the muzzle. Quickly elevate the cannon to its maximum elevation. Elapsed time: 3 to 5 minutes. Six to eight grenades per cannon are required.

(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 HE or AP 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 250 yards.

(2) Detroy 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 XI
GENERAL

36. 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 description of the major systems and units and their functions in relation to other components of the equipment.

37. CLEANERS AND PRESERVATIVES. The following cleaning and preserving materials are required for use with this materiel. Additional information to that included in this manual with regard to use of these materials is contained in TM 9-850.

ALCOHOL, ethyl, grade 1
BRUSH, artist, camel's hair
BURLAP, jute, 8 oz (40 in. wide)
CHALK, white, railroad (1 x 4 in.)
CLEANER, rifle bore
CLOTH, abrasive, aluminum oxide
CLOTH, crocus
CLOTH, wiping, cotton
NAPHTHALENE, balls
NEEDLE, sacking
OIL, neat's-foot
PALM, sailmaker's
PAPER, flint
PAPER, lens tissue
REMOVER, paint and varnish
SOAP, castile
SOAP, liquid, lens cleaning
SOAP, saddle
SODA-ASH
SOLVENT, dry cleaning
SPONGES, cellulose or natural
TWINE, jute
WASTE, cotton (2 grades, colored and white)

Section XII
SPECIAL ORGANIZATIONAL TOOLS AND EQUIPMENT

38. GENERAL. Following is a list of accessories issued per firing battery of 155-mm guns, mounted on the 155-mm gun carriage M1.

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
ADAPTER, S. (plug), oil filling, recoil mechanism, diam. hex. head ¾ in., over-all length 1 1/16 in.	70	41-A-26-500	—
CAP, oil screw filler (gun)	70	41-C-395-625	—

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
CHEST, oil pump, wood, S. reinforced, w/contents		41-C-738-540	For filling recoil system.
(Composed of:			
1 CHEST, oil pump, wood, S. reinforced, w/o contents, M16 (41-C-738-550)	70		
1 FUNNEL, copper, w/o strainer, cap. ¼ pt. (41-F-3580)	70		
1 HOSE, gasoline and oil, nonmetallic, high temp. resisting, complete w/couplings, length 120 in., ends threaded ¼ in.-18NPT and ⅛-27NPT (33-H-535)	70		
1 PUMP, hydraulic, oil M3 (11-P-575-300)	70		
1 RULE, S., flexible, length 30 cm, grad. one edge mm, other 64ths (41-R-2909)			
1 TUBE and CONNECTIONS, oil pump, M3 (44-T-3197)			
1 WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of opngs. ¾ x 13/16 in. (41-W-1012))	70		
CHEST, tool, empty, metal, Ordnance design, w/o partitions, inside height, in. 11 1/16, inside width, in. 13¼, inside length, in. 28⅞, material S.	18	41-C-857-330	—
CHISEL, machs., hand, cold, width of cut ¾ in., length 8 in.	20	41-C-1124	—
CYLINDER, gas, filled, compressed gas, M1, O.D. 9 1/16 in., length 56 3/16 in.	20	51-C-2255	For adj. equilibrator pressure.
DRIFT, brass, taper, diam. of pt. 5/16 in., diam. ½ in., length 4 in.	20	41-D-1530	—
DRIFT, brass, rd., taper, diam. of pt. ½ in., diam. ¾ in., length 6 in.	20	41-D-1533	—
FILE, A.S., hand, cut second, length point to shoulder 8 in.	20	41-F-1016	—
FILE, A.S., three square, cut smooth, length point to shoulder 6 in.	20	41-F-1572	—

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

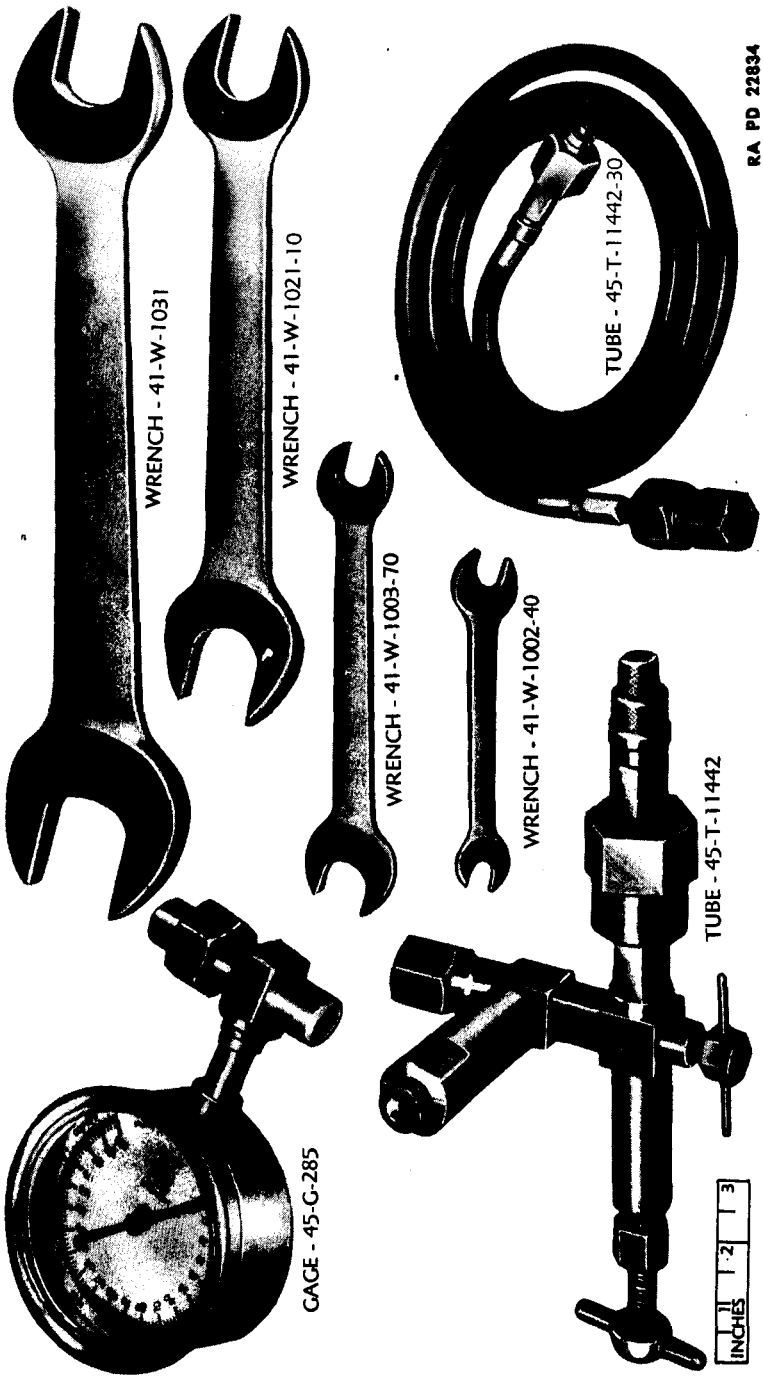


Figure 69 — Organizational Tools and Accessories

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
GAGE, pressure, metal case, hydraulic, master assembly, size of dial 4½ in., pressure 200 kg. (graduated in lbs, and in kg. per sq. cm)	69	45-C-285	—
GAGE, tire pressure, piston type, balloon type, range 10 to 60 in one-lb. units, 60 to 160 in five-lb. units (sgle.-ft.)	21	8-G-357	—
HAMMER, hide faced, diam. of face 1¾ in., weight 2 lb	16	41-H-473	—
HAMMER, machs., ball peen, weight ½ lb		41-H-521	—
HAMMER, machs., ball peen, weight 1¼ lb	20	41-H-524	—
HANDLE, file and tool, wood, med., diam. of hand grip 1¼ in.	20	41-H-1116	—
HANDLE, wheel bearing adj. and wheel stud nut wrench, diam. ¾ in., length 20 in.	19	41-H-1541	Used w/socket wrench for wheel stud nuts.
HOSE, tire inflating complete w/single ft. chuck and air brake coupling, I.D. ¼ in., length 25 ft	71	33-H-986	—
PLIERS, side cutting, flat nose, length over-all 8 in.	20	41-P-1977	—
PUNCH, drift, tapered, diam. ¼ in., length 10 in.		41-P-3538	—
PUNCH, drive pin, standard, diam. of pt. ⅛ in., over-all length 4 in.	20	41-P-3602	—
PUNCH, drive pin, standard, diam. of pt. ¼ in., over-all length 4 in.	20	41-P-3606	—
RELEASE, filling and drain valve		45-R-3649	—
RELEASE, gage, pressure, filling and drain valve	70	45-R-3650	—
ROLL, tool, canvas, empty, M4, size 26 x 30 in.	20	41-R-2705-5	—
ROLL, tool, canvas, empty, M16, No. 4 cotton duck, 26½ x 25⅜ in., w/10 pockets, 1½ to 3⅛ in. deep	18	41-R-2705-41	—
SCREWDRIVER, common, normal duty, sgle. grip, length of blade 6 in., width of blade 5/16 in.	20	41-S-1104	—

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

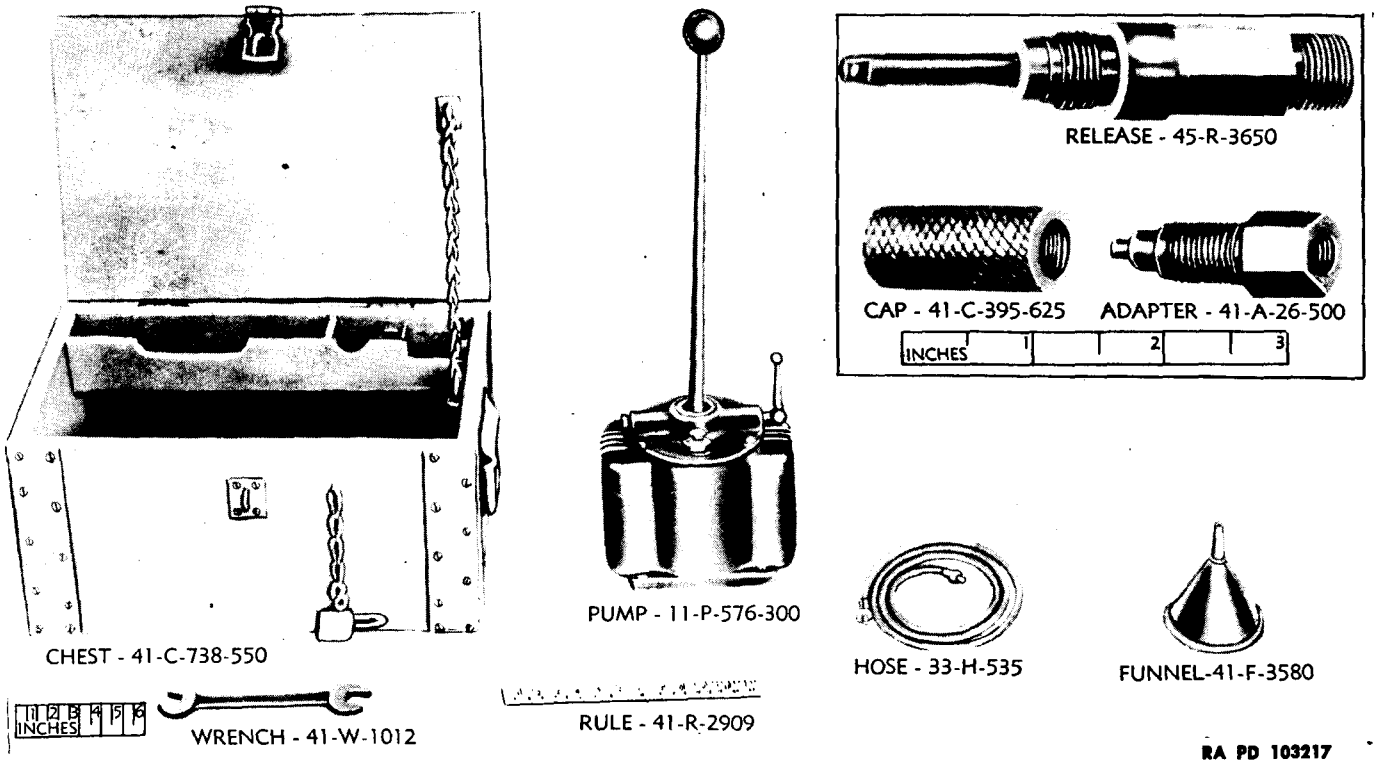
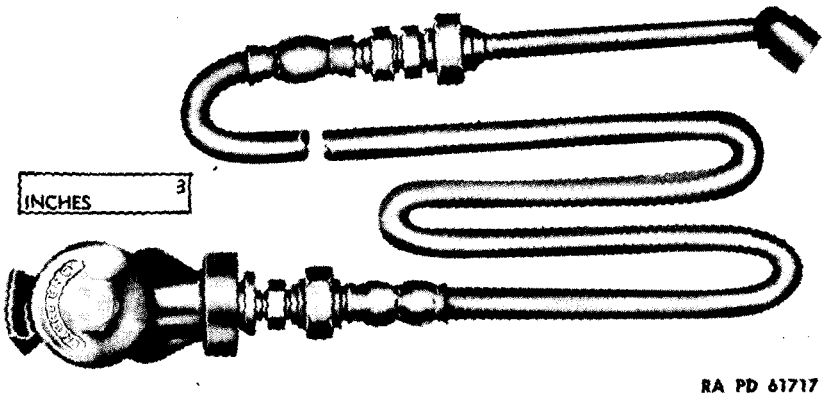


Figure 70 — Oil Pump Chest M16, w/Contents



RA PD 61717

Figure 71 — Tire Inflating Hose (33-H-986)

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
SCREWDRIVER, machs., extra heavy duty, wood insert handle, length of blade 5 in., width of blade ½ in.	20	41-S-1385	—
TUBE, air filling, complete	69	45-T-11442	For adj. equilibrator pressure.
TUBE, air filling, copper, flexible, w/couplings	69	45-T-11442-30	For adj. equilibrator pressure.
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of opngs. ½ x 9/16 in.	69	41-W-1002-40	—
WRENCH, engrs., angle 15°, dble. head, normal duty, alloy-S., size of opngs. ½ x 11/16 in.	69	41-W-1003-70	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of opngs. ¾ x 13/16 in.	70	41-W-1012	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of opngs. 15/16 x 1 1/16 in.	69	41-W-1021-10	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of opngs. 1¼ x 1 7/16 in.	69	41-W-1031	—
WRENCH, pipe strap, pipe cap. 1 to 5 in., length 18 in.	19	41-W-1853	—
WRENCH, screw, monkey, knife handle, 8 in.	20	41-W-2341	—

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
WRENCH, screw, monkey, knife handle, jaw opng. 3 in., length over-all 18 in.....		41-W-2345	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. 3/32 in., screw size set No. 10, cap No. 5-6.....	19	41-W-2449	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. 1/8 in., screw size No. 1/4 in., cap No. 8, socket No. 10 flat		41-W-2450	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. 3/16 in., screw size set 3/8 in., cap 1/4 in.....	19	41-W-2452	—
WRENCH, socket, sgle. head, offset, sq-opng., size 7/16 in.....		41-W-2850	—
WRENCH, wheel stud nut, dble. end hex. and sq-opngs., hex. opng. 1 33/64 in., sq-opng. 0.817 in., length 14 7/8 in.....	19	41-W-3838-30	Used w/HANDLE 41-H-1541, for wheel stud nuts.

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Section XIII

LUBRICATION

39. LUBRICATION ORDER.

a. Reproduction of War Department Lubrication Order LO 9-350, figures 72 and 73, prescribes first and second echelon lubrication maintenance.

b. The lubricating fittings indicated on the order are illustrated in figures 74 to 78, showing their location on the materiel. The fittings shown in the figures may be identified on the order by the key numbers around the border.

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

40. GENERAL LUBRICATION INSTRUCTIONS.

a. 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 grades of lubricants is determined by maintaining a close check on operation of the materiel during the approach to prolonged periods when temperatures will be consistently in higher or lower ranges. Because of the time element involved in preparing for operation at lower prevailing temperatures, a change to lubricants prescribed for a lower range will be undertaken the moment operation become sluggish. Ordinarily, it will be necessary to change lubricants *only when expected air temperatures will be consistently in the next higher or lower range,* unless malfunctioning occurs sooner due to lubricants being of improper consistency. NOTE: *Seasonal changes of lubricants and recoil oils will be recorded in the Artillery Gun Book.*

b. Service intervals specified are for normal operating conditions and continuous use of the materiel with frequent firing. Reduce these intervals under extreme conditions such as excessively high or low temperatures, prolonged periods of traveling or firing, continued operation in sand or dust, immersion in water, or exposure, or 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 materiel.

c. Lubricating equipment.

(1) Be sure to 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 lubrication fitting valves stick and prevent the entrance of lubricant, remove the fitting and determine cause. Replace broken or damaged lubricators. If lubricator cannot be replaced immediately, cover hole with tape as a temporary expedient to prevent the entrance of dirt. If oil lines become clogged, disassemble the line and remove the obstruction.

(2) Lubrication fittings, grease cups, oilers, oil holes, and plugs are circled in red for ready identification.

(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 or 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) Unless otherwise specified, use rifle bore cleaner or dry-cleaning solvent to clean or wash all metal parts, whenever partial or total disassembly is undertaken or when renewing the protective film

WAR DEPARTMENT LUBRICATION ORDER LO 9-350

18 FEBRUARY 1945 (Supersedes WDLO No. 10, 4 August 1944)

GUN, 155-mm, M1 AND M1A1, M2
CARRIAGE, GUN, 155-mm, M1
LIMBER, CARRIAGE, HEAVY, M2 AND M5

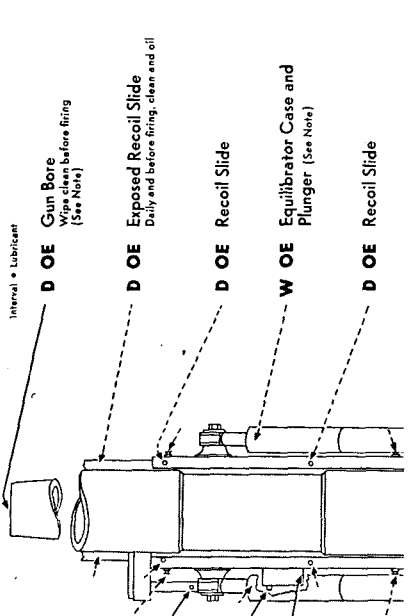
References: ORD 7 SNL D-24, TM 9-350, TM 9-1350

Clean fittings before lubricating. Lubricate after washing.

Intervals are based on actual operation under normal conditions. Reduce intervals under extreme dust, sand, heat or humid conditions. Extend when not in use.

* To clean parts, use SOLVENT, dry cleaning or Oil, fuel, Diesel. Dry before lubricating. For exceptions, see Gun Bore and Breech and Firing Mechanism Notes.

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



	Lubricant • Interval				
11	Recoil Slide	CG	D	D OE	Gun Bore Wipe clean before firing (See Note)
13	Variable Recoil Control Shaft Springly Bring gun to 0° elevation	CG	M	D OE	Exposed Recoil Slide Daily and before firing, clean and oil
9	Recoil Cylinder Replenisher Fill and Drain Cap. 170 pts., reserve 2 pt.	RS		D OE	Recoil Slide
10	*Recoil Mechanism Replenisher Level Opening* Check daily and before firing	D		W OE	Equilibrator Case and Plunger (See Note)
	Recoil Slide	CG	D	D OE	Recoil Slide

1 2 11 12 11

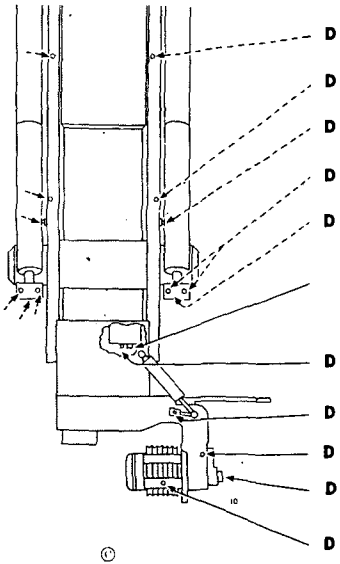
Figure 72 — Reproduction of War Department

NOTES

BREECH AND FIRING MECHANISM—Immediately after firing and on 3 consecutive days thereafter, disassemble the gas check pad from the obturator spindle and clean all parts of the breech and firing mechanism, M1, except the gas check pad with bore swabbing solution. Rinse with clean water, dry thoroughly and oil. Daily, when the gun is not being fired, clean with SOLVENT, dry cleaning, wipe dry and oil. Daily and immediately after firing, the firing lock, M17 will be cleaned with SOLVENT, dry cleaning, wiped thoroughly dry and oiled. At time of disassembly, wipe the gas check pad clean (do not use dry cleaning solvent or bore swabbing solution). Apply a film of OE (SAE 30) above +32°F. or (SAE 10) below +32°F. prior to reassembly.

EQUILIBRATOR CASE AND PLUNGER—With gun at 0° elevation, unscrew cover from front of equilibrator and slide toward narrow end of case. Wipe moisture from all surfaces and apply a thin film of lubricant to all exposed parts including outer surface of both plunger and case.

GUN BORE—Immediately after firing and on 3 consecutive days thereafter, swab with solution of 1/2 pound of SODA ASH to each gallon of warm water. Rinse with clean water, dry thoroughly and oil. Daily, when gun is not being fired, renew the oil film—every 5 days, clean with SOLVENT, dry cleaning, wipe dry and oil.



D OE	Recoil Slide	11
D OE	Recoil Slide	11
D CG	Recoil Slide	11
D OE	Equilibrator Guide Slides	19
D OE	Equilibrator Guide Adjusting Screw Clean and oil	20
RS	Recupertor Cylinder Reserve Oil Filling Valve Cap. 2 pt.	42
D	*Recuperator Cylinder Oil Index* Check daily and before firing	43
D OE	Breech Hinge Pin	7
D OE	Breech Crankshaft Bearing	5
D OE	Breech and Firing Mechanism (See Note)	4, 6
D OE	Obturator Spindle	8

KEY

LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE			LUBRICANTS	INTERVALS
	above +32°F.	+32°F. to 0°F.	below 0°F.		
OE—OIL, engine	SAE 30	SAE 10	PS	WB—GREASE, general purpose, No. 2	D—Daily W—Weekly M—Monthly 3M—3 months 6M—6 months
CG—GREASE, general purpose	No. 1	No. 0	No. 0	RS—OIL, recoil, special	
				PS—OIL, lubricating, preservative, special	

*SEE PARAGRAPH 58

RA PD 102379

Figure 73 — Reproduction of War Department

LIMBER M2 LIFTING SCREW — Loosen locking pin, raise lock and partially fill chamber.
OIL CAN POINTS — Weekly, lubricate M2 Limber Base and Trail Bearing Surface, M2 Limber Hole Support Locks, Clevises, Hinges and Latches; M5 Limber Eye Bolt Anchor Pins, Clamp Bolt Hinges with OE.
DO NOT LUBRICATE — Springs, Limber Spring Pins, Bogie Torque Arms.
DISASSEMBLED PERIODICALLY BY ORDNANCE PERSONNEL—Equilibrator Guide Bearings, Variable Recoil Gears, Counter Balance, Cradle Trunnion Bearings, Elevating Clutch Mechanism Yoke, Elevating Brake Drum Shaft Bearings, Elevating Handwheel Gear and Pinion, Elevating Shaft Bearings, Elevating Shaft Gear and Pinion, Traversing Mechanism Housing, Traversing Worm Wheel Pinion Shaft Lower Bearing, Traversing Handwheel Shaft Bearing, Top Carriage Support Roller Bearing, M2 Limber Trail Base Thrust Bearing, Bogie Spring Seat Bearings (not fitted with oil plugs).

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 18 February 1945.

[A.G. 300.8 (18 February 1945)]

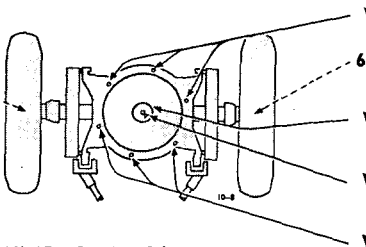
BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

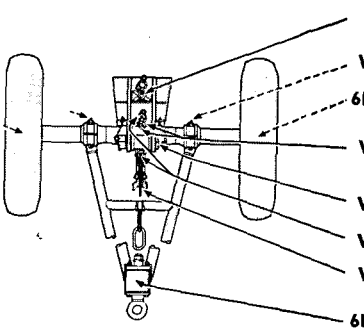
J. A. ULIO,
Major General,
The Adjutant General.

LO 9-350



LIMBER, CARRIAGE, HEAVY, M2

W CG	Limber Base Bearings		37
6M WB	Wheel Bearings	Remove, clean and repack	
W OE	Trail Base Thrust Bearing	(For disassembly, See ORD. Note)	39
W OE	Limber Lifting Screw	(See Note)	38
W CG	Limber Base Bearings		

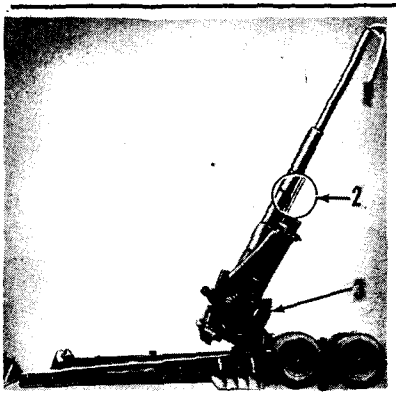


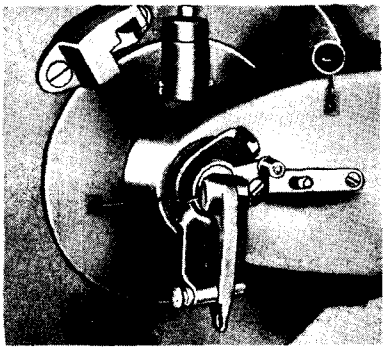
LIMBER, CARRIAGE, HEAVY, M5

D OE	Eye Bolt	*Clean and oil threads*	51
W CG	*Drawbar Bearing*		40
6M WB	Wheel Bearings	Remove, clean and repack	48
W CG	Spindle Bearings, Upper and Lower		41
W OE	Yoke Block Pin		47
W CG	Rocker Pin Bushing		36
W OE	Sling	Clean and oil	49
6M CG	Lunette	Disassemble, leaving spring in housing, clean and repack	50

Requisition additional *Lubrication Orders* in conformance with instructions and lists in FM 21-6

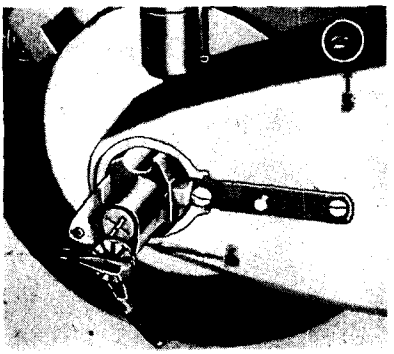
RA PD 102380

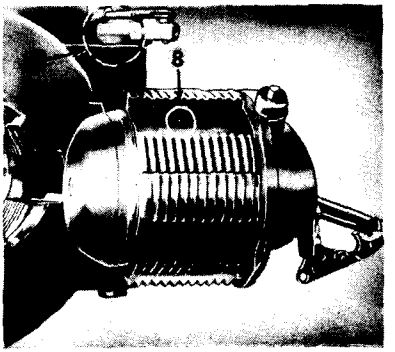




1 — GUN BORE
2 — EXPOSED RECOIL SLIDE
3 — ELEVATING ARC AND PINION

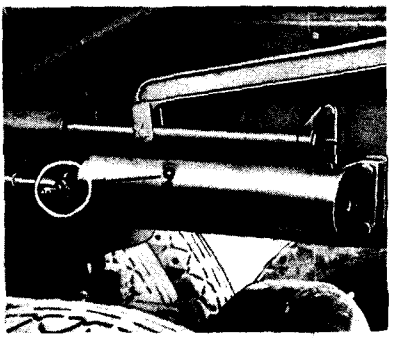
4 — BREECH AND FIRING MECHANISM
5 — BREECH CAMSHAFT BEARING

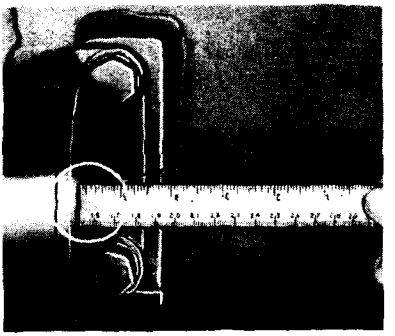




5 — BREECH CRANKSHAFT BEARING
6 — BREECH AND FIRING MECHANISM

7 — BREECH HINGE PIN
8 — OBTURATOR SPINDLE



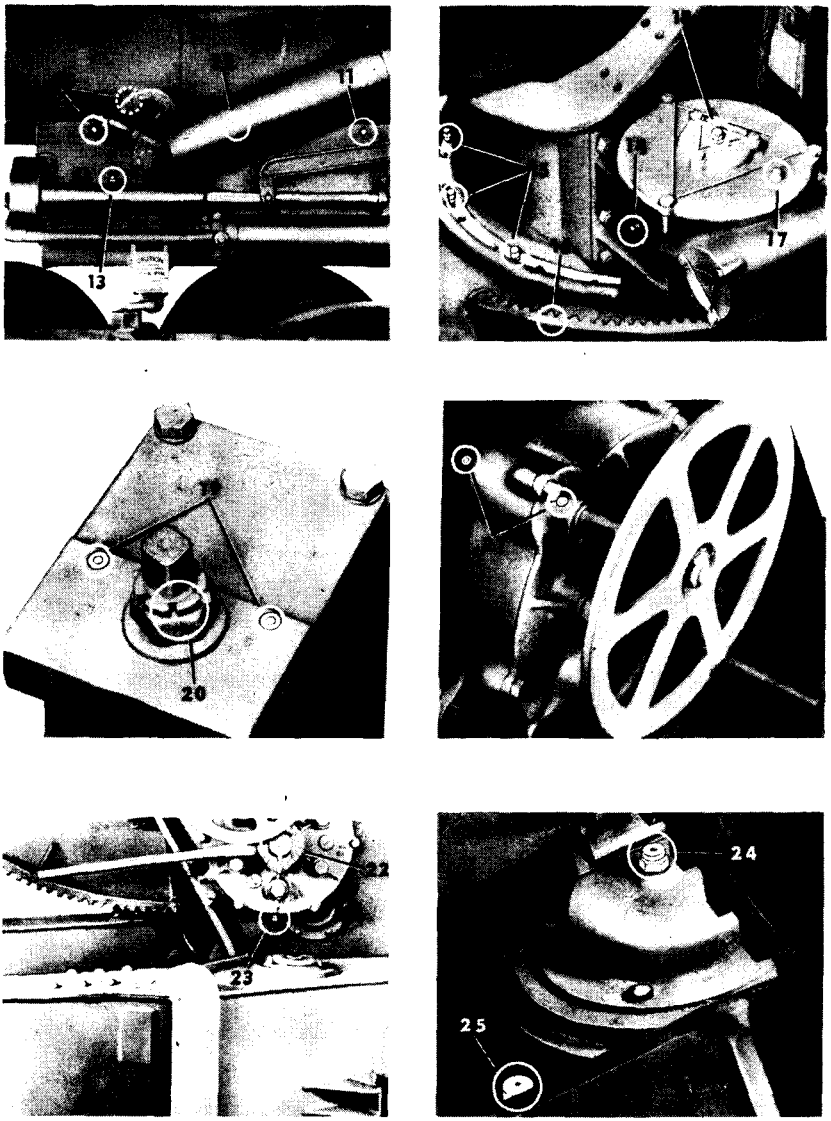


9 — RECOIL CYLINDER REPLENISHER FILL AND DRAIN

10 — RECOIL MECHANISM REPLENISHER LEVEL OPENING

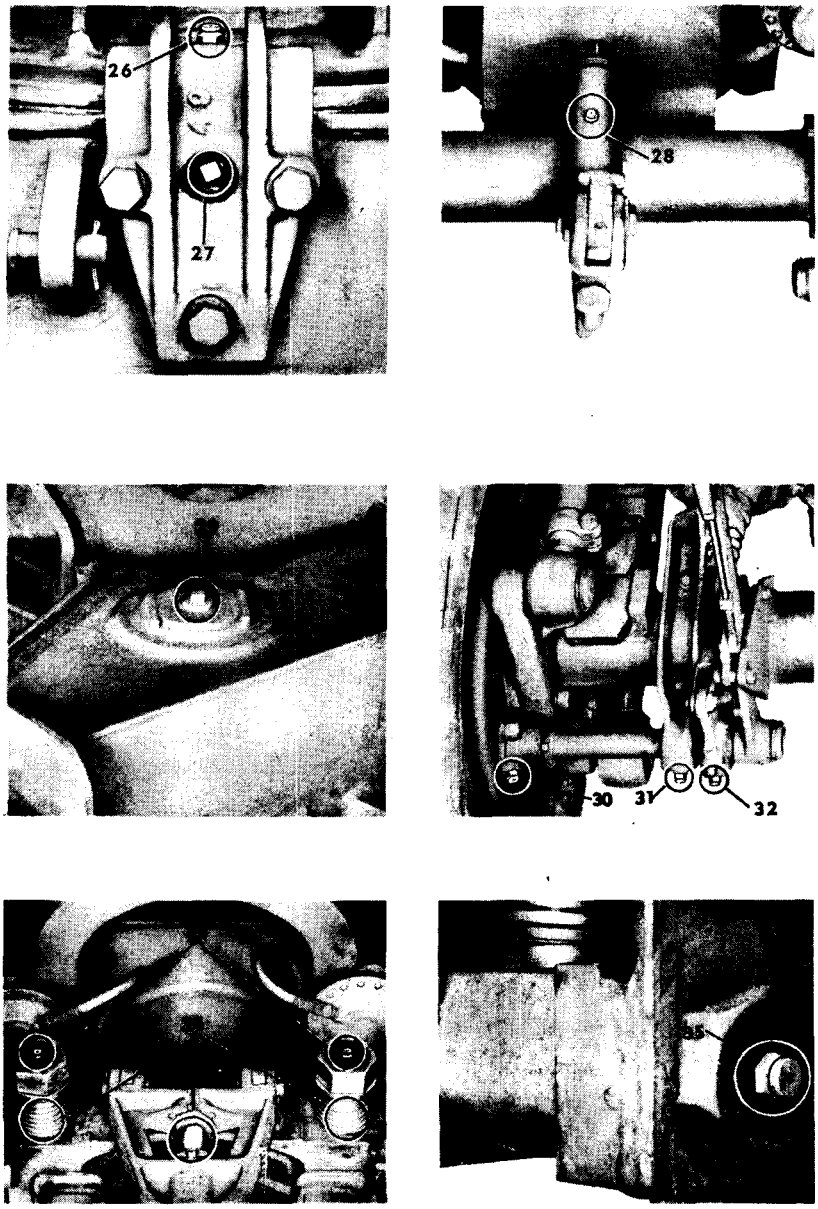
RA PD 102374

Figure 74 — Lubricating Points, Nos. 1 to 10 Inclusive



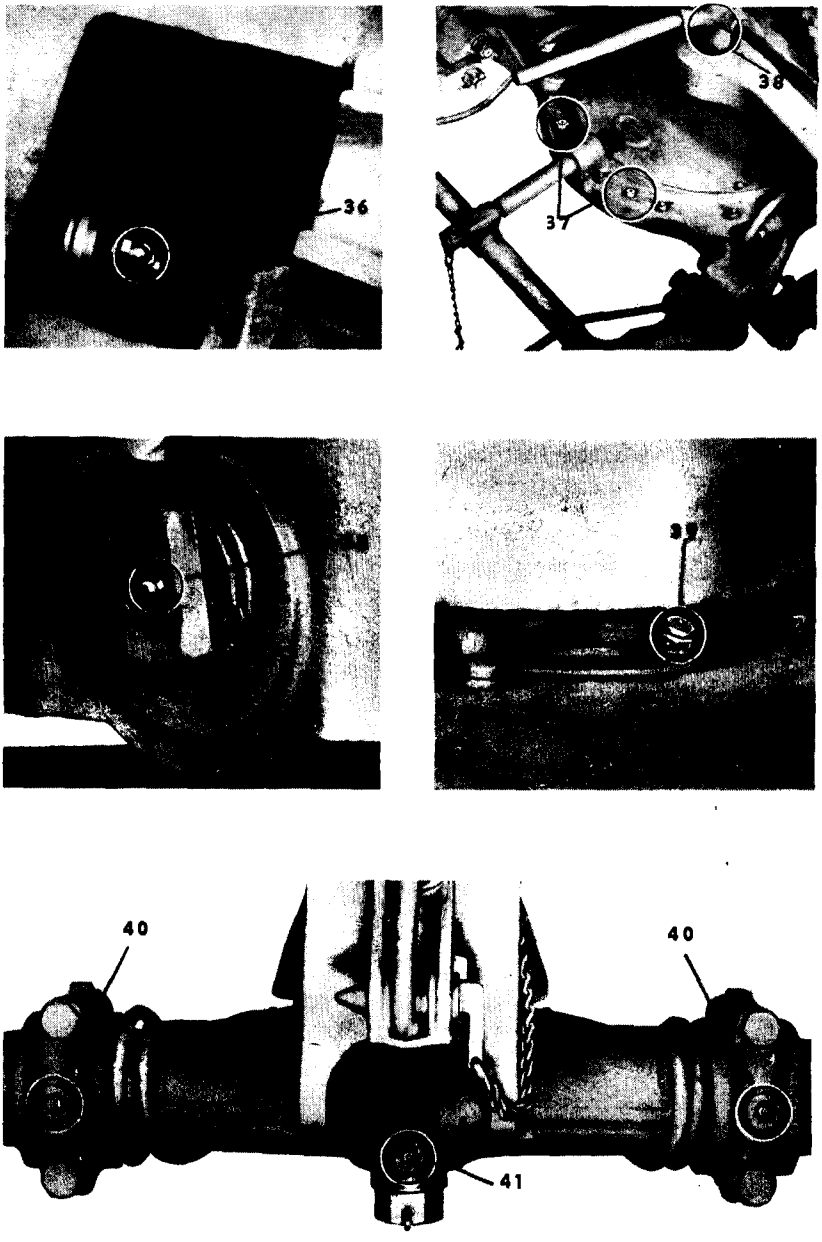
RA PD 102375

Figure 75 — Lubricating Points, Nos. 11 to 25 Inclusive



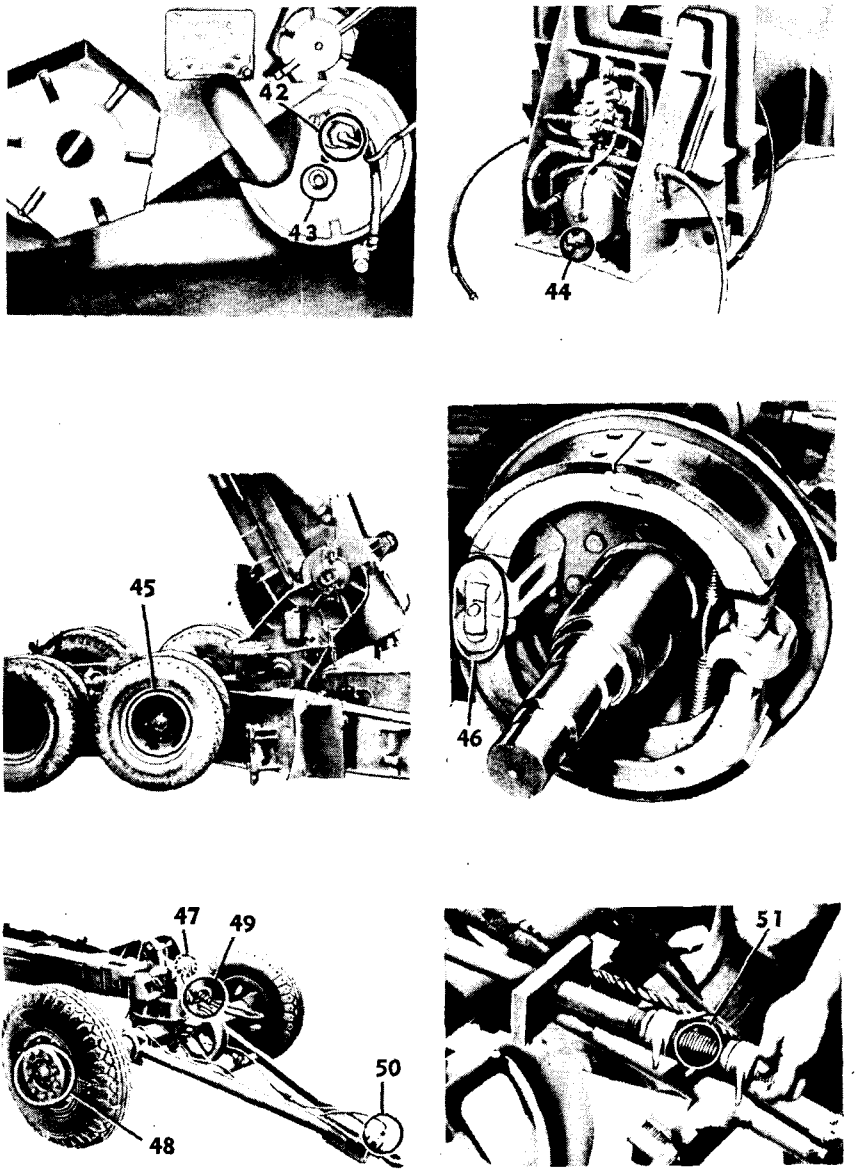
RA PD 102376

Figure 76 — Lubricating Points, Nos. 26 to 35 Inclusive



RA PD 102377

Figure 77 — Lubricating Points, Nos. 36 to 41 Inclusive



RA PD 102378

Figure 78 — Lubricating Points, Nos. 42 to 51 Inclusive

on exposed metal surfaces. Flushing of gear cases and bearing housings will not be undertaken unless inclosed mechanism is first disassembled in order to insure complete removal of the cleaner or solvent prior to application of lubricants. Use of gasoline for cleaning is prohibited. Dry all parts thoroughly before lubricating.

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

e. Preservative lubricating oil (medium).

(1) Preservative lubricating oil (medium) contains inhibitors which provide excellent protection against rust and corrosion on metal surfaces for short periods. The viscosity (grade) is comparable to engine oil (SAE 30).

(2) When engine oil (SAE 30) is prescribed by War Department Lubrication Orders and Technical Manuals for oiling bores, breech and firing mechanisms, and other points lubricated by oil can, or by wiping with a cloth wrung out in oil, preservative lubricating oil (medium) will be submitted therefor under the following conditions:

(a) Landing operations.
(b) Salt air areas.
(c) High humidity.
(d) Excessive moisture conditions, especially when prescribed daily lubrication service cannot be performed regularly.

CAUTION: *Preservative lubricating oil (medium) will not be used in gear cases or other internal mechanisms unless so prescribed by applicable War Department Lubrication Orders or Technical Manuals nor will it be used below +32° F in lieu of engine oil (SAE 10) or preservative lubricating oil (special or light).*

Section XIV

PREVENTIVE MAINTENANCE SERVICE

41. GENERAL.

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

b. Incidents of wear, breakage, cleaning, and inspection make necessary the occasional disassembly of various parts of the gun and carriage. This work comes under two headings; that which may be performed by the battery personnel with the equipment furnished and that which must be performed by trained ordnance personnel.

c. The battery personnel may, in general, do such dismounting as is required for the assembling of parts indicated for battery use. Such work should be done in the manner prescribed herein. Any difficulty which cannot be overcome by the prescribed method must be brought to the attention of ordnance maintenance personnel.

d. The battery personnel will not attempt to disassemble any part of the materiel not authorized in this manual.

42. COMMON PROCEDURES.

a. The use of wrenches 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 a danger of spreading the wrenches and rendering them useless.

b. Bolts should be coated with white lead before the nuts are assembled to them.

c. Dirt and grit settle on bearing surfaces and, in combination with the lubricants, form a cutting compound. Powder fouling attracts moisture and hastens the formation of rust. It is essential that all parts be kept clean. If rust should accumulate, its removal requires special care in order that clearances shall not be unduly increased. Crocus cloth should be used for this purpose; the use of coarse abrasives is forbidden. In disassembly, assembly, or inspection, extreme care must be exercised to prevent dust, dirt, or other foreign matter from entering mechanisms of the gun and carriage.

d. Oilcups, lubricating fittings, oilholes and fill, level, and drain plugs should be marked with a circle about three-quarters of an inch in diameter. The circle is to be painted red in order that the lubricating point may be readily located. The fittings themselves should not be painted.

e. 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 materiel clean. Clean parts such as bearings, slide surfaces, threads, etc. thoroughly anl 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.

f. The breech and muzzle covers should be used when traveling, or when the gun is not in service. When the gun is inactive for a considerable length of time, the gun and carriage should be prepared for storage as described in section XXX.

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

h. Tires requiring repairing or treading will be replaced with serviceable tires. Any oil, grease, gasoline, or kerosene which comes in contact with tires under any circumstances will be washed immediately.

i. Water must not be played from a high-pressure hose on any part of the gun or carriage. Washing should be done with a sponge and water. Carefully dry parts which have become wet during washing, and then oil the parts in manner prescribed in section XIII.

43. PREVENTIVE MAINTENANCE SCHEDULES.

a. Daily service.

Point	Preventive Maintenance	Detailed Instructions
Gun, carriage and limber as a unit.	Inspect over-all for general appearance. The materiel should be clean, and painted and lubricated properly. Examine all exposed unpainted surfaces for signs of rust. Check over-all for cracked, damaged or broken parts.	WDLO 9-350
Gun tube.	Note condition of bore. Look for erosion at the origin of rifling, bruises in the gas check seat, burs or roughness on the leveling plates. Remove rust from leveling plates with crocus cloth. Clean gun bore and powder chamber. Wipe dry and reoil.	WDLO 9-350 and par. 58
Firing mechanism or firing lock.	Test the firing mechanism by firing two primers. The primers should necessarily extend more than one-eighth of an inch out of the obturator spindle plug when pressed in hard with finger or thumb. Ream out the primer seat if necessary. Examine the mechanism closely for signs of rust, as the closely finished surfaces of the firing mechanism rust very easily. Repair or replace parts of the firing mechanism which may be worn or broken. Keep well lubricated. Note the action of the firing mechanism by pulling on the lanyard. Action should be positive.	WDLO 9-350 and sections XVIII and XIX.

Point	Preventive Maintenance	Detailed Instructions
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 the mechanism and reassemble. If it is still difficult to operate, notify ordnance maintenance personnel. Examine the breechblock and breech recess for burs, indentations on the threads, rust, pitting, and other evidence of erosion. If not possible to smooth or clean with crocus cloth, notify ordnance maintenance personnel. Do not use any other abrasive. 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. Examine obturator spindle for burs. If possible, smooth the spindle using crocus cloth; if not possible notify ordnance maintenance personnel. Examine the split rings for burs or cracks. Replace the defective rings. Examine gas check pad for bruises or torn covering. Replace defective pad. Inspect for proper functioning. Open and close the breech several times to make sure that it functions properly. Examine closely for signs of rust, as the closely finished surfaces of the breech mechanism rust very easily. Keep well lubricated.	WDLO 9-350 and section XVII
Breech hinge pin.	Lubricate.	WDLO 9-350
Breech crank shaft bearing.	Lubricate.	WDLO 9-350
Obturator spindle.	Clean the face of the obturator spindle and ream the obturator spindle vent hole.	Par. 62
Counterbalance assembly.	Test the mechanism to see that it functions properly at different degrees of elevation. If out of adjustment, notify ordnance maintenance personnel.	Par. 59
Recoil and counterrecoil piston rod nuts.	Make certain the recoil and counterrecoil piston rod nuts are fully engaged and pinned.	Par. 17
Recoil mechanism.	Inspect for leakage at recoil rod and counterrecoil rod stuffing boxes.	Par. 55
Recoil slides and guides.	Clean and lubricate. Inspect closely for scores, bruises or pitting.	WDLO 9-350 and par. 52
Recoil mechanism replenisher piston.	Check position of replenisher piston.	Pars. 56 and 79

Point	Preventive Maintenance	Detailed Instructions
Recoil cylinder oil index.	Check position of oil index.	Pars. 54 and 76
Wipers.	See that the front gun rail wipers and upper and lower rear gun rail wipers are in good position so that they will prevent dust or sand from entering the slides of the recoil mechanism.	—
Equilibrator slide guides.	Clean and lubricate.	WDLO 9-350
Equilibrator guide adjusting screw.	Clean and lubricate.	WDLO 9-350
Elevating arc and pinion.	Clean and oil.	WDLO 9-350
Elevating clutch mechanism.	Inspect for proper functioning.	Par. 15
Elevating hand-wheel pinion bearing.	Lubricate.	WDLO 9-350
Top carriage support.	Lubricate.	WDLO 9-350
Traversing arc and pinion.	Clean and oil.	WDLO 9-350
Cradle lock.	Clean and oil.	WDLO 9-350
Bogie lifting outer screws.	Clean and oil.	WDLO 9-350
Air reservoir drain.	Open and drain.	WDLO 9-350 and par. 84

b. Before firing.

Point	Preventive Maintenance	Detailed Instructions
Gun tube.	Wipe off excess lubricant from exposed gun tube.	—
Gun bore.	Wipe the bore dry with clean, dry burlap or wiping cloth.	—
Firing mechanism or firing lock.	Check for proper functioning.	Sections XVIII and XIX
Recoil and counter-recoil piston rod nuts.	Note that these nuts are fully engaged and pinned.	Par. 17
Recoil mechanism replenisher piston.	Check position.	Par. 79
Recoil cylinder oil index.	Check position.	Par. 76
Recoil slides and guides.	Clean and lubricate.	WDLO 9-350
Recoil indicator.	Set to "ON" position.	Par. 16
Elevating mechanism.	Check for proper functioning.	Par. 15
Equilibrator.	Check setting of equilibrator temperature adjusting scale.	Par. 81
Traversing mechanism.	Check for proper functioning.	Par. 15

Point	Preventive Maintenance	Detailed Instructions
Carriage, trails and spades.	After the weapon is in firing position, but before firing, make certain that the carriage is emplaced firmly, the trails are properly spread and the spades set securely in position.	Section VII

c. During firing.

Point	Preventive Maintenance	Detailed Instructions
Gun bore.	Whenever the rate of fire permits, examine the bore for powder fouling. Clean with bore brush if necessary.	Par. 58
Firing mechanism.	Check between rounds for proper functioning. Clean and lubricate.	Sections XVIII and XIX
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.	Par. 62
Recoil indicator.	The length of recoil should be measured for the first several rounds and then at regular intervals during firing. Figures 95 and 96 show the limits of allowable recoil of the gun at all elevations, for muzzle velocities of 2,100 feet per second and 2,800 feet per second, when operated at normal temperatures of the recoil oil (70° F). For the first round fired and at other temperatures, the length of recoil may not be within the limits shown in the illustrations. However, if the length of recoil does not fall within the desired limits when the gun is operated at normal temperatures, ordnance maintenance personnel should be notified.	—
Recoil cylinder oil index.	Check position.	Par. 76
Recoil mechanism replenisher piston.	Check position.	Par. 79
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.	Section VII

d. After firing.

Point	Preventive Maintenance	Detailed Instructions
Gun bore.	Clean and oil.	Par. 58
Firing mechanism.	Clean and oil.	WDLO 9-350
Breech mechanism.	Clean and oil.	WDLO 9-350
Equilibrators.	Clean.	WDLO 9-350
Recoil mechanism.	Inspect over-all.	Section XX
Recoil indicator.	Set to "OFF" position.	Par. 16
Recoil cylinder oil index.	Check position.	Par. 76

Point	Preventive Maintenance	Detailed Instructions
Recoil mechanism replenisher piston.	Check position.	Par. 79
Elevating mechanism.	Inspect over-all.	—
Traversing mechanism.	Inspect over-all.	—
Carriage.	Inspect carriage for condition. When damaged, notify ordnance maintenance personnel. Clean carriage thoroughly.	WDLO 9-350
Brakes.	Inspect.	Par. 84
Wheels and tires.	Inspect.	Par. 83

e. **Weekly service.** Perform all daily service as listed above and in addition the following:

Point	Preventive Maintenance	Detailed Instructions
Equilibrator case and plunger.	Inspect and service.	WDLO 9-350
Trail hinge pin pintle bracket.	Inspect and service.	WDLO 9-350
Lifting screw pins.	Inspect and service.	WDLO 9-350
Bogie spring seat bearing.	Inspect and service.	WDLO 9-350
Bogie lifting inner screws.	Inspect and service.	WDLO 9-350
Brake drum and pinion gear housing drain.	Inspect and service.	WDLO 9-350
Top carriage support housing drain.	Inspect and service.	WDLO 9-350

(1) HEAVY CARRIAGE LIMBER M2.

Point	Preventive Maintenance	Detailed Instructions
The limber as a unit.	Note the general appearance and condition.	—
Lifting mechanism.	Note ease of operation of the limber lifting mechanism. Examine the lifting mechanism center screws for burs or scores. Note that the lifting screw functions smoothly through its full length of travel, and does not bind.	Par. 86
Trail base and lifting mechanism lock.	Note that the trail base swivels smoothly and that the lifting mechanism lock functions without binding.	Par. 86
Axle.	Check the spring shackle and lifting mechanism base pins.	Par. 86
Locking pins.	Note ease of operation of the various locking pins, handles, handwheels, etc., and that they perform their proper function without underbinding.	Par. 86

Point	Preventive Maintenance	Detailed Instructions
Wheels.	Note condition of tires, tubes, tire air valve, disks, and rims. Check disk and rim nuts for tightness. Check disk and rim studs for body bruises or scored threads.	Pars. 83 and 86
Air line clips.	Check for broken or loose air line clips.	Par. 86

(2) HEAVY CARRIAGE LIMBER M5

Drawbar bearing.	Inspect and service.	WDLO 9-350
Spindle bearings upper and lower.	Inspect and service.	WDLO 9-350
Yoke block pin.	Inspect and service.	WDLO 9-350
Rocker pin bushing.	Inspect and service.	WDLO 9-350
Sling.	Inspect and service.	WDLO 9-350

f. Monthly. Inspect and make certain that all previously scheduled preventive maintenance operations have been performed.

Point	Preventive Maintenance	Detailed Instructions
Variable recoil control shaft.	Inspect and service.	WDLO 9-350
Brake camshaft bracket.	Inspect and service.	WDLO 9-350
Traversing mechanism housing.	Inspect and service.	WDLO 9-350
Traversing worm wheel.	Inspect and service.	WDLO 9-350
Pintle pin bearing.*	Inspect and service.*	WDLO 9-350
Top carriage support roller bearing.	Inspect and service.	WDLO 9-350
Top carriage rear hold-down clip.	Inspect and service.	WDLO 9-350
Slack adjuster.	Inspect and adjust.	Par. 84
Heavy carriage limber M2 as a unit.	Inspect and service.	WDLO 9-350
Heavy carriage limber M5 as a unit.	Inspect and service.	WDLO 9-350

g. Semi-annually. Inspect and make certain that all previously scheduled preventive maintenance operations have been performed.

Point	Preventive Maintenance	Detailed Instructions
Brake camshaft bearing.	Inspect and service.	WDLO 9-350
Wheel bearings.	Assemble, clean and repack.	Par. 83
Brake anchor pins.	Inspect and service.	WDLO 9-350
Lunette.	Inspect and service.	WDLO 9-350

*In order to lubricate the pintle pin bearing properly and to prevent interference with the elevating pinion, remove the straight lubricating fitting from the pintle bolt cover and replace it with an elbow type lubricating fitting.

h. Before traveling.

Point	Preventive Maintenance	Detailed Instructions
Gun bore.	Open the breech and make certain the gun bore is clean; close the breech.	—
Traveling locks.	Make certain that the cradle lock is locked and that the traveling lock is in position on trails.	Par. 23
Piston rod nuts.	After the gun is retracted and the tube is locked to the traveling lock, make sure the piston rod nuts are replaced on the piston rods.	Par. 23
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. 23
Trails.	Make sure the trails are raised and properly clamped to the limber for traveling.	Par. 23

Section XV

MALFUNCTIONS AND CORRECTIONS

44. 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.

45. FAILURE TO FIRE.

a. Failure to fire with the firing lock M17.

(1) If the gun fails to fire, make two more attempts to fire. After the last attempt, wait at least 60 seconds and open the firing lock. If the percussion element on the primer has been struck solidly, replace the primer and continue firing.

(2) If the percussion element of the primer is struck lightly, disassemble the firing lock and clean thoroughly with dry-cleaning solvent. Relubricate lightly and reassemble the lock.

(3) If trouble still is not remedied, disassemble the lock and examine the firing spring and pin. If the spring is weak, replace. If the point on the firing pin is deformed, replace the pin.

b. Failure to fire with firing mechanism M1.

(1) If the gun fails to fire, make two more attempts to fire. After the last attempt, wait at least 60 seconds and remove the firing mechanism. If the percussion element of the primer is struck solidly, replace the primer and continue firing.

(2) If the percussion element of the primer is struck lightly and trouble may be that the lanyard was not pulled hard enough, replace the primer and pull the lanyard with considerable snap.

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

(4) The firing mechanism may not be screwed fully home. Make sure that the firing mechanism is screwed as far beyond the latch as possible.

c. Gun fails to fire after primer has discharged.

(1) If the primer is heard to fire and gun does not fire, the vent-hole through the obturator spindle may be fouled or damp. Wait at least 60 seconds and remove the primer.

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

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

d. 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 lanyard with considerable snap.

(2) FIRING MECHANISM M1 NOT SCREWED HOME. Adjust the firing mechanism so 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.

46. 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. Examine the breechblock and breech recess threads for burs and scores. If any are present, notify ordnance maintenance personnel.

b. If the breechblock closes hard at high angles of firing, the counterbalance may be improperly adjusted. Adjust (par. 59).

c. Breechblock does not open (seized breechblock). Tap the rear of the breechblock with brass hammer 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 and at the same time have a man exert 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.

47. GUN RETURNS TO BATTERY WITH TOO GREAT A SHOCK.

a. The gun returning into battery with too great a shock may be caused by either 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. 79) and drain the reserve oil off and refill to normal (par. 80). Allow mechanism to cool before continuing firing. If this malfunction is not then correct notify ordnance maintenance personnel.

48. GUN OVERRECOILS.

a. The gun overrecoiling (figs. 95 and 96) 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. 79). If action is not normal then notify ordnance maintenance personnel.

49. GUN UNDERRECOILS.

a. If the gun underrecoils, the recoil mechanism may not be warmed up and the oil too thick. The gun will recoil normally after a few rounds.

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

50. GUN WILL NOT RETURN TO BATTERY.

a. When the gun does not return to battery it may be caused either by 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.

51. 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.

52. 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.

53. NO SOUND OF AIR ESCAPING FROM AIR RELIEF VALVE IN COUNTERRECOIL HEAD DURING COUNTER-RECOIL.

a. The air relief valve in the counterrecoil cylinder front head may become rusted shut, collect foreign matter under the seat and prevent closing, have broken valve spring or scored seat. Remove and clean the air relief valve.

b. Remove set screw. Remove the guide, valve spring, valve, and valve housing from the counterrecoil cylinder front head. Clean and replace broken or damaged parts. 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.

54. OIL INDEX REMAINS STATIONARY WHEN THE RESERVE IS PUMPED IN AGAINST EVIDENT PRESSURE. The packing is too tight, or the index is broken or locked by some foreign substance. Drain off all reserve oil and refill. While injecting the oil, tap the oil index gently with each stroke of the pump. If the oil index fails to move after approximately 300 strokes of the pump, refer the matter to ordnance maintenance personnel.

55. OIL LEAKAGE.

a. 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. 79) and drain and reestablish the proper oil reserve (par. 80). If oil has to be replaced in the replenisher and if the oil reserve has to be reestablished so often that it interferes with 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 due to broken packing springs or lack of compression on the spring. Report leak of clear oil to ordnance maintenance personnel.

d. **Excessive leaks from recuperator and recoil filling and drain valve.** Sticking of valve or defective packing. Report to ordnance maintenance personnel.

56. POSITION OF REPLENISHER PISTON DOES NOT CHANGE DURING CONTINUED FIRING. Replenisher piston stuck. Drain oil from replenisher through filling and drain 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, refill as prescribed in paragraph 79. If piston does not move, notify ordnance maintenance personnel. If a gun 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 water and oil that has passed the replenisher piston and to provide for the circulation of air through the replenisher. The two holes in the piston guide are in the center of the teat wrench holes. The cylinder hole is in the underside of the replenisher about 1¼ 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.

57. 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 valve and 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 soap suds 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 soap suds. 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. 84).

(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 of slow release.

(1) The slack adjuster may be out of adjustment causing travel of chamber push rod. Adjust brakes (par. 84).

(2) The air filters may be dirty. Clean air filters (par. 84).

(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 maitenance personnel.

(2) The slack adjuster may be improperly adjusted. Adjust brakes (par. 84).

(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) Over-lubrication 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. 84).

(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. 84).

(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 XVI

TUBE AND BREECH RING

58. GENERAL.

a. The using arm personnel are not permitted to do repair work on the tube or breech ring.

b. The 155-mm gun is fitted with longitudinal gun slides and bearing strips. A recoil scale is fastened to the right-hand side rail. The interior surface of the breech recess is threaded to receive the breechblock. An extension on the underside of the breech ring forms a recoil lug by means of which the gun is connected to the recoil mechanism. A hook on the underside of the recoil lug is used for retracting the gun from firing position to the traveling position. Leveling plates that include finished seats for the gunner's quadrant are set in the breech ring.

c. Maintenance. 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, IF AVAILABLE.

(a) Thoroughly clean after firing, *when the tube has cooled sufficiently to touch with the bare hand,* and for 2 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, renew the oil film daily. Every 5 days, clean the bore with rifle bore cleaner, wipe dry, and reoil.

NOTE: *When necessary to conserve the supply, the cleaner may be diluted up to 50 percent with water without reducing the cleaning action materially, provided prevailing temperatures are above +32° F. However, when the product is diluted, the rust-preventive qualities are so reduced that the surfaces cleaned must be dried thoroughly and oiled.*

(2) SODA-ASH.

(a) Swab the bore immediately after firing, *while the tube is still hot,* and daily thereafter on the following 3 days, with a solution of ½ pound of soda-ash to each gallon of warm water. When all powder fouling has been removed, rinse with clear water, dry thoroughly with clean burlap, and oil.

(b) When the piece is not being fired, renew the oil film daily. Every 5 days, clean the bore with dry-cleaning solvent, wipe dry, and reoil.

(3) WHITE CASTILE SOAP OR ISSUE SOAP. Prepare a solution by shaving 1 pound of soap into 4 gallons of water (preferably warm water, to dissolve the soap more readily) and follow the same procedure as in (2), above.

CAUTION: *When issue soap is used, special care must be taken to rinse the bore thoroughly after cleaning, because the soap may contain free caustic which will cause corrosion if not removed completely.*

(4) 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 as soon as possible thereafter by one of the preferred methods in (1), (2), or (3), above.

Section XVII

BREECH MECHANISM

59. GENERAL.

a. The breech end of the gun or powder chamber is opened for loading and closed and sealed for firing by means of the breech mechanism. The carrier-supported breechblock is the principal part of the breech mechanism. The associated mechanisms with their related

parts are: the breech operating mechanism, obturator mechanism, counterbalance and firing mechanism (figs. 79 and 80).

(1) The principal part of the breech operating mechanism is the breechblock operating lever. By means of this lever the breech mechanism is rotated from its fully locked to its fully unlocked position. The breech mechanism is then swung out of the breech recess leaving the powder chamber clear for loading. After loading the breech mechanism is swung around on its carrier into the breech recess and rotated and locked in its fully closed position by means of the breechblock operating lever and its actuated parts.

(2) The obturator mechanism (fig. 81) is housed in the breechblock. The obturator mechanism seals the breech, thereby preventing the rearward escape of the powder gases. As the powder charge is ignited, the pressure against the spindle head compresses the gas check pad, expanding it and the split rings to effectively seal the rear of the powder chamber. The obturator assembly used with the firing mechanism M17 is the same as that used with the firing mechanism M1 except for the spindle plug. NOTE: *There are two types of gas check pads which may be issued for use with this materiel. The old type pads consisted of a dense rubber-like compound encased in a wire mesh and asbestos covering. The new gas check pad are solid Neoprene rubber containing no metal or asbestos covering.*

(3) The counterbalance mechanism (fig. 85) is provided to facilitate opening the breech, to provide greater ease in closing the breech mechanism, particularly at greater angles of elevation, and also to hold the breechblock back to keep the breech fully open for loading. The counterbalance mechanism compensates for the effect of gravity in the operation of the breech mechanism, thereby making it easier to open and close. Some early models are equipped with a regulating device as an extension of the hinge pin. By rotating the counterbalance regulating screw, the tension of the spring can be increased or decreased to suit the angle of fire.

(4) Through the action of the lanyard operating firing mechanism attached to the firing mechanism housing in the breechblock, the firing pin is actuated and strikes the primer, thereby firing the piece.

60. DISASSEMBLY OF BREECH MECHANISM.

a. Remove firing mechanism safety plunger housing assembly. With the firing mechanism removed and the breech open, remove the two screws and washers which secure housing assembly to carrier, using a scribe or thin-bladed knife; push detent away from lock, turn lock to left and withdraw it. Remove safety plunger housing assembly.

b. Remove firing mechanism receiver housing assembly and obturator spindle assembly. Unscrew and remove firing mechanism

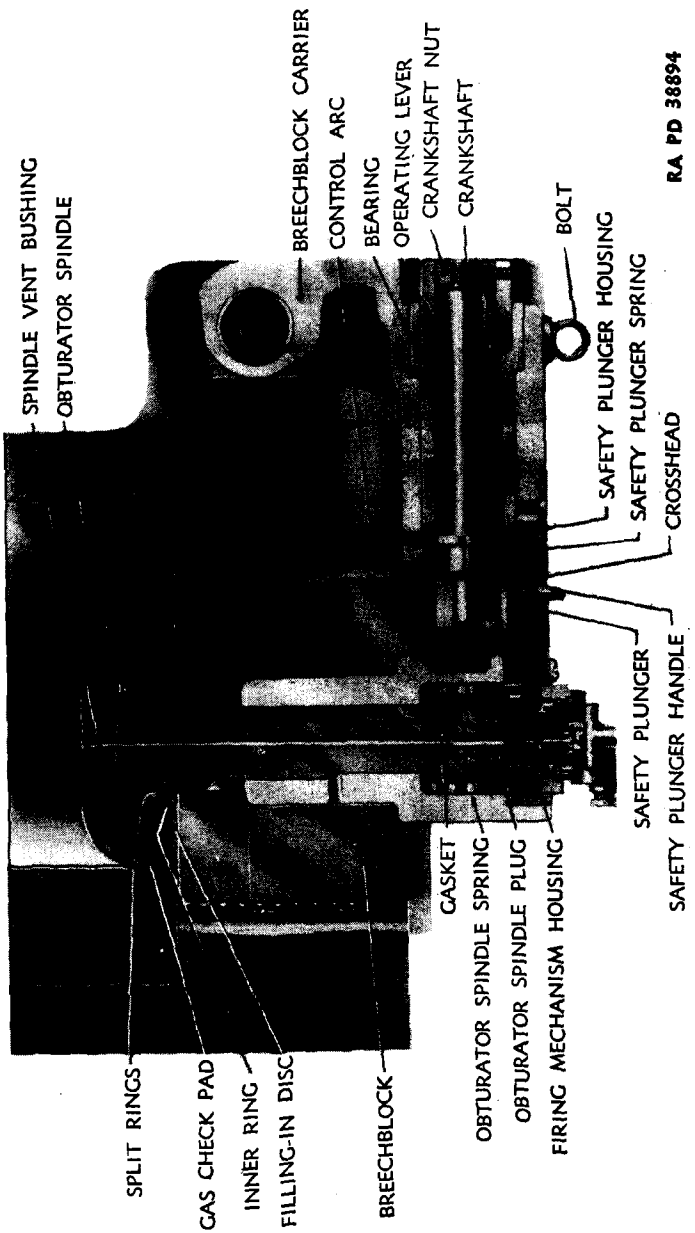


Figure 79 — Breech Mechanism — Sectional View

receiver housing assembly while holding mushroom-head against breechblock. Push obturator spindle back through the carrier with a hammer handle. Withdraw obturator spindle, split rings, inner ring, gas check pad, and filling-in disk from breechblock. Remove spring from carrier. CAUTION: *Never unscrew firing mechanism receiver housing assembly from its position on rear end of obturator spindle until breech has been opened.*

c. **Remove breechblock assembly.** Remove screws from arc and breech ring. Remove arc. Slide a wood pole, 1¾-inch diameter by 4 feet long, through the breechblock. With one man holding the pole and another working the operating lever up and down, and at the same time pushing the breechblock back on the pole, remove the breechblock. Carefully lift the breechblock (on pole) away from the breechblock carrier.

d. **Remove operating lever assembly.** Remove pin from breechblock operating lever bearing retaining bolt and remove bolt. Work operating lever up and down easily, and, at the same time, pull out on operating lever to remove crosshead. Swing the carrier to closed position and withdraw operating lever, bearing, and crankshaft from carrier.

e. Replace all damaged and worn parts replaced in first and second echelon, and refer to higher authority for replacement of other worn or damaged parts. Clean and lubricate.

61. ASSEMBLY OF BREECH MECHANISM.

a. **Install operating lever assembly.**

(1) Lubricate outside surface of operating lever bearing and bearing opening in breechblock with oil. Slide operating lever assembly into opening in breechblock carrier and swing carrier to open position.

(2) Lubricate crankshaft and crosshead, and slide crosshead into position on crankshaft, with flat side of crosshead toward crankshaft. Push operating lever all the way into position.

(3) Lubricate body of breechblock operating lever bearing retaining bolt, and push bolt into position in carrier and operating lever. Secure with pin.

b. **Install breechblock assembly.** NOTE: *Operations given in this subparagraph and the following subparagraph c are to be performed with the breechblock carrier in open position. Closing the breech before these steps are performed may result in improper assembly or injury to components.*

(1) Place a wood pole through breechblock and, with two men lifting, insert end of pole in carrier. Then push breechblock from pole onto carrier pintle. Rotate operating lever to a position which

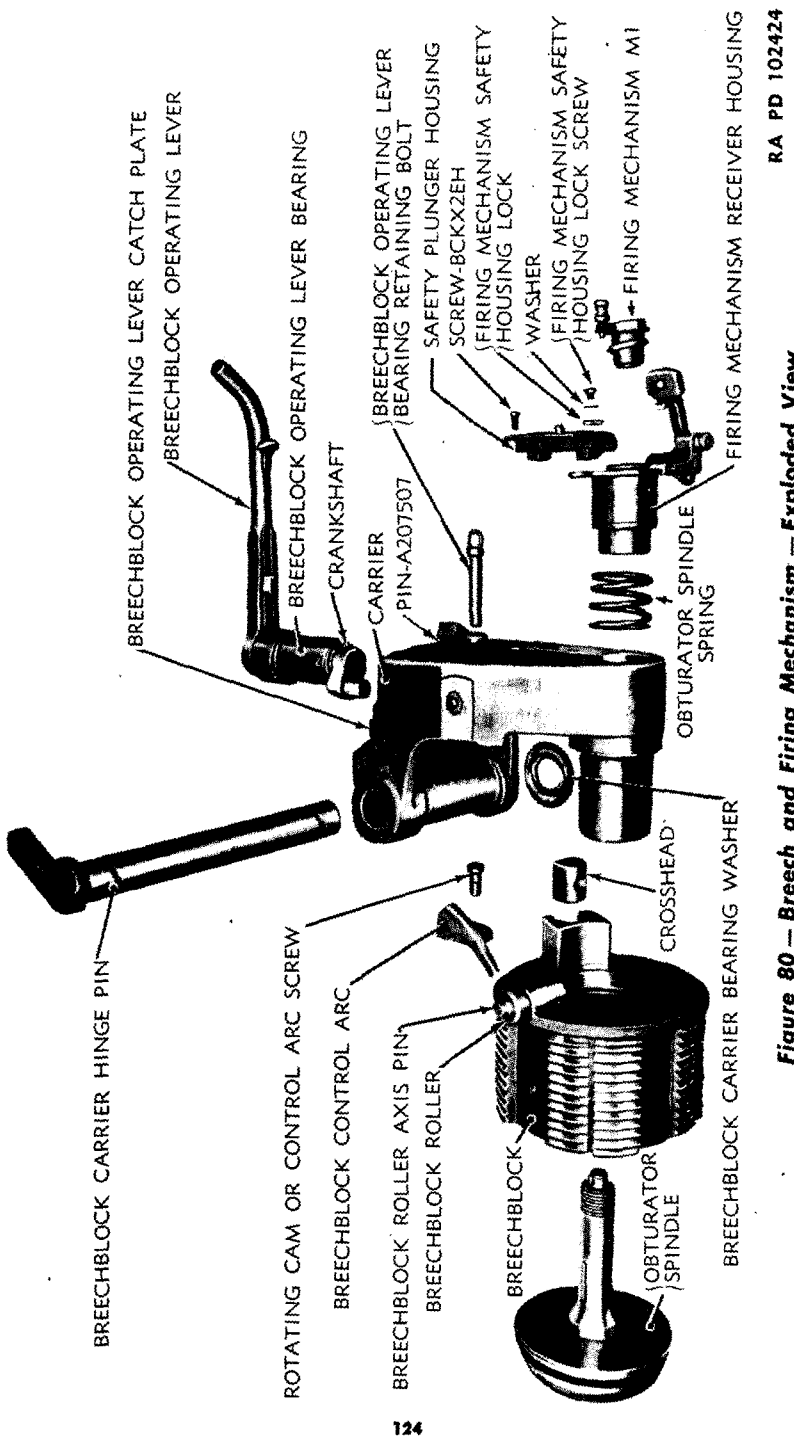


Figure 80 — Breech and Firing Mechanism — Exploded View

will allow crosshead to enter grooved lug on rear of breechblock. Then slide breechblock all the way into position on the carrier pintle and withdraw wood pole.

(2) Place breechblock control arc in position, and secure with two screws.

c. Install obturator spindle and firing mechanism receiver housing assemblies.

(1) Place a light film of oil all over obturator spindle spring. Slide spring into place in breechblock carrier.

(2) Place in the following order, the front split ring, gas check pad, rear split ring, inner ring, and filling-in disk, on stem of obturator spindle.

(3) Insert threaded end of obturator spindle through spindle opening of breechblock and carrier.

(4) Insert firing mechanism receiver assembly in place in carrier. Press inward on the receiver housing to compress the obturator spindle spring, and screw the receiver assembly on the obturator spindle as far as it will go, making sure gas check pad and split rings are in proper position. Approximately 7 full turns should be made. Insert headspace gage in firing mechanism receiver housing as shown in figure 82. Space between the shoulder of the gage and the housing, as shown in figure 83, denotes proper assembly and proper headspace. If shoulder of gage rests on housing as shown in figure 84, improper assembly and excessive headspace is denoted. When this condition exists, the firing mechanism receiver housing must be screwed 1 or 2 complete turns further onto the obturator spindle. The headspace should again be checked. CAUTION: *Excessive headspace between firing mechanism and obturator spindle plug will cause blowback of the primer. Hence, it is essential that firing mechanism receiver housing assembly be screwed onto the obturator spindle as far as it will go. After the firing mechanism safety plunger housing is installed, the receiver housing can be backed off the obturator spindle (subpar. e, below).*

d. Install firing mechanism safety plunger housing assembly.

(1) While retaining the lock detent and detent spring in position, fasten the safety housing back to safety plunger housing by screwing in the housing lock screw behind the housing lock screw washer.

(2) Turn housing lock so housing can be placed in its recess in carrier. Slip the left end through flanges of breechblock carrier retainer ring.

(3) Rotate lock 90 degrees to secure housing in position. Detent will now be in the notch in the lock.

(4) Screw flat-head machine screw into place through right end of housing into carrier.

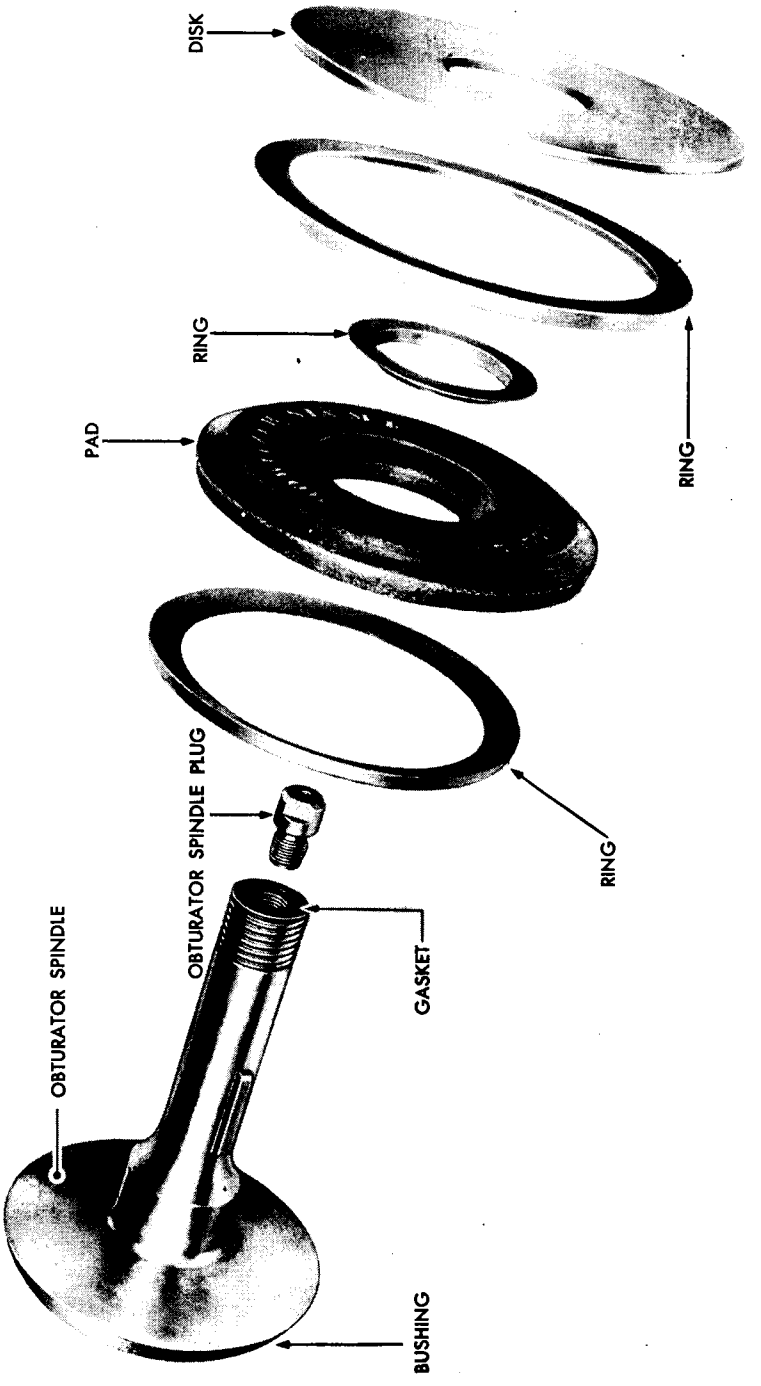


Figure 81 — Obturator Spindle Assembly Used With the M1 Firing Mechanism

e. Headspace 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 to allow the safety plunger to enter the slot freely.

f. Removal.

(1) Rotate the breechblock carrier until a U-shaped block (or open-end wrench) 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 2¾ inches from the head.

(2) With the U-block 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 keyholed end of the counterbalance cylinder is lifted upward.

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

g. Disassembly of the counterbalance assembly. The counterbalance assembly contains a strong spring which requires special tools and equipment for compressing. Whenever the counterbalance assembly requires disassembly, notify ordnance maintenance personnel.

h. Installation.

(1) 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.

(2) 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.

(3) Rotate the breechblock carrier toward open position until the U-shaped block and small block which holds the counterbalance piston rod spring in compression can be removed.

62. MAINTENANCE OF BREECH MECHANISM.

a. Breech mechanism. 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 the mechanism and reassemble. If it is still difficult to operate, notify ordnance maintenance personnel.

b. Breechblock and breech recess. Examine the breechblock and breech recess for burs, indentations on the threads, rust, pitting,

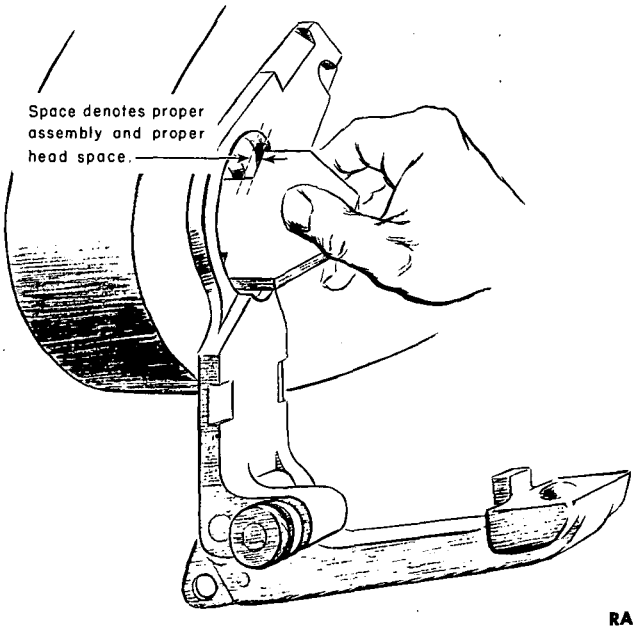


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Figure 82 — Method of Using Gage To Check Assembly for Proper Headspace

and other evidence of erosion. If not possible to smooth or clean with crocus cloth, notify ordnance maintenance personnel. Do not use any other abrasive.

c. 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.

d. Obturator spindle. Examine obturator spindle for burs. If possible, smooth the spindle using crocus cloth; if not possible, notify ordnance maintenance personnel.

e. Split rings. Examine the split rings for burs or cracks. Replace defective rings.

f. Gas check pad. Examine gas check pad for bruises or torn covering. Replace defective pad.

g. Daily, when the gun is not being fired, the breech mechanism (except the gas check pad) must be cleaned thoroughly, dried, and coated with a thin film of oil. Application to moving parts will be by oilcan if oilholes are provided, otherwise, use a clean wiping cloth. Disassembly will be undertaken if necessary to insure complete lubrication of all moving parts.

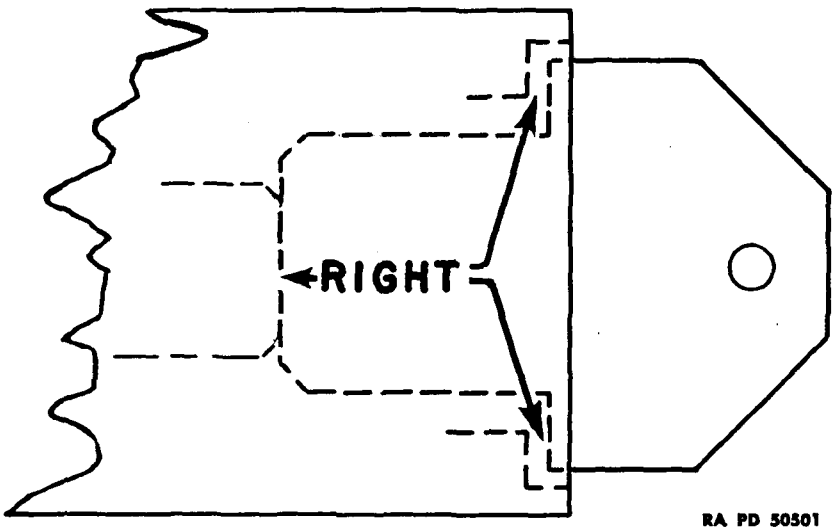


Figure 83 — Correct Use of Headspace Gage

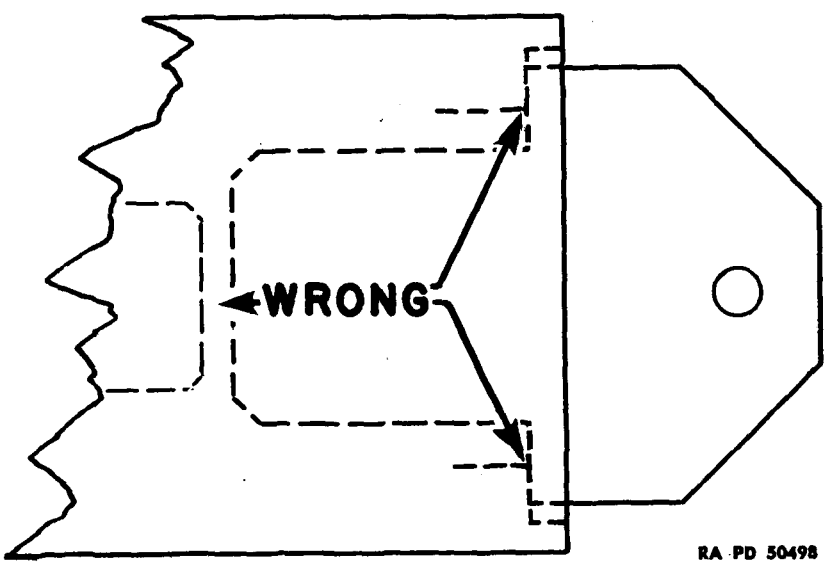


Figure 84 — Incorrect Use of Headspace Gage

h. The entire breech mechanism including the firing mechanism M1, obturator spindle, primer seat, primer vent, filling-in disks, split rings, etc., should be disassembled and (except the gas check pad) cleaned immediately after firing, in the same solution used to swab the bore. All traces of powder fouling and primer residue should be

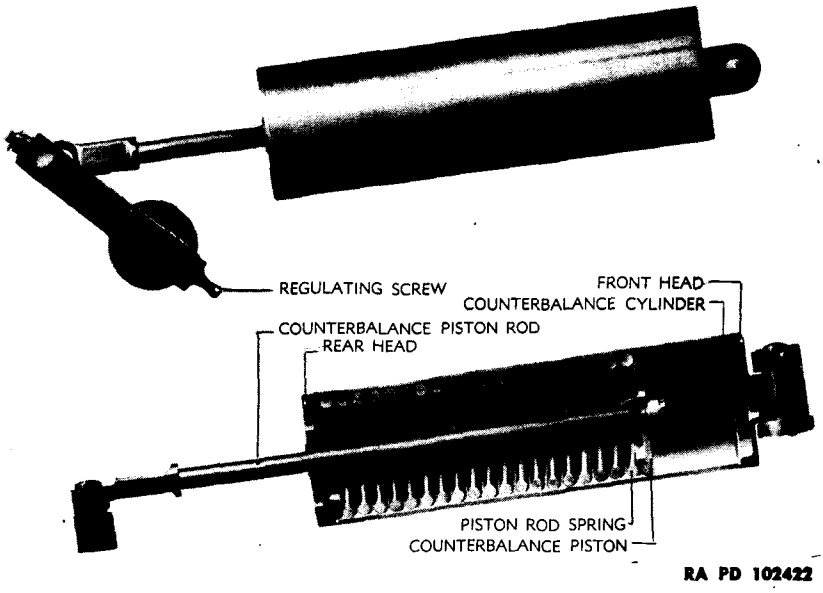


Figure 85 — Counterbalance Mechanism

carefully removed. After rinsing in clean water, dry thoroughly, and coat with oil. Application to moving parts will be made by oilcan if oilholes are present, otherwise, use a clean wiping cloth. Cleaning will be repeated daily until all traces of primer residue have been removed. Daily and after firing, firing lock M17 will be cleaned with dry-cleaning solvent, wiped dry, and oiled. Do not clean this mechanism with soda-ash or soap solutions.

i. Gas check pads.

(1) Extreme care should be exercised in cleaning the gas check pad. After removal from the obturator spindle, the gas check pad will be wiped clean with a dry cloth. 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 solution. CAUTION: *When cleaning the breech assemblies, precaution should be taken that no bore swabbing solution or dry-cleaning solvent ever comes in contact with the gas check pad.*

(2) The old type 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. The Neoprene rubber gas check pad is not affected by normal use of oil, solvents, rifle bore cleaner, or water. It is not seriously affected if dropped to the ground or by

moderately rough handling. Chafing from the openings in the split rings does not seriously affect the proper functioning and serviceability of the Neoprene pads. Periodic reports on operation, maintenance, serviceability, and malfunctioning of the Neoprene gas check pads should be submitted through technical channel to Officer, Chief of Ordnance, Attn: SPOFM.

j. Leveling plates. The leveling plates should be protected. Tools or other articles will not be placed upon them. In case of damage, repair must be made by ordnance maintenance personnel.

Section XVIII

FIRING MECHANISM M1 AND PERCUSSION MECHANISM

63. GENERAL.

a. Firing mechanism (figs. 86 and 87).

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

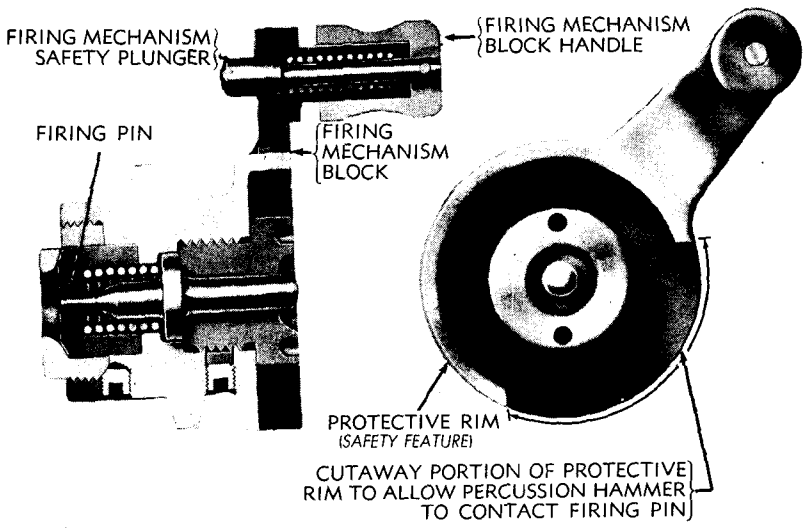
(2) The primer holder (fig. 87) has a left hand thread to prevent it from becoming loose when the firing mechanism is inserted into its receiver housing. The firing pin is guided by the firing pin housing at the rear end and by the part called the guide, at the front end. The pin is held rearward by the firing spring. Set screws secure the primer holder and the firing pin housing.

(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.

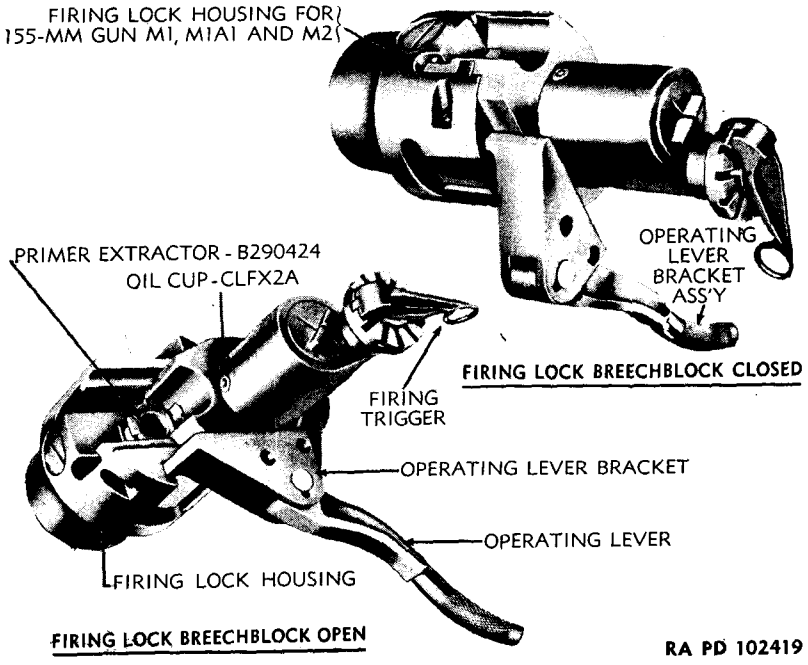
b. Percussion mechanism.

(1) The percussion mechanism consists of the hammer and hinge pin, and the hammer locking pin. These are mounted on the lower arm of the receiver housing. When a lanyard is attached to the hammer and pulled, the hammer swings in an arc, and strikes the firing pin of the firing mechanism, firing the piece (fig. 86).

(2) When the 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.



FIRING MECHANISM M1



FIRING LOCK BREECHBLOCK CLOSED

FIRING LOCK BREECHBLOCK OPEN

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Figure 86 — Firing Mechanism M1 and Firing Lock M17

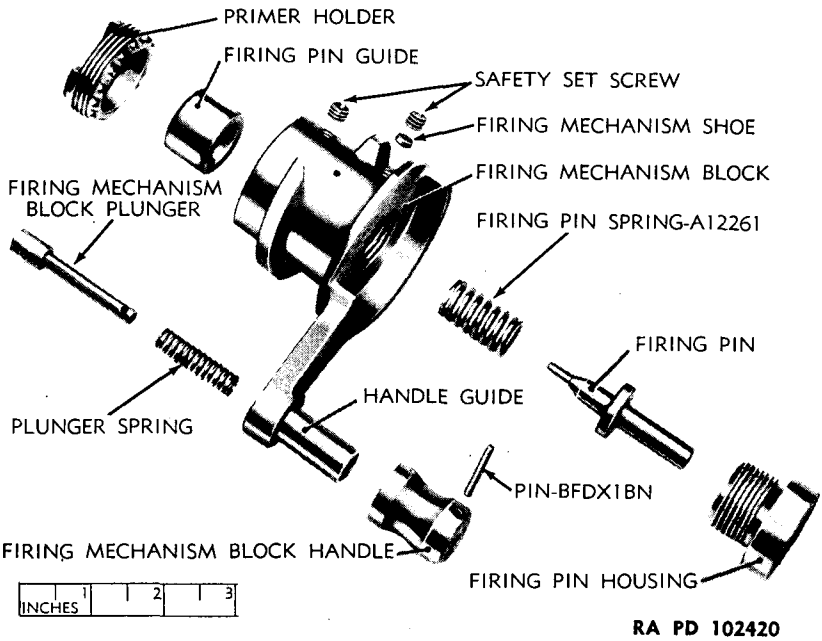

Figure 87 — Firing Mechanism M1 — Exploded View

64. DISASSEMBLY OF FIRING MECHANISM M1 (fig. 87). Remove the safety set screw from the primer holder and unscrew the primer holder. Remove the firing pin guide and the (firing pin) compression spring. Remove the safety set screw and shoe, unscrew the firing pin housing with the wrench provided, and remove the firing pin.

65. ASSEMBLY OF FIRING MECHANISM M1. Place the firing pin guide in its seat in the block and screw the primer holder firmly into its seat, which will hold the guide in position. Aline the nearest serration in the primer holder in the center of the set screw hole. Lock the primer holder with the safety set screw. Place the firing pin spring in the firing pin guide, and the firing pin in the spring. Screw the firing pin housing into the rear end of the firing mechanism block, and assemble the shoe and safety set screw. When the set screws are seated, they must be flush or below the outside of the firing mechanism blocks.

66. DISASSEMBLY OF PERCUSSION MECHANISM. Disassemble the percussion mechanism, starting with the positioning pin located in the knob (fig. 80), then remove the pin in the knob to release the spring and locking pin. Remove pin in forked end of receiver to release hinge pin, then remove percussion hammer.

67. ASSEMBLY OF PERCUSSION MECHANISM. Referring to figure 80, the assembly of the percussion mechanism can be accomplished by a reverse of the disassembly operations.

Section XIX

FIRING LOCK M17

68. GENERAL. The firing lock M17 (figs. 86, 88, and 89) is known as the continuous-pull, self-cocking type; that is, no cocking of the firing pin is required other than a pull on the trigger. This arrangement permits repeating the blow from the firing pin in case of a misfire as often as desired without opening the mechanism or recocking the firing pin. The firing lock, once installed, remains on the weapon and is not removed between successive rounds. This lock is provided with a drop block and the primer is inserted in a manner similar to putting a cartridge in a rifle.

69. REMOVAL OF THE FIRING LOCK. Remove the safety plunger and safety plunger sleeve and unscrew the firing lock and housing from the obturator spindle. NOTE: *This operation should not be attempted unless the breechblock of the cannon is open.* Swing the firing lock operating handle to the right until it disengages the firing lock body. Slide the breechblock clear of the firing lock housing (fig. 90).

70. DISASSEMBLY OF THE FIRING LOCK M17.

a. Remove face plate retaining pin and remove face plate. Lift out firing pin and firing spring (fig. 91).

b. Screw the firing spring locking cap in until it unlocks from the selector. Unscrew the selector four turns and trip the trigger to relieve firing spring pressure. Unscrew trigger assembly and remove.

c. Unscrew firing spring locking cap and remove firing spring. Remove firing hammer and firing spring stop (fig. 91).

d. Compress pull rod spring until the firing trigger pivot pin can be driven out. Remove firing trigger. Compress the pull rod spring further until the keyed end of the pull rod clears the pull rod washer. Rotate the pull rod 90 degrees to aline keyed end with the open end of the washer. Remove pull rod and spring. Remove pull rod bushing from the pull rod. Remove tripper pin and tripper. Remove pull rod washer and rotor from the firing trigger selector (fig. 91).

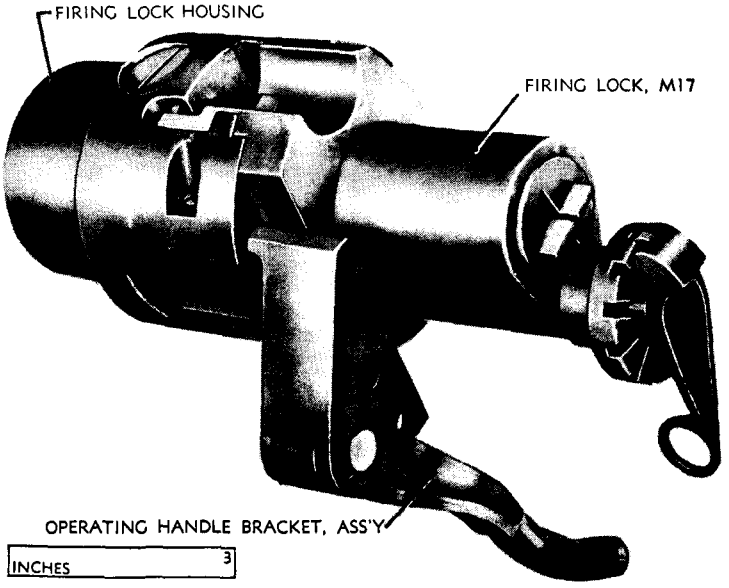

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Figure 88 — Firing Lock M17 — Closed Position

71. REMOVAL AND DISASSEMBLY OF OPERATING HANDLE BRACKET ASSEMBLY. Remove the operating handle bracket pin, and slide the operating handle bracket out of the firing lock bracket. Rotate the operating handle until the keyway in the bracket lines up with the keyway in the lever. Remove the operating handle pivot pin and remove the handle (fig. 89).

72. ASSEMBLY AND INSTALLATION OF OPERATING HANDLE BRACKET ASSEMBLY. Place the operating handle in the operating handle bracket and aline the keyways. Insert the operating handle pivot pin and rotate the handle to lock the pin. Replace the operating handle bracket assembly in the firing lock housing and lock in place with the operating handle bracket pin.

73. ASSEMBLY OF THE FIRING LOCK M17.

a. Assemble the firing hammer tripper to the pull rod and lock in place with the tripper pin. Assemble the pull rod bushing with inner shoulder of the bushing to the rear. Place the pull rod spring over the pull rod. Replace the firing trigger rotor and the pull rod washer in the firing trigger selector. Insert the pull rod in the selector and aline the keyed end of the pull rod with the open slots in the pull rod washer. Compress the pull rod spring and push the

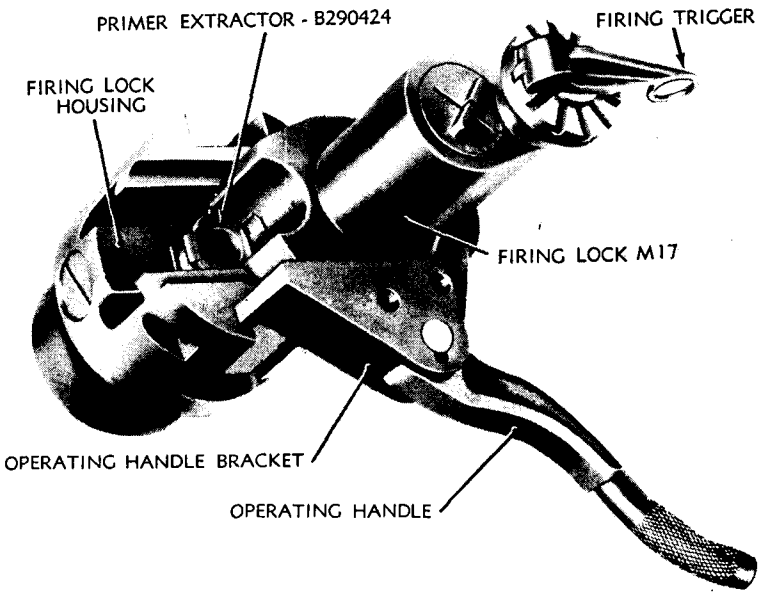

Figure 89 — Firing Lock M17 — Open Position

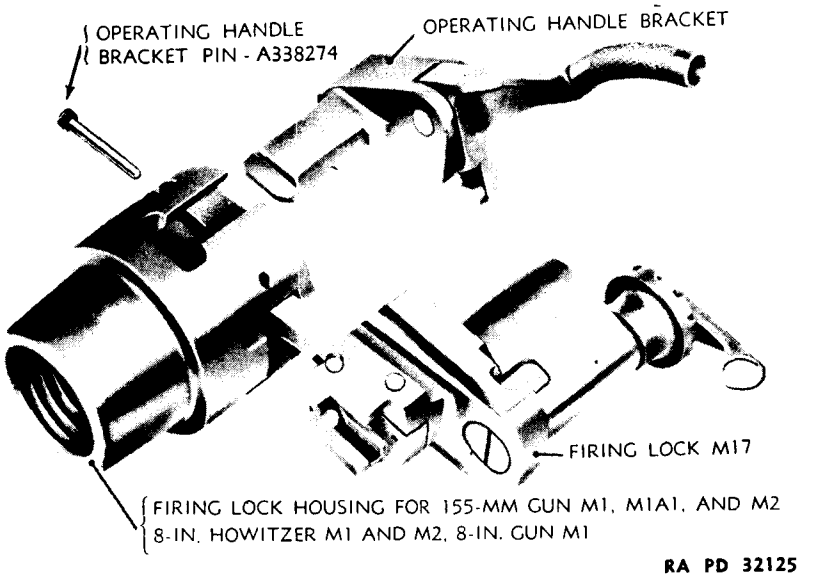

Figure 90 — Firing Lock and Housing

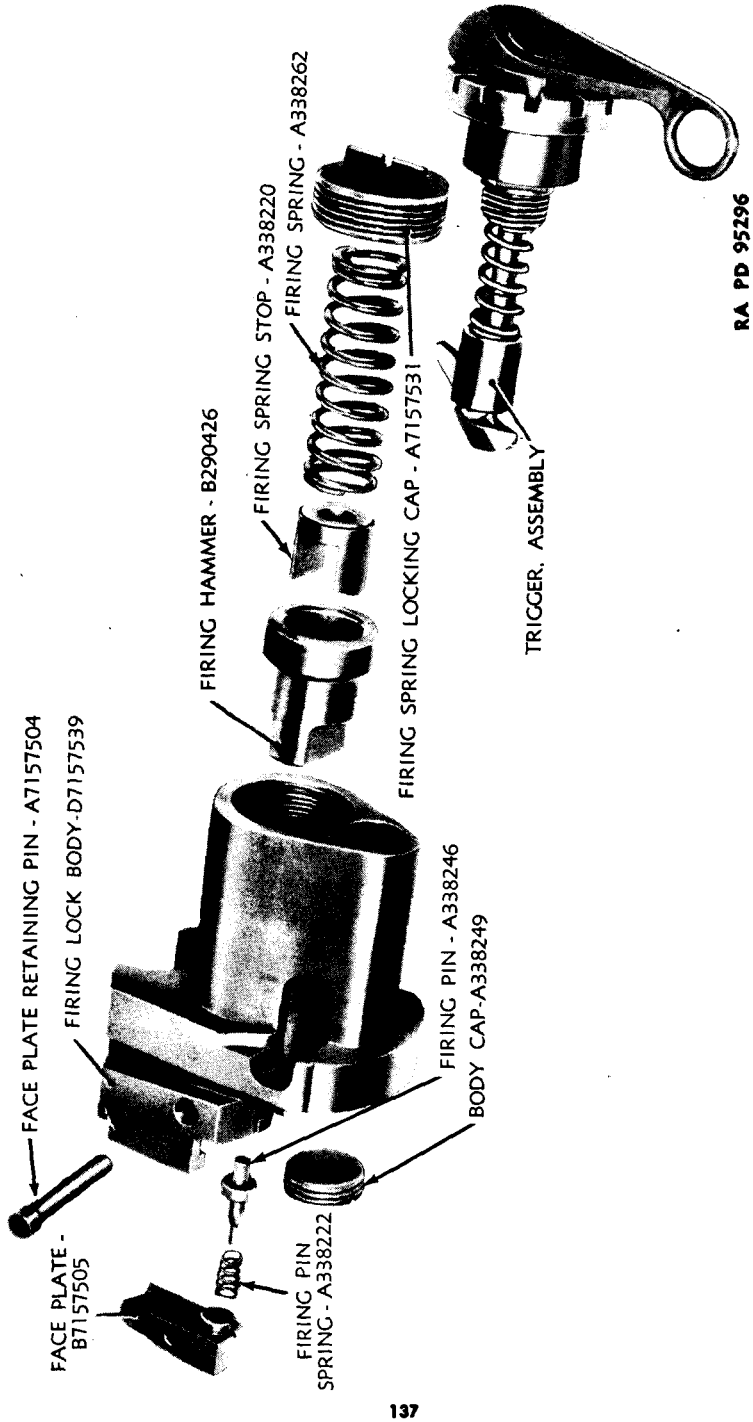

Figure 91 — Trigger Assembly and Firing Hammer and Spring — Exploded View

keyed end of the pull rod through the washer and rotate the pull rod at 90 degrees to aline the keyed end of the pull rod with the closed slots in the washer. Further compress the spring and place the firing trigger in the rotor. Aline the holes and replace the firing trigger pivot pin. Release spring tension.

b. Place the firing spring stop in the firing hammer. Replace the hammer and stop in the firing lock body. Install the firing spring and the firing spring locking cap and screw in cap until snug (fig. 91).

c. Insert assembled trigger assembly into the body. Screw in selector as far as possible, then back off until locking groove on face of selector is alined with the tip of the firing spring locking cap. Unscrew the locking cap until it stops against the face of the selector.

d. Replace the firing pin in the body and place the firing pin retracting spring in place. Assemble the face plate over the firing pin and spring and lock in place with the face plate retaining pin (fig. 91).

74. INSTALLATION OF THE FIRING LOCK M17.

a. Assemble the obturator spindle and the obturating parts to the carrier. Assemble the obturator spindle spring. Screw the firing lock M17 onto the obturator spindle until it stops against the rear face of the shoulder on the obturator spindle plug.

b. Unscrew the firing lock until the elongated hole in the left side of the firing lock housing is alined with the safety plunger hole in the carrier. Install the safety plunger mechanism.

75. CARE AND PRESERVATION.

a. The firing lock (fig. 86) should be kept clean and the parts lightly lubricated. When not in use, remove from the gun.

b. If the firing lock does not work smoothly, or if it requires a greater effort than usual to operate, it should be disassembled and examined. Scoring or bruises on the body or firing lock housing should be reported to ordnance maintenance personnel.

Section XX

RECOIL MECHANISM M3 AND CRADLE

76. RECOIL MECHANISM M3.

a. General. The 155-mm gun recoil mechanism M3 is of the hydropneumatic (variable) recoil type. It is composed essentially of the recoil cylinder, counterrecoil cylinder, and recuperator cylinder (all of which are assembled in the cradle), and the replenisher cylinder (fig. 97). The function of the recoil portion of the recoil

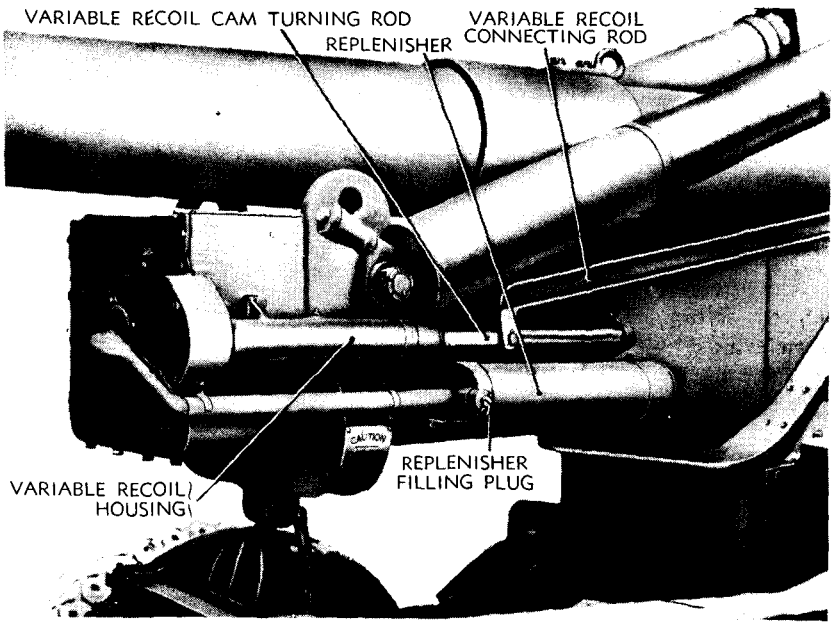

Figure 92 — Replenisher and Variable Recoil Mechanisms

mechanism is to absorb and dissipate part of the recoil energy by compressing the nitrogen gas in the counterrecoil system, limiting length of recoil, and bringing recoiling parts to rest. The function of the counterrecoil and recuperator portions of the recoil mechanism is to store the remainder of the recoil energy. Upon completion of recoil, this stored energy is utilized to return the gun to the in-battery or firing position.

b. Recoil.

(1) During recoil, oil in the recoil cylinder is throttled through openings past the recoil piston, so that recoil energy is absorbed and the gun motion is slowed to a stop. The throttling rod, housed in the recoil piston rod, remains stationary when the gun is fired.

(2) When elevating or depressing the gun, rotation of the control rod controls the size of orifice through which the oil is forced past the piston and this provides a variable recoil. Raising the gun changes the grooves in the recoil cylinder through which the oil is throttled and shortens the length of recoil.

(3) The rear end of the throttling 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 gun is eased into battery position.

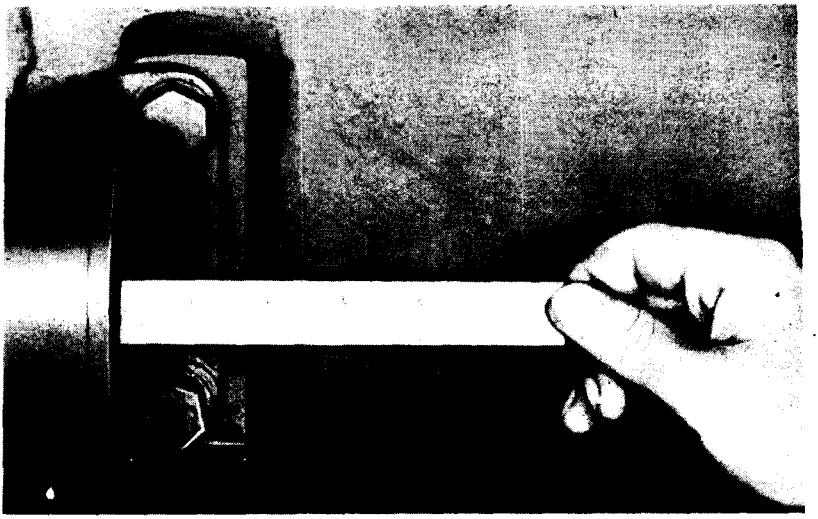

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Figure 93 — Measuring Position of Replenisher Piston

(4) A replenisher is connected to the front end of the recoil cylinder (fig. 92). It serves as a reservoir for excess oil when increased atmospheric temperature or heat develops during firing which 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 muzzle end of the replenisher.

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 oil in the recuperator cylinder, and forces the floating piston in the recuperator cylinder forward to compress further the nitrogen gas in the forward end of the recuperator cylinder. 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. This oil forces the counterrecoil piston and the gun back into battery position.

d. Oil index. The position of the floating piston in the recuperator cylinder and the amount of oil in reserve is indicated (par. 80 b)

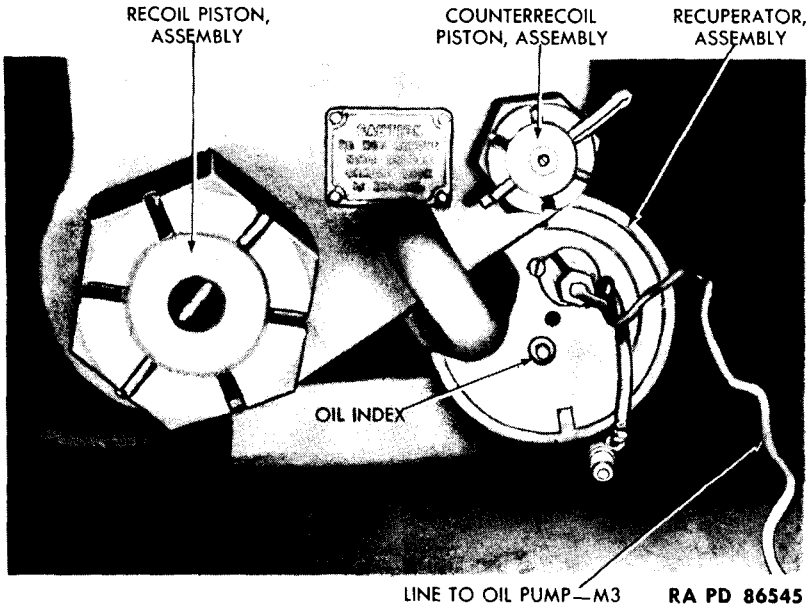

Figure 94 — Pumping Oil Reserve Into Recuperator

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 completely disappear. When the oil index projects less than 5 millimeters, it is necessary to drain completely and refill the oil reservoir as described in paragraph 80.

77. **CRADLE.** The cradle is mounted on the trunnion bearings of the top carriage. It houses the recoil, counterrecoil, and recuperator cylinders, and has the replenisher cylinder attached. The cradle trunnions form the fulcrum for the movement of the gun in elevation. One end of each of the two equilibrators is secured to the cradle near its front end. The other end of the equilibrator is attached to the trunnion cap on the top carriage. A cradle lock connection at the front end secures the cradle lock mount on the bogie to the cradle and is used to hold the cradle in travel position. The elevating arc, which is engaged by the pinion of the elevating mechanism, is secured in alinement on the bottom of the cradle by a projection which fits a mating groove in the cradle. The replenisher and the variable recoil mechanism are assembled to the left side and front end of the cradle. A gun retracting hoist is used for retracting the gun.

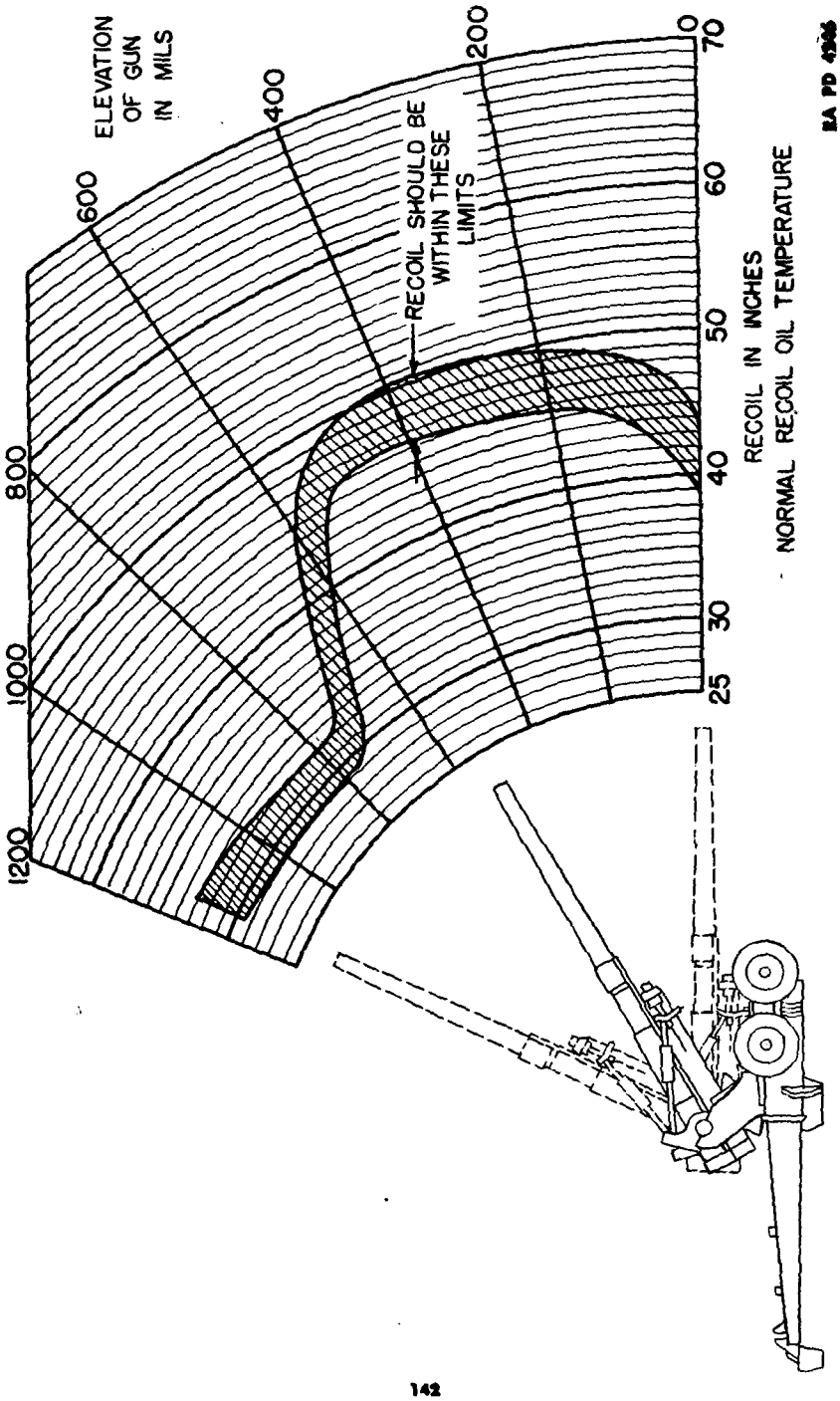

Figure 95 — Limits of Length of Recoil — Normal Charge

78. RECOIL OIL.

a. General. Care must be taken not to use other than the recoil oil prescribed by the Lubrication Order.

(1) Water must not be introduced into recoil mechanism.

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

(3) It is advisable that recoil oil be tested for water. Use a clean glass bottle filled with recoil oil. The oil should be put in a warm place and allowed to settle. If water is present, the water being heavier than the oil will sink to the bottom. With the bottle slightly tilted, drops or bubbles will form in the lower portion. Invert the bottle and hold it to the light. Drops or bubbles of water, if present, may be seen slowly sinking in the oil. If the oil has a cloudy appearance, the cloudiness may be ascribed to particles of water.

(4) If this test should show the presence of water, the oil on hand should be turned in.

b. Care of recoil oil. The transfer of recoil oil to a container not marked with the name of the oil may result in the wrong oil getting into the recoil mechanisms or in the use of recoil oil for lubricating purposes. Recoil oil must not be put into a container not marked with the name of the oil. The following should also be observed: Recoil oils should not be left in open containers, nor subjected to excessive heat. The greatest care must be taken with the recoil oils to exclude moisture and dirt. Except in an emergency, dirty recoil oil should be replaced with new oil. Strain used recoil oil through clean cloth before reinserting in recoil mechanism in the event an emergency arises requiring such reuse. Do not mix recoil oils with any other type of oil.

79. FILLING RECOIL CYLINDER WITH OIL.

a. Purging means removing all air from the line when forcing in the oil. This is accomplished by having one connection in the line slightly loose, and allowing the air to escape, after which the connection is tightened.

b. 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. 93). The normal position of the replenisher piston is 5¾ 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 the replenisher piston is at a point 4 inches

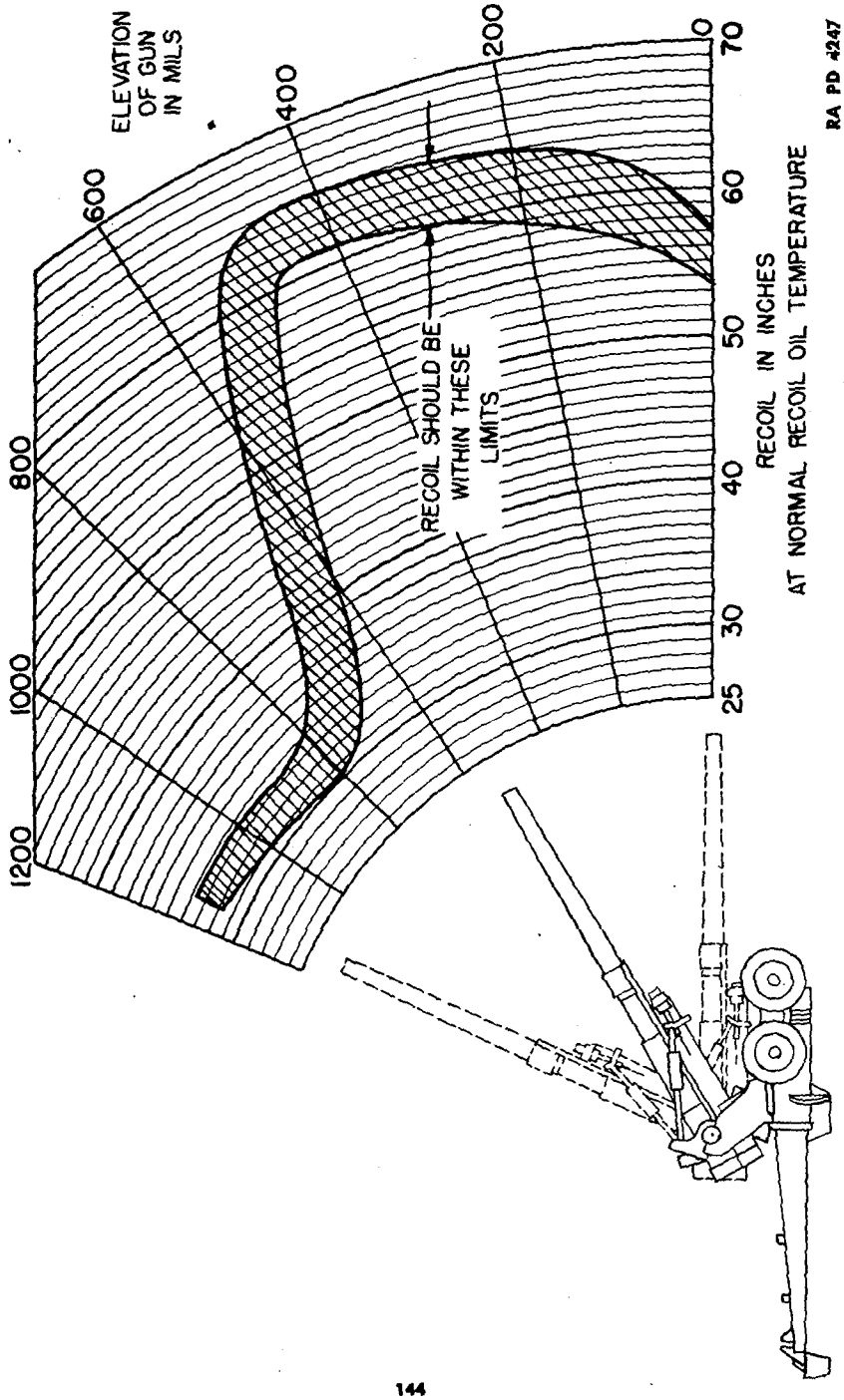

Figure 96 — Limits of Length of Recoil — Supercharge

(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 (oil extractor). When the replenisher piston has moved in to a point 7⅞ inches (200 millimeters) or more from the rear face of the replenisher, add oil.

c. 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. Then release oil from the replenisher by means of the filling and drain valve release (oil extractor) screwed into the replenisher filling and drain hole on the side of the replenisher. If movement of the replenisher piston takes place, proceed with the filling of the recoil cylinder as follows: Unscrew the filling and drain valve release from the replenisher filling and drain hole, screw union of the pump filling tube into the filling and drain hole loosely, and pump a little oil through until all air is excluded. The union should be set up without the use of a wrench, except for the final tightening, and should be just tight enough to prevent oil from escaping. Extreme care must be taken to prevent any damage to the threads of the filling and drain hole, as any damage may put the cradle out of action. Work the pump until the rear end of the replenisher piston is 5¾ inches (150 millimeters) from the rear face of the replenisher. Remove the filling pipe union and replace the filling and drain plug.

d. Measurement of the replenisher piston should conform to the following: *Before firing,* for anticipated slow fire, from 5¾ inches to 7⅞ inches; for anticipated rapid fire and extreme high temperatures, 7⅞ inches. *During firing* 7⅞ inches to "0." Firing should not continue before "0." "0" measurement is obtained when the rear face of the replenisher piston is flush with the rear face of the replenisher. When replenisher piston approaches "0" measurement, drain oil from replenisher. CAUTION: *Be sure to fill replenisher at the end of the day's firing to take care of the contraction of oil which will take place when the system cools off. Never allow replenisher to go beyond the "0" measurement.*

80. FILLING RECUPERATOR CYLINDER WITH OIL (fig. 94).

a. The following instructions, as to the number of strokes, apply only to the oil pump M3.

b. The position of the oil index, which is below the filling and drain plug, should not be used as an absolute guide for determining whether or not 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. This position is not a definite indication of the

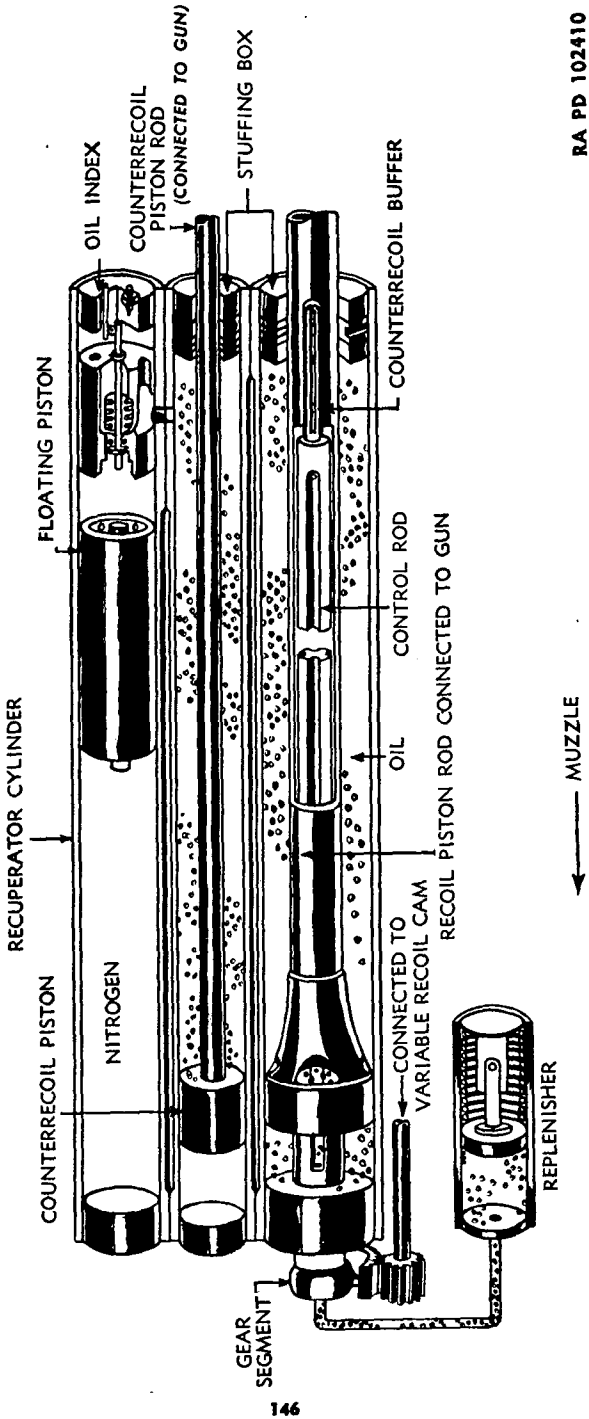

Figure 97 — Variable Recoil Mechanism With Replenisher — Schematic View

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. On the other hand, it may extend out 5 millimeters, and there may not be sufficient reserve in the system. The only way to know that the system is full is by filling it.

c. When the gun does not return to battery, or the position of the oil index indicates that there is too small a quantity of oil in the recuperator, it will be necessary to drain off the reserve oil before refilling. This is accomplished by removing the plug from the filling and drain hole located on the breech end of the recuperator. Screw in the filling and drain valve release (oil extractor), and allow oil to drain until the flow ceases. Remove the filling and drain valve release (oil extractor). It will be noted that the oil index has receded before all of the reserve oil has been releasd. If the oil index has not moved, tap it gently with a small piece of wood, as it may be stuck. Purge the oil pump, clean the union of the pump tubing or hose, and screw the union loosely into the filling and drain hole. Work the pump a few times until 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 it running dry. If air should get in the tubing, it will be necessary to purge the line again. Tighten the union just 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. 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. One stroke is considered one complete cycle of the pump handle.) This quantity of oil is considered the correct reserve.

Section XXI

EQUILIBRATORS

81. GENERAL.

a. Two equilibrators of the pneumatic type (fig. 98) are provided to balance the weight of the gun muzzle and reduce the manual effort required to elevate the gun through the lower elevations. They consist primarily of cylindrical cases and plungers (fig. 99). They are filled with nitrogen gas under pressure and are equipped with appropriate grease seals to retain the gas. NOTE: *The equilibrators are not to be disassembled except by ordnance personnel.*

b. Temperature adjustment scale (fig. 26). Temperature adjustment scales are provided on both sides of the gun to provide for an adjustment of the tension of the equilibrators for various

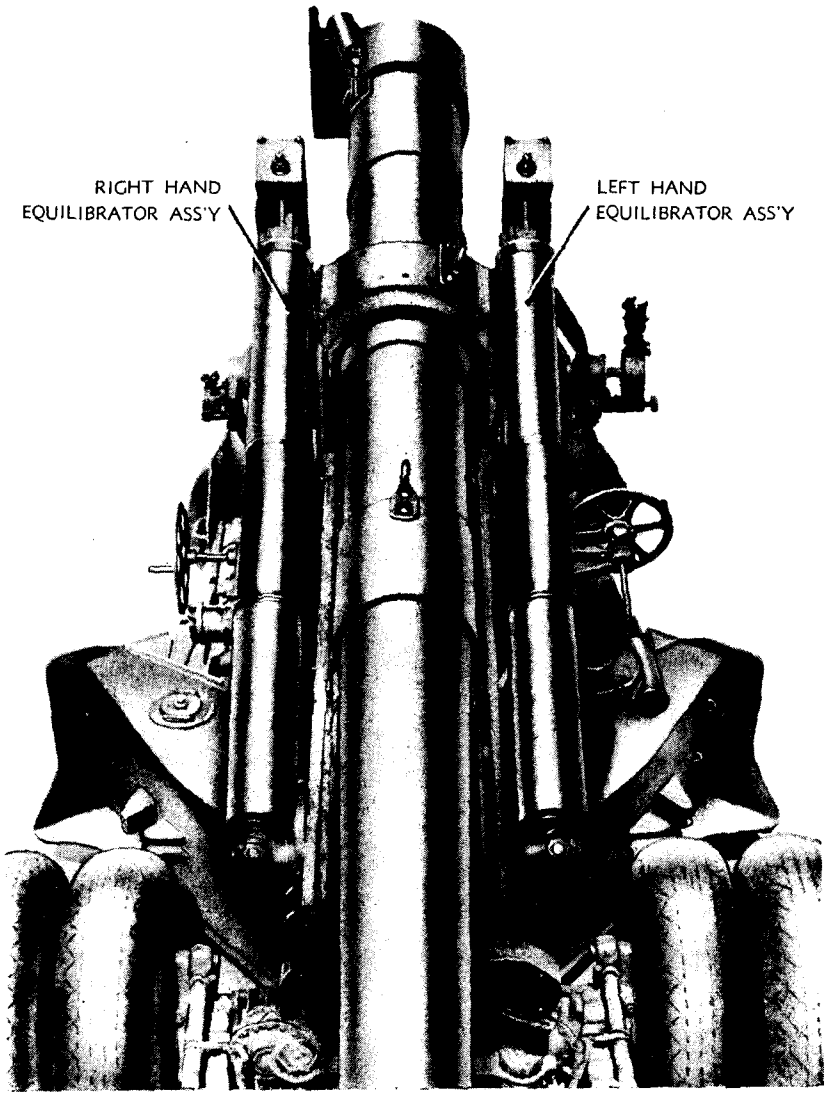

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Figure 98 — Equilibrators

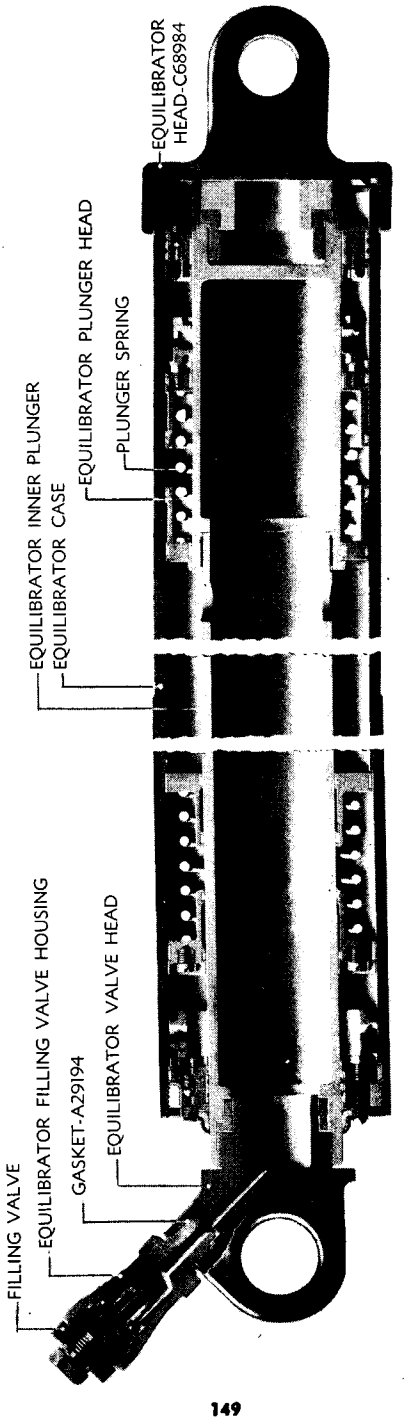

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Figure 99 — Section Through Equilibrator Cylinder

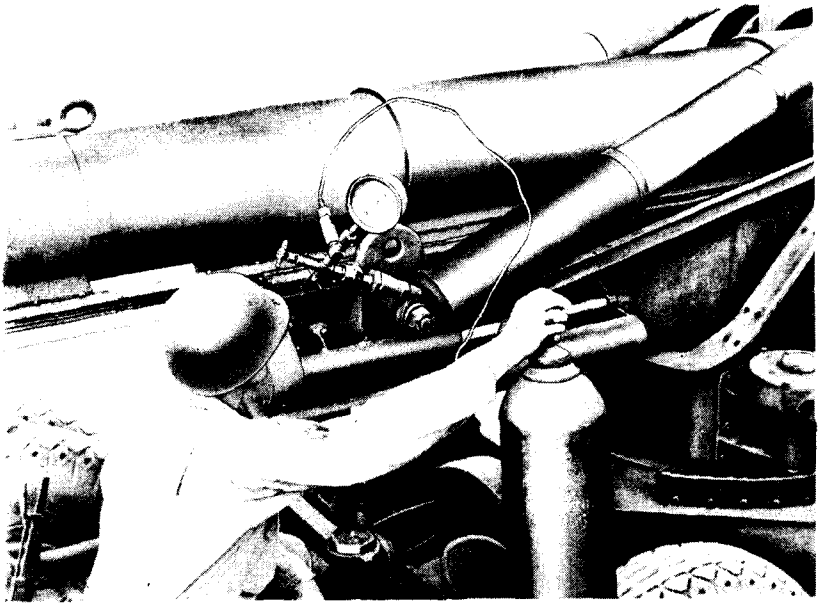

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Figure 100 — Charging Equilibrators With Nitrogen

temperatures. For satisfactory functioning, the equilibrators should be set for a temperature corresponding to the atmospheric temperature at the time of firing the gun. The adjustment may be made by trail since the scale is not correct if the equilibrator pressure is not normal. Operation of the temperature adjusting screw raises or lowers the guide and index along the temperature scale.

c. To measure the nitrogen pressure (figs. 100 and 101). CAUTION: *The nitrogen pressure in the equilibrators is normally about 1500 pounds per square inch at 70° F. Hence, every caution in the following steps 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.*

(1) With the carriage approximately level, place the gun in battery and bring it to zero elevation. Check with gunner's quadrant.

(2) Remove the gas filling 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 device are closed, and that the valve opener has been

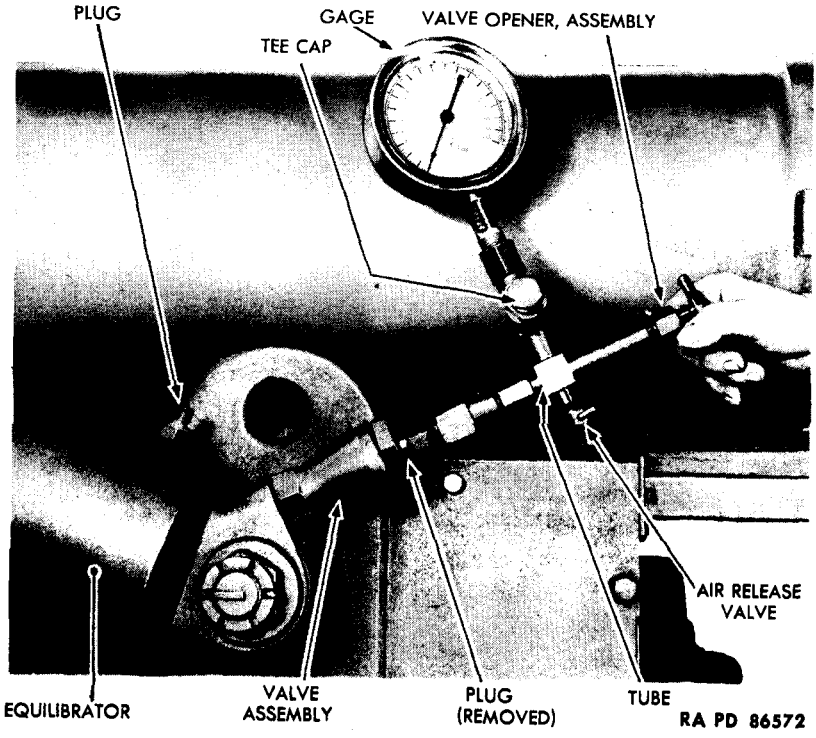

Figure 101 — Checking Equilibrator Pressure

unscrewed until the point has been withdrawn into the body of the device.

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

(5) Screw the air filling device and gage into the gas filling valve assembly of the equilibrator from which the plug was removed. 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.

(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 band.

(7) The pressure in the equilibrator will now be indicated on the gage. The gage reading should coincide with the pressure required for the elevation of the gun and the atmospheric temperature as specified in the table below. The leeway allowed is 89 pounds above the specified reading, and 56 pounds below. (The tolerance on the lower limit is smaller than on the higher limit because about 15 pounds of pressure is lost during each test.)

(8) If the pressure is more than 89 pounds above that given in the table for the charging temperature, partially open the air release valve and allow a slow escape of gas while tapping the gage lightly until the proper pressure is indicated. Close the air release valve. 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 device and allow the pointer to go back to zero gradually. Remove the air filling device and gage. Install the gas filling plug and gasket. Tighten the plug fully.

(9) If the pressure is between the limits given in step (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 device and allow the pointer to go back to zero gradually. Remove air filling device and gage. Install plug and gasket. Tighten plug.

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

Temperature (degrees F)	Weapon at Zero-degree Elevation Equilibrator Extended
−40	1110
−20	1185
0	1308
10	1337
20	1366
30	1395
40	1423
50	1452
60	1481
70	1510
80	1539
90	1567
100	1596
110	1625
120	1710

d. To add nitrogen to the equilibrator. If the pressure is more than 56 pounds below the desired pressure, 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 (fig. 100). Be sure the air release valve is closed. Open the cylinder valve very slowly, tapping the gage lightly until it registers. The pressure of the nitro-

gen cylinder registered on the gage should exceed the desired pressure in the equilibrator, as specified in the table.

(3) Close the cylinder valve. Screw in the valve opener, just far enough to allow the gage to register the pressure of 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 (from 10 to 40 pounds) of that specified in the table for the temperature at which the filling operation is taking place, close the nitrogen cylinder valve.

Section XXII

BOGIE

82. DESCRIPTION.

a. General. The two-axle dual-tired bogie supports the weight of the gun carriage when it is in traveling position and is equipped with mechanism for lowering the carriage to the ground for firing position. The carriage is raised for traveling or lowered for firing by means of the bogie lifting mechanism actuated by turning the two bogie lifting screws.

b. Disassembly and assembly. No disassembly or assembly of the bogie is permitted.

c. Maintenance. The bogie should be kept clean all over and lubricated properly. Tires should be cared for as outlined in paragraph 83.

Section XXIII

WHEELS AND TIRES

83. GENERAL.

a. The bogie is equipped with four sets of dual-disk and rim-type wheels with pneumatic tires (fig. 102). The heavy carriage limbers are equipped with two single-disk and rim-type wheels with pneumatic tires. Disk and rim wheels of the limbers are interchangeable with the disk and rim wheels on the bogies. An alternate type of disk and rim wheel is issued with these units that is interchangeable with the present type used, provided the alternate disk and rim wheel is equipped with its proper tire locking ring. The tire locking rings of the regular-type disk and rim wheel and the alternate-type are not interchangeable.

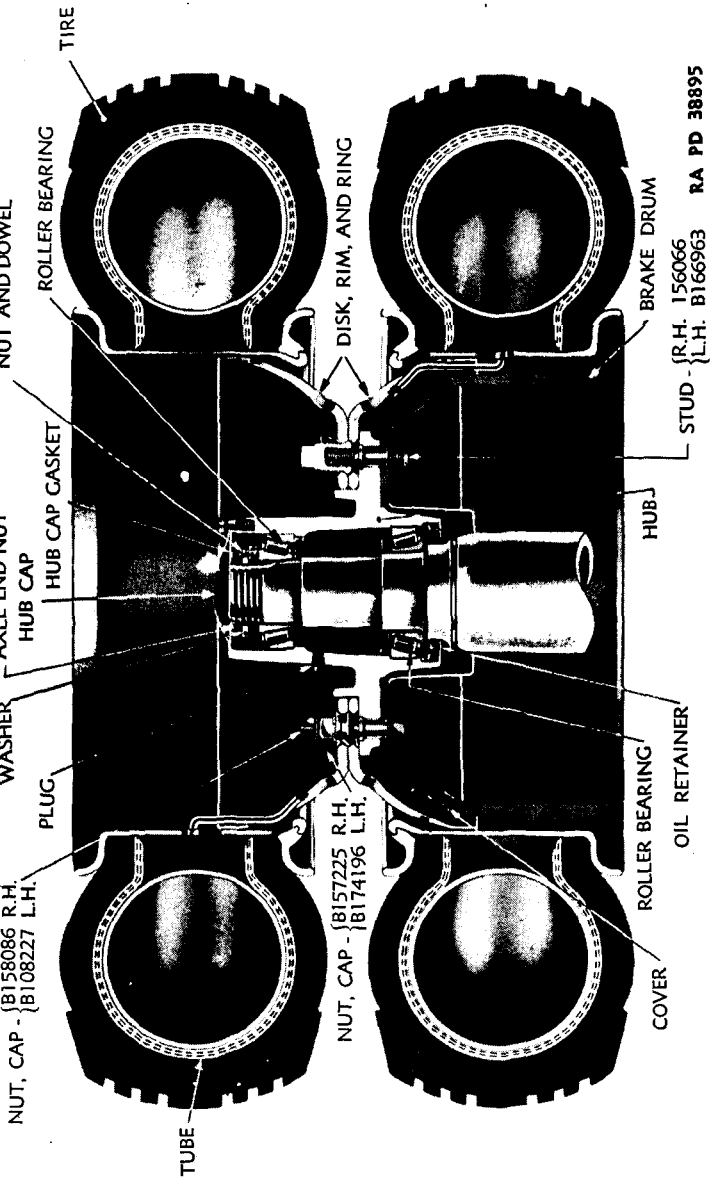

Figure 102 — Dual Wheel — Sectioned

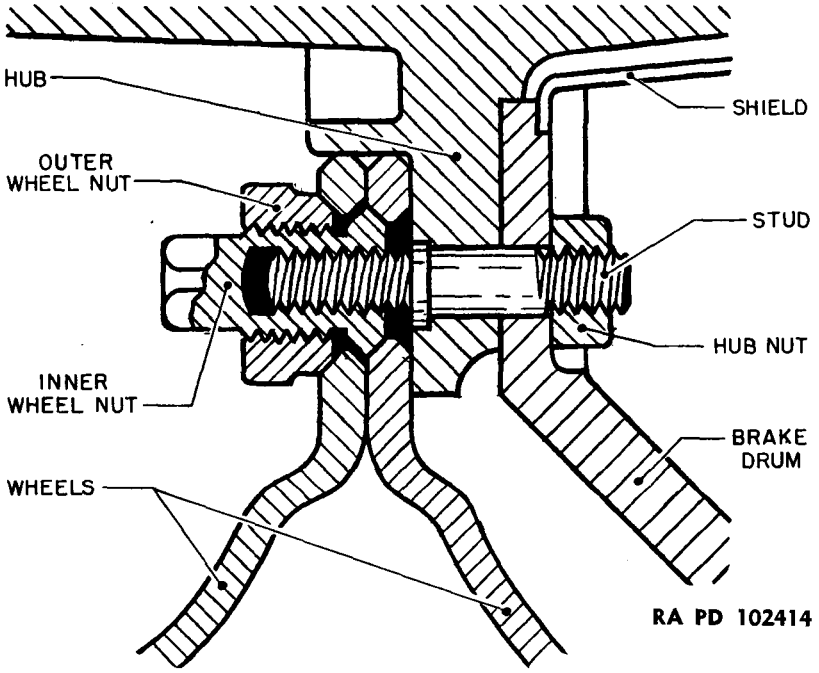

Figure 103 — Dual Wheel Mounting

b. To remove wheels and hubs.

(1) Raise the wheels clear off the ground by means of the jack provided, or by lowering the carriage to the ground and raising the bogie wheels with the lifting mechanism.

(2) OUTSIDE WHEELS. Remove cap nuts (fig. 103). Note right- and left-hand thread feature of the nuts.

(3) INSIDE WHEELS. Remove outside wheels as described. Remove cap nuts. Note left- and right-hand thread feature of the nuts.

(4) HUBS. Remove wheels as described. Remove the hub cap and its gasket by removing the six cap screws which secure them to the hub. Remove the axle and 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 roller bearing or the oil retainer at the inner end of the hub.

(a) Remove bearing cone assemblies from hub. Wash bearings, cones, spindle, and inside of hub, and dry thoroughly. Inspect bearing races and report to ordnance maintenance personnel if damaged. Coat the spindle and inside of hub and hub cap with prescribed grease to a maximum thickness of $\frac{1}{16}$ inch only, to retard rust.

Lubricate bearings with a packer, or by hand, kneading lubricant into all spaces in the bearing. Use extreme care to protect the bearings from dirt, and immediately reassemble and replace wheel. Do not fill hub or hub cap. The lubricant in the bearing is sufficient to provide lubrication until the next service period; any excess might result in leakage into the drum.

(b) Thoroughly clean all component parts of the assembly. 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 toward the roller bearing. Carefully place the hub and bearing over the axle end. 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 of the nut engages one of the holes in the washer, thereby locking the nut. Assemble and tighten the axle and nut against the axle washer. Put the hub cap and gasket back on the hub. Assemble the wheels to the hub.

c. Removal of tires and tubes.

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

(2) REMOVE TIRE LOCKING RING. Figure 106 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.

(3) 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. 104) or a blunt wedge and mallet.

(4) 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.

(5) REMOVE INNER TUBE (fig. 105). With a tire spreader, spread the casing 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. 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 with no sharp edges may be used after removal has been started by hand. Bullet-resisting tubes should be partially

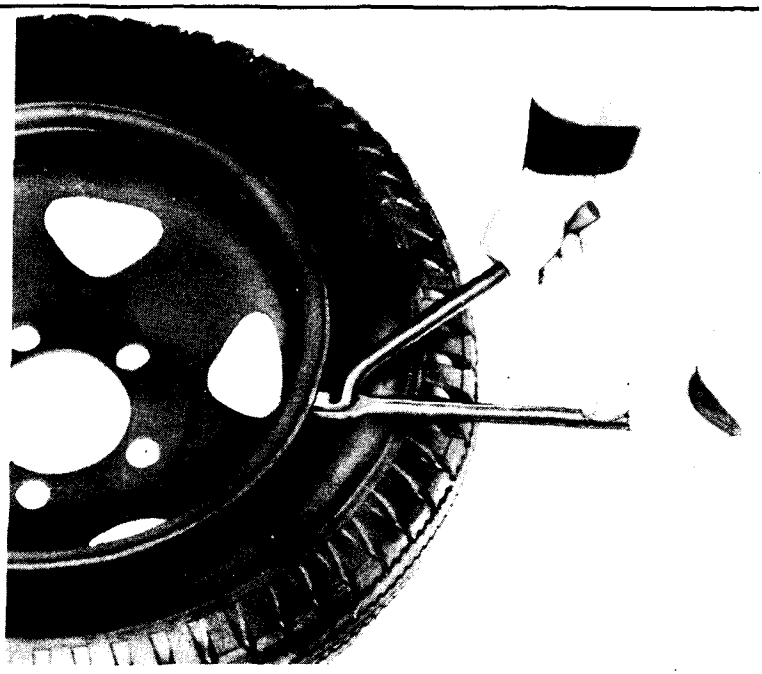

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Figure 104 — Loosening Tire From Wheel

inflated immediately after removing the tire to prevent the inside surfaces from sticking and sealing together.

d. Installation of tires and tubes.

(1) INSPECT AND REPLACE PARTS. Inspect the wheel and locking ring to see if they are bent or otherwise damaged, excessively worn, or unfit for service. Damaged tires, in many cases, can be repaired, while excessively worn tires and damaged inner tubes should be replaced.

(2) INSTALL INNER TUBE. Spread the tire casing with the tire spreader or wooden blocks to permit installing the inner tube. 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, however, they are more difficult to handle. NOTE: *After installing the tube, partially inflate and deflate several times to remove all kinks and folds.*

(3) MOUNT TIRE ON WHEEL.

(a) Insert the valve stem in the wheel slot, working the tire into position on the wheel. Soap may be used as a lubricant to aid in slipping the tire onto the wheel.

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Figure 105 — Removing Tube From Tire

(b) Place the tire and wheel flat on the floor (gutter side of 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.

(4) PARTIALLY INFLATE TIRE. With wheel and tire assembly flat on the floor (locking ring up), 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.

(5) INFLATE TIRE. Place tire in normal vertical position and inflate from the side opposite the tire locking ring. CAUTION: *Stand to the side of the wheel and tire assembly, away from the tire locking ring, to avoid injury in case improper installation causes the locking ring to blow off.*

e. Maintenance of tire.

(1) AIR PRESSURE IN TIRES.

(a) Tires should be checked for proper readings and inflated when necessary to prescribed air pressure. The air pressure for the bogie tires under average conditions is 45 pounds. This air may be increased to 54 pounds when traveling over improved highways or

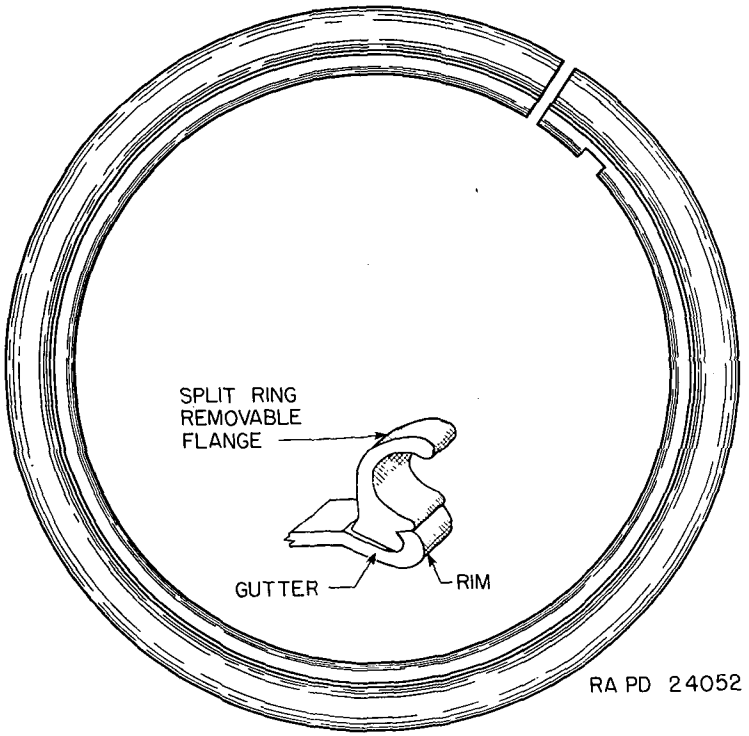

Figure 106 — Tire Lock Ring

decreased to 36 pounds when traveling over soft terrains. The air pressure for the limber tires under average conditions is 65 pounds. This air may be increased to 70 pounds when traveling over improved highways or decreased to 60 pounds when traveling over soft terrains. When checking pressures, check valve cores for leaks. Always use an accurate gage to determine air pressure. All air gages should be checked periodically with a precision-type gage. Never try to judge air pressure by the eye or by kicking a tire. Check pressure when tires are cool.

(b) Tires should never be bled (air let out) during or immediately after operation. Tires heat as they roll, and heat causes air to expand, which increases the pressure. Bleeding reduces air pressure, not the temperature. Bleeding actually makes tires run hotter, and may cause sudden, complete tire failure. When a bled tire cools, it is dangerously underinflated.

(2) VALVE CAPS ON ALL TIRES. Equip every tire with a valve cap to prevent dirt from entering the valve core and causing leakage. In addition, a firmly screwed-down cap provides a final seal against air escaping from the tire. Tighten with fingers only; do not use pliers.

(3) POSITION OF VALVE. For speed and convenience in inflating, valve stems should be readily accessible. They should be properly centered in valve slots.

(4) TIRES TO BE RETREADED.

(a) Tires should be watched carefully, and then removed when the tread is worn off the center. If removed too soon, usable rubber is wasted. If removed too late, cord body may be injured, since it then lacks protection provided by the tread, or tire may be worn to the extend that retreading is impossible. It should be noted that tires are very easily punctured by studs left from wood and brush.

(b) When the tread design is worn off, so that the tire is smooth in the center, the tire should be replaced. Tires with irregular wear, worn to the extent that the cord body shows in any spot, or worn through the tread design in several spots, should likewise be replaced.

(5) INJURED TIRES.

(a) Tires are constantly subjected to injuries from cuts, bruises, and road shocks. It is dangerous to drive with an injured tire, because it may blow out any moment and cause the driver to lose control, and possibly put a much needed vehicle out of military action. Carefully inspect your tires after every run. Remove glass, nails, stones, and other foreign materials imbedded in tires.

(b) Always be on the alert against the following tire condition:

1. Replace when cuts extend to or into the fabric.

2. A bulge indicates internal injury. This injury may have been developing for some time. Replace in the event that cord fabric is injured or tire is otherwise damaged or has failed.

3. Small tread cuts, not extending to or into the fabric, is not reason to replace tire, but watch such cuts for penetration to cord body and enlargement, at which time the tire should be replaced. Large cuts, with exposure of cord fabric imminent, is reason for tire replacement.

(6) IRREGULAR TIRE WEAR. At the first sign of irregular wear, tires should be changed at different wheel positions, and immediate investigation of cause should be made by ordnance maintenance personnel.

(7) TOE-IN MISALINEMENT. Tires wear rapidly when wheels are improperly alined, and the telltale sharp or feathered edges appear on the tread. Front tires, especially, should be watched for rapid wear with sharp or feather edges. When this condition develops, ordnance maintenance personnel should be notified immediately.

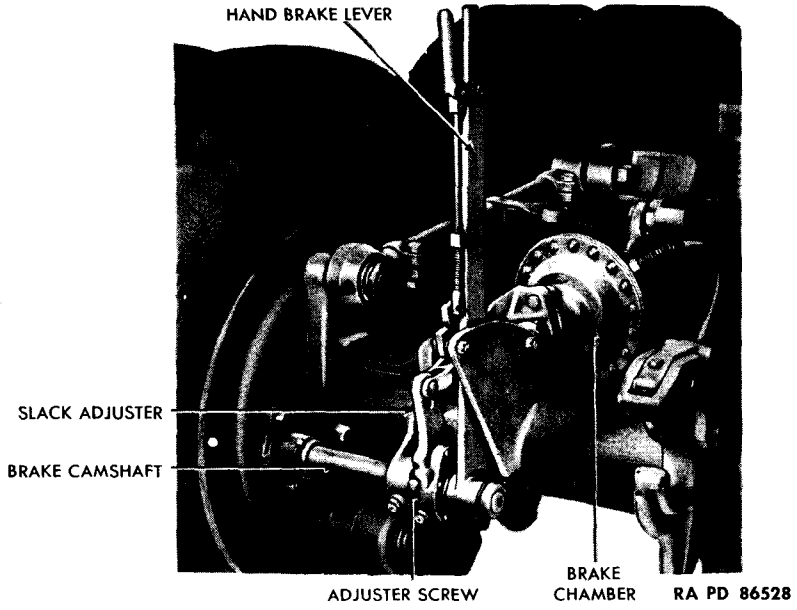

Figure 108 — Slack Adjuster

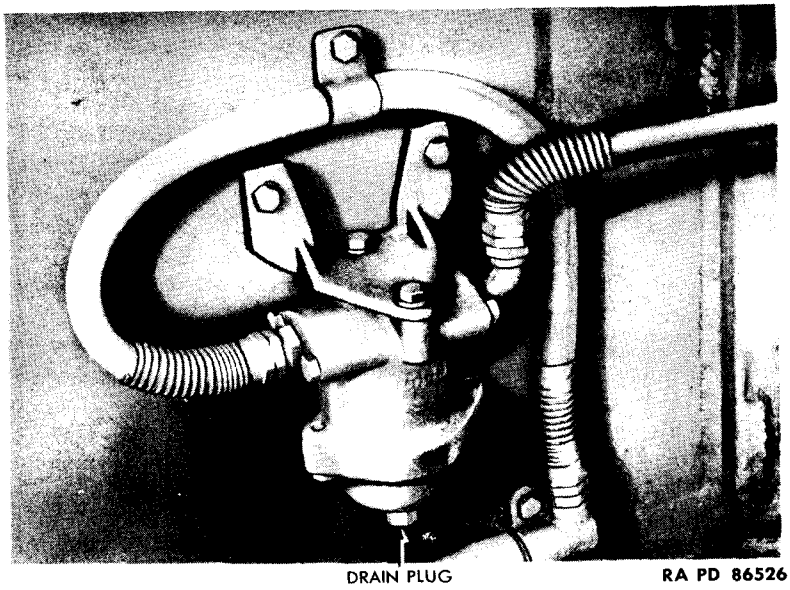

Figure 109 — Air Filter