

TM9-463

WAR DEPARTMENT

TECHNICAL MANUAL

GUN, 8 IN., MK. VI, MOD. 3A2 AND
MOUNT, RAILWAY, GUN, 8 IN., M1A1

JANUARY 26, 1942

*Rescinded by
D/A Circular 310-31
dtc-4 JAN 56*

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1

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Gun, 8 in., Mk. VI, Mod. 3A2
and mount, railway, gun, 8
in., M1A1

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ERRATA SHEET

Technical Manual 9-463 - Gun, 8 in., Mk. VI, Mod.
3A2 and Mount, Railway, Gun, 8 in., M1A1 - January
26, 1942.

Page 57 - Paragraph 54 is changed in its entirety
to read as follows:

54. GENERAL. - a. The purpose of inspection
is to observe the condition of the materiel, to
determine whether repairs or adjustments are re-
quired, and to recommend remedies necessary to
insure that the materiel is serviceable.

b. Certain inspections herein outlined re-
quire disassembly normally performed by Ordnance
personnel. Such disassembly will be carried on
under the supervision of an officer or a chief
mechanic.

Page 62 - Add as last sentence in paragraph 73 a.

"Whenever ordnance personnel are available
they should be notified when disassembly is neces-
sary."

TECHNICAL MANUAL
No. 9-463

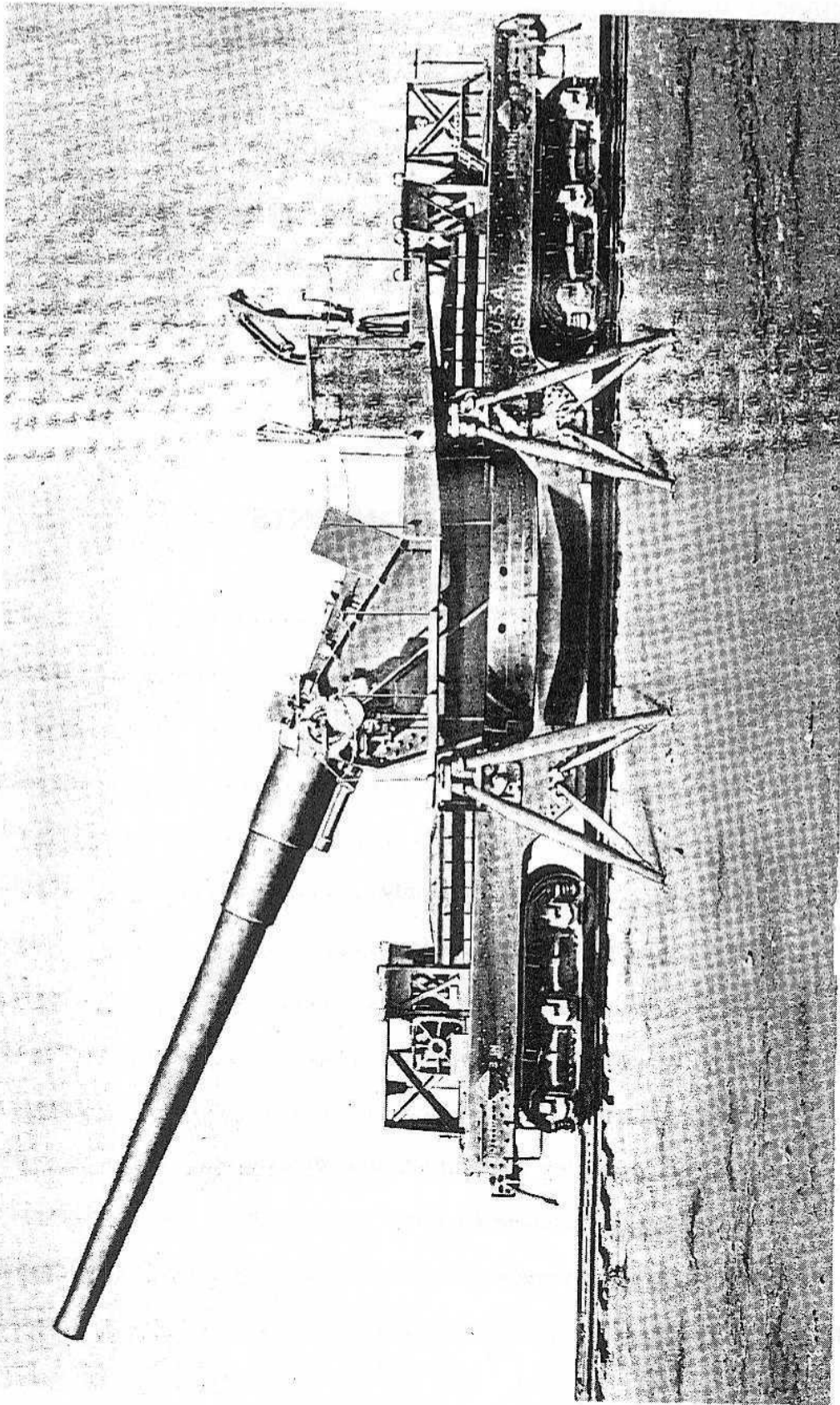
WAR DEPARTMENT,
Washington, January 26, 1942

ORDNANCE MAINTENANCE
GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT,
RAILWAY, GUN, 8 IN., M1A1

Prepared under the direction of the
Chief of Ordnance

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INTRODUCTION

SECTION I

INTRODUCTION

	Paragraph
Scope	1
Data	2

1. SCOPE. — *a.* This manual is published for the information and guidance of the using arms and services and ordnance maintenance personnel.

b. In addition to the description of the 8-in. railway gun materiel, this manual contains technical information required for identification, use and care of the materiel.

c. Complete disassembly, assembly, inspection, maintenance and repair instructions are included in the manual and are for the information of ordnance personnel.

2. DATA. — *a.* *Weights, dimensions, and ballistics of the 8-in. gun, Mk. VI, Mod. 3A2.*

- Depth of rifling.....07 in.
- Length of bore.....45 calibers
- Length of rifling.....288.79 in.
- Type of breechblock..... Interrupted screw
- Type of firing mechanism..... Electrical and percussion
- Type of rifling..... Right hand, uniform twist,
one turn in 25 calibers
- Weight of gun with breech mechanism. 42,000 lb.

b. Ammunition Data.

- Maximum range 32,000 yards (approx.)
- Maximum service powder pressure... 38,000 lb. per sq. in.
- Muzzle energy (A.P. 260 lb. shell)... 13,647 ft. long tons
- Muzzle velocity*
- A.P. 260 lb. Mk. XX (Normal charge). 2100 ft. per sec.
 (Super charge)... 2750 ft. per sec.
- H.E. 240 lb. M103 (Normal charge)... 2150 ft. per sec.
 (Super charge)... 2840 ft. per sec.
- Practice projectile 260 lb.
- (Normal charge) 2100 ft. per sec.
- (Super charge) 2750 ft. per sec.
- Seating of shell*
- A.P. 260 lb..... 74.75 in.
- H.E. 240 lb..... 70.5 in.
- Travel of projectile in barrel*
- A.P. 260 lb..... 294.6 in.
- H.E. 240 lb..... 298.59 in.
- Volume of powder chamber..... 5,410 cu. in.

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Weight of powder charge

- Normal75 lb. 12 oz.
- Super108 lb. 8 oz.

c. *Mount, 8-inch gun, railway, M1A1.*

- Brakes, typeMechanical, air operated
- Maximum elevation45°
- Maximum firing elevation.....45°
- Minimum elevation.....(-)5°
- Minimum firing elevation.....0°
- Over-all weight (carriage and gun)...230,000 lb.

Recoil mechanism

- Final air pressure in recuperator...2683 lb. per sq. in.
- Final liquid pressure in intensifier...3065 lb. per sq. in.
- Initial air pressure in recuperator...1660 lb. per sq. in.
- Initial liquid pressure in intensifier..1828 lb. per sq. in.
- Normal recoil27 in.

Traveling dimensions

- Height13 ft. 10 in.
- Length49 ft. 4 in.
- Width10 ft. 3 in.
- Traverse360° (continuous)

INTRODUCTION

RA PD 4949

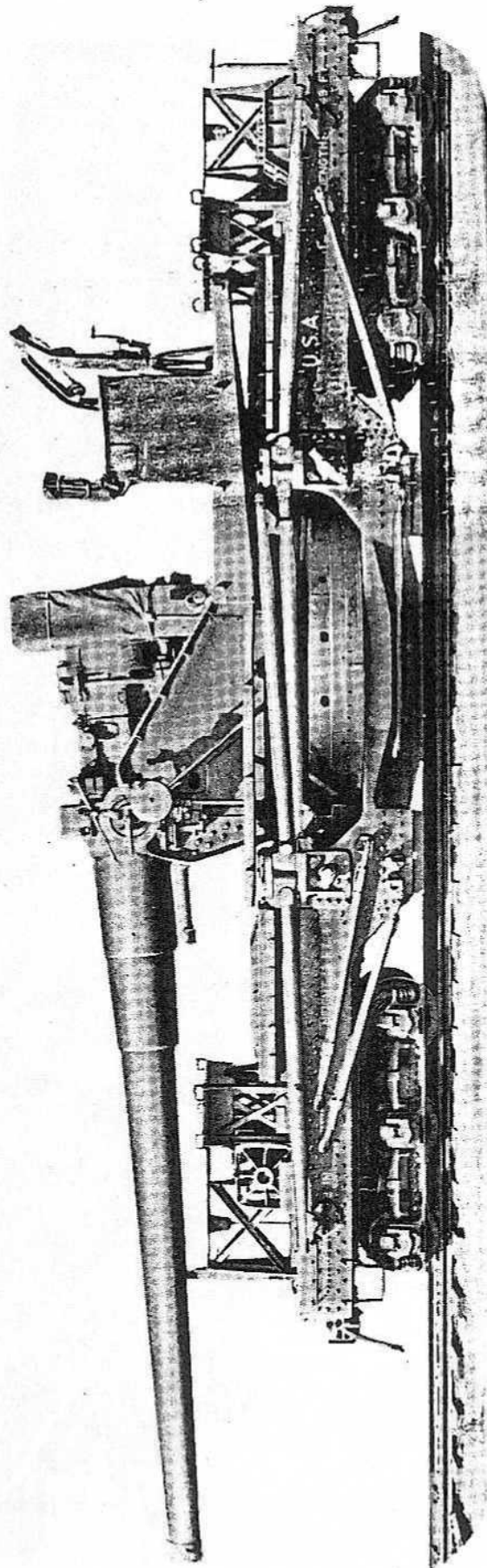


FIGURE 1 — TRAVELING POSITION — LEFT SIDE

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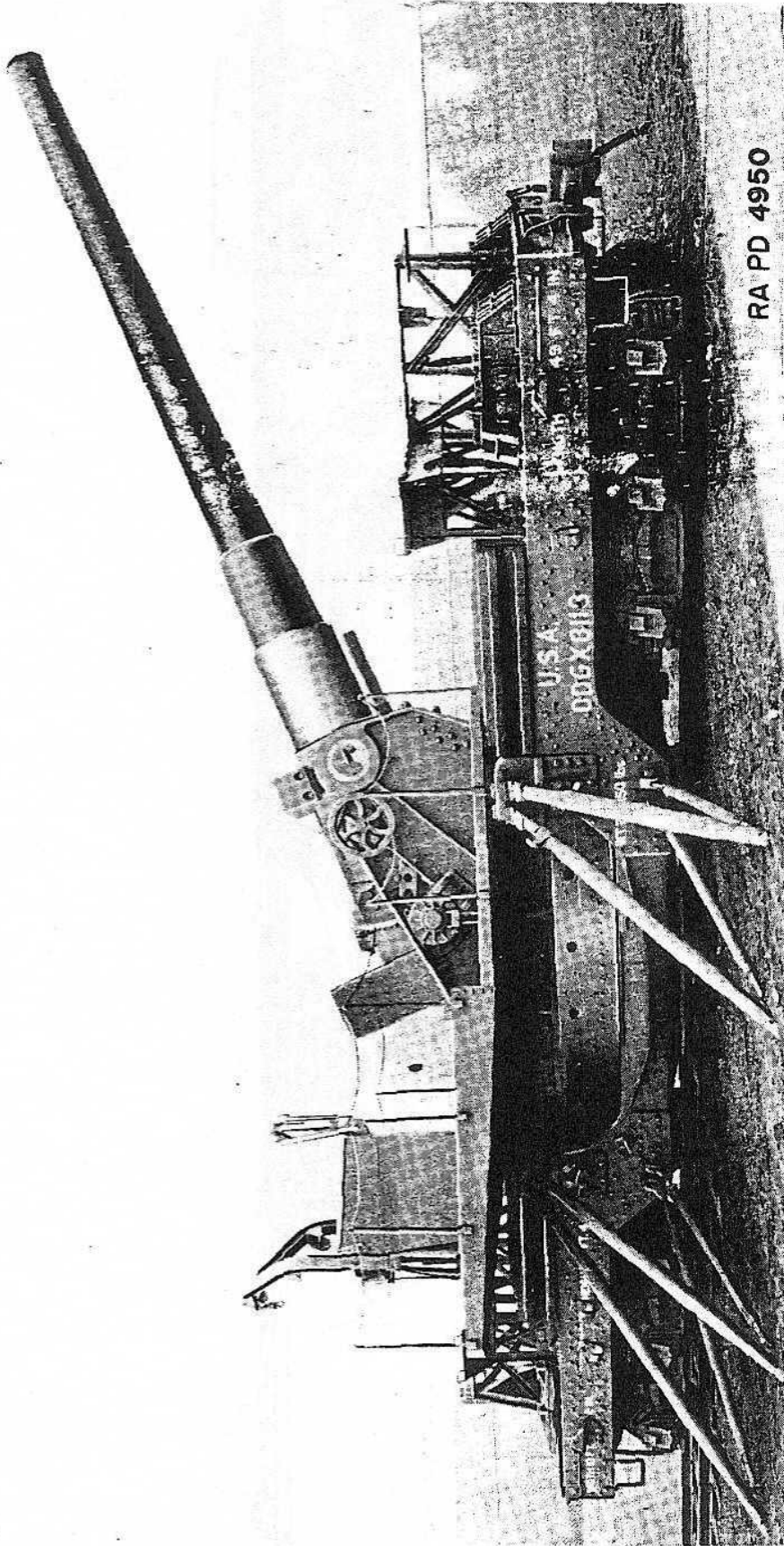
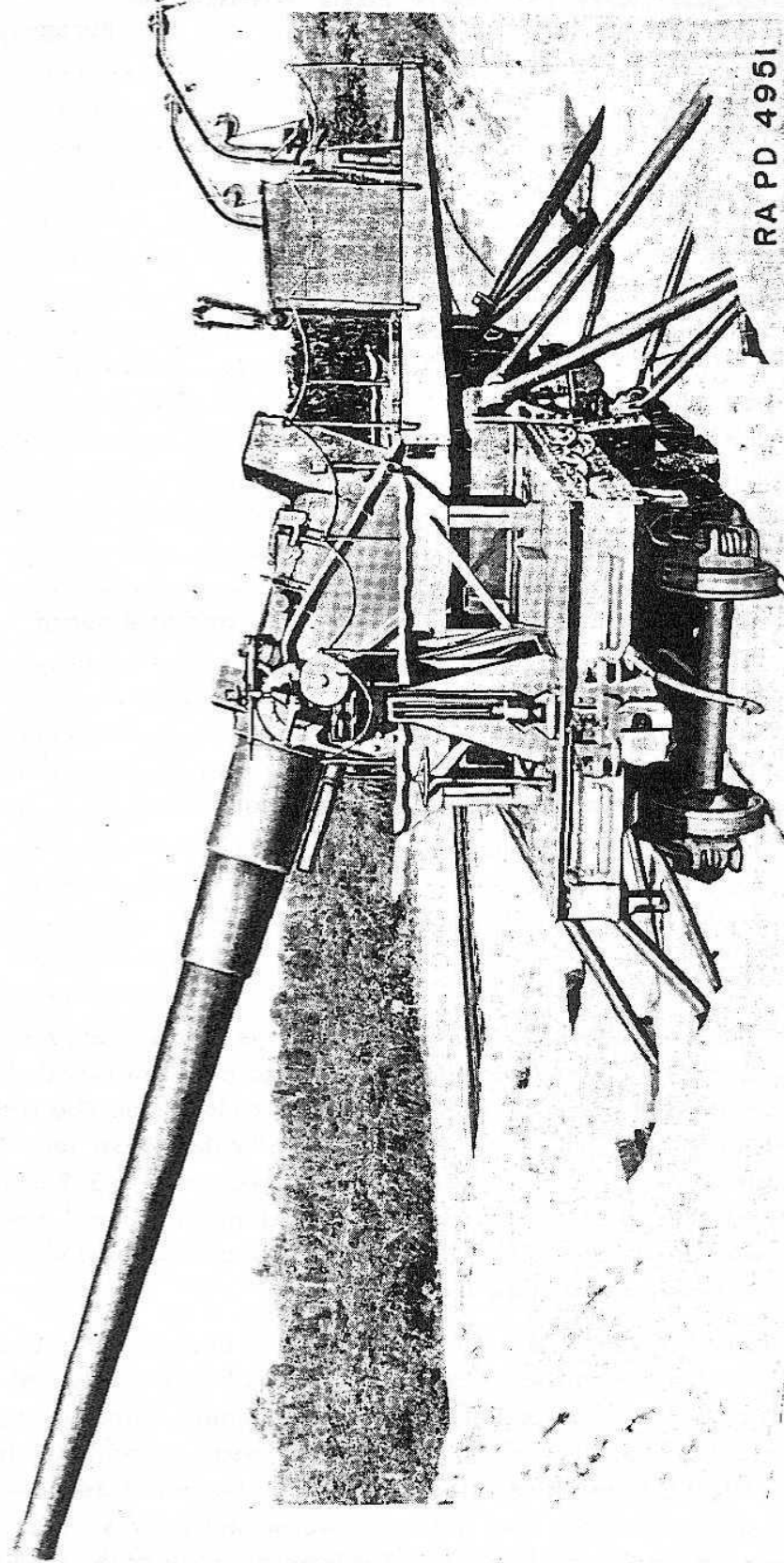


FIGURE 2 — FIRING POSITION — RIGHT SIDE — WITHOUT FLOATS



RA PD 4951

FIGURE 3 — FIRING POSITION — TRAVERSED 70° RIGHT

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1

**SECTION II
DESCRIPTION OF GUN AND CARRIAGE**

	Paragraph
Barrel	3
Breech mechanism	4
Base plate	5
Racer	6
Traversing roller system	7
Side frames	8
Main platform	9
Breech operating platform	10
Elevating mechanism	11
Traversing mechanism	12
Elevation indicator mechanism	13
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Azimuth indicator drive mechanism	15
Cradle and elevating rack	16
Recoil mechanism	17
Recuperator mechanism, pressure gage, liquid pump, and dust guard	18
Recoil parts lock	19
Ammunition cranes	20
Outriggers, floats, and foot plates	21
Ammunition troughs	22
Ammunition table, loading stand, and loading trough	23
Lifting jacks	24
Car body	25
Trucks	26
Hand and air brakes	27
Draft gear and coupler	28

3. BARREL. — The barrel used on this carriage is of the 8", Mk. VI, Mod. 3A2 built-up type with liner, tube, jacket, and hoops of nickel steel. The liner is secured in place by a locking ring of nickel steel. The rifling of the gun is right hand with a uniform twist of 25 calibers per turn. The over-all length of the gun exclusive of the breech mechanism is 369 inches. The weight of the barrel with recoil band, locking ring, and breech mechanism is approximately 55,292 lb. The volume of the powder chamber is approximately 5,410 cubic inches.

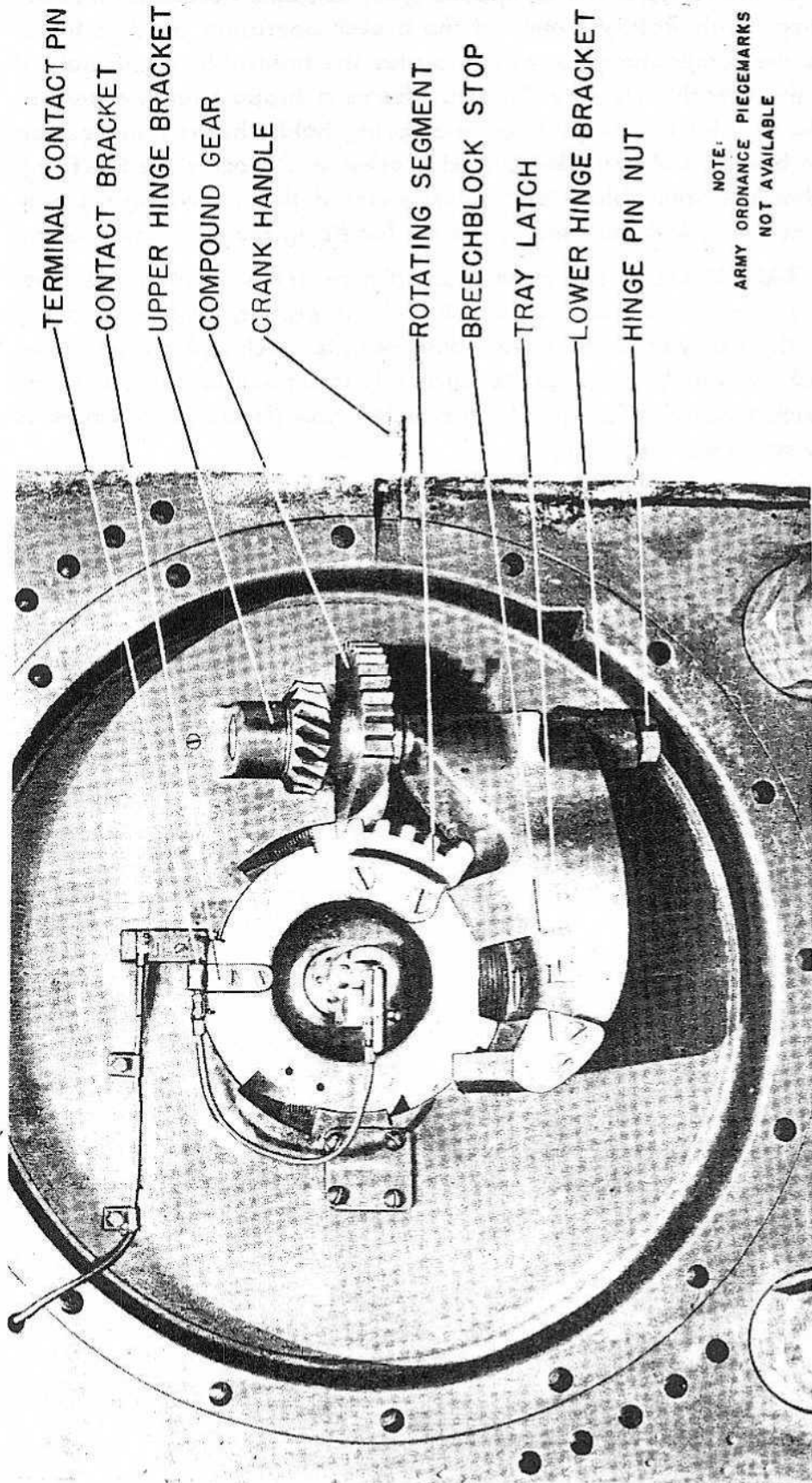
4. BREECH MECHANISM (Figures 4, 5, 6, 7 and 8).— The breech mechanism is of the modified "Navy" design, Mk. V. It consists of the following principal parts: breechblock, obturator spindle, spindle nut and key, obturator keys, gas check pad, rotating segment, breechblock tray, hinge pin and nut, breechblock stop, tray latch, compound gear, worm and crank shaft, bushing, nut, and pin; worm shaft thrust bearings, breech operating crank, and firing lock. The breechblock is of the modified

DESCRIPTION OF GUN AND CARRIAGE

interrupted thread type. The compound gear contains horizontal threads and vertical teeth. Rotary motion of the breech operating crank is transmitted to the compound gear which rotates the breechblock and pulls it back on the breechblock tray. The tray forms a support for the breechblock. The tray latch with plunger and spring holds the tray in position when the breech is closed. The contact bracket and block close the firing circuit when the breechblock is completely closed thus providing a safety device. The firing lock furnishes a means for firing the gun electrically.

5. BASE PLATE. — The base plate (*Figure 21*) is a one-piece steel casting used as the center section of the car proper, each end being bolted to the car frame. The lower roller path is machined on the upper surface of the base plate. A pintle surface is machined on the outer side of the vertical angular flange. The traversing rack (*Figure 22*) is bolted to the inner surface of this flange.

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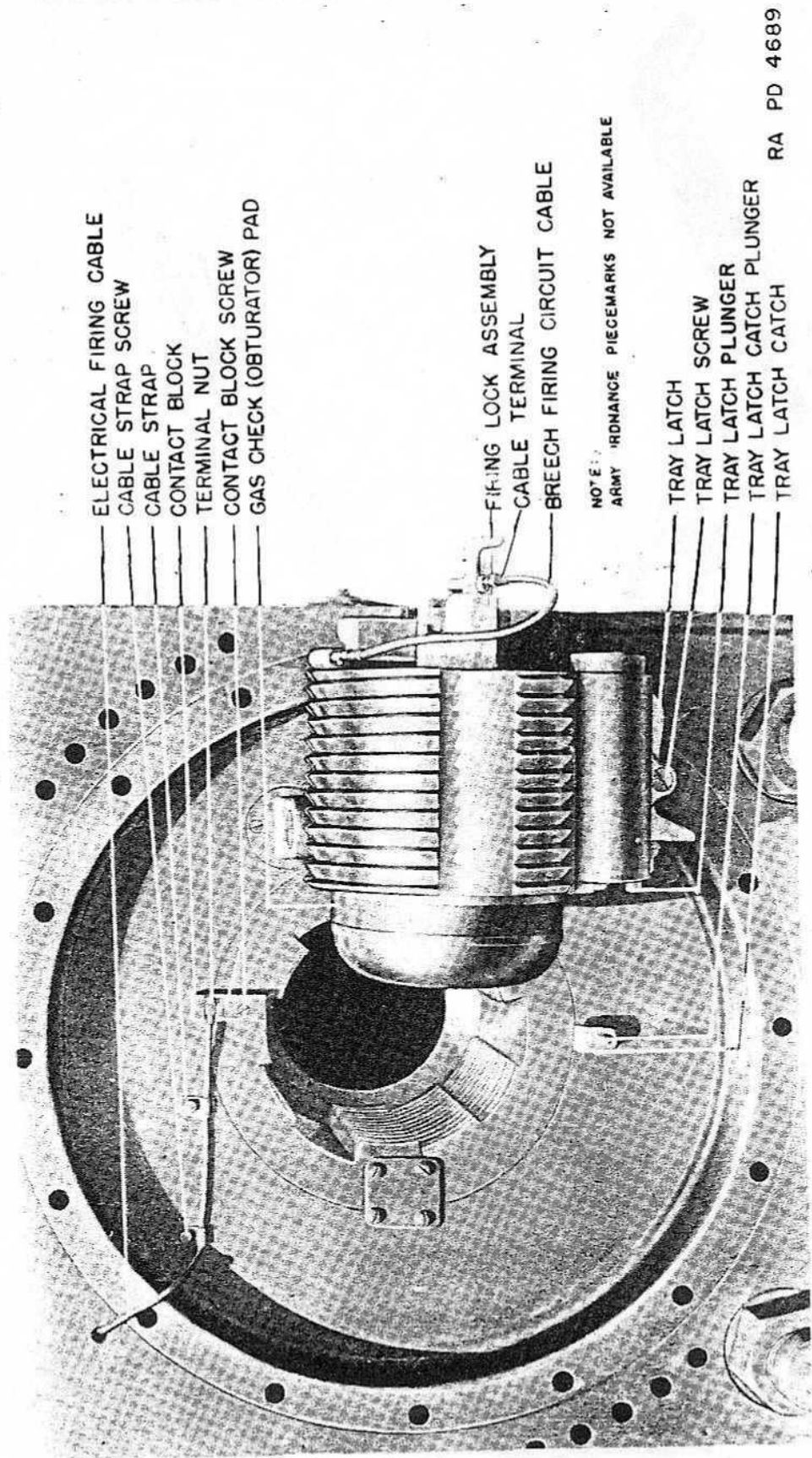
- TERMINAL CONTACT PIN
- CONTACT BRACKET
- UPPER HINGE BRACKET
- COMPOUND GEAR
- CRANK HANDLE
- ROTATING SEGMENT
- BREECHBLOCK STOP
- TRAY LATCH
- LOWER HINGE BRACKET
- HINGE PIN NUT

NOTE:
ARMY ORDNANCE PIECEMARKS
NOT AVAILABLE

RA PD 4700

FIGURE 4 — BREECH CLOSED

DESCRIPTION OF GUN AND CARRIAGE



ELECTRICAL FIRING CABLE
 CABLE STRAP SCREW
 CABLE STRAP
 CONTACT BLOCK
 TERMINAL NUT
 CONTACT BLOCK SCREW
 GAS CHECK (OBTURATOR) PAD

FIRING LOCK ASSEMBLY
 CABLE TERMINAL
 BREECH FIRING CIRCUIT CABLE

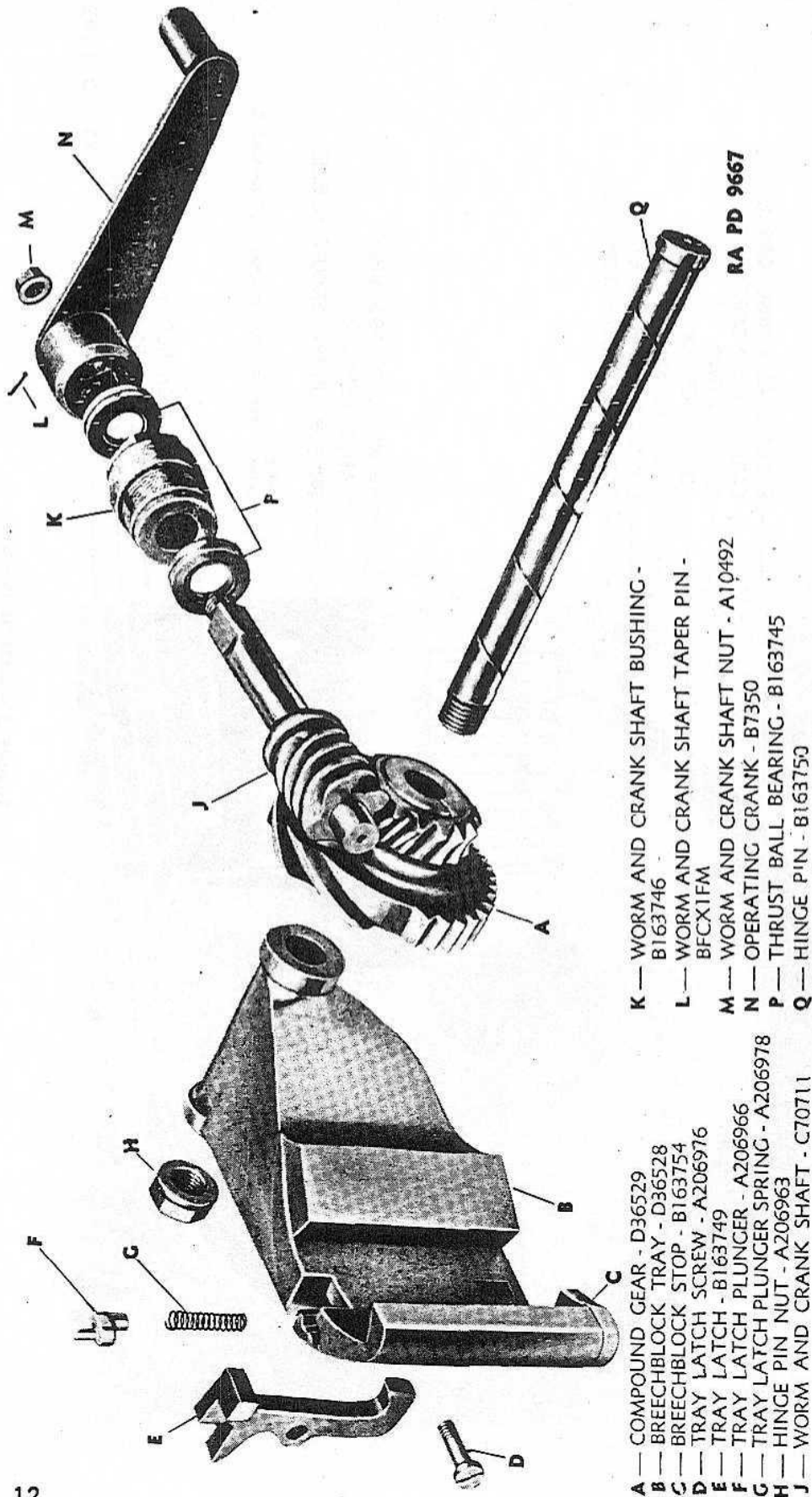
NOTE:
 ARMY ORDNANCE PIECEMARKS NOT AVAILABLE

TRAY LATCH
 TRAY LATCH SCREW
 TRAY LATCH PLUNGER
 TRAY LATCH CATCH PLUNGER
 TRAY LATCH CATCH

RA PD 4689

FIGURE 5 — BREECH OPEN

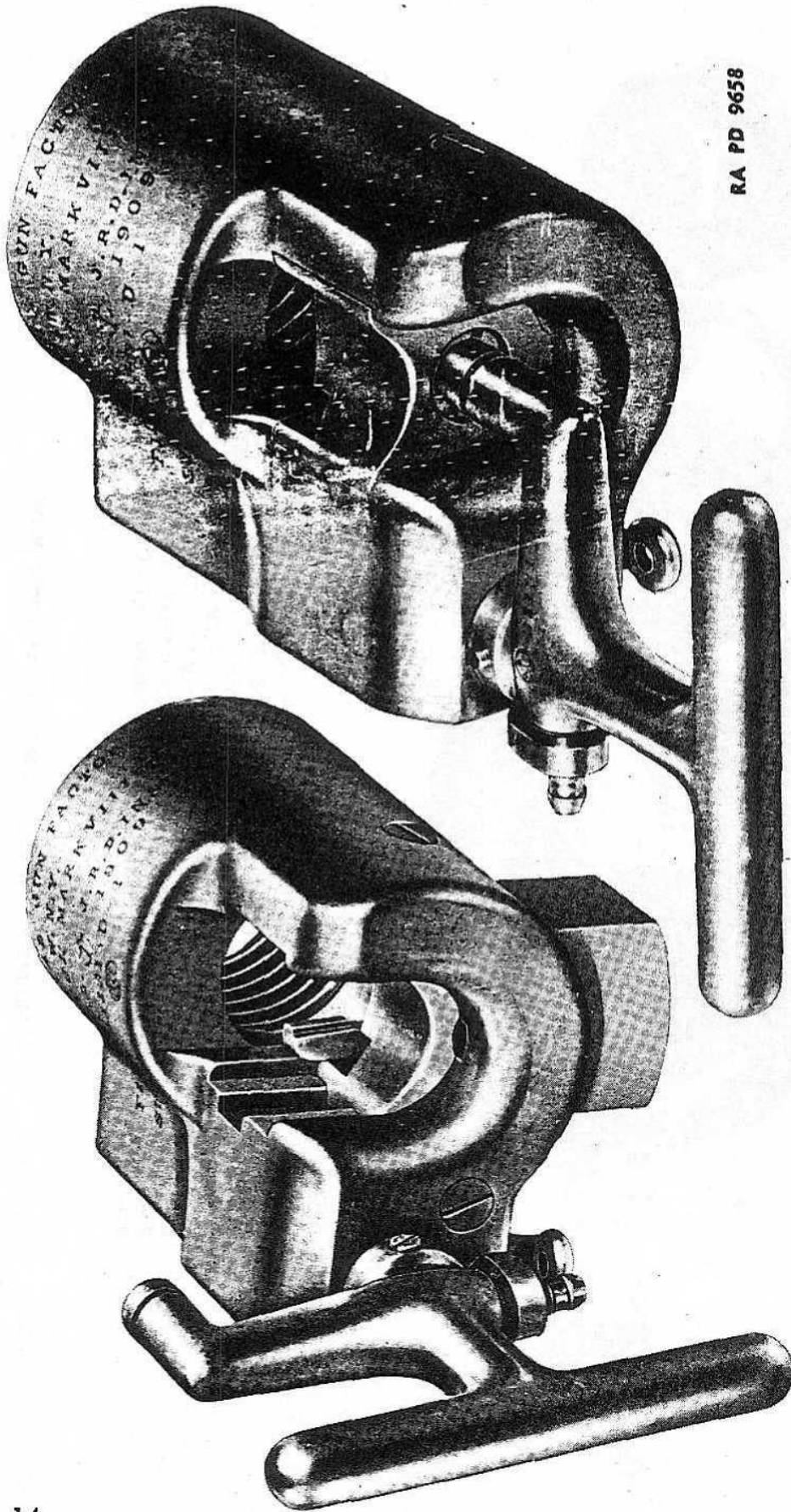
GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1



RA PD 9667

- A — COMPOUND GEAR - D36529
- B — BREECHBLOCK TRAY - D36528
- C — BREECHBLOCK STOP - B163754
- D — TRAY LATCH SCREW - A206976
- E — TRAY LATCH - B163749
- F — TRAY LATCH PLUNGER - A206966
- G — TRAY LATCH PLUNGER SPRING - A206978
- H — HINGE PIN NUT - A206963
- J — WORM AND CRANK SHAFT - C70711
- K — WORM AND CRANK SHAFT BUSHING - B163746
- L — WORM AND CRANK SHAFT TAPER PIN - BFCX1FM
- M — WORM AND CRANK SHAFT NUT - A10492
- N — OPERATING CRANK - B7350
- P — THRUST BALL BEARING - B163745
- Q — HINGE PIN - B163750

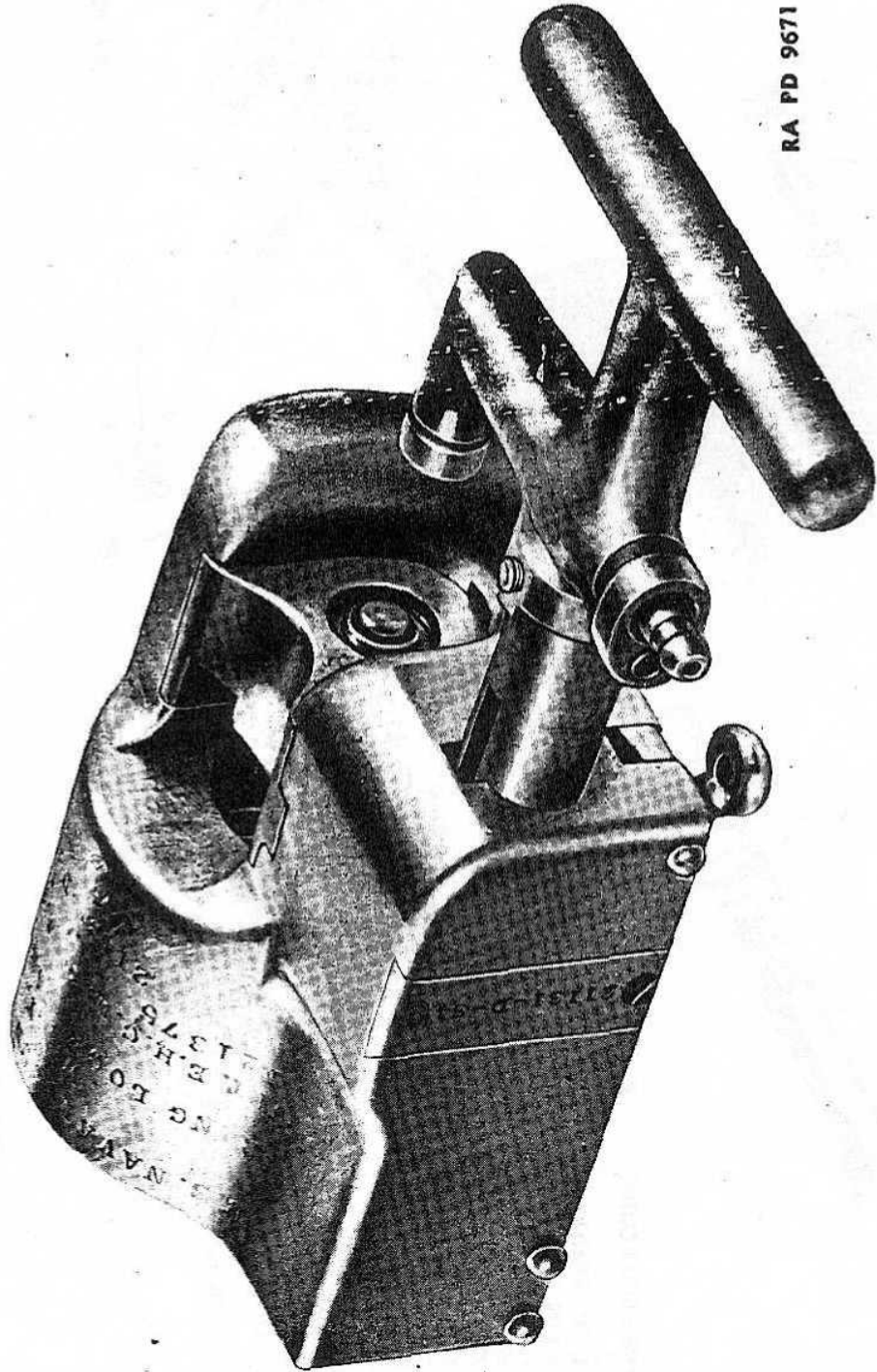
FIGURE 6 — BREECH OPERATING MECHANISM PARTS — EXPLODED VIEW



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FIGURE 8A — NAVY FIRING LOCK, MARK VIII, MOD. II — REAR VIEW --
OPEN AND CLOSED POSITION

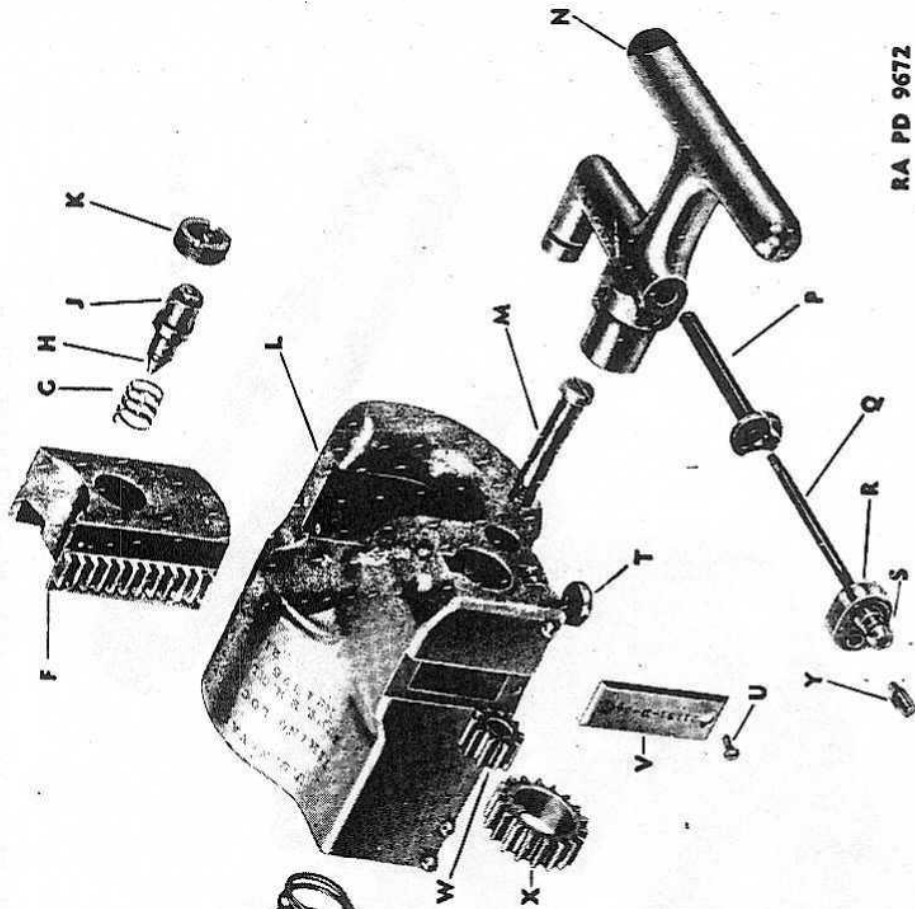
DESCRIPTION OF GUN AND CARRIAGE



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FIGURE 8B -- NAVY FIRING LOCK, MARK VIII, MOD. II -- REAR VIEW -- COCKED POSITION

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1



RA PD 9672

- | | |
|---|---|
| <p>A — HAMMER STEM GUIDE PIN</p> <p>B — GUIDE PIN SPRING</p> <p>C — GUIDE PIN RETAINING SCREW</p> <p>D — HAMMER STEM</p> <p>E — FIRING SPRING</p> <p>F — FIRING LOCK WEDGE</p> <p>G — FIRING PIN RETRACTING SPRING</p> <p>H — FIRING PIN</p> <p>J — FIRING PIN SLEEVE</p> <p>K — FIRING PIN NUT</p> <p>L — FIRING LOCK HOUSING</p> <p>M — WEDGE OPERATING SHAFT</p> <p>N — FIRING LOCK HAMMER</p> | <p>P — CONTACT PIN INSULATING SLEEVE</p> <p>Q — CONTACT HAMMER PIN</p> <p>R — BINDING POST NUT</p> <p>S — BINDING TERMINAL POST</p> <p>T — TRIGGER</p> <p>U — HOUSING PLATE SCREW</p> <p>V — HOUSING PLATE</p> <p>W — WEDGE OPERATING PINION</p> <p>X — WEDGE OPERATING GEAR</p> <p>Y — BINDING POST NUT - RETAINER SCREW</p> |
|---|---|

FIGURE 8C — NAVY FIRING LOCK, MARK VIII, MOD. II — REAR VIEW — EXPLODED

DESCRIPTION OF GUN AND CARRIAGE

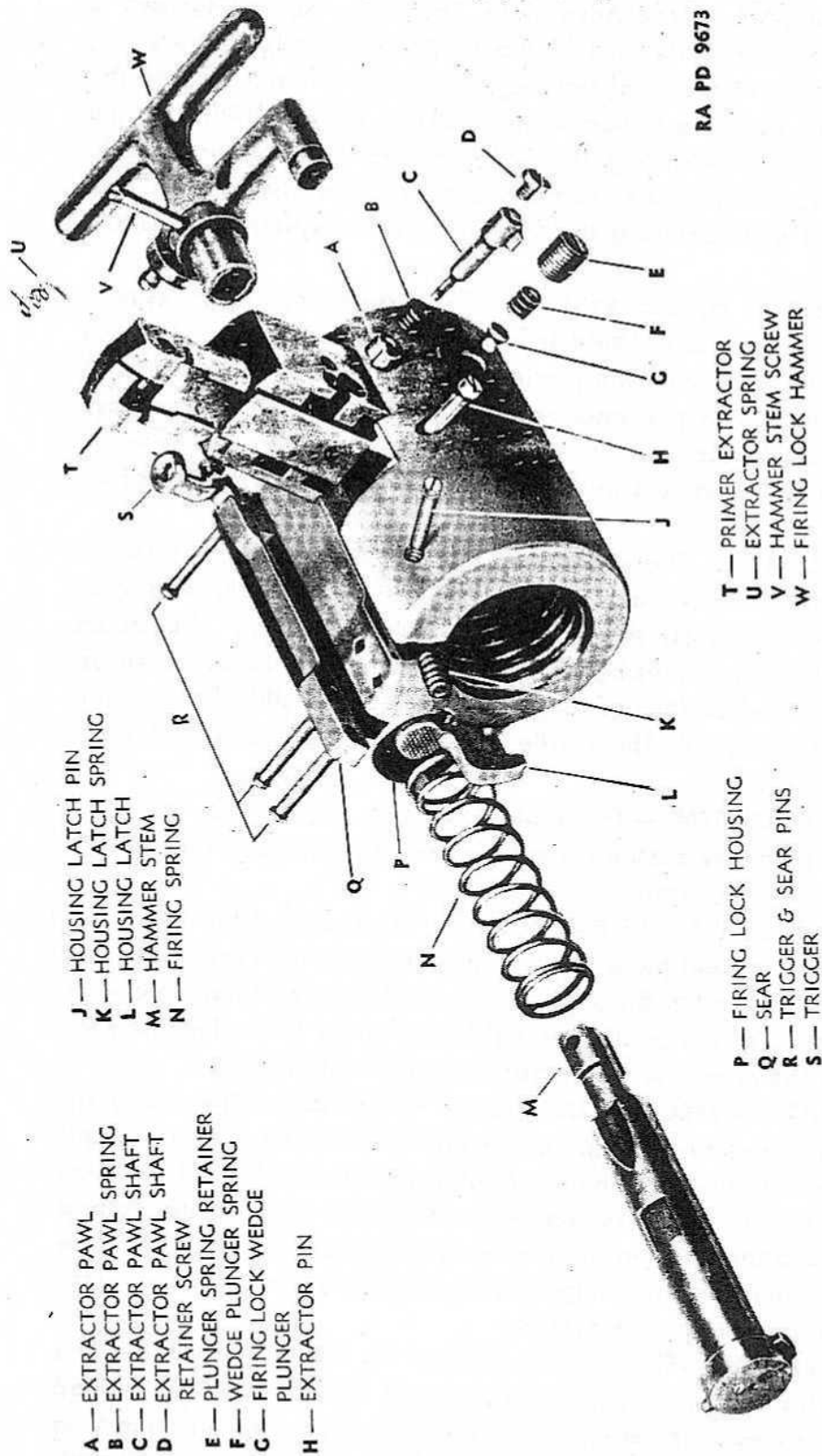


FIGURE 8D — NAVY FIRING LOCK, MARK VIII, MOD. II — FRONT VIEW — EXPLODED

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6. **RACER.** — The racer (Figure 21) is a one-piece steel casting with the lower surface machined to form the upper roller path corresponding to the lower roller path on the base plate. The inner vertical surface is machined to form the female part of the pintle. Three clips (Figure 22), together with the traversing gear housing, engage the under side of the base plate flange. They are bolted to the racer to prevent lifting of the racer from the base plate during the action of recoil and counterrecoil. Dust guards (Figure 20) are bolted to the outer surface of the racer to prevent dust and dirt from entering the traversing roller system and pintle bearing.

7. **TRAVERSING ROLLER SYSTEM.** — The traversing roller system consists of forty conical rollers held in a radial position by the distance ring, and kept concentric with the pintle by flanges on the inner ends of the rollers in contact with the inner edge of the roller path on the base plate. Oil cups are located on the upper surface of the racer, with oil tubes leading to oil gutters cut in the distance ring for distribution of oil to the rollers.

8. **SIDE FRAMES.** — The side frames (Figure 19) are bolted to the upper surface of the racer and held together by the front and rear transoms. This unit supports the tipping parts of the mount. The cradle is supported in the side frames by its trunnions encased in roller bearings, and the interior bored surface of the cradle serves as a slide for the gun in recoil and counterrecoil. The cradle also carries the recoil and recuperator mechanisms.

9. **MAIN PLATFORM.** — The main platform (Figure 20), made of structural steel, is in five sections, held in place by supports fastened to the side frames and rear transom.

10. **BREECH OPERATING PLATFORM.** — The breech operating platform (Figure 12) is of steel plate construction and extends rearward from the rear end of the cradle. Brackets of the platform are fitted into slots in the lower section of the cradle and held in place by bolts. Two tie rods connected with the cradle serve to cross-brace the platform.

11. **ELEVATING MECHANISM** (Figures 14 and 33). — The elevating mechanism is mounted on the right side frame and rotates the cradle and gun in elevation about the trunnion. Motion of the handwheel is transmitted through a series of gears to a shaft and pinion which engages and operates the elevating rack on the cradle. Anti-friction bearings facilitate operation of the mechanism. Oiltight cases provide a means for constant lubrication of the gears and bearings.

12. **TRAVERSING MECHANISM** (Figures 20, 22, 31 and 32). — The traversing mechanism consists of a circular rack in seven sections, bolted to the inner surface of the base plate, and the gear train necessary to transmit motion from the traversing handwheel to the rack. The handwheel is mounted on the left side frame. The mechanism is enclosed in gear housings which provide a means of lubrication and protection

DESCRIPTION OF GUN AND CARRIAGE

against dirt and abrasives. The lower section of the pinion housing has a projecting lip which makes contact with the under side of the base plate flange and acts as a clip to prevent the racer and other rotating parts from moving vertically.

13. ELEVATION INDICATOR MECHANISM (Figure 34). — The elevation indicator mechanism provides a means of placing the gun at the desired elevation. By a chain of shafts, couplings and a pinion that meshes with a small gear rack on the inside of the elevating rack, the elevation of the barrel at any point is indicated on the elevation indicator.

14. GUN TRAVELING SUPPORTS. — To protect the trunnion roller bearings against wear caused by vibration of the gun during travel, supports are provided which entirely relieve the cradle of this weight. The gun breech support (Figure 36) consists of two plungers, lodged in the lower part of the recoil band, which may be extended laterally until they project over the machined lugs on the two side frames. At either end of the plunger movement, the crank must be locked in position by means of its plunger-pin which fits into a drilled hole in the recoil band. By means of the elevating gear, the gun and cradle is elevated until the plungers rest on the side frame lugs. The gun traveling muzzle support (at the end of the front ammunition trough) is then jacked up until a .02 in. feeler gage can be inserted between the under side of the gun and the bronze liner at the front end of the cradle. The jack screw is then locked by means of the fork. After travel, when reversing these operations, care must be taken that the plungers are fully retracted into the recoil band and the crank locked before firing the gun.

15. AZIMUTH INDICATOR DRIVE MECHANISM. — The azimuth indicator drive mechanism (Figures 20, 21 and 35) consists of a rack fastened to the base plate, meshing with a pinion attached to the end of a shaft connected with the azimuth indicator by an intermediate shaft, upper azimuth indicator shaft and couplings. The lower section of the mechanism is supported by a bracket fitted with roller bearings and bolted to the racer. A guard is provided at the lower end of the mechanism to protect the moving parts and to exclude dirt and grit from the indicator rack and pinion.

16. CRADLE AND ELEVATING RACK (Figures 9, 10 and 11). — The cradle serves as a slide for the gun during recoil and counterrecoil. It supports the elevating rack, recoil and recuperator mechanisms, and the breech operating platform. Two roller bearings shrunk on the trunnions of the cradle support it in the side frames. The elevating rack is bolted to the cradle and meshes with a pinion in the elevating mechanism to allow elevation and depression of the gun.

17. RECOIL MECHANISM. — The recoil mechanism (Figure 28) consists of two cylinders, one long and one short, fitted into the lower section of the cradle. The long cylinder has a stuffing box at each end through which the piston rod moves in recoil and counterrecoil when the

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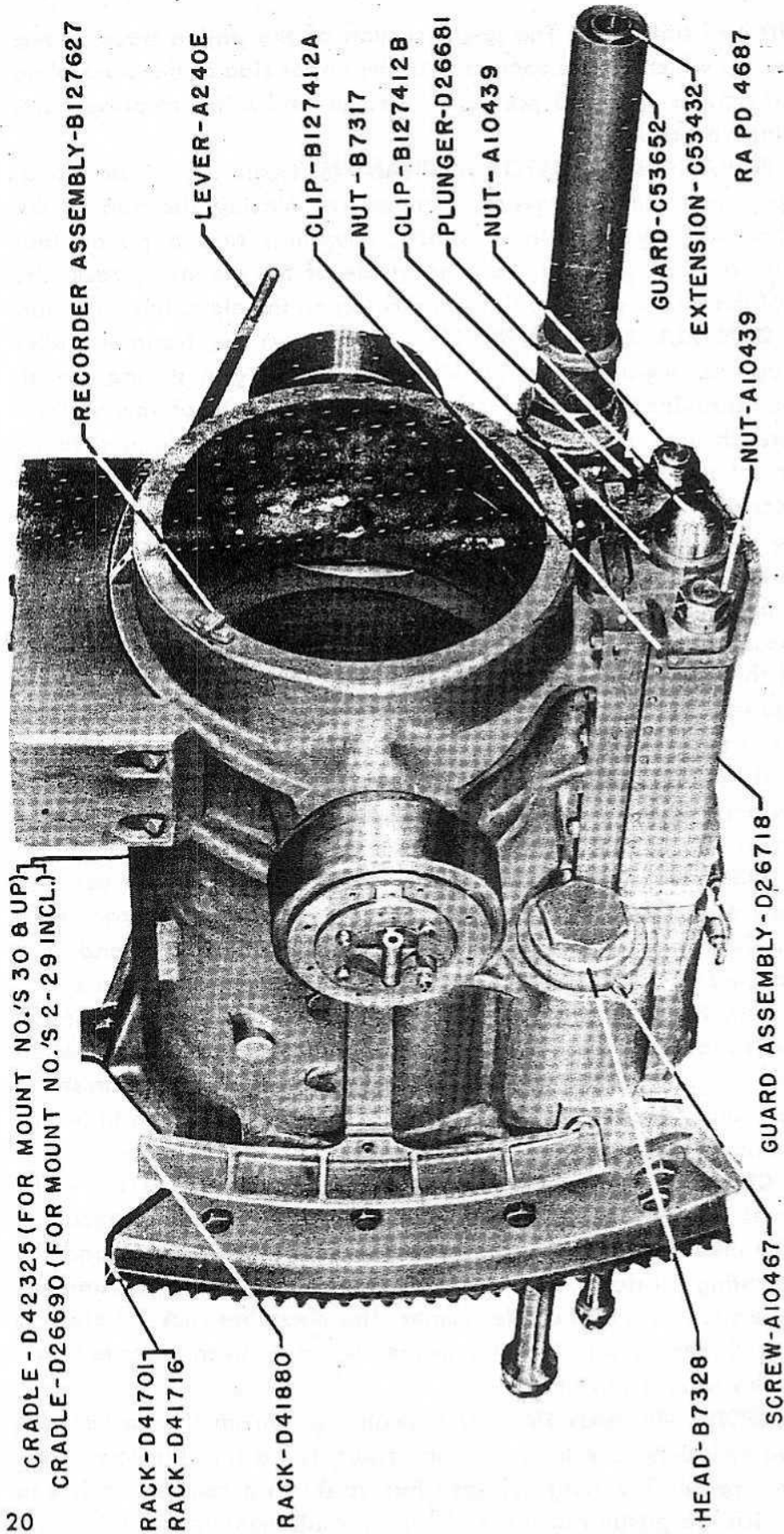
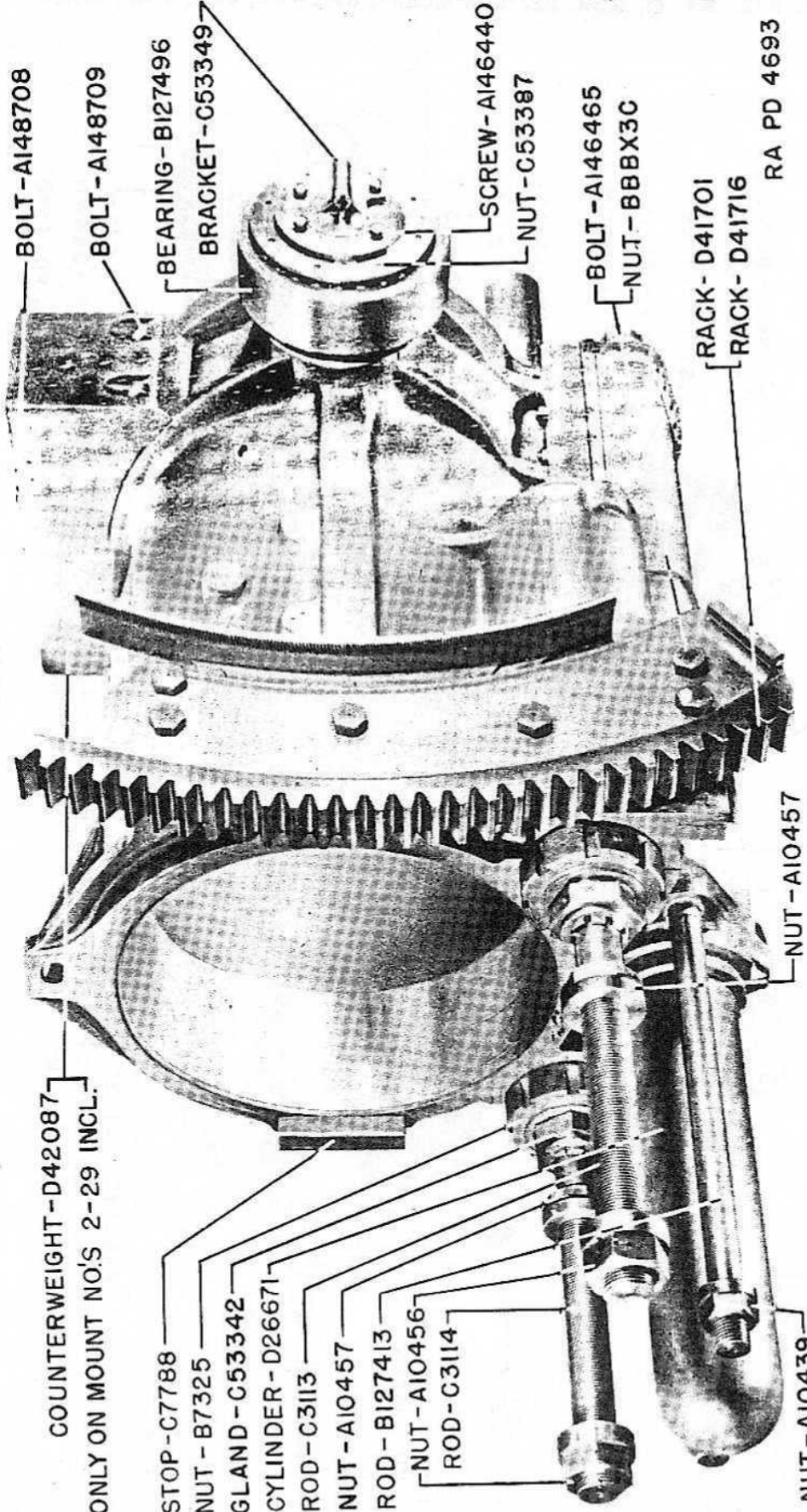


FIGURE 9 — CRADLE (FRONT RIGHT)

DESCRIPTION OF GUN AND CARRIAGE



BOLT - A148708

BOLT - A148709

BEARING - B127496

BRACKET - C53349

SCREW - A146440

NUT - C53387

BOLT - A146465

NUT - BBBX3C

RACK - D41701

RACK - D41716

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COUNTERWEIGHT - D42087

ONLY ON MOUNT NO'S 2-29 INCL.

STOP - C7788

NUT - B7325

GLAND - C53342

CYLINDER - D26671

ROD - C3113

NUT - A10457

ROD - B127413

NUT - A10456

ROD - C3114

NUT - A10457

NUT - A10439

FIGURE 10 - CRADLE (REAR RIGHT)

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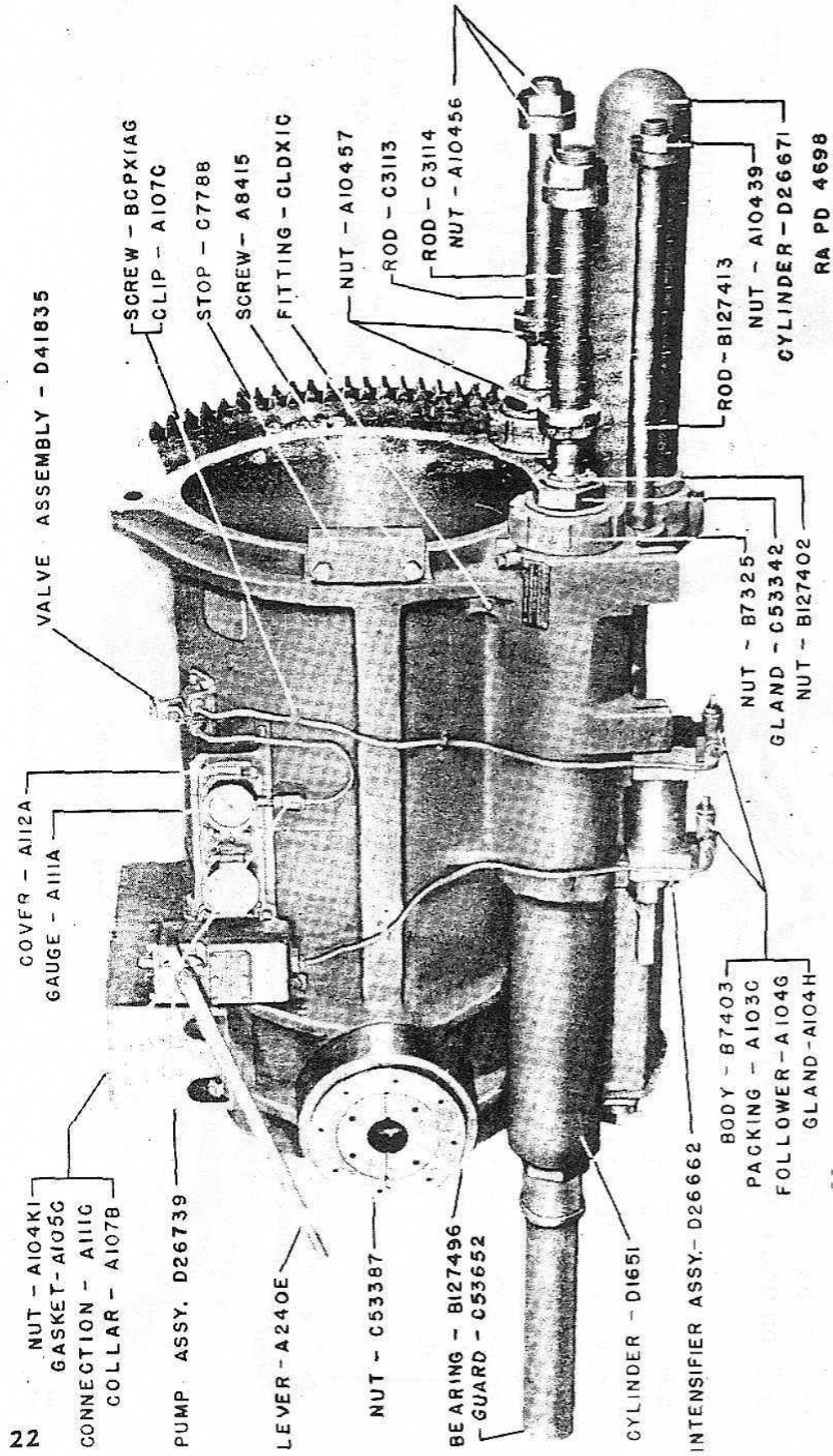
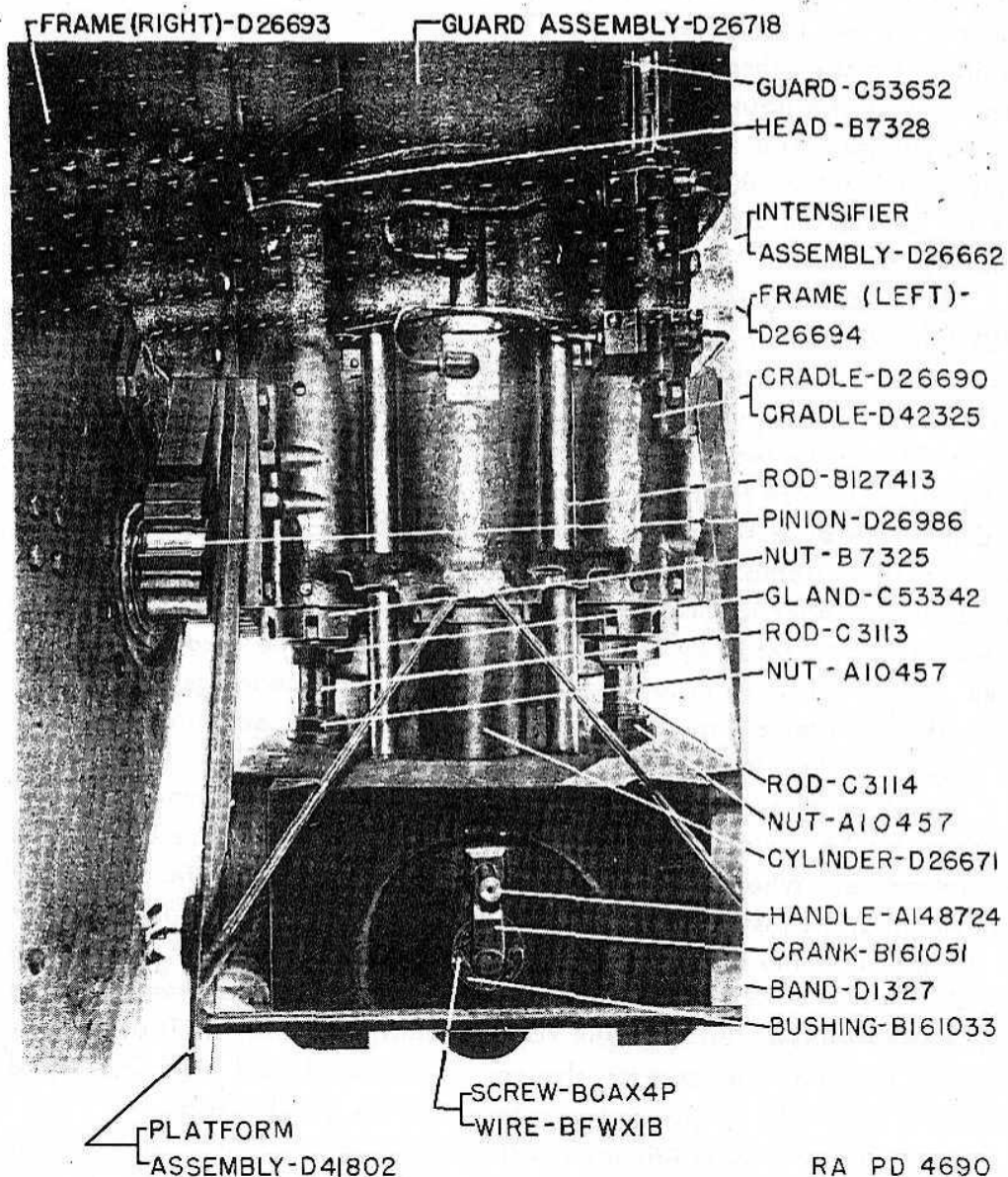


FIGURE 11 - CRADLE (LEFT SIDE)

DESCRIPTION OF GUN AND CARRIAGE



RA PD 4690

FIGURE 12 — CRADLE ASSEMBLED — BOTTOM VIEW

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1

piece is fired. The stuffing boxes, two in the long cylinder and one in the short cylinder, consist of glands, nuts, and chevron packing to provide a tight joint between the piston rods and cylinders. They prevent leakage of the cylinder oil at these points. The short cylinder is entirely closed at one end by a solid cylinder head. The piston rods slide in the cylinders. Their threaded sections extend through the recoil band to which they are fastened by two nuts on each rod. The recoil band recoils with the gun, moving the pistons through the cylinders. Recoil of the gun is controlled by resistance of the liquid being forced through throttling grooves in the recoil cylinders. The mechanism limits the distance and regulates the velocity with which the gun recoils when fired. This distance is approximately 27 inches. About 96 pints of recoil oil is required to fill both of the cylinders.

18. RECUPERATOR MECHANISM, PRESSURE GAGE, LIQUID PUMP, AND DUST GUARD (Figures 13, 29 and 30). — The recuperator mechanism in the under side of the cradle consists of an air cylinder, plunger, bearing, packing, yoke, pull rods, intensifier, liquid pump, and dust guard.

a. The recuperator cylinder is solid at the rear end. The other end is fitted with a bronze bearing, liquid seal chevron packing, and a follower held in place by a second bronze bearing screwed into the end of the cylinder. This assembly provides a complete bearing in which the plunger slides. The plunger is secured to the plunger yoke by a special nut. It is operated during recoil by two pull rods fastened to the recoil band and yoke. Bronze bushings in lugs on the cradle provide bearings for the pull rods. The cylinder plunger cavity is filled with air at an initial pressure of 1600 lb. per sq. in.

b. A small section of the plunger between the chevron packings contains liquid, maintaining a seal by means of the pressure built up in the intensifier. When the air pressure in the cylinder is increased by movement of the piston, it is transmitted through copper tubing to the rear of the piston in the intensifier. This forces the piston back and creates a pressure against the liquid in the intensifier, which is transferred to the seal on the plunger through the copper tubing and valve. Thus the air pressure automatically controls the pressure in the liquid seal. The liquid pressure is always 14 percent greater than the air pressure.

c. A pressure gage attached to the upper part of the cradle indicates the air pressure in the intensifier. This pressure gage is connected by copper tubing to an air valve which in turn is connected to the intensifier by copper tubing.

d. A liquid pump is fastened to the upper section of the cradle on the left side and is connected by copper tubing to the intensifier. The pump consists of a pump case or reservoir for holding the liquid. A plunger, actuated by a lever, crank and link, operates in the pump body to supply oil to the intensifier.

e. The recuperator dust guard, of steel plate construction reinforced

DESCRIPTION OF GUN AND CARRIAGE

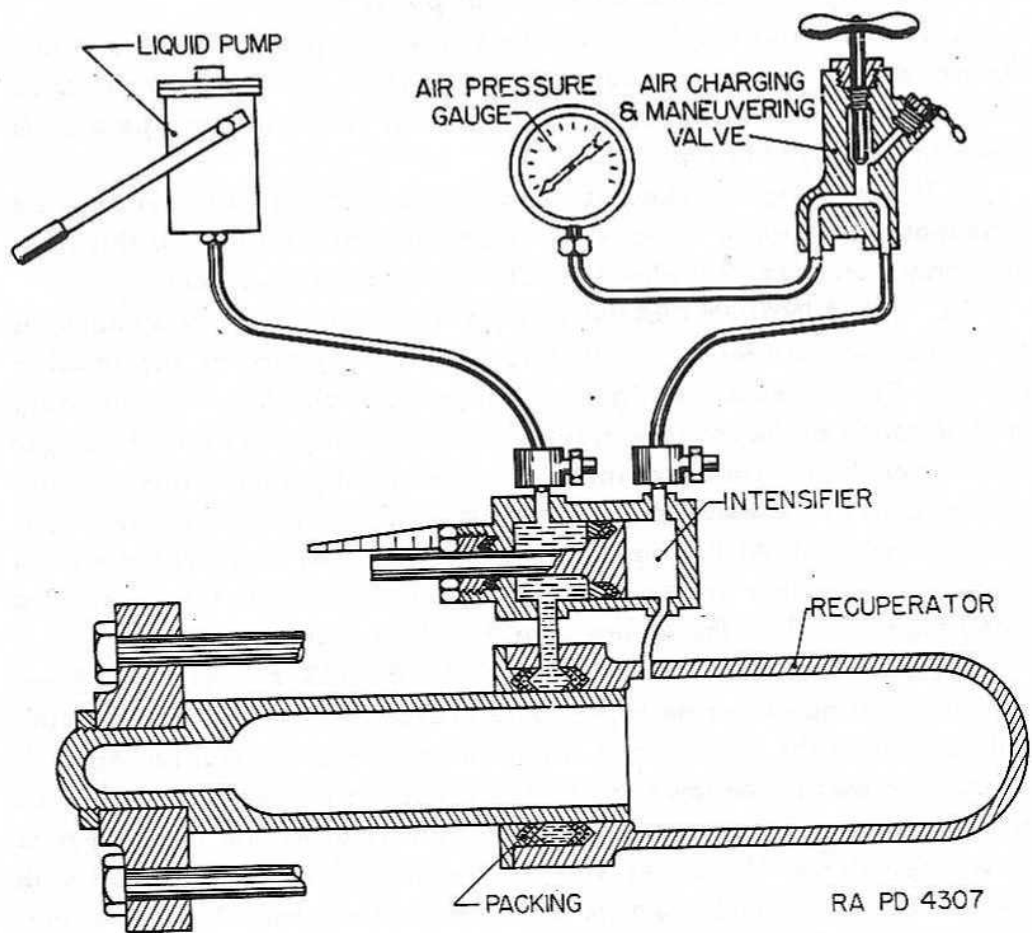


FIGURE 13 - RECUPERATOR SYSTEM

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1

by steel angles, is provided with felt strips which act as wipers and protect the mechanism from dirt and grit. The dust guard is bolted to the clips which are a part of the bearings in which the yoke slides.

19. RECOIL PARTS LOCK. — a. The recoil parts lock consists of a coupling bar held in the front side of the recoil band by a nut pinned in place. The coupling bar passes through a lug on the rear end of cradle, and when the front nut is screwed up, holds the gun and cradle together. This permits elevation of the gun without danger of its sliding rearward, even though the recuperator be empty or partly charged.

b. The front nut should always be screwed in place when the mount is in travel, and whenever the mount is inactive. It should be removed only when the gun is about to be fired and when the recuperator is known to be fully charged.

c. The coupling is necked down to permit breakage without damage to the mount, in case of firing with the coupling nut in place. If this happens, only authorized couplings should be used for replacement.

20. AMMUNITION CRANES (Figures 16, 38 and 39). — Two pedestals for ammunition cranes are bolted to the rear corners of the loading platform. The cranes are designed for hoisting projectiles to the loading stand. Rotation of the crane is prevented by a locking device in the upper section of each pedestal. The cranes are operated by hand cranks driving a drum to which is fastened a wire cable passing over pulleys mounted on the crane mast. At its upper end one crane mast is provided with a female and the other with a male fitting. By this means the cranes are locked together when the mount is in traveling position.

21. OUTRIGGERS, FLOATS, AND FOOT PLATES (Figures 1, 3, 17 and 18). Eight outriggers act as supports to prevent the mount from tipping or sliding when the gun is fired. The outriggers are of steel tubing with adjusting screws in the lower ends. The adjusting screws have ball ends resting in sockets in the foot plates. These plates distribute the load over the wooden floats. The upper ends of the outriggers are fastened with pins to hinges or swivel brackets on the side of the car. Tie rods or outrigger chords are fastened to the car below the outriggers and support the outriggers. The upper side of the cast steel foot plates which support the outrigger thrust have ball sockets to receive the thrust end of the outrigger. The floats are built up of two layers of white oak blocks bolted together. Two pieces of steel angle are bolted to the upper surface of each float and act as guides for the foot plates. When not in use the floats and foot plates are stored on the car floor. In traveling position the outriggers and chords fold against the side of the car and are secured by clips and hangers attached to the car frame.

22. AMMUNITION TROUGHS. — Two ammunition troughs of built-up structural steel (Figures 1 and 16), one front and one rear, are bolted to the floor of the car ends. They are used to transfer shells from an ammunition car to the ammunition tables.

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23. AMMUNITION TABLE, LOADING STAND, AND LOADING TROUGH (Figures 16 and 23). — An ammunition table with a capacity for seven shells is bolted to the floor of each car end. Ammunition may be hoisted from this table to a loading stand by the loading cranes. The loading stand, bolted to the loading platform, is of built-up structural steel and connects to the loading trough. The loading trough is in two parts hinged to each other. The rear section of the loading trough is hinged to the loading stand. The entire loading trough is counterbalanced by a spring inside of the loading stand.

24. LIFTING JACKS (Figures 17 and 18). — a. Four built-in jacks are located in the corners of the base plate directly above the rails of a standard gage railroad track. Each jack consists of a ram and bronze nut through which the lifting screw operates. A bevel gear keyed to the lifting screw meshes with a pinion whose shaft mounts the ratchet and housing for the jack levers. Near the inside end of the pinion shaft is a ratchet wheel and pawl for locking the jack mechanism against running down while in travel. The ram is supported at the upper end by a roller bearing encased in a housing bolted to the base plate. The lower part of the ram extends through holes in the base plate. A shoe attached to the lower end of the ram makes contact with the rails when the mount is being raised.

25. CAR BODY. — The car body (Figures 16, 17 and 18) is of the drop frame type with ends of built-up structural steel plates and base ring. The car ends are bolted to the base plate which forms the center of the car. Consisting of center, intermediate, and side sills, the car ends are fastened together at each end by channels and sills, and are cross-braced by body bolsters. The whole is covered by steel floor plates. Steps and handholds are provided at each end of the car.

26. TRUCKS. — The two trucks (Figure 24) of six-wheel special type are of built-up construction; the frame is made of steel plates and castings. The journals are standard, 5½" x 10". Twenty-eight inch diameter wheels of rolled steel are placed on the axles. The load on the trucks is transmitted to the journals by semi-elliptic springs and equalizers. The equalizers balance on the journal boxes and their outer ends are supported by coil springs held in place by the pedestal castings. Provisions have been made for the installation of anti-friction bearings to permit the carriage to be moved at high rates of speed. Without anti-friction bearings the carriage can be pulled at a rate of only 35 miles per hour or less without overheating.

27. HAND AND AIR BRAKES (Figure 15). — a. The mount is equipped with two independent air brake systems of the latest A B freight type. Each system operates on one truck only. A train-line pipe extends the length of the mount and connects both systems. The air hose coupling at either end of the mount, connects the air line to the next car in the train. When the mount is uncoupled from the train, the air brake is auto-

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matically set, holding the mount stationary. Manual operation of the duplex release valve will release the brakes. If the handle is moved part way, the auxiliary air reservoir is drained without draining the emergency reservoir. If the handle is moved its full travel, both the auxiliary and emergency reservoirs will be drained.

b. A pressure retaining valve (Figures 1 and 15) is located beneath the ammunition trough at both ends of the car. It is a three-position valve and may be set either with lever vertical to permit the brake cylinder to exhaust freely into the atmosphere, or with lever horizontal to retain a portion of the air in the brake cylinder to hold the brake applied when making a release while recharging the system. The intermediate position (at 45°) retains high pressure in the brake cylinder.

c. The mount is also equipped with two independent hand brake systems, one for each truck.

28. DRAFT GEAR AND COUPLER (Figure 15). — The draft gear is known as the "Cardwell-Westinghouse, type NZ-11E, special." The friction parts are enclosed in a drum applied between cast steel draft lugs to receive the buffing and pulling shocks. The coupler is a type E Gould Freight Coupler, E63.

DESCRIPTION OF GUN AND CARRIAGE

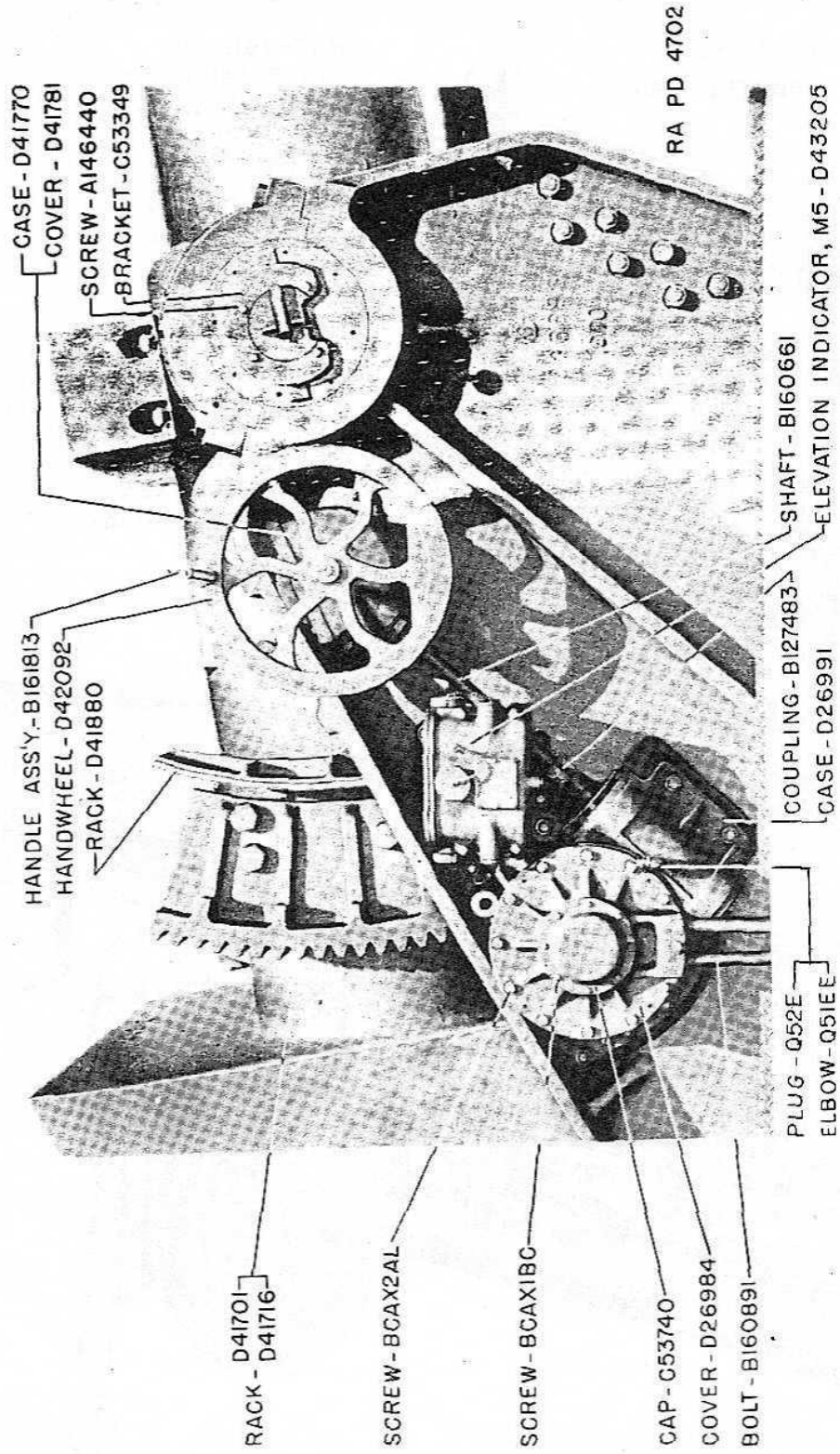
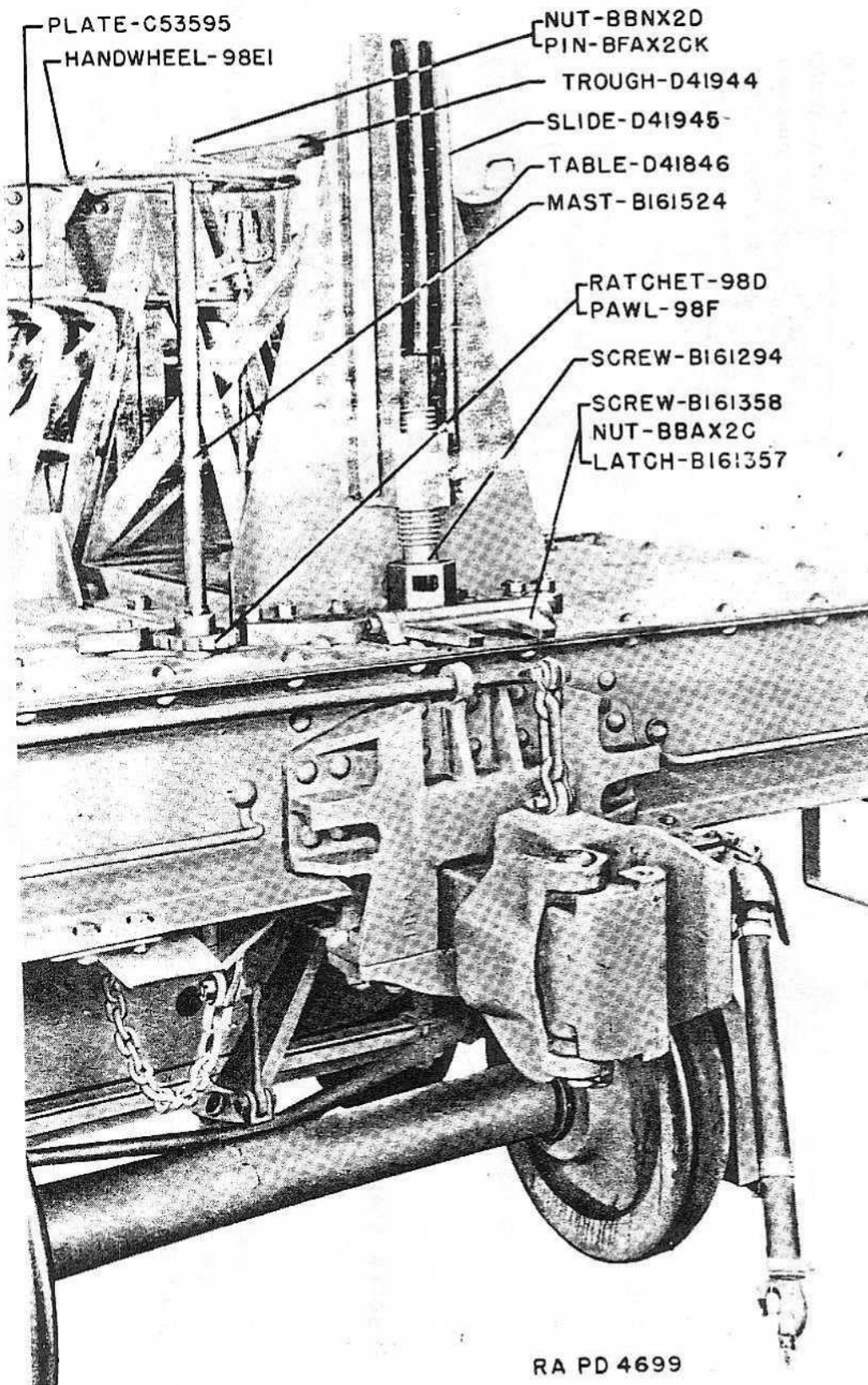


FIGURE 14 - ELEVATING MECHANISM

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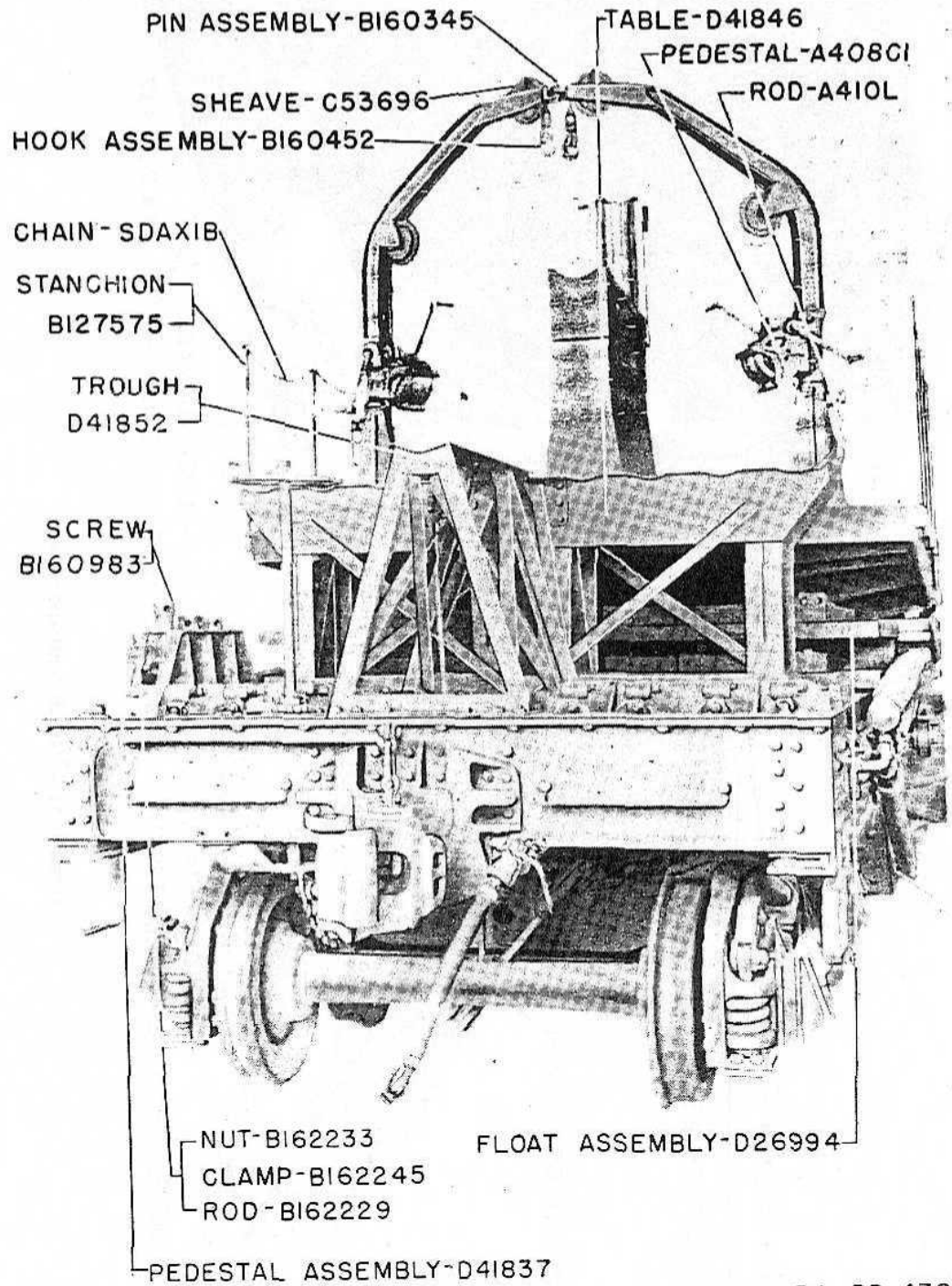
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RA PD 4699

FIGURE 15 — MOUNT (FRONT VIEW)

DESCRIPTION OF GUN AND CARRIAGE



RA PD 4701

FIGURE 16 - MOUNT (REAR VIEW)

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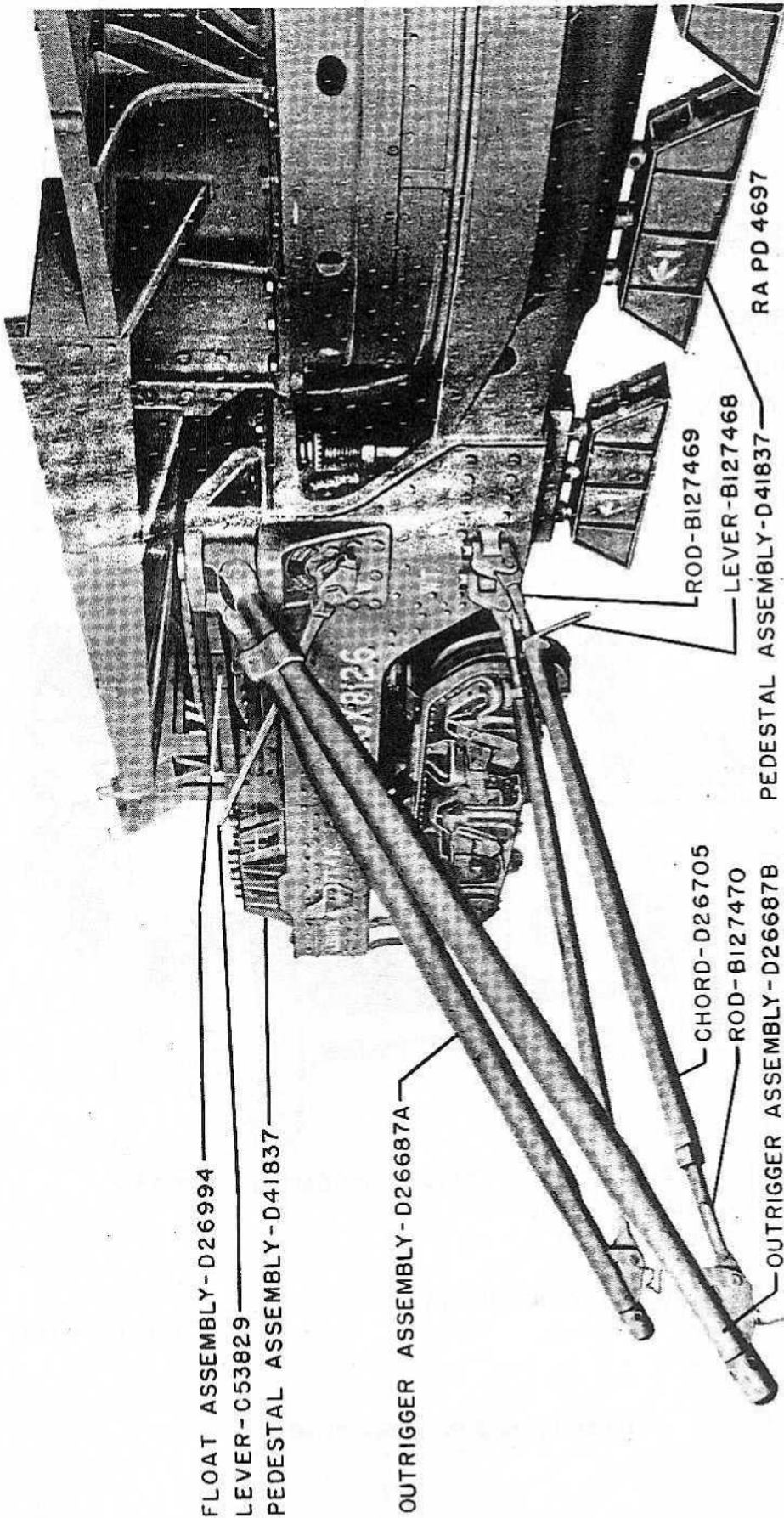
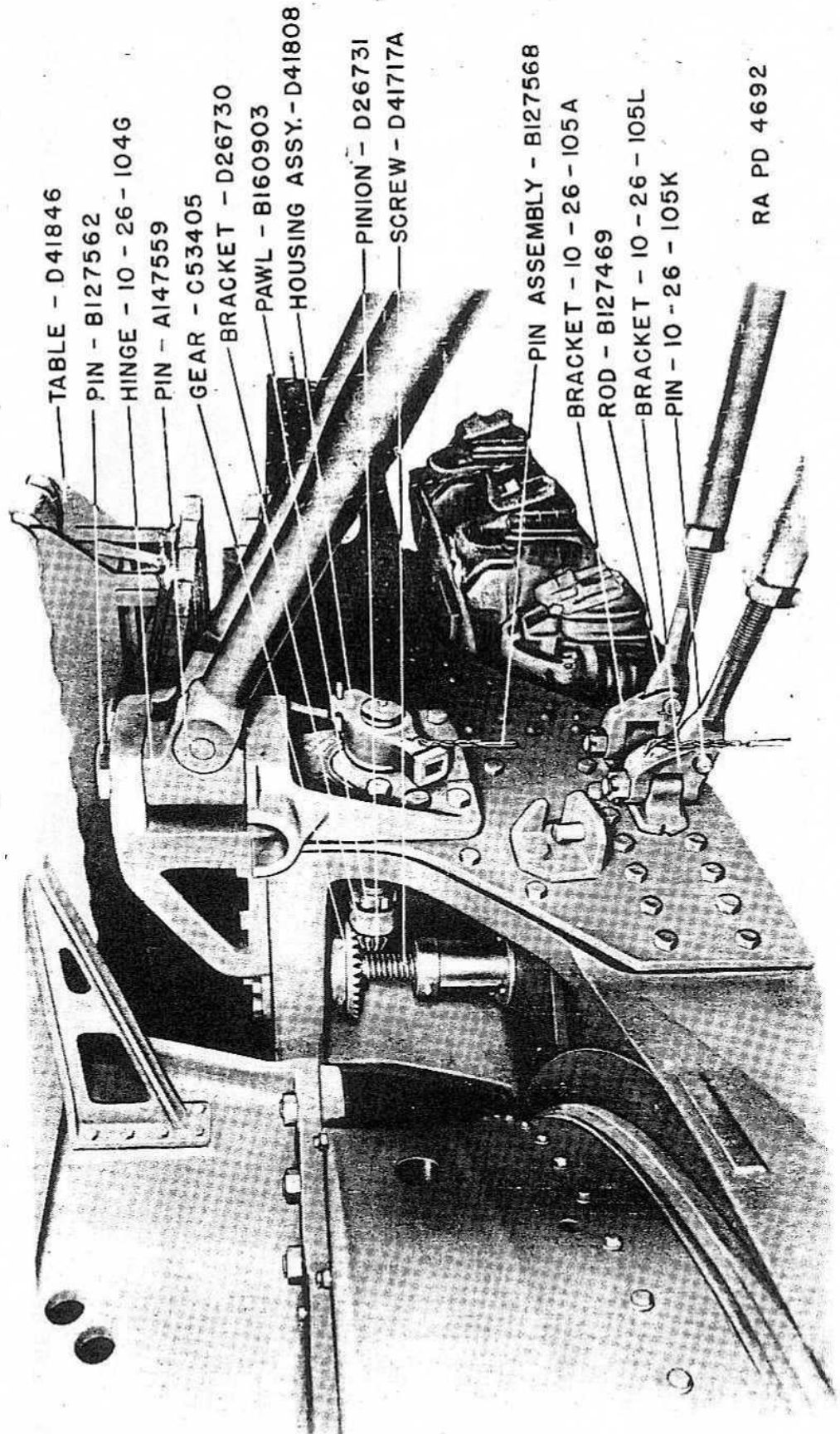


FIGURE 17 -- MOUNT (RIGHT REAR)

DESCRIPTION OF GUN AND CARRIAGE



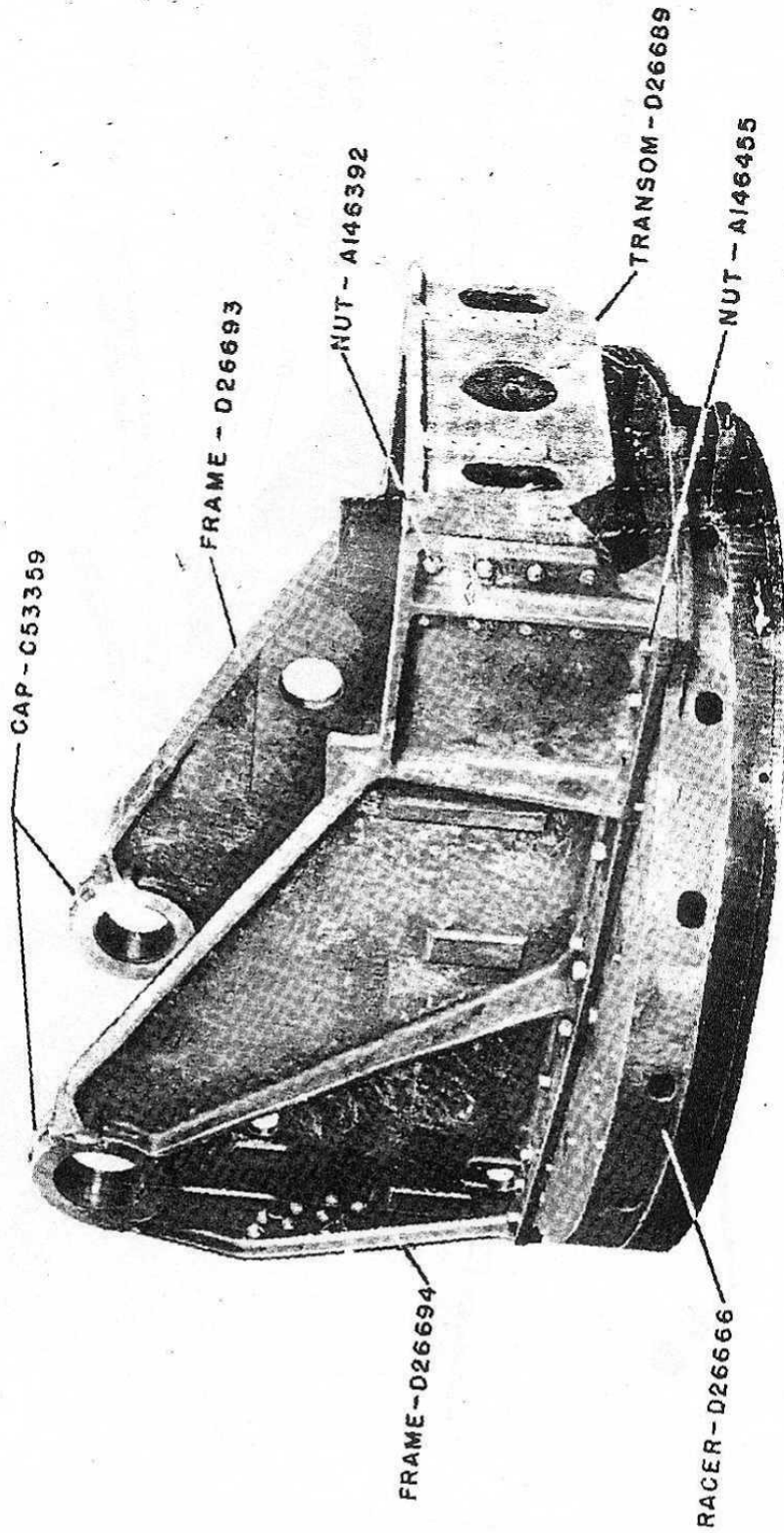
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- PIN - B127562
- HINGE - 10 - 26 - 104G
- PIN - A147559
- GEAR - C53405
- BRACKET - D26730
- PAWL - B160903
- HOUSING ASSY. - D41808
- PINION - D26731
- SCREW - D41717A
- PIN ASSEMBLY - B127568
- BRACKET - 10 - 26 - 105A
- ROD - B127469
- BRACKET - 10 - 26 - 105L
- PIN - 10 - 26 - 105K

RA PD 4692

FIGURE 18 - ELEVATING JACK MECHANISM

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RA PD 4694

FIGURE 19 - RACER, SIDE FRAME, AND REAR TRANSOM ASSEMBLY

DESCRIPTION OF GUN AND CARRIAGE

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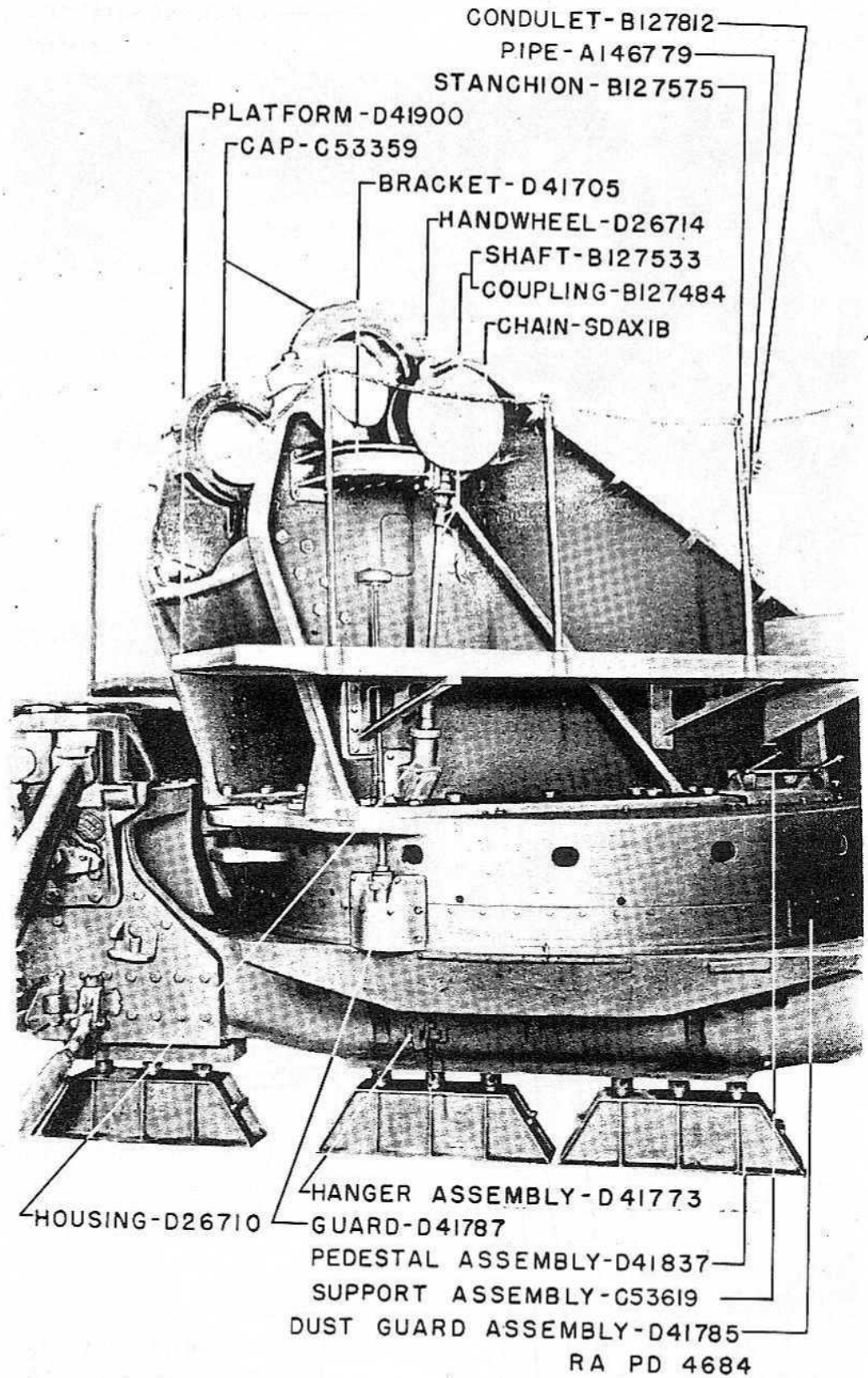


FIGURE 20 — MOUNT (LEFT SIDE)

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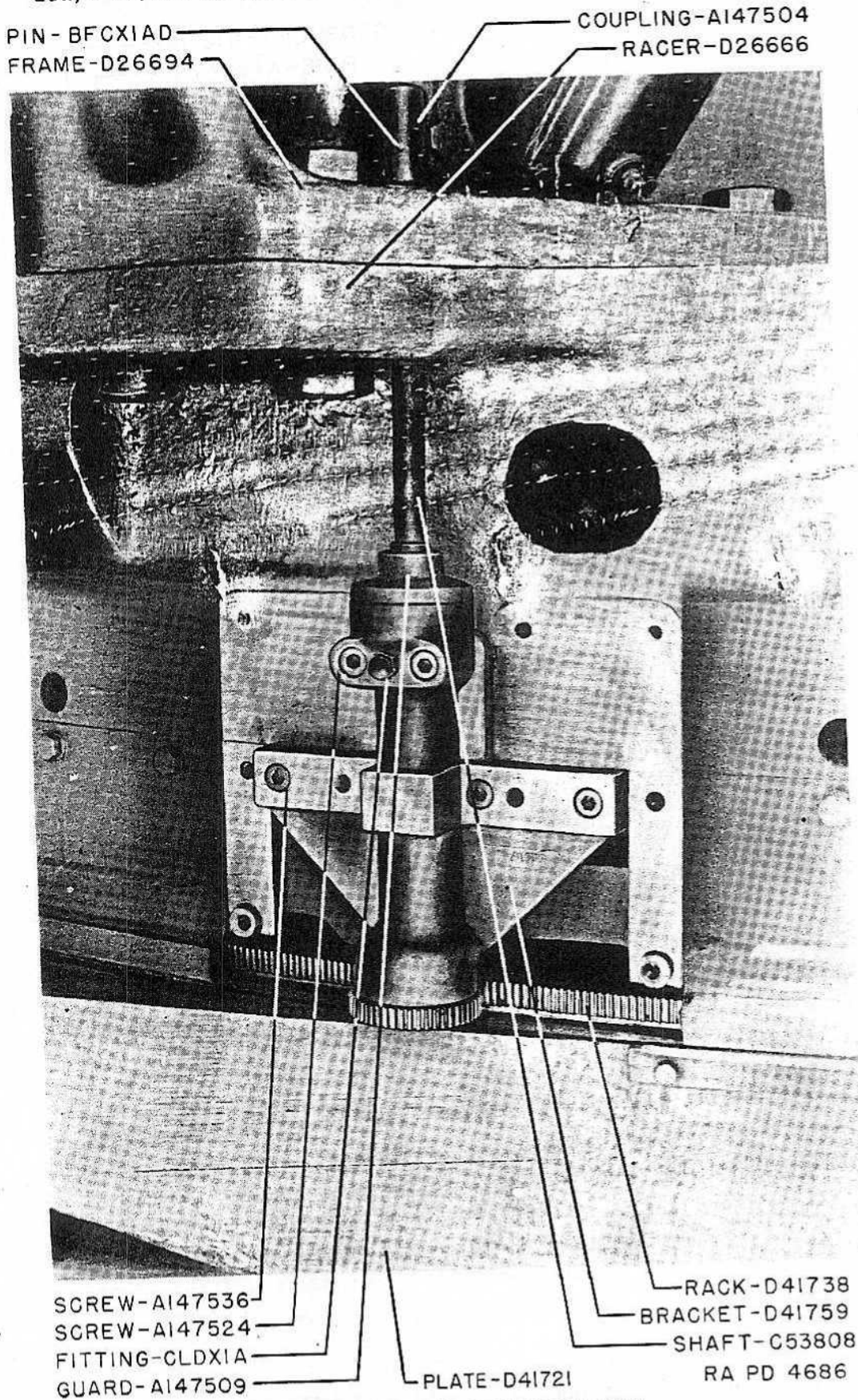


FIGURE 21 - AZIMUTH INDICATOR DRIVE

DESCRIPTION OF GUN AND CARRIAGE

RA PD 4688

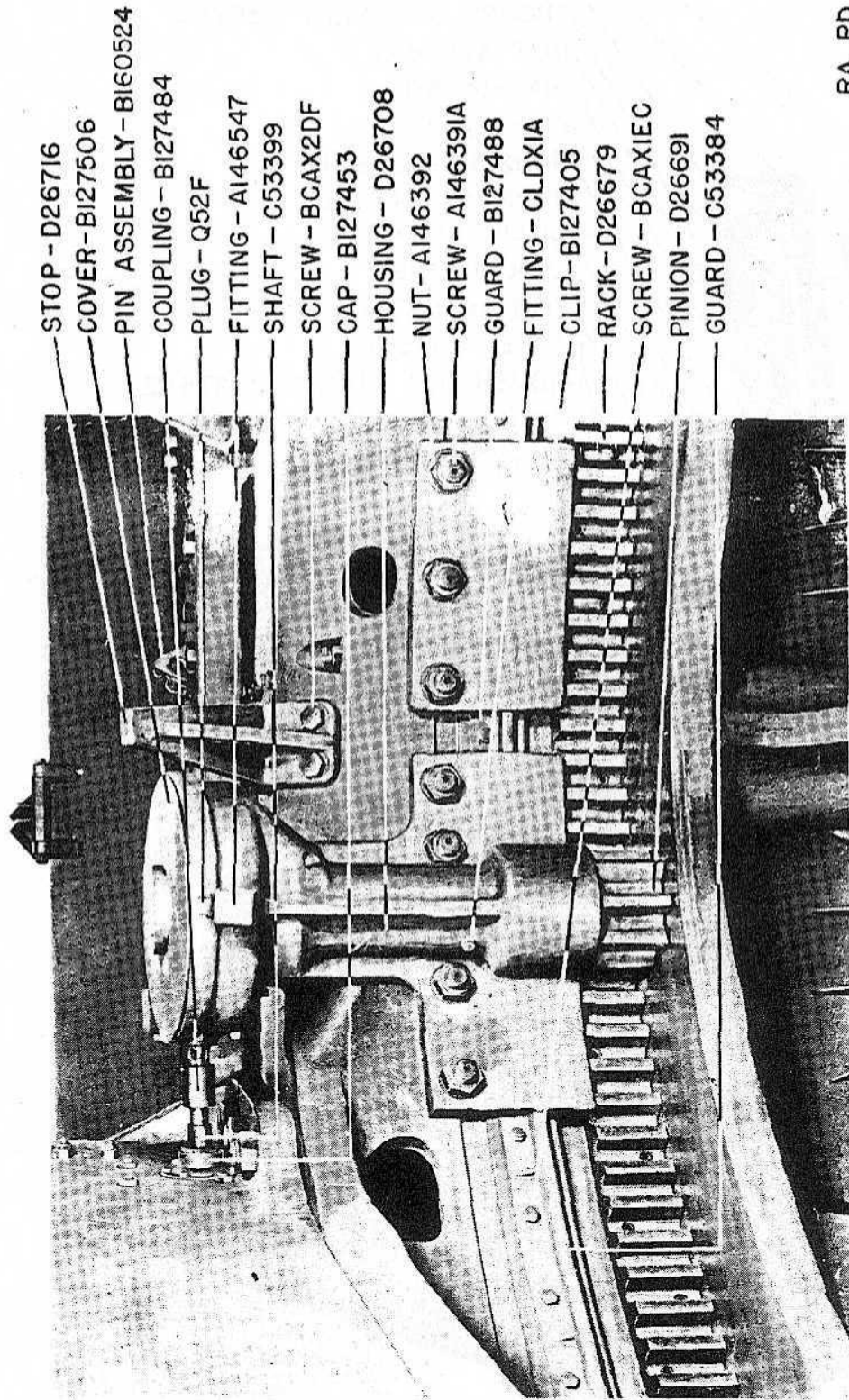
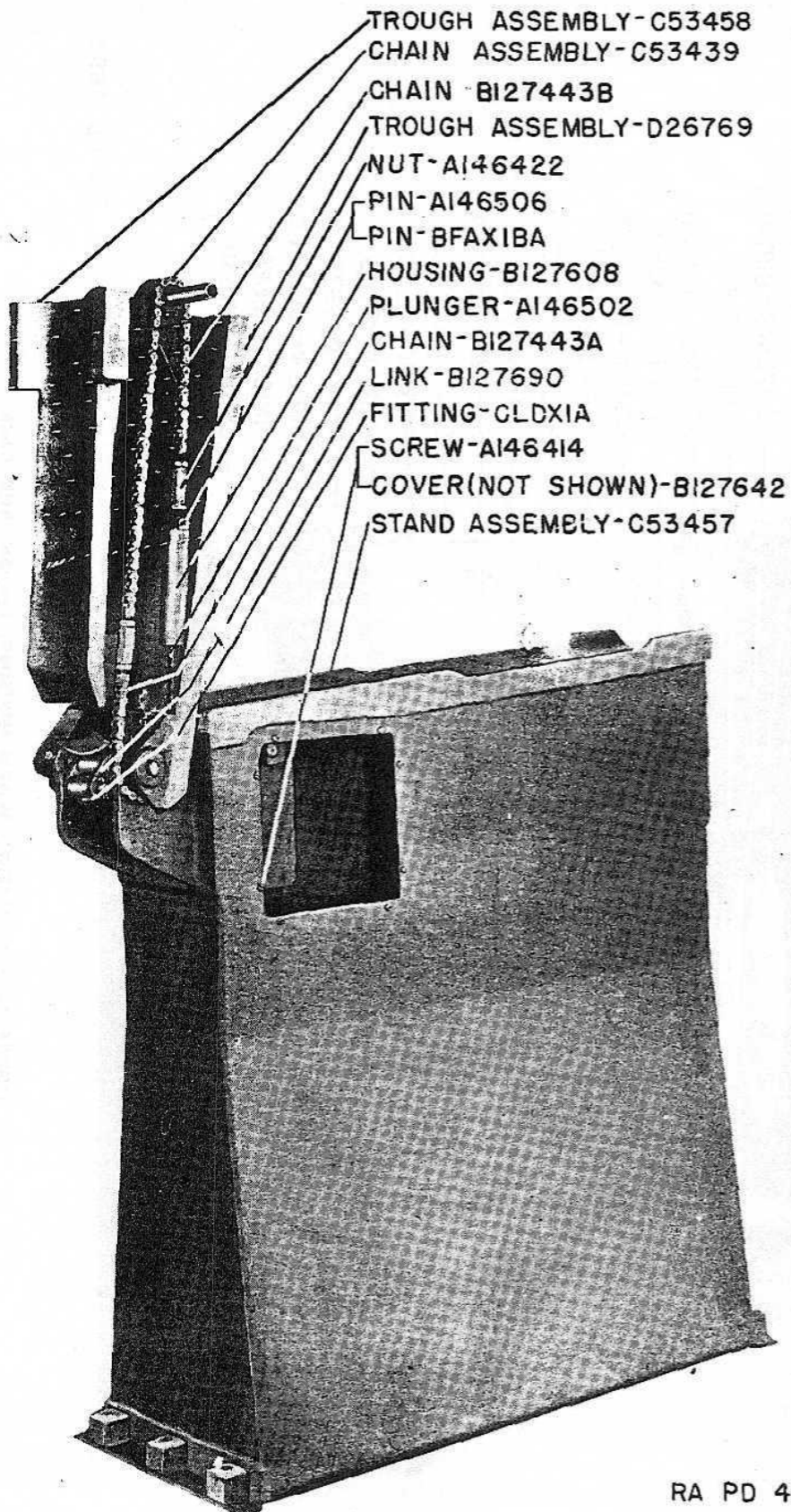


FIGURE 22 - TRAVERSING WORM HOUSING, PINION, AND RACK

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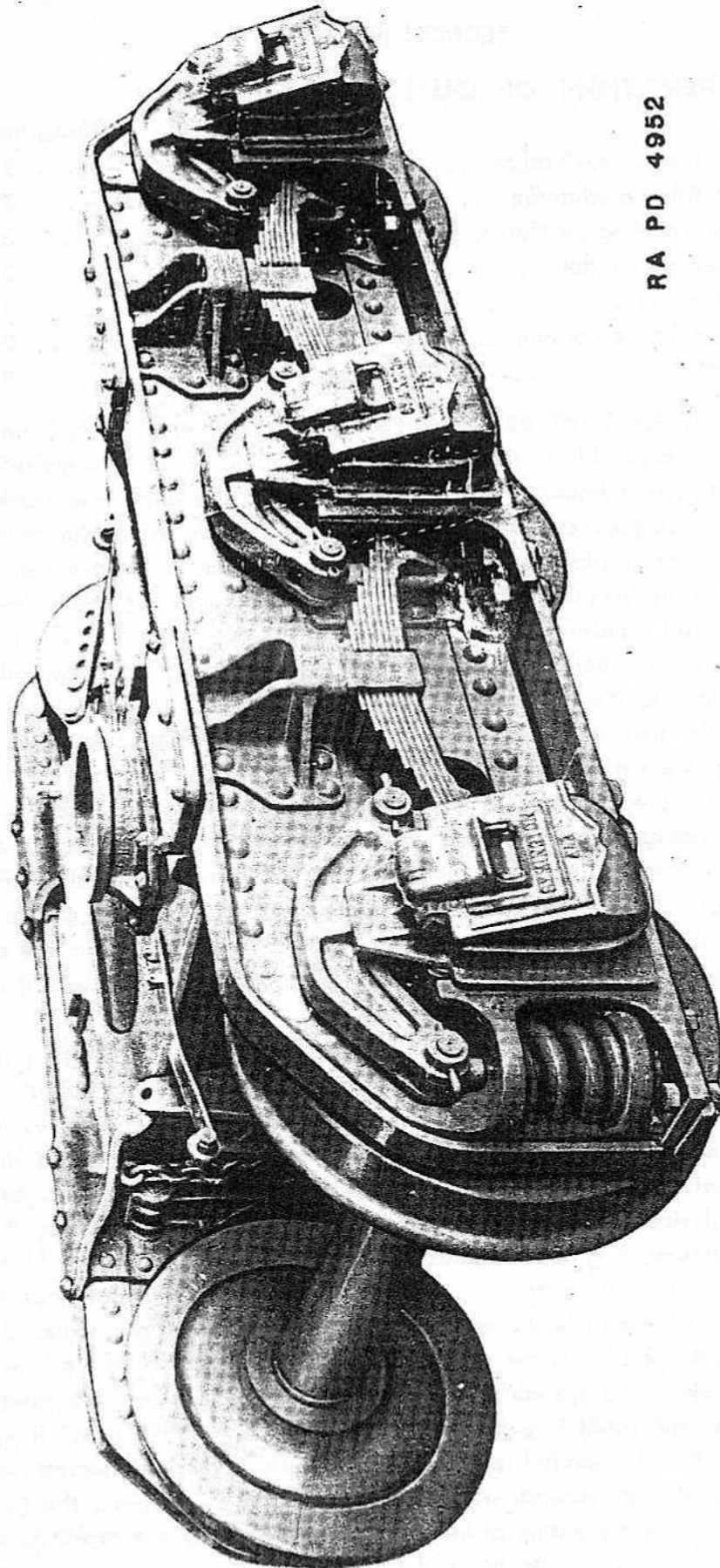
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RA PD 4696

FIGURE 23 — LOADING TROUGH AND STAND

DESCRIPTION OF GUN AND CARRIAGE



RA PD 4952

FIGURE 24 — 6-WHEEL TRUCK ASSEMBLY

SECTION III

OPERATION OF GUN AND CARRIAGE

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29. TO OPERATE THE BREECH MECHANISM (*Figures 4, 5, 6, 7 and 8*). — To open the breechblock, turn the breech operating crank counterclockwise (to the left). Manipulation of the crank attached to the worm and crankshaft actuates the compound gear on the face of the breech. When the crank is turned left, the horizontal threads on the compound gear engage the segment attached to the breechblock and rotate the block counterclockwise. This breaks the seal and translates the block slightly to the rear. The vertical teeth in the compound gear then engage the breechblock threads and completely translate the block to the rear onto the breechblock tray. In this action the block releases the tray latch and the tray swings to the right, clearing the breech opening in the gun. A stop attached to the tray limits the swing of the block. To close the breechblock, turn the operating crank clockwise. To remove the firing lock, disengage the ends of the breech firing circuit cable (*Figure 5*) from the firing lock and contact bracket (*Figure 4*), then unscrew the firing lock from the end of the obturator spindle by turning the lock housing counterclockwise. Assemble the obturator spindle thread protecting cap on the end of the spindle. Remove the firing lock from the obturator spindle and store it in a safe place when the gun is not in operation.

30. TO OPERATE THE FIRING MECHANISM. — *a.* To fire the gun electrically it is necessary that a continuous electrical circuit be established from the firing pistol on the left side of the carriage to the firing lock (*Figure 5*) in the breech mechanism. To prevent accident from premature firing of the piece, several safety devices (*Figure 37*), "breaks" in the firing circuit, are employed. These devices are located at the gun commander's push button, the recoil firing contactor, and at the contact bracket (*Figure 4*) and contact block (*Figure 5*) on the breech of the gun. The firing mechanism will not operate until the breechblock is entirely closed and the gun counterrecoiled approximately to its normal firing position in the cradle. Failure to close the breechblock will result in a break in the breech firing circuit. Failure of the gun to return to firing position will result in a break in the firing circuit at the recoil firing contactor. With the gun loaded and in firing position, the breech mechanism properly closed, and the breech personnel off the breech platform, the gun commander will press the button at his station. Final check of the readings of the azimuth and elevation indicators will be made by the observers at these

OPERATION OF GUN AND CARRIAGE

devices to co-ordinate the readings. The gunner at the firing position will pull the pistol trigger to fire the piece.

b. If the electrical firing circuit fails to operate properly, the piece may be fired with the gunner's lanyard. To fire the piece by hand use the firing lock (Figure 5) as follows: Withdraw the firing lock hammer to its extreme rearward position; this compresses the firing spring (Figure 8c), which is held in place by the hammer stem and sear. Engage the lanyard hook in the trigger eye. On signal to fire, give the lanyard a quick jerk, being careful that neither the firing lock parts nor the lanyard are injured in the operation. Pulling the trigger disengages the sear from the hammer stem, allowing the firing spring to expand to its full open position. The hammer sharply contacts the firing pin, which explodes the primer, firing the piece.

(Do not fire the gun with the lanyard unless it is absolutely necessary. No safety devices are provided.)

31. TO CHANGE FROM TRAVELING POSITION TO FIRING POSITION.

a. In choosing a position from which the mount is to be fired, select a road bed as nearly level as possible. The truck center plate and body bolster plates disengage at one end of the mount when it is jacked to level position if the firing position is on a grade. Under this condition the male and female parts of the center plate are likely to be thrown out of alignment during firing. If this should occur, realignment before lowering the mount onto the trucks may be obtained by operating the appropriate outrigger adjusting screws.

b. When the mount reaches the position selected for firing, it should be located so that two ties support each pedestal. Set the hand brake at each end of the mount if necessary to prevent movement. Release the air brakes by pulling outward on the two release valve rods projecting from the side sills near the ammunition tables. Break the air hose connection at each end of mount. Remove eight pedestals (Figure 20) from stowing position on the car floor and lower carefully to prevent damage. The cranes may be used for this if desired. See that all pedestal screws are run down into the pedestals as far as they will go. Unlock the four jacks on the corners of the base plate by throwing the inner pawls out of action. Run down the jack plungers by turning the ratchet lever sockets with the pin handle provided. When jack plungers are in contact with the rails, insert the jack levers in their sockets and pin in place. Release the hand brake, if set. With a man at each jack lever, raise the mount evenly until the eight pedestals can just be placed in position under the base plate, (Figure 17). (The jack levers are stowed for travel under the ammunition tables at each end of the mount.) The mount should be leveled as close to the ground as possible. When the pedestals are set in place, level the mount by using the four jacks and the four levels permanently mounted on the base plate near the jacks (Figures 17 and 18). In operating the jack levers, the ratchet pawls should be set so the work is done on the down stroke.

NOTE: In Figure 17 the jack levers are shown incorrectly. They should project toward each other, i.e., toward center of mount to clear the end outriggers.

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c. When the mount is leveled accurately, run up the screws in the pedestals until they seat firmly and uniformly against the under side of the base plate. This should require only the pull of one hand on a three-foot lever. Care must be taken not to disturb the level of the base plate when screwing up. When all pedestals are carrying the load equally and the mount is level, raise the jack plungers enough to clear the rail head by one-half inch, relieving them of firing load. With normal roadbed the bolster center plates should then be well down inside the truck center plates.

d. Excavating for the outrigger floats may be done while the above operations are taking place. Picks and spades are provided in the equipment. If accurate location of the mount with respect to the railroad ties can be determined in advance, digging for the floats may be done before the mount is brought into position.

e. Recesses for the floats should be dug to the proper depth so the float seats in the bottom of the recess. When emplaced, the thrust surface of the float should be square with the main outrigger tube, and the ball-end adjusting screws in the lower end of outrigger should project as little as possible. The floats carried on the front end of the mount should be removed first and located in the recesses dug at the sides of the mount. This enables the side outriggers (those projecting outward at right angles to the side of the car) to be set completely in place before the mount is traversed around. *The mount should never be traversed 90° unless at least one side outrigger is in place on the muzzle side to give stability.* Before traversing the mount, the two locking pins between racer and base plate must be lifted out and hung in their receptacles. The gun traveling muzzle support is then slacked off and the gun traversed (muzzle toward the outriggers already in place) so the remaining floats at the rear end of the car are accessible.

f. With all floats located in their seats, assemble the outriggers and lower chords, and adjust the length of the chords so the ball-end of the outrigger screw is level with the bottom of the railroad ties. Each outrigger unit may then be swung like a gate, engaging the ball-end of the screw in the socket in the footplate as the foot plate is slid into place sidewise on the float. The ball-end screws are then adjusted to seat firmly in the sockets in the foot plates. *They must be kept firmly seated during firing.* Too tight an adjustment should be avoided, as this tends to lift the mount affecting the leveling. The screws should never be run out more than 10 inches when under load as this might result in bending. If an extension of more than 10 inches is necessary for proper tightening, the screws should be run completely in, the floats pried up against them, and earth tamped behind the floats.

g. When all outriggers are set, lower the muzzle support and depress the muzzle of the gun sufficiently to permit the plungers of the breech support to be retracted into their recesses in the recoil band. Make sure after this operation that the locking pin in the crank handle is engaged in its hole in the band.

h. Before elevating the gun, see that the recoil parts lock is coupled up.

(See par. 19.)

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32. TO ELEVATE OR DEPRESS THE GUN. — *a.* The elevation indicator and elevating mechanism (Figures 14 and 34) are located on the right side of the mount. The indicator consists of electrically and mechanically controlled dials. The gun is set at proper elevation for any target by matching the mechanically controlled indicator with the electrically controlled indicator.

b. To elevate or depress the gun, turn the handwheel on the right side frame. One revolution of the handwheel counterclockwise elevates the gun 1.367° . To elevate the gun from minus 5° to its maximum elevation of 45° requires approximately $36\frac{1}{2}$ turns of the handwheel. The degree of elevation at any point between minus 5° and plus 45° is indicated on the elevation indicator dial by the movement of the elevation indicator rack (Figures 10 and 14) attached to the right side of the cradle. Turning the handwheel clockwise depresses the gun.

33. TO TRAVERSE THE MOUNT. — *a.* The traversing and azimuth indicator drive mechanisms (Figures 20, 21, 22, 31 and 32) are complementary units attached to the left side of the mount.

b. Traversing the mount is accomplished by turning the handwheel mounted on the left side frame (Figure 31). One turn of the handwheel traverses the gun 1.028° . Turning the handwheel clockwise traverses the gun to the left. To traverse the mount 360° requires approximately $350\frac{1}{5}$ turns of the traversing handwheel. Manipulation of the handwheel actuates a train of gears (Figures 31 and 32) extending to the main traversing pinion (Figure 22) located on the inside of the racer in contact with the traversing rack which is bolted to the base plate. The azimuth indicator consists of electrically and mechanically controlled dials by which the gun is set at proper azimuth. It is located on the left side of the mount below the traversing handwheel and connected to the azimuth indicator drive rack by a train of shafts and gears. The azimuth indicator drive rack (Figure 21) attached to the base plate actuates a pinion on the lower end of the indicator drive shaft (Figure 21) when the mount is traversed.

34. TO OPERATE THE BRAKE MECHANISMS (Figures 15 and 16). — The mount is provided with air brake and hand brake mechanisms which are operated independently. A hand brake mechanism is attached to each end of the car structure, each one working independently. When the air brake couplings are disconnected upon reaching firing location, the hand brakes at each end of the car platform should be set securely to prevent movement of the mount during placing of firing pedestals, arrangement of outriggers, and contacting of jack plunger shoes to the rails. Before jacking the mount to relieve the weight from the trucks, the brakes must be released.

35. TO LOAD THE GUN (Figure 23). — The two cranes at the rear corners of the loading platform are intended to be operated by two men at each crane. With the two cranes working, it is normally possible to deliver a shell onto the loading box before the gun can be brought back to the loading angle (-5°) after the preceding shot. The breech operating crank is so located that it can be operated as the gun breech is coming up to the loading position.

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When the gun arrives at the loading angle, the breech should be fully open. The loading trough is then operated by the handle on the left side, so the front end of the trough rests in the breech recess. Two men, one on each side of the loading box, then impel the projectile by hand into the chamber, imparting to it the maximum attainable velocity in order to obtain perfect seating. The bottom of the loading trough should be lubricated slightly throughout its length to facilitate this. The powder charge is then placed on the trough and pushed into the chamber by hand.

CARE AND PRESERVATION

SECTION IV

CARE AND PRESERVATION

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Center truck and body bolster plates	42
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Springs	49
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Lubrication instructions for ordnance maintenance personnel at the time of ordnance inspection	51
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Painting	53

36. GENERAL. — a. Keeping all parts of the materiel in proper condition and ready for immediate service is of vital importance. In care and preservation of the materiel, exercise extreme care to insure that all moving parts of the various mechanisms are properly lubricated, that all rust discolorations, sediment, dirt and grit are removed from the working parts, and that paint and other preserving materials are applied to the gun and mount when necessary. Lubricating, cleaning, and preserving materials provided with the mount will enable the personnel to keep the parts in proper working condition.

b. Moving parts of the various mechanisms should be lubricated frequently, and periodical examinations should be made of the parts to insure that the lubricant used is reaching the part for which it is intended. It is essential that all parts of the mount be kept free from rust and that all moving parts be cleaned and kept free from dirt, grit, gummed oil and other foreign substances. If rust should accumulate, its removal from all bearings, and especially from piston rods, recuperator rods and all sliding surfaces requires special care in order that clearances shall not be unduly increased. Use of coarse abrasives for this purpose is forbidden.

37. GUN. — a. Barrel. (1) See that unburnt particles of powder and powder bags do not accumulate in the barrel during firing. During night firing, swab the barrel with the sponge between rounds.

(2) To clean the barrel after firing, wash with a solution of half a pound of soda ash or a pound of sal soda in a gallon of water. If this is not available,

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use hot, soapy water. Rinse thoroughly with clean water and lubricate after cleaning.

b. *Breech mechanism.* (1) Keep the breech mechanism clean and well lubricated. When it is not in use, disassemble periodically to detect rust. Immediately after firing, clean and lubricate the breech mechanism.

(2) If the gun is not to be used for a considerable time, all bright and unpainted surfaces should be cleaned thoroughly and freed of rust, moisture, and lubricants. Apply COMPOUND, rust preventive.

c. Protect the barrel and breech mechanism with canvas covers when the material is not in use.

38. CRADLE (Figures 9, 10 and 11). — a. Exercise particular care to lubricate the internal surfaces of the cradle liners in which the gun slides. Grease nipples are provided to apply the lubricant to these surfaces with a pressure gun.

b. Keep the cradle trunnion bearings filled with grease at all times. This will prevent entrance of water and foreign substances into the bearings.

39. TRAVERSING ROLLER SYSTEM AND PINTLE BEARING. — a. In oiling the traversing rollers and pintle bearing, the gun should be traversed 180° to the right and left to insure distribution of oil over the whole circumference. The outrigger should be in place on the muzzle side when this is done to insure against tipping. The mount must also be approximately level. For lubricating these parts, numerous oilholes are provided in the upper surface of the racer. Into these holes oil tubes leading to the pintle surface of the racer and base plate and to the distance ring have been inserted. The openings are provided with spring covers to exclude dirt and sediment, and care must be exercised to see that the covers are closed after each lubricating operation.

b. It is of vital importance that the rollers and roller paths be kept free from dirt and grit, as such substances quickly impair the serviceability of the traversing roller system. Particular care must be exercised in lubricating the pintle surfaces of the base plate and racer, as the clearance at this point is slight. Unless these surfaces are lubricated thoroughly there is danger of binding of the racer and base plate, which would make traversing of the mount extremely difficult.

c. The distance ring is provided with two grooves extending around its entire circumference to receive the oil and distribute it to the journals of each roller. Oilholes are provided through the bottom of these grooves at each journal bearing, and it is especially important that these oilholes be kept clean and free from dirt, gummed oil, or sediment of any kind. For this reason frequent examination of the traversing roller system should be made. To make this examination and to do such maintenance work as may be required, remove the outer dust guard.

d. In the event of serious malfunction in the traversing roller system, the racer must be raised from the base plate in order that the rollers and distance ring may be worked on. As this would result in a considerable loss of time, and inconvenience, extreme care should be exercised in keeping this system clean and lubricated.

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40. TRAVERSING AND ELEVATING MECHANISMS (Figures 31, 32 and 33). — The worm and worm wheels, handwheel and shaft gearing of the traversing and elevating mechanisms are designed to operate with the parts immersed in oil. Make frequent examinations of these parts to insure that sufficient oil is present in the housings of these devices. Drain the oil frequently by the drain plugs if the oil in the housings shows evidence of dirt or other sediment, or if it is found that the lubricating value of the oil has been impaired. When it is necessary to remove the oil from any mechanism or device on the mount, the parts of the mechanism should be cleaned thoroughly with SOLVENT, dry cleaning, and refilled with fresh oil.

41. AZIMUTH AND ELEVATION INDICATORS (Figures 34 and 35). — It is important that the azimuth indicator and drive mechanism and the elevation indicator mechanism be kept lubricated. Make frequent examinations of these devices to see that the moving parts are oiled and that they are free from rust, dirt, or sediment of any kind.

42. CENTER TRUCK AND BODY BOLSTER PLATES. — Give special attention to lubrication of the center truck and body bolster plates connecting the mount body to the trucks. For lubricating this connection a flange supporting an oil cup is attached to the bolster cover plate on both front and rear ends of the car body. The upper or male part of the connection is provided with a reservoir for holding lubricating oil. The sides of this reservoir contain four drilled holes to permit the oil to escape to the contacting surfaces, and a draining device extending from the female part of the device to the surface of the truck frame is provided for drawing off superfluous oil should there be evidence of an overflow of lubricant at this point.

43. LIFTING JACK MECHANISMS (Figures 17, 18 and 40). — For the operation of the lifting jack mechanisms, it is essential that they be well lubricated and kept free from rust, dirt and grit on the rotating and sliding surfaces. Make frequent tests of the devices to insure good working condition. Particular attention is directed to the lubricating device at the upper end of each ram, which supplies lubricant to the threads of the lifting screws. It is necessary that lubricant be applied under pressure frequently at this point to avoid undue friction on the threads of these screws which engage with the nuts in the lifting rams.

44. OUTRIGGERS (Figures 17 and 18). — To insure freedom of movement of the outrigger struts and chords, clean and lubricate the hinges and other fittings attaching the parts to the car body.

45. RECUPERATOR, INTENSIFIER, LIQUID PUMP AND AIR VALVE (Figures 9, 10, 11, 13 and 29). — a. The recuperator system, composed of the recuperator, intensifier, liquid pump and air valve, has the function of returning the gun into battery after firing. The liquid pump must be supplied with oil (heavy recoil low pour point) only when the intensifier is to be replenished. Care must be taken to see that no water is in the pump reservoir. Always drain before supplying with oil.

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b. The recuperator yoke carrying the plunger and recuperator rods slides horizontally in recesses in the gun cradle. The bearing surfaces of these sliding parts should be kept well lubricated.

c. The recuperator rods slide horizontally through bushings assembled in the cradle casting, and the rods must be lubricated and kept clean to keep friction or binding to a minimum in these bushings.

d. The recuperator plunger slides through an oil seal in the recuperator cylinder. The outer surface of the plunger should be examined occasionally to insure that the surface shows no abrasion.

e. The liquid pump should be disassembled only when it fails to function properly. Special care should be taken to prevent water entering the reservoir. Drain and refill only when about to use.

f. The intensifier is provided with a piston and rod actuated by the air pressure and oil supplied from the liquid pump. The position of its piston rod in relation to the intensifier indicator shows whether oil should be supplied to the recuperator seal. The parts of the intensifier should be kept clean.

g. The air charging and maneuvering valve through which the compressed air is admitted to the intensifier should be examined periodically to see that the parts are clean and in working condition.

h. For charging the recuperator (*Figures 11 and 12a*) with compressed air, an air cylinder and maneuvering valve connection are provided. This connection consists of about ten feet of copper tubing equipped on one end with a female fitting for attaching it to the air cylinder, the other end is equipped with a male fitting for attachment to the maneuvering valve.

i. (1) With the valves in the maneuvering valve body and intensifier (*Figure 11*) closed, remove the filling plug from the maneuvering valve and screw the male fitting of the filling connection into the filling hole in the maneuvering valve. Connect the female fitting of the connection to the compressed air cylinder. Now open the air valve in the intensifier to full open position. Open the valve in the compressed air cylinder and permit the air to enter the recuperator by opening the needle valve in the maneuvering valve body very slowly. Control of the flow of air into the recuperator can be regulated by manipulating the valve in the maneuvering valve body. Care must be exercised to permit only a gradual flow of the air through the filling device.

(2) While charging the recuperator, watch the air pressure gage (*Figure 11*) near the maneuvering valve, and when the pressure is slightly over 1600 lb. per sq. in., close the valves in the maneuvering valve body and intensifier and the valve in the compressed air cylinder; then remove the connection.

(3) If the required pressure cannot be obtained from the air in one compressed air cylinder, use another cylinder, repeating the above procedure until the required pressure is obtained.

(4) When it is necessary to take a reading to determine the air pressure in the recuperator, only the needle valve in the air end of the intensifier need be opened.

(5) For correct return of the gun to the battery when firing, particularly at

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higher elevations, the air pressure in the recuperator cylinder should be kept at 1600 lb. per sq. in. and frequent readings of the pressure gage taken to make sure this pressure is maintained.

46. RECOIL CYLINDERS (Figures 10 and 28). — a. If the piece is in continuous service, it will only be necessary to refill the cylinders as required. If inactive, the recoil cylinders should be kept completely filled by filling when gun is depressed. Once in each six-month period the cylinders should be flushed thoroughly and refilled.

b. For cleaning the cylinders, a plumber's hand force pump, with approximately 25 ft. of hose, is provided with the accessories for the mount.

c. It will be noted that it is not necessary to remove the packings from the cylinder head stuffing boxes to clean the cylinders. In this work the following procedure should be observed:

(1) Place the gun and cradle at zero elevation and lock the gun to the cradle with the recoil parts locking device.

(2) Remove the oil from both the long and short cylinders through the emptying plug, A10465.

(3) Flush the cylinders with SOLVENT, dry cleaning, and drain thoroughly.

d. To fill the cylinders, pour clean OIL, heavy recoil, into the cylinders until the level of the oil reaches the filling hole. Allow any air present to escape, then pour in more oil until it is level with the filling hole. Oil which has been withdrawn from the cylinders or which may have been used for any other purpose must never be put back in the cylinder until it has been filtered or carefully strained, and then only on approval of a responsible officer. During the filling of the cylinders, the gun and cradle must be set at 0° elevation with the recoil parts locking device assembled, and care should be exercised to see that the draining plugs, recoil cylinder heads, stuffing boxes and other parts of the mechanism are securely in place.

47. LOADING STAND AND TROUGH (Figure 23). — It is important that all moving parts of the loading stand and trough, including the sprocket chain, be kept lubricated properly so the mechanism may be operated with a minimum of effort. Particular attention is directed to the fitting on the under surface of the spring rod at the link end. In lubricating at this point take care to see that the lubricant reaches the bearing surfaces. Make periodical examination of the parts to see that they are clean and free from rust.

48. JOURNAL BOXES (Figure 25). — a. *General.* — Serious delays in railroad transportation may occur from failure of the car journal bearings. The most frequent cause of bearing failure is the condition known as "hot box," which is an increase in bearing temperature sufficient to cause failure unless given prompt attention. "Hot boxes" are sometimes caused by improper functioning of the bearing lubricants and occur mostly in cold weather. Proper selection of lubricating materials and expert application of these materials are the best insurance against breakdown.

b. *Materials.* — (1) The oil used in the journal boxes is OIL, lubricating,

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car and locomotive engine, of the latest issue in effect. If this is not available, the advice of an experienced railroad man should be followed.

(2) The lubricant is applied to the journal by means of waste which is saturated with the oil and packed in the box along with the small excess of oil. The waste should be new, of high quality, free from dirt, lint, lumps and knots, sweepings, flyings, wire, straw, paper, wood, or similar foreign matter.

c. Instructions for packing. — (1) The following instructions briefly outline the correct method of packing journal boxes. If possible, it is desirable to pack journal boxes under the supervision of an experienced railroad man.

(2) *Preparation of journal box packing.* — Both new and renovated waste must be carefully pulled apart and a known weight placed in a saturating tank with a measured amount of oil sufficient to submerge the waste completely. Soak new waste 48 hours and renovated waste 24 hours at a minimum temperature of 70° F. Draw off excess oil, leaving just sufficient quantity to maintain the specified ratio of:

3½ pt. of oil per lb. of new waste
1½ pt. of oil per lb. of renovated waste

As oil continues to drain, it must be drawn off at the bottom and poured back over the waste, maintaining the ratio. This may also be accomplished by stirring the waste. (Renovated waste is clean waste removed from journals and reclaimed. Renovated waste shall be used only for emergencies in case new waste is not available.)

(3) *Packing of journal boxes.* — Journal boxes should be thoroughly cleaned, and then repacked as shown in diagrams Nos. 1 and 2, Figure 25. Waste is applied in four rolls of approximately 5-inch diameter which is prepared by the box packer when applying. Rows become matted together after they are tucked firmly under the journal. The maximum height of waste in the box is 1 inch below the center line of the journal. Packing removed from journal boxes for any reason shall be renovated for reuse. Use TOOL, combination hook and packing, for placing the rows of waste in the journal box as shown in diagram 2 of Figure 25. Packing can be tested in boxes properly by inserting the packing tube under the front of the journal and squeezing the packing against the journal. If oil appears on top of the packing on the front end of the box, no free oil is needed. If packing appears dry on top, add oil. Apply oil sparingly, since overapplication causes soggy waste to fall away from the journal.

d. Care during idleness. — (1) Prolonged idleness of railway cars equipped with standard journal bearings will result in rusting and pitting of the journals if steps are not taken to prevent this. Pitting usually results in hot journals and bearing failure during movements. The oil will drain from that part of the journal above the waist and leave the metal exposed to the atmosphere. The entire bearing is lubricated only when the cars are in motion, that is, when the journals are continually revolving in waste and oil.

(2) In order to prevent rusting of the bearings from exposure to the atmos-

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where, they must always be protected with oil or COMPOUND, rust preventive. One of the following alternative procedures will be followed:

(a) Set the trucks in motion at least once per week and examine the journals to be sure that the entire surface is coated with a film of oil. In the case of railway gun mounts with detachable trucks, it will be satisfactory to move the trucks only. In addition to the weekly exercising, the trucks must be moved a minimum distance of 100 feet once a month.

(b) If it is not possible to move the trucks, remove the waste from the boxes and thoroughly coat the entire surface of the journals with COMPOUND, rust preventive. Before moving the cars, the rust preventive compound must be thoroughly wiped off and the journal boxes repacked with waste and oil. COMPOUND, rust preventive, light, should be used for short or temporary periods of inactivity such as occur when gun trucks are removed from a gun carriage while the gun is emplaced but manned. The metal surface so protected should be inspected once every two weeks and recoated if necessary. For long periods of inactivity such as occur when the materiel is not in service, COMPOUND, rust preventive, heavy, should be used.

(3) The journals will be carefully inspected and serviced prior to any movement of the trucks. If it is known in advance that the railway units are to be moved to a new location, all cars should be exercised.

(4) While the cars are in motion, personnel should be on the alert for smoke or the characteristic smell of burning rags and oil. This is the first indication of a "hot box."

(5) At every stop, servicing personnel must check all journals. If the temperature of the boxes are found to be above normal as indicated by slight smoking condition, the hot box must be reported, the boxes marked, and the journal, brass, and wedge carefully inspected.

49. SPRINGS. — When no travel of the mount is in prospect, run down the jacks, lifting the mount enough to relieve the truck springs of their load. If trucks are left under load for long periods, permanent set of the springs will result.

50. LUBRICATION AND SERVICE INSTRUCTIONS FOR THE USING ARM. — *a. General.*

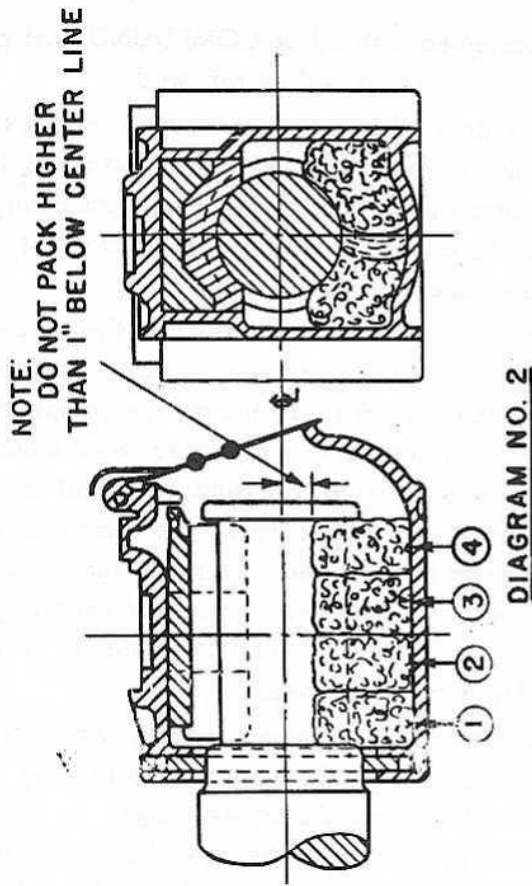
(1) Intervals indicated in Figures 26 and 27 are for normal service. For extreme conditions of heat, water, dust, etc., lubricate more frequently.

(2) Clean settings and oilers before lubricating.

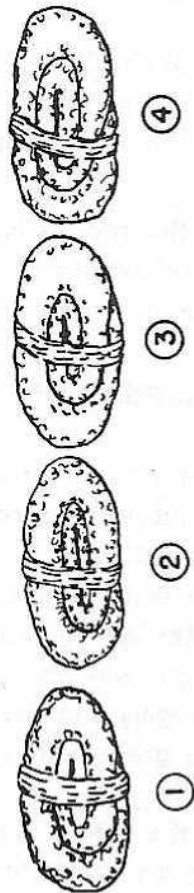
b. Elevating rack and pinion. — (1) The teeth of the elevating rack and pinion require little lubrication but as a protection against rust they must be covered with a thin coat of oil. Dust and grit will adhere to this oily film. Consequently, the teeth must be cleaned thoroughly and fresh oil applied before elevating or traversing the gun; otherwise, the grit will cause rapid wear of the rack and pinion.

(2) If considerable dust is present when the gun is operated the oil should be removed from the teeth; they should remain dry until action is over. If surfaces

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RA PD 10231



NO. 4 ROLL SHOULD BE LARGE ENOUGH TO FILL OUT TO COLLAR

DIAGRAM NO. 1

DIAGRAM NO. 2

FIGURE 25 — JOURNAL BOX AND PACKING

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are dry, there is less wear than when coated with lubricant contaminated with grit.

c. *Traversing and elevating gear cases.*— Gear cases must be flushed when changing grades of oil to clear them of sediment and moisture that collects in them. In localities where atmospheric temperatures permit the use of the same grade the year around, they must be drained and flushed once a year. Follow the procedure below:

- (1) Drain used oil and replace the drain plug.
- (2) Fill the cases approximately half full with OIL, engine, SAE 10, and manipulate the gears rapidly for five minutes.
- (3) Drain the flushing oil, replace the plug and fill the cases to the level plug opening with OIL, engine, SAE 10, for temperatures below 32°F or OIL, engine, SAE 30, for temperatures above 32°F.

d. *Truck journal boxes.* Inspect waste and oil level before rolling. Add OIL, lubricating, car and locomotive engine, when necessary.

51. LUBRICATION INSTRUCTIONS FOR ORDNANCE MAINTENANCE PERSONNEL AT THE TIME OF ORDNANCE INSPECTION.— a. *Cradle trunnion bearings.* Moisture and grit accumulate in the cradle trunnions, so they must be cleaned once a year. They should also be cleaned before changing grades of lubricant. When providing this service:

- (1) Remove trunnion covers and clean all grease from the bearings, housings, and covers with SOLVENT, dry cleaning.
- (2) Dry bearings and housings thoroughly and pack bearings with GREASE, O. D. No. 00 or No. 0. (See *Lubricating Guide*).

b. *Traversing rack and carriage support rollers.* Although the traversing rack and carriage support bearing are enclosed, dirt and water contaminating the lubricant, leave deposits that must be removed. To avoid damage, parts must be disassembled and cleaned once yearly.

52. REPORTS AND RECORDS.— a. *Reports.* If lubrication instructions are followed closely, proper lubricants used, and satisfactory results still not obtained, make a report to the ordnance officer responsible for maintenance of the materiel.

b. *Records.* A complete record of lubrication servicing will be kept on materiel.

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

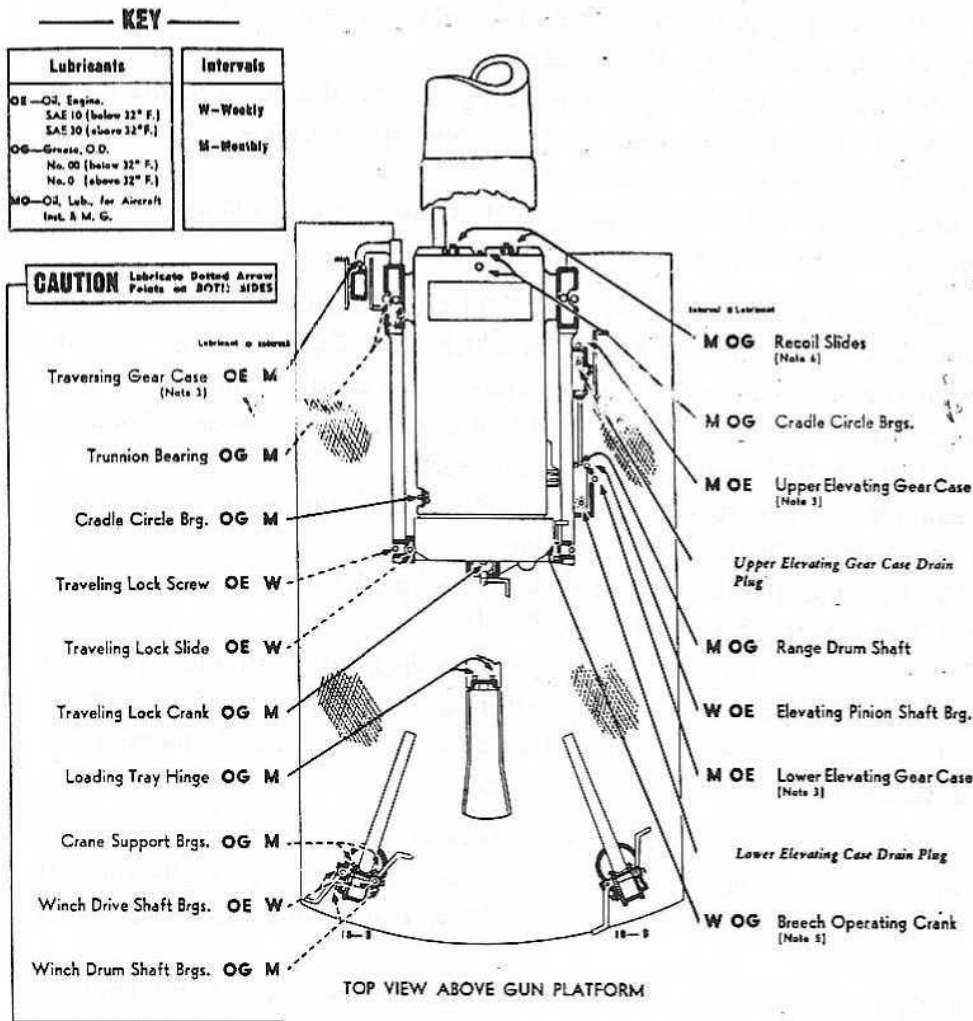
b. *Preparing for painting.*— (1) If the base coat on the materiel is in poor condition, it is more desirable to strip the old paint from the surfaces than to use sanding and touch-up methods.

- (2) Clean materiel surfaces with a solution of one-half pound of SODA

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WAR DEPARTMENT LUBRICATION GUIDE

MOUNT 8", GUN, RAILWAY, M1A1
GUN, 8", MARK VI, MOD. 3A2 (SNL E-6)



RA PD 10668

FIGURE 26 — LUBRICATION GUIDE

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WAR DEPARTMENT LUBRICATION GUIDE

MOUNT, 8", GUN, RAILWAY, MIAI
GUN, 8", MARK VI, MOD. 3A2 (SNL E-6)

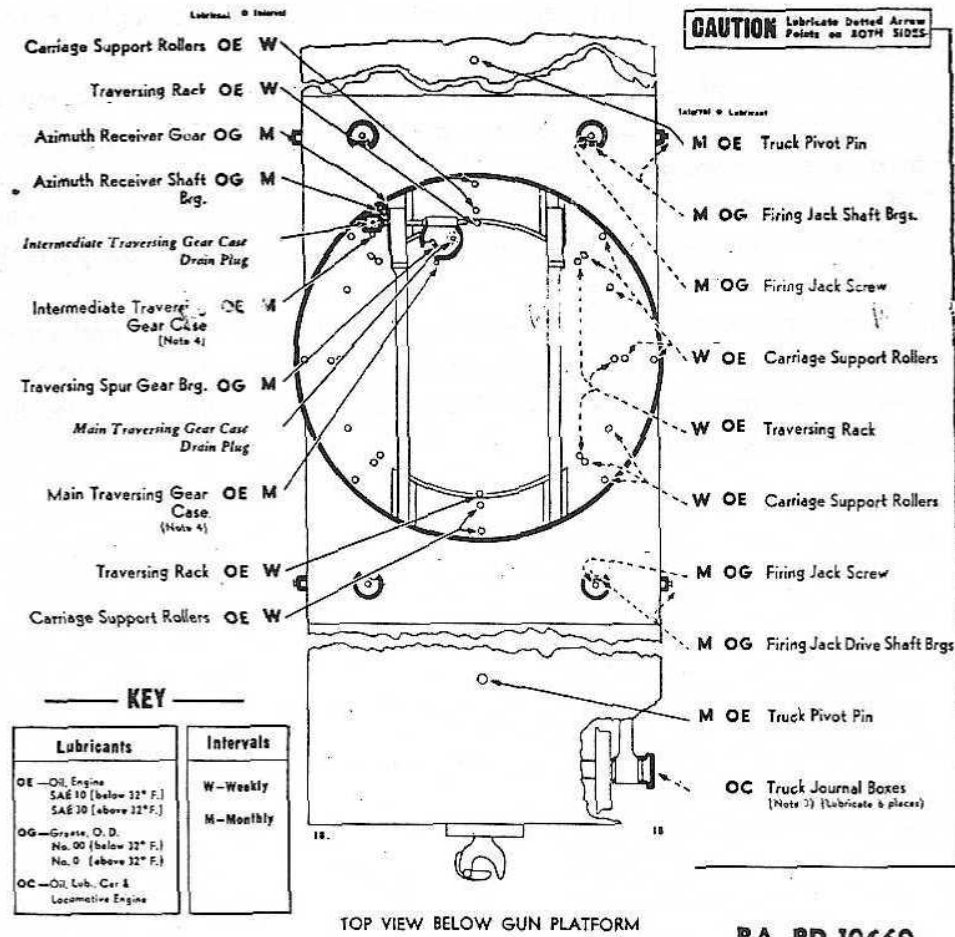


FIGURE 27 — LUBRICATION GUIDE

TM 9-463

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ASH in eight quarts of warm water, or an equivalent solution, then rinse with clear water and wipe thoroughly. If the material is marred in spots, touch the bad places with ENAMEL, synthetic, olive-drab, lusterless, and permit to dry. Sandpaper the old surface with PAPER, flint, No. 1, and apply a finished coat of ENAMEL, synthetic, olive-drab, lusterless, and allow to dry thoroughly. If the equipment is in bad condition, all parts should be thoroughly sanded with PAPER, flint, No. 2 or equivalent, given a coat of PRIMER, ground, synthetic, and permitted to dry for at least 16 hours. They will then be sandpapered with PAPER, flint, No. 00, wiped free from dust and dirt, given a final coat of ENAMEL, synthetic, olive-drab, lusterless, and allowed to dry thoroughly before the material is used.

c. *Removing paint.* — After repeated painting, the paint may become so thick as to crack and scale off in places, presenting an unsightly appearance. In such a case, remove the old paint by use of a lime-and-lye solution or REMOVER, paint and varnish. It is important that every trace of lye or other paint remover be completely rinsed off and that the equipment be perfectly dry before repainting is attempted.

d. *Painting lubricating devices.* — Oil, grease fittings, oilholes, and similar lubricating devices as well as a circle about $\frac{1}{4}$ in. in diameter at each point of lubrication will be painted with ENAMEL, red, water-resisting, in order that they may be located readily.

INSPECTION
SECTION V
INSPECTION

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54. GENERAL. — The purpose of inspection is to observe the condition of the materiel, to determine whether repairs or adjustments are required, and to recommend remedies necessary to insure that the materiel is serviceable.

55. BARREL. — a. The estimated average accuracy life in full service rounds of the 8-Inch Gun, Mk. VI, Mod. 3A2, on 8-Inch Railway Mounts, M1A1, is 300 rounds. Star-gage the guns in service after approximately 10 percent and 90 percent of their estimated average accuracy life in rounds fired, and thereafter at intervals of 10 percent of the original estimated accuracy life during the remainder of their service. They should also be star-gaged at any time an inspector may deem it necessary on account of doubtful conditions, or when the bores show signs of unusual wear or other irregularities. Decoppering of the bores of cannon before star-gaging is prohibited. When star-gaging these guns, the greatest distance from the muzzle at which star-gaging measurements are to be made is 281½ in. (300 rounds estimated average accuracy life of this gun and point of star-gaging, i.e., 281½ inches, is taken from OFSB 4-1, page 6, and applies to 8-Inch Gun, Mk. VI, Mod. 3A1, which is, with modifications, the same as the 8-Inch Gun, Mk. VI, Mod. 3A2, used on this mount.)

b. For such defects in the bore of the gun as need to be measured accurately, use plaster of paris if practicable, as it gives a harder surface than gutta-percha and permits more accurate measurements.

56. BREECH MECHANISM. — To effect an inspection of the breech mechanism manipulate the operating handle on the right side of the gun band and open the breechblock. Note that the block opens easily and that the tray

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latch disengages from the tray latch catch without difficulty. Remove the firing lock and manipulate the moving parts to see that they work freely. Examine the threads on the obturator spindle to make sure they are not battered or otherwise damaged. Examine the gas check pad to see that it is in serviceable condition. To make this inspection it will generally not be necessary to disassemble the parts of the breech mechanism unless there is evidence of malfunction. In that case, order corrective action. To complete the inspection, close the breechblock, assemble the firing lock breech firing circuit cable, and test the electrical contacts to see that they are in good working condition.

57. RECOIL MECHANISM. — The recoil mechanism (Figure 28) should be inspected as follows:

a. Remove the filling plugs in both the long and short cylinders to ascertain whether they contain the required amount of fluid. These cylinders are filled with the gun and cradle parts at 0° elevation, no allowance being made for any void in the cylinders.

b. Examine recoil cylinder heads, glands, packing, etc., to determine whether any leakage occurs at either end of the cylinders.

c. If there is evidence of malfunctioning in the recoil or counterrecoil action in the cylinders, examine the piston rod nuts connecting the piston rods to the recoil band to insure that the piston rods are not binding at this point and that they can "float" into proper alignment. After this operation reassemble the nuts and fasten in place with the set screws provided.

d. If there is evidence of leakage through the gland packings, adjustment or replacement of packings should be made only under the supervision of a trained mechanic familiar with this type of packing.

e. Examine filling and draining plugs for worn or distorted gaskets and order replacements where necessary.

f. Examine the piston extension on the long recoil cylinder and the piston rods of both long and short cylinders for signs of unusual wear or scored surfaces.

g. Examine the recoil recording device to see that the body is fastened securely in place and that the marker is in proper contact with the gun.

58. RECUPERATOR ASSEMBLY (Figures 11, 13 and 29). — a. Examine the intensifier indicator to see that the intensifier piston rod end is within prescribed limits, between 0 and 7 on the indicator.

b. Examine the recuperator plunger for scoring or other defects.

c. Examine the position of the intensifier piston rod at a two or three day interval, to determine whether there is any creeping. This would indicate leakage at the intensifier piston rod packing, at the piston packing, or at the recuperator plunger packing. Adjustment or replacement should be made only under the supervision of a trained mechanic familiar with this type of packing.

d. Examine all oil and air fitting joints, the intensifier liquid pump and air valve assemblies for indications of leakage.

e. Check the air gage against a calibrated gage to see that readings in the neighborhood of 1600 lb. per sq. in. are correct.

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59. TRAVERSING MECHANISM. — *a.* Inspect the traversing mechanism (Figures 20, 21, 22, 31 and 32) by maneuvering the traversing handwheel through 360° traverse of the mount in both directions. Note backlash and any "hard spots" for corrective action. Uniform handwheel pull can only be obtained when mount is level on the pedestals.

b. If there is evidence of excessive backlash or distortion of any of the parts of the traversing mechanism, including the azimuth indicator drive mechanism, immediate corrective action will be ordered.

60. ELEVATING MECHANISM. — *a.* Inspect the elevating mechanism (Figures 14 and 33) by manipulating the handwheel through the maximum degrees of permissible elevation and depression and test for "hard spots" or backlash due to improper functioning of the rack and elevating pinion.

b. Examine the elevation data receiver drive for possible distortion and malfunction.

c. If there is evidence of excessive backlash or distortion of any of the parts of the elevating mechanism, including the elevating data receiving mechanism, immediate corrective action should be ordered.

61. ELECTRICAL EQUIPMENT (Figure 37). — *a.* Inspect all parts of the electrical firing mechanism to determine that the complete circuit is in working condition.

b. Test the firing pistol and gun commander's push button to be sure proper contact is made when those parts are operated.

c. Examine the springs and blades in the recoil firing contactor for evidence of fouling, distortion, or maladjustment of the parts.

d. See that the battery "ground" makes a clean contact and is bolted securely to the side frame and that all parts are securely fastened in place.

e. A 6-volt storage battery should be used for the above test.

62. CRADLE (Figures 9, 10 and 11). — See that the cradle trunnion bearings are packed solidly full of grease. Apply the grease gun to two nipples on each bearing while elevating and depressing the gun slightly.

63. LOADING TRAY. — *a.* Test the operation of the loading tray (Figure 23) to see that it can be maneuvered with a minimum of effort to its folded and extended positions.

b. Check the position of outer end of the tray to see that it rests properly in the gun breech.

c. Examine tables and ammunition troughs (Figure 16) for rigidity and proper alinement and make sure there are no sharp protruding shoulders at any joints of the loading tray or troughs.

64. DUST GUARDS. — Examine all dust guards to determine whether they are securely in place, and check for excessive friction.

65. LUBRICATION. — *a.* Inspect all lubricating fittings for correct functioning of covers and other closing devices

b. Carefully observe the condition of tubes and channels to ascertain

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whether there is any clogging of pipes, etc., due to sediment, deformation, or other causes.

66. AMMUNITION CRANES. — a. Check ammunition cranes (Figures 38 and 39) for smooth and free operation.

b. Test their sustaining power, using a 260-lb. load for functioning.

c. Note the position of the wire cable on the drum during the above test to see that there is no improper "riding" of the cable on the grooved surface of the drum. See that the cable is free of kinks and broken strands. Use only authorized cable assemblies for replacements.

d. Check the alignment of cranes in locked traveling position.

67. LIFTING JACKS. — a. Examine the lifting jacks (Figure 40) to ascertain whether the moving parts are properly lubricated.

b. See that set screws attaching the gear to the elevating screw are securely in place and properly wired.

c. With four men, one man at each jack lever, lift the mount clear of the trucks and return it to its normal position, observing any evidence of distortion due to malfunctioning of any of the jacks during this operation.

d. See that all bolts attaching the jacks to the base plate are securely in place.

e. See that the pawl and pawl ratchet wheel in the jack lever housing and also the pawl and ratchet of the jack lock are functioning properly.

68. OUTRIGGERS. — a. Examine the outriggers (Figures 1, 3, 17 and 18) including lower chord assemblies to ascertain whether all members can be maneuvered into position with a minimum of effort.

b. See that the traveling support and locking device for the lower chords are in proper working condition.

c. Check to see that all locking pins and chains are present and oiled lightly.

d. Note whether the devices for retaining the outrigger parts in traveling position are in a satisfactory condition.

69. GUN TRAVELING SUPPORTS (Figure 36). — a. With the gun at maximum depression, manipulate the breech support crank until the right- and left-hand plungers are extended to full traveling position.

b. By means of the elevating handwheel, elevate the gun until the plungers are in contact with the finished lugs on the side frames.

c. Test with a .02 in. thickness gage to insure that both plungers are in actual contact with the lugs referred to in subparagraph b.

d. By means of the muzzle support mechanism, relieve the weight of the gun in the cradle body, lifting the gun to its traveling position.

e. With a .02 in. thickness gage, test the clearance between the bottom of the gun and the bronze liner at the front end of the cradle to insure that the gun is in proper traveling position.

f. In manipulating the crank of the gun traveling breech support, note whether the mechanism works freely and whether the crank can be returned to its locked position in the recoil band.

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70. LOCKING AND HOLDING DEVICES. — *a.* Examine the recoil parts locking device to determine that the front retaining nut can be assembled and removed easily and that there is no binding or twisting of the chain parts when the front nut is assembled.

b. See that all parts of the stowage devices, including parts for securing the electric firing battery in place, are secured in their proper position.

71. TOOLS AND ACCESSORIES. — *a.* Check tools and accessories in their respective chests to determine whether the full complement of these items is on hand.

b. See that all clips and other holding devices securely support tools and accessories in their specified location and that all implements are protected against dirt and corrosion.

72. BRAKES. — *a.* Test the air brake line including air cylinders and other component parts of the air brakes system for leakage.

b. Note whether air hose connections are in serviceable condition.

c. Test the efficiency of the hand brake system by actual trial. The test of the hand and air braking systems is to be in accordance with standard railroad practices.

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SECTION VI

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73. GENERAL. — a. When the gun and mount is received by the using service it is fully assembled. The purpose of these instructions is to enable the ordnance personnel charged with the responsibility of the materiel to disassemble and reassemble the various mechanisms making up the complete unit. Except in case of unusual emergency it is not intended that the gun, cradle, racer and side frames be disassembled or assembled in the field. This work should, wherever possible, be done at an arsenal or other point where suitable cranes and equipment for handling these parts are available. Instructions for disassembly of these parts as outlined in paragraphs 74, 75, and 76 are intended, therefore to cover only cases of extreme emergency. To dismount the 8-Inch Railway Gun and Mount in the field requires special equipment not listed in any group of equipment provided as tools, equipment, and accessories for this gun and mount. This materiel would include such items as locomotive cranes, shears, falls, blocking, jacks, slings, etc., in addition to the standard and special equipment provided for the gun and mount.

b. In all cases, unless otherwise directed, the reassembly of parts will be in the reverse order of disassembly.

c. Wherever group packing is required in the various assemblies of the mount, the entire group must be inserted. It is not permissible to add individual packing rings in any group assembly.

74. GUN. — a. In order to reduce to a minimum the weight of the parts to be handled, it will be necessary to remove the gun from the cradle. The cradle in turn should be dismantled by removing such items

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as recoil cylinders, recuperator, counterweight (when attached to cradle), etc., if facilities for lifting the parts intact are not available.

b. To disassemble the breech mechanism remove the breech firing circuit cable and firing lock from the breechblock. Open the breechblock in the usual manner. Remove the obturator spindle nut with key. Remove the obturator spindle spring. Remove the obturator spindle with rings and gas check pad. Remove the tray latch screw and tray latch with plunger and plunger spring. Remove the rotating segment and breechblock stop. The block may now be removed from the breechblock tray. Remove the hinge pin nut. Raise the hinge pin until it is clear of the breechblock tray and compound gear. Remove the tray and gear. Back out taper pin and remove the worm and crankshaft nut. Remove the breech operating crank. Unscrew the worm and crankshaft bushing and remove the worm and crankshaft with thrust bearings.

c. To remove the gun from the cradle the following procedure should govern: First set the hand brakes to prevent movement of the mount on the rails, connect the recoil parts locking device with the gun and cradle, and elevate the gun to an angle of not more than 2° to insure easy movement of the gun in disassembly. In this position the cradle should be locked securely in place to prevent tipping by inserting blocking beneath the cradle body. This blocking should furnish support for the wooden cradle which it will be necessary to employ in removing the gun. The loading stand with loading tray should be removed together with the loading cranes, ammunition table, and all movable parts carried on the rear car platform. Now remove the breech operating platform and rear transom and build a crib of timber upon the racer, extending across the open area of the well formed by the centers of the racer and base plate. To afford additional strength to the crib-work, it should, if necessary, be supported at the center by timbers built up from the railroad tracks. A wooden cradle should be constructed to carry the gun, this cradle to be of heavy timber securely braced and bolted together. It should extend from the cribbing at the cradle to a point on the rear car end where connecting timbers may be used to continue the movement of the gun onto a flat car for transportation. Care must be taken in the placing of timbers or other moving material on the racer that no injury is done to the oil fittings used for lubricating the pintle surfaces, rollers, and center plates.

d. To facilitate the movement of the gun rearward in the wood cradle, oak rollers about eight inches in diameter and three feet in length will be needed, operating between the wooden cradle and the timbers laid parallel upon the surface of the racer and car end floor plates.

e. When the crib-work, blocking, wooden cradle, rollers, etc., are in position, remove the rear nuts from the cylinder piston rods and recuperator pull rods, then disconnect the recoil parts locking device on the gun and cradle. The gun may now be moved freely rearward through

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the cradle. Before disassembling any parts of the recoil or recuperator mechanism, be certain that the compressed air in the intensifier and recuperator cylinders is released. To facilitate dismantling of the gun, locomotive cranes may be used to advantage as well as standard screws or hydraulic jacks, shears and other similar available equipment. To prevent injury to the gun traveling breech support mechanism (Figure 36), the crank assembly, together with bushing, B161033, and pinion, B161050, should be removed before dismantling the gun. The ends of plungers, D41861A and D41861B, should be set flush with the surface of the recoil band before this part of the mechanism is removed.

NOTE: — The weight of the gun with breech band is approximately 55,280 pounds.

75. CRADLE. — a. When the gun has been cleared of the cradle, (Figure 11), the cradle can then be removed from the side frames after certain assembled parts have been disconnected and removed, if limited facilities for handling the cradle make such action necessary. These parts include the recoil cylinders, long and short; recuperator cylinder, counter-balance, liquid pump, intensifier, air charging and maneuvering valve, air and oil tubing, electrical circuit (Figure 37) including the firing pistol, recoil firing contractor, and any other parts likely to be defaced or injured in the operation of disassembling the cradle.

b. To remove the cradle from the side frames, first remove the trunnion caps, roller bearing retaining nut, and elevating quadrant bracket. All parts pertaining to the trunnion roller bearing mechanism should be handled with extreme care, and if bearings are to remain on the trunnion they should be protected by lagging before attempting to ship the cradle or store it in a place where injury to the parts might occur. All parts of the trunnion roller bearing should be kept free from moisture, dirt, grit, or other foreign substances.

c. Hydraulic jacks or a screw suitably arranged may be used in raising the cradle to clear the trunnion beds in the side frames. Locomotive cranes, Garrison gins, or other available lifting devices may also be used. The use of blocking and crib-work on the base plate, racer, and car ends, is directed to insure the safety of the cradle while it is being removed from the side frames. The use of rope slings for lifting the cradle is recommended and care must be exercised so no deformation or injury to the finished surfaces of the cradle occurs.

76. RACER AND SIDE FRAMES (Figure 19). — a. Use extreme care in removing the racer and side frames from the base plate and traversing roller system. Clearances between the pintle surfaces of the base plate and racer are very slight, and any tipping of the racer during disassembly might seriously injure the pintle surfaces. It is desirable to remove the racer and side frames intact if the facilities at hand are sufficient to do so. If the side frames must be disassembled from the racer to reduce the weight of the parts to be handled, exercise care that

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no damage occurs to the key and keyways connecting the side frames to the racer, as these keys definitely locate the side frames in proper alinement. If, however, the side frames are to remain assembled to the racer when it is removed, the rear transom should be reassembled following the removal of the gun from the gun cradle as directed in paragraph 74c.

b. To lift the racer off the traversing rollers, it is first necessary to remove the front and rear racer clips. It will then be necessary to remove the worm and worm wheel housing D26708 (Figures 22 and 32), the lower section of which serves the same purpose as the racer clips. To remove the housing it will be necessary to disassemble shaft coupling, B127484 (Figure 22), by removing cotter pin and pushing the coupling outward to clear the end of the worm shaft. Next remove the outer dust guards covering the distance ring and traversing rollers. Rotate the mount until the azimuth indicator and drive mechanism (Figure 20) is at right angles to the center line of the mount in traveling position. Disassemble the lower element of the mechanism in accordance with instructions contained in paragraph 82 covering disassembly of azimuth indicator and drive mechanism.

c. In removing the azimuth indicator drive mechanism and in lifting the racer from the rollers, extreme care must be exercised to avoid injury to the drive mechanism rack fastened to the upper part of the pintle surface of the base plate. Before attempting to lift the racer from its position on the traversing rollers it should be rotated sufficiently to insure that the bosses (Figure 20) on the racer and base plate which are provided for locking the racer in traveling position are completely disengaged.

77. TRAVERSING ROLLER SYSTEM.— Should it be necessary to clean thoroughly or to make repairs to the roller paths, rollers, distance rings, journal bushings, or pintle surfaces, it will be necessary generally to follow the procedure outlined in the disassembly of the gun, cradle and racer as above outlined.

78. TRAVERSING MECHANISM.— The traversing mechanism consists of a traversing rack made in seven sections, which is fastened to the interior surface of the base plate. A pinion engaging with the rack, the worm and worm wheel, and a train of gears and shafting connected with the traversing handwheels on the left-hand side of the mount near the cradle trunnion, furnish mechanical means for traversing the gun and mount 360° in either direction. In disassembling the traversing mechanism, it is immaterial whether the traversing handwheel parts, the intermediate gear parts, or the worm and worm wheel parts be disassembled first, as each is in itself a unit which may be removed without disturbing the other parts of the traversing system. To disassemble the mechanism the following procedure should be employed:

a. *Worm, worm wheel, and pinion mechanism (Figures 31 and 32).* Remove pin, BFCX1GG, from coupling, B127484, on shaft, C53399, and push the coupling outward to clear the splined end of worm, C53381. Remove

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screws, A146391 and A146440, and disengage the worm and worm wheel housing, D26708, from the racer. Remove drain and filling plugs and drain oil from housing. Remove screws, BCDX2CB. Remove cover, B127506, with gasket, B127501. Remove screws, BCAX1CA, and plate, B127475, with gasket, B127497. Remove screws, BCAX2AE, and retainer, B127493, with gasket, B127502. With a screwdriver or similar tool bend the edges of lock washer, BEFX1AL, to clear grooved surfaces of nuts, B127539 and BBRX1AL. Remove these nuts on both ends of worm, C53381. Remove ball bearings, CAAX3AL (formerly B127463) and CABX3AL (formerly B127464). Packing, B127553, in retainer, B127493, may be removed and replaced at the time of disassembly. Remove pin, BFAX2AN, and nut, B127510, from the upper end of the pinion shaft. Remove pinion, D26691, from the housing at the bottom end. Remove roller bearing, B127480, and collar, B127500. Remove worm wheel, C53377, and worm, C53381, from the housing. With a sharp chisel or similar instrument cut out the peened metal in slots of screws, A146559, attaching ring, B127499, to the housing. Remove screws, A146559, and ring, B127499. Remove ball bearings, CABX3AR (formerly B127511). Remove locking wire, BFWX1A, from screws, A146566, and remove ring, B127498. Remove packing, A146654, which consists of chevron packing rings, B127512, B127513 and B127514.

b. *Intermediate bevel gear mechanism (Figure 31).* With coupling, B127484, disassembled in the manner described in paragraph 76b, remove pins, BFCX1GH, from coupling, B127483, and pin, BFCX1GG, from coupling, B127484. Remove intermediate shaft, B127533. Release nuts, BBAX2B, from bolts, A146477, and remove gear housing, D26710. Remove drain plug, Q52B, and drain oil from housing. Release screws, BCAX1BA, and remove cover, C53388, with gasket, B127543. Remove cap, B127517, at the upper end of the housing. Remove split pin, BFAX1DL, from the lower end of shaft, B127550. Remove nut, A146478. Lift shaft, B127550, out of the housing and remove gear, B127532, and roller bearings, CADX1AK (formerly B127523). Remove gland, A146458, from cap, B127453, and packing, A146653, consisting of chevron rings, A146451, A146452, and A146453. Release screws, BCAX1BB, and remove cap, B127453, with gasket, A146469. Remove lock washer, BEFX1AK, in the manner previously described in paragraph 78a for lock washer, BEFX1AL, and disassemble nut, BBRX1AK. Remove shaft, C53399, and roller bearings, CADX1AK (formerly B127523). Remove filling plug, Q52E, and elbow, Q51EE.

c. *Handwheel gear mechanism (Figure 31).* Remove screws, BCFX2BD, from handwheels, D26714 and D26714A. Remove screws, A146464, from both ends of shaft, B127551. Remove handwheels, D26714 and D26714A. The handwheel handles are riveted and welded construction and will not be disassembled except for replacement. Release screws, BCDX1DD and BCAX2AC, and remove gear housing, D26711, from housing bracket, D41705. Dowel pin, BFDX2EK, is a drive fit in housing and will not be

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removed. Release screws, BCAX1BB. Remove cover, B161028, with gasket, B127547. Remove pipe, A217713. Remove shaft, B127551, from gear, B127531. Remove gear, B127531, from housing. Release screws, BCAX1CC, from covers, B127515. Remove covers, B127515, with gaskets, B127548. Packing, B127552, may be replaced while covers are disassembled. Remove roller bearings, CAAX1AQ (formerly B127544) and CABX1AL (formerly B127545). Disassemble gland, A146458, and remove packing, A146653, consisting of chevron rings, A146451, A146452, and A146453. Remove drain plug, Q52A, and drain oil from the housing. Remove screws, BCAX1BB, from cap, B127516. Remove cap, B127516 with gasket, B127549. With a screwdriver or similar tool bend the projections on lock washer, BEFX1AK, to clear the grooves in the nut, BBRX1AK. Remove nut, BBRX1AK, and roller bearing, CADX1AK (formerly B127523). Remove gear, C53395, from the housing. Remove roller bearing, CADX1AK (formerly B127523).

79. ELEVATING MECHANISM (Figures 10, 14 and 33). — *a. Handwheel and handwheel gearing.* The elevating mechanism consists of an elevating rack attached to the cradle, meshing with a pinion which is connected through a train of gears to the elevating handwheel, D42092, located on the right side of the mount. To disassemble the elevating mechanism, remove pin, BFCX1GG, from coupling, A147578; and pins, BFCX1GH, from coupling, B127483; and remove shaft, B160661. Remove split pin, A147667, connecting the handwheel to shaft, B160635, and remove the handwheel. The handwheel handle is a welded and riveted assembly and will not be disconnected from the handwheel except for replacement. Fitting, CLDX1A, may be disconnected from the handwheel if desired (Figure 14). Remove nut, BBAX2C; bolt, A148035; and bolts, A147742, attaching gear case to the side frame, and remove the case for convenience in disassembling the parts. Remove drain and filling plugs, Q52E, and elbow, Q51EE, and drain oil from the case. Remove screws, BCAX1CB, and cover, D41781, with gasket, B160662. Remove countersunk screws, BCKX2DG, from seal, B160642, and remove the seal and gasket, A147550. Packing, A147549, in the seal should be examined and replaced if necessary. Remove headless locking screw, BCTX2C, from retainer, B127454, and unscrew retainer. With screwdriver or similar tool bend the projections on washer, BEFX1AF, and remove nut, BBRX1AF, and washer from handwheel shaft, B160635. Remove roller bearing, CABX5CC, and disassemble the handwheel shaft from large gear, C53817. Remove ball bearing, CAAX3AG, and remove gear, C53817, from case, D41770. Unscrew cap, B160637. Remove ball bearing, CADX1AN. Remove pinion, B160631, and shaft, B160636. Remove ball bearing, CADX2AF. Pinion, B160631, is pinned to shaft, B160636, and the two parts must be removed together. Countersunk riveted pin, BFDX2AL, holds the pinion and shaft together. If necessary, this pin may be drilled or driven out and replacement made before the parts are reassembled.

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b. *Elevating pinion gearing.* With intermediate shaft, B160661, removed, the following procedure will govern in disassembling the elevating pinion gearing: First attach hook, C53777, to the boss provided for it on the upper section of the gear case, sustaining the weight of the parts by a crane or other similar device holding the hook securely in place by means of screw, A147422. Remove the six-inch cotter pin from tie bolts supporting gear case. Back off and remove tie bolts, B160891 (Figure 14). Remove nuts, BBAX2E, and remove bolts, B127476, attaching the housing to the side frame. Remove the gear housing for convenience in disassembly, using releasing screws, A148592, to disengage the gear case from the side frame. Remove drain plug, Q52B, and filling plug, Q52E, together with elbow, Q51EE, and drain oil from housing. Fitting, A148968, is welded to the gear case and will not be removed. Tube, A148969, together with plug, A8053, may be removed if necessary. Remove screws, BCAX1BC, (Figure 33), and cap, C53740, with gasket, B160563. Remove pin, BFAX2CQ, from nut, B160441, and remove nut. Remove roller bearing, B127461, and spacer, B160434. Disassemble pin, D26986, from worm wheel, C54111. Remove screws, BCKX2DG, from retainer, C53739, and remove retainer. Packing, B160443, should be examined and replaced if necessary. Remove bearing, B160420. Remove spacer, B160433, and seal, B160508. Remove screws, BCAX2AD, and screw, BCAX2AL, from cover, D26984. Remove cover, D26984, with gasket, B160444. Remove screws, BCKX4DM, from plate, B161814, and remove plate. Screws, BCKX4DM, are locked in place by prick punch and some difficulty may be experienced in removing them. Remove screws, BCAX2AD, from covers, C53725 and C53726. Remove covers, C53725 and C53726, with gaskets, B160509. Remove roller bearings, B160423, from both ends of worm, C54110, and remove worm wheel, C54111, and worm, C54110, from the gear case. In reassembling the pinion gear housing care should be taken to see that pin, A147420, is in its proper position.

c. *Elevating rack (Figure 10).* The elevating rack which constitutes a part of the elevating mechanism is attached to the right side of the cradle. To disengage the rack remove nuts, BBBX3C, from bolts, A146465, at the lower end of the rack and from bolts, A10451, at the upper end of the rack. Remove these bolts and unscrew bolts, B127479, near the middle section of the rack. Racks are of alternate design. Welded rack, D41701, may be substituted for the forged rack, D41716, and vice versa. In replacing the elevating rack, extreme care must be exercised to insure that the bolts are reassembled in their original location. Care must also be exercised to insure that the teeth of the rack are not burred or defaced.

80. LIFTING JACKS. — To disassemble the lifting jacks (Figure 40) withdraw lever locking pin, A147537, and remove lever, C53829, if assembled. This locking pin with chain is a riveted assembly and should not be removed except for replacement. If riveted pins, BFDX2AE or BFDX2AA, are removed, new stock should be used for their replacement.

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Remove fitting, CLDX1A, from end of pinion shaft, D26731. Remove taper pins, BFCX1GK, from nut, B161136, and unscrew nut. Remove housing assembly, D41808. To disassemble housing parts remove split pin, BFAX2AB. Remove pawl pin, A147518. Remove pawl, B127567. To remove block, B160752; plunger, A146490; and spring, A146491, it will be necessary to drive out pins, A147743 and BFDX2ES. These pins are riveted in place and should not be removed except to effect repairs or replacements to the block, plunger, or spring. If these pins are removed, new pins should be used for replacement when the parts are reassembled. Screws, BCDX2CG, attaching the direction plate to bracket, D26727, are staked in place and will have to be replaced should it be necessary to remove direction plate, C53943, for right hand screw, or direction plate, C53944, for left hand screw. Remove split pins, BFAX2EL, from pins, B160565, in shoe, D41741. Remove the shoe and insert blocking between the lower end of the ram and the railroad rail. Remove fitting, CLDX1A, and pins, BFDX5BF, from nut, B127560. Remove nut, B127560, from screw, D41717A, right hand thread; or D41717B, left hand thread, according to location. Remove bushing, A147408. Remove ball, A147543, from housing, C53762. Remove housing. Remove ball bearing, B127558, from screw. Remove locking wire, BFWX1C, from screws, A147409, and remove screws. Reassemble nut, B127560, with pins, BFDX5BF, and back off main screw from its position in the ram nut, turning the screw to the right or left depending upon whether it is a right or left hand thread. In this operation the gear, C53405, will be forced off the screw when the gear comes in contact with the surface of the base plate. Keys, A148053, are staked in place with screw, A148093, and will not be removed unless damaged. When the main screw has been removed the gear, C53405, may be removed. Remove plug, A147538, with fitting, CLDX1A, from stop, B127569. Lift ram, D41739, through the opening in the base plate. Remove stop, B127569. If it is necessary to remove nut, B160517 or B160518, first remove screws, BCTX1DQ, and unscrew the nut from its position in the ram. Remove screws, BCAX2AD; washer, BEAX2D; and guide, B160516. Now remove sleeve, C53409, on the outer end of the horizontal pinion. Remove bolts, A147387, and washers, BEAX2G. Remove bushing, C53407. Remove pins, BFCX1GM, from nut, B160932. Remove nut, B160932, from pinion, D26731. Remove nuts, BBAX3B, from bolts, A147544. Remove bracket, D26730, for right hand screw, or D41821, for left hand screw, together with pinion, D26731, and ratchet gearing from the base plate. Remove split pins, BFAX2CK, and remove pawl pin, A147542, and pawl, B160903. Remove split pin, BFAX2CP, and pawl wheel, B160904, for right hand screw, or B160962, for left hand screw. Remove pinion, D26731, from bracket. Pinion bushing, B127591, is fastened in place in the pinion shaft bracket by pins, BFDX6ES, and will not be removed except for replacement.

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81. ELEVATION INDICATOR MECHANISM.— To disassemble the elevation indicator mechanism (*Figure 34*), remove split pin, BFAX1EH, from nut, BBHX1A. Remove the nut and disassemble pinion, A148021. Tighten socket-head cap screw, A147500, sufficiently to prevent free movement of the worm wheel, B160584. Remove taper pin, BFCX1F, from collar, A147501, and remove collar and worm, A147503. Remove taper pin, BFCX1AD, attaching body, B160585, to shaft, A148022. Remove flathead screws, BCMX2H, from cover, A148024. Remove cover. Remove roller bearing, A148023, and shaft, A148022. Remove body, B160585. Remove socket-head screws, BCTX1BH. Now loosen screw, A147500, and remove worm wheel, B160584, from the elevation indicator shaft. To disassemble the elevation indicator from bracket, D41879, remove nuts, BBBX1E, with washers, BECX1M, and screws, A148025. To disassemble the elevation indicator bracket from the side frame remove screws, A148026. To remove the elevation indicator rack, D41880, from the cradle remove the five screws, A148026, being careful that the screws are reassembled in their same position when the elevation rack is replaced. In handling the elevation rack extreme care must be taken to see that it is not strained or deformed and that no injury occurs to the teeth.

82. AZIMUTH INDICATOR DRIVE MECHANISM.— a. To disassemble the azimuth indicator drive mechanism (*Figure 35*) rotate the mount until the mechanism is at right angles to the center line of the mount in traveling position. Remove the steel angle attached to the racer at this point. Remove screws, A147894 and A147771, and washers, BECX1M, attaching the guard, D41787, to the racer. Lower the guard slightly so that the cover plate, C54467, will clear the nut, BBFX1E, attaching pinion, B160667, to shaft, C53808, and remove guard. To disassemble cover plate, C54467, remove flathead screws, BCKX2DF, attaching the cover to the inside surface of the guard. Remove pins, BFCX1AD, from coupling, A147504, connecting shafts, C53807 and C53808. Push the coupling upward on splined section of shaft, C53807. Remove screws, A147536 and A147524, attaching bracket, D41759, to the racer. Pry the bracket outward to clear the groove in the racer and to disengage the teeth of the pinion, B160667, from the azimuth indicator rack, D41738. Now move the housing downward with parts assembled until shaft, C53808, is clear of the opening in the side frame and racer.

b. To disassemble the parts of the lower element of the mechanism remove split pin, BFAX1CG, from nut, BBFX1E, on the lower end of shaft, C53808. Remove pinion, B160667, and lower roller bearing, A147508. Remove set screw, BCTX1BD, from guard, A147509. Remove guard from shaft, C53808. Remove the shaft from bracket, D41759, and remove upper roller bearing, A147508. Remove fitting, CLDX1A, from bracket, D41759. In disassembling the lower element of the azimuth indicator drive mechanism, care must be taken that no injury occurs to the pinion teeth or to the teeth in the azimuth indicator drive rack.

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c. To disassemble the upper element of the azimuth indicator drive mechanism remove screw, BCTX1BD, from guard, A147502, at bearing, B160515. Remove pin, BFCX1AD, attaching the adjustable coupling body to the end of the azimuth indicator shaft. Lower shaft, C53807, with adjustable coupling attached until the parts clear the end of the azimuth indicator shaft.

d. To disassemble the adjustable coupling remove screws, BCTX1AC, attaching cover, B160589, to body, B160587. Unscrew body, B160587, and remove it from the mechanism. Remove screws, A147507, from cover, B160589. Disassemble cover, B160589. Disassemble ring, B160588. Remove hub, A147505, with disk, A147506, from shaft, C53807. Disk, A147506, is fastened to hub, A147505, by rivets, BMHX1, and should not be removed except in case of necessary replacement. With the adjustable coupling parts disassembled push shaft, C53807, downward through bearing, B160515, and remove. For convenience in moving the shaft screws, BCAX1EC, with washers, BECX1M, should be removed from bearing, B160515, permitting the shaft to be tipped sufficiently to clear the base of the side frame, D26694, and racer, D26666. Fitting, CLDX1A, may be removed from bearing, B160515, if desired.

83. LOADING STAND AND TROUGH (Figure 23). — a. To disassemble the parts of the loading stand and trough, release the jam nuts in both sections of the sprocket chain assembly. Unscrew right and left hand thread turnbuckle nuts, A146422, until tension on the chain is released. Remove split pins, BFAX1BA, from chain housing pin, A146506. Disassemble the pin and remove chain from sprockets.

b. To disassemble the chain completely, first remove split pins, BFAX1BA, and chain housing pin, A146506, as previously described. Loosen jam nuts and back out chain housing screws. Remove split pin connecting chain end screw to housing, B127608. Remove chain end screw. Remove housing spring plunger, A146502, and spring. To remove the spring and plunger from the housing it will be necessary to cut off the riveted end of the link pin connecting the chain to the plunger. This part of the disassembly should be undertaken only in the event of injury or replacement of parts of the spring housing assembly.

c. To reassemble the chain, lower the front trough into the breech recess of the gun with the gun at loading angle of minus 5°. Assemble the chain on sprockets so that the sixth link of the short chain is on the top tooth of the large sprocket. Tighten the upper turnbuckle nut, A146422, until the top section of the chain is taut. Plunger, A146502, will then be pulled out of housing, B127608, about 1/16 of an inch. Now adjust the lower turnbuckle nut, A146422, so that the lower section of the chain is slightly slack. Test this assembly with the breech open and gun set at loading angle. Excessive tension in the top section of the chain will tend to lift the end of the tray and prevent it from resting in the breech recess

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of the gun at loading position. When proper adjustment of the chain is effected, tighten the jam nuts.

d. Remove screws, A146414, from covers, B127642, and remove covers. Remove split pins from handle shaft. Withdraw shaft and disconnect front trough, C53458. Now back off the nut on the spring rod until the spiral spring comes in contact with the swivel, thus releasing in part the tension from the spring. Remove lubricating fittings from spring rod and front section of stand. Remove split pins from splined shaft in the rear trough. Remove the shaft, thus disconnecting the link and spacer from the splined shaft. Remove the rear trough. Remove split pins from spring rod pin and withdraw the pin. Move the journals of the spring rod swivel forward through slots provided in the swivel supports and disconnect the spring rod swivel and nut. Remove bushings from splined shaft.

e. To remove the loading stand from the platform, release locking screws by operating the locking handle of the loading stand fastening. The loading stand fastening is a riveted construction and will not be disassembled.

84. RECOIL CYLINDERS (Figure 28). — a. To disassemble the recoil cylinder parts, it will be generally desirable to remove the cylinders from the cradle casting, although disassembly of the parts can be made with the cylinders attached to the cradle. Before any action is taken to disassemble the cylinders or cylinder parts from the cradle, be sure that the recoil parts locking device connecting the gun and cradle is assembled in place. Cylinder pistons should not be removed from piston rods except at an arsenal or other point where facilities are available for manufacturing and assembling parts requiring exceptionally close tolerances. In the disassembly or assembly of cylinder parts, extreme care must be exercised to avoid injury or deformation of the parts.

b. *Short recoil cylinder.* To disassemble the short recoil cylinder and cylinder parts from the cradle, first remove filling plug, A10465, with gasket, A10466, to permit air to enter the cylinder. Remove drain plug, A10465, with gasket, A10466, and drain the oil from the cylinder. Remove screw, A10464, from nut, B7325, and unscrew the nut from the cylinder body. Back off set screw, A10458. Remove front nut, A10456, from piston rod, C3113. Remove locking screw, A10467, from the cylinder and cradle and move the cylinder and cylinder parts forward out of the cradle casting. To continue the disassembly of the cylinder parts, remove set screw, A10458, from the front nut, A10457, and unscrew the nut from the piston rod. Unscrew cylinder head, B7328, with gasket, A10468, and remove from the cylinder. Remove the piston and piston rod from the cylinder. Unscrew nut, B127402. Examine wiper, A146509, and make replacement if necessary. Unscrew gland, C53342, and remove chevron packing group assembly, A146659. This group assembly is made up of seven rings of chevron packing, A146386. Remove washer, A146385. Piston, B7327, is screwed onto the piston rod and held in place by screw, BCDX2CB.

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c. *Long recoil cylinder.* — (1) To disassemble the long recoil cylinder and cylinder parts from the cradle, first remove filling plug, A10465, with gasket, A10466, and plug, Q52D, to permit air to enter the cylinder. Remove drain plug, A10465, with gasket, A10466, and drain the oil from the cylinder. Remove screw, A10464, from nut, B7325, and unscrew the nut from the cylinder body. Back off set screw, A10458. Remove the rear nut, A10456, from the piston rod, C3114. Remove locking screw, A10467, from the cylinder and cradle, and move the cylinder and cylinder parts forward out of the cradle casting.

(2) To continue the disassembly of the cylinder parts, remove set screw, A10458, from the front nut, A10457, and unscrew the nut from the piston rod. Unscrew guard, C53652, covering the extension, C53432. Remove nut, B127402. Examine wiper, A146509, and replace if necessary. Remove cylinder head, C53433, and gasket, A10468. Remove packing group assembly, A146658. This group assembly is made up of six rings of chevron packing, A146386. Now remove the pistons, piston rod, and assembled parts, including piston rod extension, C53432. It will be noted that the piston rod extension is riveted to the front piston, C53431, and that this assembly prevents removal of valve, B127597, and valve spring, A10470. The valve and valve spring, therefore, will not be disassembled, unless for replacement. Should it be necessary to remove the piston rod extension, C53432, from piston, C53431, when replacement is made, new stock for pin, A146521, will be required. The front piston, C53431, is riveted to the piston rod and will not be disassembled except in case of replacement. Should it be necessary to disassemble this piston from the piston rod, new stock for pin, A10471, will be required when it is reassembled. The rear piston, B7327, is screwed onto the piston rod and locked in place by screw, BCDX2CB. Remove nut, B127402, from the rear end of the cylinder. Examine wiper, A146509, and replace if necessary. Unscrew gland, C53342, and remove chevron packing group assembly, A146659. This group assembly is made up of seven rings of chevron packing, A146386. Remove washer, A146385.

85. GUN TRAVELING BREECH SUPPORT (Figure 36). — a. To disassemble the gun traveling breech support, depress the gun to its maximum allowable depression. Remove screws, B161034B, and work the plungers, B41861A and B41861B, outward by manipulating the crank, B161051, until the screw ends of gear, D41866, are disengaged from the threaded portion of the plungers. Remove the plungers. Remove locking wire, BFWX1B, from screws, BCAX4P, attaching bushing, B161033; shim, A148019; pinion, B161050, and crank assembly, to the gun band. Detach locking wire, BFWX1C, from screws, B161034A, and remove screws. Now disassemble gear, D41866, with collars, B161036 and B161037, by pushing the parts through the opening in the breech band from either end. Remove the collars. Bearings, A148038 and A148039, are a pressed fit in the collars and will not be removed except for replacement.

b. To disassemble the pinion, B161050, and crank assembly, remove pin, BFDX2BR, attaching crank, B161051, to the pinion. This pin is a riveted assembly and must be replaced by new stock when the crank is reassembled. Remove the crank with crank handle assembly. Parts of the crank handle consist of pin,

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A148036, which locks the hollow stem, A148013, to the crank body; spring, A148020, encased in the hollow stem, A148013; pin, A148018, which engages in a drilled hole in the gun band when the crank is not being operated; and hollow handle, A148724, in which all of the parts of the crank handle are contained. Pin, A148018, is riveted to handle, A148724. The parts of the handle should not be disassembled except in case of injury or for replacement. Disassemble pinion, B161050, from bushing, B161033. Remove shim, A148019. Bearing, A148037, is a pressed fit in bushing, B161033, and will not be removed except in case of replacement.

c. Oil cups, A146404, in the ends of the plungers and in the oilholes through the breech plate are a pressed fit and will not be disassembled except for replacement. The fitting, CLDX1A, in the recoil band for lubricating the parts of the mechanism may be removed if necessary. Pipe plugs, Q52A, in the end of each plunger will not be removed.

86. ELECTRICAL FIRING CIRCUIT (Figure 37). — a. To disassemble the electrical firing circuit, disconnect terminals, A147006, from storage battery. Remove battery. Back out screws, BCBX1AA, with lock washers, BECX1G, and remove ground terminal, A147065, from side frame.

b. Disconnect the connector assembly, B127924, at the firing pistol, C53607. Disassemble cotter pin and remove pistol and holder. Remove screws from contactor guard and remove guard. Remove cotter pins. Back off nuts and disconnect terminals. Remove screws and disconnect the terminal brackets. Back off nuts. Withdraw blade, support, and spring. Remove insulators. The spring is attached to the support by rivets and will not be disassembled except for replacement.

c. To disassemble firing pistol, remove nuts and screws connecting pistol body to holder. Remove screws holding the right and left sides of the body together. Remove trigger. The trigger pin is attached to trigger by a riveted pin and will not be removed. A molded phenolic support separates the two sections of the contact spring. Brass binding screws are soldered to the contact spring sections connecting the firing cables to the pistol. Contact rivets are permanently assembled to the contact spring ends. The parts of the trigger spring assembly will not be disassembled except to make replacements.

d. Cables are connected to the gun commander's push button in conduit, B127812, by soldered eyelets. The cables must be disconnected at this point before they can be disassembled. The conduit is welded to pipe, A146779, and the pipe and conduit must be removed together.

e. Remove terminal, A146922, from breech circuit contact block. Remove screws, BCAX1CA, from the single and double straps, A146751 and A146752, and disassemble cable.

87. RECUPERATOR MECHANISM. — a. To disassemble the parts of the recuperator mechanism, first release the air from the recuperator cylinder and the intensifier. To do this, open the valve in the intensifier and back off the needle valve in the maneuvering valve body sufficiently to permit the air

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to escape from the recuperator cylinder and the intensifier. Care must be exercised to control the flow of the air so that the cylinder will be emptied gradually. Before removing the air from the cylinders, the gun and cradle should be placed at 0° elevation and locked with the recoil parts locking device. Drain the oil from the liquid pump case.

b. *Intensifier (Figure 11).* — Remove nuts from the tubing connecting the intensifier cylinder to the recuperator. Remove the tubing. Back off nuts connecting the oil and air tubing to the intensifier. Remove elbows from the recuperator, and valves from the intensifier. To disassemble the parts of the valve remove follower, A104G; gland, A104H; and packing, A103C. Remove valve stem with valve and pin, and disassemble the valve bodies, B7403, from the intensifier. Remove cap screws attaching the intensifier to the cradle and remove intensifier. To disassemble the parts of the intensifier unscrew the indicator body. Remove the gland and gasket from the intensifier body. Unscrew the gland and remove group packing. Withdraw the piston and disassemble the nut from the piston head. Remove group packing from the piston head. The group packing used in the cylinder is made up of chevron rings assembled together.

c. *Dust guards.* — To disassemble the parts of the recuperator dust guards (Figures 9, 10, 11, and 30) remove nuts and screws, together with the dust guard plate, dust seal, and auxiliary dust guard. Remove the guards.

d. *Recuperator cylinder.* — To disassemble the recuperator cylinder (Figure 29) remove pins, BFX2CP, and nuts, A10439, from both ends of the recuperator rods, B127413. Remove nut, B7317, from plunger, D26681, and remove yoke, C3109. Remove screws, BCKX2CG, from ring, C53338, and remove the ring and wiper, C53339. Withdraw plunger, D26681. Unscrew bearing, C53312, and remove group packing, A146657. Remove follower, C53314, and withdraw bearing, C53315. Remove group packing, A146657, from the bearing and remove bearing from the cylinder. Unscrew nut, B7318. Remove screw, A10467, and withdraw cylinder, D26671, from the cradle. Recuperator rod bushings, A10448, are a close fit in the cradle casting and should not be removed except for replacement. Clips, B127412A and B127412B, may be removed by disassembling screws, A10449 and A147761, with nuts, BBBX2E. Bearings, C53993 and B161112, are fitted and fastened in place and should not be removed except for replacement.

e. *Air charging and maneuvering valve.* — To disassemble the air charging and maneuvering valve (Figure 11) back off the nuts on the ends of the tubes connecting it with the air gage and the intensifier. Remove screws, BCPX1AG, from clips, A107C, and remove tubing. Pressure gage, A111A, is permanently attached to a connection by a sweated joint and will not be disassembled except for replacement. To disassemble the parts of the maneuvering valve, first remove eye screw. This screw is connected by a chain assembly to the valve body and will not be disassembled. Back off nut and remove inlet plug. Remove the gland follower, gland, packing rings, valve stem, and valve. The valve is attached to the valve stem by a riveted pin and will not be removed from the valve stem except for replacement.

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f. *Liquid pump.* — (1) To disassemble the liquid pump (*Figures 11 and 30*) remove nuts with gaskets from both ends of the tubing connecting the pump to the intensifier. Remove screw, BCPX1AG, and clip, A107C, and remove tubing. Take out split pin, BFAX1DH, back off nut, A240B, and remove lever, A240E. Remove nuts, BBAX2B, with lock washers, BECX1P, from screws, BCAX2AE and BCAX2AK, and remove pump from the cradle.

(2) To disassemble the parts of the pump remove nuts, BBAX1E, and lock washers, BECX1M, from studs, A236F. Remove cover, A236D. Cap, A236C, is attached by wire loop to the cover and will not be disassembled. Remove screws, BCAX1EE, from gland, A236B, and remove gland with packing, A238B, and collar, A240C. Remove pin, BFAX2AB, from shaft, A240A, and crank, A240D. Remove the shaft. Remove plunger, A238E. Remove pins, BFDX6CR and A238G. Remove crank, A240D, and link, A238F. Remove pin, A238H. Remove screws, BCAX1BC, and lock washers, BECX1H, from instruction plate, B127408, with gasket, A238A. Back off nut, A237C, and remove pump body, A237A, and gasket, A238D, from case, A236A.

(3) To disassemble the parts of the pump body back off follower, A146381, remove gland, A146379, with packing, A146650, and gasket, A146378. Remove plug, A217589, with washer, A238C. Remove stem, A239D, from pump body. Remove seat, A239E, with washer, A239F, and ring, A239G, and washer, A238D. Disassemble stem, A239D, from seat, A239E. Remove plug, A236E, from case, A236A. Plug, A237B, at the plunger recess may be removed for convenience in disassembling the parts. Plugs, A237B, which are cut flush with the pump body are permanently in place and will not be removed.

88. AMMUNITION CRANES (*Figures 16, 38 and 39*). — a. The mount is provided with two ammunition cranes of identical construction except that the upper end of one crane has a female fitting and the other a male fitting.

b. To disassemble the cranes, remove screws, BCAX1BB, from rope clamp, A147197, on drum, D26960, and remove the rope from the drum and sheaves. To disassemble the parts of the ammunition crane hook assembly, B160452, drive out pin, unscrew nut, and disassemble hook from the socket. Remove split pin, back off nut, and remove ball bearing. The end of the steel rope is brazed in the socket and will not be removed except for replacement. It is not intended that the rope shall be assembled to the socket in the field except in cases of extreme emergency, in which case the assembly shall be made in accordance with Ordnance Specification RR-R-571-78 (1-12). If assembly is made in the field, the rope should be tested by a pull of 3,000 lb. before being put into service. When necessary to remove the snap from the hook, drive out the pin which is a riveted assembly, and remove the snap. In replacing the pin, new stock will be used. The snap spring is attached to the snap by rivets and will not be removed except for replacement.

b. In traveling position the cranes are locked together at the upper end by pin assembly, B160346, which is held in place by a split pin and chain assembly, B160345. Both pin assemblies are attached to the crane masts and will not be disassembled except for replacement.

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d. To disassemble the upper sheave, C53696, from the crane mast remove screws, BCAX1CA, and guard, B160348. Remove pin, A147196. Pin, BFDX2AA, is a drive fit in pin, A147196, and will not be removed. Remove upper sheave. Sheave bushing, A147195, is held in place by pins, BFDX6CP, and will not be removed except for replacement. To remove the lower sheave, drive out pins, BFDX2AM, remove shaft, A147194, and remove sheave. The upper and lower sheaves are of identical construction.

e. To disassemble the rope drum gearing remove fitting, CLDX1A, and nut, A147208. Remove pin, BFCX1FE, from collar, A147206, and remove crank. Remove nut, A147208, from crank, C53702. Remove crank. Remove screws, BCAX1AA, and withdraw bushing, B160347, with dowel, A147199. Withdraw crankshaft, C53700. Remove oil cup, A147283. Remove countersunk-head screws, BCDX2BA, and cover, C53698. Remove split pin, BFAX2AA, and pawl pin, A412C. Remove pawl, A412D. Remove pawl ratchet A412A, and friction disks, A412F, A412G, and A412E. Friction disk, A412B, is riveted to ratchet, A412A, by rivets, BMHX2, and will not be disassembled. Remove pinion, C53699; spacer, B160353; and collar, A147206. Remove fitting, CLDX1A, from drum shaft, B160350. Remove split pins, BFAX2AA, and remove shaft, B160350. Remove drum, D26960, and gear, C53697. This gear is attached to the drum by screws, A147207; washers, BECX1M; and nuts, BBAX1E. The gear may be disassembled from the drum if necessary. Drum shaft bushings, A147204, are held in place by pins, BFDX6CL, and will not be removed except for replacement. Bushing, A146553, is fastened in place by pin, BFDX6CG, in bracket, D26961, and will not be disassembled.

(1) To disassemble rollers, B160349, unscrew trunnions, A147200, and remove rollers. The rollers, made up of bushings, A147201 and A147202, and tube, B160352, are a welded construction and will not be disassembled.

(2) To disassemble the handles from the cranks remove nuts, A146499, with washers, BEAX3H, and remove the handles. The handle is a riveted construction made up of stem, B160351; bushing, A147198; and sleeve, A147205; and will not be disassembled except for replacement.

(3) To disassemble bracket, D26961, from crane mast remove screws, BCAX2BG and BCAX2BD, with nuts, BBAX2C, and washers, BECX1R.

(4) To disassemble crane mast, D26962A or D26962B, from pedestal, A408C1, first back off screw, A410N, with rod, A410L, and cap, A410K. The rod and cap is a riveted construction and will not be disassembled from screw, A410N. Drive out pin, BFCX1HL, and back off nut, A410P. Withdraw shoe, A410M. Lift the mast until it is clear of the upper surface of the pedestal. Shaft, A408H, is riveted to the crane mast by pins, A146498, and will not be disassembled. Bushings A408A and A408B, are held in place by pins, BFDX6FS, and will not be disassembled. Remove lubricating fittings, CLDX1A, from crane mast base and pedestal roller bushing boss. Remove bearing, A408F, from pedestal base.

(5) To remove the pedestal from the platform remove screws, BCAX2BG, with nuts, BBAX2C, and washers, BECX1R.

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89. OTHER MATERIEL.— Disassembly and assembly of the outriggers, ammunition tables, loading troughs, gun support, storage battery support platforms, and devices for storing floats, pedestals, etc., requires no special instructions; the manner in which the work is to be accomplished is obvious. No detailed instructions covering the disassembly and assembly of the parts of the six-wheeled trucks including draft gear and air and hand brakes are included in this manual, as this work, when necessary, will be done by trained railroad personnel.

DISASSEMBLY AND ASSEMBLY

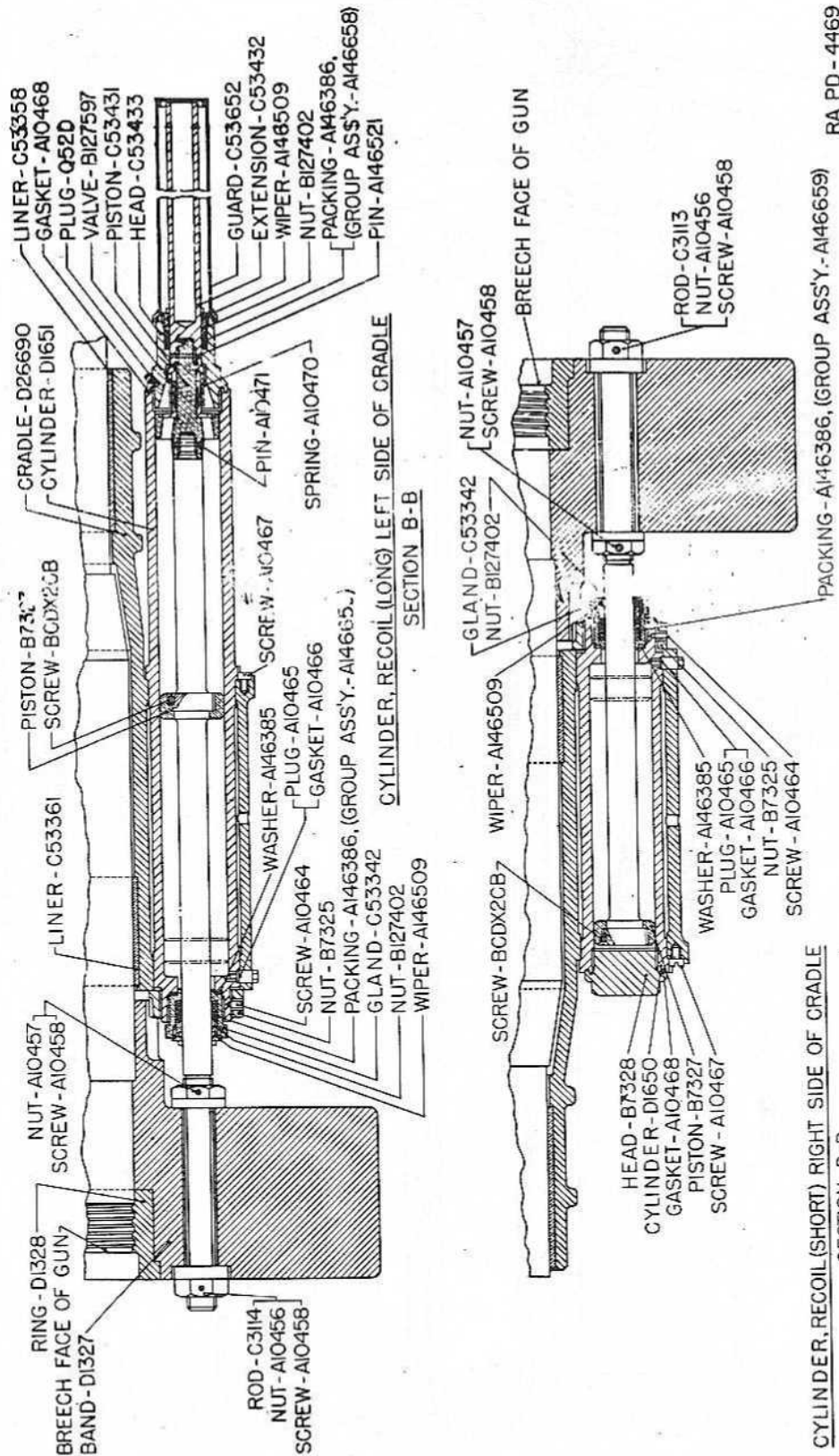


FIGURE 28 — RECOIL CYLINDERS

RA PD - 4469

CYLINDER, RECOIL (SHORT) RIGHT SIDE OF CRADLE

SECTION D-D

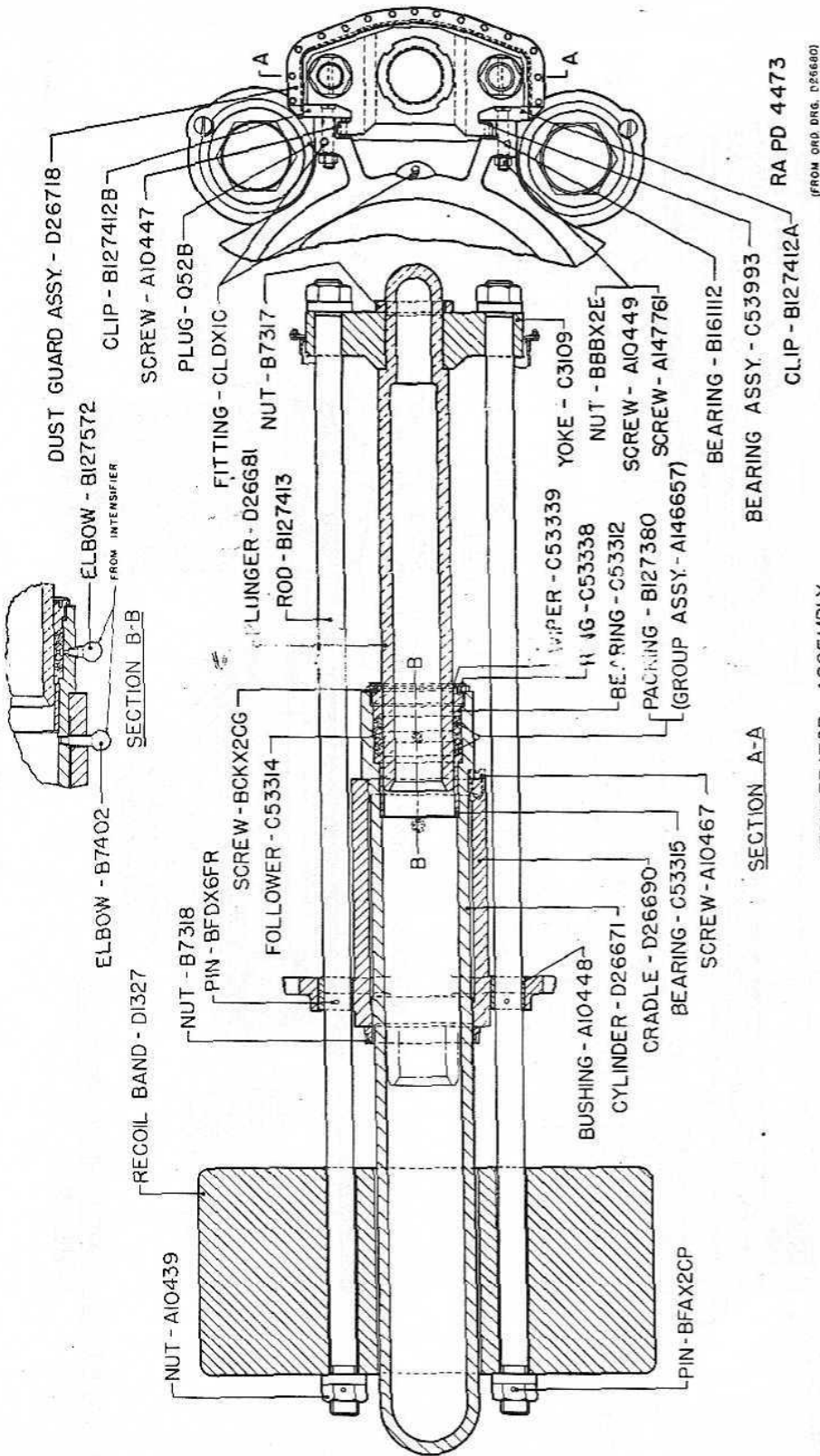
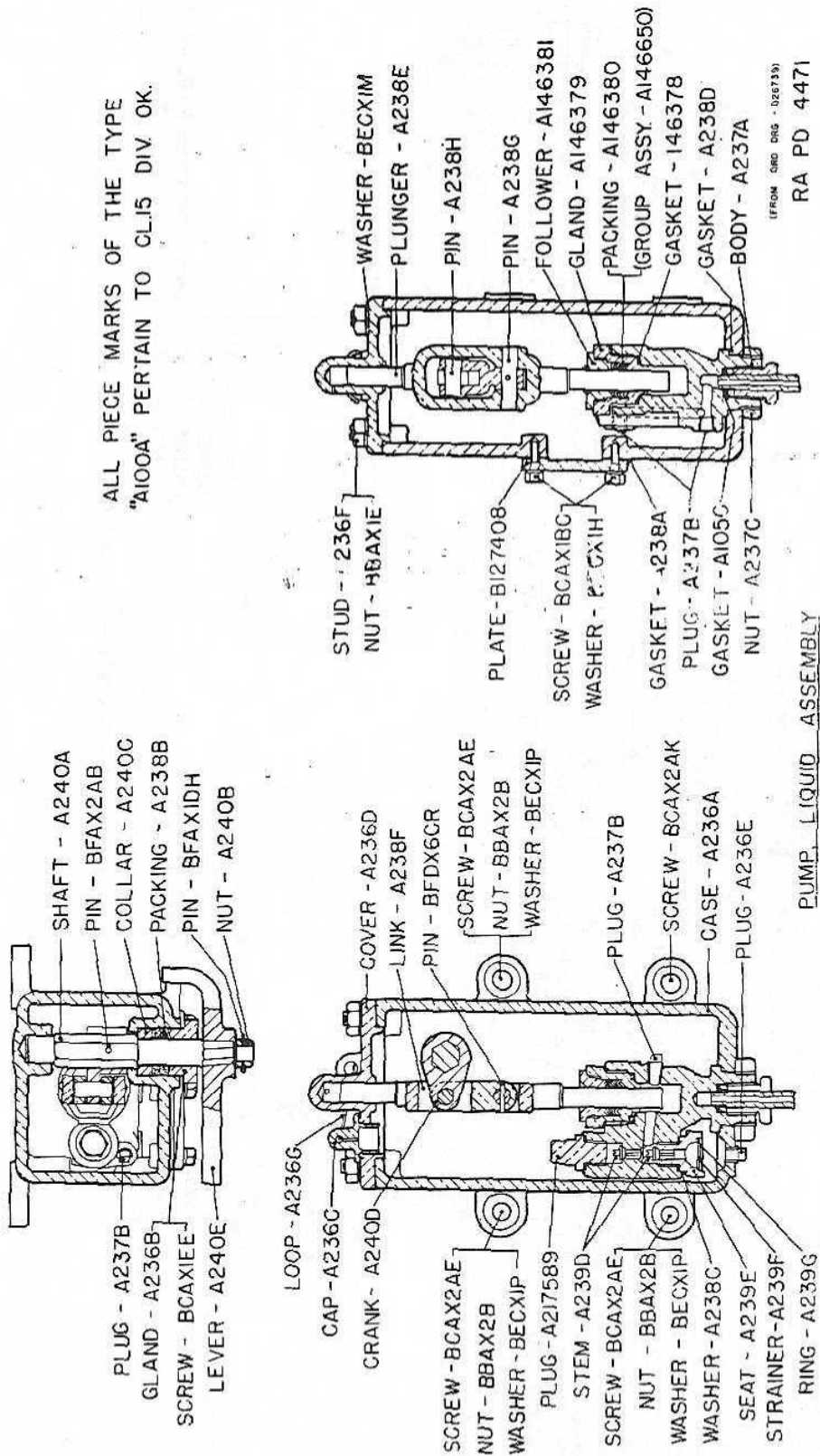


FIGURE 29 - RECUPERATOR ASSEMBLY

DISASSEMBLY AND ASSEMBLY

TM 9-463

ALL PIECE MARKS OF THE TYPE
"A100A" PERTAIN TO CL15 DIV. OK.



PUMP, LIQUID ASSEMBLY

FIGURE 30 - LIQUID PUMP

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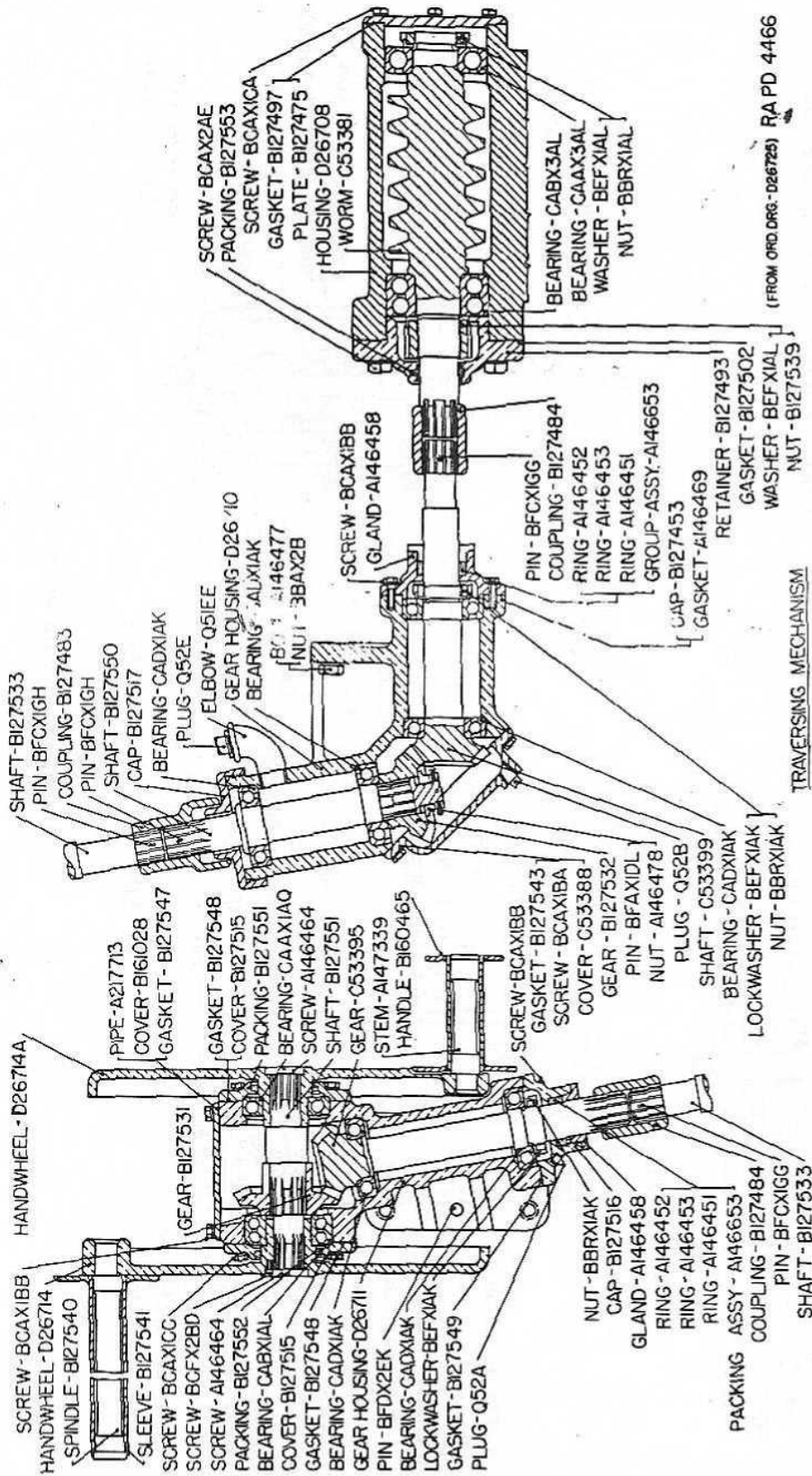


FIGURE 31 - TRAVERSING MECHANISM

DISASSEMBLY AND ASSEMBLY

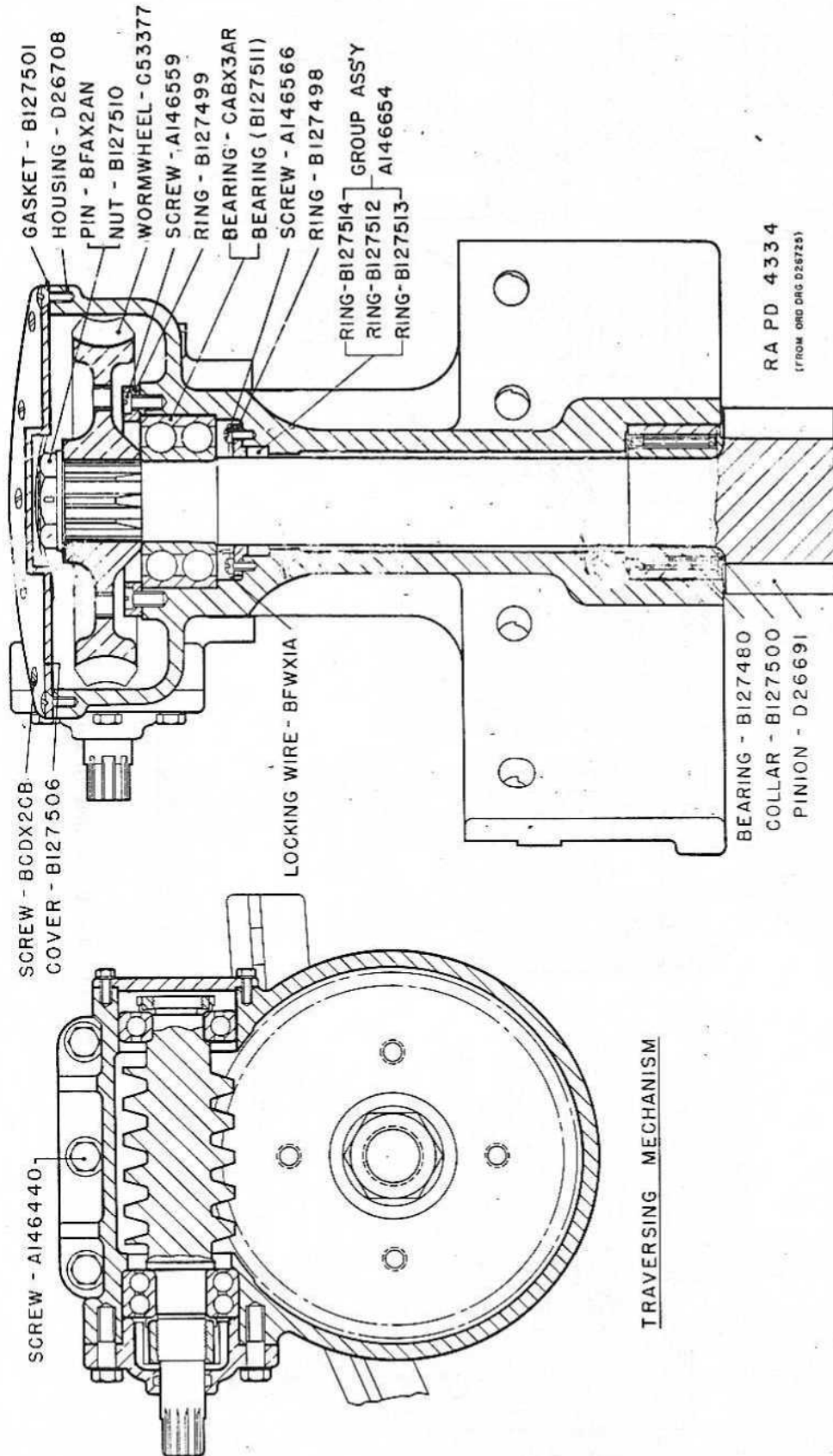
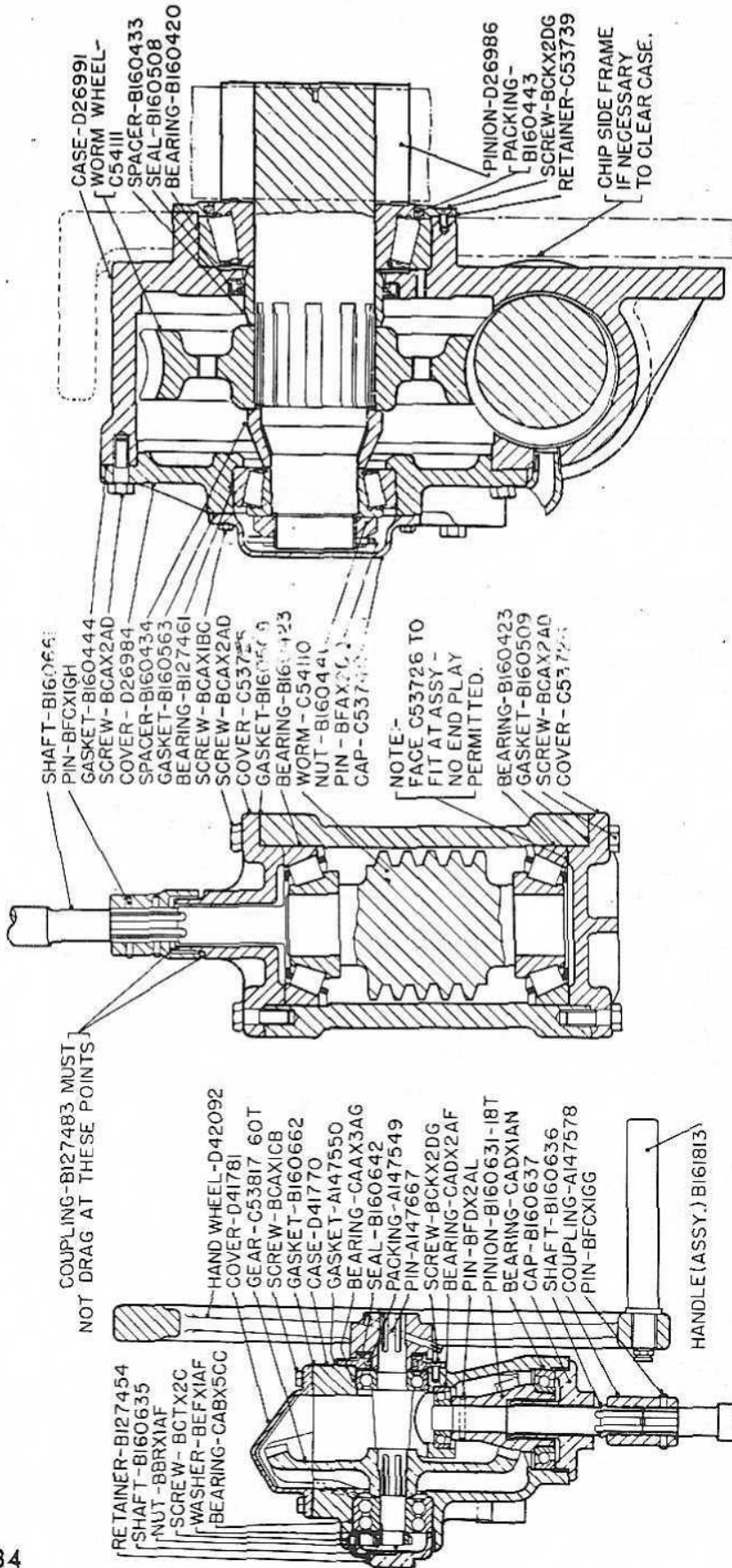


FIGURE 32 — TRAVERSING MECHANISM

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(FROM ORD. DRG. D41780) RA PD 4467

ELEVATING GEARING SECTIONS.

FIGURE 33 — ELEVATING GEARING SECTIONS

DISASSEMBLY AND ASSEMBLY

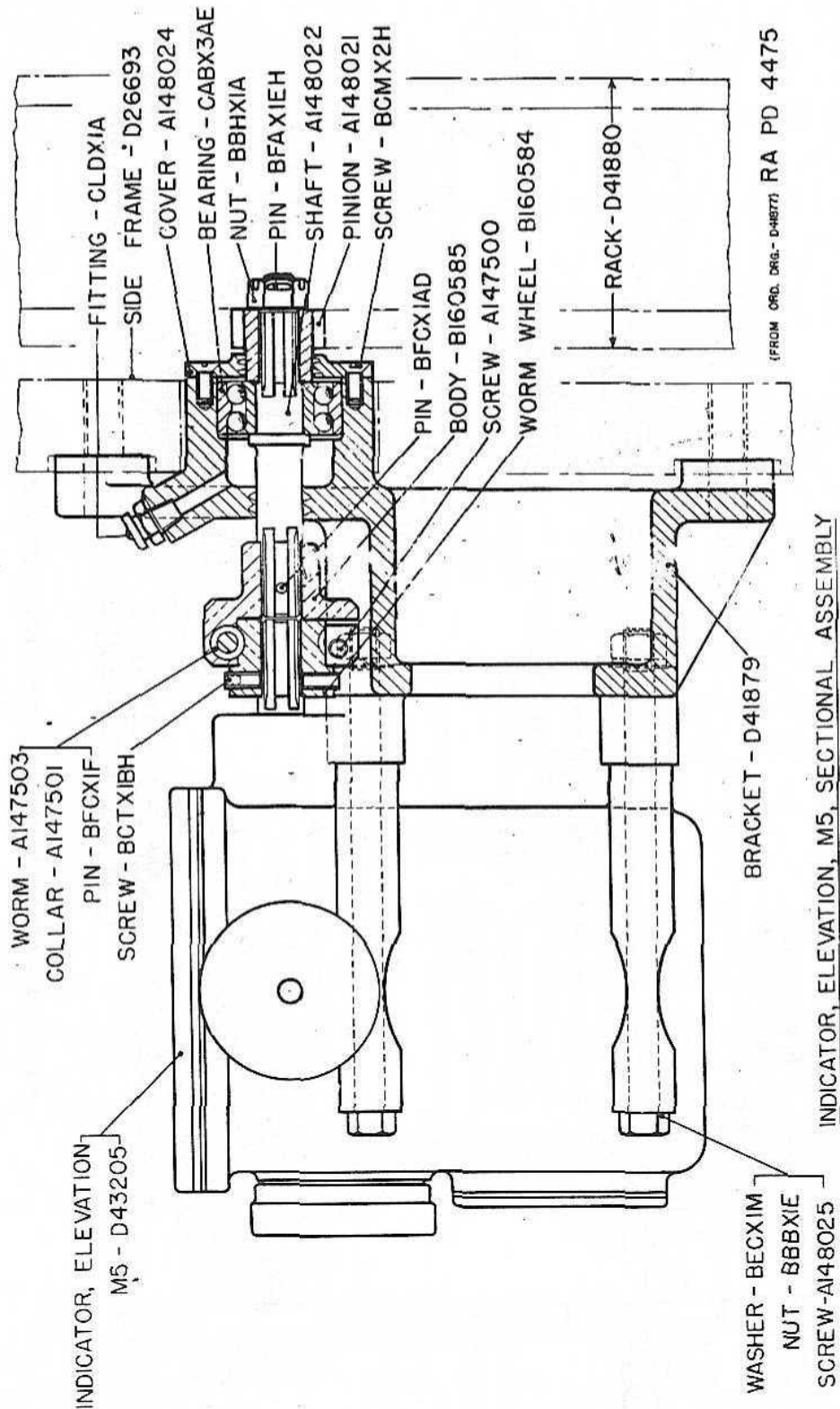


FIGURE 34 - ELEVATION INDICATOR

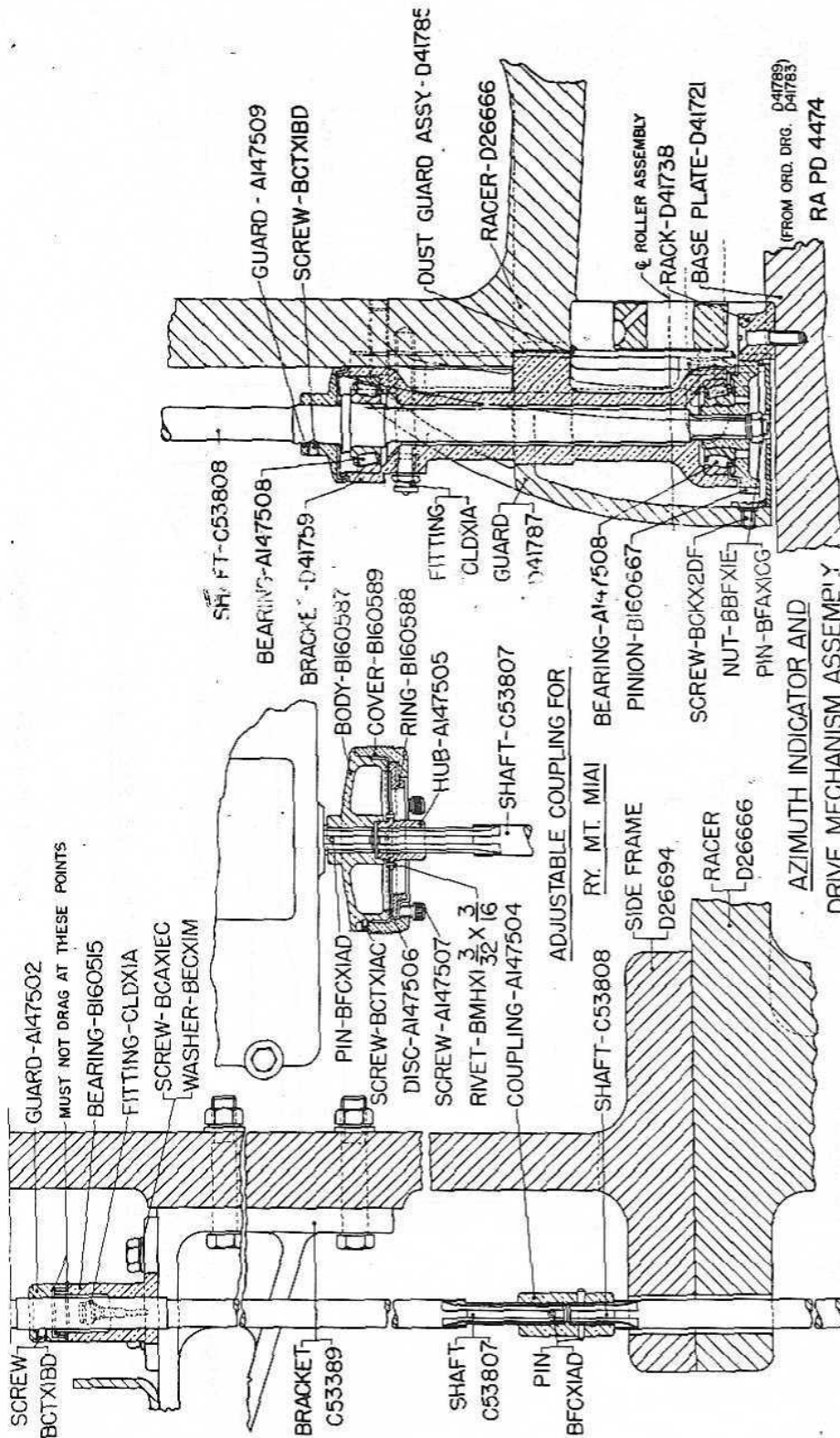
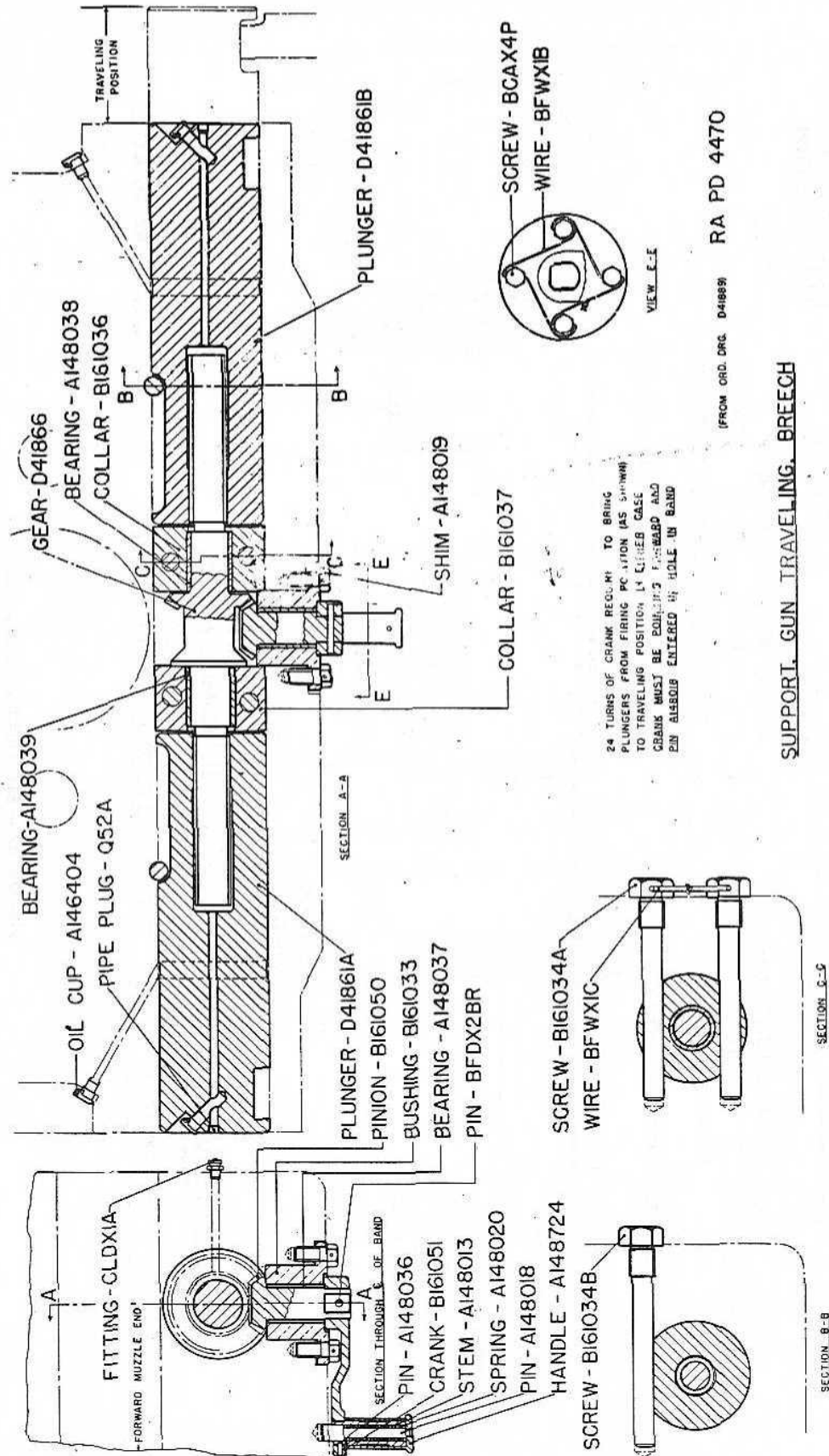


FIGURE 35 - AZIMUTH INDICATOR AND DRIVE MECHANISM

DISASSEMBLY AND ASSEMBLY



24 TURNS OF CRANK REQUIRED TO BRING PLUNGERS FROM FIRING POSITION (AS SHOWN) TO TRAVELING POSITION IN EITHER CASE. CRANK MUST BE EQUIPPED FORWARD AND PIN ALTHOUGH ENTERED BY HOLE IN BAND.

FIGURE 36 - GUN TRAVELING BREECH SUPPORT

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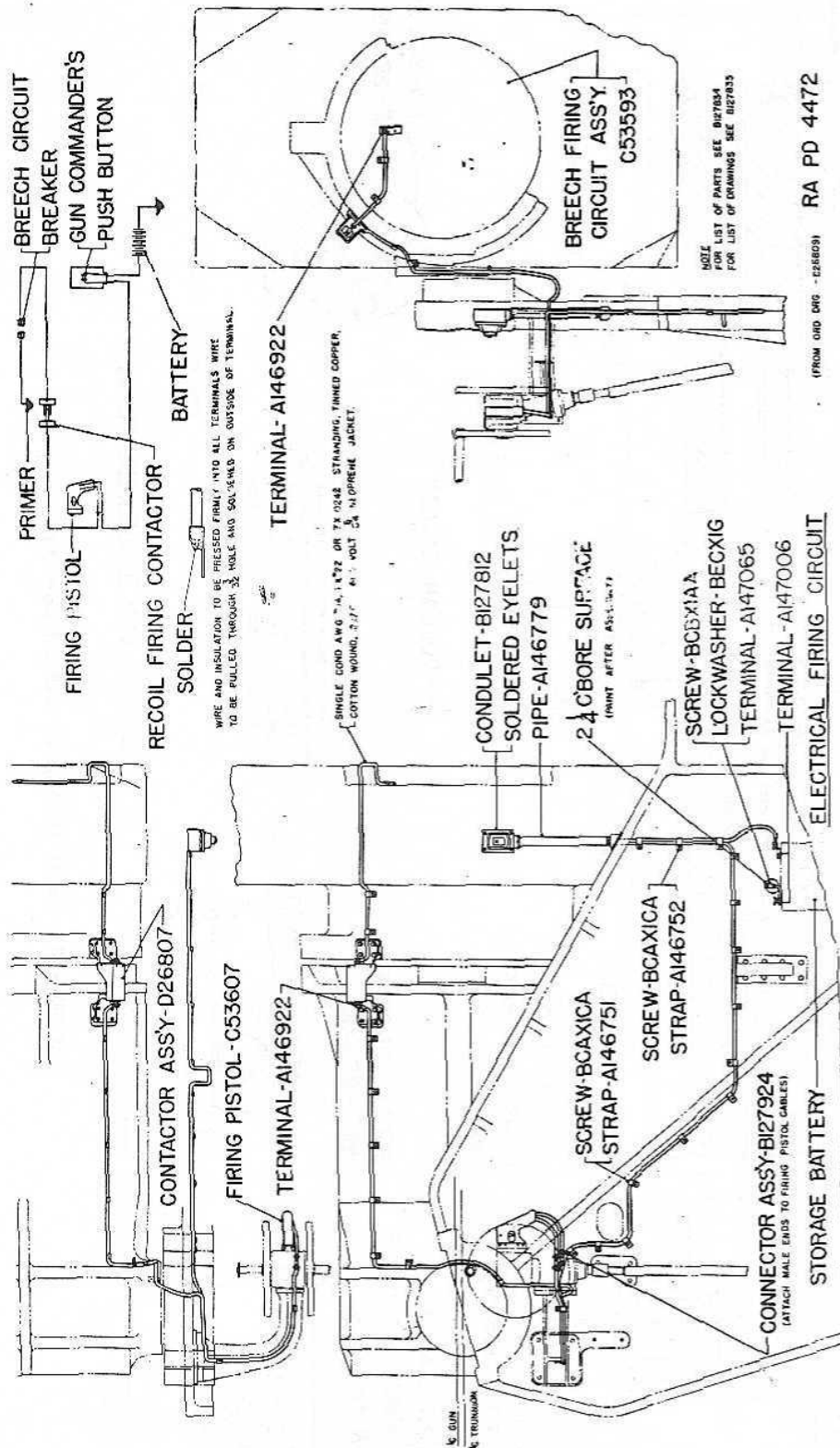


FIGURE 37 — ELECTRICAL FIRING CIRCUIT

DISASSEMBLY AND ASSEMBLY

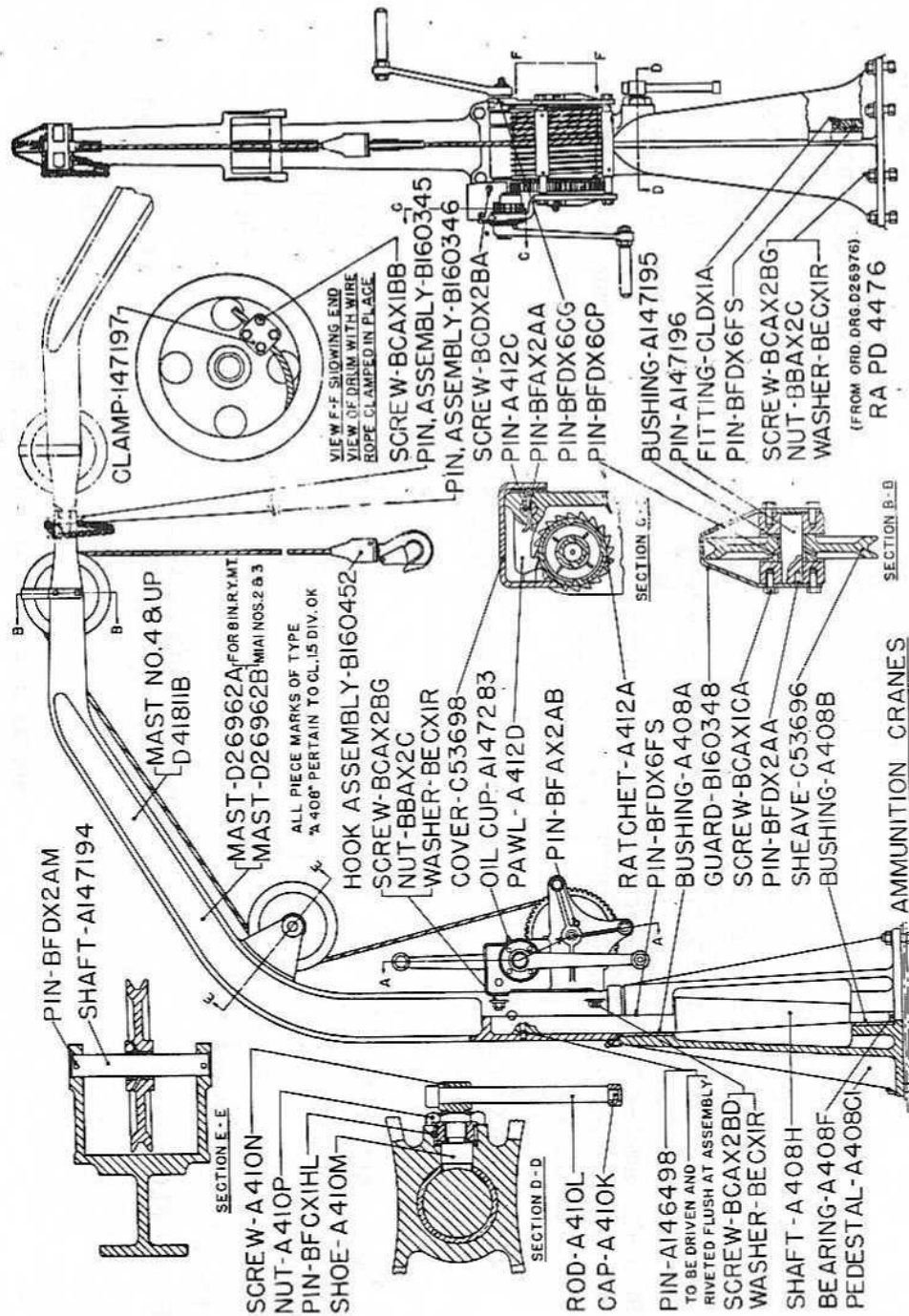
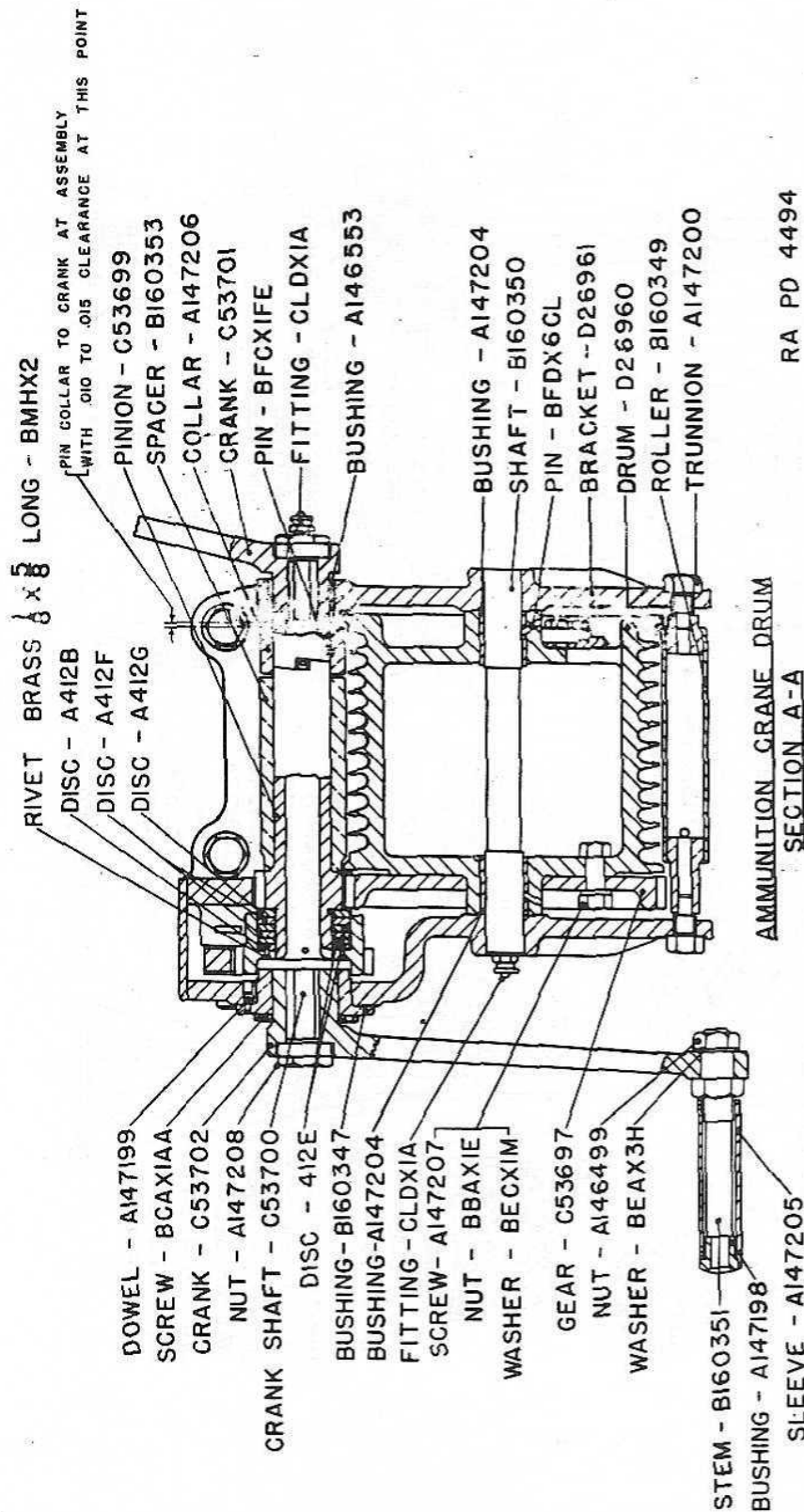


FIGURE 38 — AMMUNITION CRANES

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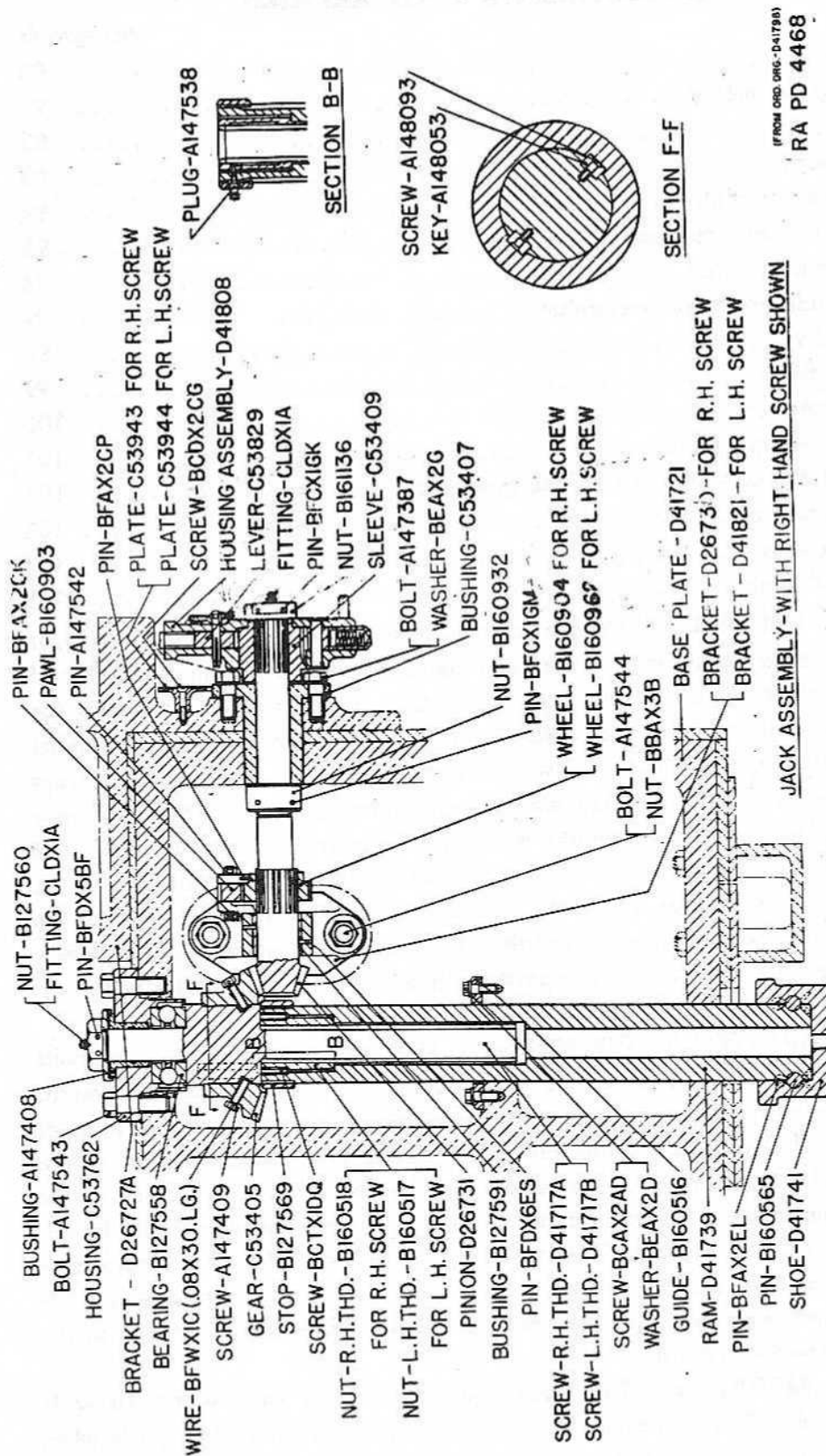


(FROM ORD. DRG. D26976)

RA PD 4494

FIGURE 39 - AMMUNITION CRANE DRUM

DISASSEMBLY AND ASSEMBLY



(FROM ORD. DRG.-D41798)
 RA PD 4468

FIGURE 40 - JACK ASSEMBLY

SECTION VII

ADJUSTMENTS AND REPAIRS

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90. **GENERAL.** — To repair and maintain the materiel in service, it will be necessary at times to make adjustments of some of the mechanisms and to effect minor repairs to the gun and mount. The following instructions for adjustment and repair of the materiel are to enable the ordnance personnel charged with responsibility for this work to keep the parts in working order. Except in emergencies, work requiring welding and forming or the making of new parts for important replacements will not be undertaken in the field. It is obvious that a complete program of repairs and adjustments cannot be outlined in a work of this kind, as it cannot be determined in advance what parts of the structure may need attention from time to time. These instructions, therefore, cover only such operations as experience has shown are generally necessary in keeping materiel of this nature in working condition.

91. **TRAVERSING THE MOUNT.** — The mount should be traversed occasionally through its entire movement but only when the mount is on its firing pedestals, accurately level, and two outriggers in place on the sides of the mount. This will serve to diminish the likelihood of rust accumulation where the rollers lie in contact with the surfaces of the roller paths. When the mount is to remain inactive for any length of time, the outer dustguard may be removed, rollers and roller paths sprayed lightly with 600W oil and dustguards replaced. If there are indications of any binding, the dust guard should be removed and the pressure of the felt slightly relieved, where necessary, at the point of excessive friction.

92. **RECOIL.** — a. The normal recoil of the gun when fired is approximately 27 in. (maximum, 28½ in.) and observation should be made when the gun is in action to see that the recoil does not approach too close to the maximum.

ADJUSTMENTS AND REPAIRS

b. To determine the movement of recoil, a recorder is attached to the right front end of the cradle. This device is provided with a marker, in contact with the gun body, to indicate the actual recoil of the gun when fired. The recorder should be examined frequently to see that the marker scribes a line in the grease smeared lightly on the gun body. Failure to do so indicates a weakness of the spring or distortion of the marker. To correct such defects, replace the spring if necessary, and see that the marker works freely in the recoil recorder nut.

93. COUNTERRECOIL — Should the gun fail to return fully to battery when fired, it will generally be found that the compressed air in the recuperator cylinder is below the prescribed requirement, and action should be taken to build up the pressure in the recuperator cylinder as prescribed in paragraph 45. Distortion of the recuperator pull rods and lack of proper lubrication of the yoke slides may also be a contributing factor in the failure of the gun to return fully to battery. These parts should be examined and corrective action taken when necessary.

94. ELEVATING MECHANISM (Figure 33).—The elevating rack should be examined frequently to see that the parts are in working condition, and that all screws and bolts attaching the mechanism to the mount are rigidly in place. The teeth of the elevating rack should be examined carefully for burs, which, if found, should be removed with a smooth file. Tests should frequently be made to see that the teeth of the rack are meshing properly with the elevating pinion and that there is no excessive backlash in the mechanism. If such backlash is present, the matter should be called to the attention of a responsible ordnance representative who will make such adjustments as may be required.

95. ELEVATION INDICATOR MECHANISM. — Examine the parts of the elevation indicator drive mechanism (Figures 14 and 34). Examine the elevation indicator rack for burs or other deformation and remove if present. Extreme care must be exercised in removing metal from the rack to prevent undue clearance.

96. TRAVERSING MECHANISM. — Examine the external parts of the traversing mechanism (Figures 22, 31 and 32) frequently. Test all screws and bolts and tighten any that may have been loosened by firing shock, etc. Test the mechanism for backlash and report any excessive clearances to the responsible ordnance officer so that necessary corrections can be made. Examine the teeth of the traversing rack and pinion and remove any burs.

97. AZIMUTH INDICATOR DRIVE MECHANISM. — Test the parts of the azimuth indicator drive mechanism (Figure 35) for loosened parts and tighten screws and nuts where necessary. Remove the guard from the lower element of the mechanism from time to time and examine the azimuth indicator drive rack for burs or other deformation which should be corrected if found present. Test the parts of the adjustable coupling at the upper end of the mechanism and see that proper clamping of the parts of this device can be maintained at all times. Should the parts of the device be damaged so that proper functioning of the azimuth indicator cannot be obtained, remove the adjustable coupling

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from the drive and indicator shafts and substitute a new coupling pending repairs to the damaged parts.

98. LIFTING JACKS. — Examine the parts of the lifting jacks (*Figures 17 and 18*) and remove any burrs from the bevel gears in the base plate recess. Test the device by manipulating the lifting jack levers and note whether the ratchet pawls are oiled lightly and engage properly in the ratchet wheels. Failure of the pawls to function properly will probably be caused by rust or corrosion, which should be removed. Examine the surfaces of the rams, remove any accumulated rust, and thoroughly lubricate the moving parts including the lifting jacks, screws, and nuts. As the finished parts of the upper section of the device are exposed to possible damage by the presence of moisture, sand, and accumulations of dirt, and grit, it is particularly desirable that these parts be examined frequently and kept free from all foreign substances.

99. ELECTRICAL FIRING CIRCUIT. — See that the parts of the electrical firing circuit (*Figure 37*) are in good condition. Examine all screws in straps and brackets to be sure that they are properly assembled. Examine the insulation on the firing cable and repair any damage by winding the parts with electrical adhesive tape. Damaged cables should be replaced as soon as practicable. Examine the parts of the contactor device and see that the blades and springs are in proper contact. Make adjustment of these parts where necessary. See that the connectors attached to the firing pistol cable are in working condition, and if damage to these parts is in evidence they should be replaced. Test the complete firing assembly frequently with a six-volt battery. In the event of failure of the electrical firing system to operate properly, look for defects in the contactor assembly, D26807; connector assembly, B127924; firing pistol, C53607; condulet, B127812; ground terminal, A147065; battery terminals, A147006; and breech terminal, A146922. Make necessary corrections. The firing pistol will not be disassembled except under direction of trained personnel.

100. AMMUNITION CRANES (*Figure 39*). — Examine screws attaching the rope clamps to the drums and see that they are clamped securely. Test the hook snap to see that it closes properly and replace if necessary. Test the holding capacity of the cranes by suspending a load 260 pounds from the crane hook. If there is evidence of failure by slipping or other causes, the drum operating device should be disassembled and necessary corrections made. See that the screws attaching the gear, C53697, to the drum are securely in place and tighten all screws attaching the cranes to the loading platform. Test the locking devices on the cranes to see that they hold the cranes from rotating, and replace any defective parts.

101. BREECH TRAVELING SUPPORT. — Manipulate the handle of the breech traveling support (*Figure 36*). See that the plungers work freely. See that the locking screws are properly wired and replace any broken or defective wires. Parts of the device most likely to be injured are the crank and handle. It is necessary that the crank be maneuvered to a position where the plunger in the crank handle will enter the recess provided for it in the recoil band at

ADJUSTMENTS AND REPAIRS

each end of the movement. If the crank or handle parts are found to be distorted or out of alinement, the pin attaching the crank to the bevel pinion should be driven out and corrections made in the crank and handle assembly.

102. INTENSIFIER, LIQUID PUMP, AND AIR CHARGING AND MANEUVERING VALVE (Figures 11 and 13). — See that the screws attaching the intensifier to the cradle are securely in place. Make sure all pipe fittings connecting the intensifier to the recuperator cylinder, liquid pump, and air charging and maneuvering valve are properly assembled and that there is no indication of oil or air leakage in any part of the piping assembly. If there is evidence of leakage, tighten the pipe nuts until the leakage stops. See that the end of the intensifier piston rod is within the prescribed limits of 0 and 7 on the intensifier indicator, and pump additional oil into the intensifier if necessary. If the piston rod creeps outward in the space of a few days, it would indicate leakage of oil at the recuperator seal, intensifier piston or intensifier rod. In that case it should be brought to the attention of ordnance personnel. Test the functioning of the liquid pump and air charging and maneuvering valve, and if any defects are found, the pump and valve may be disassembled in accordance with the procedure outlined in paragraphs 87 e. and f., and repairs or replacement effected.

103. LOADING STAND AND TROUGHS (Figure 23). — With the loading stand locked securely to the platform, test the operation of the loading tray to see that the forward end of the front trough rests properly in the gun breech. When necessary, make adjustment of the loading assembly chain by means of the turnbuckle nuts. Check smoothness of the surfaces of the loading stand and troughs. Remove any burs and check the joints for unevenness, which, if present, may be scraped or filed until a satisfactory smooth surface is obtained. Adjust the tension of the link rod spring by means of the adjusting nut until it balances the loading tray when half raised to its folded position. See that the moving parts of the device are properly lubricated and that any accumulated rust, dirt, or other foreign substances are removed from the finished parts of the mechanism.

104. LOCKING DEVICES. — Check all chain and pin assemblies and other locking devices to see that they are intact, and make replacements where necessary.

105. TRUCKS AND BRAKES. — Parts of the six-wheeled trucks including air and hand brakes should be examined frequently and repairs and replacements made as required. Repairs and replacements of any of the parts of the trucks, including the braking system, will be done by or under the direction of trained railroad personnel.

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SECTION VIII

SIGHTING EQUIPMENT

	Paragraph
Clinometer M1912	106
Mount, telescope, M20; quadrant, elevation, M1; telescope, panoramic, M8	107
Quadrant, gunner's, M1	108
Quadrant, gunner's, M1918	109
Sight, bore	110

106. CLINOMETER M1912. — *a.* The clinometer M1912 (Figure 37) is an instrument for measuring gun elevations accurately in degrees and minutes. It is used in conjunction with a bore rest which fits into the muzzle opening of the gun. A clamp is provided for securing the clinometer to the bore rest. The clinometer is supplied complete with packing chest.

b. The indicating element of the clinometer consists of a scale and vernier. The scale is engraved on the clinometer support and is graduated from minus 5° to plus 75° in 20-minute intervals. The vernier is attached to the level holder and when read against the scale, the graduations indicate to the nearest minute $5'$ etc.

c. To prepare the clinometer for operation, secure the clamp at a central position on the bore rest and open the two screws at the top of the clamp. Slide the clinometer into position so that the central clamping lug is between the upper clamp screws. Tighten the clamp screws and adjust to center the bubble in the clinometer cross level.

d. To read gun elevation, set the level holder to the approximate elevation and clamp by means of the screw at the rear (not shown). Use the slow motion screw to center the bubble in the elevation level, then read the scale and vernier as follows:

(1) On the elevation scale, against the zero line of the vernier, read degrees and minutes to the nearest 20-minute interval. If the zero line indicates between two scale graduation lines, read the lower of the two.

(2) On the vernier, against the scale line which matches exactly to a vernier line, read minutes from 0 to 20. Use the positive portion of the vernier only for the positive portion of the scale, and the negative portion of the vernier only for the negative portion of the scale.

(3) Add together the separate readings of the scale and vernier.

e. The clinometer should be verified at frequent intervals, using the following procedure: Set the clinometer to read zero elevation and place it in position on the gun. Elevate or depress the gun as required to center the bubble in the longitudinal level. Reverse the clinometer end-for-end and again read gun elevation. If the reading is other than zero an instrument error is indicated, and the amount of the error is one-half of the reading so obtained. The amount of the error should be allowed in subsequent readings, or correction should be made by adjusting the level vial using the two vertical screws at the forward end of the level vial holder.

RA PD 7146

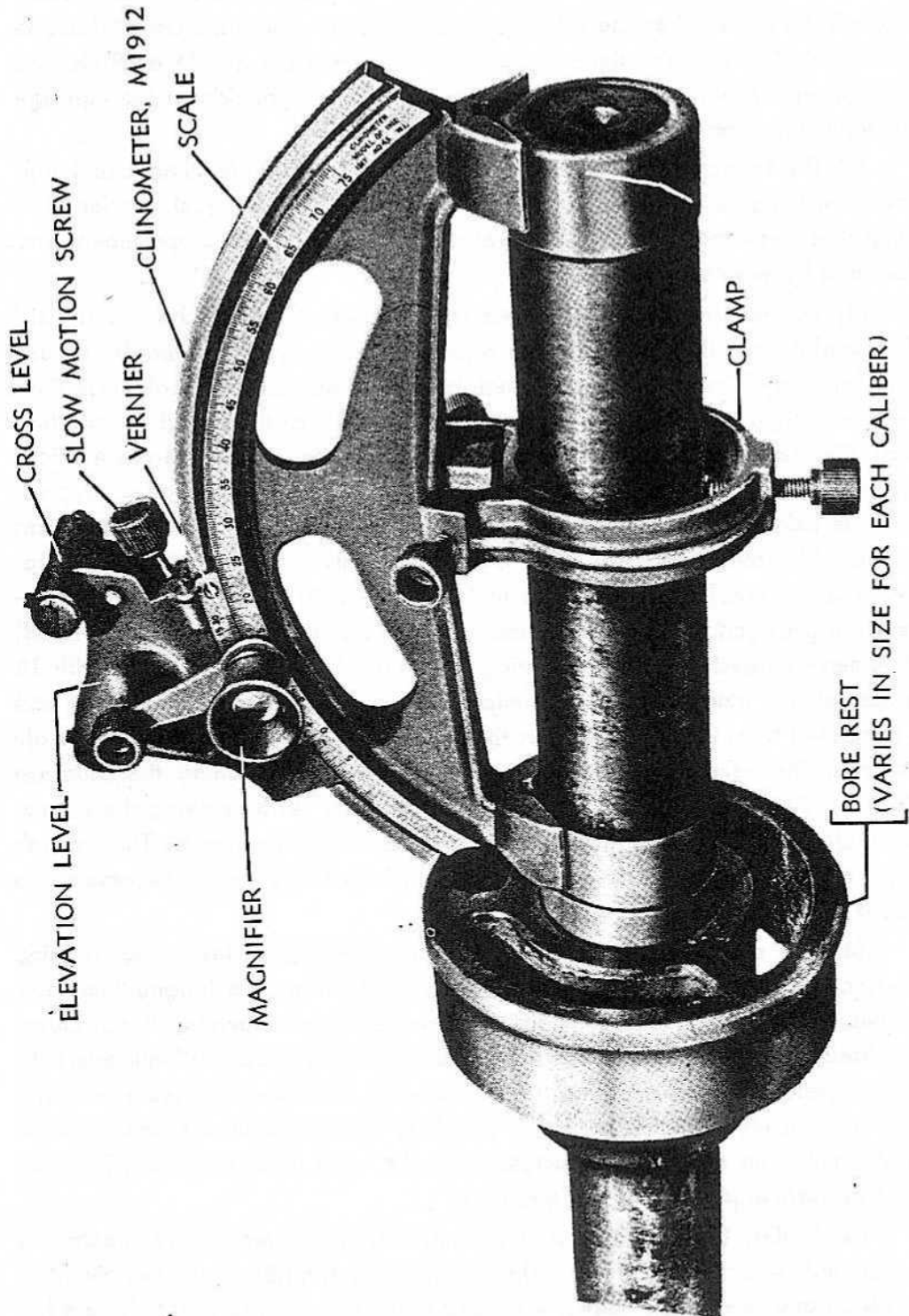


FIGURE 41 — CLINOMETER M1912

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f. Handle the clinometer carefully to prevent damage to the finished surfaces or disturbance of adjustments. Keep metal surfaces lightly oiled. When the clinometer is not in use, keep it in the chest provided.

107. MOUNT, TELESCOPE, M20; QUADRANT, ELEVATION, M1; TELESCOPE, PANORAMIC, M8. — *a. Description.* (1) The telescope mount M20 (Figure 42) is mounted on the left side of the carriage. The panoramic telescope M8 (Figure 43) forms the sighting element for aiming the gun in azimuth. The elevation quadrant M1 (Figure 44) is mounted on the right side of the carriage and forms the element for laying the gun in elevation.

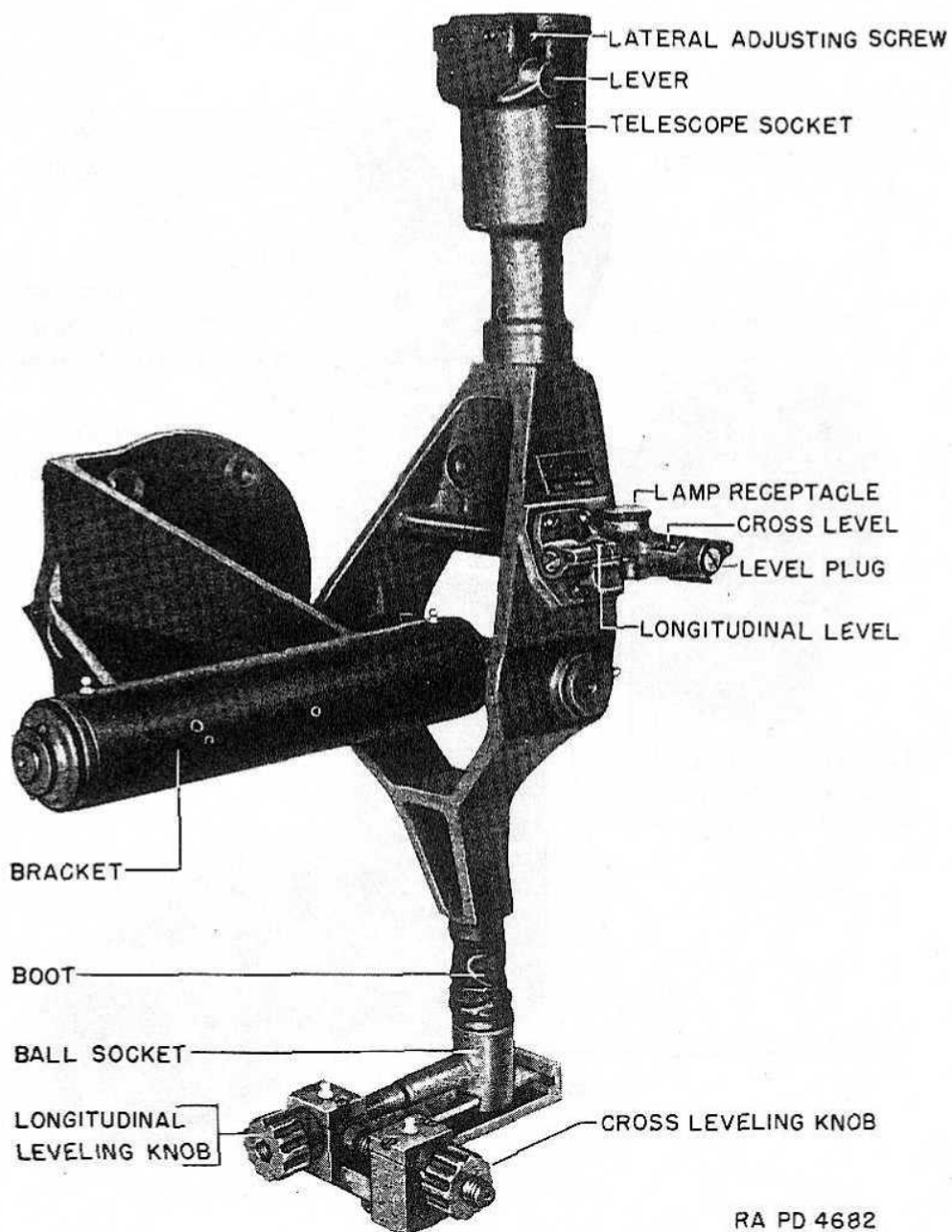
(2) The telescope mount contains provisions for cross leveling and longitudinal leveling, a level vial and knob being provided for each motion. The panoramic telescope fits into the socket at the top of the telescope mount and is secured by means of the lever.

(3) The panoramic telescope M8 is a 6-power telescope having a field of view of $6^{\circ} 40'$. It is provided with a prism erecting system, a diopter adjustment, and ray filters. The reticle contains horizontal and vertical cross lines. The line of sight is elevated or depressed by the knob at the top of the rotating head. Coarse and fine index graduations indicate the normal (zero elevation) position; there is no provision for reading other angles of elevation or depression. The azimuth scale is graduated at 10° intervals from 0° to 360° , and can be shifted for orientation. The scale is clamped to its upper index after orientation, and is thereafter read against its lower index. Separate azimuth micrometers are provided for case II and case III pointing. The deflection (right-hand) micrometer is used for case II pointing and is numbered from 5 to 15 with 10 as normal. The azimuth (left-hand) micrometer is used for case III pointing and is numbered from 0° to 10° so that the readings supplement the azimuth scale readings. The azimuth micrometer can be shifted by loosening the adjacent wing nut. Corrections up to 1° in either direction are set by moving the correction scale index, using the lever alongside the azimuth micrometer. The azimuth worm can be disengaged by pushing forward on the azimuth micrometer, to permit rapid approximate setting.

(4) The elevation quadrant includes a longitudinal level and leveling mechanism, and a cross level and leveling mechanism. The longitudinal level rotates with the elevation scale and is actuated by the elevating knob. Elevation indications are obtained on the elevating scale (coarse, 100-mil intervals) and elevation micrometer (fine, 1-mil intervals). The elevation scale indicates from a maximum elevation angle of 1,200 mils to a maximum depression angle of 200 mils. The cross level is actuated by the cross level knob and indicates the true vertical position of the quadrant.

(5) Scales, level vials and panoramic telescope reticle are electrically illuminated. A 4-ft. connecting cable with plugs is furnished with the elevation quadrant and two similar cables, 4 ft. long and 22 in. long respectively, are furnished with the telescope mount. Two panoramic telescope lamp brackets and a

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RA PD 4682

FIGURE 42 — TELESCOPE MOUNT, M20

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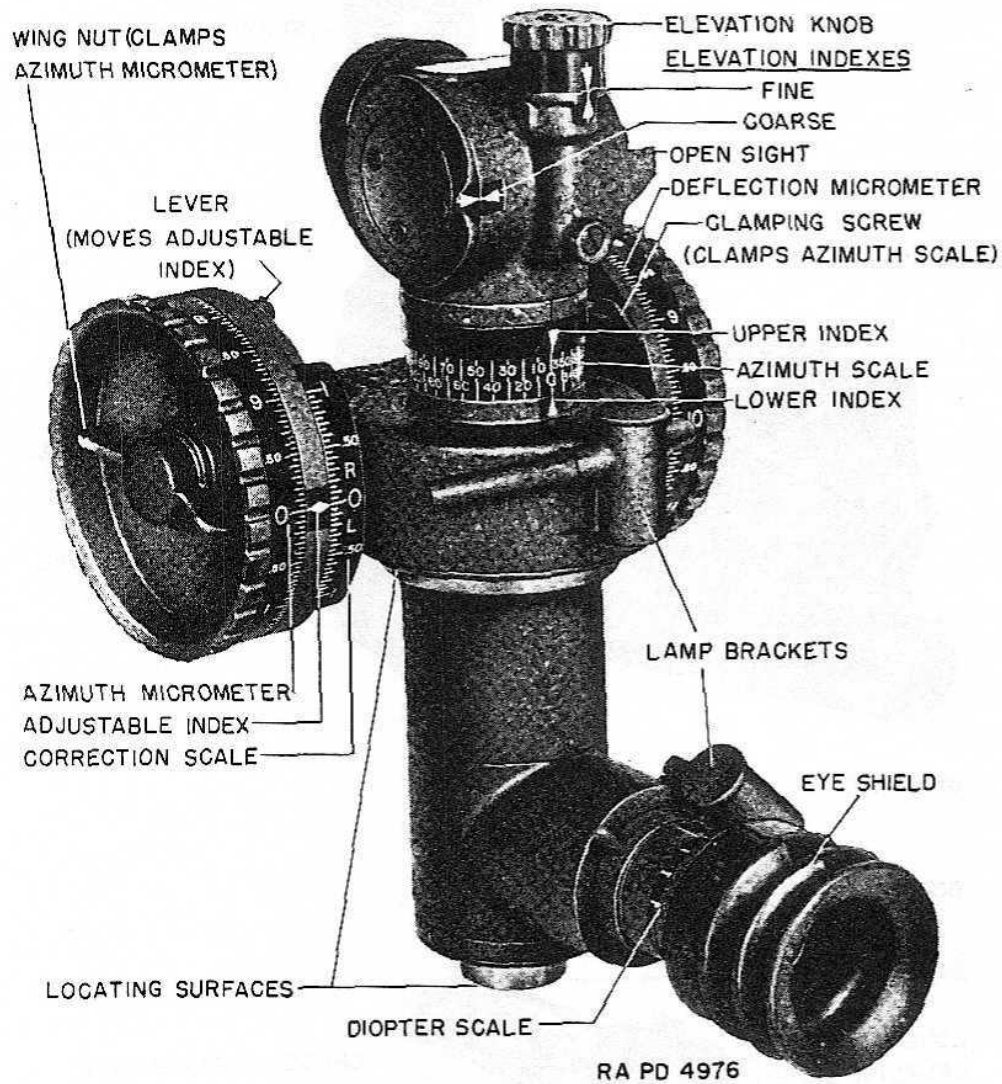
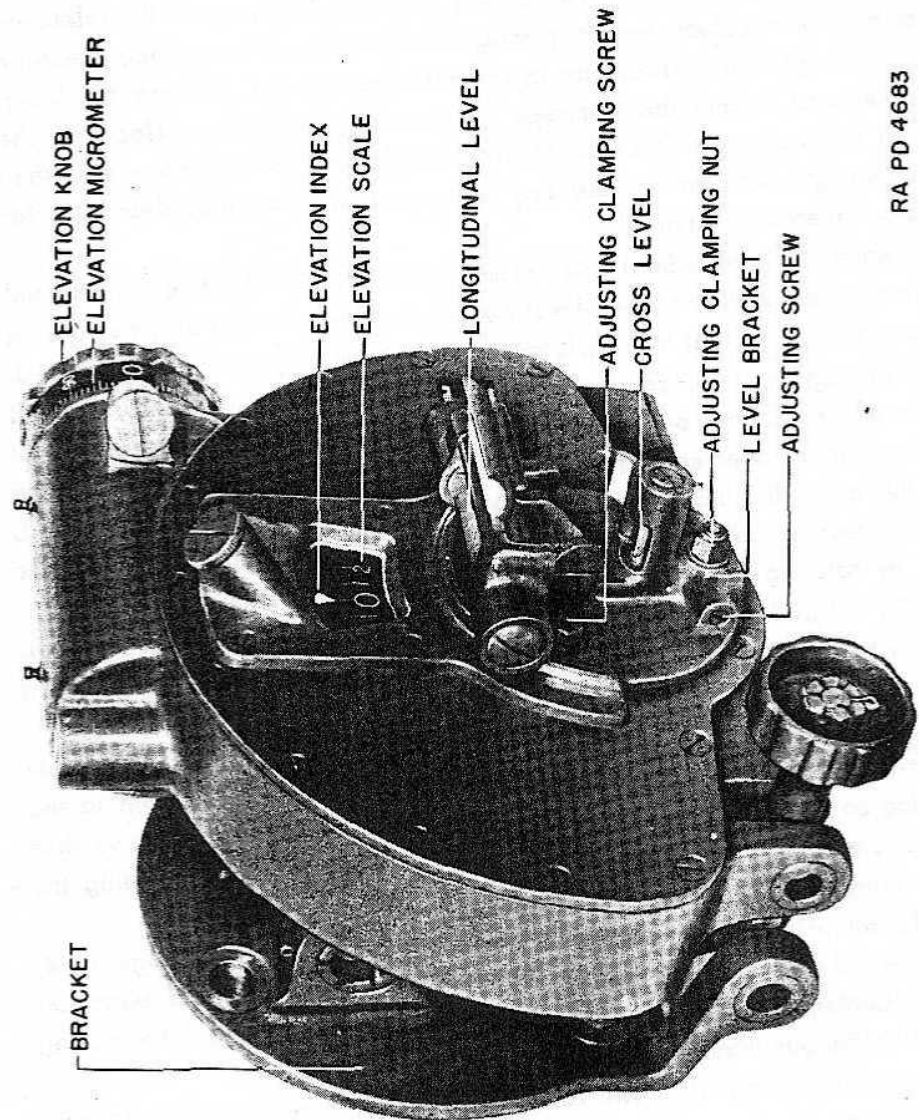


FIGURE 43 — PANORAMIC TELESCOPE, M8

SIGHTING EQUIPMENT



RA PD 4683

FIGURE 44 — ELEVATION QUADRANT M1

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trouble lamp for connection to the telescope mount are also furnished. Individual lamp circuits are controlled by toggle switches on the telescope mount and elevation quadrant. Each lamp receptacle is removable for lamp replacement, and is normally locked in position by a small headless screw; a jeweler's screwdriver is provided for operating this screw.

b. *Operation.* — (1). To place the panoramic telescope into the telescope mount, hold down the lever (*Figure 42*) and place the telescope in the telescope socket so that the eyepiece projects through the cut-out section and the telescope lugs slide through the vertical slot in the telescope socket. Release the lever, thus locking and forcing the telescope down onto the seating surfaces of the socket. To remove, press down on the lever to loosen the telescope and then lift the telescope out. Do not use any other method than that described for carrying out these operations.

(2) Keep the longitudinal and cross level bubbles of the telescope mount and the cross level bubble of the elevation quadrant centered at all times during operation. This insures that true horizontal and vertical angles will be measured.

(3) To apply lateral correction to the individual gun (a constant small correction of one degree or less) shift the correction scale index by means of its lever until the proper correction is indicated on the correction scale. Set the zero of the azimuth micrometer against this index. This establishes the initial, or zero, correction. Subsequent deflections in azimuth may be set in either direction by rotating the azimuth micrometer or deflection micrometer.

(4) To set deflections for case II pointing. Deflections of 5° or less can be set by rotating the knob of the deflection micrometer until the deflection is indicated against the case II index.

(5) To set azimuth for case III pointing, set off the announced azimuth of the set-forward point to the nearest 10° on the azimuth scale, and to the exact setting on the azimuth micrometer of the panoramic telescope. The vertical line of the telescope is brought to bear on the aiming point by operating the traversing handwheel of the gun mount.

(6) To set off quadrant elevation rotate the elevation knob (*Figure 44*) until the desired elevation is registered on the elevation scale and elevation micrometer. Center the bubble in the longitudinal level by operating the elevating handwheel on the gun mount.

c. *Test and adjustment.* — The following operations are to be performed with the gun mount accurately leveled.

(1) To verify the adjustment of the telescope mount, M20, first center the bubbles in the longitudinal and cross level vials and then place a test level on the machined surface at the top of the telescope socket. (It may be necessary to use a parallel plate or bar to seat the test level.) Check the levelness of the surface along the longitudinal axis and along the cross level axis. The surface should be level along both axes. If the surface is out of level along either axis, adjustment of the corresponding level vial will be required. This adjustment is performed by removing temporarily the plug at the end of the level vial and

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shifting the four small screws to center the bubble. The screws should be tight but not overstrained when adjustment is completed.

(2) To verify the adjustment of the elevation quadrant M1 elevate the axis of the gun bore to quadrant elevations corresponding to short, medium, and long range. Check the quadrant readings against clinometer readings for each elevation. Examine the results of the check and, if the readings do not agree, determine the correction required. If the error is not constant, the quadrant should be serviced by ordnance personnel. If the error is constant for all elevations, proceed in making the correction as outlined below:

(a) Level the gun by means of the clinometer and do not disturb until the adjustment is completed.

(b) Set the zero graduation on the elevation scale exactly to the elevation scale index. Note the position of the zero on the elevation micrometer. If it is not in line with the micrometer index, loosen the three screws in the end of the knob and slide the micrometer until the indexes fall in line, being careful not to rotate the knob. Tighten the screws.

(c) With elevation scale and micrometer set at zero, note the position of the bubble in the longitudinal level. If the bubble is not centered, loosen the locknut and the two screws which secure the level bracket (Figure 44) and the two headless screws below the locknut which secure the tangent screws. Operate the tangent screws to center the level bubble. Tighten the screws and locknut.

(d) It should not be necessary to adjust the cross level, as any error in elevation resulting from a possible inaccuracy of the level would be negligible.

(3) To verify the adjustment of the panoramic telescope M8 place the telescope in the adjusted telescope mount M20. Level the gun. Place bore sights in the gun and place testing target in position so that line of bore sight falls on the gun aiming point of the testing target. If the telescope is in adjustment, the intersection of the reticle cross lines will fall on the telescope aiming point of the testing target. Adjustment, if required, is performed as described below.

(a) *Vertical adjustment.*— Turn the elevation knob (Figure 43) until the horizontal cross line on the reticle falls on the aiming point. Loosen the screws in the top of the elevation knob and slide the micrometer until the index on it lines up with the fixed index. If the coarse index lines are not exactly in register, loosen four screws which secure index clamping disk and shift index ring until the index on it lines up with the fixed index. Tighten all screws, being careful not to disturb the adjustment.

(b) *Lateral adjustment.*— Bring the upper and lower azimuth scales into line with each other by use of either of the azimuth knobs. The deflection micrometer should then indicate normal (10) if it is in adjustment. If the reading is other than normal, loosen the four fillister head screws on the deflection knob, shift the deflection micrometer until the normal graduation is in line with the fixed index, and then tighten the screws. Leave the micrometer at the normal setting and proceed with the adjustment to bring the vertical cross line onto the aiming point, as follows: Loosen the two clamping screws at the front of

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the telescope mount socket, near the top. By means of the tangent screws, rotate the telescope in the socket until the vertical cross line falls on the aiming point. Tighten the clamping screws.

d. Settings for case II and case III pointing. — (1) *Case III pointing.* — Place the bore sights in the gun and direct the gun on a distant object of known azimuth as an aiming point. Rotate the azimuth knob or deflection knob of the panoramic telescope until the vertical cross line falls on the object. Set the azimuth scale and micrometer to read the azimuth of the aiming point. This is accomplished by loosening the wing clamping screw near the azimuth scale upper index and shifting the azimuth scale as required, then loosening the wing nut in the end of the azimuth micrometer knob and shifting the azimuth micrometer to complete the setting.

(2) *Case II pointing.* — The change from case III to case II pointing can be made quickly by shifting the azimuth scale to bring the zero on the azimuth scale in line with the upper index. However, it will be necessary to bore sight the gun as outlined above when changing from case II to case III pointing.

e. Care and preservation.— (1) Care must be exercised to prevent bumping the level brackets and the locating surfaces of the instruments.

(2) The telescope mount and the elevation quadrant are not to be removed from the gun trunnions or carriage by the using arms. When not in use, these instruments must be kept protected by the canvas covers issued for this purpose.

(3) Keep level vials covered at all times when not in use.

(4) When disengaging the azimuth mechanism of the panoramic telescope to permit rapid motion, move the worm shoe sufficiently to allow the worm teeth to clear. When re-engaging, do not allow the mechanism to snap into mesh. With this procedure, excessive wear and burring of the teeth can be avoided.

(5) When not in use, keep the panoramic telescope in the carrying case provided for it.

(6) Fittings are provided for lubricating the principal bearing surfaces of the telescope mount and elevation quadrant. A lubricating gun is furnished for applying oil to these fittings. The telescope mount and elevation quadrant should be lubricated at regular intervals, depending on service conditions. Finished machined surfaces should be kept lightly oiled.

(7) The panoramic telescope requires lubrication only at long intervals, and then only by trained ordnance personnel.

(8) Replace the leather boot of the telescope mount if it becomes torn or perforated. The boot is secured by wires with ends twisted together.

108. QUADRANT, GUNNER'S, M1. — *a. Description.* — This quadrant (Figure 45) includes a sector-shaped frame to which is pivoted an arm carrying a level. Notches on the frame engaging with a plunger in the arm permit rapid setting of the arm to the desired angle. The frame has two fiducial surfaces, one used for elevations from 0 to 800 mils and the other from 800 to 1600 mils. Separate scale and micrometer indications on opposite sides of the quadrant

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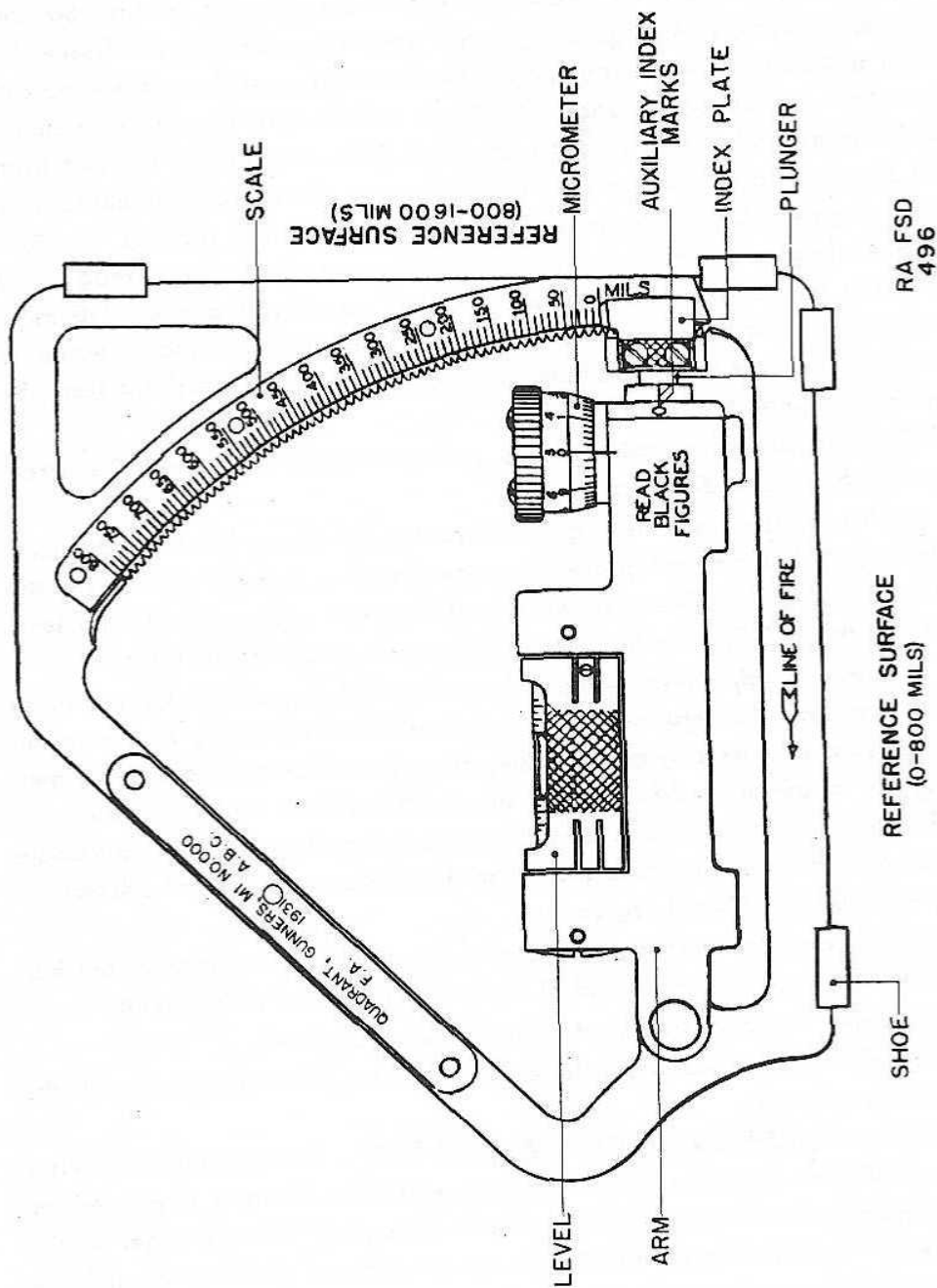


FIGURE 45 — GUNNER'S QUADRANT M1

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1

are used for the two different regions.

b. *Operation.* — (1) To measure the elevation of the piece, place the proper reference surface of the quadrant on the leveling plates, parallel to the bore with the associated arrow pointing in the direction of fire. Set the micrometer to zero. Disengage the plunger from the notches in the frame, lift the arm and slowly lower it until the bubble is seen to pass through the central point. Allow the plunger to engage with the notches and turn the micrometer until the level bubble is accurately centered. Face the side of the quadrant which bears the arrow in use and read the scale and micrometer indications. A note engraved below the micrometer indicates whether the red or black micrometer figures are to be read; a zero micrometer indication is read as "0 mils" when the auxiliary indexes are matched (as shown) and as "10 mils" when they are not matched. The elevation of the piece in mils is equal to the sum of the scale and micrometer readings. Remove the quadrant from the piece before firing.

(2) To measure depression angles, proceed as above, but with the arrow pointed in the reverse direction.

(3) To lay the piece to a given elevation, set the scale and micrometer to the required angle and place the corresponding fiducial surface on the leveling plates of the piece. Elevate the piece, then depress it until the level bubble is centered. Remove the quadrant from the piece before firing.

c. *Test and adjustment.* — No adjustment of the quadrant by the using arm is permitted. The zero indication may be verified by setting the quadrant to zero elevation, elevating or depressing the piece to center the bubble, then turning the quadrant end-for-end. If the bubble is not centered, determine the elevation or depression angle necessary to center it; one-half of this angle is the error and a corresponding correction should be applied to all subsequent indications in the 0-800 mil region.

d. *Care and preservation.* — (1) Exercise particular care to prevent burring, denting or nicking of the shoes and of the notched portion of the frame.

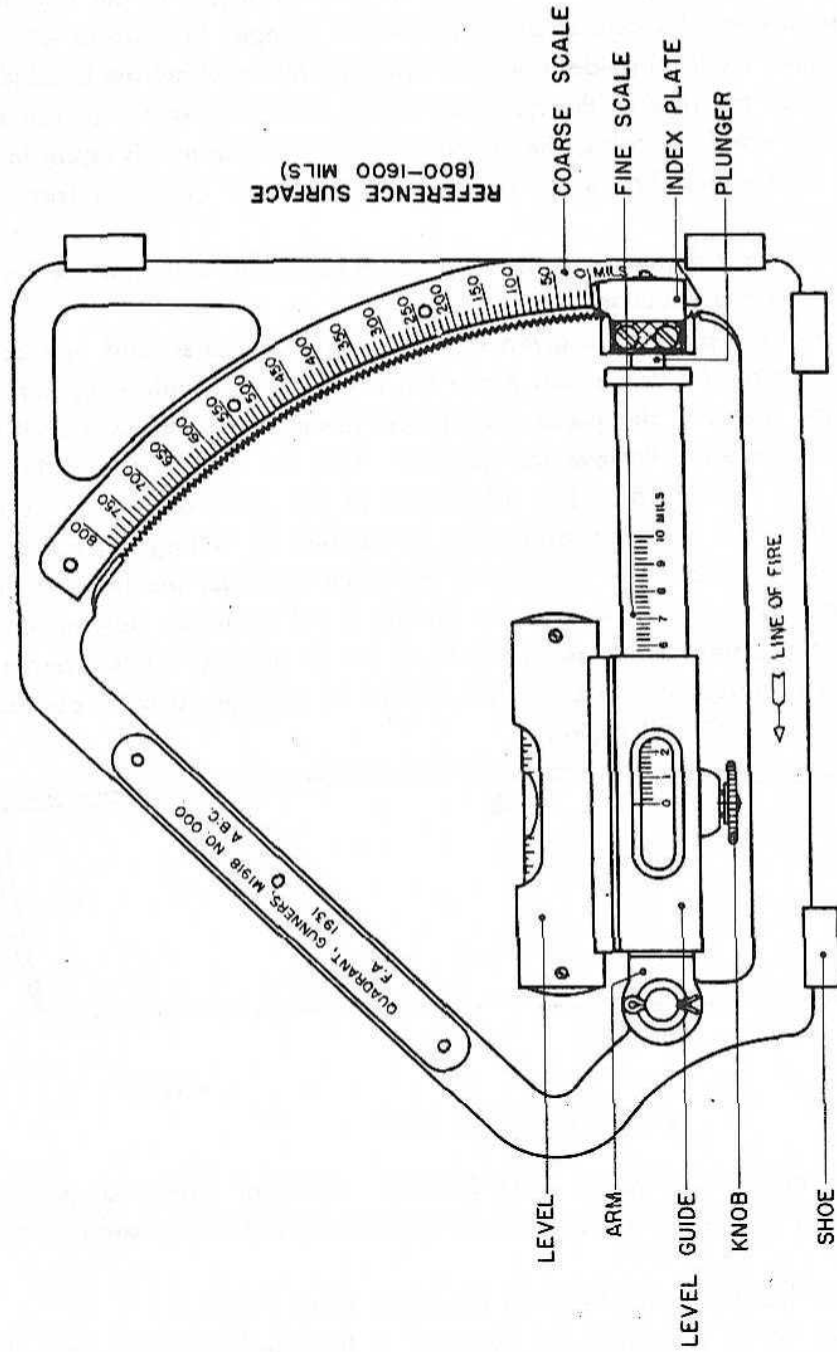
(2) Never leave the quadrant on the piece when firing.

(3) When not in use, keep the quadrant in the chest provided, with the shoes lightly greased.

109. — QUADRANT, GUNNER'S, M1918. — a. *Description.* — This quadrant (Figure 46) includes a sector-shaped frame to which is pivoted an arm carrying a level. Notches on the frame engaging with a plunger in the arm permit rapid setting of the arm in 10-mil steps to the desired angle as indicated on the coarse scale. The arm is slightly curved and the level guide is arranged to be positioned along the arm to provide a fine indication supplementing that on the coarse scale. The frame has two reference surfaces, one used for elevations from 0 to 800 mils and the other from 800 to 1,600 mils; separate indications on opposite sides of the quadrant are used for the two different regions.

b. *Operation.* — (1) To measure the elevation of the piece, place the

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FIGURE 46 - GUNNER'S QUADRANT M1918

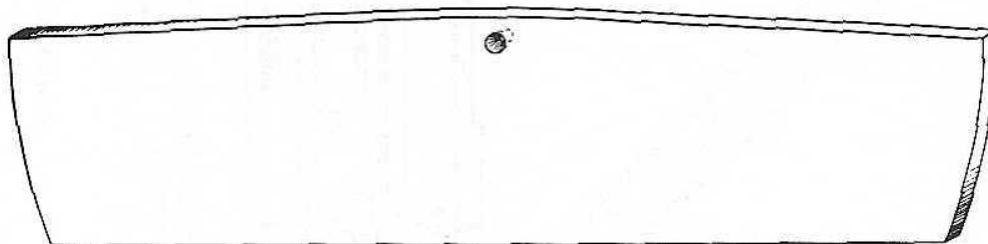
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proper reference surface of the quadrant on the leveling plates parallel to the bore, with the associated arrow pointing in the direction of fire. Clamp the level guide to indicate zero on the fine scale. Disengage the plunger from the notches in the frame, lift the arm and lower it slowly until the bubble is seen to pass through the central point. Allow the plunger to engage with the notches and slide the level guide along the arm until the level bubble is centered accurately. Face the side of the quadrant which bears the arrow in use and read the coarse and fine scales. The elevation of the piece in mils is equal to the sum of the coarse and fine scale readings. Remove the quadrant from the piece before firing.

(2) To measure depression angles, proceed as above, but with the arrow pointed in the reverse direction.

(3) To lay the piece to a given elevation, set the coarse and fine scale indexes to the required angle and place the corresponding reference surface on the leveling plates of the piece. Elevate the piece, then depress it until the level bubble is centered. Remove the quadrant from the piece before firing.

c. *Test and adjustment.* — No adjustment of the quadrant by the using arm is permitted. The zero indication may be verified by setting the quadrant to zero elevation, elevating or depressing the piece to center the bubble, then turning the quadrant end-for-end. If the bubble is not centered, determine the elevation or depression angle necessary to center it; one-half of this angle is the error and a corresponding correction should be applied to all subsequent indications in the 0-800 mil region.



RA PD 4977

FIGURE 47 — BORE SIGHT

d. *Care and preservation.* — (1) Exercise particular care to prevent burring, denting, or nicking of the reference surfaces and of the notched portion of the frame.

(2) Never leave the quadrant on the piece when firing.

(3) When not in use, keep the quadrant in the chest provided, with the shoes forming the reference surfaces lightly greased.

110. SIGHT, BORE. — The bore sight is used to indicate the direction of the axis of the bore of the piece, for orientation purposes. Each bore sight is composed of a breech element and a muzzle element.

a. *Description.* — (1) The breech bore sight (Figure 47) is a disk segment which fits accurately in the breech chamber of the gun. The model of the gun for which it is to be used is engraved on the segment.

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(2) The muzzle bore sight includes a quantity of black linen cord, to be stretched tightly across the muzzle vertically and horizontally in the score marks on the muzzle, and a web belt to be buckled around the muzzle to hold the cord in place.

b. *Operation.* — With the two elements in place, look through the aperture in the breech bore sight; the direction of the axis is indicated by the cord intersection.

c. *Care and preservation.* — Handle the breech bore sight carefully to prevent occurrence of nicks and burs. Wind the cord and web belt into a compact bundle when not in use.

SECTION IX

FIRE CONTROL EQUIPMENT

	Paragraph
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111. BOARD, ADJUSTMENT, FIRE, M1. — *a. Description.* — The fire adjustment board M1 (Figure 48), formerly known as the impact board, is used to determine the range correction to be applied as a result of the observation of fire.

(1) This board furnishes means for locating rapidly by inspection the center of impact (center of gravity) of any number of previously fired shots and provides a record of the corrections applied and the resultant deviations.

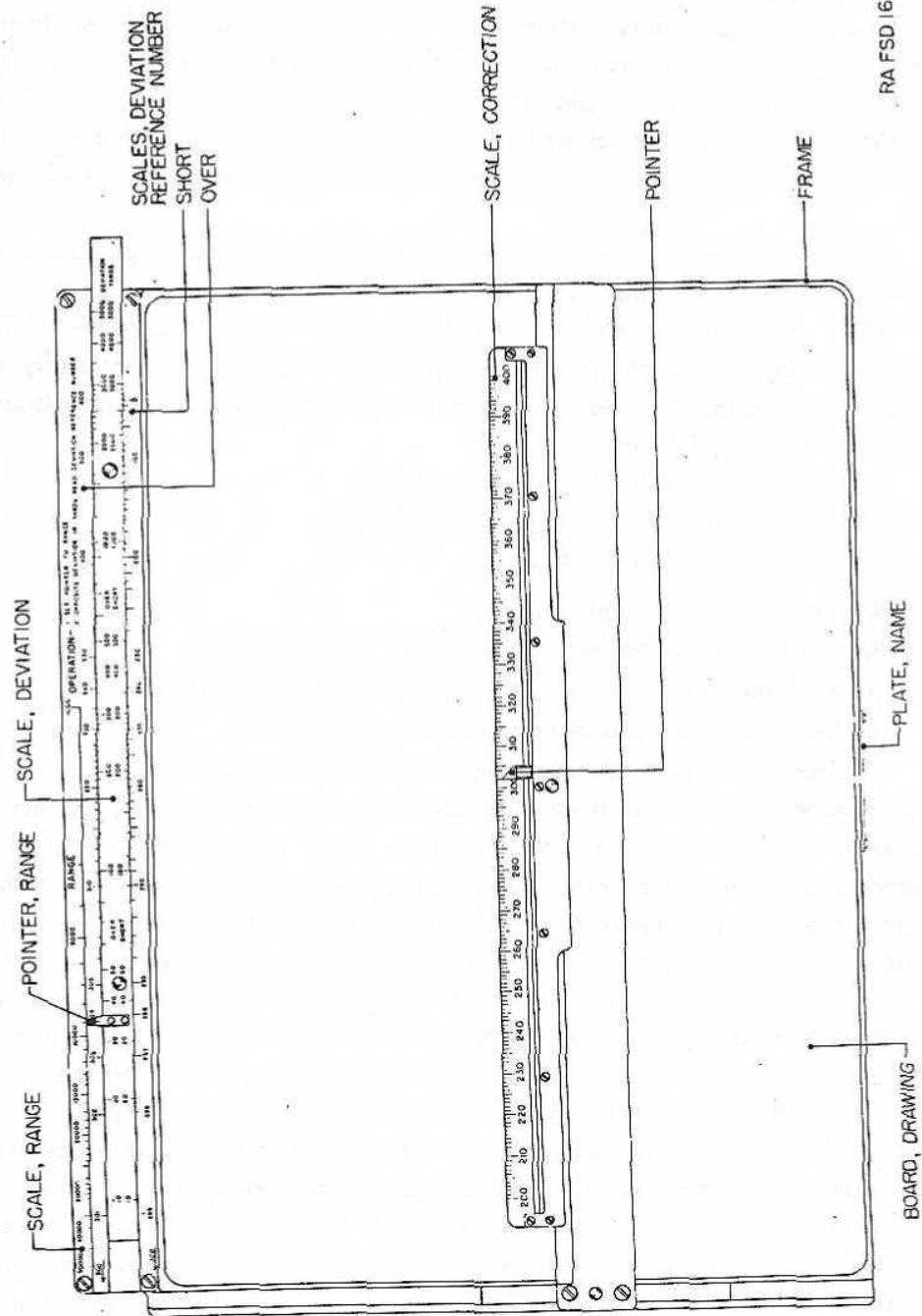
(2) This board includes two principal components: A wooden drawing board with a correction scale arranged to slide in a manner similar to a T-square, and a slide rule at the top for converting range deviations to deviation reference numbers which are functions of per cent of range.

b. Operation. — (1) The board may be used in a horizontal, vertical, or inclined position.

(2) To place the board in operation, fasten a piece of cross section paper (10 divisions per inch) to the board so that the horizontal lines are parallel to the T-square blade. Draw a pencil line over the heavy vertical line nearest the center. This line is the zero axis of percentage corrections and deviations plotted on the paper. The vertical scale may be a scale of time to any convenient dimension, or shots may be numbered and plotted at equal vertical intervals.

(3) To plot the percentage deviation of a shot, move the correction scale vertically until the edge of the scale coincides with the horizontal line corresponding to the numbered graduation for that shot, or to the proper time graduation. Place the 300-graduation on the correction scale at the point

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FIGURE 48 - FIRE ADJUSTMENT BOARD M1

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indicating the correction that was applied for that shot (or on the vertical axis if no correction has been applied) and plot the deviation opposite the corresponding deviation reference number.

(4) To measure and plot the correction to be applied to any shot, move the correction scale vertically until the edge of the scale coincides with the horizontal line corresponding to the numbered graduation for that shot, or to the proper time graduation. Determine by inspection the center of impact (center of gravity) of the deviations of the previously fired shots on which the correction is to be based and plot its position, using the correction symbol. Place the 300-graduation of the correction scale on the point plotted and read the correction reference number on the correction scale, opposite the zero correction axis.

(5) The pointer on the correction scale serves as a sliding marker for checking and rejecting wild shots readily.

112. BOARD, CORRECTION, RANGE, M1. — *a. Description.* — (1) The range correction board M1 (Figure 49) is used to compute mechanically the correction to be applied to the setforward range indicated on the plotting board, due to the following factors:

- (a) Variation from standard muzzle velocity.
- (b) Variation from normal atmospheric density.
- (c) Variation of the tide effect.
- (d) Variation of the wind effect.
- (e) Variation from the standard weight of the projectile.
- (f) Variation in the atmospheric temperature-elasticity effect.
- (g) Variation in the effect of the rotation of the earth.

(2) The board provides rapid means for determining the values of the various corrections and for combining them into a single net range correction. Provision is also included for the insertion of an adjustment correction, if desired. Corrections are expressed either as range corrections or as percentage range corrections, depending upon the scale of the chart in use. The chart also carries several other elements of range table data for ready reference.

(3) This board consists primarily of a pair of rollers, operated by a knob for rolling the chart to the desired position, and a range correction ruler assembly for combining the individual corrections and indicating the net correction. The charts used with this board are furnished by the Coast Artillery Corps.

(4) The rollers are connected by a sprocket chain. A torsion spring arrangement within the lower roller takes up any slack and keeps the chart taut. The chart is attached to each roller by a flat strip held in place by 15 small screws.

(5) The range correction ruler assembly is held in place by two wing nuts and is readily removable when installing or changing charts. The mounting holes are slotted so the ruler may be aligned readily with the range graduations on both sides of the chart.

(6) The ruler assembly includes a stationary bar and a movable bar. The latter is driven by the correction knob, through a rack-and-gear drive, and

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carries an index opposite which the range correction scale is read. The latter scale is arranged to be offset manually for the insertion of an adjustment correction, read opposite the associated index. Projecting knobs are provided on the scale for this purpose.

(7) Seven pointers, one for each set of curves on the chart, are provided. Each pointer is mounted on both the stationary and the movable bar, and has a clamping knob with three positions. In the extreme clockwise position of the knob (designated "S") the pointer is clamped only to the stationary bar; in the extreme counterclockwise position (designated "M") the pointer is clamped only to the movable bar; in the midposition (designated "L") the pointer is clamped to both bars and hence the movable bar is locked in position.

(8) A notation strip is provided at the top of the board for recording pertinent data.

b. Operation. — (1) The instrument may be operated in a horizontal, vertical or inclined position. The roller operating knob may be attached to either end of the upper or lower roller, as convenient, by means of a wing screw concentric with the knob.

(2) Turn the rollers until the proper chart appears and the setforward range falls opposite both range pointers. If necessary, aline the rule to indicate the same range at both sides.

(3) Set the clamping knobs on all pointers to the M position. By means of the range correction knob, bring each pointer in succession to the normal (zero-correction position) of its respective set of curves and clamp in that position by turning the clamping knob to S.

(4) In regular succession, starting at one side of the board, turn the clamping knob on the first pointer to the M position, bring the pointer to the proper curve by means of the range correction knob, return the clamping knob to S and repeat for each of the other pointers in turn.

(5) When all pointers have been set, turn the knob on one of the pointers to the L position, thus clamping the movable bar against inadvertent displacement. Do not attempt to turn the range correction knob when the movable bar is so clamped.

(6) Set any required adjustment correction by sliding the associated scale to indicate the proper value. Read the range correction or percentage range correction on the associated scale.

(7) To prepare the instrument for traveling, set all pointers and scales to normal, clamp the movable bar by turning one or more pointers to the L position, remove the roller knob and wing screw concentric therewith and attach to the holder provided inside the lid.

(8) Exercise particular care to avoid the following mistakes in operation; these will result in incorrect data, often difficult to detect and requiring complete resetting of all pointers and corrections to normal.

(a) Failure to return one pointer to S before setting to a curve with the next, thereby moving two pointers at a time.

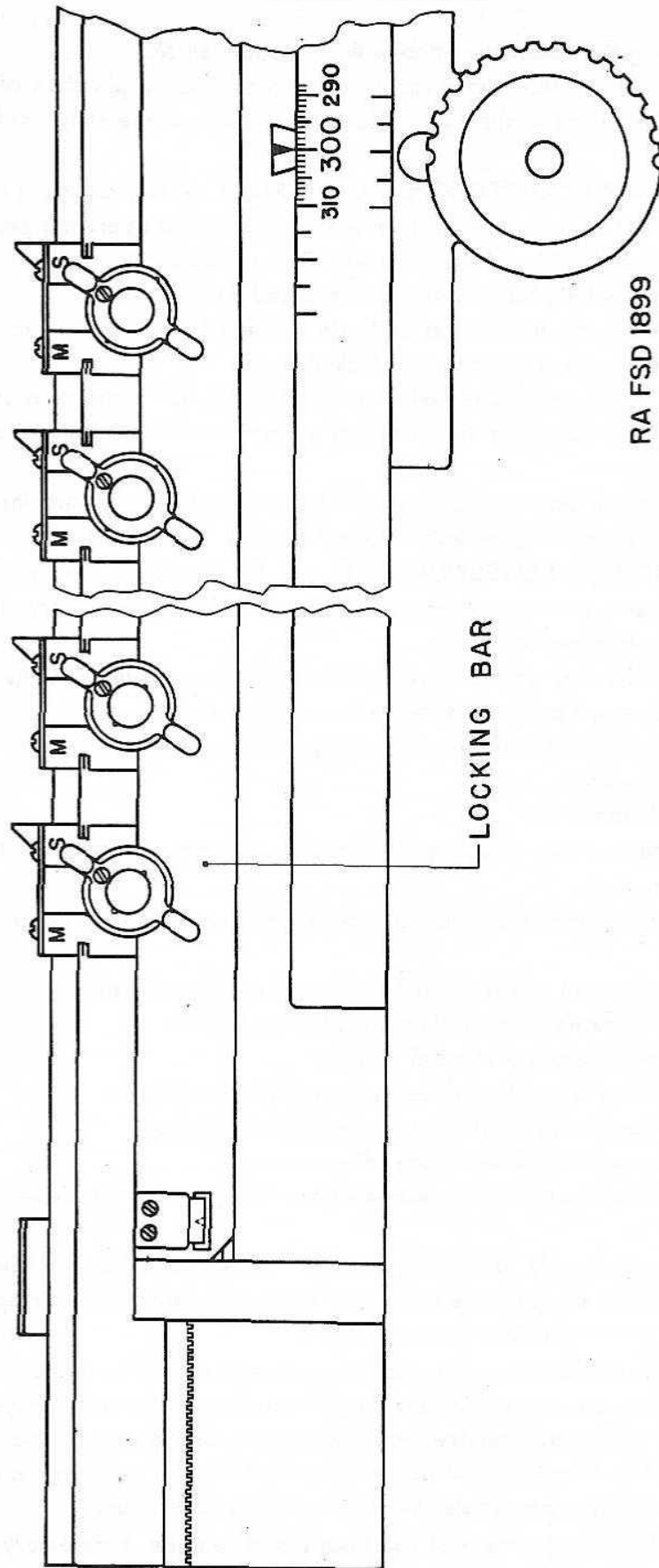


FIGURE 50 — RANGE CORRECTION BOARD M1A1 - ARRANGEMENT OF LOCKING BAR

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(b) Turning the correction knob with no pointer at M.

c. *Lubrication.* — This board requires the occasional application of a few drops of lubricating oil in the oil cup located just above the range correction index.

113. BOARD, CORRECTION, RANGE, M1A1. — This board is a modification of the M1 board arranged to prevent the incorrect operating procedure noted in paragraph 112. — b. (8), above. This modification provides pointers of a new design locking bar (Figure 50) arranged as follows:

a. When all pointers are set at S, the locking bar is up and movement of the range correction knob becomes locked.

b. When one pointer is turned to M the locking bar is down, causing all other pointers to be locked in their original S positions and releasing the range correction knob.

c. The locking bar may be pulled down manually to release the range correction knob for making the initial normal setting.

114. BOARD, DEFLECTION, M1. — a. *Description.* — The deflection board M1 (Figure 51) is used for the computation of the necessary data for aiming the gun in direction.

(1) The following data are utilized in making the settings on the board:

(a) Uncorrected azimuth of the setforward point.

(b) Corrected range of the setforward point.

(c) Wind velocity.

(d) Wind azimuth.

(e) Azimuth of the distant gun from the directing gun or point (indirect aiming).

(f) Displacement of the distant gun from the directing gun or point (indirect aiming).

(g) Time interval of predetermined length (direct aiming).

(2) The following data are indicated by the board:

(a) Range component of wind velocity.

(b) Corrected azimuth of directing gun (indirect aiming).

(c) Corrected azimuth of distant gun (indirect aiming).

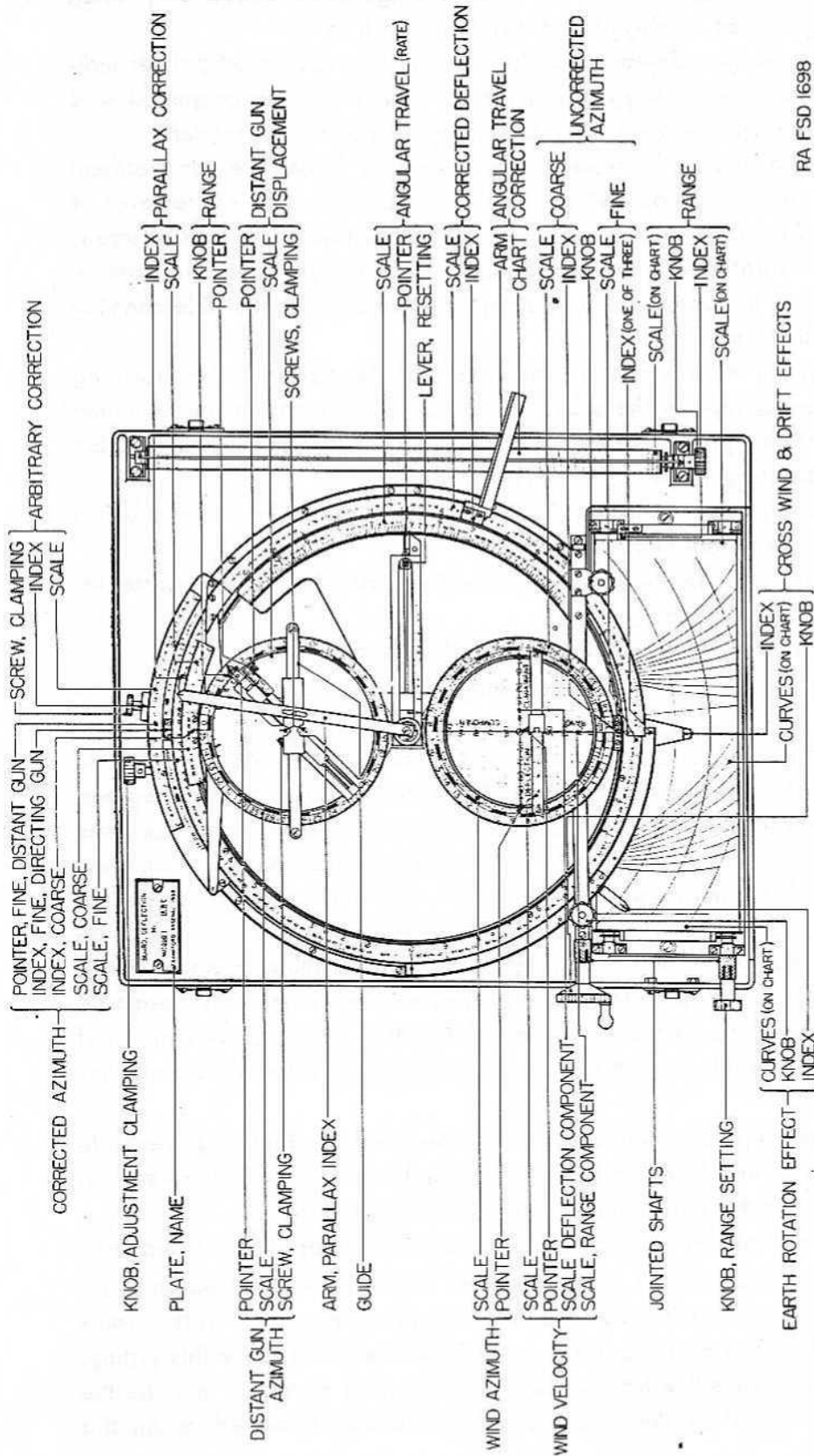
(d) Corrected lateral deflection (direct aiming).

(3) The charts used on this instrument are furnished by the Coast Artillery Corps.

b. *Operation.* — (1) *Placing in service.* — (a) Release the four trunk bolts and remove the cover. Place the two knobs with jointed shafts in their operating positions and slide the sleeves over the joints.

(b) Ascertain that the proper scales and gear ratios for degrees or mils, as the case may be, are in use and, if direct aiming is to be employed, that the "normal" graduation on the deflection scale corresponds to that on the telescope cradle. Ascertain that the proper charts are in place for the scales (degrees or mils), weapon, projectile and muzzle velocity in use.

(c) Verify the adjustment of the board and readjust if necessary.



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FIGURE 51 - DEFLECTION BOARD M1

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(2) *Parallax settings.* — These parallax settings are required only when indirect aiming is to be employed and a distant gun is in use.

(a) Orient the gun displacement scale so that the associated pointer indicates the gun displacement in yards when the azimuth of the distant gun (viewed from the directing gun or point) appears under the associated pointer.

(b) To orient the above scale, it is necessary to loosen the two flathead screws in the central clamping ring which are accessible only on removal of several parts. Take off the parallax index arm by removing the central screw, and remove the transverse guide thereunder, held by two screws at the extremities. The screws in the clamping ring become accessible when the slide carrying the pointer is lifted off.

(c) When the scale is properly oriented and the screws in the clamping ring are tightened, replace the slide and clamp it by means of the clamping screw to indicate the proper azimuth. Replace the transverse guide and parallax index arm, tightening the screws securely therein.

(d) The foregoing settings, once properly made, require no change unless the location of the distant gun is changed.

(3) *Preliminary operating procedure.* — This procedure is the same for either direct or indirect aiming.

(a) Roll the wind-drift chart to the corrected range.

(b) Bring the earth rotation effect index into coincidence with the associated curve.

(c) Set the uncorrected azimuth of the setforward point. Make the coarse setting (tens of degrees or hundreds of mils) first, then the fine setting (degrees, tenths and hundredths or mils). The latter setting must be made using the same one of the three index graduations for which the board has been adjusted. If this index is obstructed from view, one of the other indexes must be selected and the board readjusted accordingly. The index at the extreme right should be employed where possible; when this index is employed, similarly painted (black or white, as the case may be) sectors on both fine and coarse scales fall opposite their respective indexes at the same time. For setting azimuth, the associated knob is ordinarily used, but the fine scale itself may be rotated manually for large changes.

(d) Set the required value of arbitrary correction by displacing the scale and clamping it by the screw provided. Arrows on the scale indicate the direction of motion to displace the trajectory to the right or to the left.

(e) Make the following settings to introduce corrections for wind and drift:

1. Set the wind azimuth (direction from which the wind is blowing) by rotating the wind scale until the pointer indicates the proper azimuth (hundreds of mils). Use the pointer at the side near the "50" graduation for this setting. Note that the reference line from which wind azimuth is measured must be the same as that from which the uncorrected azimuth was measured, when this pointer is used.

2. Set the wind velocity pointer to indicate the proper value (miles per hour).

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3. Read the reference number of the deflection wind component and bring the index into coincidence with the similarly numbered curve on the wind-drift chart. Read the reference number of the range wind component.

(4) *Removal from service.* — (a) Slide back the sleeves on the two jointed shafts and fold the two knobs back so as to be cleared by the cover.

(b) Place cover in position and secure in place by means of trunk bolts.

c. *Disassembly and assembly.* — (1) Disassembly by the using arm of the parallax mechanism for orientation of the gun displacement scale is permitted as described in paragraph b. — (2), above.

(2) This instrument is constructed so that settings and readings may be in mils or degrees and hundredths, as required. Conversion from one system to the other necessitates reversal or change of scales, replacement of wind-drift and travel charts and change of gearing. Conversion is not to be performed by the using arm.

(3) This instrument is also constructed so that each deflection scale reading in degrees and hundredths may be removed and replaced by a similar scale with another value for the "normal" graduation. Scales with normal graduations of 10° , 6° and 3° are available. Change is not to be performed by the using arm.

d. *Adjustment.* — Adjustment of the board is performed by changing the relative position of the arbitrary correction index with respect to the wind-drift curve index. Readjustment becomes necessary when changing from one set of wind-drift curves to another, from one azimuth index graduation to another or from one method of aiming (direct or indirect) to the other.

(1) *Preliminary settings.* — (a) Data for the adjustment will be found on an arc near the midrange position of the wind-drift curves.

(b) Roll the chart to the range specified in the adjustment data.

(c) Set the arbitrary correction to zero.

(d) Procedure thereafter depends upon whether direct or indirect aiming is to be employed.

(2) *Adjustment for direct aiming.* — (a) Set the angular travel chart arm to the normal (6°) graduation on the chart.

(b) Release the adjustment clamping knob.

(c) Rotate the deflection scale so that the proper deflection setting, obtained by subtracting algebraically the uncorrected azimuth* indicated by the adjustment data, appears opposite the index.

(d) Without disturbing the foregoing setting, match the wind-drift chart index to the point on the chart indicated in the adjustment data.

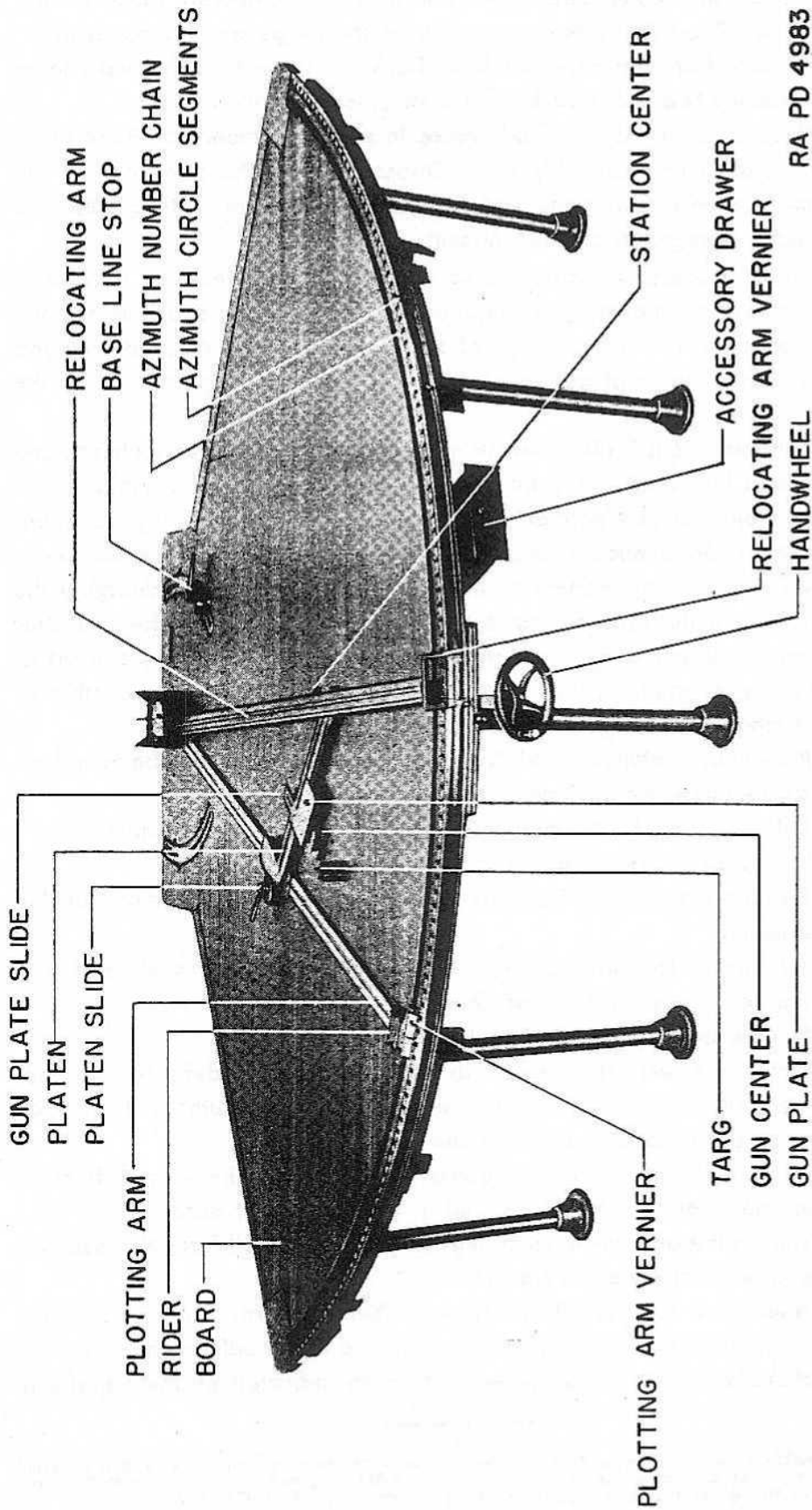
(e) Tighten the adjustment clamping knob and verify all foregoing settings; if unchanged, the adjustment is correct.

(3) *Adjustment for indirect aiming.* — (a) Set the earth rotation correction index to the point on the associated curve indicated in the adjustment data.

(b) Make the setting of uncorrected azimuth indicated by the adjustment

*EXAMPLE: Suppose the adjustment data indicate an uncorrected azimuth 0.00° and a corrected azimuth 359.43° . The angular value of the deflection is 0.57° . For deflection scales with "normal" graduations at 10° , 6° or 3° , the respective deflection settings should be 9.43° , 5.43° or 2.43° .

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FIGURE 52 — PLOTTING AND RELOCATING BOARD M1
 Three slides are not shown — one carrying the station center slide, one carrying the station center, and one carrying the gun plate slide.

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data. The same fine index graduation must be used for adjustment as is to be used subsequently in operation. Whenever possible, the index nearest the center of the wind-drift chart should be employed.

(c) Release the adjustment clamping knob.

(d) Displace the fine corrected azimuth index to indicate the corrected azimuth specified in the adjustment data.

(e) Without disturbing the foregoing setting, match the wind-drift chart index to the point on the chart indicated in the adjusting data.

(f) Tighten the adjustment clamping knob and verify all foregoing settings; if unchanged, the adjustment is correct.

115. BOARD, PLOTTING AND RELOCATING, M1. — a. Description. —

(1) The plotting and relocating board M1 (Figure 52) is used in relocating and in determining the range and azimuth of a target from one or more directing points of a battery.

(2) The wooden board is sector-shaped and is supported by a spider and spider arms which constitute the frame of the board. The circular end of the frame forms the support for the azimuth circle segments. These segments contain two rows of azimuth graduations, spaced one degree apart. The azimuth number chain fits into a groove of the azimuth circle segments and is engraved with numbers that run consecutively from 0 to 359. Provision is made for adjusting and clamping the chain so that the normal of the board may be set opposite any desired graduation on the azimuth circle.

(3) The plotting arm rests on the surface of the board and pivots about the center of the board. Both sides are fiducial edges and are parallel and coincident with the axes of the pivot holes and the zero graduations on the plotting the arm vernier. This arrangement permits either left- or right-hand situations of plotting. A groove is provided on the arm for the insertion of detachable numbered strips. Numbered strips for indicating graduations of 200, 400, 800 and 1000 yards to the inch are provided for each plotting board, thereby permitting the scale of the board to be readily changed to suit conditions of plotting. The platen slide carrying the platen fits snugly on the plotting arm and contains the pivot about which the platen rotates. The center of this pivot coincides with the edge of the plotting arm and represents one observing station. Provision is made for reversing and clamping the platen slide on the plotting arm for right- or left-hand situations of plotting.

(4) The relocating arm lies above the plotting arm and is pivoted about a pivot at the center of the board. One end of the arm carries a vernier, indicating against the outer row of graduations on the azimuth circle. Provision is made on the relocating arm, as on the plotting arm, for the insertion of numbered strips and for adapting the arm to right- and left-hand situations of plotting. The relocating arm is used for orienting the platen and reading the range of the target from the gun or directing point.

(5) Verniers containing two scales are provided on both arms. The scales

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are so arranged that the zero graduations are opposite the working edges for use in right- or left-hand situation in plotting. Covers are provided to obscure the scale not in use.

(6) A base-line stop is provided on the board. This stop is used to maintain the orientation of the base-line platen while the plotting and relocating arms are being set. A plotter's target is provided for use in reading the range and azimuth of a point or points.

b. Operation, Orientation. — There are three methods of orientation. Only the simplest method will be described:

(1) Slide the platen on the plotting arm until the platen pivot and the plotting arm pivot are brought into coincidence. The station center should be placed on its bearing and the slides moved until the index at the edge of the station center indicates the length of the base line on the range scale of the relocating arm.

(2) Tighten the slide screws. If the gun position falls on the platen, the platen should be removed from the platen slide and reversed. Remount gun plate and slides and relocate the station center.

(3) Move the azimuth number chain until the integer of the base line azimuth is an index to one of the lines on the azimuth circle near the end of the board. Tighten the hand-wheel shaft clamping screw.

(4) Release the platen clamp so that the platen can be revolved. Set the fiducial edge of the relocating arm at the exact azimuth of the base line and clamp.

(5) Swing the platen about its pivot until the vertical edge of the station center is against the fiducial edge of the relocating arm. The rear edge of the platen slide must be against the platen stop on the end of the plotting arm.

(6) Move the base line stop until it rests against an edge of the platen. Clamp by means of the clamping lever. Insert the gun center in the recess in the fixed platen to represent the directing point or gun of a battery. This completes the orientation of the fixed platens.

c. Operation, Plotting. — Four men are required in service plotting: a plotter, a platen operator, a plotting arm setter and a relocating arm setter. Two methods of plotting may be used, *direct plotting* and *offset plotting*.

(1) *Direct plotting* is used when relocation for a single directing point or gun will meet the needs of a battery.

(a) Locate the gun center or the platen by polar co-ordinates at the point for which relocation is desired. On fixed platens a gun center is inserted in a previously prepared recess.

(b) The arm setters set the arms at the azimuths sent from the respective observing stations at the usual time intervals. The platen operator keeps the platen at the orienting position and the platen slide resting against the base-line stop.

(c) After the plotting arm setter and the relocating arm setter calls "set," the platen operator clamps the platen to the platen slide and moves the slide

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along the plotting arm until the station center touches the relocating arm. The platen operator should not jam the station center against the relocating arm.

(d) The plotter presses the gun center, thus obtaining a mark on the surface of the board. The platen operator withdraws the platen to the orienting position and releases the platen clamp.

(e) The plotter locates a setforward point and places a targ on this point. The relocating arm setter brings the relocating arm against the targs, the plotter calls out the range indicated on the range scale of the relocating arm and the relocating arm setter calls out the azimuth.

(2) *Offset plotting* is used when it is necessary to relocate for more than one gun. The various gun positions may be located on the gun plate by polar co-ordinates from the observing station located at the platen pivot.

(a) Follow the same procedure as for direct plotting as given in subparagraphs c. (1) (a) to (d) above, for direct plotting.

(b) The plotter locates a setforward point from several successive plotted points and places the targ on the setforward point. The plotting arm setter brings the plotting arm against the targ and calls "set." The platen operator clamps the platen to the platen slide and slides the platen along the plotting arm until the end of the rider strip touches the targ.

(c) Clamp the rider to the plotting arm and remove the targ in time to permit the platen operator to bring the end of the platen slide against the rider. The plotter places the targ on each gun position on the gun plate in turn. The locating arm setter brings the relocating arm against each position of the targ. The plotter calls the range and the relocating arm setter calls the azimuth of each gun position. The plotter then calls "clear" and releases the clamp on the rider. The platen operator withdraws the platen to the orienting position and releases the platen clamp.

d. *Operation, Relocating.* — To determine the range and azimuth of the target from some given point, move the platen so that the platen pivot represents the given point. With the other point located on the platen in correct azimuth and distance from the center, set the plotting arm at the desired azimuth. Move the platen slide on the plotting arm until the index on the movable platen indicates the given range. Move the relocating arm over the point and read its relocated range and azimuth.

e. *Care and preservation.* — (1) Accessories not in use should be stored in the drawer provided.

(2) When not in use the numbered strips for the arms should be left in the rack provided. Handle them gently when in use.

(3) Avoid damage to the fiducial edges. The station center may dent the fiducial edge of the relocating arm and cause springing of parts if handled forcefully.

(4) In changing arm pivots at the board center, the clamps at the arm ends should be released to avoid straining the arms.

(5) The arm, platen and azimuth clamp pivots should be slightly

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lubricated at long intervals. The contact surfaces of the platen slide and rider should be slightly lubricated.

(6) When the board is not in use it should be covered with canvas cover provided.

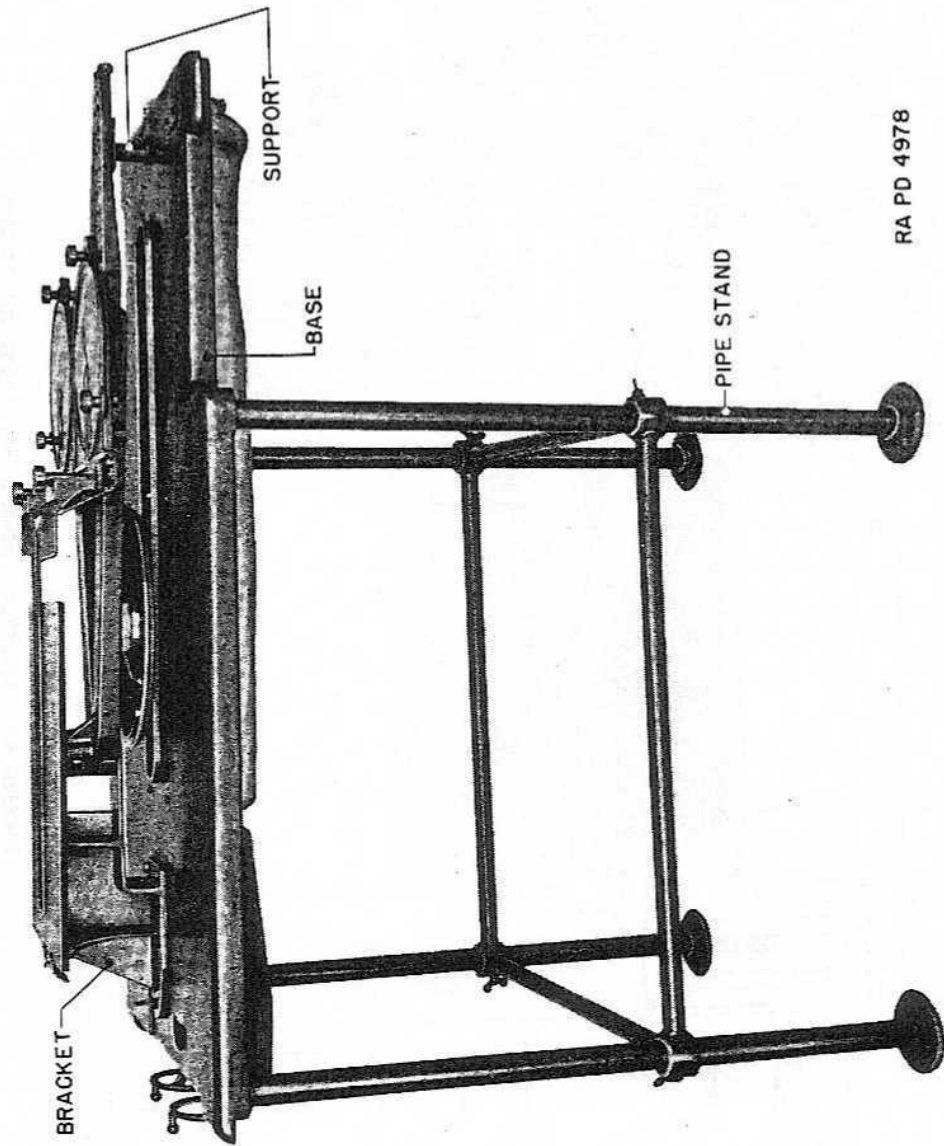
116. BOARD, SPOTTING, M3. — *a. Description.* — (1) The spotting board M3 (*Figures 53 and 54*) is a fire control instrument used when bilateral observation is available. The instrument determines corrections for range deviations in per cent of range and corrections for lateral deviations in angular units. Spotting board M3 may be used when both spotting stations are located on the same side of the gun-target line. The instrument consists of orientation and deviation devices supported on a base casting and mounted on a four-legged pipe stand.

(2) The instrument is arranged to permit geometrical laying out of the positions of gun, target, and spotting stations to a nominal scale while the area surrounding the target is laid out to exaggerated scale. The geometrical situation is laid out as a whole, to get the angles and ranges from the spotting stations to the target, when the gun-target range and the relation of the spotting stations to the gun is known. Hits are plotted on the spotting board from the data received from the observation stations. Corrections necessary to bring fire on the target are then figured and sent to the gun position.

(3) The orientation mechanism includes the station-arm plate, station arms and targs, the spotting arms, and the range setting and azimuth setting drives (*Figure 54*). The station-arm plate and the station arms set off the distances and angles between the gun (location represented by center of station-arm plate) and the stations (location represented by the targs, which slip into holes in the station arms). The arms are locked against sliding by eccentric pins. Slipping in azimuth is prevented by the guide clamping screws. The range setting hand-wheel moves the station-arm plate along the longitudinal axis of the board and turns the range counters which record, each on its own scale, the gun-target range. The spotting arms are pivoted about a shaft under the center of the platen grid and have grooves which are engaged by the targs. Three sets of scales are used to indicate the spotting station range, 600, 1200, and 2400 yards per inch. The proper set of scales is positioned by the scale setting knob. Two complete station-arm plates with eight pairs of arms of varying lengths permit a second gun spotting station triangulation system to be set up and held in readiness.

(4) The deviation mechanism consists of the deviation disk assemblies, the deviation arms mounted on the spotting arms, and the grid engraved on the platen. The deviation disks each include a series of curves representing the deviations as observed in the telescopes or determined by other means. The periphery of each disk has a logarithmic scale, "Range

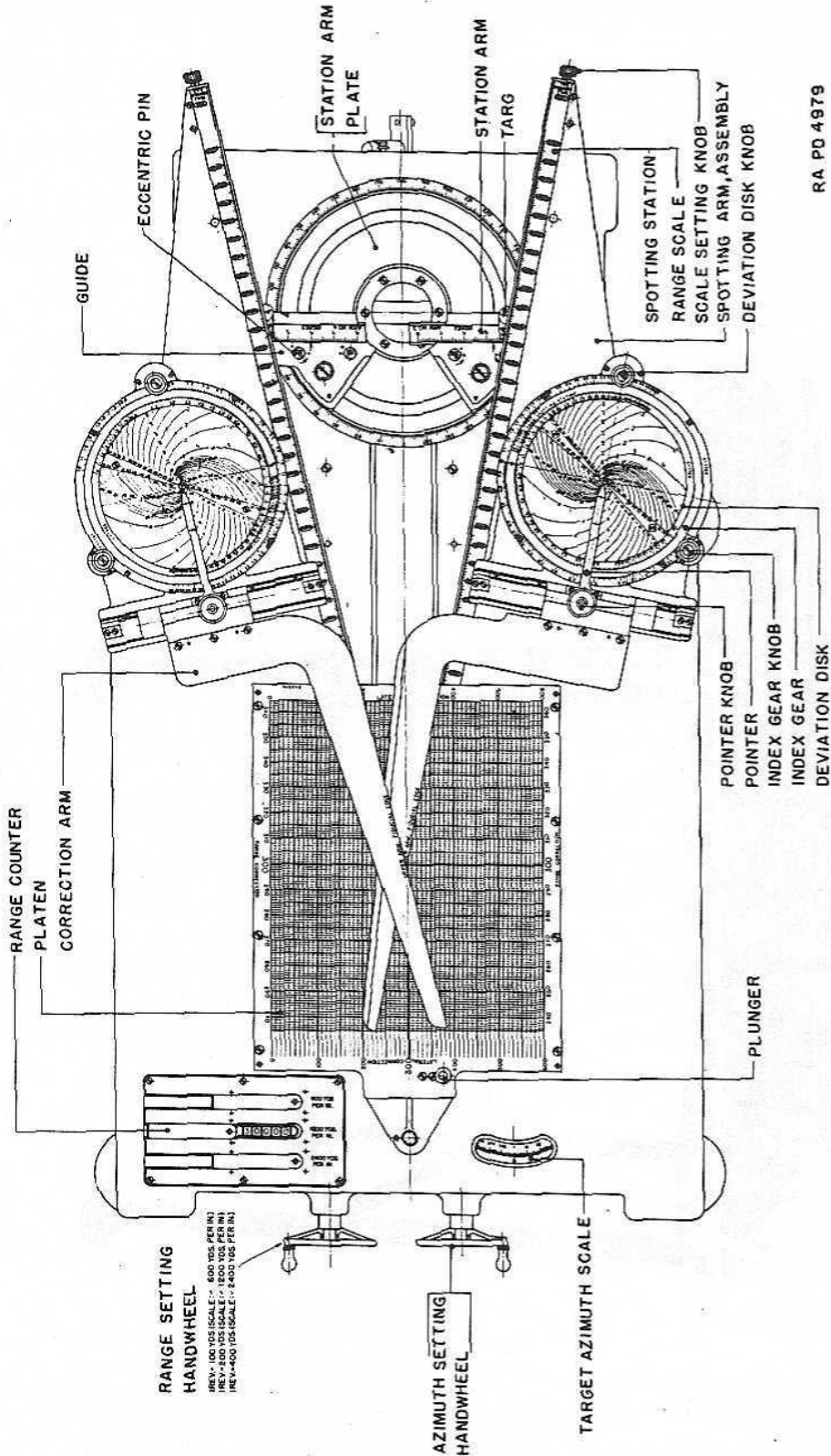
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FIGURE 53 — SPOTTING BOARD M3

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FIGURE 54 — SPOTTING BOARD M3 - VIEW OF BOARD

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From Spotting Station." This range may be indexed by rotation of the deviation disk knob after the index has been positioned with respect to the outer scale, "Range From Gun." The pointer is set to the proper deviation curve on the dial by rotating the pointer knob. This setting will also move the deviation arm laterally across the spotting arm. The fiducial edges of the deviation arms are always parallel to the inner edges of the spotting arms. The grid is graduated to permit reading corrections for lateral deviations from 3° left to 3° right and corrections for range deviations from 6.5 per cent "short" to 6.5 per cent "over." The 300 mark is normal. The plunger, when pressed, releases a spring catch, permitting the platen to be withdrawn to facilitate reading the corrections for the previously marked splash. This is also useful when setting for short ranges. The support fits the base and engages the spotting arms, locking them for traveling. A canvas cover for the board and an accessory chest for the extra station arm platen and station arms are furnished with each instrument.

b. Operation. — (1) *Orientation.* — The gun is represented by the center of the station arm plate. The spotting stations were represented by the targs. To orient the targs with respect to the center proceed as follows:

(a) Choose the station arm according to the distance to the station, the scale being used, and the side of the gun on which the station is located.

(b) Place the arms in the guides with the proper values indexed and lock in position, using the eccentric pins.

(c) Rotate each guide to the proper azimuth reading on the scale of the station arm plate body. Lock with guide clamping screws.

(d) Rotate station arm plate to target azimuth, using azimuth handwheel. Set according to degrees on the target azimuth scale.

(e) Rotate the scale setting knobs until the desired scale numbers appear and then engage the targs in the grooves in the spotting arms.

(f) Set off the gun-target range by rotating the range handwheel until the correct range is indicated on the proper counter. Cover the counters pertaining to the scales not in use.

(g) The targs will now indicate on the spotting station range scales the ranges from the spotting stations. The board is ready for computation of the corrections.

(h) If the targs are concealed by the platen the platen may be withdrawn temporarily by pressing the plunger, to permit reading the scales. The platen must be restored to its original position before resuming operation.

(2) *Operation.* — (a) Rotate the index gear knobs until both indexes on the index gears are alined with the correct ranges from gun.

(b) Rotate the "Range From Spotting Station" knobs until each deviation disk indicates the range from its spotting station, obtained as in subparagraph b. (1) (g) above.

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(c) Turn the pointer knobs until the pointers indicate on the deviation disks the deviation readings obtained by the observation telescopes. This also moves the upper and lower deviation arms parallel to their oriented setting.

(d) The corrections for the deviation of the splash are now read at the intersection of the fiducial edges of the arms. The lateral deviation will be in degrees and hundredths of degrees, read as three whole numbers with 300 as normal. The range deviation will be in per cent of range, also read as three whole numbers, with 300 again as the normal.

(e) Care must be taken to determine the correct scale and to use the same scale.

c. *Test and adjustment.* — (1) No adjustment on this board is to be made by the using arm except by competent personnel.

(2) To check the zero position:

(a) Select a suitable spotting station arm and set it to zero so that the targ is directly over the center of the station arm plate.

(b) Engage the targ in one of the spotting arms and turn the azimuth handwheel until a zero reading is obtained on the scale.

(c) Set the pointer to the center of the deviation disk. The inner edge of the spotting station range scale should pass through the 0° and 180° graduations of the station-arm plate azimuth scale. The fiducial edge of the deviation arm should coincide with the zero lateral correction line of the grid.

d. *Care and preservation.* — (1) The spotting board is not a delicate instrument but should not be subjected to rough handling.

(2) No movement should be forced since all moving parts normally operate freely.

(3) Particular care should be taken to avoid damaging the edges of the spotting station arms and the T-slots in the guides.

(4) When not in use the spotting board should be covered with the canvas cover provided. The spare station-arm plate and spare arms should be kept in the accessory chest. For storage or shipment the spotting board should be securely packed in its packing chest.

117. CORRECTOR, PERCENTAGE, M1. — a. *Description.* — The percentage corrector M1 (Figure 55) is a device for applying ballistic and adjustment corrections to the uncorrected range of the setforward point, and for transforming the corrected range into the corresponding elevation. Means are also provided for interpolating or extrapolating elevation data.

(1) The corrector consists of a box containing a roller at each end on which is wound a tape carrying scales of range and the corresponding elevation. The pointer against which the readings are made is arranged to be offset to introduce ballistic and adjustment corrections. Scales of

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range and corrections are graduated logarithmically so that corrections are applied on a percentage range basis.

(a) The ballistic correction scale is stationary. The 300 graduation thereon corresponds to normal (zero correction) and each scale division corresponds to 0.1 per cent.

(b) The ballistic correction pointer, which indicates against the above scale, is attached to a slider which carries the adjustment scale. This scale is graduated similarly to the ballistic correction scale and the ballistic correction pointer is permanently alined with the normal (300) graduation.

(c) The reading pointer is attached to a sliding carrier. When the edge of this pointer is set to the desired indication on the adjustment scale, it receives a total displacement equal to the combined effects of the ballistic and adjustment corrections.

(d) The index line on the transparent window, alined with the zero-correction position of the reading pointer, is used for setting the tape to the proper uncorrected range indication.

(e) The cloth-backed tape with range and elevation graduations is furnished by the Coast Artillery Corps. It is operated by means of knobs and rollers which have internal springs to keep the tape taut.

(2) The interpolator is used for computing elevations at intervals more frequent than the predicting interval. It includes a tape, marker, and splitter.

(a) The splitter is an aluminum plate graduated with converging lines. It may be moved in or out so that the central and outer line indicate opposite elevations corresponding to the start and finish of a 30-second interval; the intermediate line then indicates the elevation corresponding to the finish of a 15-second interval. The markings "1" and "3" on these lines indicate the corresponding number of strokes of the bell of the time interval system.

(b) The cloth-backed tape, furnished by the Coast Artillery Corps, is graduated in terms of elevation angles. It is operated by means of knobs and rollers which have internal springs to keep the tape taut.

(c) The marker is arranged to clip on the edge of the tape.

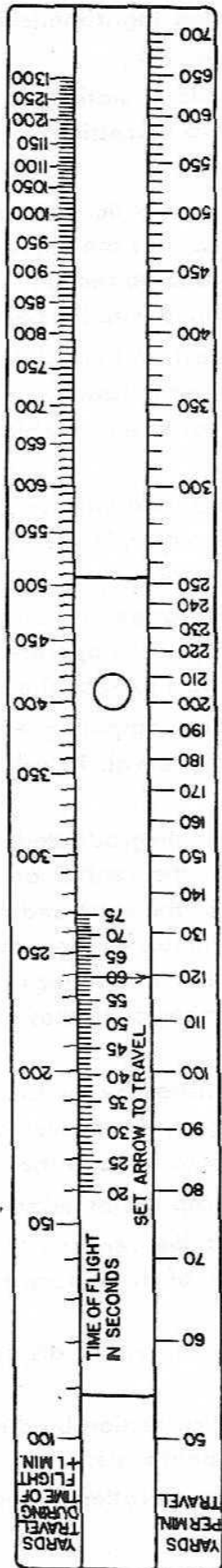
b. Operation. — (1) Operation of the corrector. — (a) Roll the tape so the uncorrected plotting board range of the setforward point is indicated under the index mark.

(b) Set the required ballistic correction by displacing the associated pointer along the scale.

(c) Set the required adjustment correction by displacing the reading pointer and carrier along the adjustment scale.

(d) Read the corrected range or elevation on the tape opposite the reading pointer.

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FIGURE 55 — PERCENTAGE CORRECTOR M1

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(e) Note that the edges of the pointers used for indication are the edges perpendicular to the longitudinal axis of the corrector. Do not use the slanting edges for indicating purposes.

(2) *Operation of the interpolator.* — The interpolator splitter is graduated to provide for 15-second intervals; it may, however, be turned over and an improvised graduation sheet attached, should it be desired to use other intervals.

118. FINDER, RANGE, STEREOSCOPIC, 6-METER BASE, M2. — Information on this range finder is lacking at this time and will be inserted when available.

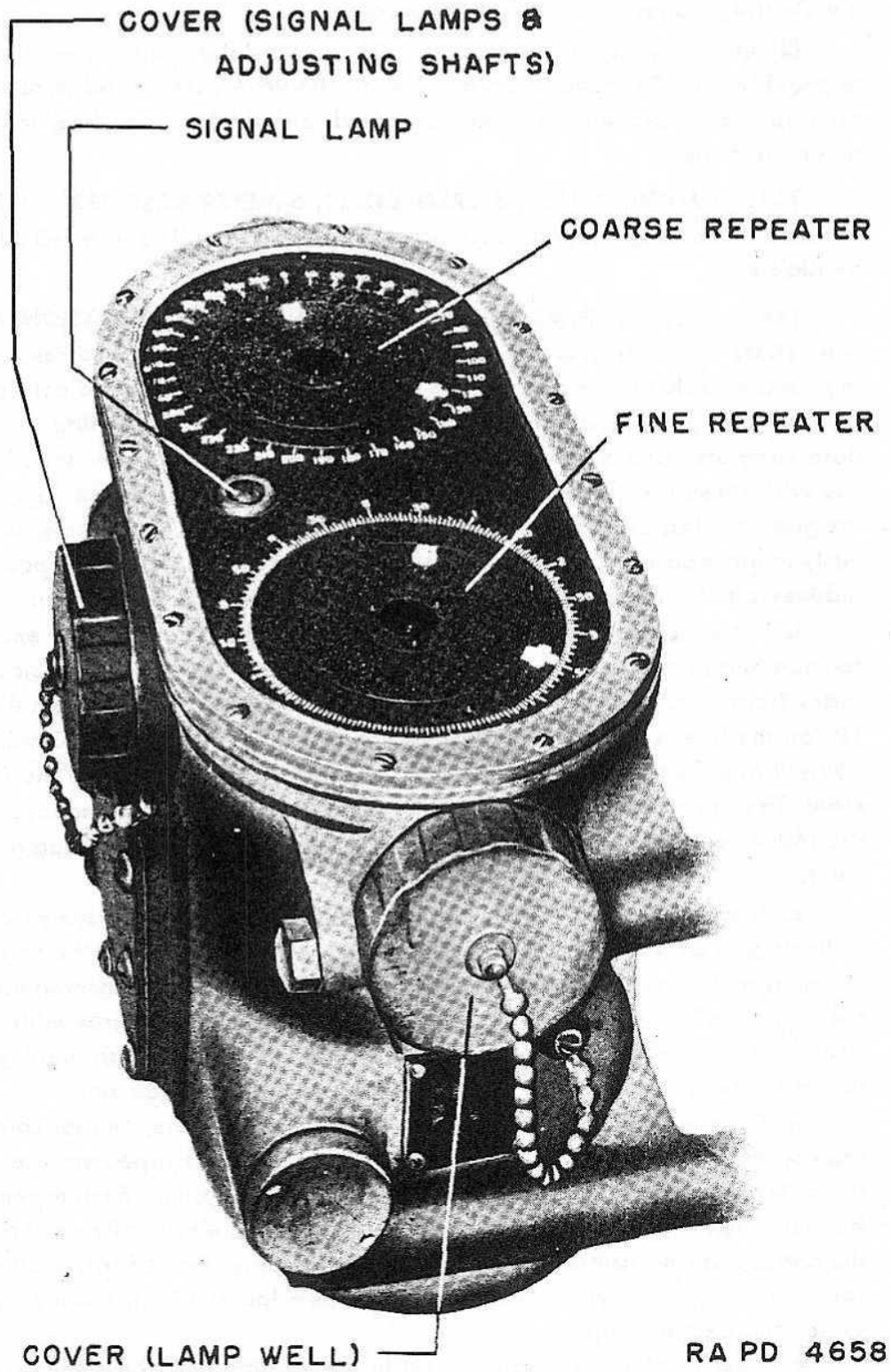
119. INDICATOR, AZIMUTH, M5, AND INDICATOR, ELEVATION, M5. — a. These indicators (*Figures 56 and 57*) are mounted near the corresponding handwheels of the gun mount and serve at present to indicate gun azimuth and gun elevation. They may be used for case III pointing. A gun data computer and a data transmission system are being developed for use with these indicators. When developed, the equipment will compute the gun pointing data and transmit the data continuously and instantaneously to the indicators. Operators at the gun handwheels will match pointer indexes on the indicators and thereby apply the data to the gun.

b. The azimuth indicator and elevation indicator are alike except for numbering of scales and direction of mounting. The azimuth indicator reads from 0° to 360° in 10° intervals on the coarse scale, and from 0° to 10° on the fine scale. The elevation indicator reads from 0 to 1600 mils in 100-mil intervals on the coarse scale, and from 0 to 100 mils on the fine scale. The indication is the sum of the coarse and fine scale readings. If the index rests between two coarse scale readings, the lower reading is used.

c. The mechanical (outer) indexes register against the scales and indicate gun azimuth or elevation. These indexes are geared to the corresponding motion of the gun mount. An adjustable coupling is assembled in the drive shaft to each indicator for setting the indexes to agree with the actual gun position (orienting). The procedure is similar to that employed for orienting the panoramic telescope and elevation quadrant.

d. Each indicator contains two synchronous repeaters, one for coarse indication and one for fine indication. The synchronous repeaters are for use only when operating from the data transmission system. Each repeater has an index (inner) assembled on its shaft which is electrically driven by the corresponding transmitter at the gun data computer. Adjusting shafts for positioning the synchronous repeaters are located in the lamp well under the signal lamp.

e. Electric lamps are provided for night illumination. These lamps are mounted on removable lamp well covers (two lamps on each cover) at each end of the indicator. In addition, two lamps are mounted in the lamp



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FIGURE 56 — AZIMUTH INDICATOR M5

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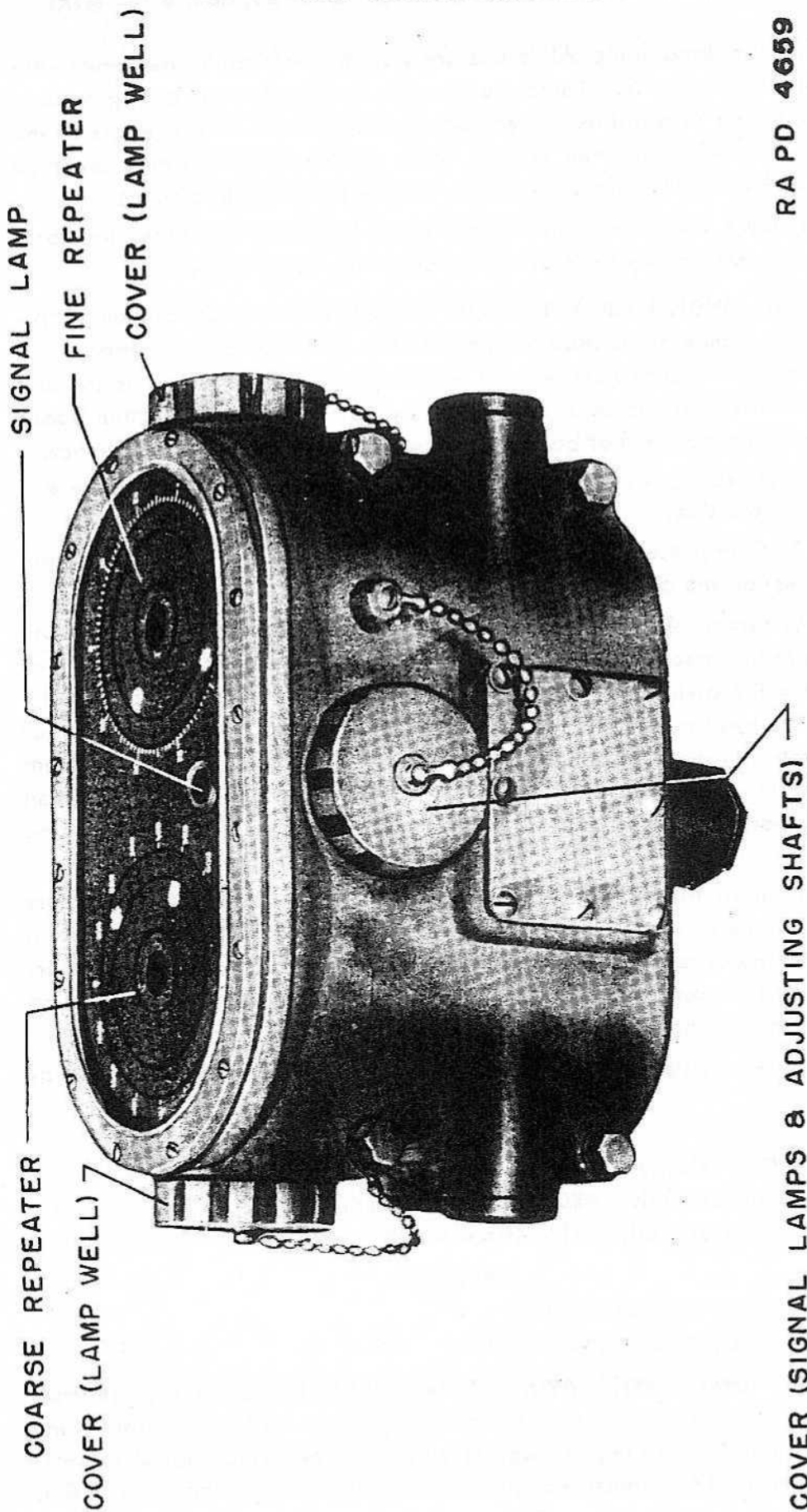


FIGURE 57 - ELEVATION INDICATOR M5

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1

well for the signal lamp. All lamps are 1 cp, 6-8 volt miniature lamps with bayonet base (no. 51). Lamp well covers are fitted with sealing gaskets and must be kept tightened securely to preserve the effectiveness of the seal. The end lamp well covers have contact fingers which must be engaged properly before the cover can be threaded into place.

f. Care must be exercised to avoid breaking the glass indicator windows. Do not lay tools or other objects on the windows.

120. INDICATOR, WIND COMPONENT, M1. — a. *Description.* — This indicator (Figure 58) is used to compute the wind component (range and deflection) reference numbers for use on the range correction board and on the deflection board. Its use is not required when the deflection board M1 is employed, as that board incorporates a wind component device.

b. *Operation.* — (1) Set the end of the pointer to the wind velocity and clamp in position.

(2) Clamp the target azimuth index to indicate the target azimuth (degrees) on the associated scale.

(3) Clamp the wind azimuth scale to indicate the wind azimuth opposite the associated index. Wind azimuth is the direction from which the wind is blowing and, together with the velocity is determined from the meteorological message. This instrument is designed primarily for target azimuths measured from the south and for wind azimuths measured from the north; when both azimuths are measured from the same direction (either north or south) add or subtract 3200 mils to or from the wind azimuth.

(4) Read the range and deflection component reference numbers along the associated scales. These scales have normal (zero component velocity) indications of 50 and the range and deflection component reference numbers read thereon are for application on the range correction board and on the deflection board, respectively.

(5) The settings and indications illustrated in Figure 58 are as follows:

Settings

Wind velocity — 20 mph

Wind azimuth — 4800 mils (from north)

Target azimuth — 315° (from north)

Indications

Range component — 35.9

Deflection component — 35.9

121. INSTRUMENT, AZIMUTH, M1910A1 (DEGREES). — a. *Description.* — This instrument (Figure 59) is used by Coast Artillery organizations as a base-end observing instrument when degree firing (naval targets) is involved and for measurement of deflection errors in the observation

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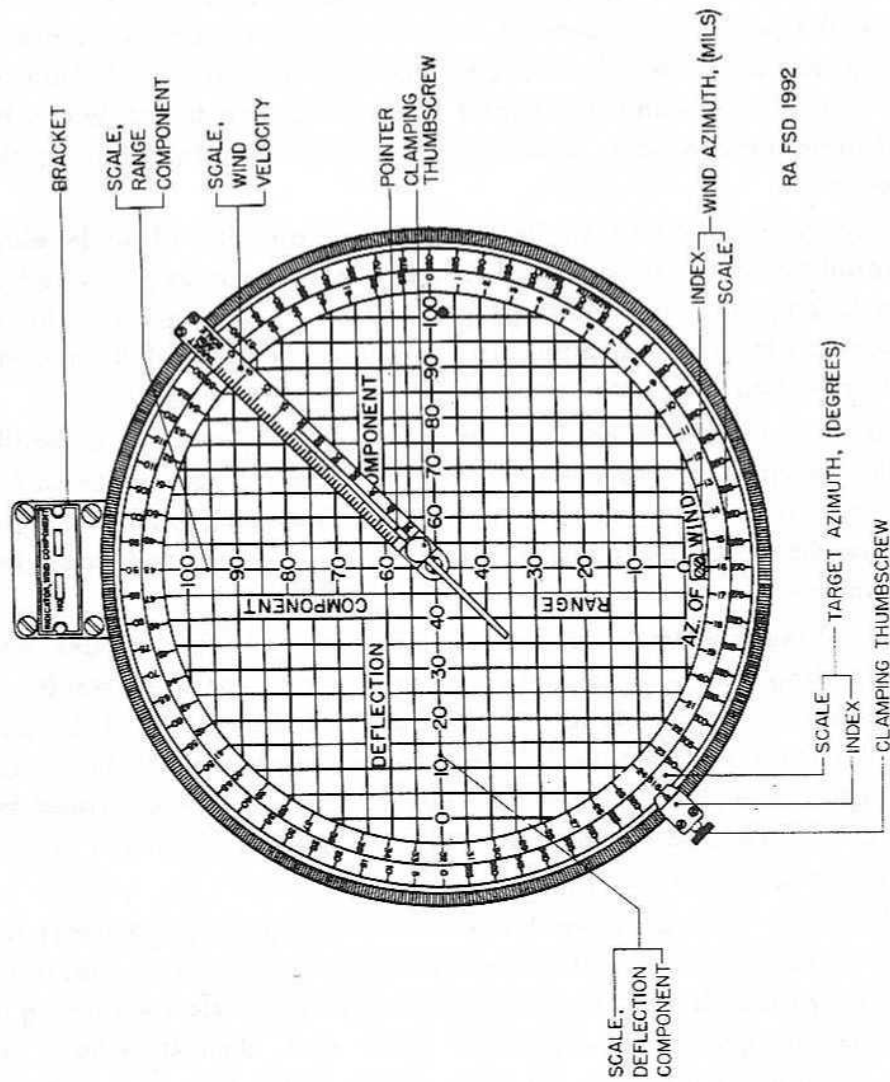


FIGURE 58 — WIND COMPONENT INDICATOR M1

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of fire. The major components of the instrument are the mount, telescope, and type A tripod. The instrument is furnished complete with carrying cases and tools, and electrical equipment for night illumination of the reticle and scales.

b. *Operation.* — (1) *Setting up and leveling.* — (a) Extend the tripod legs and clamp them so that the tripod head is approximately level and at a convenient height. The legs should be spaced at least 2½ feet apart at the ground to insure stability. Use the plumb bob provided to center the tripod over the point on the ground from which the observations are to be made. Readjust the length of the tripod legs to center the bubble in the circular level vial within the tripod head. Brace the tripod legs with the telescoping tube braces, pinning in position and clamping at the proper length.

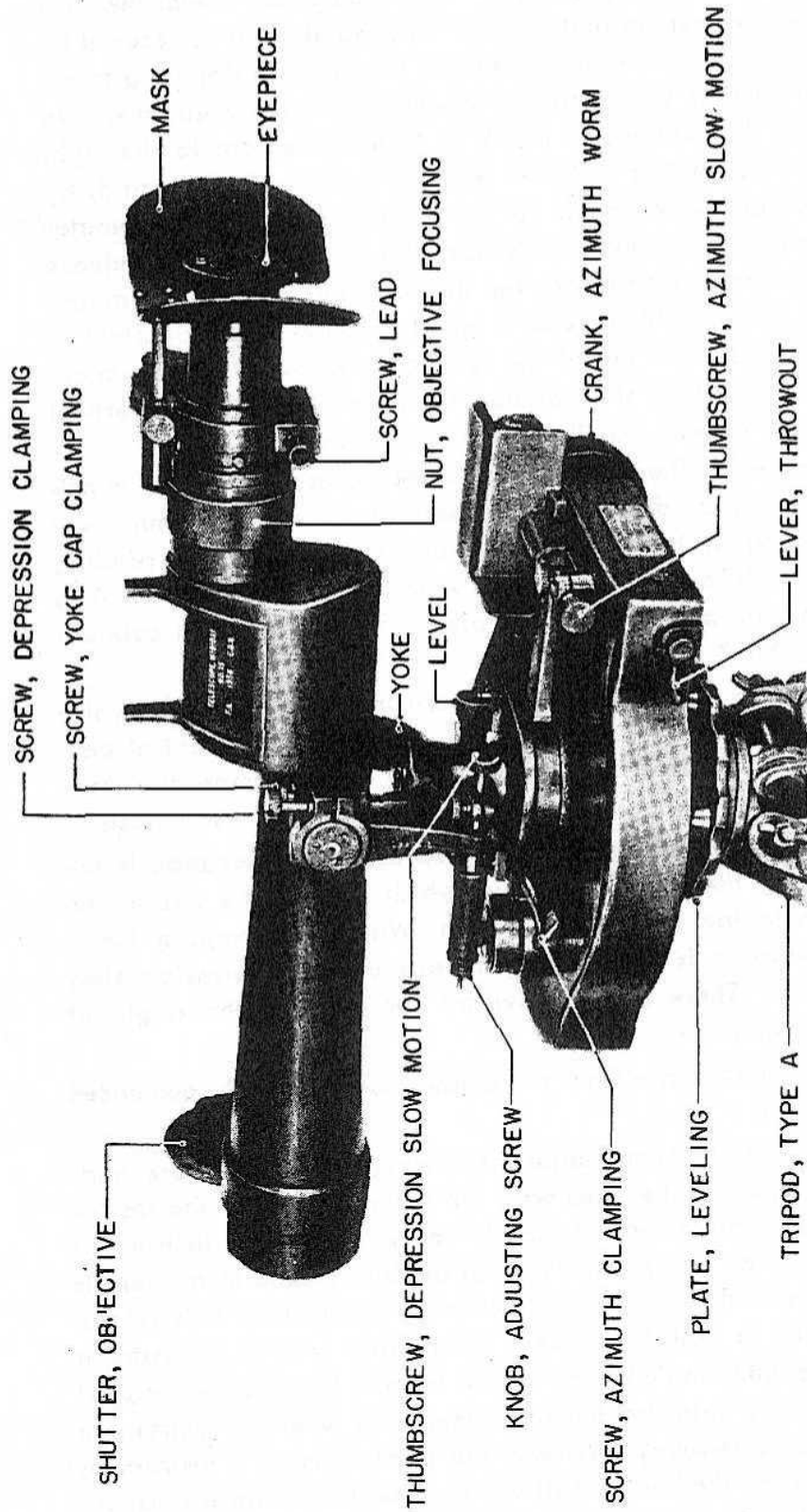
(b) Remove the mount from its packing chest and thread the leveling plate carefully onto the tripod head. Extreme care must be exercised at this point to engage the threads properly. Turning pressure should be exerted only on the leveling plate, and not on other parts of the mount. Approximately four turns are required for secure mounting.

(c) Remove the telescope from its carrying case, place it carefully in the yoke bearings and secure with the yoke cap clamping screws. For convenience in assembling, retract temporarily the spring plunger on the yoke, using the adjusting screw knob. Attach the mask and open the objective shutter.

(d) Level the instrument, using the two level vials on the yoke and the four leveling screws above the leveling plate. For best results in leveling, orient the level vials so that each is parallel to a pair of diagonally opposite leveling screws; each level is then affected only by the corresponding pair of leveling screws. The leveling screws are operated by lowering one screw and raising the other of a pair. Tighten the screws only until a snug contact is made.

(2) *Focusing* — The telescope has two interchangeable eyepieces for 10-power or 15-power magnification. Focusing procedure is the same for either eyepiece. First focus the eyepiece on the reticle by turning it until the reticle graduations appear clear and distinct when the telescope is pointed toward the sky. Then focus the objective by means of the objective focusing nut until an object at which the telescope is pointed appears clear and distinct. When the image appears to be clear, move the eye from side to side as far as possible, keeping the image still in view. If the vertical line on the reticle appears to remain upon exactly the same point on the object the focusing is satisfactory. Refocus the objective if necessary until a satisfactory result is obtained. This focusing varies with the range, and it may be necessary to refocus the objective when objects at greatly different ranges are to be observed. The eyepiece focusing, however, should not require change

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FIGURE 59 — AZIMUTH INSTRUMENT M1910A1 (DEGREES)

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after it has once been set for a given observer.

(3) *Orienting.* — Set the azimuth slow motion thumbscrew with the slow motion arm approximately in midposition. This thumbscrew is secured by its auxiliary thumbscrew. If necessary, loosen the azimuth clamping screw temporarily and turn the yoke until the telescope is in the position shown in Figure 59. The azimuth worm crank is then convenient to the right hand of the observer. Select a datum point of known azimuth and, by means of the azimuth worm crank, set the azimuth scale and micrometer to the exact number of degrees and hundredths of this azimuth. Release the four leveling screws and rotate the entire upper part of the mount (not the leveling plate) until the datum point appears approximately in the center of the field of view of the telescope. Relevel the instrument and then with the azimuth slow motion thumbscrew bring the vertical line on the reticle to appear exactly on the datum point.

(4) *Observing.* — (a) The azimuth worm crank moves the telescope in azimuth. This crank may be disengaged, if desired, by the throwout lever for rapid traversing of the instrument, but final setting and reading should be made with the worm in mesh. Azimuth indications from 0 to 360° are read on the azimuth scale (coarse, 1° divisions) and azimuth micrometer (fine, 0.01° divisions).

(b) The telescope reticle contains a horizontal degree scale which is numbered from 1.6 to 4.4°, the 3° graduation being the central one. A movable pointer, operated by the lead screw, moves across the scale and indicates lateral deviations of fire by marking the point of splash.

(c) Rapid motion of the telescope in depression or elevation is obtained by loosening the clamping screw which clamps the depression slow motion arm to the telescope trunnion. With the clamping screw tightened, the telescope is actuated by means of the depression slow motion thumbscrew. There is no provision for reading the angle of depression or elevation.

c. *Tests and adjustments.* — Only the adjustments specifically authorized herein are permitted.

(1) The levels are in correct adjustment when the bubbles are midway between the lines on the vials with the azimuth axis of the instrument vertical. This condition can be readily verified when the instrument is set up and leveled by observing the level bubbles as the instrument is rotated slowly in azimuth. If they remain central no adjustment is required. If the bubble of one or both levels does not remain central, adjustment is performed in the following manner. Set the level to be adjusted parallel to a pair of diagonally opposite leveling screws and level the instrument so that the bubble is midway between the lines. Turn the instrument 180° in azimuth. Return the bubble halfway to its original central position, using the group of three screws which is located at one end of the level vial holder. The two outer screws of this group are operated as a pair

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and act in opposition to the central screw, so that each screw locks the others. In the final adjustment, each of the screws should be set up tight, but not overstrained. Level the instrument again and repeat the above procedure if necessary.

(2) Tests for verticality and horizontality of the cross lines on the reticle may be performed by sighting on a vertical line, such as a plumb line, with the instrument level. No adjustment by the using arm is permitted.

(3) The azimuth micrometer should read zero when the azimuth scale is set to indicate exactly on a degree graduation line. Adjustment, when required, is performed by loosening the three micrometer clamping screws and turning the micrometer relative to the worm. The micrometer clamping screws should be tightened securely when adjustment is completed.

(4) The azimuth worm should turn freely when actuated by the azimuth worm crank and should cause the instrument to respond immediately to reversals of motion. Should backlash develop, adjustment can be made as follows:

(a) Rotate the throwout lever to disengage the azimuth worm and tighten the fillister head screw in the hub of the azimuth worm crank until the worm rotates freely but without longitudinal play. In some instruments the fillister headscrew is locked by a headless flat lock screw which is loosened temporarily to permit adjustment.

(b) Re-engage the azimuth worm and uncover the opening in the rear surface of the mount below the azimuth slow motion thumbscrew. This opening is concealed either by a spring cover or by a large fillister headscrew. Set the adjusting screw for minimum backlash. It will be found that, as the screw is turned, a point is reached where backlash is completely eliminated and that further turning beyond this critical point merely brings about increased friction on the gear teeth. The correct adjustment is at this critical point. Cover the opening when adjustment is completed.

d. Care and preservation. — (1) Refer to paragraph 128 for general instructions pertaining to the care and preservation of fire-control instruments.

(2) One of the eyepieces should always be assembled in the telescope. The other eyepiece should be kept in the pocket provided in the telescope carrying case.

(3) The mount should be lubricated occasionally with OIL, lubricating, for aircraft instruments and machine guns, placing a few drops only in the oil cups provided. The instrument should be kept clean from any excess lubricant, and particular care should be exercised that no oil or grease is allowed to come in contact with the optical surfaces. Before the telescope is assembled in the yoke, the trunnions and trunnion bearings should be carefully wiped clean and then covered with a light coating of oil.

122. INSTRUMENT, AZIMUTH, M1918 (MILS). — a. Description. —

This instrument (*Figure 60*) is used by Coast Artillery organizations as a base-end observing instrument when mil firing (land targets) is involved and for measurement of deflection errors in the observation of fire. The major components of the instrument are the mount, telescope, and type H tripod. The instrument is furnished complete with carrying cases, tools, and electrical equipment for night illumination of the reticle and scales.

b. Operation. — (1) Setting up and leveling. — (a) Extend the tripod legs and clamp them so that the tripod head is approximately level and at a convenient height. The legs should be spaced at least 2½ feet apart at the ground to insure stability. Use the plumb bob provided to center the tripod over the point on the ground from which the observations are to be made. Readjust the length of the legs to center the bubble in the circular level vial within the tripod head.

(b) Remove the mount from its packing chest and thread the leveling plate carefully onto the tripod head. Extreme care must be exercised at this point to engage the threads properly. Turning pressure should be exerted only on the leveling plate, and not on other parts of the mount. Approximately four turns are required for secure mounting.

(c) Remove the telescope from its carrying case, place it carefully in its bearings and secure, using the clamping screws. The V-shaped locating surface of the left-hand trunnion seat should fit squarely in the corresponding surface of the worm gear segment. Remove the telescope objective cap.

(d) Level the instrument, using the two level vials on the yoke and the four leveling screws above the leveling plate. For best results in leveling orient the level vials so that each is parallel to a pair of diagonally opposite leveling screws; each level is then affected only by the corresponding pair of leveling screws. The leveling screws are operated by lowering one screw and raising the other of a pair. Tighten the screws only until a snug contact is made.

(2) Focusing. — The telescope has two interchangeable eyepieces for 10-power or 20-power magnification. The use of the lower power eyepiece results in a wider field of view and a brighter, steadier image than that obtained with the higher power eyepiece, but with either eyepiece the focusing procedure is the same. To focus, rotate the diopeter scale until the reticle markings appear clear and distinct; if the correct diopter setting for the observer is known, it may be set in directly. Targets at normal ranges will then be sharply defined, and there will be no parallax (apparent relative motion between the target image and the reticle as the observer's eye is shifted) for targets beyond 400 yards. Should parallax be apparent when sighting at short ranges, it may be eliminated by placing before the objective an opaque diaphragm of paper or similar material with a comparatively small circular opening.

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(3) *Orienting.* — Set the azimuth slow motion thumbscrew with the slow motion arm approximately in midposition. This thumbscrew is secured by its auxiliary thumbscrew. If necessary, loosen temporarily the slow motion arm clamping screw on the left side of the instrument and turn the yoke until the telescope is in the position shown in Figure 60. The azimuth worm crank is then convenient to the right hand of the observer. Select a datum point of known azimuth and, by means of the azimuth worm crank, set the azimuth scale and micrometer to indicate the exact number of mils and tenths of mils of this azimuth. Release the four leveling screws and rotate the entire upper part of the mount (not the leveling plate) until the datum point appears approximately in the center of the field of view of the telescope. Relevel the instrument and then with the azimuth slow motion thumbscrew bring the vertical line on the reticle to appear exactly on the datum point.

(4) *Observing.* — (a) The azimuth worm crank moves the telescope in azimuth. This crank may be disengaged, if desired, by operating the throw-out lever for rapid traversing of the instrument, but final setting and reading should be made with the worm in mesh. Azimuth indications from 0 to 6,400 mils are read on the azimuth scale (coarse, 10-mil divisions) and azimuth micrometer (fine, 0.1-mil divisions).

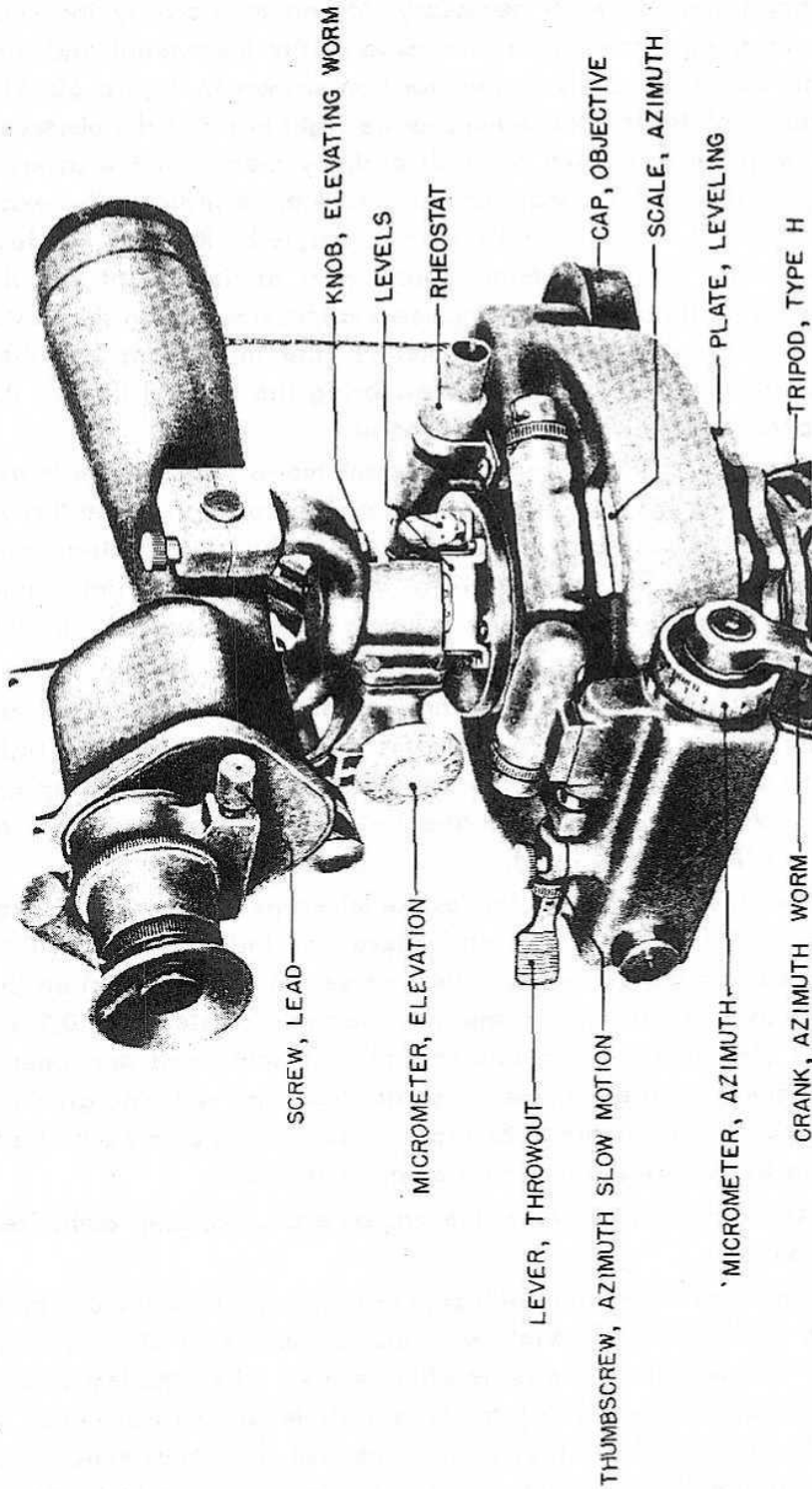
(b) The telescope reticle contains horizontal and vertical cross lines and a horizontal mil scale which indicates 5-mil intervals to the right and to the left of the vertical line. A movable pointer, operated by the lead screw, moves across the scale and indicates lateral deviations of fire by marking the point of burst.

(c) The elevating worm knob moves the telescope in elevation. Elevation indications from 0 to 500 mils and depression indications from 0 to 300 mils are read on the elevation scale (coarse, 10-mil divisions) on the left side of the instrument, and on the elevation micrometer (fine 0.2-mil divisions). The elevation graduations on both the scale and micrometer are colored white, and the depression graduations are red. The graduations of corresponding color are to be read in conjunction with each other, and are not to be confused with those of opposite color.

c. *Tests and adjustments.* — Only the adjustments specifically authorized herein are permitted.

(1) The levels are in correct adjustment when the bubbles are midway between the lines on the vials with the azimuth axis of the instrument vertical. This condition can be readily verified when the instrument is set up and leveled by observing the level bubbles as the instrument is rotated slowly in azimuth. If they remain central no adjustment is required. If the bubble of one or both levels does not remain central, adjustment is performed in the following manner. Set the level to be adjusted parallel to a pair of diagonally opposite leveling screws and level the instrument so that the bubble is midway between the lines. Turn the

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FIGURE 60 — AZIMUTH INSTRUMENT M1918 (MILS)

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instrument 180° (3200 mils) in azimuth. Return the bubble halfway to its original central position, using the group of three screws which is located at one end of the level vial holder. The two outer screws of this group are operated as a pair and act in opposition to the central screw, so that each screw locks the others. In the final adjustment, each of the screws should be set up tight, but not overstrained. Level the instrument again and repeat the above procedure if necessary.

(2) Tests for vertical and horizontal positioning of the cross lines on the reticle may be performed by sighting on a vertical line, such as a plumb line, with the instrument level. No adjustment by the using arm is permitted.

(3) The azimuth micrometer should read zero when the azimuth scale is set to indicate exactly on a graduation line. Adjustment, when required, is performed by loosening the retaining nut on the end of the azimuth worm, using the pin face adjustable teat wrench provided, and turning the micrometer relative to the worm. The retaining nut should be tightened securely when adjustment is completed.

(4) The elevation mechanism is in correct adjustment when the elevation scale and micrometer indicate zero with the instrument level and the line of sight of the telescope horizontal. The horizontal position of the line of sight can be determined by sighting on a distant point at the same height, as determined by a level or other instrument of known accuracy. Adjustment, when necessary, is performed by loosening temporarily the two retaining screws on the elevation scale index and moving the index to zero, and by loosening temporarily the retaining screw at the center of the elevation micrometer and turning the micrometer to zero. If more convenient, the adjustment may be performed by using a datum point of known elevation or depression and adjusting the scale index and micrometer to the corresponding reading.

d. Care and preservation.—(1) Refer to paragraph 128 for general instructions pertaining to the care and preservation of fire control instruments.

(2) One of the eyepieces should always be assembled in the telescope. The other eyepiece should be kept in the pocket provided in the telescope carrying case. The ray filter fits in either eyepiece and is transferred from one to the other as required.

(3) The mount should be lubricated occasionally with OIL, lubricating, for aircraft instruments and machine guns, placing a few drops only in the oil cups provided. The instrument should be kept clean from any excess lubricant, and particular care should be exercised that no oil or grease is allowed to come in contact with the optical surfaces. Before the telescope is assembled in the yoke, the trunnions and trunnion bearings should be carefully wiped clean and then lightly covered with oil.

(4) The dry cell batteries should be removed habitually from the bat-

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tery case when the light is not in use, to avoid damage to the case due to deterioration of the dry cell. Exhausted batteries should be removed and replaced.

(5) Electrical equipment plugs and sockets have colored bands which serve to identify each plug for its particular use. Each plug should connect only in the socket for which intended. When properly connected, the reticle illuminating lamp is controlled by the rheostat.

123. RULE, AIMING, M1918, WITH SIGHTS. — *a. Description.* — (1) The aiming rule M1918, used in conjunction with a panoramic telescope or aiming circle as a sight, provides a moving aiming point to eliminate pointing errors in azimuth due to movement of the gun sight about the pintle center of the gun.

(2) The aiming rule includes a horizontal connecting bar, several feet long, supported on two upright steel stakes which are driven into the ground. The rule, slightly shorter than the connecting bar, is clamped along and above the connecting bar. Adjustment of position along the connecting bar is provided. A sight bracket slides on the rule. The panoramic telescope may be mounted on the bracket. An adapter is provided when an aiming circle is to be used.

b. Operation. — (1) The aiming rule is set up about 100 yards from the gun, at right angles with a line from the gun to the center of the field of fire. This line should cross the rule close to the left end of the rule (looking from the aiming rule to the gun). Place the sight on the rule and direct its line of sight on the gun sight. If the gun points to the center of the field of fire the sight should be near the right end of the rule. If the gun points to the right or left edge of the field of fire the sight should be near the left end of the aiming rule. Point the gun sight at the aiming rule sight which is thereafter used as an aiming point.

(2) To traverse the gun a certain angle in azimuth, set the value into the gun sight, opposite to the direction desired. Traverse the gun until the line of sight is directed on the aiming rule sight. At the same time, slide the aiming rule sight, with azimuth unchanged, along the rule until both sights aline.

c. Care and preservation. — (1) Refer to paragraph 128 for general instructions pertaining to the care and preservation of fire control instruments.

(2) The sights should be handled with care, when mounted on the rule and should be returned to carrying cases immediately after use. If exposed to dust, rain, or mud they should be wiped carefully.

(3) Unpainted surfaces of the rule should have a thin film of grease or oil when the instrument is in use and should be protected by grease when not in use.

(4) The sliding surfaces of the rule and bracket should be kept free of nicks and burs.

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(5) Thumbscrews should be oiled or greased occasionally.

124. RULE, SETFORWARD, TYPE B. — *a. Description.* — This rule (Figure 61) is a white celluloid slide rule of conventional design with two stationary scales and a movable slide.

b. Operation. — (1) Place the slide so that the arrow indicates the rate of travel in yards per minute.

(2) Opposite the time of flight in seconds, obtained from firing tables or from the data on the side of the chart of the range correction board, read the yards of travel during the time of flight plus one minute.

125. SCALES, PREDICTION, M1. — These scales (Figure 62) are used for measuring and laying out distances on the plotting and relocating board. They are available with the same scale ratios as those of the plotting board number strips. It is necessary that the ratios of the plotting board number strips and prediction scale in use be the same.

126. TRAINER, STEREOSCOPIC, M2, — *a. General.* The stereoscopic trainer M2 (Figures 63 and 64) is an instrument used for training stereoscopic observers. It is a table model stereoscope equipped with several reticles, targets, and controls to set up optical conditions simulating those encountered in the use of stereoscopic height or range finders.

b. Description. — (1) The eyepieces are for the observer's use. The eyepieces can be set to the observer's interpupillary distance by rotation of the interpupillary adjustment knob (Figure 63). Individual diopter scales permit separate focusing of each eyepiece.

(2) The three pairs of reticles provided are brought into view by rotation of the reticle selectors. The reticles corresponding to the several selector settings are: 0. Clear; 1. Reference mark pattern of height finder M2; 2. Shrapnel burst; 3. Single geometrical figure (balloon).

(3) Several target slides are provided, representing airplanes of various types in various positions. The slides are readily inserted and removed through the door as shown in Figure 64.

(4) The convergence and divergence knob provides angular adjustment of the optical path from the eyepieces to the targets from 6° maximum convergence to 6° maximum divergence. The knob has a scale graduated at $.5^\circ$ intervals. The normal or parallel position is indicated by the zero graduation.

(5) The reticle displacement knobs provide horizontal and vertical movement of the reticle. With motion of the knobs the observer sees the reticle pattern move upward or downward and to the right or left in the field of view. The scale attached to each knob indicates in degrees of inclination of the light rays from the normal optical path. The zero graduation is the normal setting.

(6) The target displacement knobs provide horizontal and vertical movement of the target pair. With motion of the knobs the observer sees the target image move upward or downward and to the right or left

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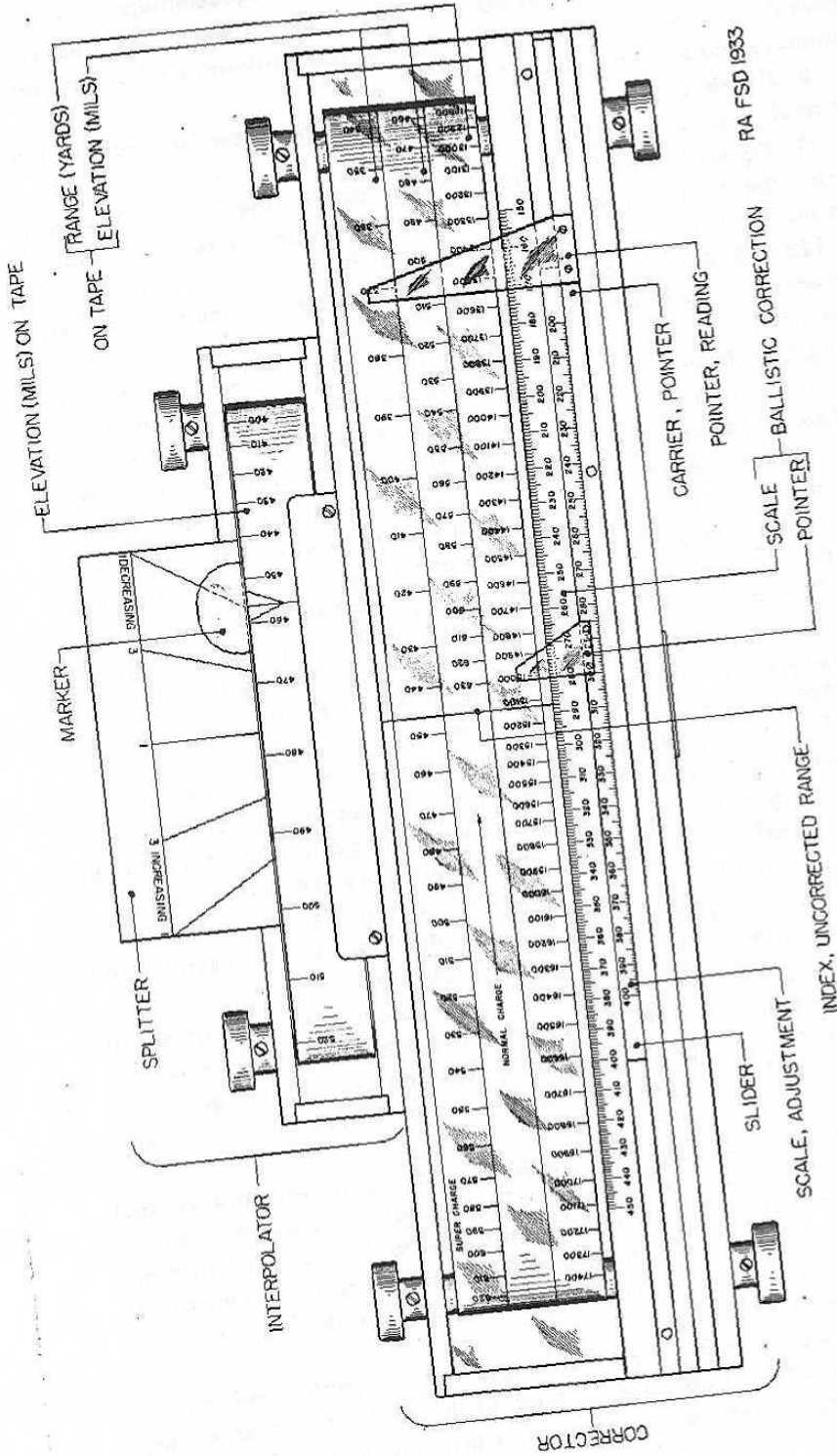
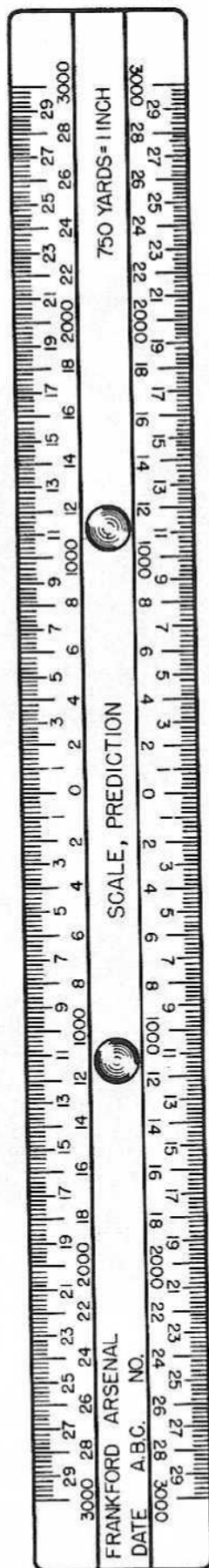


FIGURE 61 -- SETFORWARD RULE TYPE B

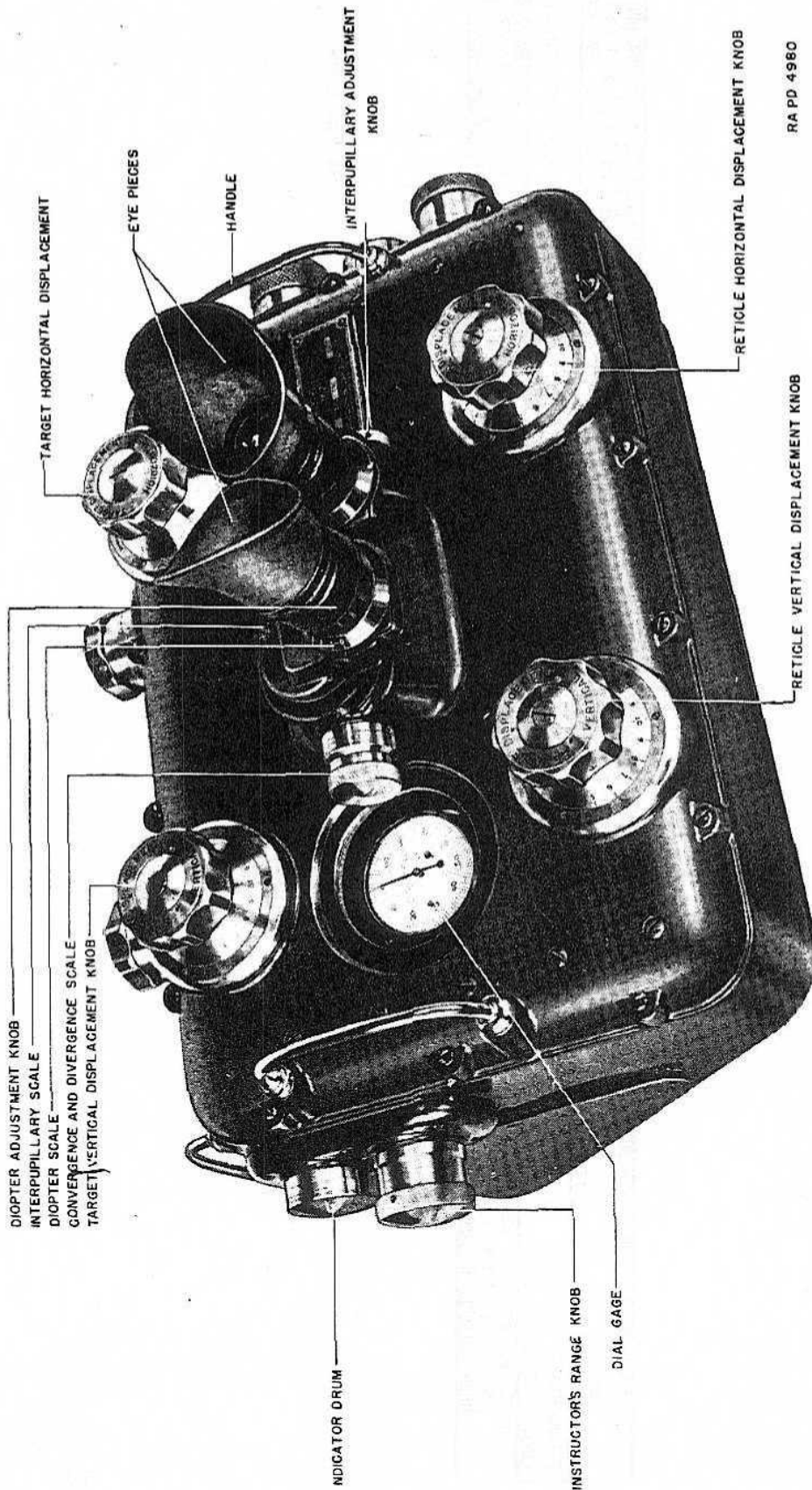
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FIGURE 62 — PREDICTION SCALES M1

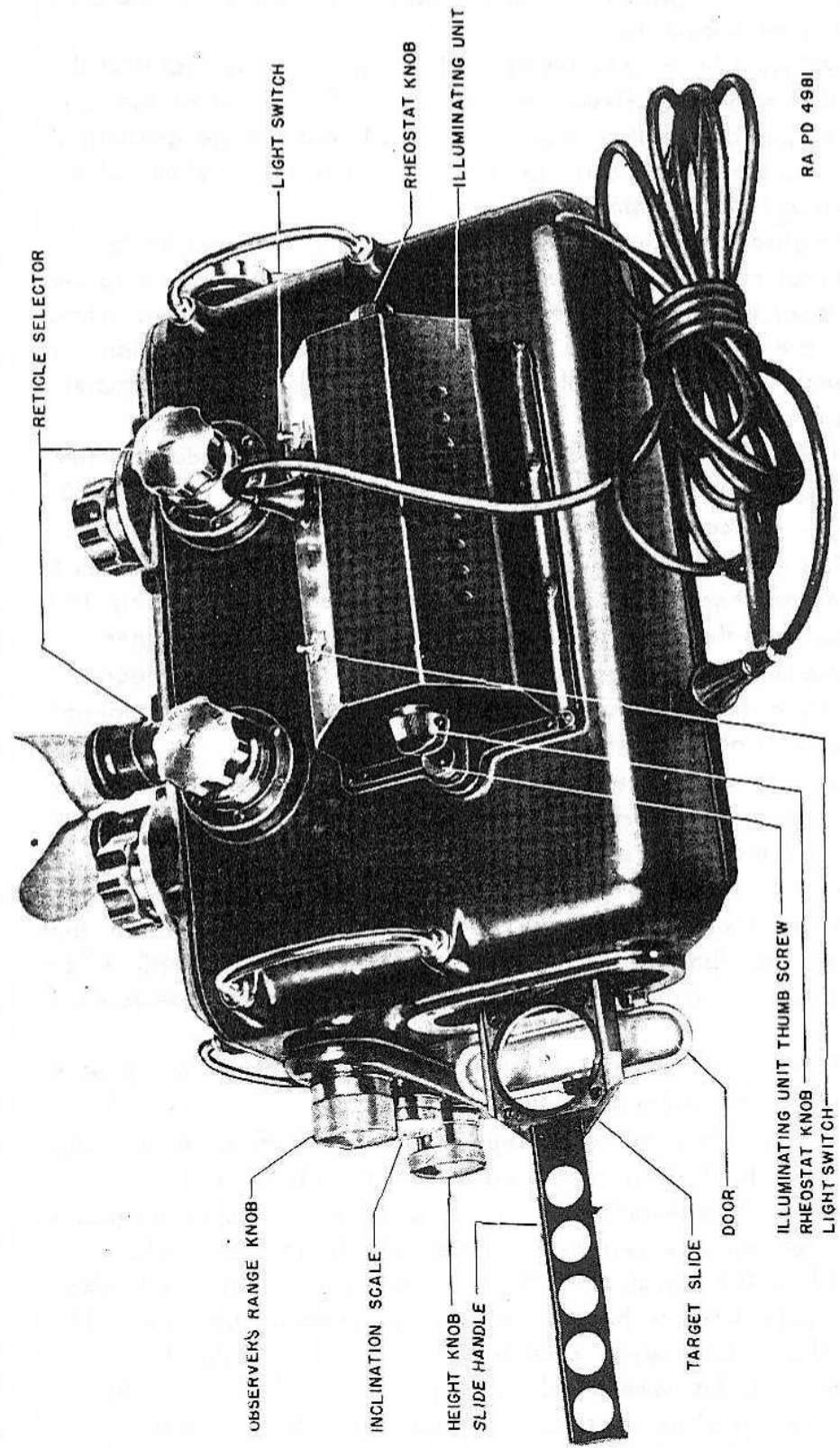
GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1



RA PD 4980

FIGURE 63 — STEREOSCOPIC TRAINER M2 - EYEPIECE SIDE

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RA PD 4981

FIGURE 64 — STEREOSCOPIC TRAINER M2 - RETICLE SELECTOR SIDE

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in the field of view. The scale attached to each knob indicates in degrees of inclination of the light rays from the normal optical path. The zero graduation is the normal setting.

(7) The height knob provides vertical movement of the right reticle, the left reticle remaining fixed. The amount of inclination of the rays (hyperphoric displacement) is read on the inclination scale graduated at 20" intervals of real field corresponding to approximately 2' of inclination of the rays (1.2' of apparent field).

(8) The observer's range knob and the instructor's range knob provide horizontal motion of the left reticle. When the instructor's range knob is rotated the motion is registered on the indicator drum. When both knobs are moved the dial gage registers the relative positions of the two range knobs. The small counter on the dial indicates complete revolutions of the large hand.

(9) Illumination is provided through a ground glass window by two lamps, controlled by switches and rheostats and supplied from a 110-volt a-c or d-c source. Handles on the case permit convenient carrying.

(10) The carrying case provided contains the instrument, the slide case, a gage for checking the instrument and material for cleaning. The slide case contains the stereoscopic slides furnished with each trainer.

c. *Operation.* — (1) The use of the stereoscopic trainer, M2, should be supervised by a qualified instructor to prevent damage to the students' eyes by improper adjustment.

(2) The observer inserts the proper slide and makes the necessary settings on the interpupillary scale and the individual diopter scales. All the knobs and indicators are then set to zero and the illumination is turned on.

(3) The tests and exercises to be made at the discretion of the instructor are described in the manual (Description and Instructions for the Use and Care of Trainer, Stereoscopic, M2) which accompanies each instrument.

d. *Care and preservation.* — (1) All movements are provided with positive stops. Do not force any knob if it turns hard or stops.

(2) The instrument should be kept in its case when not in use. Four handles are provided for lifting the instrument from its case.

(3) Exercise care when handling the target slide. The target plates are photographs on glass and are protected only by transparent lacquer. Avoid scratching the film surface. The film surface should not be touched with the fingers. Use the handle which is attached to each slide. The lower side of the plate may be cleaned with PAPER, lens tissue. The upper or film side should be cleaned only with a clean camel's-hair brush.

(4) The target slides are numbered and should be kept in the corresponding slots in the instrument case.

127. UNIT, GENERATING, M1. — a. *Description.* — This generating

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unit (Figures 65 to 68) is a portable gasoline engine driven generator of the type extensively used commercially on boats, camps and farms. It is furnished complete with storage batteries, control panels, portable cables, extension lamps, spare lamps, hydrometer, and trunk type metal box. This unit is employed to illuminate plotting rooms and command stations.

(1) *Generator.* — The generator is a shunt-wound, direct-current generator rated at 650 watts, 12 volts.

(2) *Engine.* — The engine is a single-cylinder, air-cooled, two-cycle (fires every stroke), high compression unit. It is mounted on spring feet. Ignition is furnished by magneto. Lubrication is accomplished by oil mixed with gasoline. The speed is controlled automatically by a built-in governor.

(3) *Batteries.* — Three 6-volt 115 ampere-hour lead storage batteries are provided.

(4) *Control panels.* — A socket panel (Figure 66) and a charging panel (Figure 67) connected as shown in Figure 66 are provided. The former has fourteen automotive-type receptacles for attaching the extension lamps and the latter has an internal resistor for reducing the 12-volt generator potential to 6 volts for battery charging. Receptacles for the portable cables which connect the charging panel to the other elements are polarized to insure connection in the correct relation. Auxiliary binding posts are provided near each polarized receptacle so that improvised connections may be employed.

(5) *Portable cables.* — Two-conductor portable cable and plug assemblies are provided for connecting the charging panel to the generator, socket panel and batteries. The plugs are polarized and can be inserted only one way in the receptacles. The 25 ft. and 50 ft. cables are interchangeable. Battery cables terminate in clamps which are marked to indicate the proper polarity.

(6) *Extension lamps.* — Fourteen extension lamps are provided. Each lamp has a 15-ft. flexible cable with automotive-type double contact plug and receptacle and a 6-inch reflector. Six 3-cp and eight 21-cp double contact 6-8 volt miniature lamps are furnished for use in these extensions; an equal number of spare lamps is also provided.

b. Operation. — (1) Set the generating unit up on any firm level base. Secure it in place, if desired, by means of screws in the loops of the spring feet. If the unit is to be operated indoors, improvise a flexible connection for conducting exhaust gases to the outside.

(2) Fill the fuel tank with gasoline, to each gallon of which has been added and thoroughly mixed, $\frac{1}{2}$ pint of lubricating oil, SAE50. Turn the shut-off cock in the fuel line to the open (vertical) position.

(3) Locate the control panels where desired, within the limit of available cable runs, throw all switches to the "OFF" position and connect up the various cables. It is essential that the battery clamps be connected

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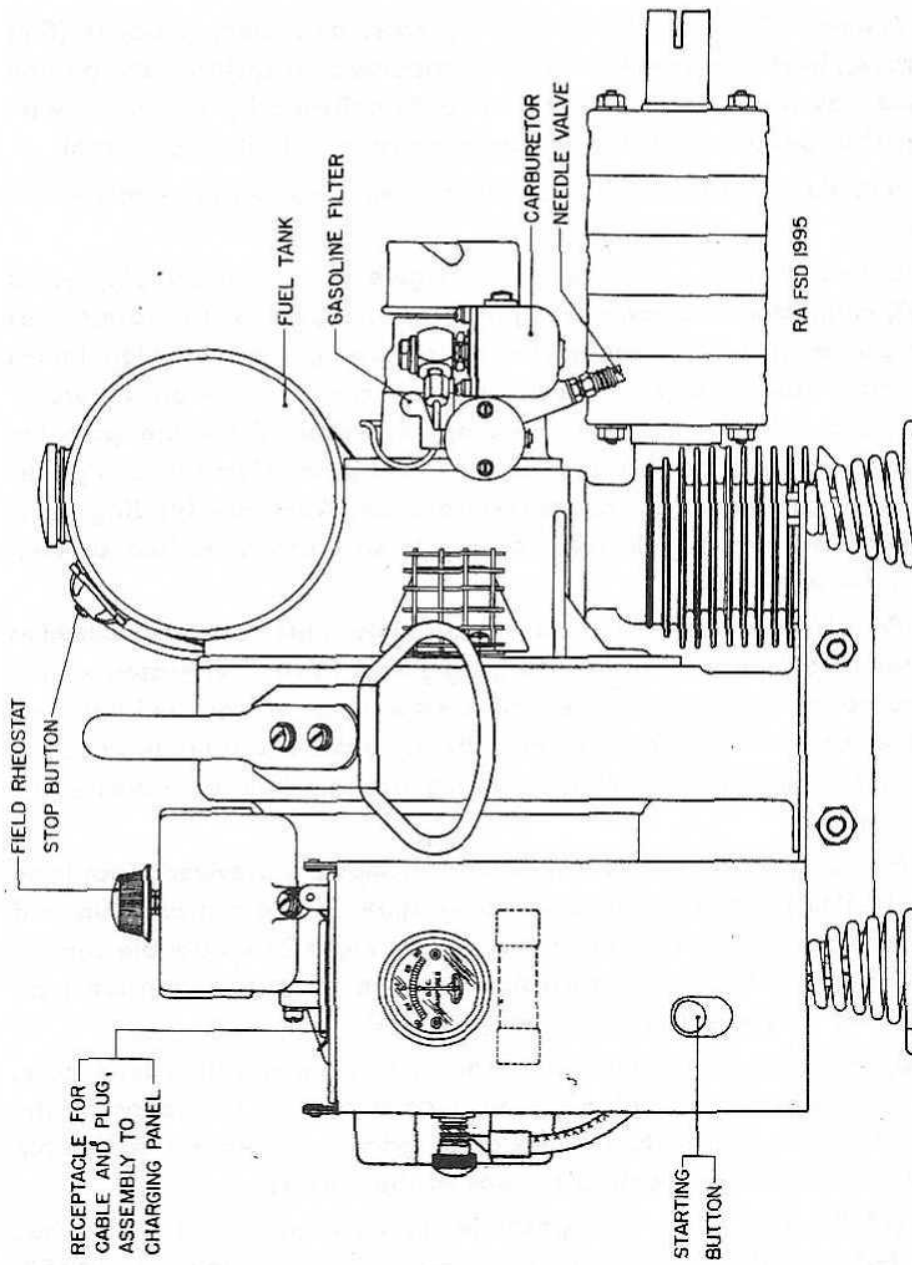
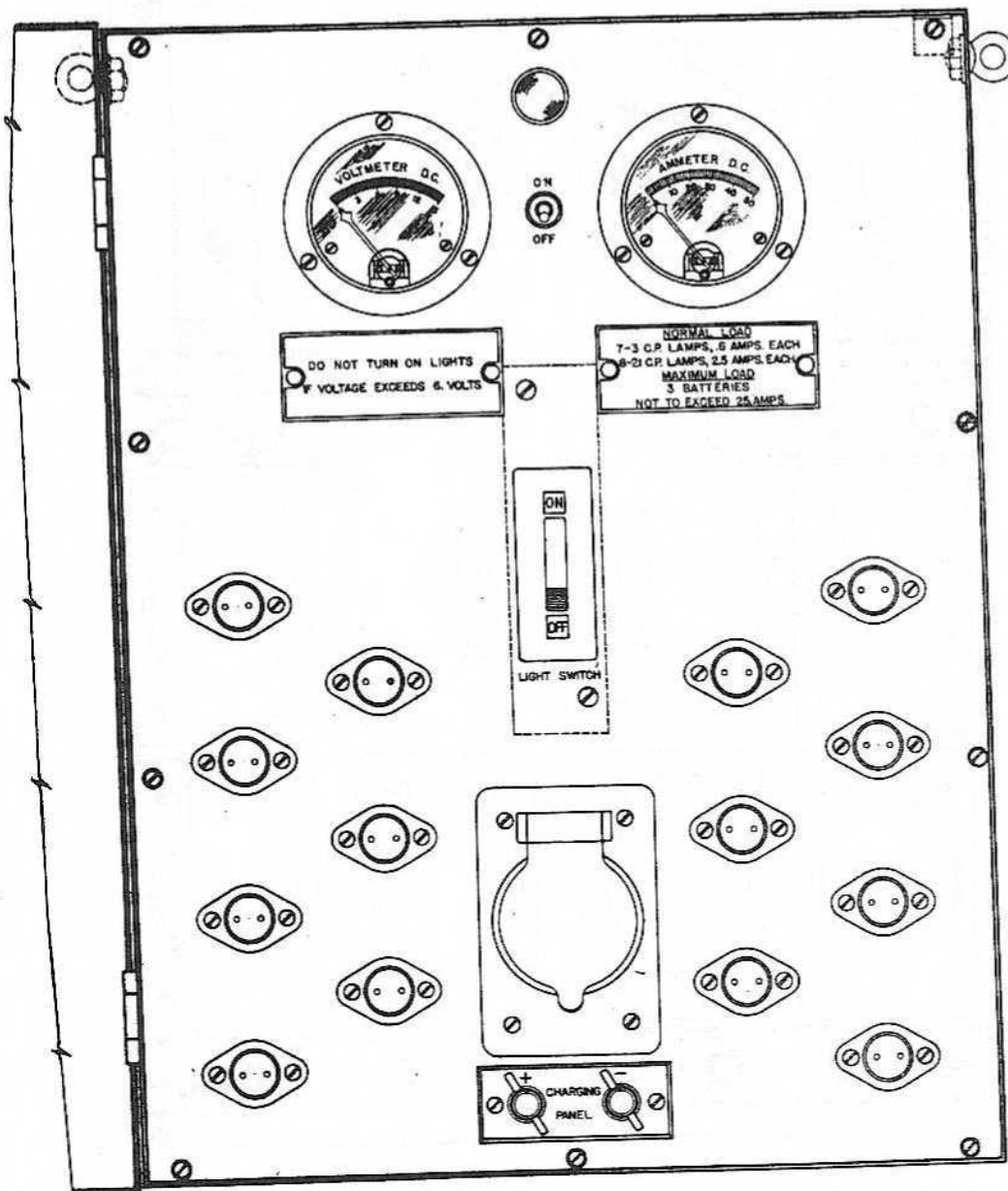


FIGURE 65 — GENERATING UNIT M1

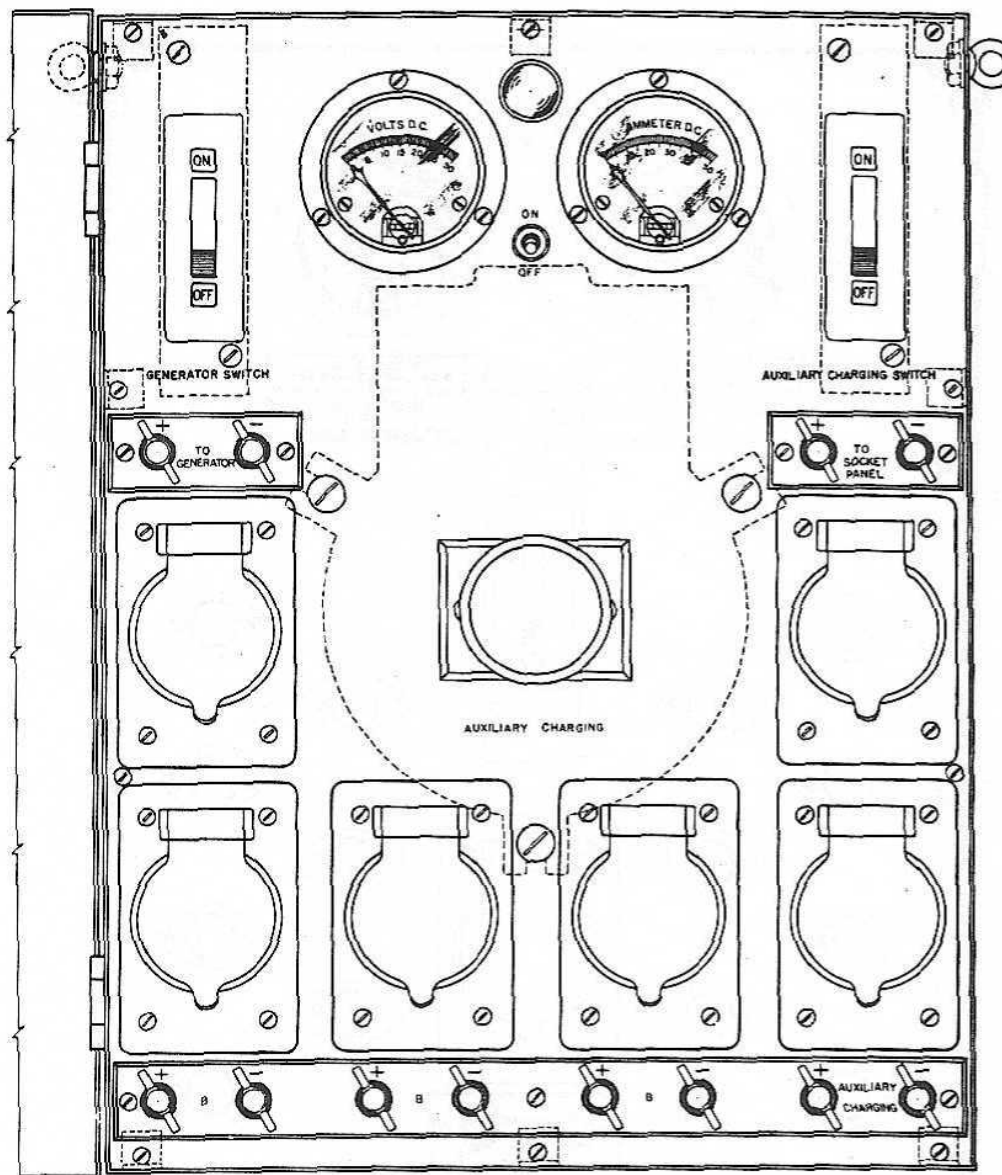
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FIGURE 66 — GENERATING UNIT M1 - SOCKET PANEL

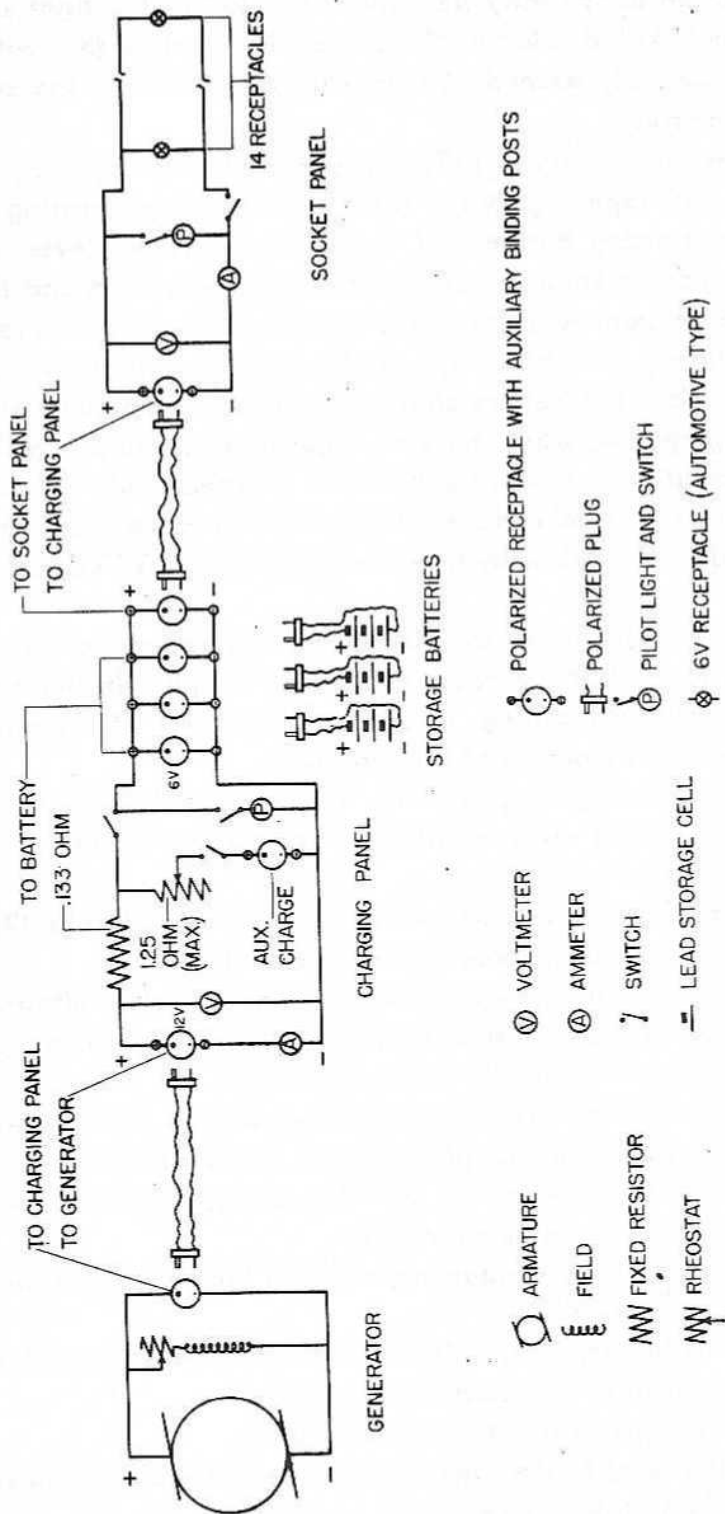
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RA FSD 1997

FIGURE 67 - GENERATING UNIT M1 - CHARGING PANEL

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FIGURE 68 — GENERATING UNIT M1 - SCHEMATIC DIAGRAM OF CONNECTIONS

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to posts of the proper polarity as marked; connect these clamps to the battery before inserting the plug in the receptacle.

(4) Extension lamps may be lighted by closing the light switch on the socket panel. As indicated on this panel, do not close the switch when the voltage materially exceeds 6 volts and do not allow the current to exceed 2.5 amperes.

(5) Unless the battery is fully charged, indicated by a hydrometer reading of 1.280 (Spec. gravity, 1.28*), start the generating unit by depressing the starting button and operating the choke lever. If necessary, the unit may be spun by means of a rope wound around the drum on the shaft extension. As soon as the engine starts, release the starting button immediately and allow the choke lever to return slowly to the open position. Close the battery charging switch; the ammeter then indicates the charging rate, which may be adjusted as required by means of the field rheostat. The battery should be charged until a hydrometer indicates the fully charged condition to be reached. Battery gravity should not be allowed to fall below hydrometer reading of 1.150 (Spec. gravity, 1.15).

(6) To use the generator for auxiliary charging, connect the battery to be charged to the battery cable and insert the plug in the receptacle marked for auxiliary charging. Close the associated switch and adjust the rate as required by means of the rheostat.

(7) To stop the engine, press the "Stop" button located on the fuel tank. Turn the shut-off cock in the fuel line to the closed (horizontal) position.

c. Care and preservation. — (1) Always add oil to gasoline (b. (2), above) and mix thoroughly before pouring into the fuel tank.

(2) Do not allow the generator to run continuously without load.

(3) Connect up the equipment only in the manner indicated; never connect the socket panel directly to the generator.

(4) Exercise care to prevent conducting objects from coming into contact with live parts, such as plug fingers, terminal nuts, etc.

(5) *Care of batteries.* — (a) Do not allow any spark, fire or flame near the battery, particularly when charging.

(b) Do not allow any conducting material to come into contact with the tops of the battery cells.

(c) Keep all battery connections, both between cells and external leads, clean, tight, and well coated with grease.

(d) Keep the tops of the battery cells clean.

(e) Keep the level of the liquid in each cell at the liquid level mark by adding distilled water as required.

(f) Add only distilled water to the cells. Many impurities common in local sources of water are extremely harmful to lead storage batteries.

*Based on a temperature of 80° F; increase (decrease) by .01 for each 30° F decrease (increase) from 80° F.

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Under no circumstances may additional electrolyte be added to the cells, as such a procedure will increase the acid concentration and cause injury to the battery.

(g) Check the condition of the battery periodically by taking hydrometer readings.

(h) Keep the battery fully charged, never allowing it to remain in a discharged condition for any appreciable length of time nor to be discharged beyond its rating.

(i) In freezing weather pay special attention to the instructions in (c. (5) (h)) above, as, while the electrolyte of a fully charged battery will not freeze at any temperature to be expected in service, at a specific gravity of 1.08 the freezing point of the electrolyte is 22° F.

(6) Be sure to use a spark plug of the proper temperature range for the engine. Use Champion C-7 spark plug or equal.

(7) Keep the strainer in the fuel inlet on top of the carburetor free from sediment. When this strainer is being inspected, open the shut-off cock in the fuel line to make sure there is a free flow of fuel; if the fuel does not flow freely, drain the fuel, remove the shut-off cock and clean the fuel tank strainer.

(8) Do not run the engine unless it is free to float on the four springs. Never use a rigid connection for the external exhaust pipe.

(9) Adjustment of carburetor needle valve, governor and breaker points by the using arm is not permitted.

128. CARE AND PRESERVATION. — *a. General.* — (1) The instructions given hereunder supplement instructions pertaining to individual instruments included in preceding paragraphs.

(2) For ordnance maintenance personnel the instructions given hereunder are supplemented by the thousand series technical manuals listed in the References, pertaining to the individual instruments.

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

(2) Disassembly and assembly by the using arm is permitted only to the extent authorized in the paragraphs dealing with the individual instruments. Unnecessary turning of screws or other parts not incident to the use of the instrument is expressly forbidden.

(3) Keep the instruments as dry as possible. Do not put an instrument in its carrying case when wet.

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

(5) Cover the level vials when these are not in use.

(6) Any instruments which indicate incorrectly or fail to function properly after the authorized tests and adjustments have been made are

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to be turned in for repair by ordnance personnel. Adjustments other than those expressly authorized in the paragraphs dealing with the individual instruments are not to be performed by the using arm.

(7) No painting of fire control equipment by the using arm is permitted.

(8) Many worm drives have throwout mechanisms to permit rapid motion through large angles. When using these mechanisms, it is essential that the throwout level be fully depressed to prevent injury to the worm and gear teeth.

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

(10) When using a tripod with adjustable legs, be certain that the legs are clamped tightly to prevent possibility of collapse.

(11) When setting up tripods on sloping terrain, place two legs on the downhill side to provide maximum stability.

b. *Lubrication.* — (1) The instruments should be lubricated when required with lubricants furnished by the Ordnance Department for fire control instruments. The lubricants commonly used are:

OIL, lubricating, for aircraft instruments and machine guns.

GREASE, special, low temperature.

(2) Use only the lubricant specified for any use.

(3) Lubricants for fire control instruments function also as rust preventives. They should be used carefully and diligently. Excessive lubrication should be avoided.

(4) The exterior of instruments should be kept free of dirt, dust, and seeping oil. Remove oil with cloth slightly moistened with SOLVENT, dry cleaning, and wipe dry with a clean cloth.

c. *Optical parts.* — (1) To obtain satisfactory vision, it is necessary that the exposed surfaces of the lenses and other parts be kept clean and dry. Corrosion and etching of the surface of the glass, which greatly interfere with the good optical qualities of the instrument, can be prevented or greatly retarded by keeping the glass clean and dry.

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

(3) For wiping optical parts use only lens paper specially intended for cleaning optical glass. Use of cleaning cloths in the field is not permitted. To remove dust, brush the glass lightly with a clean camel's-hair brush and rap the brush against a hard body in order to knock out the small particles of dust that cling to the hairs. Repeat this operation until all dust is removed. With some instruments an additional brush with coarse bristles is provided for cleaning mechanical parts; it is essential that each brush be used only for the purpose intended.

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(4) Exercise particular care to keep optical parts free from oil and grease. Do not wipe the lenses or windows with the fingers. To remove oil or grease from optical surfaces, apply ethyl alcohol with a clean camel's-hair brush and rub gently with clean lens paper. If alcohol is not available, breathe heavily on the glass and wipe off with clean lens paper; repeat this operation several times until clean.

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

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1**SECTION X****AMMUNITION**

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129. GENERAL. — Ammunition for the GUN, 8-inch, Mk. VI-Mod. 3A2, is of the separate loading type. The loading of each complete round into the cannon requires three separate operations — those of loading: one, the projectile; two, the propelling charge; and three, the primer. These components are shipped separately. Armor-piercing and high explosive projectiles for this gun are shipped fuzed.

130. NOMENCLATURE. — Standard nomenclature is used in this section in references to specific items of issue.

131. FIRING TABLES. — For applicable firing tables, see the section of this manual entitled "References."

132. CLASSIFICATION. — The projectiles authorized for use in this gun are classified as armor-piercing, high explosive, practice, and dummy. The armor-piercing projectile has thick walls, hence a relatively small quantity of high explosive filler, whereas the high explosive projectile has relatively thin

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walls and a correspondingly larger quantity of high explosive filler. The practice projectile may have a tracer or may be inert. The dummy projectile is inert.

133. IDENTIFICATION. — *a. General.* — Ammunition, including components, is completely identified by means of the painting, marking (including ammunition lot number), and accompanying data card or tag. Other essential information is marked on the components, for example: on the projectile, its weight and the kind of filler; on the propelling charge, the weight of igniter, designation of each section, etc. (See Figures 69 to 74, and the following paragraphs.) The muzzle velocity may be obtained from the tag on the propelling charge.

b. Mark or model. — To identify a particular design, a model designation is assigned at the time the design is classified as an adopted type. This model designation becomes an essential part of the standard nomenclature and is included in the marking on the item. The present system of model designation consists of the letter M followed by an arabic numeral. Modifications are indicated by adding the letter A and the appropriate arabic numeral. Thus, M1A1, indicates the first modification of an item for which the original model designation was M1. Prior to July 1, 1925, it was the practice to assign mark numbers. The word "Mark," abbreviated "Mk.," was followed by a roman numeral, for example: SHELL, H.E., Mk. I. The first modification of a model was indicated by the addition of M1 to the mark number, the second by MII, etc.

c. Ammunition lot number. — When ammunition is manufactured, an ammunition lot number, which becomes an essential part of the marking, is assigned in accordance with pertinent specifications. In the case of separate loading ammunition, such a lot number is assigned to, and marked on, each of the components — projectile, fuze, propelling charge, and primer — as well as on all packing containers and the accompanying data card. It is required for all purposes of record. To provide for the most uniform functioning, all of the components in any one lot are manufactured under as nearly identical conditions as practicable. For example, in the case of projectiles, any one lot consists of projectiles made by one manufacturer, loaded by one manufacturer, and of one weight. Therefore, to obtain the greatest accuracy in firing separate loading ammunition, successive rounds should consist of projectiles of one lot number, propelling charges of one lot number, fuzes of one lot number, and primers of one lot number, whenever practicable.

d. Ammunition data card. — A 5- by 8-inch card, entitled ammunition data card because of the data contained thereon, is placed in the packing box with the ammunition or ammunition components. In the case of separate loading propelling charges, a linen tag containing essential data is attached to the charge in place of a data card. When required, assembling and firing instructions are printed on the reverse side of the card.

e. Painting and marking. — (1) Painting. — All projectiles are painted to

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prevent rust and, by the color, to provide a ready means of identification as to type. For the projectiles described herein, the color scheme is as follows:

- High explosive or armor-piercing . . . Yellow; marking in black.
- Practice Black; marking in white.* (Projectiles may contain a tracer, or may be completely inert.)
- Dummy or drill (inert) Black; marking in white, except band at center of gravity which is red.

(2) *Marking.* — For purposes of identification, the following is marked on the components of separate loading ammunition.

- (a) On the projectile:
 - Caliber and type of cannon in which fired.
 - Kind of filler, for example, "TNT."
 - Mark or model of projectile.
 - Weight.
 - Lot number.
- (b) On the propelling charge or sections thereof:
 - Designation of section, for example, "BASE" on base section, and "INCREMENT" or "INCR." on increment section.
 - Type of powder and powder lot number.
 - Caliber, type, and model of cannon in which fired.
 - Weight of igniter charge.
 - On dummy propelling charges: "DUMMY CHARGE" or "DUMMY PROPELLING CHARGE" together with the caliber and model of gun in which it is used.
- (c) On the fuze (stamped on the body):
 - Type and model of fuze.
 - Loader's initials.
 - Month and year loaded.
 - Loader's lot number.
- (d) On the primer (stamped in the metal):
 - Initials of loader.
 - Loader's lot number.
 - Year of loading.
 - Mark or model.

f. Weight markings. — Because it is not practicable to manufacture projectiles within the narrow weight limits required for the desired accuracy of fire, the weight of each projectile is stenciled thereon in order that the appropriate ballistic corrections indicated by firing tables may be applied.

134. CARE, HANDLING, AND PRESERVATION. — *a.* Ammunition and explosives are packed to withstand conditions ordinarily encountered in the field. Projectiles for this gun are shipped with a grommet to protect the rotating band,

*It should be noted that the above color scheme is not wholly in agreement with the basic color scheme described in TM 9-1900, practice projectiles being generally painted blue.

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one projectile per wooden box or crate. Charges and primers are packed in moisture-resistant containers. Since ammunition and explosives are adversely affected by moisture and high temperature, the following precautions should be observed:

- (1) Moisture-resistant seals should not be broken until the ammunition is to be used.
 - (2) Ammunition, particularly fuzes, primers, and propelling charges, should be protected from high temperatures and the direct rays of the sun. More uniform firing is obtained if successive rounds are at the same temperature.
- b. No attempt will be made to disassemble any fuze.
 - c. Primers must always be stored in a dry place. Prolonged exposure to moisture or dampness may cause malfunctioning.
 - d. Explosives and ammunition must be handled with appropriate care at all times. The explosive elements in primers and fuzes are particularly sensitive to undue shock and high temperature.
 - e. Each of the separate loading components should be free of foreign matter — sand, mud, grease, etc. — before loading into the gun.
 - f. Protection will not be removed from fuzes until just before use.
 - g. Components of rounds prepared for firing but not fired will be returned to their original condition and packings and appropriately marked. Fuzes will be inspected prior to repacking. Such components will be used first in subsequent firings, in order that stocks of opened packings may be kept at a minimum.

135. AUTHORIZED ROUNDS. — The ammunition authorized for use in the GUN, 8-inch, Mk. VI, Mod. 3A2, is listed in the table below. No other ammunition will be used in this gun. The nomenclature completely identifies the ammunition.

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AMMUNITION FOR THE GUN, 8-INCH, MK. VI-MOD. 3A2

Nomenclature of Fuzed Projectile	FUZE		Propelling Charge (Model or type)	Primer (Model)
	Type and Model	Action		
Service Ammunition SHELL, A.P., 260-lb. (Navy), Mk. XX, w/-FUZE, B.D., Mk. X, 8" GUN	B.D. Mk. X	Delay	Base and increment ¹	Mk. XV-Mod. 1 ³
SHELL, H.E., 240-lb., M103, w/FUZE, P.D., M51-Mod. 1, w/-BOOSTER, M21, 8" GUN, Mk. VI-Mod. 3A2 (Navy)	P.D. Mk. 51-Mod. 1	Superquick and delay	Base and increment ¹	Mk. XV-Mod. 1 ³
Practice Ammunition SHELL, C.I., 260-lb., Mk. XVIII, 8" GUN	none	Base and increment ¹	Mk. XV-Mod. 1 ³
Dummy Ammunition PROJECTILE, dummy, 260-lb., T12, 8" GUN, Mk. VI-Mod. 3A2	Base and increment ²	Inert Mk. XV-Mod. 1 ⁴

A.P. — Armor-piercing
H.E. — High explosive

B.D. — Base-detonating
P.D. — Point-detonating

C.I. — Cast iron

1 — Service or practice charge is designated, CHARGE, propelling, base and increment, NH Powder, 8" gun, Mk. VI-Mod. 3A2 (Navy), 240-lb. and 260-lb. proj.

2 — Dummy charge is designated CHARGE, propelling, dummy, (72-lb. base with 32-lb. increment) M5, 8" gun, Mk. VI-Mod. 3A2.

3 — Service or practice primer is designated, PRIMER, combination electric and percussion, Mk. XV-Mod. 1.

4 — A fired service primer is used with dummy ammunition for drill purposes.

136. PREPARATION FOR FIRING. — Aside from removal of the packing material (including the grommet which protects the rotating band), the armor-piercing and practice projectiles are ready for firing — likewise, the high explosive projectile when delay action is required. When superquick action of the high explosive shell is required, the fuze head must be changed as described in paragraph 147. After removal from the cartridge storage case, the propelling charge is prepared for firing by removing the igniter protector caps (paragraph 142) and data tag (paragraph 133d).

137. PROJECTILES. — The projectiles authorized for use in this gun comprise an armor-piercing type (Figure 69) fitted with a base-detonating fuze, a high explosive type (Figure 70) fitted with a point-detonating fuze, an inert

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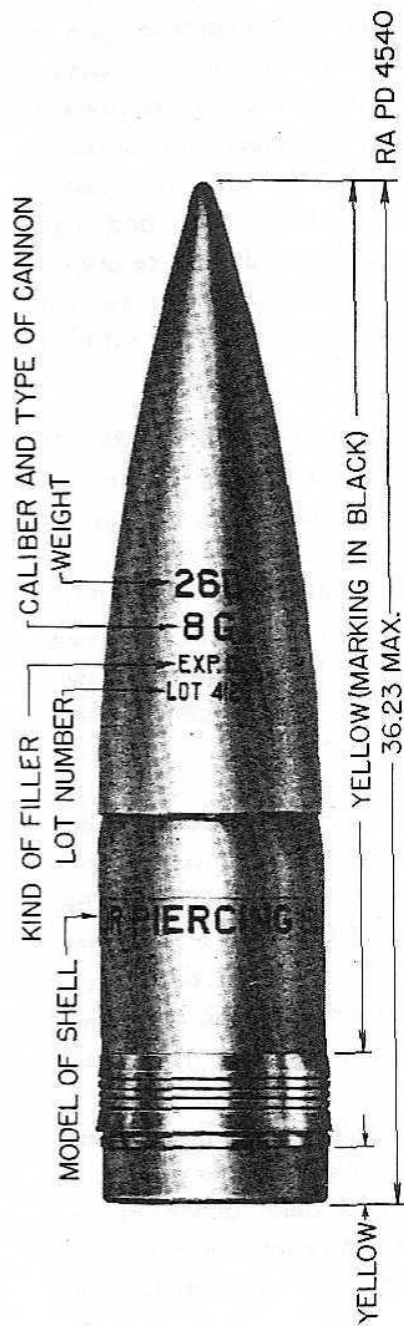


FIGURE 69 — SHELL, A. P., 260-LB. (NAVY), MK. XX, W/FUZE, B. D. MK. X, 8" GUN

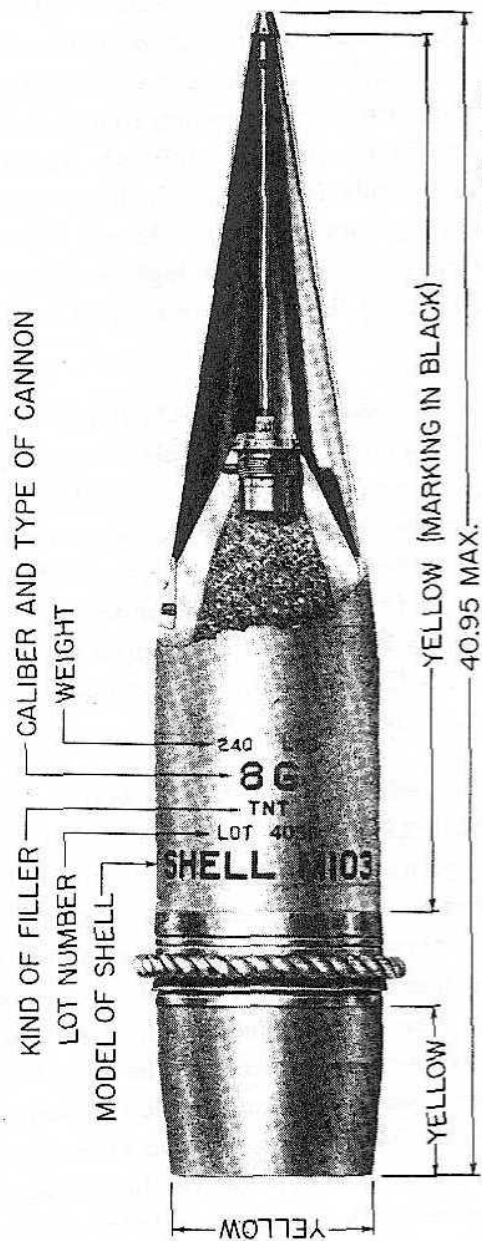


FIGURE 70 — SHELL, H. E., 240-LB., M103, W/FUZE, P. D., M51-MOD. 1, W/BOOSTER, M21, 8" GUN, MK. VI-MOD. 3A2 (NAVY)

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practice projectile (*Figure 71*) which has no fuze, and a dummy type used for training in service of the piece. All of these projectiles except the dummy have a false ogive or a windshield. The windshield of the armor-piercing projectile has an ogive of $10\frac{1}{2}$ calibers radius, whereas that of the high explosive projectile is conical. The armor-piercing and practice types have "square" bases (surface to rear of rotating bands is cylindrical). The high explosive type is boat-tailed (surface to the rear of the rotating band is tapered). The armor-piercing and high explosive projectiles are fitted with base covers to prevent the hot gases from the propelling charge from coming in contact with the bursting charge in the projectile through possible flaws in the base. The weight of each projectile is included in the marking. The armor-piercing and high explosive projectiles are shipped fuzed. The armor-piercing and practice projectiles are shipped in crates; the high explosive projectile is shipped in a wooden packing box. All three types are fitted with grommets to protect the rotating band.

138. SHELL, A.P., 260-LB. (NAVY), MK. XX, W/FUZE, B.D., MK. X, 8-INCH GUNS. — This armor-piercing projectile (*Figure 69*) has an armor-piercing cap and false ogive or windshield. It has two bourrelets, one just to the rear of the ogive, the other to the rear of the rotating band. Both bourrelets are 7.977 inches in diameter. A fuze of the base-detonating type, FUZE, B.D., Mk. X, is fitted to the base of the projectile as shipped. The projectile, weighing approximately 260 pounds, contains an explosive filler of 3.40 pounds of ammonium picrate (Explosive D). After removal of packing material and grommet, the projectile is ready for firing.

139. SHELL, H.E., 240-LB., M103, W/FUZE, P.D., M51-MOD. 1, W/BOOSTER, M21, 8-INCH GUN, MK. VI-MOD. 3A2 (NAVY). — This high explosive projectile (*Figure 70*) is fitted with FUZE, P.D., M51-Mod. 1, w/BOOSTER, M21. It has a windshield, and two bourrelets each 7.990 inches in diameter. The front bourrelet is just to the rear of the windshield. The rear bourrelet is separated into two parts, one just in front of the rotating band, the other just to the rear. The rotating band, 3.3 inches wide, is located approximately six inches forward of the base. The boat-tailed base has a taper of 6° . A base cover is welded or caulked to the base of the shell. This shell, weighing approximately 240 pounds, contains an explosive filler of twenty-one pounds of TNT. The fuze in this projectile as shipped is arranged for delay action; hence, after removal of the packing material, the projectile is ready for firing for delay action. For superquick action, the fuze is arranged as described in paragraph 147.

140. SHELL, C.I., 260-LB., MK. XVIII, 8" GUN. — This practice projectile (*Figure 71*) has a cast iron body and a steel windshield. It is similar in size, shape, and weight to the armor-piercing projectile described in paragraph 138 but contains no explosive. Provision is made in the base of the projectile

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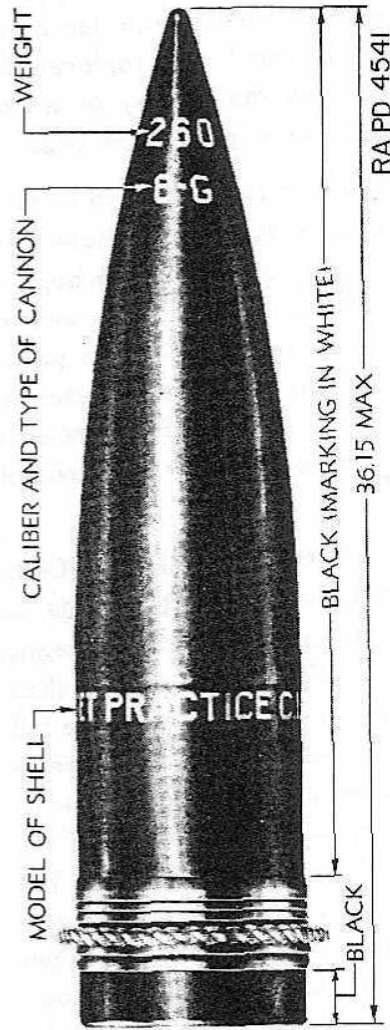


FIGURE 71 — SHELL, C. I., 260-LB., MK. XVIII, 8" GUN

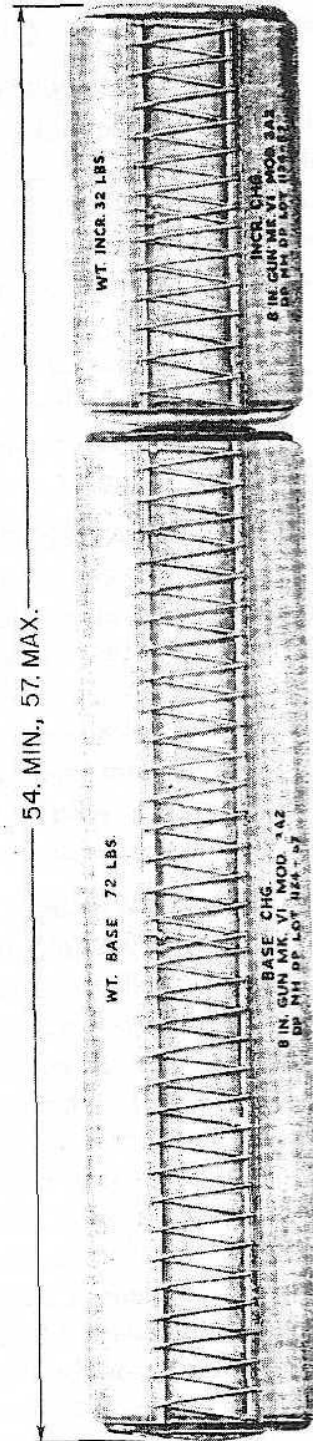
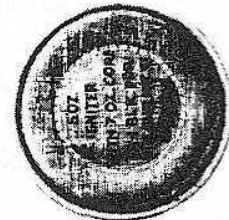


FIGURE 72 — CHARGE, PROPELLING, BASE AND INCREMENT, NH POWDER, 8" GUN, MK. VI-MOD. 3A2 (NAVY), 240-LB. AND 260-LB. PROJECTILE



GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1

for a tracer, or, if a tracer is not used, a metal plug. After removal of the packing material, the projectile is ready for firing.

141. PROJECTILE, DUMMY, 260-LB., T12, 8" GUN, MK. VI-MOD. 3A2. — This drill projectile is designed for training in service of the piece. Its principal parts are the bronze cap, steel body, bronze front band, steel base, and steel rear ring with bronze rear band. The bronze cap is ogival in shape and is attached to the forward end of the body. The bronze front band simulates the bourrelet of a service projectile. The steel rear ring is mounted on the cylindrical portion of the base and can slide freely upon it. The bronze rear band, mounted on the rear ring, simulates the rotating band of a service projectile. Both front and rear bronze bands are replaceable. As this projectile is not fired, it must be removed from the gun by means of an extractor after each loading operation as described in paragraph 153.

142. PROPELLING CHARGES. — The propelling charges used in this gun consist of a service charge and a dummy charge, both of the base and increment type. The service charge consists of smokeless powder in two bags — one, the base section and the other, the increment section. The base section of the service charge is fitted with a black powder igniter, described in paragraph 143. As shipped, both ends of the base section of the service charge are covered by igniter protector caps. The dummy (drill) charge simulates the service charge in size, weight, and general appearance; it is provided for training in handling, and in service of the piece.

143. CHARGE, PROPELLING, BASE AND INCREMENT, NH POWDER, 8-INCH GUN, MK. VI, MOD. 3A2 (NAVY), 240-LB. AND 260-LB. PROJ. —
a. Description. — This propelling charge (Figure 72) is composed of two sections — the base section and the increment section. Each section consists of unstacked grains of nonhygroscopic (NH) smokeless powder in a laced cloth bag. The full charge (base and increment) is the supercharge and is used only for extreme ranges; it is $9\frac{1}{4}$ inches in diameter and has an overall length (both sections) of approximately 57 inches, the base section being 40 inches long and the increment section, 17 inches long. This supercharge weighs approximately 104 pounds — 72 pounds for the base section and 32 pounds for the increment section. The base section alone is the normal charge; it is used for all ranges up to the maximum obtainable with it. The igniter consists of a core and 2 pads, all three containing black powder. The core extends through the axis of the base section, each end terminating in a pad sewed to the end of the section. The total igniter charge consists of 17 ounces of black powder — 5 ounces in each of the 2 pads and 7 ounces in the core. The cloth of the igniter pads is dyed red to indicate that they contain black powder. The base and the increment sections are not attached. All necessary data concerning the charge are contained on the data tag (paragraph 133d). The following identifying markings are stenciled on the charge:

AMMUNITION

On the base section —

EACH END
5 OZ.
IGNITER
WITH 7 OZ. CORE
A-1 BLACK POWDER
8-IN. GUN, MK. VI
MOD. 3A2

SIDE
WT. BASE 72 LBS.
BASE CHG.
8-IN. GUN, MK. VI-MOD. 3A2
XX NH XX LOT XXXX

On the increment section —

EACH END
Unmarked

SIDE
WT. INCR. 32 LBS.
INCR. CHG.
8-IN. GUN, MK. VI-MOD. 3A2
XX NH XX LOT XXXX

b. *Preparation for firing.* — To prepare the charge for firing, it is only necessary to remove the igniter protector caps and the data tag. As the normal charge (base section) has an igniter pad at each end, it may be loaded into the gun, either end toward the breech.

CAUTION: When firing the supercharge (base and increment sections), the increment section will be loaded first; either end may be toward the breech as both ends are alike. The base section will then be loaded; either end may be toward the breech as the igniter pads in each end are alike. If the base section should be loaded first, the charge will not burn properly and this might result in a serious accident should a hangfire occur.

144. CHARGE, PROPELLING, DUMMY, (72-LB. BASE WITH 32-LB. INCREMENT) M5, 8-INCH GUN, MK. VI-MOD. 3A2. — This dummy charge is used for drill purposes with the dummy projectile listed in the table in paragraph 135 and described in paragraph 141. It is of the base and increment type simulating the service propelling charge described in paragraph 143. It consists of a quantity of small hardwood and lead cylinders (simulated smokeless powder grains) contained in cotton duck bags which are similar in size and shape to those of the service charge. There are no simulated igniter pads on this charge. A strap of cotton duck is sewed to one end of both the base and the increment sections for use in removing the charge from the chamber of the gun by the extractor described in paragraph 153.

145. FUZES. — a. *General.* — A fuze is a mechanical device used with a projectile to explode it at the time and under the circumstances desired. Fuzes may be classified according to the manner of functioning as time or impact. A further division — as to type of action after impact — is superquick and delay.

b. *Boresafe fuzes.* — Dependent upon the manner of arming, certain fuzes are considered boresafe as distinct from those that do not come within the definition of boresafe fuzes. A boresafe fuze is one in which the explosive train is so

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1

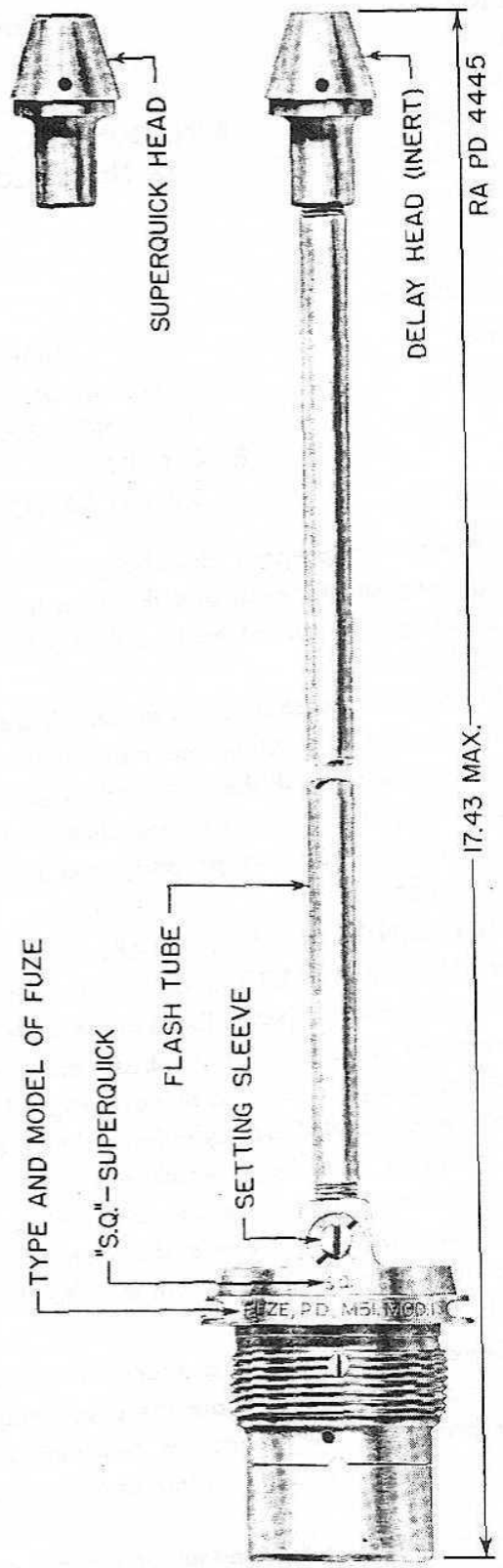


FIGURE 73 - FUZE, P. D., M51-MOD. 1, W/BOOSTER, M21

AMMUNITION

interrupted that, prior to firing and while the projectile is in the bore of the gun, premature detonation of the bursting charge of the projectile is prevented should any of the more sensitive explosive elements in the fuze function prematurely.

NOTE: No attempt will be made to disassemble any fuze or part thereof. The only authorized assembling or disassembling operation is that of changing the fuze head of the FUZE, P.D., M51-Mod. 1, as described in paragraph 147.

146. FUZE, B.D., MK. X. — This base-detonating fuze is the standard delay fuze for major caliber armor-piercing projectiles. Due to the arrangement of the explosive elements, it is classified as a boresafe fuze. Being assembled in the base of the projectile and covered by the base cover, the fuze is not visible.

147. FUZE, P.D., M51-MOD. 1, W/BOOSTER, M21. — *a. General.* — This fuze, a boresafe type, is shown assembled to the shell as shipped in Figure 70, and in greater detail in Figure 73. The fuze is so designed that it may be arranged for either delay or superquick action, to accomplish which, two heads are provided. One, the delay head (inert) is assembled to the shell as shipped; the other, the superquick head, which contains a firing pin and primer, is shipped in a separate container, but in the same packing box as the shell. The complete delay element and mechanism, including the delay firing pin, is housed in the body of the fuze; delay action requires that the delay head (inert) be used. Superquick action is obtained when the superquick head is used in place of the delay head. These two heads are distinguished by differences in the end — the delay head is solid brass, whereas the superquick head is closed with a disk of aluminum, crimped in place. The delay action is always operative; hence if the fuze is arranged for superquick action and this action should fail, the fuze will still function with delay action. As assembled and shipped, this fuze is covered by the windshield except that the delay head protrudes approximately $\frac{3}{4}$ inch.

b. A retaining screw, packed in the box with the high explosive projectile, is intended for use only with the delay head of the FUZE, P.D., M51-Mod. 1, when this fuze is replaced by a time fuze. The time fuze does not have an extended flash tube, hence the requirement for this retaining screw to secure the delay head to the end of the windshield.

c. Preparation for firing. — As shipped, the fuze of this projectile is arranged for delay action; hence when delay action is required, the projectile is fired as shipped. To arrange the fuze for superquick action:

- (1) Unscrew the delay head from the point of the projectile with the fuze wrench provided for this purpose.
- (2) Assemble superquick head in place of the delay head and tighten with the fuze wrench.

148. PRIMER. — A primer used with rounds of separate loading ammunition consists in general of a small quantity of high explosive which is sensitive to heat or percussion, and an appropriate firing device, together with a quantity of black powder — all contained in a brass cylindrical container similar

GUN, 8 IN., MK. VI, MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1

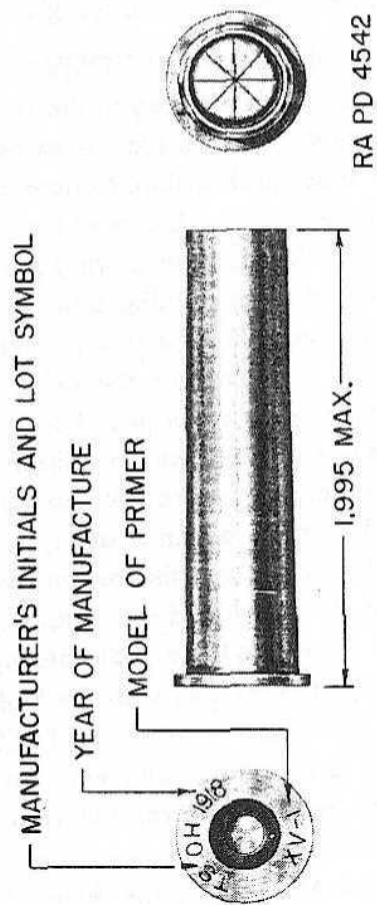


FIGURE 74 — PRIMER, COMBINATION ELECTRIC AND PERCUSSION, MK. XV-MOD. 1

AMMUNITION

in shape to a shot gun shell or a blank cartridge. The primer is used for firing the igniter charge which is attached to the service propelling charge.

149. PRIMER, COMBINATION ELECTRIC AND PERCUSSION, MK. XV-MOD. 1. — This primer, shown in Figure 74, is standard for all cannon using separate loading ammunition and equipped with the combination electric-percussion firing mechanism. The primer consists of a brass case which contains a primer charge of 30 grains of black powder and two initiating elements — one, electric; the other percussion. Thus the primer may be fired by percussion should the electric circuit fail.

150. PACKING. — a. Complete packing data covering dimensions, volume, and weight of the various components of the ammunition described herein are published in SNL P-1, P-3, P-6, and P-7.

b. Although weights of individual projectiles vary somewhat, dependent upon the type and model — propelling charges likewise, dependent upon the particular powder charge — the following data are considered representative for estimating weight and volume requirements:

	Weight (pounds)	Volume (cubic feet)
8" projectiles as shipped		
High explosive, one per box.....	286	3.89
Over-all dimensions (inches):		
46 $\frac{5}{8}$ x 12 x 12		
Armor-piercing and practice, one per crate.....	292	3.22
Over-all dimension (inches):		
42 $\frac{1}{8}$ x 11 $\frac{1}{2}$ x 11 $\frac{1}{2}$		
Propelling charge		
Charge without packing material.....	107	...
As shipped, packed in an individual metal cartridge storage case, one case (1 charge) per crate..	171	5.81
Over-all dimensions of crate (inches):		
66 $\frac{1}{4}$ x 12 $\frac{5}{8}$ x 12 $\frac{5}{8}$		
Primers. As shipped, packed 24 per metal container, 42 containers (1008 primers) per box.....	126	2.00
Over-all dimensions of box (inches):		
24 x 12 x 12		

151. FIELD REPORT OF ACCIDENTS. — Any serious malfunction of ammunition must be promptly reported to the ordnance officer under whose supervision the materiel is maintained or issued (see paragraph 7, AR 45-30).

SECTION XI
ORGANIZATION SPARE PARTS AND ACCESSORIES

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152. ORGANIZATION SPARE PARTS. — *a.* A set of organization spare parts is supplied to the using arm for field replacement of those parts most likely to become broken, worn or otherwise unserviceable. The set is kept complete by requisitioning new parts for those used. Organization spare parts are listed in pertinent SNL'S.

b. Care of organization spare parts is covered in Section IV of this manual.

153. ACCESSORIES. — *a.* Accessories include 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, 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 those prescribed, and when not in use should be properly stored.

b. There are a number of accessories whose names or general characteristics indicate their use. Others, embodying special features or having special uses, are described below:

c. Brush, slush. — The slush brush is a cylindrical piece of wood to which is attached bristles fastened with hard brass wire. It is used to coat the rifling of the gun with lubricating oil or other slushing compound necessary for the prevention of rust and decomposition.

d. Brush, wire cleaning. — The brush is used for cleaning the bore of the gun.

e. Extractor, hand (for drill projectile). — The hand extractor consists of a long wooden pole, one end fitted with a bronze hook, while near the other is a bronze handle. To remove the drill projectile, the hook end is inserted in a cavity in the base of the projectile. The pole is then pulled smartly backward, causing the great mass of the drill projectile to strike the rear ring and band. This momentum is usually sufficient to loosen the rear band and the drill projectile may be drawn from the gun.

f. Extractor, power — The power extractor consists of a steel bar threaded on one end and formed on the other into a hook, similar to that on the hand extractor. Immediately above the threaded end of the bar is a square section which fits into a squared hole in a cast steel yoke and prevents the bar from turning. The yoke fits on the breech face of the gun. A steel washer and steel nut are placed on the threaded end of the bar. The drill projectile is forced from the gun by turning up the nut which exerts considerable power due to the coarse, pitch thread.

ORGANIZATION SPARE PARTS AND ACCESSORIES

g. Hook, assembling, elevating worm case. — The elevating worm case assembling hook is of steel. One end is designed to engage in a boss provided on the elevating worm case housing (Figure 14) to enable the housing to be suspended in balance while assembling the housing bolts and nuts. It is locked in place in the housing by a set screw during the operation of assembling. The opposite end of the hook is provided with a three-inch bevel-edged hole for engagement with the crane hook or other lifting device employed.

h. Prop, sponge. — The sponge prop is used as a stand for the sponge and staff. The head end of the sponge and staff rests upon the support to facilitate changing of head parts, and to insure that head parts are kept clean by being kept off the ground.

i. Pump, force (plumber's). — This hand pump, connected with a hose, is used to force water under pressure to inaccessible parts of the gun to facilitate cleaning and rinsing.

j. Scraper. — The scraper may be attached to the same staff as the brush. It is used to scrape loose the rust preventive compound and other substances which have hardened to the surfaces and require more than a brush to dislodge.

k. Tub, sponge. — The sponge tub is used to rejuvenate used sponges. The tub is filled with a special cleaning compound in which the used sponges are allowed to soak.

l. Book, artillery gun. — The gun book (O. O. Form 5825) is used to keep an accurate record of the materiel and remains with the piece regardless of where it may be sent. It includes records of assignments, the battery commander's daily record, and the inspector's record of ammunition, as well as forms to be filled out in case of premature explosions. This book should be in the possession of the organization at all times. It is the sole responsibility of the organization commander as to the completeness of the record and as to the whereabouts of the book. It must also contain the date of issuance of the materiel, to and by whom issued, and the place where issued. If a new cannon is installed on the carriage, all data in the old book with references to sights, carriage, etc., must be copied into the new gun book before the old gun book is relinquished.

(NOTE: Records of assignment data must be removed and destroyed prior to entering combat.)

SECTION XII

MATERIEL AFFECTED BY GAS

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154. PROTECTIVE MEASURES. — *a.* When materiel is in constant danger of gas attack, unpainted metal parts will be lightly coated with engine oil. Instruments are included among the items to be protected by oil from chemical clouds or chemical shells, but ammunition is excluded. Care will be taken that the oil does not touch the optical parts of instruments or leather or canvas fittings. Materiel not in use will be protected with covers as far as possible. Ammunition will be kept in sealed containers.

b. Ordinary fabrics offer practically no protection against mustard gas or lewisite. Rubber and oilcloth, for example, will be penetrated within a short time. The longer the period during which they are exposed, the greater the danger of wearing these articles. Rubber boots worn in an area contaminated with mustard gas may offer a grave danger to men who wear them several days after the bombardment. Impermeable clothing will resist penetration more than an hour, but should not be worn longer than this.

155. CLEANING. — *a.* All unpainted metal parts of materiel that have been exposed to any gas except mustard and lewisite must be cleaned as soon as possible with SOLVENT, dry cleaning, or ALCOHOL, denatured, and wiped dry. All parts should then be coated with engine oil. The using arm will decontaminate the exterior surfaces, the bore, the breechblock assembly, and all porous attachments such as straps, covers, etc., of artillery field pieces exposed to gas.

b. Ammunition which has been exposed to gas must be thoroughly cleaned before it can be fired. To clean ammunition use AGENT, decontaminating, non-corrosive, or if this is not available, strong soap and cool water. After cleaning, wipe all ammunition dry with clean rags. *Do not use dry powdered AGENT, decontaminating (chloride of lime) (used for decontaminating certain types of materiel) on or near ammunition supplies, as flaming occurs through the use of chloride of lime on liquid mustard.*

156. DECONTAMINATION. — For the removal of liquid chemicals (mustard, lewisite, etc.) from materiel, the following steps should be taken:

a. Protective measures. — (1) For all of these operations a complete suit of impermeable clothing and a service gas mask will be worn. Immediately after removal of the suit, a thorough bath with soap and water (preferably hot) must be taken. If any skin areas have come in contact with mustard, if even a very small drop of mustard gets into the eye, or if the vapor of mustard

MATERIEL AFFECTED BY GAS

has been inhaled, it is imperative that complete first-aid measures be given within 20 to 30 minutes after exposure. First-aid instructions are given in TM 9-850 and FM 21-40.

(2) Garments exposed to mustard will be decontaminated. If the impermeable clothing has been exposed to vapor only, it may be decontaminated by hanging in the open air, preferably in sunlight for several days. It may also be cleaned by steaming for 2 hours. If the impermeable clothing has been contaminated with liquid mustard, steaming for 6 to 8 hours will be required. Various kinds of steaming devices can be improvised from materials available in the field.

b. Procedure. — (1) Commence by freeing materiel of dirt through the use of sticks, rags, etc., which must be burned or buried immediately after this operation.

(2) If the surface of the materiel is coated with grease or heavy oil, this grease or oil should be removed before decontamination is begun. SOLVENT, dry cleaning, or other available solvents for oil should be used with rags attached to ends of sticks.

(3) Decontaminate the painted surfaces of the materiel with bleaching solution made by mixing one part AGENT, decontaminating (chloride of lime), with one part water. This solution should be swabbed over all surfaces. Wash off thoroughly with water, then dry and oil all surfaces.

(4) All unpainted metal parts and instruments exposed to mustard or lewisite must be decontaminated with AGENT, decontaminating, non-corrosive, mixed one part solid to fifteen parts solvent (ACETYLENE TETRACHLORIDE). If this is not available, use warm water and soap. Bleaching solution must not be used, because of its corrosive action. Instrument lenses may be cleaned only with PAPER, lens, tissue, using a small amount of ALCOHOL, ethyl. Coat all metal surfaces lightly with engine oil.

(5) In the event AGENT, decontaminating (chloride of lime) is not available, materiel may be cleaned temporarily with large volumes of hot water. However, mustard lying in joints or in leather or canvas webbing is not removed by this procedure and will remain a constant source of danger until the materiel can be properly decontaminated. All mustard washed from materiel in this manner lies unchanged on the ground, necessitating that the contaminated area be plainly marked with warning signs before abandonment.

(6) The cleaning or decontaminating of materiel contaminated with lewisite will wash arsenic compounds into the soil, poisoning many water supplies in the locality for either men or animals.

(7) Leather or canvas webbing that has been contaminated should be scrubbed thoroughly with bleaching solution. In the event this treatment is insufficient, it may be necessary to burn or bury such materiel.

(8) Detailed information on decontamination is contained in FM 21-40, TM 9-850, and TC 38, 1941, Decontamination.

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157. SPECIAL PRECAUTIONS FOR GENERATING UNIT. — a. When unit has been subjected to gas attack with the engine running, the air cleaner should be serviced by removing the oil, flushing with SOLVENT, dry cleaning, and refilling with the proper grade of oil.

b. Instrument panels should be cleaned in the same manner as outlined for instruments.

c. Washing the compartments thoroughly with bleaching solution is the most that can be done in the field. Operators should constantly be on the alert, when running under conditions of high temperatures, for slow vaporization of the mustard or lewisite.

**GUN, 8 IN., MK. VI. MOD. 3A2 AND MOUNT, RAILWAY, GUN, 8 IN., M1A1
SECTION XIII**

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- Fuzes and primers..... SNL P-6
- Propelling charges..... SNL P-3
- Separate loading projectiles..... SNL P-1

b. Cleaning, preserving, and lubricating materials.. SNL K-1

c. Firing tables SNL F-69

d. Gun materiel.

- Board, adjustment, fire, M1..... SNL F-116
- Board, correction, range, M1..... SNL F-81
- Board, correction, range, M1A1..... SNL F-81
- Board, deflection, M1..... SNL F-19
- Board, plotting and relocating, M1..... SNL F-100
- Board, spotting, M3
- Clinometer, M1912
- Corrector, percentage, M1..... SNL F-103
- Finder, range, stereoscopic, 6-meter base, M2.. SNL F-164
- Indicator, wind component, M1..... SNL F-56
- Instrument, azimuth, M1910A1 (degrees)..... SNL F-84
- Instrument, azimuth, M1918 (mils)..... SNL F-149
- Gun, 8 in., Mk. VI, Mod. 3A2, Mount, Railway,
 Gun, 8 in., M1 and M1A1..... SNL E-34
- Mount, telescope, M20..... SNL F-186
- Quadrant, elevation, M1
- Quadrant, gunner's, M1
- Quadrant, gunner's, M1918 (mils)..... SNL F-13
- Rule, aiming, M1918, with sights..... SNL F-108
- Rule, set forward, type B..... SNL F-57
- Sights, bore
- Telescope, panoramic, M8..... SNL F-196
- Trainer, stereoscopic, M2..... SNL F-193
- Unit, generating, M1..... SNL M-1

e. Kit, repair, optical, for harbor defense..... SNL F-93

Current Standard Nomenclature Lists are as tabulated here.

An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index"..... OPSI

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159. EXPLANATORY PUBLICATIONS.

a. Ammunition.

- Ammunition, coast artillery TM 4-205
- Ammunition, general TM 9-1900
- Range regulations for firing ammunition in times
of peace AR 750-10

b. Cleaning, and preserving materials..... TM 9-850

c. Gun materiel.

- Boards, plotting, for coast artillery..... TM 9-1570
- Instruction guide — Generating unit, M1..... TM 9-2615
- Instruction guide — Sighting equipment, 8-inch
gun railway mount, M1..... TM 9-2674
- Instruction guide — Spotting board, M3..... TM 9-2682
- Instrument, azimuth, M1910 and M1910A1
(degrees) TM 9-1675
- Instrument, azimuth, M1918 (mils)..... TM 9-1680
- Seacoast artillery, fire control and position
finding FM 4-15
- Telescope, panoramic, M8..... TM 9-1582

d. Maintenance.

- Electric and oxiacetylene welding..... OFSB 5-2
- Instructions for packing railroad car journal
bearings OFSB 6-E-1
- Lubrication instructions for mount, 8-inch
railway, M1A1 gun, 8-inch, Mk. VI, Mod.
3A2 (SNL E-6)..... OFSB 6-E-34
- Maintenance of materiel in the hands of troops.. OFSB 4-1
- Defense Against Chemical Attack..... FM 21-40
- Decontamination TC 38, 1941

160. FIRING TABLES.

- a. Firing tables for gun, 8-inch, Mk. VI, Mod. 3A2. FT 8-I-1*

[A.G. 062.11 (1-6-42)]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

Distribution:

1R 4 (5); IBN 4 (5); IC 4 (10); 9 (3)

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