

W1.35. 9-350

W1.35: 9-350

TM 9-350

NON-CIRCULATING

Document
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WAR DEPARTMENT

TECHNICAL MANUAL

155-MM GUN MATÉRIEL M1

May 11, 1942

TM 9-350, 155-MM GUN MATÉRIEL M1

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W11.35: 9-350

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TECHNICAL MANUAL

155-MM GUN MATÉRIEL M1

CHANGES }
No. 1 }

WAR DEPARTMENT,
WASHINGTON, July 31, 1942.

TM 9-350, May 11, 1942, is changed as follows:

SECTION XVI (ADDED)

STORAGE AND SHIPMENT BY RAIL

Storage.....	Paragraph 108
Shipment by rail.....	109

108. **Storage.**—*a. General instructions.*—Store the 155-mm gun and carriage M1 with gun in traveling position but not dismantled from the carriage. Take all precautions to prevent corrosion, to keep the recoil mechanism and equilibrators exercised, and to prevent deterioration of rubber. Lubricate the carriage completely before storing.

b. Rust prevention on unpainted surfaces.—(1) *Exterior surfaces.*—All unpainted exterior surfaces must be protected from corrosion in the following manner: First, films of moisture and other corrosive agents must be removed from all surfaces. This is done by thoroughly cleaning the surfaces with solvents, such as solvent, dry-cleaning, or with a hot, soapy water solution. After a soap solution is used, the surfaces must be rinsed with clean, hot water. Then dry the surfaces thoroughly before applying the rust preventive. The rust preventive used will be compound, rust-preventive, light, for short time storage. Thin film compound, rust-preventive, will be used on flat readily accessible exterior surfaces from which it can readily be removed, when the matériel is stored for long periods of time. Apply this to the surface by brushing or spraying. The rust preventive may be removed with solvent, dry-cleaning, by means of a cloth or brush.

(2) *Interior surfaces.*—All unpainted interior surfaces from which it would be difficult to remove a hardened rust preventive, such as the inside of the barrel, will be protected against corrosion with compound, rust-preventive, light. The surfaces will be cleaned and the rust preventive applied as described in (1) above. The rust preventive must be completely removed before the mechanism is used.

c. Sealing the barrel.—After the above operations are complete, a piece of canvas or burlap should be impregnated with compound, rust-preventive, light, and placed over the muzzle of the gun and firmly tied or strapped in place. The breech is also sealed by use of heavy grease and the breech cover and carriage covers are put in place.

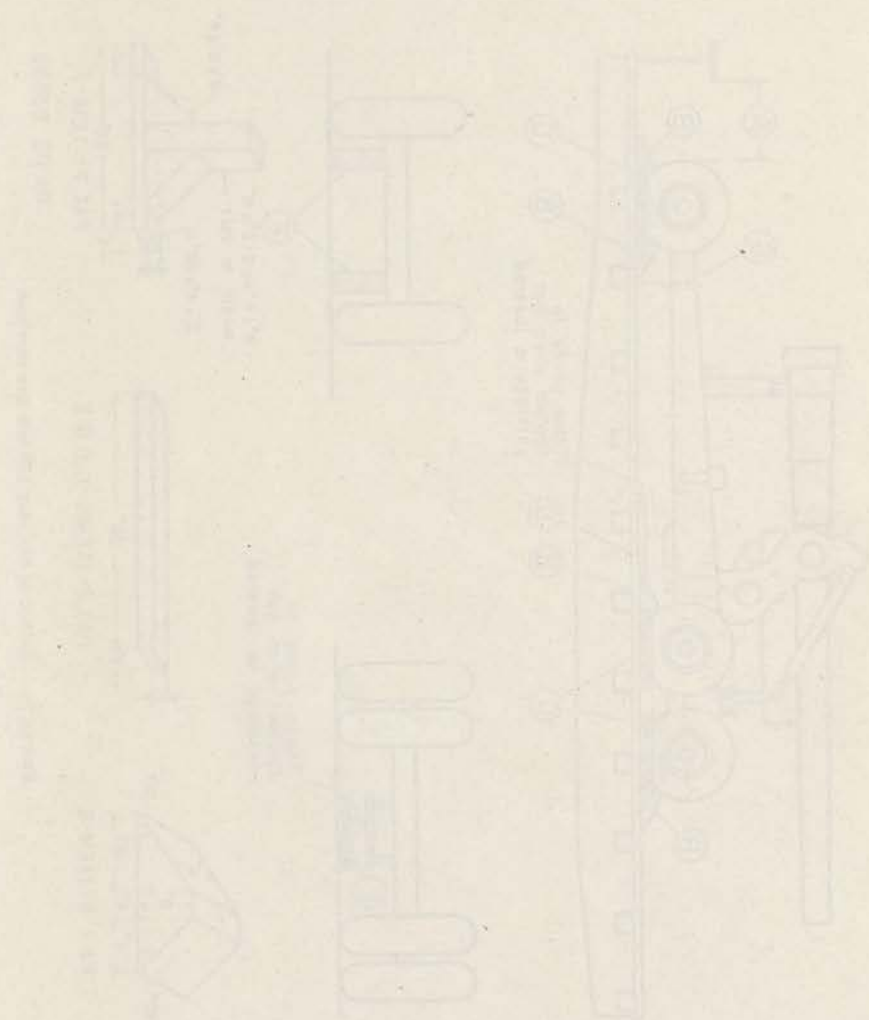
(2) Place blocking F under the limber axle to relieve partially the weight on the tire. The wheels are now blocked using B and C. Then secure the trails to the stake pockets with No. 8 gage, black annealed wire. Take care to protect the points of contact between the carriage and the wire with canvas or burlap.

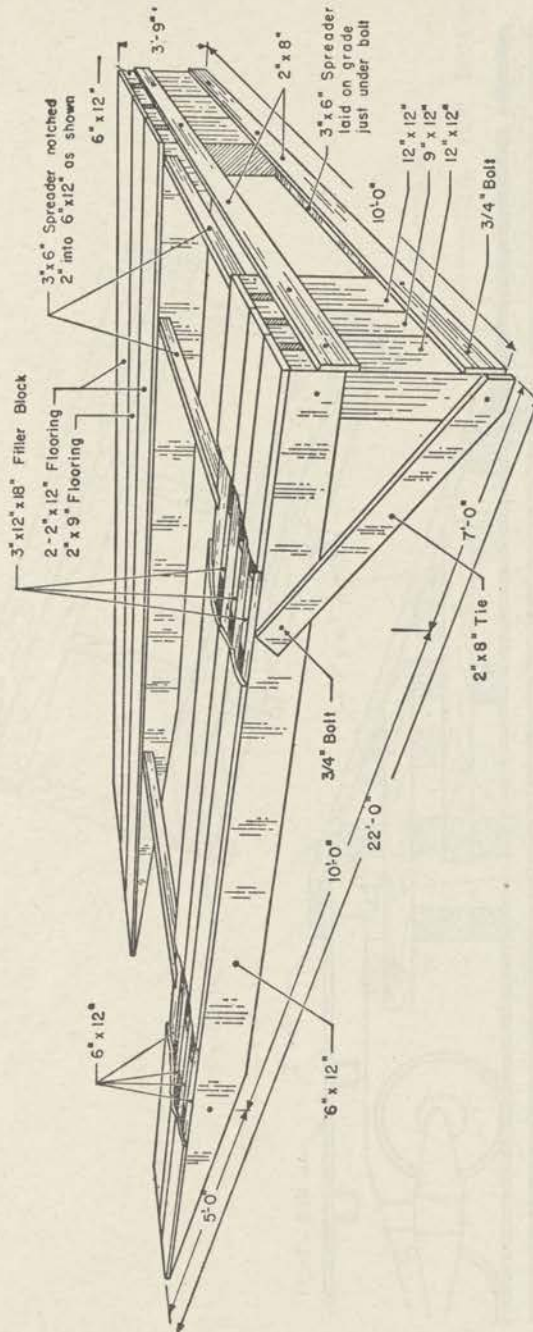
f. Minimum requirements for securing 155-mm gun M1 howitzer carriage.

Item	Number of pieces	Description
A-----		Brake wheel clearance, 6 inches minimum.
B----- 8-----	6-	by 8- by 24-inch blocks (pattern 3). Height at point of contact with tire must be not less than 4 inches from car floor. Nail heel of block to car floor with three 40d nails and toe-nail that portion under tire to car floor with two 40d nails before items C are applied.
C----- 12-----	2-	by 4- by 26-inch cleats (pattern 2). Nail lower piece to car floor with three 40d nails and top piece to one below with three 40d nails.
D----- 2 each side-----	2-	by 4- by 36-inch cleats (pattern 2). Place side by side, lengthwise of car, and nail each to car floor with three 40d nails. Lower carriage to rest on items D enough to relieve partially weight on tires.
E----- As required-----		Fill space under front end of gun carriage with 2- by 4- by 36-inch pieces (pattern 2). Wedge tight and secure to prevent displacement.

- F----- 2----- Brace (pattern 7), length $\frac{1}{4}$ inch longer than the distance between axle of timber and car floor. Place between car floor and axle to relieve partially weight on tires. Nail each to car floor with six 40d nails.
- G----- 1----- 6 strands, 3 wrappings, No. 8 gage black annealed wire. Loop around and over top of rear end of gun trail and secure to opposite stake pockets. Twist tie with rod or bolt on both sides of trail.

Brakes must be applied.

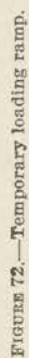




RAPD 23938

Figure 71.—Permanent loading ramp.





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TM 9-350
C 1

[A. G. 062.11 (4-30-42).] (C 1, July 31, 1942.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

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W1.35:9-350
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TECHNICAL MANUAL

155-MM GUN MATÉRIEL M1

CHANGES }
No. 2 }

WAR DEPARTMENT,
WASHINGTON, October 29, 1942.

TM 9-350, May 11, 1942, is changed as follows:

1. Scope and data.

b. Data.—(1) *Weights, dimensions, and ballistics of 155-mm gun M1 and M1A1.*

Muzzle velocity (maximum zone charge)— **feet per second**— 2,800

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

10. Recoil mechanism.—*a. General.*—The recoil mechanism * * *. The counterrecoil mechanism is used to return the recoiling mass into battery so that the gun is ready to be fired again. A recoil marker * * * top of the cradle.

c. Counterrecoil.—(1) The counterrecoil mechanism * * * counterrecoil action starts. The oil in the rear end of the recuperator is throttled through the regulator valve in returning to the counter-recoil cylinder and forces the counterrecoil piston and the gun back into the battery position.

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

23. Firing.

c. Recoil.—During firing, the length * * *. Figures 24 and 25 show the limits of allowable recoil of the gun at all elevations, for muzzle velocities of 2,100 **feet per second** and 2,800 **feet per second**, when operated at normal temperature of the recoil oil (70° F.). For the first round fired and at other temperatures, the length of recoil may not be within the limits shown in the illustrations. However, if the length * * * should be notified.

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

37. Inspection of carriage.

Parts to be inspected in order of inspection

* * * *

f. Bogie.

Points to observe

* * *

f. Note any scores of ratchet wrenches. Check odometer. Check to see that the leaf spring clips are tight and that the spring center bolts are not worn.

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

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charges 2

41. Malfunction of carriage.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
* *	* *	* *
<i>m.</i> Gun does not recoil full distance.	<i>m.</i> (1) High viscosity of oil due to low temperature.	<i>m.</i> (1) After firing two or more rounds, the recoil will become normal.
* *	* *	* *

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

47. Assembly of firing mechanism.—Place the firing pin guide in its seat in the block and screw the primer holder firmly into its seat, which will hold the guide in position. Aline the nearest serration in the primer holder in the center of the setscrew hole. Lock the primer holder * * * assemble the safety setscrew. When the setscrews are seated, they must be flush or below the outside of the firing mechanism blocks. Insert the firing mechanism * * * straight steel pin.

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

651½ (added). Compass M2.—*a. General.*—The compass M2 (figs. 531½ and 532½) is a multiple-purpose instrument used for measuring angles of site, clinometer angles, and magnetic azimuths. It has been adopted as standard to replace the prismatic compass M1918 (Sperry), which has been reclassified as limited standard.

b. Description.—The compass weighs about 8 ounces, and measures over-all about 2¾ by 2¾ by 1⅛ inches when closed. It consists of a compass and angle of site mechanism contained in a body with a hinged cover. When the cover is closed, the magnetic needle is lifted from its pivot and clamped securely for traveling. The north-seeking end of the magnetic needle is painted white. The compass scale can be oriented on grid (Y) north for any locality. Front and rear sights, together with a mirror in the cover, permit measurements to be made while observing the object.

c. Accessories.—The compass is furnished complete with carrying case M19. The case is velveteen lined and has a leather loop on the back for carrying on the user's belt.

d. Operation.—Compass operating positions are shown in figures 533½ and 534½. The compass should be held as rigidly as possible to obtain the most accurate readings. The use of a sitting or prone position, a rest for the hands or elbows, or a solid support for the compass will help to eliminate unintentional movement of the instrument. When measuring angles in azimuth, the compass should be used away from steel or iron masses which would distort the local magnetic field. The time of oscillation of the magnetic needle can be

shortened by partially depressing the needle locking pin, or the average position of the needle in its swing may be used. Practice in the operation of the compass greatly increases the proficiency and accuracy attained by the operator.

e. To measure angles in azimuth by reading reflected image of azimuth scale.—Hold the open compass in both hands at eye level with arms braced against the body, and the rear sight nearest the eyes. Place the cover at an angle of approximately 45° to the face of the compass (fig. 53 $\frac{3}{5}$) so that the reflected scale can be readily viewed. Level the instrument by means of the reflected circular level, sight on the desired object, and read the azimuth in the reflected image of the scale. The azimuth reading is indicated on the azimuth scale by the south-seeking (black) end of the compass needle. When sighting, hold hands rigid and turn body. The instrument can be sighted by any of the methods below. More accurate readings result from the use of a longer sight base.

(1) Raise the rear sight holder approximately perpendicular to the face of the compass. Sight on the object through the opening in the rear sight holder and through the window in the cover (fig. 53 $\frac{3}{5}$). Keep the compass level and raise or lower the eye along the opening in the rear sight holder until the black center line of the window bisects the object and the opening in the rear sight.

(2) Fold the rear sight holder out, parallel with the face of the compass, with the rear sight perpendicular to its holder. Sight through or over the rear sight and view the object through the window in the cover. If the object sighted is at a lower elevation than the compass, raise the rear sight holder as needed. The compass is correctly sighted when it is level and the operator sees the black center line of the window bisecting the rear sight and the object sighted.

(3) Raise the front sight and the extended rear sight assembly perpendicular to the face of the compass. Sight over the tips of the rear and front sights. If the object is above the line of sighting, fold the rear sight toward the eye as needed. The instrument is correctly alined when, with the level centered, the operator sees the tips of the sights and the center of the object sighted in coincidence.

f. To measure angles in azimuth by reading azimuth scale directly.—

(1) Hold the opened compass in both hands at about waist level, braced against the body, with the rear sight away from the body. Open the cover until the mirror affords a clear image of the object sighted. Extend the rear sight and raise the rear sight assembly until it is approximately perpendicular to the face of the compass. Level the instrument by means of the circular level. Holding arms

rigid and the instrument level, turn body until the center line on the mirror bisects the opening in the rear sight holder and the mirror image of the object sighted.

(2) Then read the azimuth indicated on the azimuth scale by the north-seeking (white) end of the compass needle.

g. To measure angles of site.—(1) Hold the opened compass in a vertical plane as in figure 534½ with the rear sight toward the body and the angle of sight level lever to the right. Open the cover to an angle of approximately 45° to the face of the compass. Fold the rear sight holder out parallel to the face of the compass with the rear sight perpendicular to the holder.

(2) Look through the rear sight and raise or lower the instrument until the center line of the window bisects the opening in the rear sight and the object sighted.

(3) Level the tubular level reflected in the mirror, by means of the lever. Open the cover and read the angle of site opposite the index.

(4) Care must be exercised to maintain the compass in a vertical plane to obtain accurate readings.

h. To measure clinometer angles.—Open the cover and rear sight holder parallel with the face of the compass. Place the edge of the opened compass on the leveling plates of the piece, center the bubble of the tubular level, and read the angle of site.

i. Orientation on grid (Y) north.—(1) The standard reference direction for compass readings is grid (Y) north, corresponding to the grid indications on standard maps. However, due to regional differences in magnetic direction and local disturbances in the magnetic field, the magnetic needle in the compass may point several degrees to either side of the reference direction. The difference between the magnetic direction and the standard reference direction is the declination constant.

(2) Allowance for declination constant can be made in this compass by orienting (shifting) the azimuth scale, using the azimuth scale adjuster (fig. 531½). The slotted head of the adjuster can be turned with an ordinary screw driver.

(3) To determine the declination constant, open the compass and set zero of the azimuth scale against the fixed index in the body by means of the azimuth scale adjuster. Take compass readings on several points of known azimuth. Compute the difference between the compass reading (mean of three readings) of each of the points and the known grid (Y) azimuth. The mean of these differences is the declination constant of the instrument for the particular locality.

(4) If the azimuth readings are greater than the grid azimuth, subtract the declination constant from the azimuth readings or rotate the



Figure 53 1/2.—Compass M2, cover closed.

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

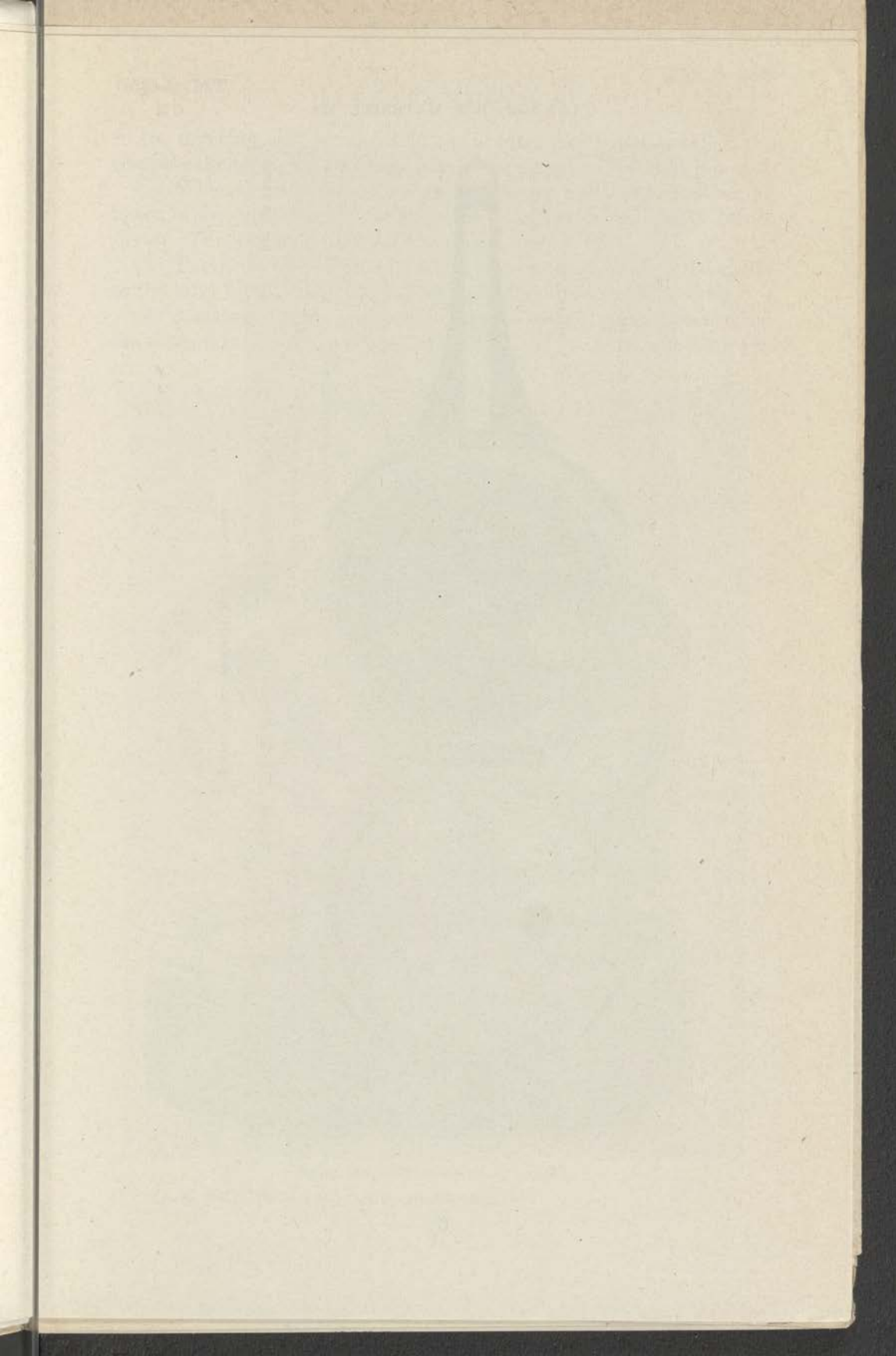
azimuth scale the amount of the declination constant in a counter-clockwise direction by means of the azimuth scale adjuster. If the azimuth readings are less than the grid azimuths, add the declination constant to the azimuth readings or rotate the azimuth scale in a clockwise direction. This orients the compass on grid (Y) north.

(5) An alternate method of finding the declination constant is to use as isogonic chart. This method is less accurate as it does not consider local disturbances in the magnetic field.

(6) If the compass is to be used in another locality, 6 or more miles distant, the declination constant should be redetermined for that locality.

j. Adjustment.—Adjustment for dip of the magnetic needle and errors in the circular and tubular levels may not be made by using arms personnel. However, errors in the tubular level may be determined by comparison against a level or gunner's quadrant of known accuracy. If the error remains constant, it can be compensated for in measuring angles of site or when using the instrument as a clinometer.

k. Care and preservation.—(1) The compass should be handled carefully to avoid unnecessary shocks. It should be closed and kept



155-MM GUN MATÉRIEL M1

TM 9-350

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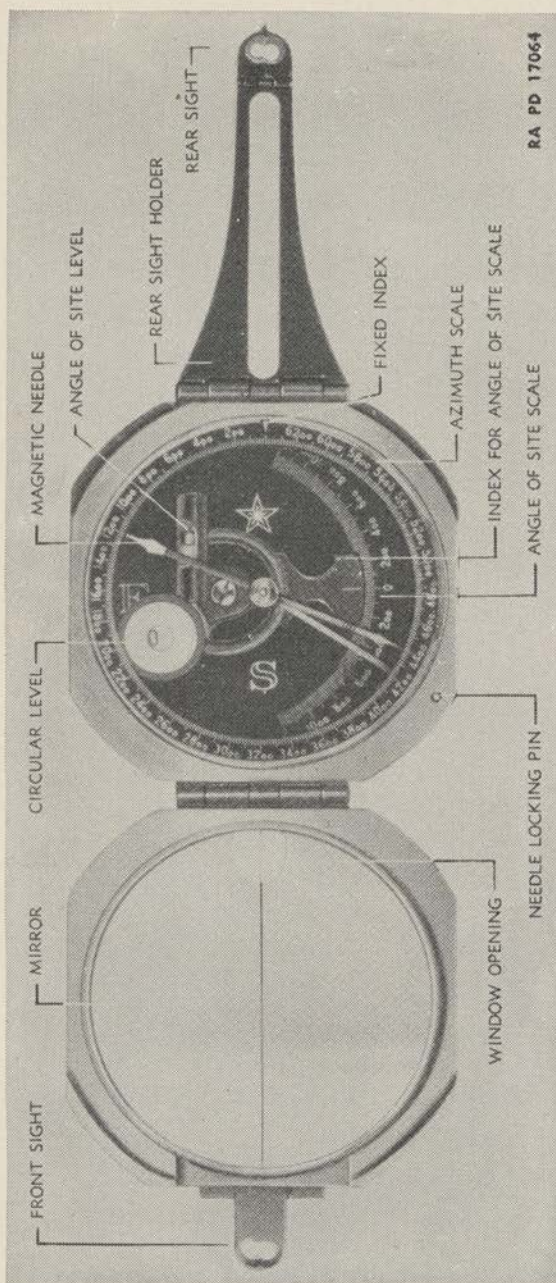


Figure 53.—Compass M2, cover open.

[A. G. 002.11 (9-24-42).] (C 2, Oct. 29, 1942.)

in the carrying case when not in use. After use in wet weather, the compass should be wiped dry before being placed in the carrying case.

(2) When the instrument is moved from one position to another, or is not in use, the cover should be closed, thus locking the needle off its pivot. This prevents injury to the needle pivot.

(3) Particular care should be exercised to prevent bending the sights or the cover hinge. Lay the rear sight flat before closing the cover.

(4) Moisture due to condensation may collect in the instrument when the temperature of the parts is lower than that of the surrounding air.

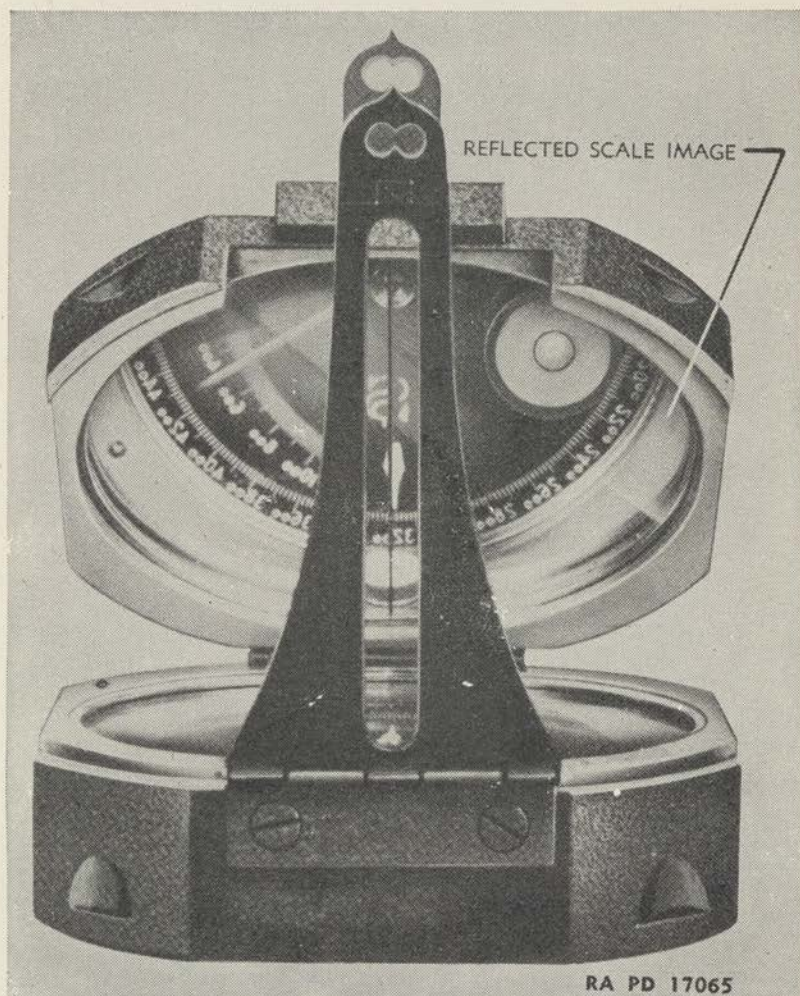


Figure 53%.—Observer's view, azimuth.

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)



The first of the two is a small, square, white building with a flat roof. It is situated on a small, raised platform. The second is a larger, rectangular building with a gabled roof. It is situated on a larger, raised platform. The buildings are surrounded by a low wall. The background is a plain, light-colored surface.

The first of the two is a small, square, white building with a flat roof. It is situated on a small, raised platform. The second is a larger, rectangular building with a gabled roof. It is situated on a larger, raised platform. The buildings are surrounded by a low wall. The background is a plain, light-colored surface.

155-MM GUN MATÉRIEL M1

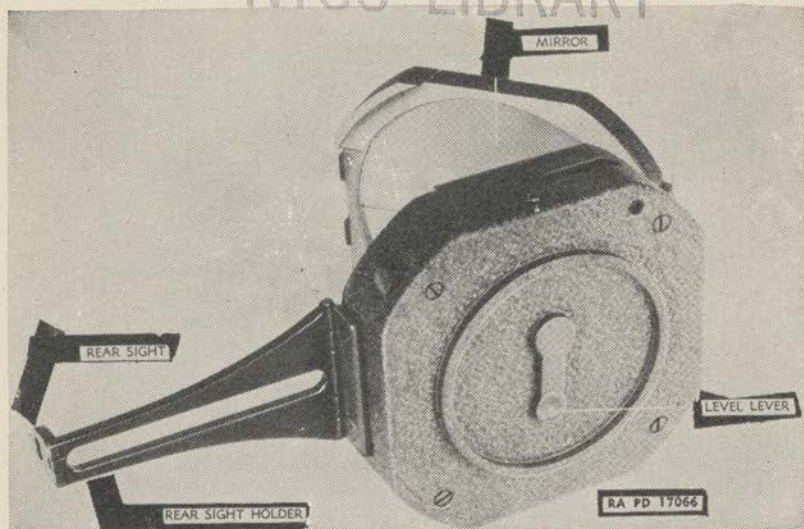


Figure 53 1/2.—Side view, site.

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

This moisture, if not excessive, can be removed by placing the instrument in a warm place.

(5) No lubrication is required.

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

661 1/2 (added). **Graphic firing tables.**—*a. General.*—Graphic firing tables are used to simplify and speed up the conduct of fire and to help reduce the probability of error. The graphic firing table consists of a graduated stock and slide, which form a Mannheim-type slide rule. The range scale on the stock of the rule is plotted logarithmically. All other scales are so plotted as to conform to this range scale. Graphic firing tables are made for each field artillery weapon used for indirect fire and are designated by model.

b. Graphic firing tables M7 and M16.—These are standard for use with the 155-mm gun M1. The M7 table is for use for ranges of 0 to 15,000 yards, and the M16 table for ranges of 10,000 yards and over. Other information is not available at this time.

[A. G. 062.11 (9-24-42).] (C 2, Oct. 29, 1942.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

TECHNICAL MANUAL

155-MM GUN AND CARRIAGE M1 AND M1A1

CHANGES
No. 4

WAR DEPARTMENT,
WASHINGTON 25, D. C., 9 November 1943.

TM 9-350, 11 May 1942, is changed as follows:

37. Inspection of carriage.—The following instructions should be scrupulously observed:

Parts to be inspected in order of inspection

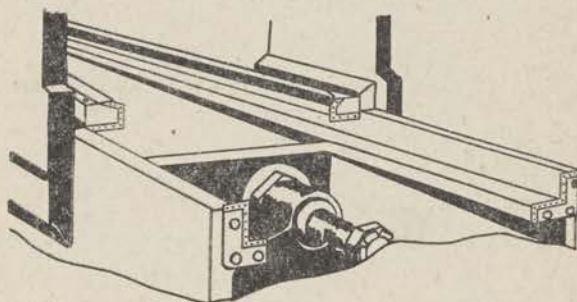
Points to observe

* * *
b. Recoil mechanism.

* * * of the
replenisher. See that the front
gun rail wipers and upper and
lower rear gun rail wipers are
in good condition so that they
will prevent dust or sand from
entering the slides of the re-
coil mechanism. Replace dam-
aged or deteriorated wipers.

* * * * *

[A. G. 300.7 (19 Oct 43).] (C 4, 9 Nov 43.)



REAR GUN RAIL WIPERS

RAPD 35672

FIGURE 42.1.—Rear gun rail wipers.

[A. G. 300.7 (19 Oct 43).] (C 4, 9 Nov 43.)

*The individual items in this change will be cut apart and pasted over the specific paragraphs or subparagraphs affected.

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1. The purpose of this manual is to provide information on the operation and maintenance of the equipment described herein.

2. This manual is intended for use by personnel responsible for the operation and maintenance of the equipment.

3. The information contained herein is based on the latest available data and is subject to change without notice.

4. The user is advised to read this manual carefully before operating the equipment.

5. The user is advised to follow the instructions contained herein to ensure safe and efficient operation.

6. The user is advised to report any malfunctions or defects to the appropriate authority.

7. The user is advised to keep this manual in a safe place for future reference.

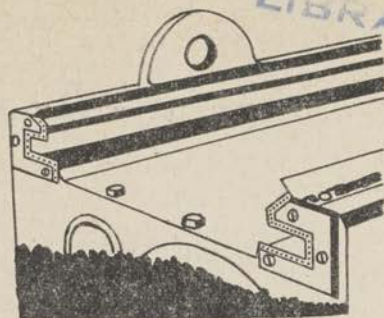
8. The user is advised to use the equipment in accordance with the instructions contained herein.

9. The user is advised to use the equipment in a safe and efficient manner.

10. The user is advised to use the equipment in accordance with the instructions contained herein.

TM 9-350
C 4

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 FRONT GUN RAIL WIPERS

RAPD 35673

FIGURE 42.2.—Front gun rail wipers.

[A. G. 300.7 (19 Oct 43).] (C 4, 9 Nov 43.)

52.1. (Added) Disassembly and assembly of gun rail wipers (figs. 42.1 and 42.2).—*a. Lower rear gun rail wipers.*—To replace lower left and right rear gun rail wipers, remove screws, washers, and retainers. Replace old wipers with new ones and assemble retainers to cradle.

b. Upper rear gun rail wipers.—To replace upper left and right rear gun rail wipers, remove screws, washers, retainers, and plates. Replace old wipers with new ones and assemble plates and retainer to cradle.

c. Front gun rail wipers.—To replace left and right front gun rail wipers, remove screws, washers, and retainers. Replace old wipers with new ones and assemble retainer to cradle.

[A. G. 300.7 (19 Oct 43).] (C 4, 9 Nov 43.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

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

TECHNICAL MANUAL

155-MM GUN AND CARRIAGE M1 AND M1A1

CHANGES }
No. 5 }

WAR DEPARTMENT,
WASHINGTON 25, D. C., 20 April 1944.

TM 9-350, 11 May 1942, is changed as follows:

8. General.—The 155-gun carriage * * * power brake mechanism (figs. 18 and 20). The carriage is equipped with one combination blackout tail and blackout stop lamp to mark the muzzle of the piece. The current to operate these lights is supplied by a cable connecting the lights directly to the power socket on the rear of the prime mover without a switch between the lights and the power socket. The blackout stop light is operated by the same mechanism that operates corresponding lights on the prime mover.

26. Gun.—*a. General.*

* * * * *

(3) Rescinded.

* * * * *

30. Equilibrators. (As changed by C 3.)

* * * * *

b. Rescinded.

31. (Superseded.) Lubrication Order.—*a. War Department Lubrication Order No. 10 (formerly Lubrication Guide No. 10) (figs. 41 and 42) prescribes first and second echelon lubrication maintenance. Lubrication to be performed by ordnance maintenance personnel is covered in TM 9-1350.*

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

*c. Lubrication instructions on the order are binding on all echelons of maintenance and there will be no deviations, except as indicated in *d* below.*

d. Service intervals specified on the order are for normal operating conditions. These intervals will be reduced under extreme conditions such as excessively high or low temperatures, prolonged periods of high speed operation, continued operation in sand or dust, immer-

*These changes supersede TB 350-(1), 11 June 1943, TB 350-(2), 23 August 1943, and TB 350-(3), 26 August 1943.

sion in water, or exposure to moisture, any one of which may quickly destroy the protective qualities of the lubricant.

e. Lubricants are prescribed in the "Key" (figs. 41 and 42) in accordance with three temperature ranges: "Above +32° F.," "+32° F. to 0° F.," and "below 0° F." When to change grades of lubricants is determined by maintaining a close check on operation of the matériel during the approach to change-over periods, especially during initial action. Sluggish operation is an indication of lubricants thickening and the signal to change to grades prescribed for the next lower temperature range. Ordinarily, it will be necessary to change grades of lubricants *only when air temperatures are consistently in the next higher or lower range*, unless malfunctioning occurs sooner due to lubricants being too thin or too heavy.

31.1. (Added.) Lubrication equipment.—a. Each piece of matériel is supplied with lubrication equipment adequate to maintain the matériel. This equipment will be cleaned both before and after use.

b. Lubrication guns will be operated carefully and in such manner as to insure a proper distribution of the lubricant.

31.2. (Added.) Points of application.—a. Lubrication fittings, grease cups, oilers, and oilholes are readily identifiable on the matériel by a red circle. Such lubricators and the surrounding surface will be wiped clean before lubricant is applied.

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

31.3. (Added.) Cleaning.—To clean parts, use solvent, dry-cleaning, or oil, fuel, Diesel. Dry before lubricating. Swab gun bore as well as breech and firing mechanism after removal of gas-check pad from obturator spindle, with a solution of $\frac{1}{2}$ pound of soda, ash, to each gallon of warm water, or with a thick suds of issue soap and warm water. Rinse with clear water and dry thoroughly before oiling.

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

31.5. (Added.) Equilibrator case and plunger.—Weekly, with gun at 0° elevation, unscrew cover from front of equilibrator and slide toward narrow end of case. Wipe accumulated dirt and moisture from all surfaces and apply a thin film of lubricant to all exposed parts including outer surface of both plunger and case.

Figure 41 is rescinded and the following is substituted therefor:

No. 10

WAR DEPARTMENT **LUBRICATION GUIDE**
 ORDNANCE DEPARTMENT

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

SHL D-34
For detailed instructions, refer to TM 9-350.

Clean fittings before lubricating. Lubricate after washing.

Reduce intervals under severe operating conditions.

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

Lubricant * Interval

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

NOTE—See Reverse Side for Lubrication of CARRIAGE

To clean parts, use SOLVENT, dry-cleaning, or OIL, kerosene, or kerosene. Dry before lubricating. Swab gun bore as well as breech and firing mechanism after removal of gas check pad from obturator spindle with a solution of 1/2 pound of SODA ash, to each gallon of warm water or with a fluid suds of issue soap and warm water. Rinse with clear water and dry thoroughly before oiling.

Recoil Slide CG D

Variable Recoil Control Shaft CG M
*Turning freely
Bring gun to 0° elevation*

Recoil Mechanism Replenisher Fill and Drain RS
Cap. 110 pt., reserve 2 pt.

Recoil Mechanism Replenisher Level Opening D
Check daily and before firing

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

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

D OE Recoil Slide

W OE Equilibrator Case and Plunger (See Note)

D OE Recoil Slide

NOTES

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

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

LUBRICATED BY ORDNANCE PERSONNEL—Equilibrator Guide, Bearings, Variable Recoil Gears, Counter Balance. (Refer to TM 9-1250.)

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

By Order of the Secretary of War:
G. C. Marshall, Chief of Staff.

KEY

LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE			ALL TEMPERATURES	INTERVALS
	above +32°F.	+32°F. to 0°F.	below 0°F.		
OE—OIL, engine	OE SAE 30	OE SAE 10	F5	RS—OIL, recoil, special	D—Daily W—Weekly M—Monthly
CG—GREASE, general purpose	CG No. 1	CG No. 0	CG No. 0	PS—OIL, lubricating, preservative, special	

COLD WEATHER: For Lubrication and Service below 0°F., refer to Q759 6-5.

No. 10 (NOT TO BE REPRODUCED in whole or in part without prior permission of the Office of the Chief of Ordnance.)
7 Jan 44
Supersedes all previous issues.

FIGURE 41.

Figure 42 is rescinded and the following is substituted therefor:

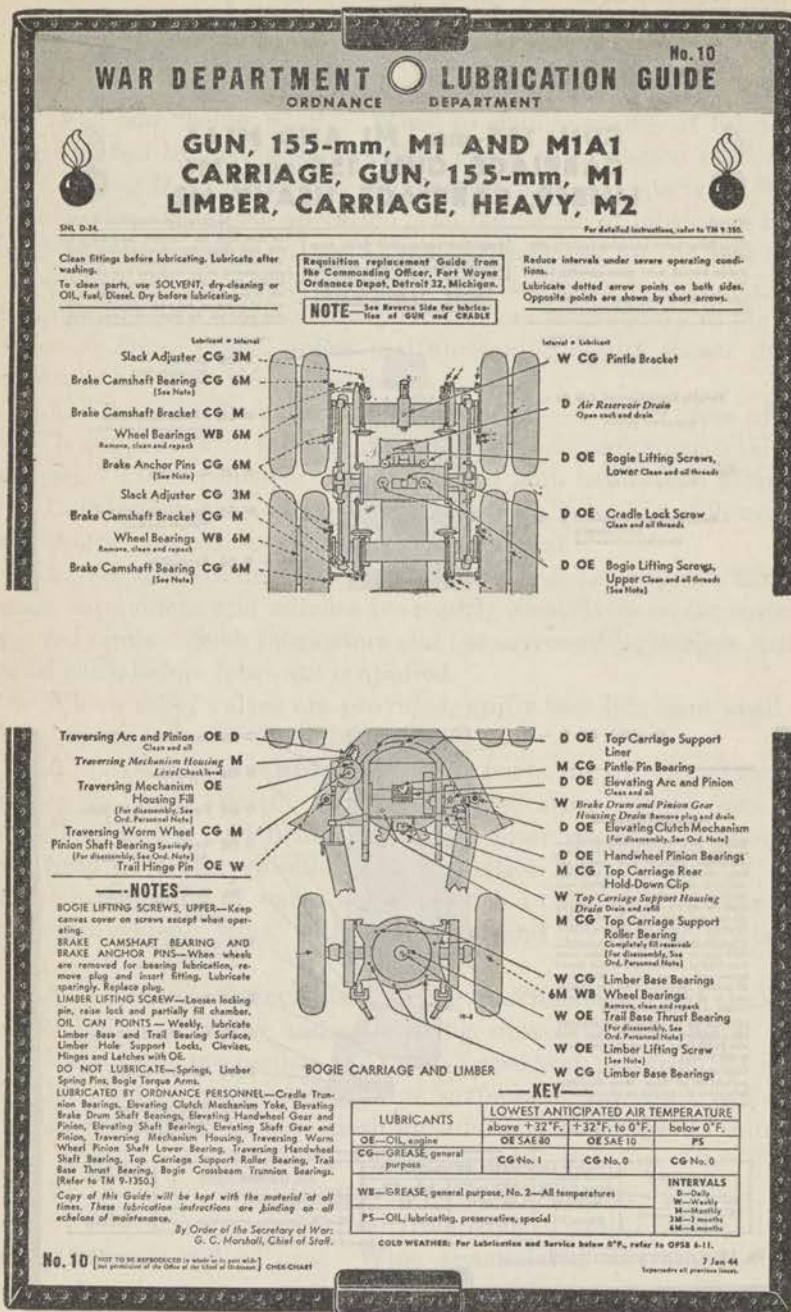


FIGURE 42.

31.6. (Added.) Wheel bearings.—Remove bearing cone assemblies from hub. Wash bearings, cones, spindle, and inside of hub, and dry thoroughly. Do not use compressed air. Inspect bearing races and replace if damaged. Wet the spindle and inside of hub and hub cap with grease, general purpose, No. 2, to a maximum thickness of $\frac{1}{16}$ inch only to retard rust. Lubricate bearings with grease, general purpose, No. 2, with a packer, or by hand, kneading lubricant into all spaces in the bearing. Use extreme care to protect the bearings from dirt, and immediately reassemble and replace wheel. Do not fill hub or hub cap. The lubricant in the bearing is sufficient to provide lubrication until the next service period. Any excess might result in leakage into the drum. Adjust bearings in accordance with instructions in paragraph 54.

31.7. (Added.) Oil can points.—Weekly, lubricate limber base and trail bearing surface, limber hole support locks, clevises, hinges, and latches with oil, engine, SAE 30 above +32° F., SAE 10 from +32° F. to 0° F., or oil, lubricating, preservative, special, below 0° F.

31.8. (Added.) Parts not to be lubricated.—Springs, limber spring pins, and bogie torque arms.

31.9. (Added.) Lubricated by Ordnance personnel.—The following are lubricated by Ordnance personnel: Cradle trunnion bearings, equilibrator guide bearings, variable recoil gears, counterbalance, elevating clutch mechanism yoke, elevating brake drum shaft bearings, elevating handwheel gear and pinion, elevating shaft gear and pinion, elevating shaft bearings, traversing mechanism housing, traversing worm wheel pinion shaft lower bearings, traversing handwheel shaft bearing, top carriage support roller bearings, trail base thrust bearing, and bogie crossbeam bearings.

51. Assembly of breech mechanism.—Place the breechblock * * * and breechblock carrier. Assemble the obturator spindle spring over the threaded end of the obturator spindle and screw the firing mechanism housing onto the obturator spindle as far as it will go approximately seven full turns). Then, back it off slightly to the nearest position where the slot in the housing will align with the firing mechanism safety plunger on the rear face of the breechblock carrier so as to allow the safety plunger to enter the slot freely. Unless the firing mechanism housing is screwed onto the obturator spindle approximately seven full turns, excessive headspace will result. Assemble the counterbalance * * * mechanism block plunger.

83. Disassembly and assembly.—The limber parts * * * studs and nuts. The using arm is also authorized to disassemble the limber for cleaning. The limber should be disassem-

bled at least once every month and thoroughly washed with solvent, dry cleaning. In sandy terrain this procedure may have to be followed more frequently.

a. (Added.) Remove the heavy limber M2 from the gun carriage and pull to a dry, clean place where a hoist is available. Attach the drawbar to the hoist and tip the limber and axle to facilitate the removal of the trail base.

b. (Added.) Remove the cotter pin which holds the hexagon nut to the limber lifting screw. Remove the slotted nut from the limber lifting screw and take off pin or crosshead.

c. (Added.) Remove the limber lifting screw and extension from the limber.

d. (Added.) Remove the hexagon nuts, lock washers, and machine screws holding the bronze plates to the base of the limber.

e. (Added.) Remove the trail base and bronze liners from the base of the limber.

f. (Added.) Wash out the trail base, bronze liners, and limber lifting screw thoroughly with solvent, dry cleaning. Remove burs with crocus cloth or a fine file.

g. (Added.) Wash out the bronze nut with solvent, dry cleaning, to remove all grease and other foreign matter. Apply a light film of oil to the limber lifting screw and repack trail-base thrust bearing with grease, general purpose, before assembling. Cover the bearing surface on the trail base with a light coating of grease, general purpose (No. 1 above 32° F. or No. 0 below 32° F.), before assembling the limber.

h. (Added.) Assemble the limber in the reverse order of disassembly.

[A. G. 300.7 (24 Dec 43).]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:

J. A. ULIO,

Major General.

The Adjutant General.

G. C. MARSHALL,

Chief of Staff.

DISTRIBUTION:

As prescribed in paragraph 9a, FM 21-6; D (2); IBn and H 4, 6 (3); IBn 9 (3); IC 4, 6 (10), 9 (4).

IB 4: T/O 4-150-18, Prov CA Brig, 155-mm Gun.

IB 6: T/O 6-10-1 FA Brig.

IR 4: T/O 4-51, CA Regt (155-mm Gun) (Mob); 4-151, CA Regt (155-mm Gun) (SM).

IBn 4: T/O 4-55, CA Bn, 155-mm Gun, M; 4-155, CA Bn, 155-mm Gun, SM.

IBn 6: T/O 6-55, FA Bn, Mtz, 155-mm Gun, Trk-Dr; 6-125, FA Bn, Mtz, Self-Propelled, 155-mm Gun; 6-335, FA Bn Mtz, 155-mm Gun, Trac-Dr.

IBn 9: T/O 9-75, Ord Maint Bn; 9-115, Ord Maint and Sup Bn; 9-315, Base Armament Maint Bn.

IC 4: T/O 4-57, Btry, CA Regt, 155-mm Gun, M; 4-157, Btry CA Regt, 155-mm Gun, SM.

IC 6: T/O 6-57, Btry, FA Bn, Mtz, 155-mm Gun, Trk-Dr; 6-127, FA Bn, Mtz, Self-Propelled 155-mm Gun; 6-337 Btry, FA Bn, Mtz, 155-mm Gun, Trac-Dr.

IC 9: T/O 9-9, Hv Maint Co, FA; 9-37, Hv Maint Co, Tk; 9-7, Ord Med Maint Co.

For explanation of symbols, see FM 21-6.

125-MM GUN M713/M1

1. Description of gun	1
II. Description of carriage	2
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X. Ammunition	10
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XII. Inspection and maintenance	12
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XIV. Material affected by gun	14

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SECTION I GENERAL

1. Section and data. (1) This manual is for the information and guidance of the crew and loader of the 125-mm gun M713/M1. (2) In addition to a description of the 125-mm gun M713/M1, this manual contains information required for the correct use, care, and maintenance of the gun. The 125-mm gun M713/M1 includes the following parts:

- 125-mm gun M713/M1
- 125-mm gun carriage M713/M1
- Heavy carriage loader M713/M1
- 125-mm gun crew loader M713/M1

(3) Documents, manuals, and parts required as they are furnished by the manufacturer will be indicated and where the origin of the material is indicated.

NTSU LIBRARY

~~LIBRARY~~

NTSU LIBRARY
The following is a list of the books in the library of the National Tenthredinid Society, which was organized in 1901 for the purpose of promoting the study of the Tenthredinidae.

1. *Die Tenthrediniden*, by H. G. Gahan. New York: The American Entomological Society, 1901. 1 vol. 128 pp. 12 plates. \$1.00.

2. *Die Tenthrediniden*, by H. G. Gahan. New York: The American Entomological Society, 1901. 1 vol. 128 pp. 12 plates. \$1.00.

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25. *Die Tenthrediniden*, by H. G. Gahan. New York: The American Entomological Society, 1901. 1 vol. 128 pp. 12 plates. \$1.00.

TECHNICAL MANUAL }
No. 9-350

WAR DEPARTMENT,
WASHINGTON, May 11, 1942.

155-MM GUN MATÉRIEL M1

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SECTION I GENERAL

	Paragraph
Scope and data.....	1

1. Scope and data.—*a. Scope.*—(1) This manual is published for the information and guidance of the using arms and services.

(2) In addition to a description of the 155-mm gun matériel M1 and M1A1, this manual contains technical information required for the identification, use, and care of the matériel. The 155-mm gun matériel includes the following major items:

- 155-mm gun M1 or M1A1.
- 155-mm gun carriage M1 or M1A1.
- Heavy carriage limber M2.
- 155-mm gun recoil mechanism M1.

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

*This manual supersedes TM 9-350, February 1, 1941.

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

(5) The sighting and fire-control matériel included herein is the matériel normally used by the Field Artillery. Different sights and fire-control matériel will probably be furnished to the Coast Artillery for use with this gun.

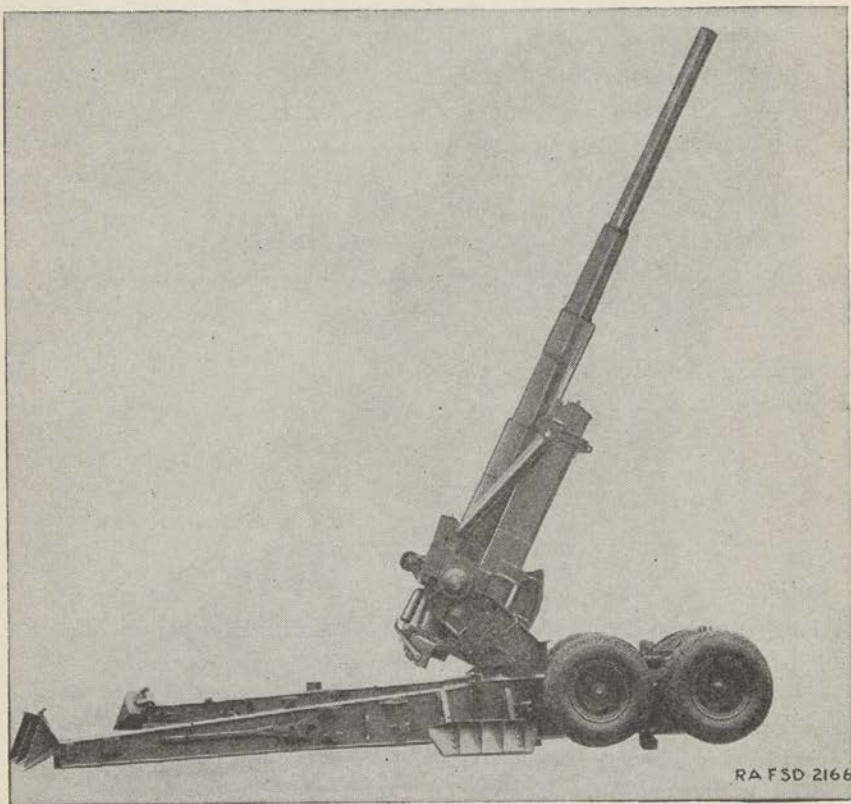


FIGURE 1.—155-mm gun carriage M1—firing position, maximum elevation.

b. Data.—(1) Weights, dimensions, and ballistics of 155-mm gun, M1 and M1A1.

Chamber volume	-----cubic inches	1,596
Density of loading	-----	0.630
Length of bore	-----calibers	45

Length of bore.....	inches	274.5
Limits of maximum powder pressure for acceptance of powder lots.....	pounds per square inch	34,000 to 40,000
Muzzle velocity (maximum zone charge).....	foot-pounds	2,800
Rate of fire.....		
Type of breechblock.....		interrupted screw
Type of firing mechanism.....		percussion
Weight of gun.....	pounds	9,595
(2) <i>Ammunition.</i>		
Model.....		M101 or M104
Type.....		separate loading
Length of projectile.....	inches	26.7
Length of propelling charge.....	do	37.4
Maximum range (elevation 844.4 mils).....	yards	25,395
Weight of projectile.....	pounds	95
Weight of propelling charge.....	do	30
(3) <i>Carriage.</i>		
Model.....		M1 or M1A1
Brakes, type.....		Mechanical, air operated
Dimensions in traveling position, over-all:		
Length, muzzle to lunette.....	feet	34¾
Width of bogie.....	inches	98¾
Height, over-all.....	do	102¾
Limits of elevation:		
Maximum.....		63°20' (1,126 mils)
Depression.....		1°50' (32.6 mils)
Limits of traverse.....	right or left	30° (533 mils)
Recoil mechanism:		
Model.....		M3
Maximum recoil.....	inches	approximately 65
Maximum recoil at maximum elevation.....	inches	approximately 33
Type of recoil mechanism.....		hydraulic
Type of counterrecoil mechanism.....		hydropneumatic
Recoil oil:		
Type.....		heavy
Reserve in replenisher (recoil).....	pints	2
Reserve in recuperator (counterrecoil).....	pints	2

Tires:

Type and size.....	11.00 by 20
Type and size of tubes.....	11.00 by 20
Pressure..... pounds per square inch..	50 to 70

Weights:

Gun and carriage (without accessories)	
	pounds.. 29,900
Bogie.....	do..... 5,375
Wheel base of bogie.....	inches.. 76¼
(4) Limber.	
Model.....	M2
Center to center of wheels.....	inches.. 83½
Height of lunette (limbered position).....	do..... 27
Tires.....	same as bogie
Weight.....	pounds.. 1,975

(5) *Sighting and fire-control equipment.*—(a) *Sighting equipment.*

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

(b) *Fire-control equipment.*

Aiming circle M1.
 Battery commander's telescope M1915A1.

(6) *Subcaliber equipment.*

Model of gun.....	M1916
Model of mount.....	M10
Caliber.....	millimeters.. 37
Length of bore.....	inches.. 29.13
Maximum rate of fire.....	rounds per minute.. 25
Method of loading.....	hand
Type of breechblock.....	eccentric screw
Type of firing mechanism.....	percussion
Recoil mechanism:	
Type of recoil.....	hydraulic
Type of counterrecoil.....	mechanical
Length of recoil.....	inches.. 7 to 10

NOTE.—The prime mover used with this weapon should be equipped for operating the air brakes.

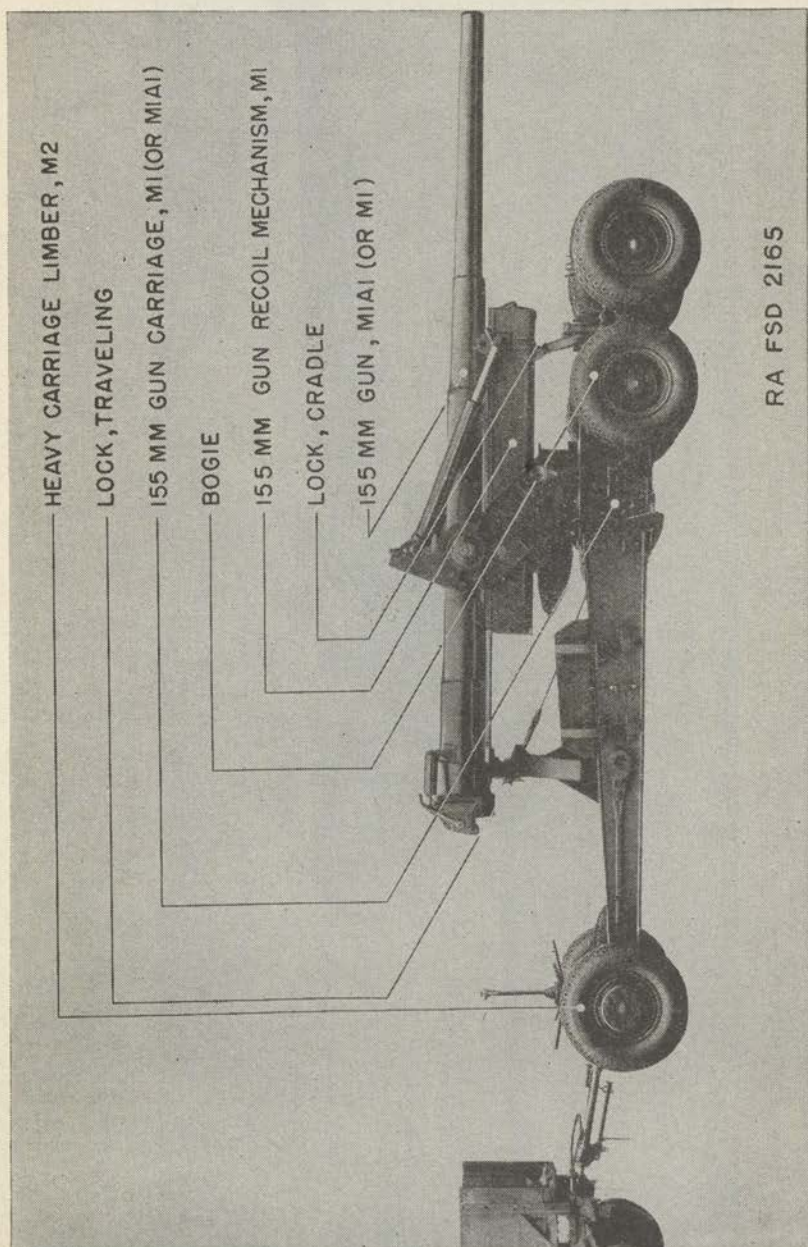
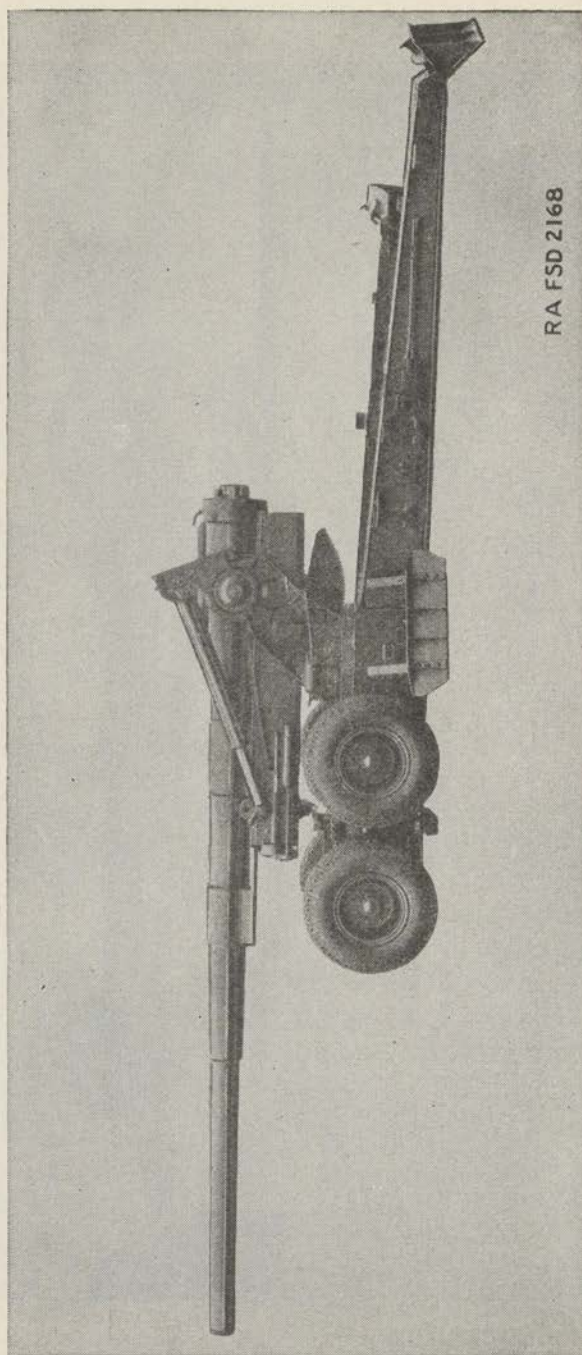


FIGURE 2.—155-mm gun carriage M1—traveling position, right side view.



RA FSD 2168

FIGURE 3.—155-mm gun carriage M1—firing position 0° elevation, left side.

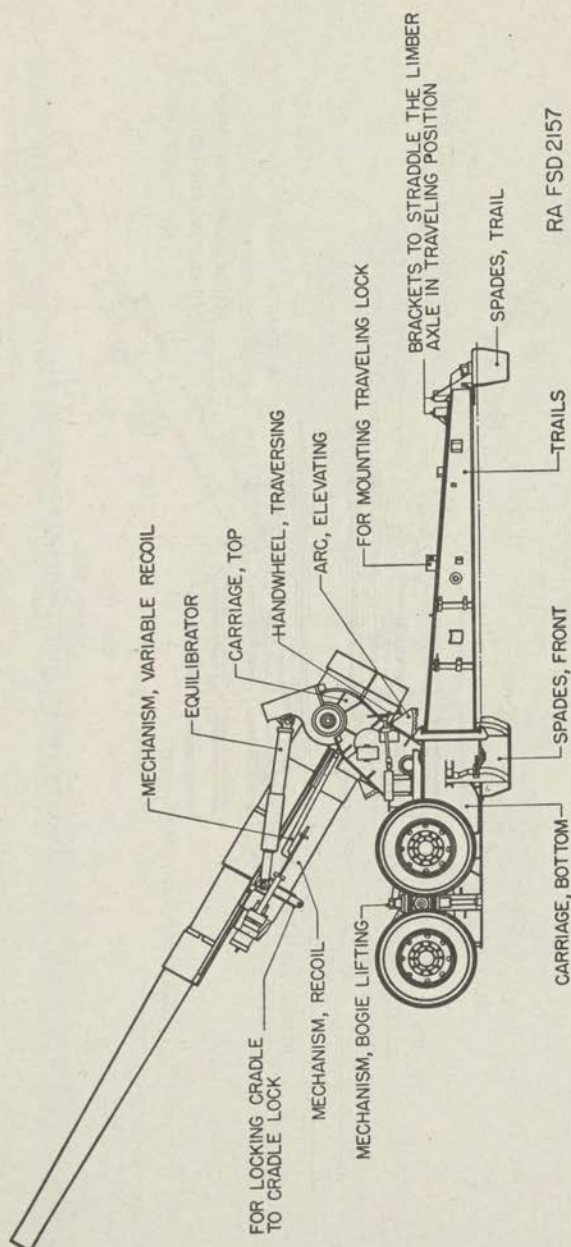


FIGURE 4.—155-mm gun carriage M1—instruction plate, left side elevation.

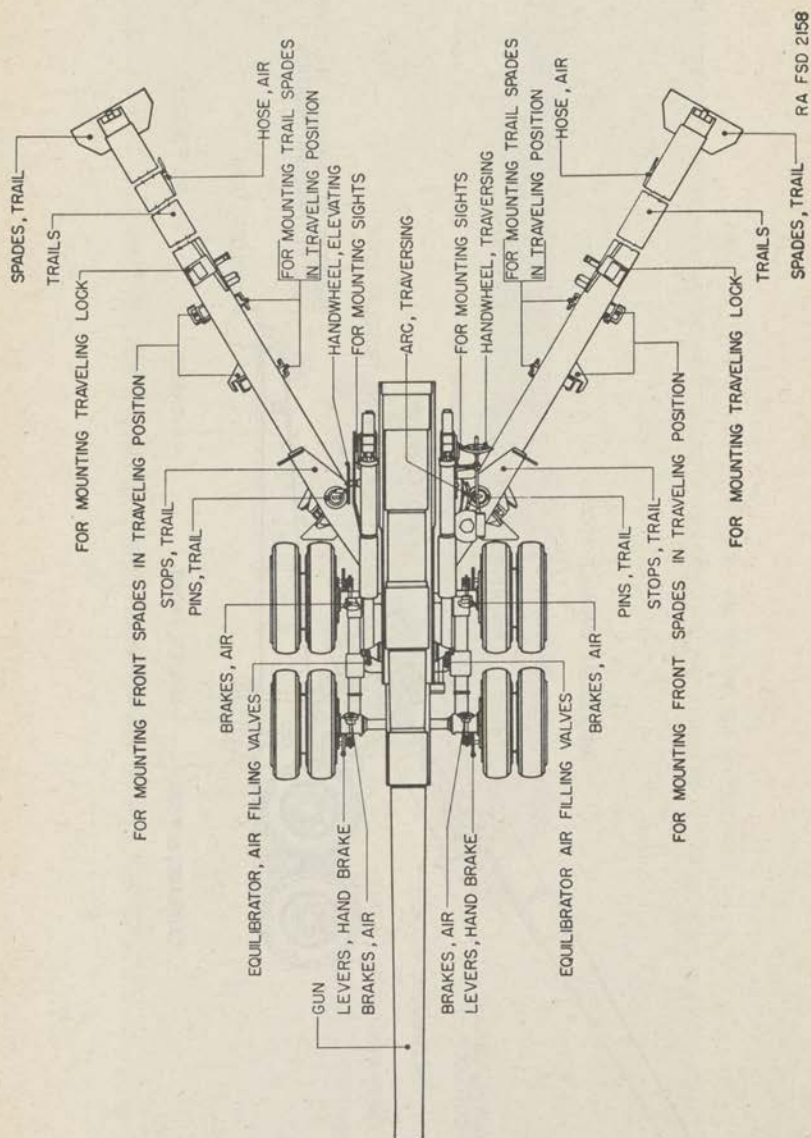


FIGURE 5.—155-mm gun carriage M1—Instruction plate, plan view.

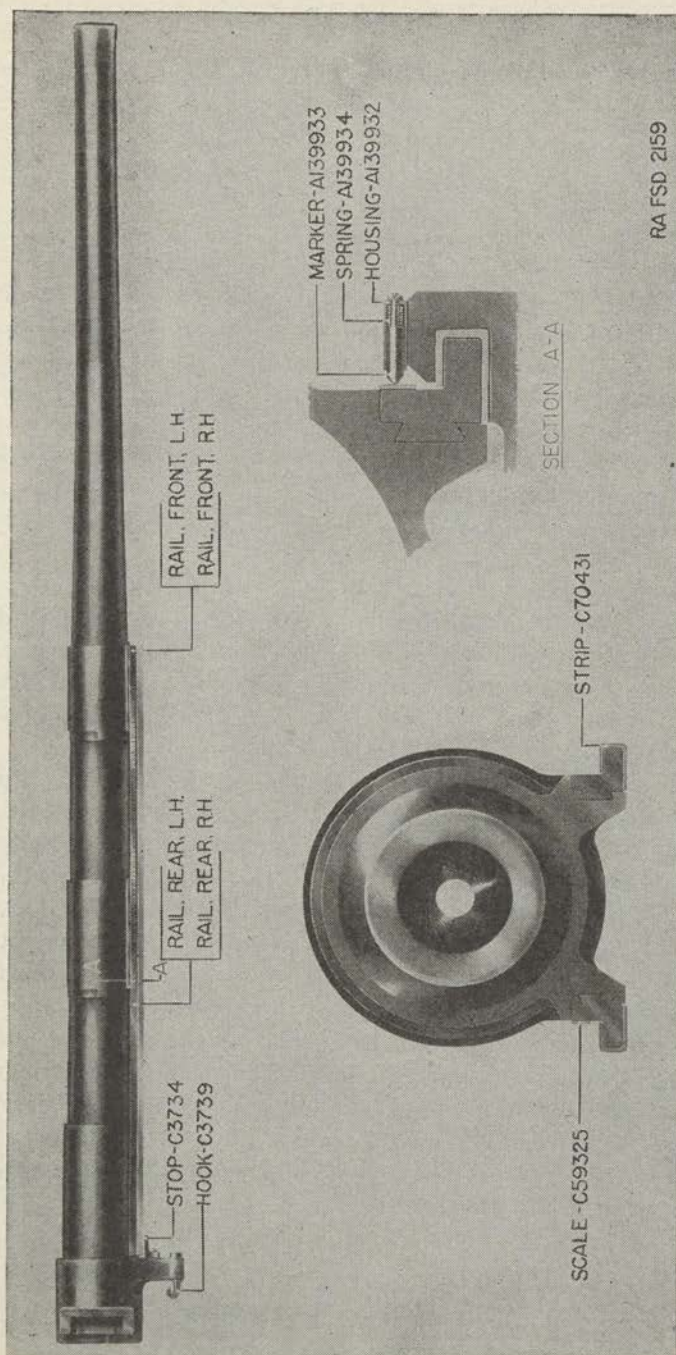


FIGURE 6.—155-mm gun M1A1.

SECTION II

DESCRIPTION OF GUN

	Paragraph
General	2
Tube or barrel assembly	3
Breech mechanism	4
Obturator mechanism	5
Firing mechanism	6
Counterbalance mechanism	7

2. General.—The 155-mm guns M1 or M1A1 may be mounted on either of the 155-mm gun carriages, M1 or M1A1. For all purposes in connection with identification, use, and care, the 155-mm gun carriage M1A1 may be considered similar to the 155-mm gun carriage M1. Likewise for the same purposes the 155-mm gun M1 may be considered similar to the 155-mm gun M1A1. The detail differences between these units are minor and affect only such parts as manufacturing components that are finished in place. The 155-mm gun carriage M1 is the standard carriage for either gun. The M1A1 carriages, of which only a few were built, were made from test models of the M1 carriage.

3. Tube or barrel assembly.—*a.* The 155-mm gun M1 is of the built-up type fitted with longitudinal gun slides and bearing strips. Stamped on the breech are the name of the manufacturer, the year of manufacture, the model and serial numbers, and the total weight including the breech mechanism (fig. 6).

b. The breech end of the tube is threaded on the exterior to fit the threads of the breech ring. Hoops are shrunk on and pinned to the tube. The dovetailed fit of the hoops retains the front and rear rails which are held in position by screws. Bearing strips, which are assembled to the projecting lugs of the front and rear rails, are the bearings on which the gun slides in recoil and counterrecoil. A recoil scale is fastened by screws to the right-hand side of the front and rear rails. The interior surface of the breech recess is threaded to receive the breechblock. An extension on the underside of the breech ring forms a recoil lug by means of which the gun is connected to the recoil mechanism. A hook, bolted to the underside of the recoil lug, is used for retracting the gun from firing position to the travel position. Leveling plates that include finished seats for the gunner's quadrant are set in the breech ring.

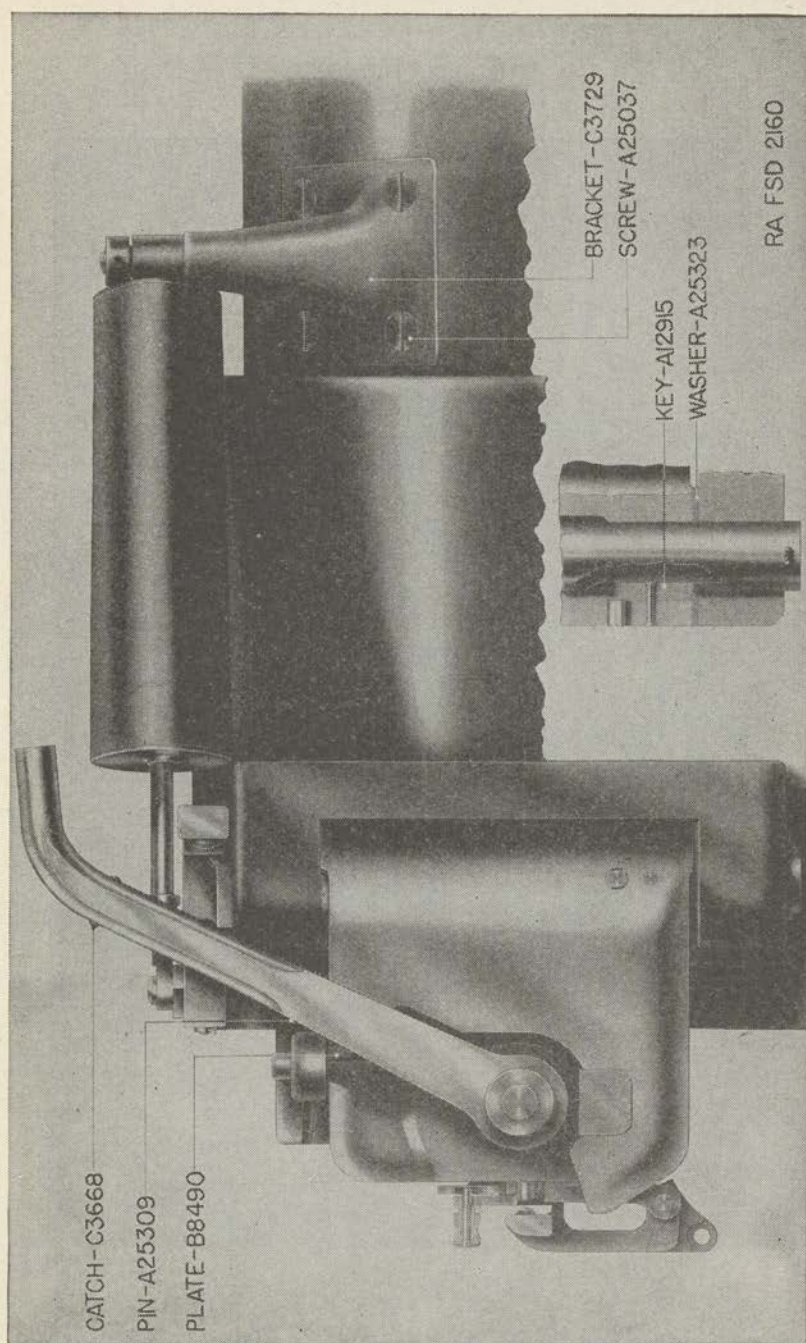


FIGURE 7.—155-mm gun breech mechanism—right side view.

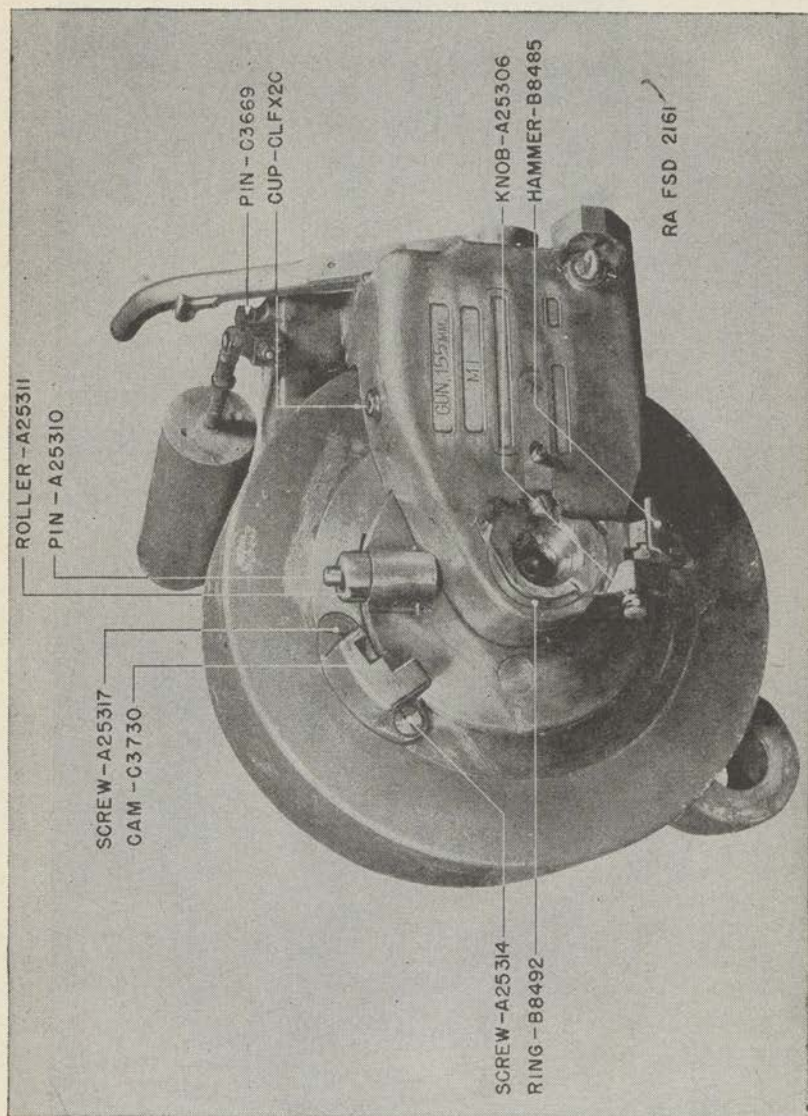


FIGURE 8.—155-mm gun breech mechanism—rear view, closed position.

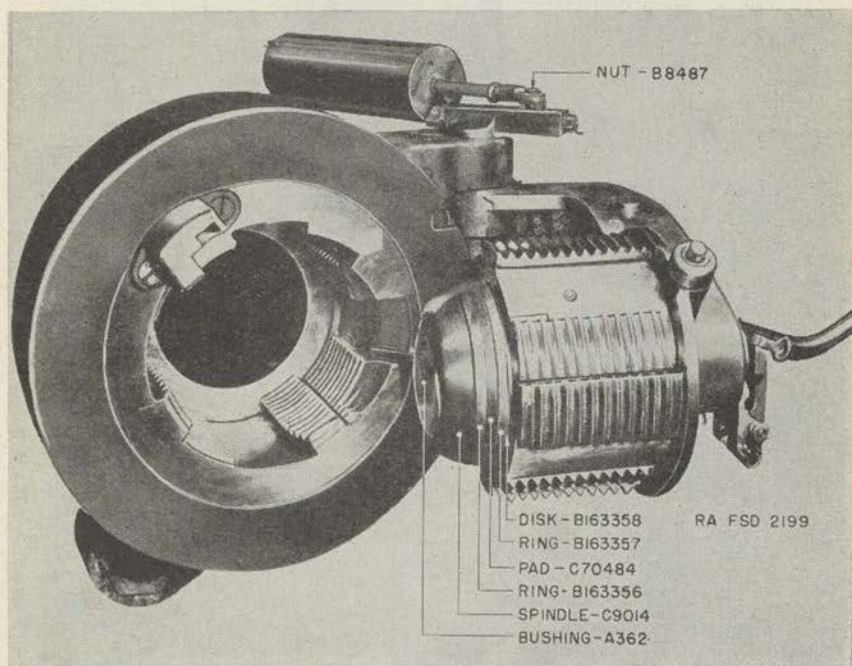
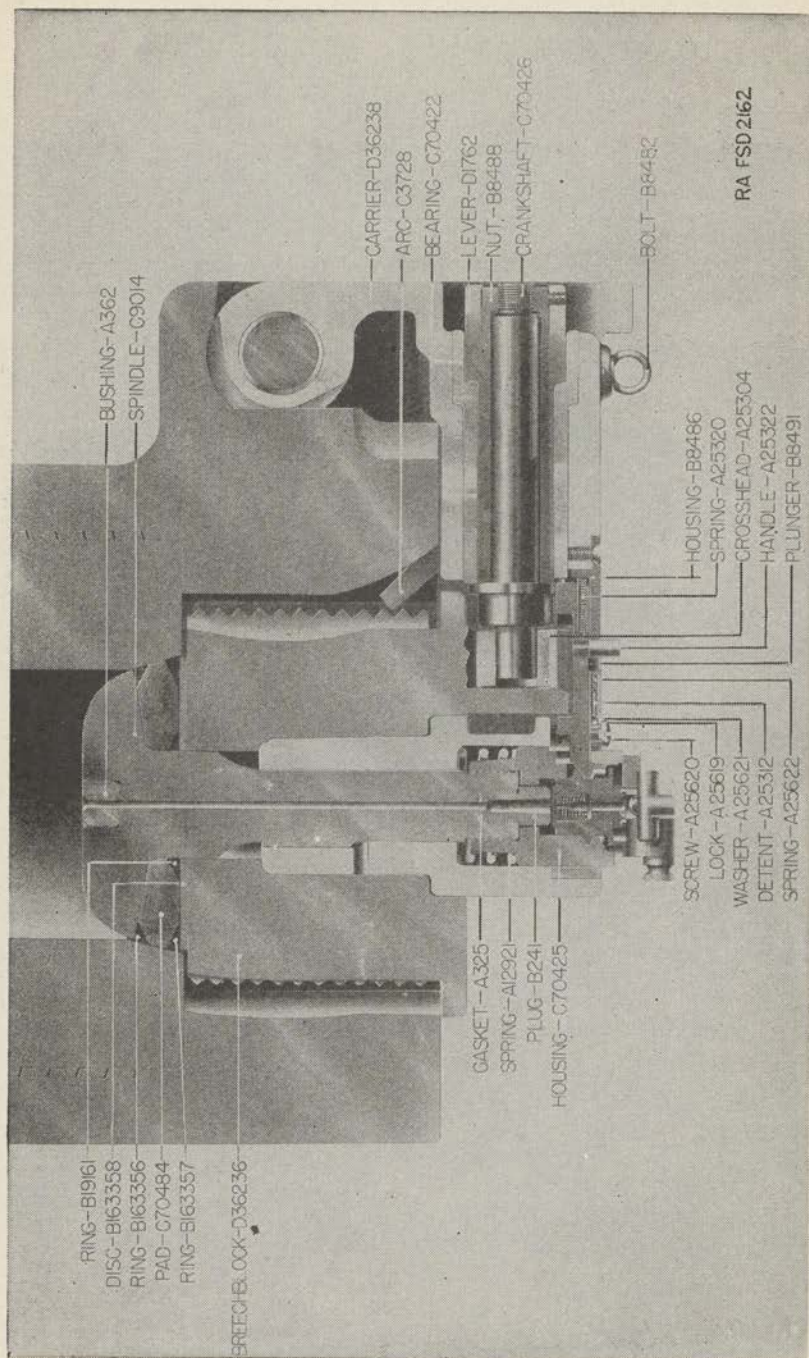


FIGURE 9.—155-mm gun breech mechanism—rear view, open position.



RA FSD 2162

Figure 10.—155-mm gun breech mechanism—sectional view.

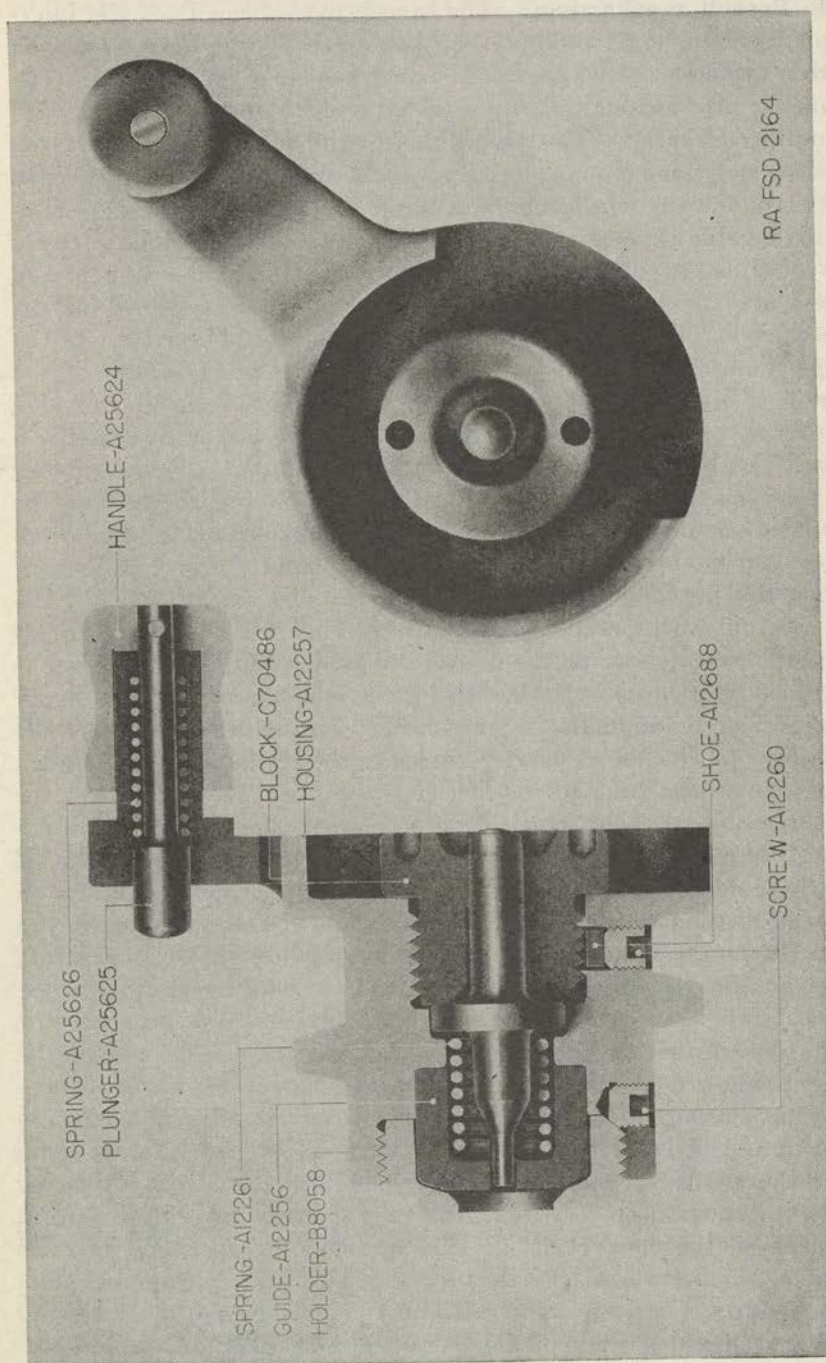


FIGURE 11.—155-mm gun firing mechanism.

4. **Breech mechanism.**—The breech mechanism is of the interrupted screw, carrier-supported, two-cycle type. It is equipped with a spring-actuated counterbalance mechanism, a percussion type of firing mechanism, and a plastic type obturator mechanism with a mushroom head. The breechblock, which is straight in cross section, is divided circumventially into 12 equal parts. Four of these are plain and the remaining eight screw-threaded, thus giving a two-thirds bearing surface in the locked position. The threaded surfaces are of different diameters. The interrupted screws in the breech recess are arranged to accommodate the interrupted screws of the breechblock. When the breechblock is unlocked, the segments of the large diameter threaded screws move into the plain sectors of the breech recess, while the segments of the smaller diameter threaded sectors move into the space left vacant by the larger threaded sectors. The breech threads are interrupted so that the breechblock may be inserted or withdrawn quickly. In closing the breech, the threaded sectors are brought opposite the blank sectors of the breech recess and the breechblock may be inserted rapidly nearly to its seat. When the breechblock is then turned through an arc of 35° , the threads on the breechblock are entirely engaged with the threads in the breech recess, and the breech is closed. An operating lever is provided which rotates the breech for the opening and closing operations. The breechblock is supported when withdrawn from the breech by a breechblock carrier hinged to the right side of the breech ring. Upon the front of the carrier is a pintle, forming a pivot for the breechblock, about which it rotates when operated by the crosshead. A recess for the crosshead is provided on the right side of the breechblock. The crosshead is actuated by means of a crank on the end of the crankshaft which engages the crosshead, operating in a recess in the breechblock. Motion of the breechblock operating lever rotates the crankshaft and imparts a rotating motion to the breechblock for locking and unlocking operations. A roller on the rear face of the breechblock and a cam on the breech end of the breech ring are provided to give a turning movement to the breechblock in closing. The breechblock control arc is secured to the pin side of the breech ring face. One sector of the breechblock rides over the arc as the mechanism is swung into the loading position and prevents it from rotating. The weight of the breech mechanism holds it in the open position. The breechblock operating lever is retained in the closed position by a catch which engages a plate attached to the carrier. The catch may be disengaged by depressing the catch lug on the side of the operating lever (figs. 7, 8, 9, and 10).

5. Obturator mechanism.—*a.* The plastic type obturator mechanism consists of the obturator spindle, front and rear split rings, inner ring, plastic gas check pad, fill-in disk, protecting disk, obturator spindle spring, and firing mechanism housing. The firing mechanism housing also acts as a nut to retain sufficient tension upon the obturator spindle to hold it in its proper position. The obturator spindle vent bushing is screwed into the head of the obturator spindle. The obturator spindle plug is screwed into the rear end of the spindle and forms the seat for the primer. A copper gasket is inserted in front of this plug to make a gastight joint. The obturator spindle passes through the breechblock and breechblock carrier. The firing mechanism housing is inserted into the breechblock carrier and is screwed onto the end of the obturator spindle, which compresses the obturator spindle spring. This draws the gas check pad and its allied parts to a tight seat on the face of the breechblock (fig. 10).

b. Upon firing the gun the pressure of the gases against the mushroom head of the obturator compresses the plastic gas check pad and further presses the split rings against the walls of the breech, thus effectively preventing the passage of gases to the rear.

c. The obturator spindle, spindle plug, and spindle vent bushing are bored through their centers, forming a vent for the passage of the flame from the primer to the propelling charge.

6. Firing mechanism.—The firing mechanism M1 is housed in the firing mechanism housing, which is screwed to the rear of the obturator spindle in the breechblock. The exterior of the firing mechanism block is threaded so it can be screwed into the firing mechanism housing. The interior is threaded to receive the primer holder. The firing pin is retained by the firing pin housing screwed into the firing mechanism housing. The interior is threaded to receive the primer holder. The firing pin is retained by the firing pin housing screwed into the rear end of the firing mechanism block. Setscrews secure the primer holder and the firing pin housing. The primer holder has a U-shaped slot for engaging and holding the rim of the primer, which is retained in position by the pressure of the firing pin spring bearing against the firing pin guide. The firing pin spring also holds the firing pin in position and prevents it from coming in contact with the primer until struck by the percussion hammer. On the rear of the firing mechanism block a projecting rim is formed, a portion of which is removed to allow the percussion hammer to pass and make contact with the firing pin. This rim is a protective feature, protecting against firing until the firing mech-

anism has been screwed all the way into its housing and locked by the firing mechanism block plunger. The percussion hammer is mounted on a lug projecting from the breechblock carrier. A percussion hammer lock pin is provided for locking the percussion hammer in neutral. The hole in the bottom of the percussion hammer is provided for the lanyard (figs. 10 and 11).

7. Counterbalance mechanism.—The counterbalance mechanism compensates for the effect of gravity in the operation of the breech mechanism, thereby making it easier to open and close. The counterbalance mechanism is attached to the gun by means of the counterbalance bracket at the front end and at the rear by means of the counterbalance piston rod. The counterbalance piston rod is attached to and operates in conjunction with the hinge pin. The mechanism consists of a counterbalance cylinder and a counterbalance piston and rod. At one end of the connecting rod the counterbalance piston bears on the counterbalance spring and at the other end fits around a pin secured to a crank extension of the hinge pin. Some of the early models are equipped with a regulating device as an extension of the hinge pin. By rotating the counterbalance regulating screw, the tension of the counterbalance spring may be increased or decreased to suit the angle of fire (figs. 7 and 12).

SECTION III

DESCRIPTION OF CARRIAGES

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8. General.—The 155-mm gun carriage M1 and the 155-mm gun carriage M1A1 are for practical purposes identical, the differences between them being minor and chiefly in the manner of manufacture. The carriage is of the split trail type, designed for ease of operation in supporting and controlling the movement of the gun. The carriage consists mainly of the bogie, bottom carriage, top carriage,

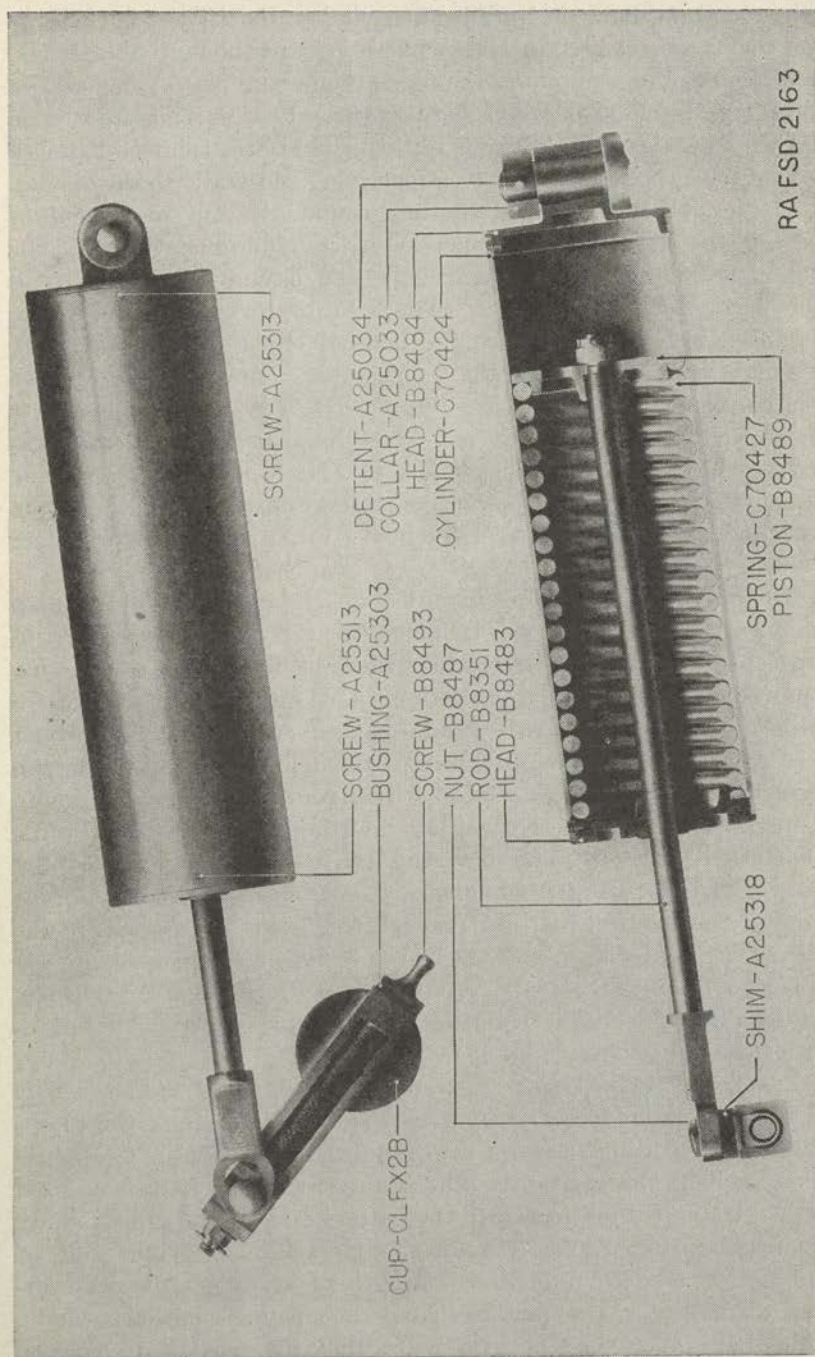


FIGURE 12.—155-mm gun counterbalance—assembly.

cradle, recoil mechanism, equilibrators, and trails. The top carriage pivots about a vertical axis on the chassis part of the bottom carriage. The bottom carriage supports the top carriage and is provided with a bogie lifting mechanism which permits the bottom carriage to rest on the ground during firing. The firing stresses are transmitted through the trunnions, top carriage, bottom carriage, and trails to the spades. The spades, being embedded in the ground, prevent movement of the carriage. The cradle is suspended by its trunnions resting in the trunnion bearings in the top carriage, and having its forward end supported by the equilibrators. The equilibrators act to neutralize unbalanced weight and reduce the manual effort needed to elevate the gun. When traveling, the carriage is connected to a power air brake system, with equalized brakes on the four bogie wheels controlled from the prime mover. Two hand brake levers are provided which operate the brakes on the two front bogie wheels. They are used for parking when the carriage is disconnected from the prime mover, and in case of failure of the power brake mechanism (figs. 18 and 20).

9. Cradle.—The cradle is mounted on the antifriction trunnion bearings of the top carriage. It houses the recoil, counterrecoil, and recuperator cylinders. The cradle trunnions form the fulcrum for the movement of the gun in elevation. One end of each of the two equilibrators is secured to the cradle near its front end. The other end of the equilibrator is attached to the trunnion cap on the top carriage. A cradle lock connection at the front end secures the cradle lock mount on the bogie to the cradle and is used to hold the cradle in the travel position. The elevating arc, which is engaged by the pinion of the elevating mechanism, is secured in alinement on the bottom of the cradle by a projection, fitting a mating groove in the cradle. The replenisher and the variable recoil mechanism are assembled to the left side and front end of the cradle. A sheave, mounted above the cradle trunnions, is used with a steel cable for retracting the gun (figs. 13 and 15).

10. Recoil mechanism.—*a. General.*—The recoil mechanism is used to control the forces created by firing and to check the movement of the recoiling parts in a gradual manner so as not to cause displacement of the carriage. The counterrecoil mechanism is used to return the recoiling mass into the battery so that the gun is ready to be fired again. A recoil marker, attached to the right side of the cradle, is used to indicate the length of recoil on the scale attached to the gun. Previous to firing, the placing of grease, chalk, or other substances on the gun will cause the marker to trace a

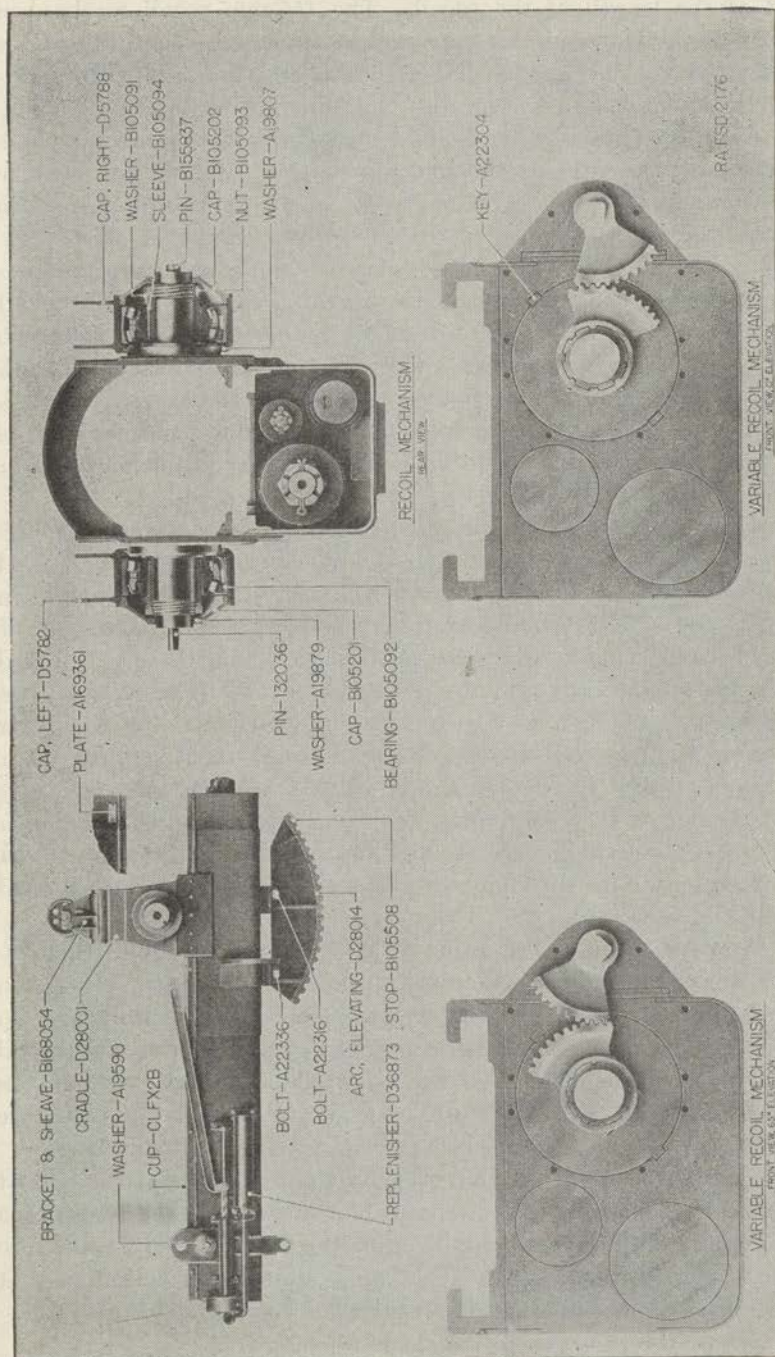


FIGURE 13.—155-mm gun recoil mechanism M1.

record of the length of the recoil. The 155-mm recoil mechanism M1 is of the hydropneumatic type and is composed essentially of the recoil cylinder, the counterrecoil cylinder, and the recuperator cylinder, all assembled in the cradle. In addition to this hydropneumatic recoil system, a separate hydraulic brake mechanism, which operates independently of the hydropneumatic system, functions in the recoil cylinder. The gun moves in recoil and counterrecoil in the gun slide guides formed in the top of the cradle.

b. Recoil.—(1) The operation of the recoil and counterrecoil mechanism can be seen from the schematic drawing, figure 14. The recoil and counterrecoil piston rods are connected to a lug at the breech end of the gun, and move with the gun in recoil and counterrecoil. The function of the recoil mechanism is to absorb the energy of recoil. The function of the counterrecoil and recuperator mechanisms is to return the gun to firing position. However, the latter mechanisms also absorb some of the energy of recoil.

(2) During recoil, oil in the recoil cylinder is throttled through openings past the recoil piston and the motion of the gun is slowed up and recoil energy absorbed. The control rod, which is housed in the recoil piston rod, remains stationary during recoil. Rotation of the control rod controls the grooves through which the oil is forced past the piston and thus provides a variable recoil. The forward end of the control rod mounts a gear segment which matches a similar gear segment connected to the variable recoil turning valve cam. This cam is linked to the top carriage by a connecting rod to give a rotative motion to the gear segment and control rod as the gun is raised or depressed in elevation. Raising the gun changes the grooves in the recoil cylinder through which the oil is throttled and shortens the length of recoil.

(3) A graph showing the limits of recoil permissible with the propellant charges for two different muzzle velocities are shown in figures 24 and 25. If the recoil does not fall within the limits therein designated when the gun is operating at normal temperature, the oil reserve in the replenisher and the recuperator cylinders should be checked immediately. If the oil reserves are normal, the ordnance maintenance company should be notified.

(4) The rear end of the control rod acts as a buffer at the end of the countercoil motion. A mechanism is provided that throttles a small amount of the recoil oil through throttling grooves and into the recoil cylinder, and slows down the counterrecoil action so that the gun is eased into the battery position.

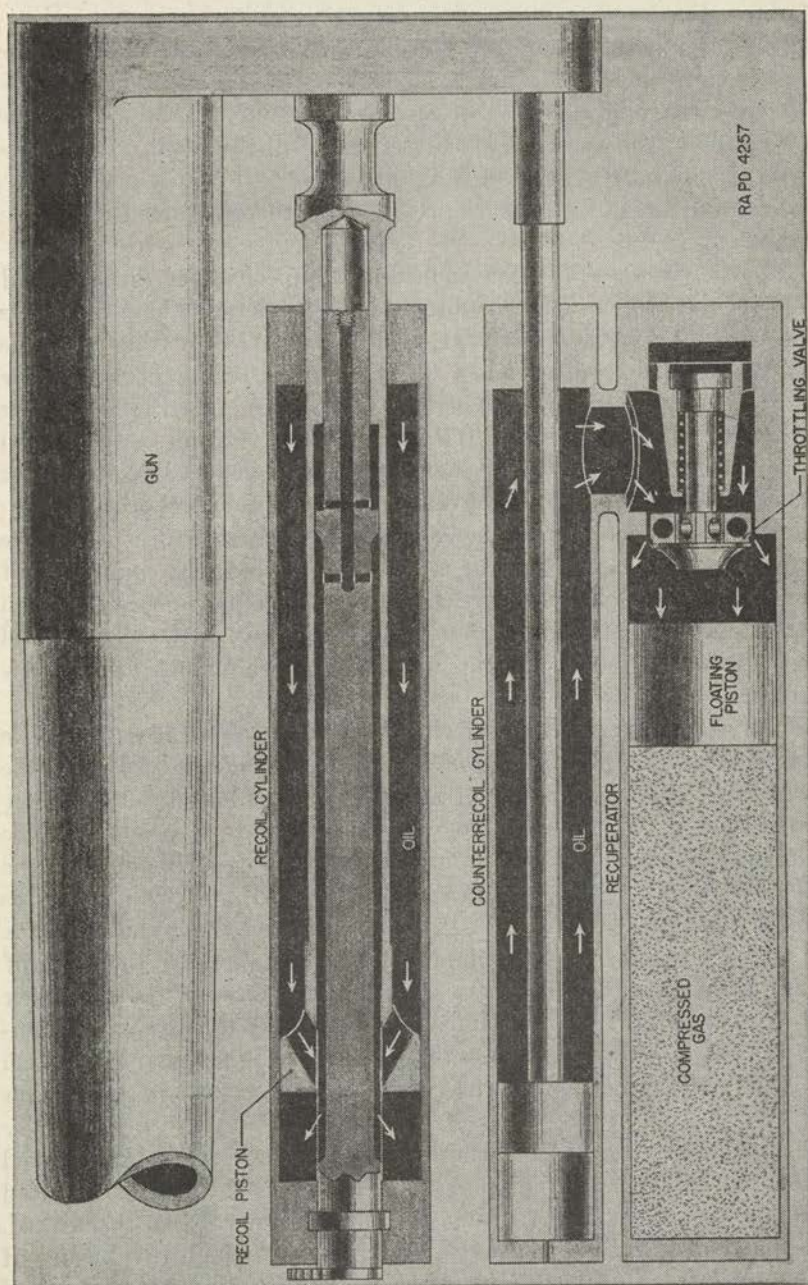


FIGURE 14.—Recoil and counterrecoil mechanism—schematic diagram.

(5) The replenisher is connected to the front end of the recoil cylinder. It serves as a reservoir for excess oil when increased atmospheric temperature or heat developed during firing expands the oil, and keeps the recoil cylinder filled when the oil contracts because of decreased temperature. During recoil a void is produced in the recoil cylinder and the replenisher serves to fill this void. When the gun returns to battery, the oil is again forced back to the replenisher. A filling and draining plug is provided on the forward end of the replenisher.

c. Counterrecoil.—(1) The counterrecoil mechanism is contained in the recuperator and the counterrecoil cylinders. These cylinders are connected together near the rear ends. A throttling valve is mounted near this connection in the rear of the recuperator cylinder (fig. 36). During recoil the motion of the counterrecoil piston forces oil through the throttling valve into the recuperator cylinder and forces the floating piston in the recuperator forward to compress further the nitrogen gas in the forward end of the recuperator cylinder. This absorbs some of the energy of recoil and stores it for the counterrecoil action. When the recoil action ceases, the counterrecoil action starts. The oil in the rear end of the recuperator is throttled through the regulator valve in returning to the recoil cylinder and forces the counterrecoil piston and the gun back into the battery position.

(2) When the gun is in the battery position, the oil occupying the space between the floating piston and the diaphragm is known as the oil reserve. A constant level of this oil must be maintained so that the mechanism will return the gun to full battery position. The position of the floating piston in the recuperator cylinder and the amount of oil in reserve is indicated by a small rod which extends through the cylinder head. If there is a full reservoir, the oil index will project 5 mm or approximately 0.20 inch beyond the face of the oil index housing. If there is insufficient reserve, the oil index will project less than 5 mm, and may completely disappear. Whenever the oil index projects less than 5 mm, it is necessary to drain completely the oil and refill the reservoir as described in paragraph 28e.

d. Variable recoil.—The variable recoil turning valve cam is linked to the top carriage by the connecting rod. As the gun is elevated or depressed, the valve turning rod moves forward or backward. This movement rotates the valve turning cam which, by means of gear segments, rotates the control rod. The position of the control rod determines the length of the oil passage in the recoil mechanism

and thereby determines the length of recoil. The recoil is shortened as the gun is elevated.

11. Top carriage.—The top carriage forms a connection between the cradle and the bottom carriage. The trunnion bearing of the top carriage is machined to seat the right and left trunnion caps, which house the trunnions of the cradle. The trunnions are supported in roller bearings and form the fulcrum of the movement of the gun in elevation. The lower portion of the top carriage is seated in and rotates on the pintle bearing of the bottom carriage, which forms the pivot for the movement of the gun in traverse (fig. 23). The pintle of the top carriage fits into a bushing in the bottom carriage and is held in place by a special antifriction bolt and nut arrangement. The top carriage is supported on a roller bearing housed in the roller path of the bottom carriage and by a circular liner of larger diameter secured to the bottom carriage. Belleville springs assembled under the roller bearings are provided to raise the top carriage slightly for ease in traversing. When the gun is fired the Belleville springs are compressed and the top carriage rests on the liner.

12. Bottom carriage.—The bottom carriage forms the connection between the top carriage and the trails. When the carriage is in firing position, the bottom carriage transmits the firing stresses to the ground. In traveling position the bottom carriage is suspended on pins on the end of the bogie lifting screws. The pins are assembled in the holes on each side of the front and of the bottom carriage. The top carriage is assembled in the pintle bearing of the bottom carriage. A supporting bearing is provided to increase the rigidity of the pintle bearing and prevent rebound of the top carriage after firing. The traversing rack is bolted to the top of the bottom carriage. The two trails are connected to the bottom carriage by the trail pins.

13. Elevating mechanism.—*a.* The elevating mechanism is mounted on the top carriage and rotates the cradle and gun in elevation about the trunnions as an axis. Motion of the handwheel is transmitted through a series of gears to a shaft and pinion which engages and operates the elevating arc on the cradle. The gear train, with the exception of the pinion, is mounted on antifriction bearings. Seals and oil retainers are provided to make the mechanism oiltight and to prevent grease or oil from coming in contact with the brake lining. The mechanism is enclosed by a cover to keep out dust and dirt.

b. The elevating mechanism is equipped with a brake which is engaged at all times and must be released in order to operate the elevating handwheel. The brake is released by pressing down on the brake lever. After the adjustment of gun in elevation is made, the lever is released, automatically engaging the brake through action of springs and lugs within the brake housing. When the brake lever is in its normal position, it is secured by means of a pin to prevent accidental release (fig. 16).

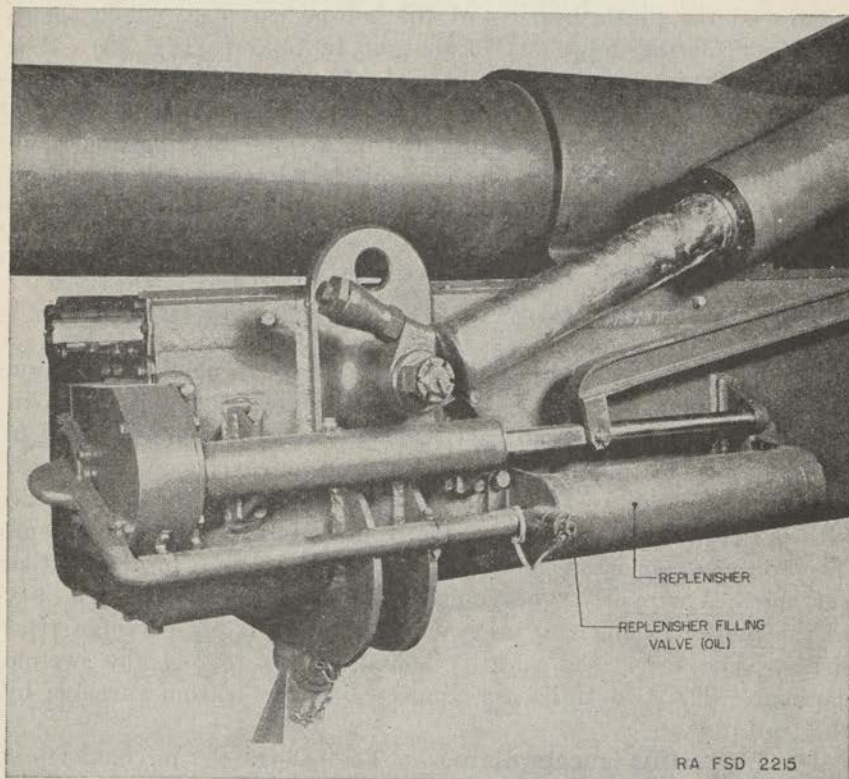


FIGURE 15.—Variable recoil mechanism and replenisher.

14. Equilibrators.—*a. Operation.*—Two equilibrators of the pneumatic type are provided to balance the weight of the gun muzzle and reduce the manual effort required to elevate the gun through the lower elevations. They consist primarily of cylindrical cases and plungers. They are filled with nitrogen gas under pressure and are equipped with appropriate grease seals to retain the gas. The equilibrators assume a nearly closed position at the maximum elevation of the gun. If the gun is depressed, the plunger, sliding in a

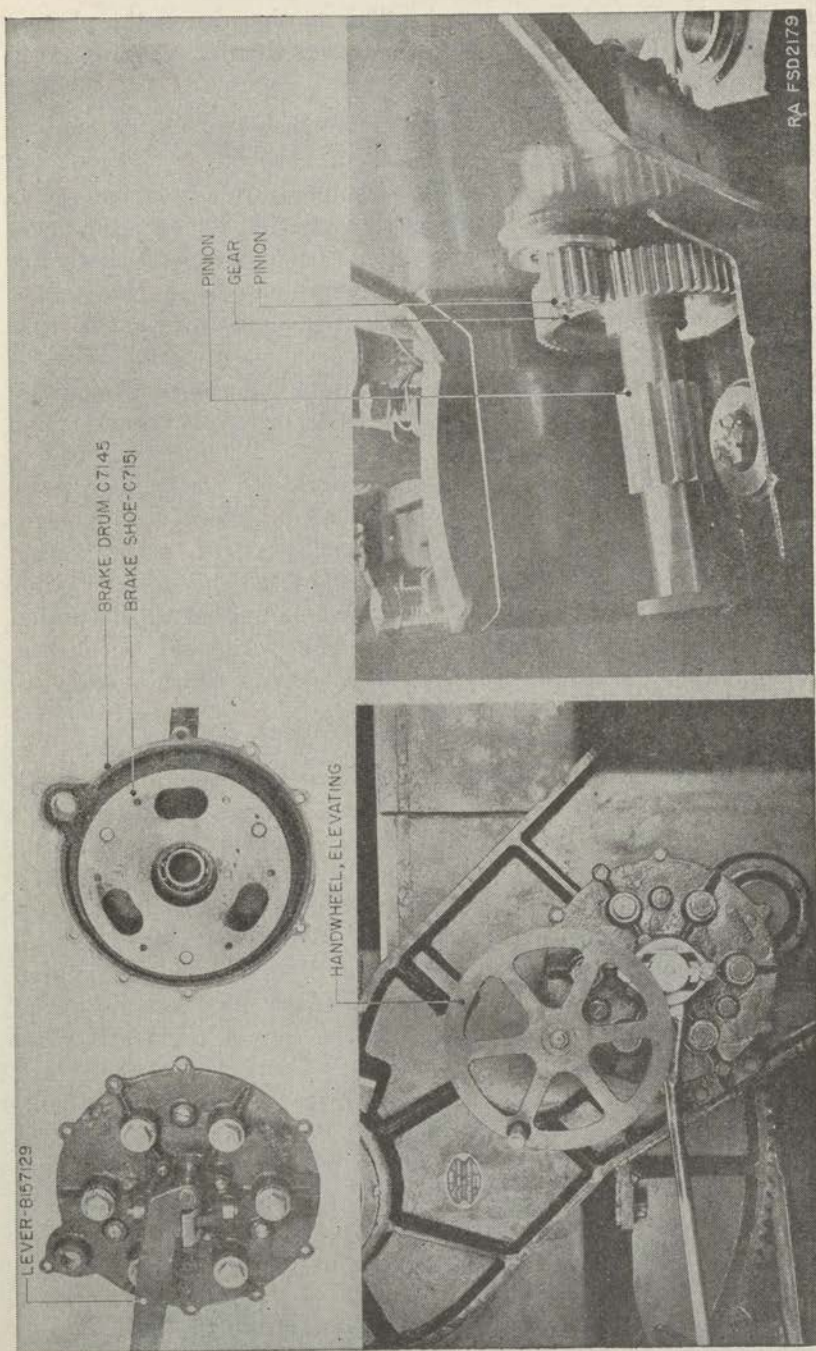


FIGURE 16.—Elevating mechanism.

stationary grease seal, is retracted. This motion draws the plunger ahead toward the stationary grease seal and further compresses the nitrogen in the equilibrators.

NOTE.—The equilibrators are not to be disassembled except by ordnance personnel.

b. Temperature adjustment scale.—Temperature adjustment scales are provided on both sides of the gun to provide for an adjustment of the tension of the equilibrators for various temperatures. For satisfactory functioning, the equilibrators should be set for a temperature corresponding to the atmospheric temperature at the time of firing the gun. The adjustment may be made by trial since the scale is not correct if the equilibrators pressure is not normal. Operation of the temperature adjusting screw raises or lowers the guide and index along the temperature scale.

15. Traversing mechanism.—The traversing mechanism is also mounted on the top carriage and rotates the gun in azimuth by means of a pinion working on the traversing rack, secured to the bottom carriage. The traversing handwheel is connected through a flexible joint to a worm which drives a worm gear connected to the pinion that meshes with the traversing rack. The worm and worm gear are mounted on antifriction bearings in a housing which is sealed to retain the lubricant and exclude dust and dirt.

16. Trails.—The two fabricated steel trails are identical. The top and bottom members of the trails form the seats for the trail pins where they are attached to the bottom carriage. The trail pins are secured in position by threaded plugs. Fastenings for carrying the spades and accessories in travel position are provided (fig. 17).

17. Spades.—The front spades are assembled in the front spade brackets on the bottom carriage when in firing position. The trail spades are attached in a slot at the end of the trails and are secured thereto by keys. These keys may be used either for the trail spades when firing or for the travel lock on the top of the trails when traveling.

18. Brakes.—*a. Power brakes.*—A power brake system of the Bendix-Westinghouse type is provided on this carriage. Each of the four bogie wheels is equipped with a mechanical brake which is operated by compressed air furnished by an air compressor unit in the prime mover. When the carriage and prime mover operate as a unit the two are connected by two air lines which feed the compressed air from the prime mover to each of the four bogie brakes. The latter are applied simultaneously by operating the brake mechanism of the prime mover. The two air lines are marked "Service"

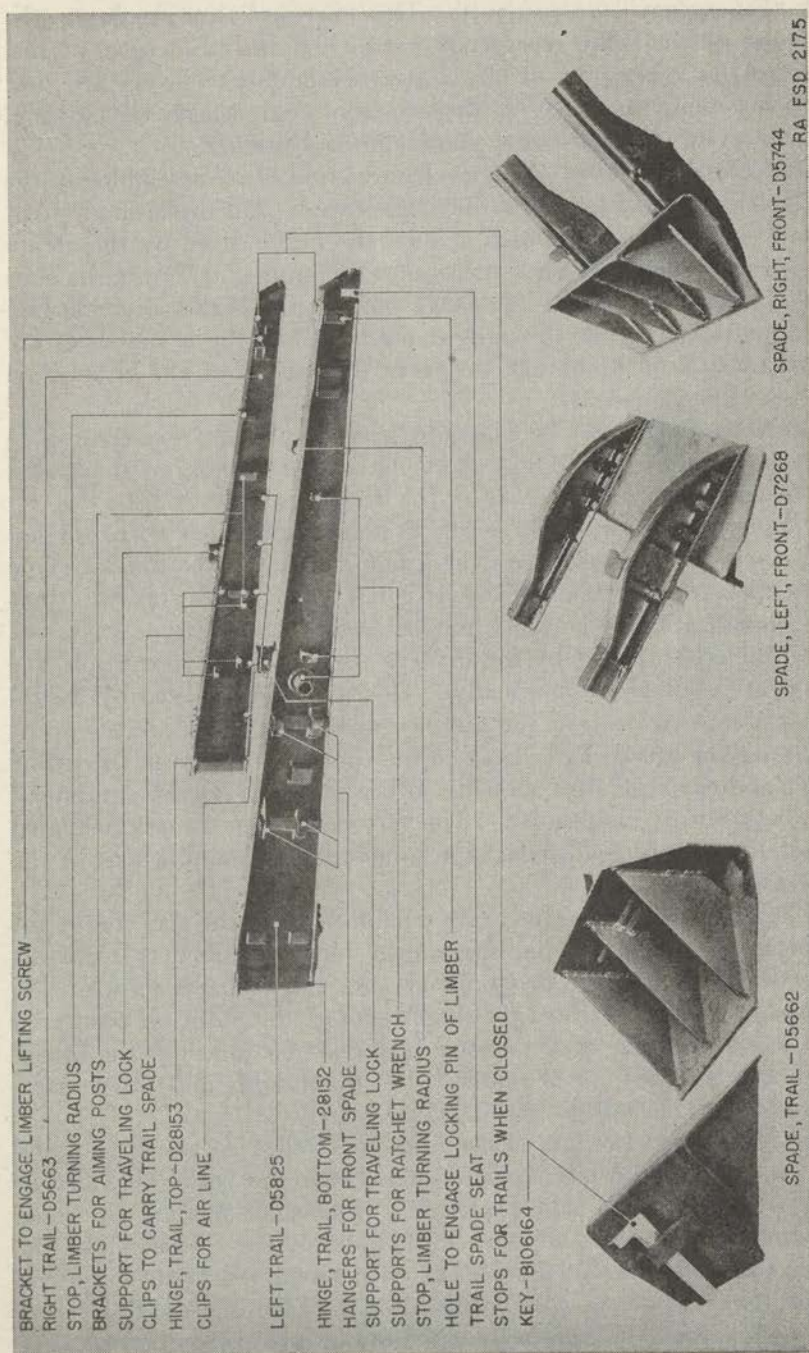


FIGURE 17.—Trails—outside view left trail; inside view right trail—and spades.

and "Emergency," respectively. The "Service" line leads to the top port of the relay emergency valve, and the "Emergency" line leads to the lower port of the valve. Hand brake levers are provided to actuate the brakes on the two front bogie wheels for parking, or in the event of failure of the power brake system.

b. Mechanical brakes.—The mechanical brakes are assembled to the dust shields secured to each of the bogie axles. The brake shoes pivot on one end and are expanded against the brake drum by the action of the brake shoe cam when the brakes are applied. The brake shoe cam is integral with the cam shaft. When the brakes are released, the cams return to the disengaged position, and the brake shoes are pulled away from the brake drums by the action of the brake shoe springs (figs. 18 and 21).

Caution: Care must be taken to prevent grease from coming in contact with the brake lining. This may cause slipping of the brakes and unsatisfactory functioning of the brake system.

c. Relay emergency valve.—The system is provided with a relay emergency valve mounted on the front end of the bottom carriage above the air reservoir. The emergency valve operation falls into two classifications: normal and emergency operations. Normal operation is controlled by the driver. In emergency operation, the brakes are applied automatically. This action is induced by a sudden or abnormal drop of the air pressure in the bogie air reservoir, which may be caused by a break in the connection between the prime mover and carriage, or a severing of the air line. Brake equipment must be carefully maintained. The valve and other connections must be sealed properly against leakage to obtain maximum benefit of the emergency brake.

d. Brake chamber.—The brake chamber converts the energy of the compressed air into the mechanical force necessary to force the brake shoes against the brake drum. As the brake is applied, the air pressure forces forward the diaphragm of the push rod connected with it, moving the slack adjuster into position to apply the brake. When the air pressure is released, the diaphragm and other parts return to their normal position (fig. 22).

e. Slack adjuster.—The slack adjuster C73324 serves as a brake lever to connect the mechanical brakes with the brake chamber of the air brake system and provides a convenient method of brake adjustment. The slack adjuster is mounted on the spline end of the camshaft and is connected with the yoke assembled to the push rod of the brake chamber. In normal braking, the slack adjuster rotates bodily with the camshaft as the brakes are applied or released.

The most efficient brake action will be obtained when the slack adjuster arm travel is held to a minimum so that the full length of the lever is used. The brake adjustment necessary to maintain proper slack adjuster arm travel is made by turning the adjusting screw. This rotates the worm gear, together with the camshaft and the cam, expanding the brake shoes so that the slack caused by the brake lining wear is taken up and the slack adjuster arm travel is returned to the minimum setting.

19. Bogie.—*a. Description.*—The bogie supports the weight of the gun carriage when it is in traveling position on the two axles, the straight axle and the arch axle. Each axle is equipped with two dual-tired wheels mounted on antifriction bearings. The axles are connected by two upper and two lower torque rods assembled to the respective axles by supports and brackets. Cables are attached to the brackets and axles to provide a support for the wheels when they are raised from the ground in firing position. Trunnions in the lower portion of the crossbeam are machined to mount the seat to which the springs are secured.

b. Bogie lifting mechanism.—Compound screws, with external right-hand threads, are screwed into the crossbeam. The internal threads of the compound screws are left-hand and are assembled with pins which fit in holes on the front end of the bottom carriage. The screws are actuated for raising and lowering the carriage by means of reversible ratchet wrenches applied to the hexagon end of the screws. Pressure lubricating fittings are assembled at the top of the screws.

c. Cradle lock.—The cradle lock is attached at the lug on top of the crossbeam of the bogie. It is used to lock the cradle to the bogie when it is in traveling position.

d. Bogie wheel.—(1) The 11.00 by 20 truck tires with puncture-sealing tubes are mounted on disk rim and ring C65401. This assembly is interchangeable on the hub of the dual-tired bogie wheel and on the single-tired limber wheel. Some of the units are equipped with combat tires and heavy duty truck tubes. These latter may be run when flat. They require special wheels and rims for mounting on the vehicle. The hub of each bogie wheel also mounts the brake drum C73210 which is secured to the hub by means of 10 studs. The studs are right-hand threaded for the left side of the bogie and left-hand threaded for wheels on the right side of the bogie.

(2) The right- and left-hand thread feature applies only to the end of the studs which fit the cap nuts B157225 and B158086 (for the left side only), and cap nuts B174196 and B108227 (for the right side

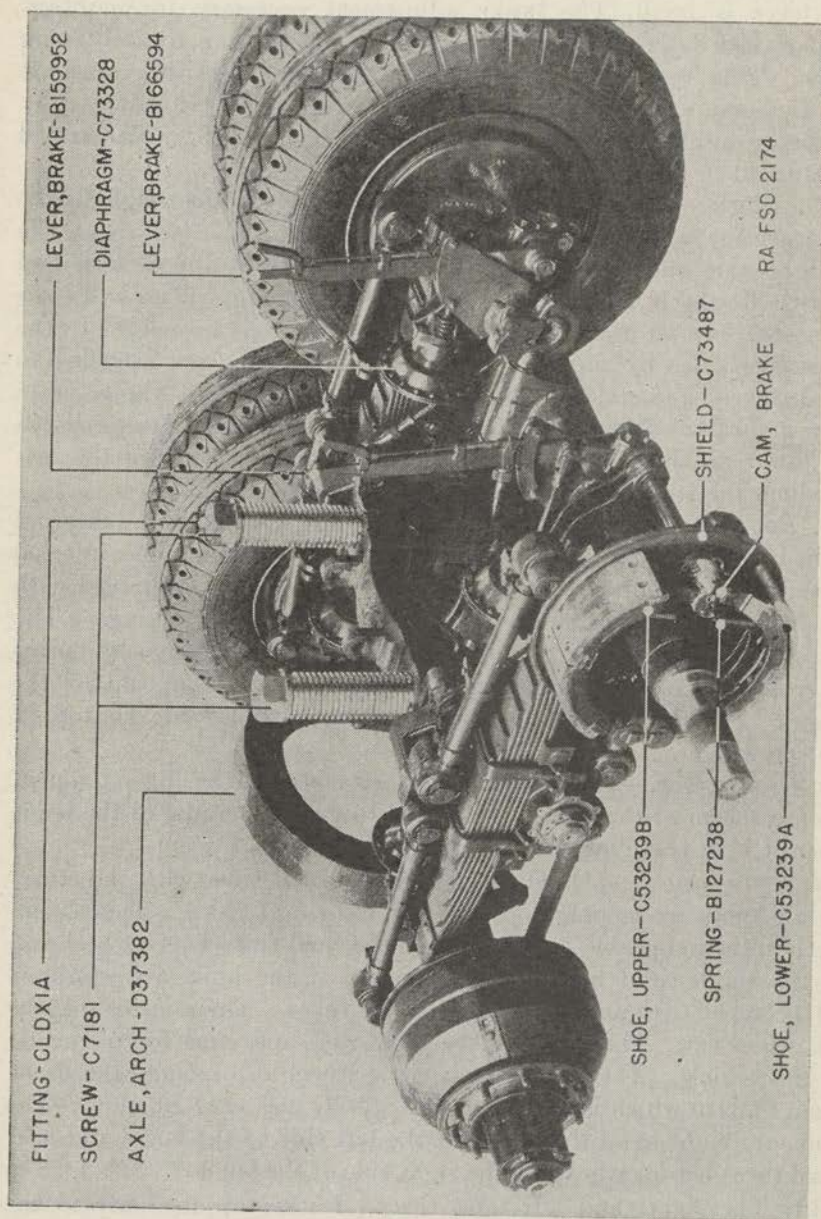


Figure 18.—155-mm gun carriage bogie M1—rear view.

only), and secure the rim to the hub. The ends of the studs, which secure the brake drum, are all threaded right-handed to fit nut A139101.

(3) The hub is mounted on antifriction bearings. The assembly is secured by means of nuts and a dowel, and is made oiltight by means of hub cap C72917 with gasket B159927 and oil retainer B166564. Plug Q52A is provided to drain the hub.

NOTE.—An odometer is mounted on the right side end of the arch axle. Right and left on the bogie and limber are determined when facing the direction of the muzzle of the gun.

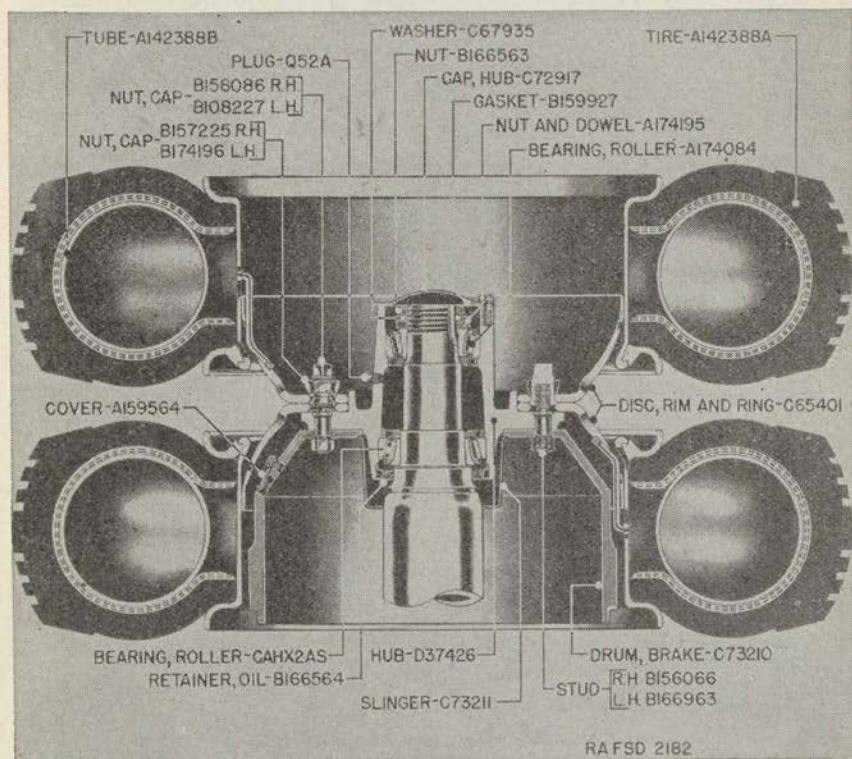


FIGURE 19.—Dual wheel.

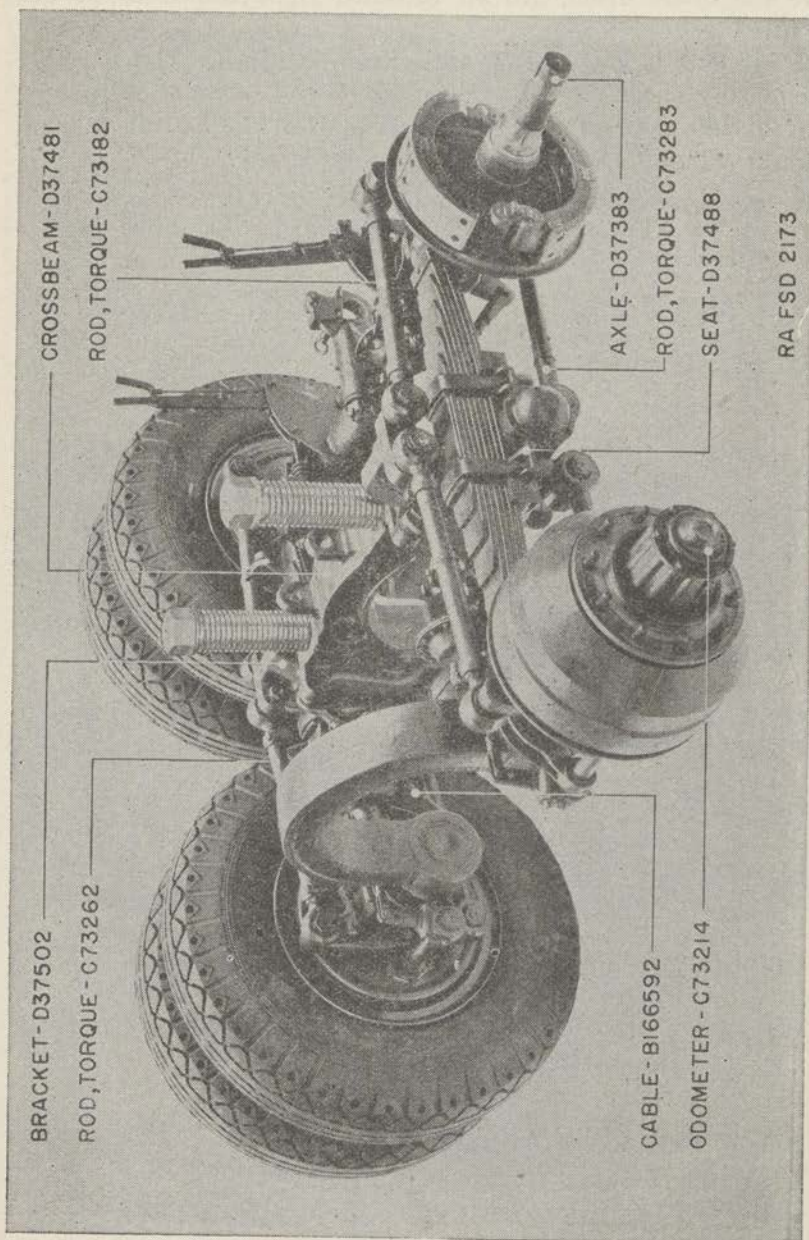


FIGURE 20.—155-mm gun carriage bogie M1—front view.

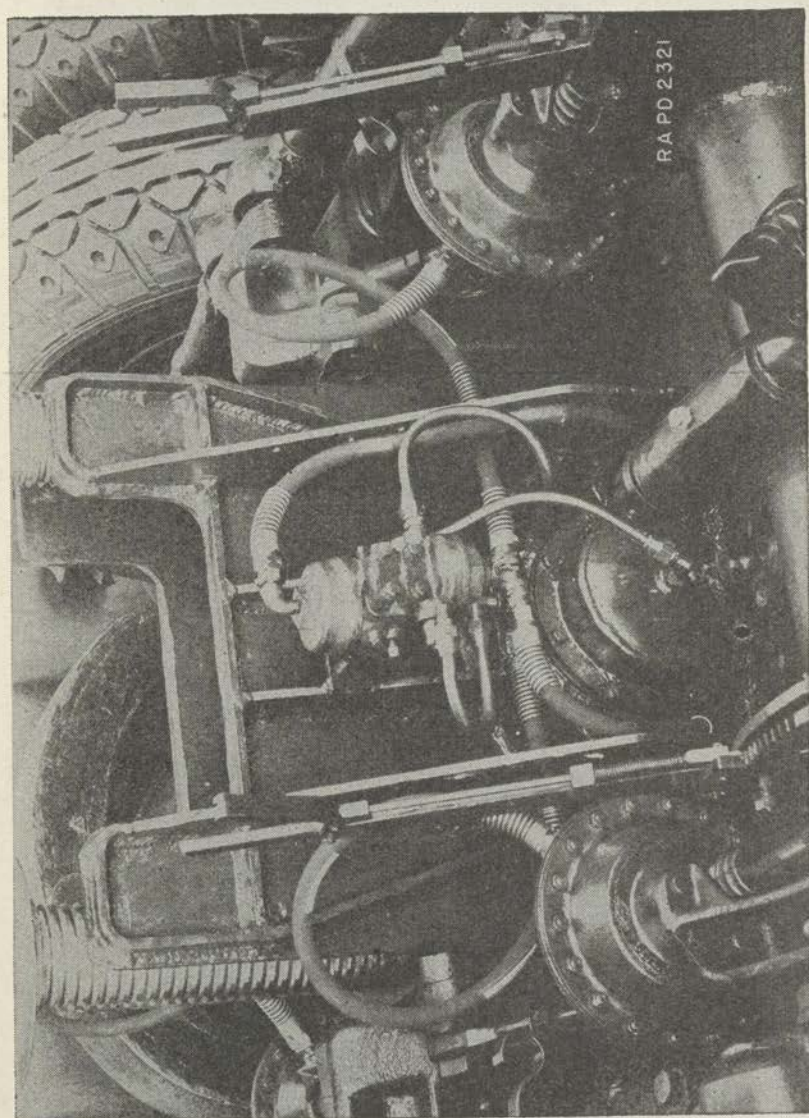
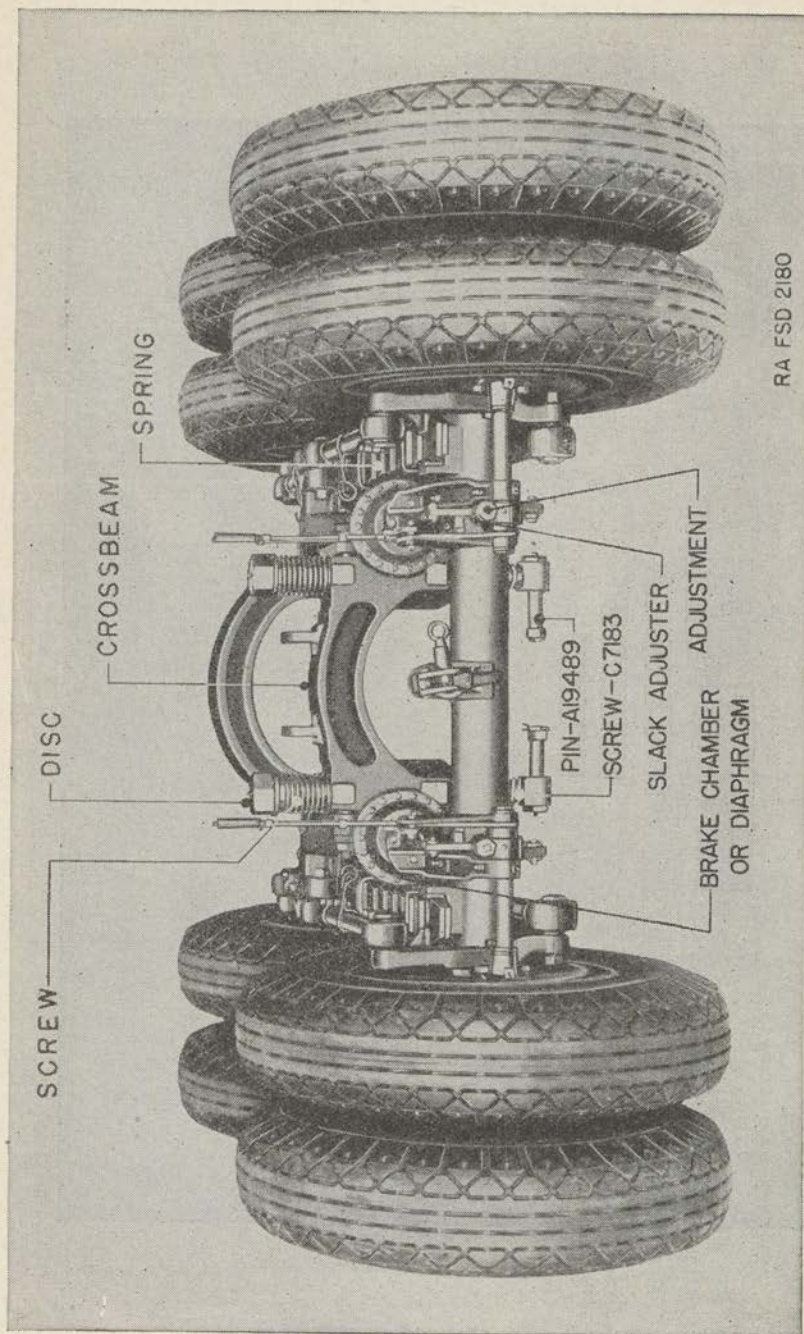


FIGURE 21.—Relay emergency valve.



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FIGURE 22.—Bogie lifting mechanism.

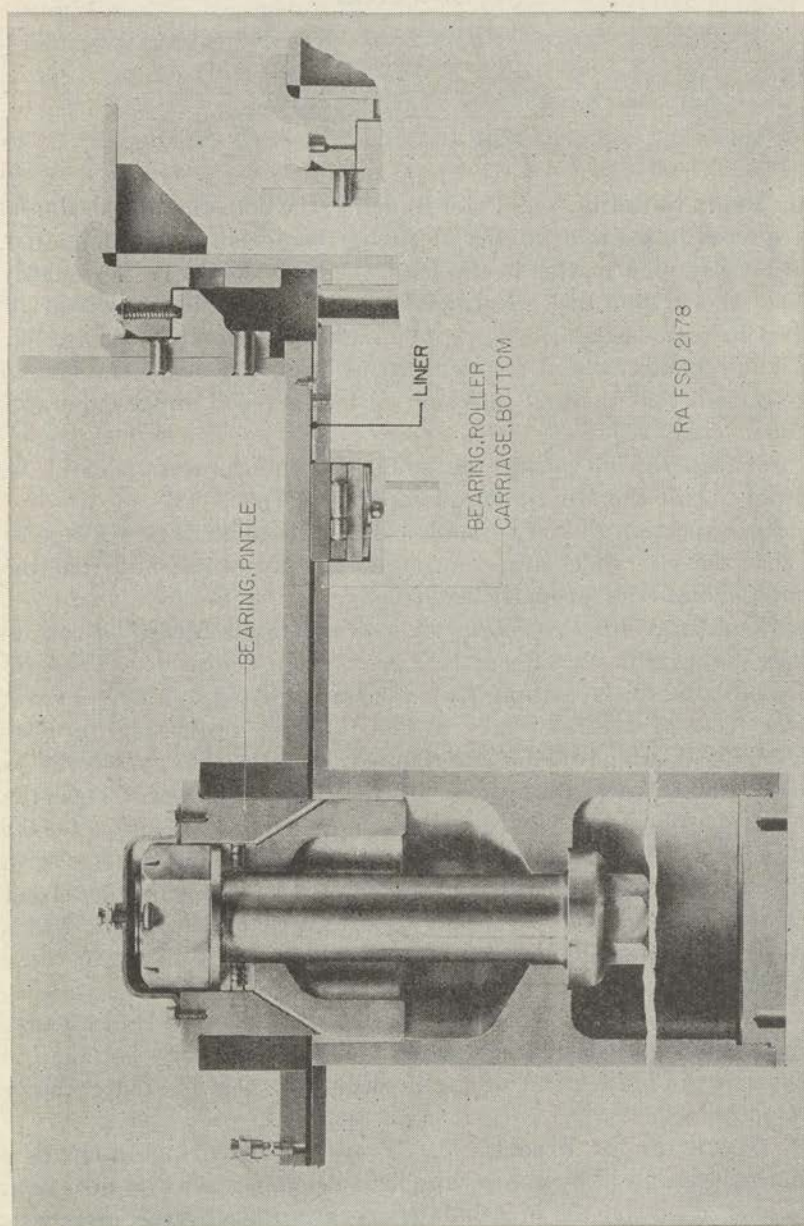


FIGURE 23.—Pintle bearing.

SECTION IV

OPERATION

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Operation of carriage.....	25

20. Prior to firing.—*a.* Prior to firing, the bore and breech should be inspected to see that no dirt or foreign material has accumulated. If there is foreign matter in the bore, the bore should be thoroughly cleaned and wiped dry. Normally, the bore should be wiped or cleaned to remove the coating applied after the previous firing.

b. The replenisher and recuperator oil levels should be checked to make certain that there is sufficient oil in the recoil and recuperator cylinders (par. 28).

c. For ease of elevating the gun, the equilibrators should be adjusted to suit the atmospheric temperature (par. 14).

d. An inspection should be made to see that there is no leakage of oil; that the gun slides are clean and well lubricated; and that the piston rod nuts are properly tightened.

21. Loading.—*a. Projectile.*—A loading tray is furnished both to provide for ease in loading and to protect the projectile. The projectile is placed in the loading tray, the tray is lifted by the gun crew, and the front of the tray placed so that the brass projecting lug rests in a blank portion of the interrupted breech. The projectile is pushed clear of the loading tray by use of the rammer. Then the tray is removed and the projectile is rammed into position in the forcing cone. It is important that projectiles be rammed home with a uniform force since variations in the ramming force will cause slight variations in the range. It is also important that the rotating bands on a projectile are not damaged, as such damage is likely to cause erratic firing.

b. Propelling charge.—It is not necessary to use the loading tray for placing the powder charge in the breech. Care must be taken to insure that the igniter end of the powder charge is located opposite the breechblock.

22. Operation of breech.—*a. To open.*—The firing mechanism must first be removed by unscrewing it in a counterclockwise direction. Then push down on the breechblock operating level catch until it is released from the catch plate. Move the breechblock operating lever down to a horizontal position, until it rests on a stop machined in

the breechblock carrier. As the operating lever moves downward it rotates the breechblock thereby disengaging the threads of the breechblock from the threads of the breech recess. The breechblock roller axis pin assembled to the breechblock then engages the breechblock rotating cam on the breech ring. At this point the rotation of the breechblock is stopped and it is located in the open position. The rotating cam then forces the breechblock carrier away from the breech face of the gun. The breech is opened by swinging the operating lever toward the muzzle of the gun.

b. To close.—Grasp the handle of the breechblock operating lever firmly and swing it toward the breech and up. The counterbalance mechanism connected to the breechblock carrier hinge pin will facilitate the movement of the breechblock carrier in closing. The counterbalance regulating nut should be set in a position suitable to the angle of elevation to which the gun is being fired. When the breech is closed, the operating lever becomes automatically locked in position by the breechblock operating lever catch. If the breechblock is fully closed, the firing mechanism can be assembled by screwing it into the housing, turning it in a clockwise direction.

23. Firing.—*a. Instructions.*—(1) Remove the firing mechanism from the breechblock and while holding the assembly in one hand, slide the primer into the U-shaped groove. Then place the mechanism in the breechblock and screw it all the way into place.

(2) Firing is accomplished by a quick pull or snap of the lanyard attached to the percussion hammer, causing the percussion hammer to strike the firing pin. When traveling, or for reason of safety, the percussion hammer may be locked in a neutral position by the percussion hammer lock pin.

NOTE.—The breechblock must be closed before assembling the firing mechanism, and the firing mechanism must be removed before the breechblock can be opened.

b. Misfires.—A misfire occurs if the piece fails to fire when desired. Failure of the piece to fire is due to one of two causes: failure of the propelling charge to ignite, or failure of the primer.

(1) *General precautions.*—The following general precautions will be taken in all cases of misfire:

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

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

(c) When removing the firing mechanism, opening the breech, or reaming the vent, the operator will stand clear of the path of recoil

and all other persons will be kept away from the rear of the breech.

(d) In no case will the breechblock be opened before the primer is removed.

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

(2) *Primer failure.*—In case the discharge of the primer is not heard, the following procedure will be observed:

(a) At least three attempts will be made to fire the primer, the lanyard being pulled with considerable snap.

(b) If a special device is available which permits the lifting of the latch and removal of the firing mechanism by a person entirely clear of the path of recoil, the primer may be removed after 2 minutes have elapsed since the last attempt to fire. If no special device is available, proceed as in (3) below.

(c) When removing the firing mechanism, the operator will note whether the firing mechanism was fully screwed home. (The primer will not be hit properly unless the firing mechanism is screwed as far beyond the latch as possible.)

(d) The primer, after removal, will be examined to determine whether it has been fired.

(e) If the primer has been fired, proceed as in (3) below.

(f) If the primer has not been fired, the percussion head will be examined. If the head has been properly indented, the primer will be handled carefully and disposed of quickly due to the possibility of a primer hang fire. A new primer should then be inserted and an attempt made to fire.

(g) If the head has not been properly struck, and if the firing mechanism was found to have been properly seated, the firing mechanism should be inspected for the following faults: dirty or gummy parts, firing pin or firing pin spring broken, firing pin housing or primer holder loosened. A new primer should then be inserted and an attempt made to fire.

(3) *Propelling charge failure.*—In case the discharge of the primer is heard but the propelling charge has failed to explode, no attempt will be made to remove the primer or to open the breech until 10 minutes have elapsed after the firing of the primer. After 10 minutes the primer will be removed, a cleaning bit will be run through the vent, another primer will be inserted, and another attempt made to fire. Failure of the propelling charge to ignite indicates an abnormal condition of the charge, such as a missing igniter, igniter end of

charge against the projectile, wet ignition, or ignition charge folded over and not accessible to the flash of the primer.

c. Recoil.—During firing, the length of recoil should be measured for the first and last rounds and at intervals between when practicable. Figures 24 and 25 show the limits of allowable recoil of the gun at all elevations, for muzzle velocities of 2,100 foot-pounds and 2,800 foot-pounds, when operated at normal temperature of the recoil oil (70° F.). For the first round fired at other temperatures, the length of recoil may not be within the limits shown in the illustra-

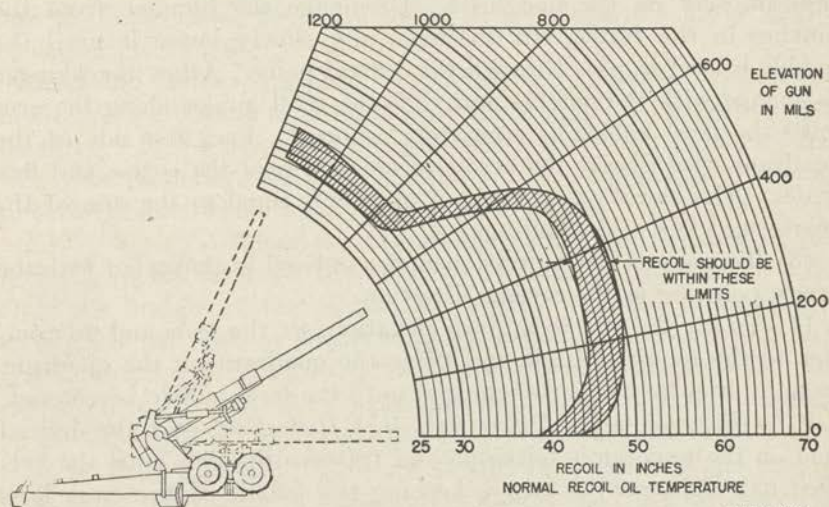


FIGURE 24.—Limits of length of recoil—normal charge.

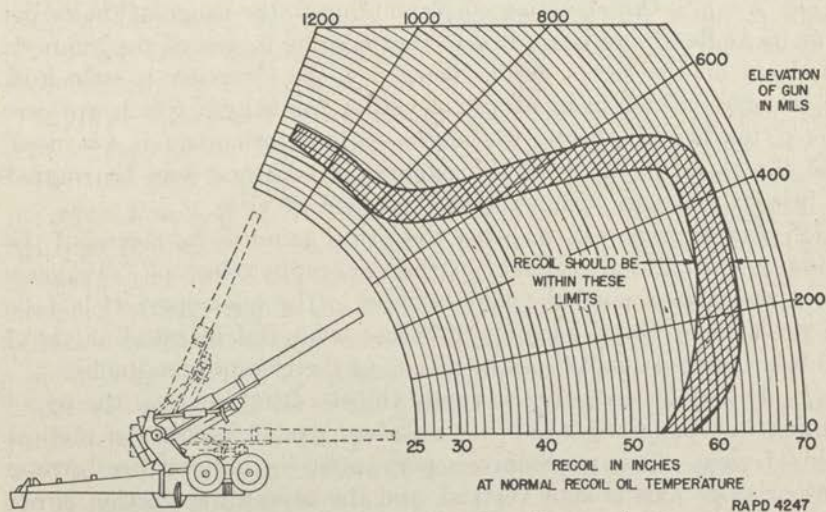


FIGURE 25.—Limits of length of recoil—supercharge.

tions. However, if the length of recoil does not fall within the desired limits when the gun is operated at normal temperature, ordnance personnel should be notified.

24. Laying the gun.—*a. In elevation.*—(1) The quadrant mount M1 and the gunner's quadrant are used for laying the gun in elevation.

(2) To measure the elevation of the gun, place the proper reference surface of the quadrant on the quadrant mount 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 slowly lower it until the bubble is seen to pass through the central point. Allow the plunger to engage with the notches and slide the level guides along the arm until the level bubble is accurately centered. Face the side of the quadrant which bears the arrow in use and read the coarse and fine scales. The elevation of the gun in mils is equal to the sum of the coarse and fine scale readings.

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

(4) To lay the gun to a given elevation, set the scale and micrometer to the required angle and place the quadrant on the quadrant mount. Elevate or depress the gun until the level bubble is centered.

b. In direction.—(1) *Direct fire.*—(a) *Deflection.*—Set the desired lead on the panoramic telescope and traverse the gun until the vertical hair falls on the target, keeping the bubble of the cross level centered by means of the cross level knob.

(b) *Range.*—An elevation corresponding to the range of the target plus its angle of site is applied to the piece by means of the gunner's quadrant on the right; or, in emergency, the elevation is estimated. If the gun is laid in quadrant elevation for ranges which are corrected for height of site, the angle of site mechanism is not used, and the elevating knob of the panoramic telescope may be rotated to bring the target within the vertical field of view.

(2) *Indirect laying.*—(a) Set the firing azimuth by means of the azimuth scale and micrometer of the panoramic telescope. Traverse the gun carriage until the vertical line in the telescope reticle falls on the aiming point, keeping the cross level and longitudinal level bubbles centered at all times by means of their respective knobs.

(b) It may be necessary to rotate the elevating knob on the panoramic telescope in order to bring the aiming point within the vertical field of view. This procedure is permissible in indirect fire because the periscope axis is kept vertical, and the azimuth correction is not affected.

(3) *Cross leveling.*—It is essential that the telescope mount be kept cross-leveled at all times during the operation of both direct and indirect fire, otherwise the telescope reticle lines will erroneously move off the target as the gun is elevated and an incorrect azimuth setting will be applied to the gun.

25. Operation of carriage.—*a. Elevating.*—Turning of the elevating handwheel, located on the right side of the top carriage, in a clockwise direction will elevate the muzzle of the gun. Before the handwheel can be operated, the brake lever lock pin must be removed and the brake lever forced down so as to release the brake on the elevating mechanism.

Caution: Before grasping the elevating handwheel, release the brake for an instant to determine if the weight of the gun tube is balanced. If the weight of the gun tube is extremely unbalanced, it will cause the handwheel to spin rapidly. It is dangerous to attempt to turn the handwheel when this condition exists.

b. Traversing.—When the traversing handwheel, located on the left side of the carriage, is rotated in a clockwise direction, it traverses the muzzle of the gun to the right. Traverse is limited to an angle of 30° right or left by stops assembled on the traversing rack.

c. Operation of brakes.—(1) Before starting the vehicle when connected to the gun, the air pressure must show at least 70 pounds on the dash gage of the prime mover in order that the brake system may be fully effective. Pressure should be checked from time to time when the vehicle is in operation and, should the air gage register a rapid drop in pressure, the brakes should be applied and held applied until the vehicle is brought to a full stop. A check of the air brake system should be made to determine the cause of this sudden drop in pressure.

(2) The emergency brake should never be used for parking purposes. Mechanical hand brakes are provided for this purpose.

(3) The best possible stop will be made when the first brake application is as hard as the speed of the vehicle and the condition of the road will permit, and then graduated off as the speed is reduced, so that at the end of the stop but little pressure remains in the brake chamber. Never apply the brakes lightly at first and increase the pressure as the speed diminishes. This would not only require more time but the final high pressure will produce a severe final stop.

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

(5) The air brake is designed so that when the brake pedal is moved to the limit of the stroke, an emergency application results, which will stop the vehicle in the shortest possible time. The application should be made only in an emergency and not employed as ordinary braking service.

(6) In making a stop or in slowing down from any speed above the idling speed of the engine, allow the engine to remain in gear with the throttle closed to get the full benefit of its retarding effect, disengaging the clutch when the idling speed is reached. Ample braking power is available in the air system. However, by drifting and utilizing the retarding effect of the engine, the vehicle may be slowed down successfully without use of the brakes.

(7) In the event of a break between the prime mover and the carriage, keep the brakes applied on the prime mover until a stop is made. Hold the prime mover by means of the hand brake and close the cut-out cocks in the service and emergency lines to prevent further loss of air. After repairs on recouplings are made, open the cut-out cock and the brake system will automatically recharge. If it is necessary to move the carriage before recoupling the air connection, the reservoir drain cock must be opened to release the air brake on the bogie.

d. To release emergency brake.—Either of two methods may be used to release the brake after emergency application has occurred. The recommended method is to repair and reconnect the air brake so that all connection lines and equipment are in their original condition and then to operate the air compressor to build up the pressure. As the pressure in the pilot reserve cavities in the relay emergency valve becomes equalized, it presses up the diaphragm in the emergency reservoir so that the emergency valve resumes its normal operating position. In this position the diaphragm, pressing against its seat, seals the lower end of the cavity against the pressure in the upper part of the cavity and holds the emergency valve off its seat. This opens the brake chambers to atmosphere. The other method is to drain the air pressure from the reservoir by means of the drain cock provided.

e. To change from traveling to firing position.—(1) Shut off the air at the prime mover, disconnect the air hose at the prime mover and the spade end of the trail, lock the ends of the hose together at the front and rear end of the limber, and place the dummy couplings on the ends of the air tubes on the trail (figs. 17 to 22, inclusive).

NOTE.—It is important to prevent dust and dirt from getting into the air lines since they cause malfunction of the brake mechanism.

(2) Disconnect the limber, set the hand brakes on the bogie, disconnect the gun from the traveling lock, and slide the gun into battery by means of the prime mover, with the cable leading over and around the sheave, over the top of the breech ring (breechblock open), and attached to the hook under the breech ring. Lock the gun securely to the recoil cradle by assembling the two piston rod nuts.

NOTE—It is necessary to allow a slight floating of the piston rod in the gun lug to prevent excessive wear on the stuffing boxes which might be caused by a slight irregularity in alinement of the recoil mechanism. The nuts should be drawn tight and then backed off enough to allow approximately 0.005 inch end play between the gun and the piston rod socket.

(3) Remove the bogie elevating screw lock, release the two locking pins on the limber, attach the four wheel supporting cables to the bogie, and release the cradle lock. Attach the front spades and lower the bogie trails by operation of the bogie and limber lifting screws, simultaneously digging in the front spades as the bogie is lowered. The wheels may be raised clear of the ground by lowering the carriage and raising the bogie wheels by the lifting mechanism. If blocks are used under the carriage, a sufficient height must be maintained on the bogie lifting screws to lift the carriage off the wheels and raise it the required height for firing. When raising or lowering the carriage, both screws must be operated in unison to prevent cramping of the mechanism. Raise the bogie wheels clear of the ground and remove the limber.

(4) Remove the traveling lock and spread the trails. Locate the holes for the rear spades and dig sufficiently deep to permit assembly of the spade to the trails. Disconnect the cradle lock from the cradle.

(5) If the bearing strength of the soil is low, or for more permanent emplacement of the gun, embedding logs are used. (Railway ties may be used.) These are placed behind the front and rear spades and dug in so as to distribute the force of recoil over a larger ground area and thus prevent movement of the weapon during firing (fig. 34).

f. To change from firing to traveling position.—To change from firing to traveling position the above operations are performed in reverse order, except that the retracting cradle is attached directly into the breech ring and not passed around the sheave. Care must be taken to attach the "Service" and "Emergency" airlines as marked on the hose connection of the prime mover. The wheel supporting cables should be detached from the pins on the cross beam and the eyes set on the hooks provided on the upper torque rods.

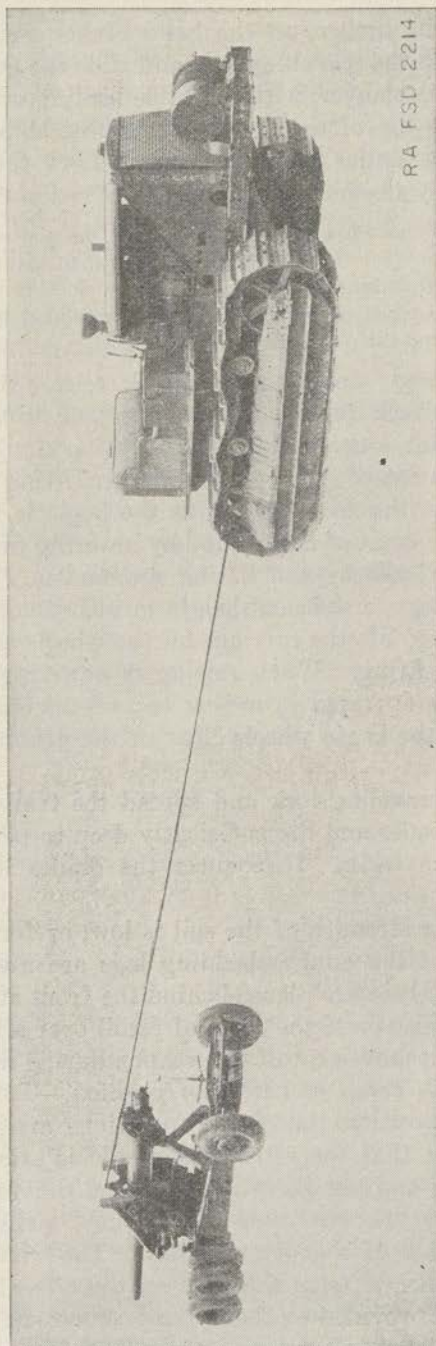


FIGURE 26.—155-mm gun M1, retracting cable attached for pulling gun into firing position—general view.

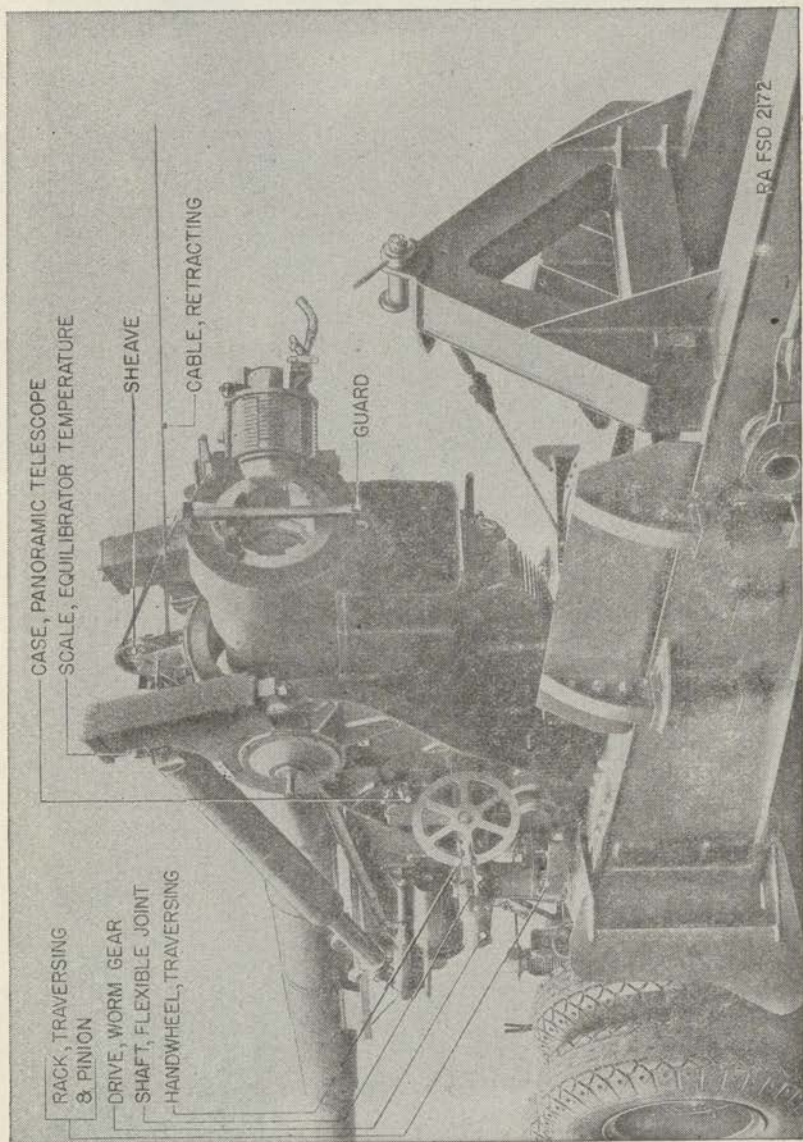
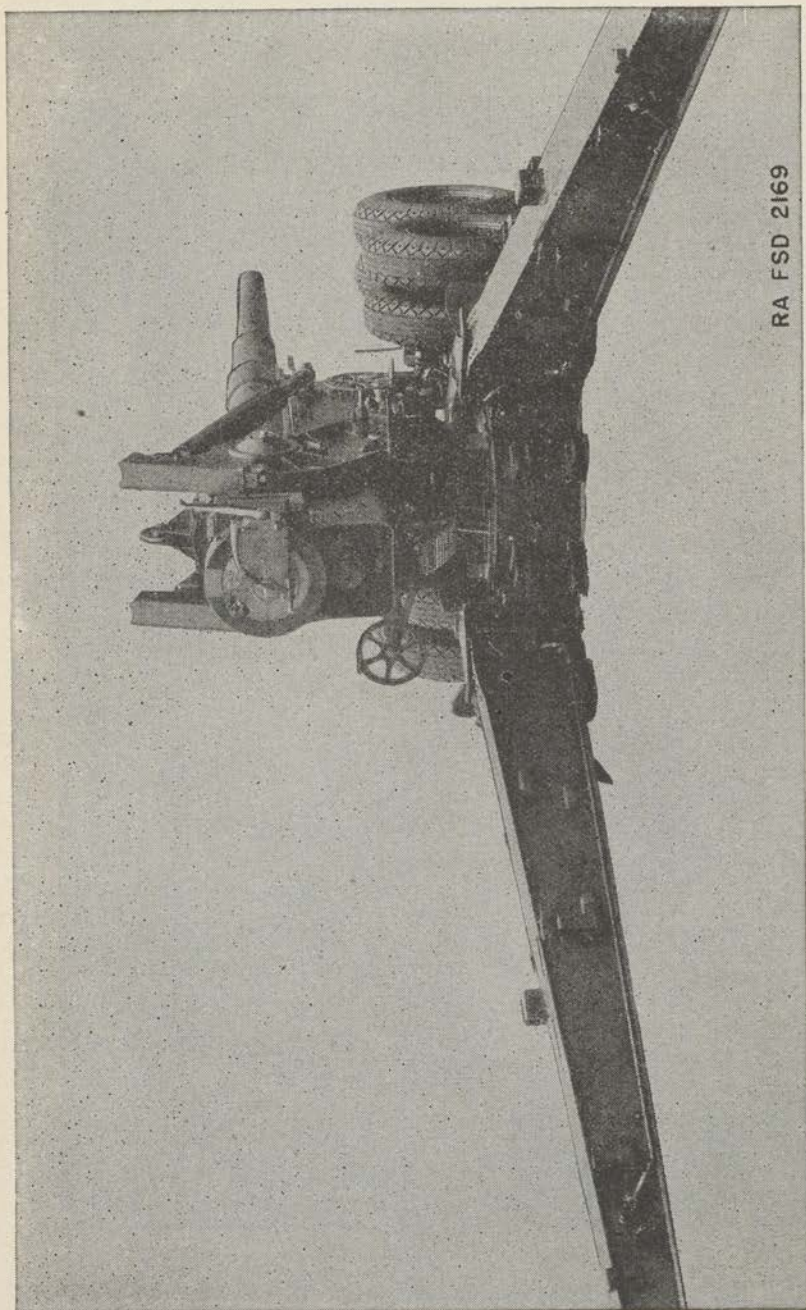


FIGURE 27.—155-mm gun carriage M1—retracting the gun.



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FIGURE 28.—155-mm gun carriage M1, firing position—rear view.

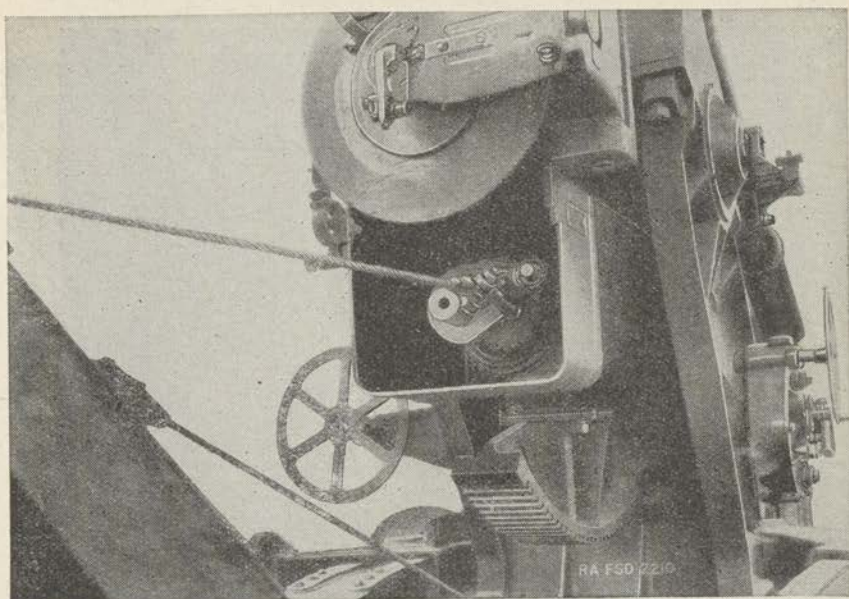


FIGURE 29.—155-mm gun M1, retracting cable, attached for withdrawal to traveling position—close-up view.

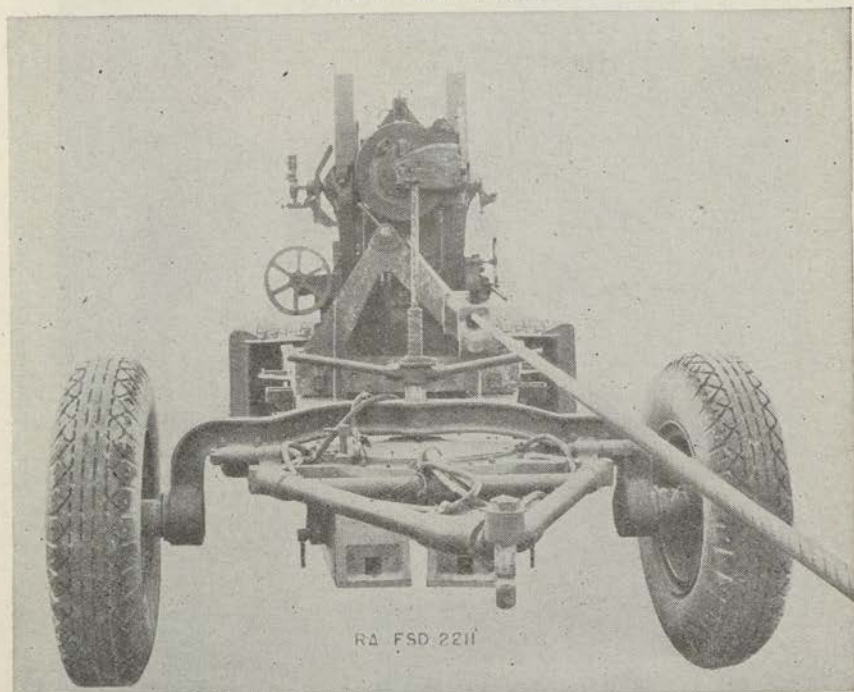


FIGURE 30.—155-mm gun M1, retracting cable, attached for withdrawal to traveling position, showing clearances.

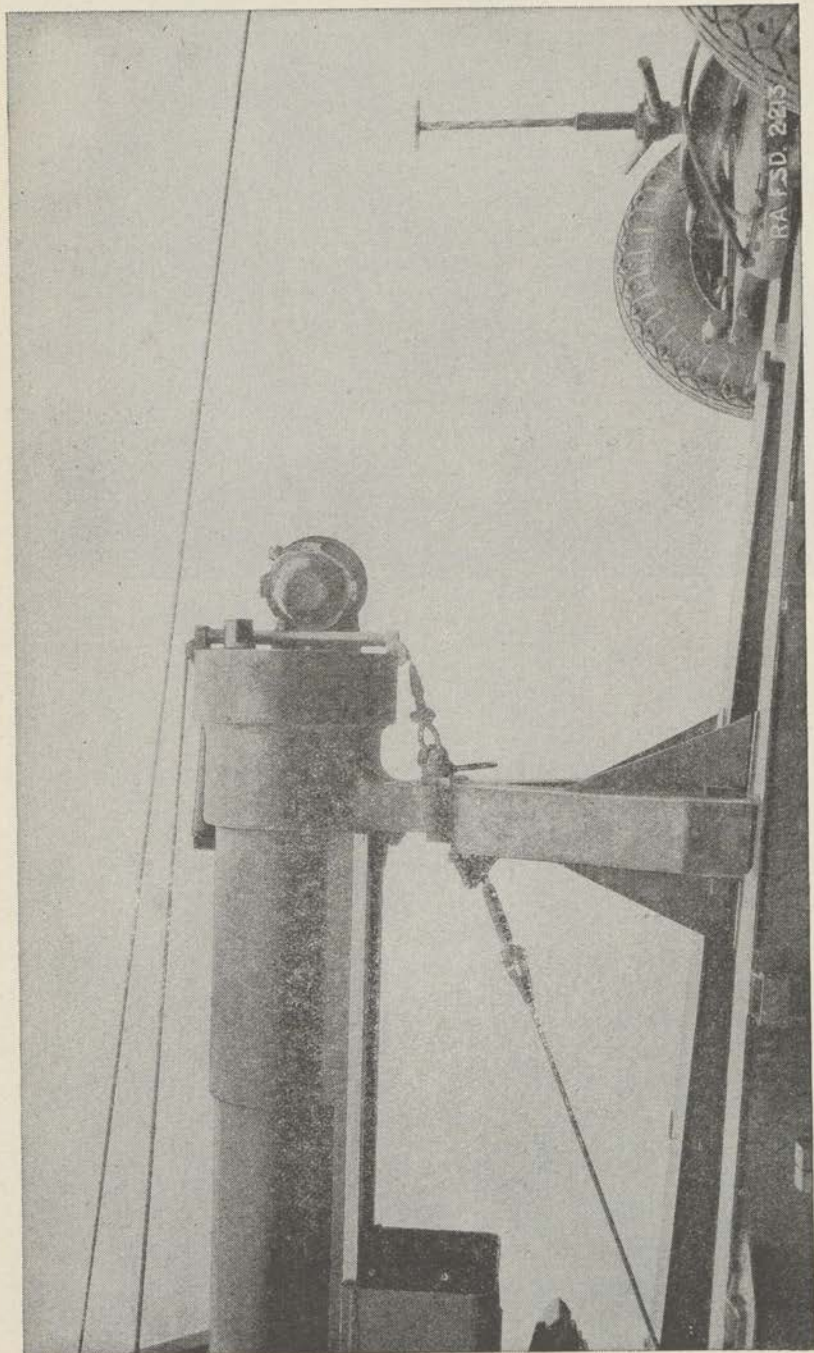


FIGURE 31.—155-mm gun M1, retracting cable, attached for pulling gun into firing position—left side view.

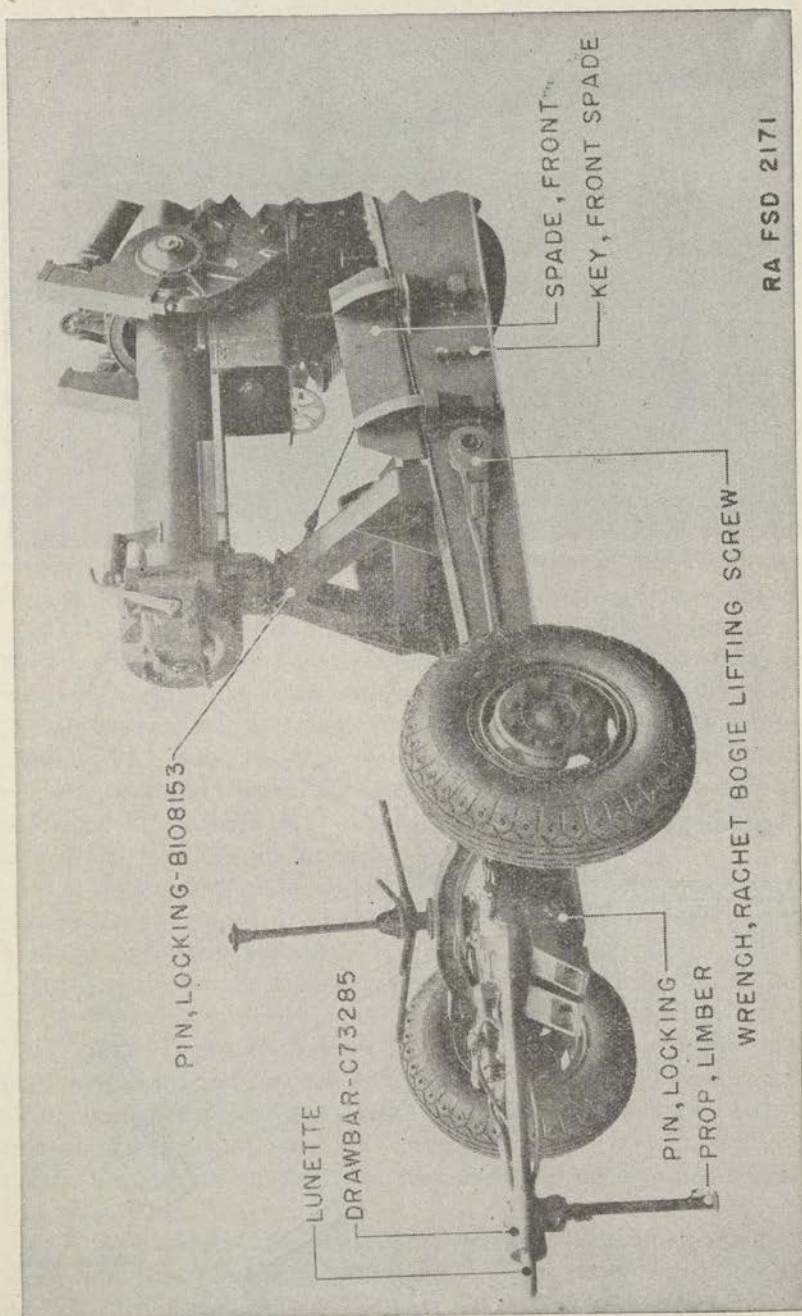


FIGURE 32.—155-mm gun carriage M1, traveling position—limber end.

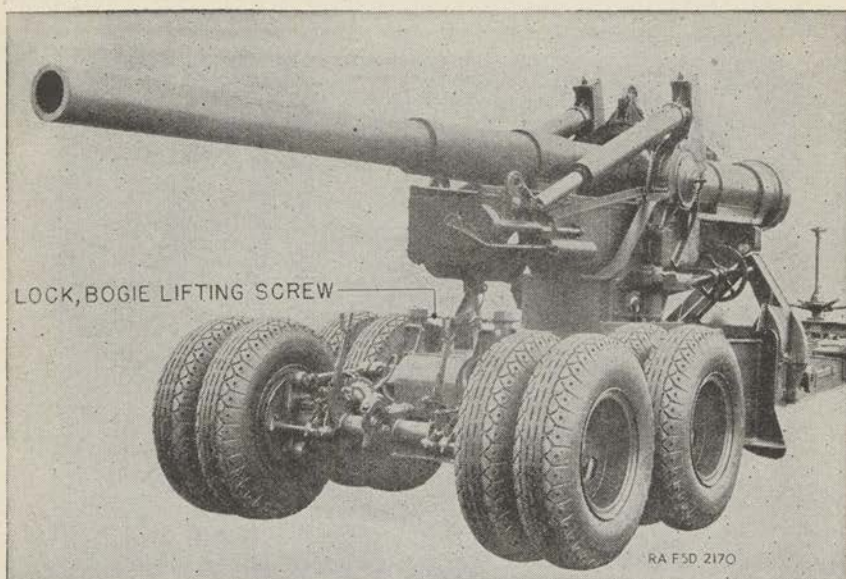


FIGURE 33.—155-mm gun carriage M1, traveling position—bogie end.

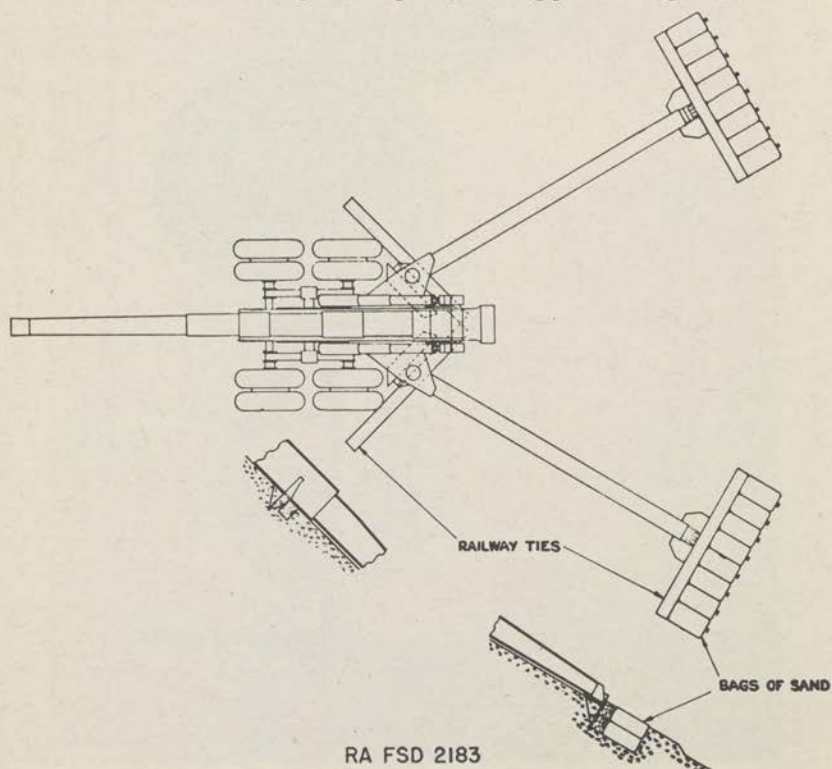


FIGURE 34.—Emplacement diagram.

SECTION V

CARE AND PRESERVATION

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Carriage.....	27
Recoil mechanism.....	28
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26. Gun.—*a. General.*—(1) It is important, whenever the rate of fire permits, that the cannoneer examine the bore before each loading to ascertain whether or not particles of powder bag or unburned powder remain in the bore. The presence of such particles may cause damage to the piece. During firing the sponge should be used between rounds.

(2) Should enemy shell burst near the weapon, be sure before firing that the weapon has not been damaged to a dangerous degree. Damage of a serious nature should be reported to ordnance personnel.

(3) In cleaning after firing, wash the bore with a solution of $\frac{1}{2}$ pound of soda ash or 1 pound of sal soda in 1 gallon of water or, if this is not available, swab with hot soapy water. In either case, use of the cleaning solution should be followed by a thorough rinse with clean water. Swab the bore, using a dry swabbing material, until it is perfectly dry and then oil with SAE 30 engine oil. (For temperatures below 32° F. use SAE 10.) A uniform, thorough coating of oil should be applied with the slush brush.

(4) The leveling plates should be protected. Tools or other articles should not be placed upon them. In case of injury repair must be made by ordnance personnel.

(5) Lubricating instructions are given in paragraph 31.

(6) When the matériel is not in use, it must be covered.

(7) When the weapon is not to be used for a considerable time the bore, breech mechanism, and bright and unpainted surfaces should be cleaned with dry-cleaning solvent and the surfaces coated with light rust-preventive compound.

(8) The various screws in the weapon should be examined frequently and kept tight.

b. Breech mechanism.—(1) The breech mechanism should be kept clean and the parts well lubricated. When not in use disassemble periodically for detection of rust. When in use disassemble fre-

quently, clean, and oil. It should be so cared for immediately after firing. This is especially important as no provision is made for oiling by means of oilers or oil channels.

(2) In removing rust preventive compound, the greater part should be scraped off. That remaining should be removed with dry-cleaning solvent used on a rag or waste.

(3) A steel hammer must not be used directly on any part of the mechanism. A buffer, such as a hardwood block, should be interposed, or a copper hammer used.

(4) Extreme care must be taken to prevent injury to the gas check seat. Bruises on the gas check seat affect the seating of the split rings and are likely to cause leakage of gas and burning of the pad. If such leakage occurs, serious erosion may result. Due to the fact that the pads are susceptible to moisture, rusting of the gas check seat is likely to occur. The seat and rings, therefore, should be well protected at all times with rust-preventive compound when the weapon is not in use, and the entire surface of the pad, in contact with the seat, split rings, obturator spindle, and filling-in disk should be kept coated with graphite lubricant.

(5) Vigilance must be exercised to detect any cutting or abrasions on the pressure side of the threads of breechblock and breech recess. If the breechblock does not rotate smoothly, or if it requires a greater effort than usual to operate, it should be disassembled and examined. Scoring or bruises on the threads of the breechblock or breech recess should be reported to ordnance personnel.

(6) In case the mechanism is not to be used for any considerable length of time, all bright or unpainted surfaces should be protected with a coat of rust-preventive compound. Before applying the rust-preventive compound the surfaces should be thoroughly cleaned and freed of rust, water, or lubricating oil. Rust-preventive compound may be readily removed by the use of dry-cleaning solvent.

c. Firing mechanism.—(1) The parts require the same attention as the breech mechanism. Therefore, frequent disassembly for the purpose of cleaning and oiling is required.

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

(3) The primer seat and the vent in the obturator spindle should be kept clean by frequent use of the vent cleaning tool. The slightest accumulation of fouling in the primer seat will cause difficulty in inserting and extracting the primer.

27. Carriage.—*a. General.*—(1) Attention should be given to cleaning, lubricating, and to loose or broken parts. Lubrication, with the method and frequency of application, is covered in paragraph 31.

(2) Bearing surfaces, revolving parts, springs, gear teeth, breech mechanisms, screw threads, and exterior parts, must be clean and free from dirt. Special attention should be given to exposed gear teeth and bearing surfaces. In disassembling and assembling operations, precautions must be taken to prevent the entrance of foreign matter.

(3) The carriage should be given a general inspection periodically.

(4) The care and maintenance of the carriage require the use of the cleaning and preserving materials issued by the Ordnance Department.

(5) When the carriage is stored, or is not to be used for a considerable length of time, all bright and unpainted surfaces should be protected with a coat of medium rust-preventive compound. Before applying the compound the surfaces should be cleaned with dry-cleaning solvent.

b. Wheels.—The pneumatic tires should be kept at 70 pounds pressure for traveling at high speed over smooth roads. At all other times the tires should be kept at a pressure of 50 pounds per square inch. The grease in the wheel hubs should be removed at least every 6 months and replaced with new grease.

c. Power brake mechanism.—The power brake mechanism should be inspected periodically for air leaks. When replacing any part of the air line be sure that all burrs are removed from ends of grease and oil fittings and that all dirt and foreign matter are removed.

d. Relay emergency valve.—(1) To test the application release portion of this valve for leakage without removing the complete valve, charge the carriage air reservoir, and with the brakes in released position apply soapsuds to the exhaust port. If air leaks through this port it indicates that the intake valve is not seating properly. Notify the ordnance personnel.

(2) If air leaks through the exhaust port when the brakes are applied, it indicates that the relay valve diaphragm is not seating properly. Notify the ordnance personnel.

(3) To test the emergency portion of this valve for leakage, disconnect the emergency hose between prime mover and gun carriage. With air pressure in the carriage air reservoir, the brakes should act automatically. Apply soapsuds to emergency hose or coupling at

the carriage to determine if the emergency diaphragm is leaking. Then apply soapsuds to the exhaust port to determine if the emergency valve is seating properly.

(4) If the leakage on any of the above tests is more than a 2-inch diameter bubble in 5 seconds, or if the brakes fail to apply when the emergency hose is disconnected, the complete valve should be repaired or replaced.

(5) The carriage air reservoir should be drained once a day in order to expel the accumulated water.

(6) The slack adjusters should be kept properly lubricated.

(7) When the carriage is coupled to the prime mover and the air pressure registers 70 pounds per square inch, the brake mechanism should be tested to determine whether or not all parts function properly when a slight pressure is applied to the brake pedal of the prime mover.

(8) Drain all air reservoirs once each 24 hours.

(9) Break carriage emergency line once each 24 hours to assure proper operation of emergency feature.

(10) Do not move vehicles with less than 70 pounds air pressure in reservoirs.

28. Recoil mechanism.—*a. Before firing.*—The recoil and counterrecoil mechanism should be examined for leakage of oil; to ascertain that proper amount of reserve oil is in the counterrecoil system and in the replenisher; and to see that the gun slides are well lubricated and that piston rod nuts are properly tightened.

b. During firing.—(1) The action of the mechanism should be watched to see that the gun returns to battery smoothly and without shock, and that there is no leakage of oil.

(2) When the gun is in action, the length of recoil should be checked constantly by means of the recoil indicator, whenever such checks do not interfere with the rate of fire.

c. Filling and drain plugs.—When removing or replacing filling and drain plugs, care should be taken that the plug gaskets are in place and are in good condition. Also examine the threads of the plugs. When replacing the plugs screw them tightly on the gaskets but do not force them excessively.

d. Filling replenisher.

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

(1) The position of the replenisher piston governs the filling of the recoil cylinder. The normal position of the replenisher piston

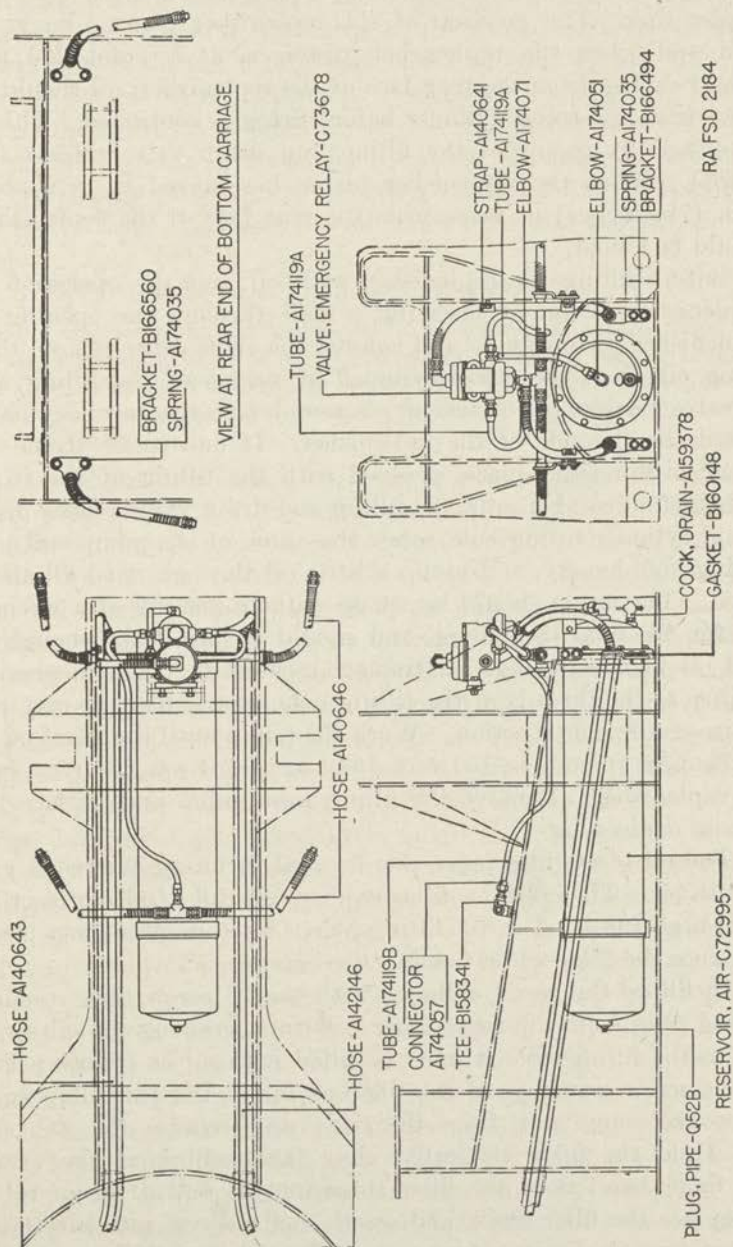


FIGURE 35.—Air brake hose diagram.

is 150 mm ($5\frac{3}{4}$ inches) from the rear face of the replenisher cylinder. This position indicates a full cylinder and sufficient reserve in the replenisher. The position of the replenisher piston should be checked and when the replenisher piston is at a point 100 mm (4 inches) or less from the rear face of the replenisher, oil should be removed from the recoil cylinder before firing is continued. This is accomplished by means of the filling and drain valve release (oil extractor). When the replenisher piston has moved in to a point 200 mm ($7\frac{7}{8}$ inches) or more from the rear face of the replenisher, oil should be added.

(2) Before filling the replenisher with oil, test the operation of the replenisher piston by inserting a scale through the opening of the replenisher piston guide and against the replenisher piston, then releasing oil from the recoil cylinder by means of the filling and drain valve release (oil extractor) screwed into the recoil cylinder drain hole on the side of the replenisher. If movement of the replenisher piston takes place, proceed with the filling of the recoil cylinder as follows: Unscrew the filling and drain valve release from the recoil cylinder filling hole, screw the union of the pump coil into the filling hole loosely, and pump a little oil through until all air is excluded. The union should be set up without the use of a wrench, except for the final tightening, and should be just tight enough to prevent oil from escaping. Extreme care must be taken to prevent any injury to the threads of the filling hole, as any damage may put the entire cradle out of action. Work the pump until the rear end of the replenisher piston is 150 mm ($5\frac{3}{4}$ inches) from the rear face of the replenisher. Remove the filling pipe union and replace the filling and drain plug.

(3) The oil screw filler may also be used in filling the recoil cylinder with oil. The oil screw filler requires careful handling in order to avoid breaking it off in the filling hole. The operator must properly balance the filler while turning the handle.

(4) In filling the recoil cylinder with the oil screw filler, remove the filling plug from the replenisher. Before screwing the oil screw filler into the filling hole it must be filled with oil as follows: Unscrew the screw assembly of the filler as far as the threads permit. Unscrew the screw nut from the body and remove the nut and screw. Hold the filler vertically, close the opening at the nozzle with a finger, and pour the filler three-fourths full of clean recoil oil. Replace the filler screw and screw on the screw nut, invert the filler, and give the screw a turn or more to remove all air contained in the filler.

(5) Screw the filler into the recoil cylinder filling hole of the replenisher with great care to avoid damage to the threads. While it is still loose, give a few turns to the screw to force out any air which may be in the filling hole; then tighten against the gasket. Turn the screw with both hands on the handle, balancing the effort so that there will be no tendency to push the filler to one side. Screw the piston in as far as it will go. Continue the above operation until the replenisher piston is 150 mm ($5\frac{3}{4}$ inches) from the rear face of the replenisher. Unscrew the oil screw filler and replace the filling plug.

e. Filling counterrecoil cylinder (recuperator).

NOTE.—The following instructions as to the number of strokes apply only to the M2A1 oil pump, which is being replaced by the M3 oil pump. If the latter is used, the number of strokes will be such as to pump 1 quart of oil, or approximately two and one-quarter times the number of strokes required with the M2A1 oil pump.

(1) The position of the oil index, which is below the filling and drain plug, should not be used as an absolute guide for determining whether or not the counterrecoil system contains the proper amount of oil. The normal position of the oil index in the counterrecoil system is 5 mm (0.20 inch) out from the rear face of the recuperator cylinder. This position is not a definite indication of the amount of oil in the system. If the index extends out less than 5 mm it is a definite indication that there is not sufficient oil. On the other hand, it may extend out 5 mm and there may not be sufficient reserve in the system. The only way to know that the system is full is to fill it.

(2) When the counterrecoil of the gun or the position of the oil index indicates there is too little oil in the recuperator, it will be necessary to drain off the reserve oil before refilling. This is accomplished by removing the plug from the filling hole located on the right of the rear face of the cradle. Screw in the filling and drain valve release (oil extractor) and allow oil to drain until the flow ceases. Remove the filling and drain valve release (oil extractor). It will be noted that the oil index has moved out of sight before all of the reserve oil has been released. If the oil index has not moved, tap it gently with a small piece of wood, as it may be frozen. Purge the oil pump, clean the union of the pump tubing, and screw the union loosely into the filling hole. Work the pump a few times until oil is forced out through the connection, thereby excluding all air. The union should then be tightened just sufficiently to prevent further escape of oil through the connection as the pump is operated. While pumping is continued, feel the oil index and after it starts

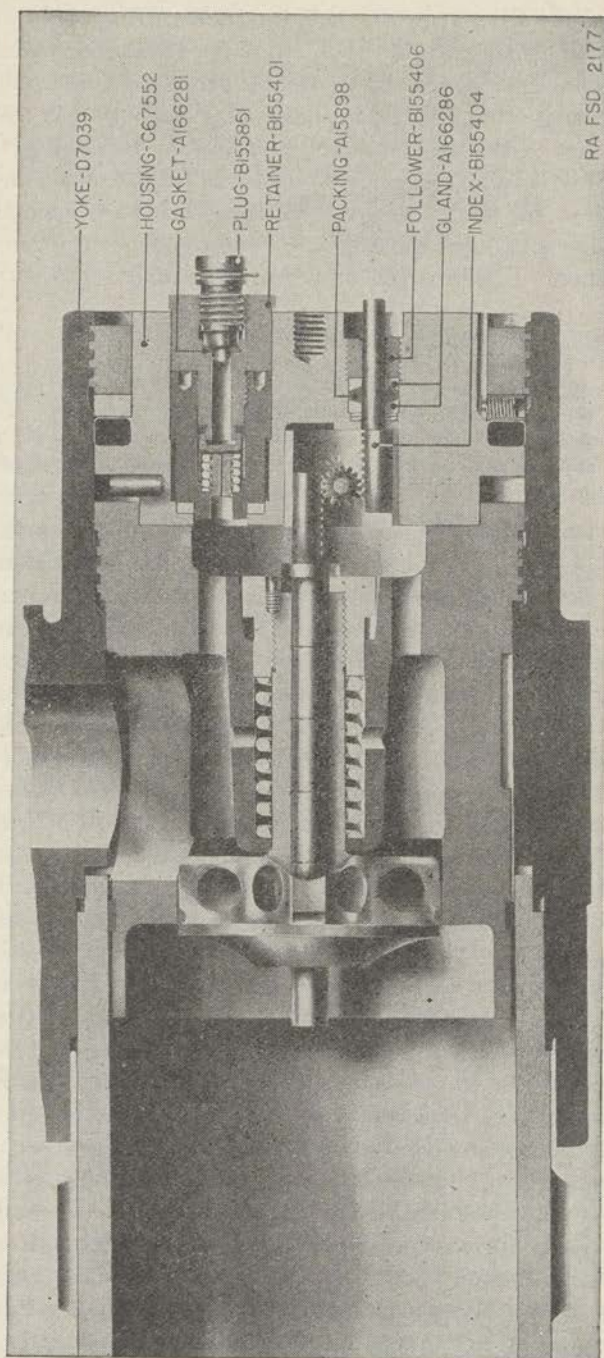


FIGURE 36.—155-mm gun recuperator cylinder head—rear view.

to move, give the pump exactly 100 strokes (1 stroke to consist of 1 complete cycle of the pump handle). It is to be noted that 30 full strokes of the pump lever will cause the oil index to move out to its maximum projection beyond the rear face of the cradle, but 70 more strokes are required to establish the necessary reserve oil.

(3) Filling the counterrecoil (recuperator) cylinder can also be accomplished by the use of the oil screw filler. The same procedure will be followed in the release of the reserve oil as outlined for filling the system by means of the pump. After the oil screw filler has been filled with recoil oil as outlined in *d(4)* above, it will be screwed into the filling hole located on the right of the rear face of the counterrecoil cylinder. The oil screw filler will be filled five times and the contents forced into the recuperator cylinder. Remove the oil screw filler and replace the filling plug.

29. Recoil oil.—*a. General.*—The recoil mechanisms use heavy recoil oil with low pour point. Care must be taken not to use any other than that prescribed. Heavy recoil oil is the only recoil oil to be used in this gun.

(1) Water must not be introduced into recoil mechanisms that use oil.

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

(3) It is advisable that recoil oil be tested for water. Use a clean glass bottle of 1 pint capacity filled with recoil oil. The oil should be allowed to settle. If water is present, the water, being heavier than the oil, will sink to the bottom. With the bottle slightly tilted, drops or bubbles will form in the lower portion. Invert the bottle and hold to the light. Drops or bubbles of water, if present, may be seen slowly sinking in the oil. If the oil has a cloudy appearance, the cloudiness may be ascribed to particles of water. Another test is to heat a shallow pan of oil to boiling. Water in the oil will appear on the surface as minute bubbles. This test will disclose water not determinable by the settling test.

(4) Should either of these tests show water, the oil on hand should be turned in.

b. Care of recoil oil.—The transfer of recoil oil to a container not marked with the name of the oil may result in getting the wrong oil into recoil mechanisms, or in the use of recoil oil for lubricating purposes. Recoil oil must not be put into any container not marked

with the name of the oil. The following should also be observed: Recoil oils should not be left in open containers, nor subjected to excessive heat. The greatest care must be taken with recoil oils to exclude moisture and dirt. Strain through clean cloth before inserting in recoil mechanism. Do not mix recoil oils with any other type of oil.

30. Equilibrators.—*a.* Two equilibrators of a pneumatic type are provided to neutralize unbalanced weight and reduce the manual effort required to elevate the gun through the lower elevations. Temperature adjustment scales are provided to adjust the tension of the equilibrators for various temperatures. These scales are a guide only, so that a setting which permits of satisfactory operation of the elevating handwheel must be determined by trial. The piece should be at 0° elevation when the adjustment is made. The setting on the two scales should be the same. If satisfactory operation cannot be obtained when the two settings are the same, the ordnance maintenance company should be notified.

b. The equilibrator protecting sleeve should be unscrewed from the front end of the equilibrator and wiped dry of accumulated moisture, weekly. The parts should be lightly oiled before reassembling.

31. Lubrication.—*a. General.*—Excessive wear can be prevented by keeping the matériel clean and well lubricated. The life of the gun and carriage depends on proper lubrication. Apply sufficient lubricants but avoid excess and wasteful practices. Excessive lubrication will result in dust accumulations on some moving parts which, if not removed, may cause wear and malfunctioning. Particular attention should be given to sliding and bearing surfaces, such as the inclined planes on the gun and cradle, and breech mechanism. All exposed parts should be kept cleaned and well lubricated. The matériel should always be lubricated after washing irrespective of the regular lubrication interval.

(1) Lubrication charts, figure 41 for the gun, and figure 42 for the carriage and limber, designate the oils and greases to be used and the lubrication intervals.

(2) No lubricants should be used other than those prescribed.

(3) The intervals indicated are for normal service. For extreme conditions of speed, heat, water, mud, snow, rough roads, and dust, lubricate more frequently.

(4) All fittings should be cleaned before applying lubricants.

(5) Lubricating fittings are painted red for ease of locating. Oil-holes are encircled by a red ring.

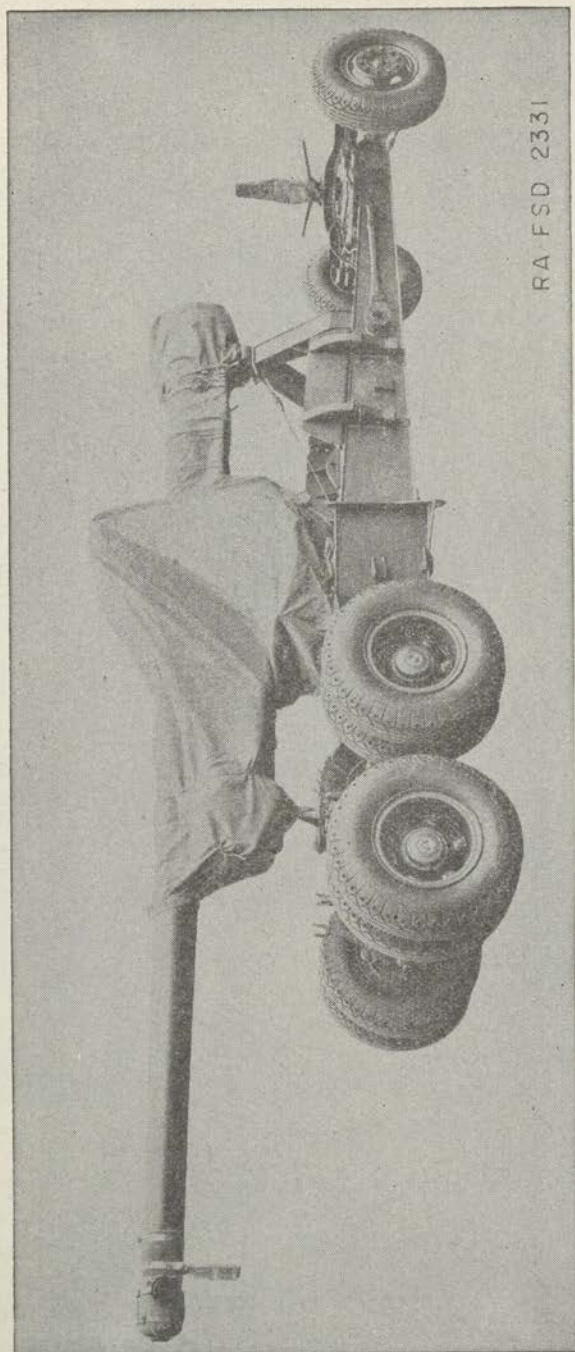
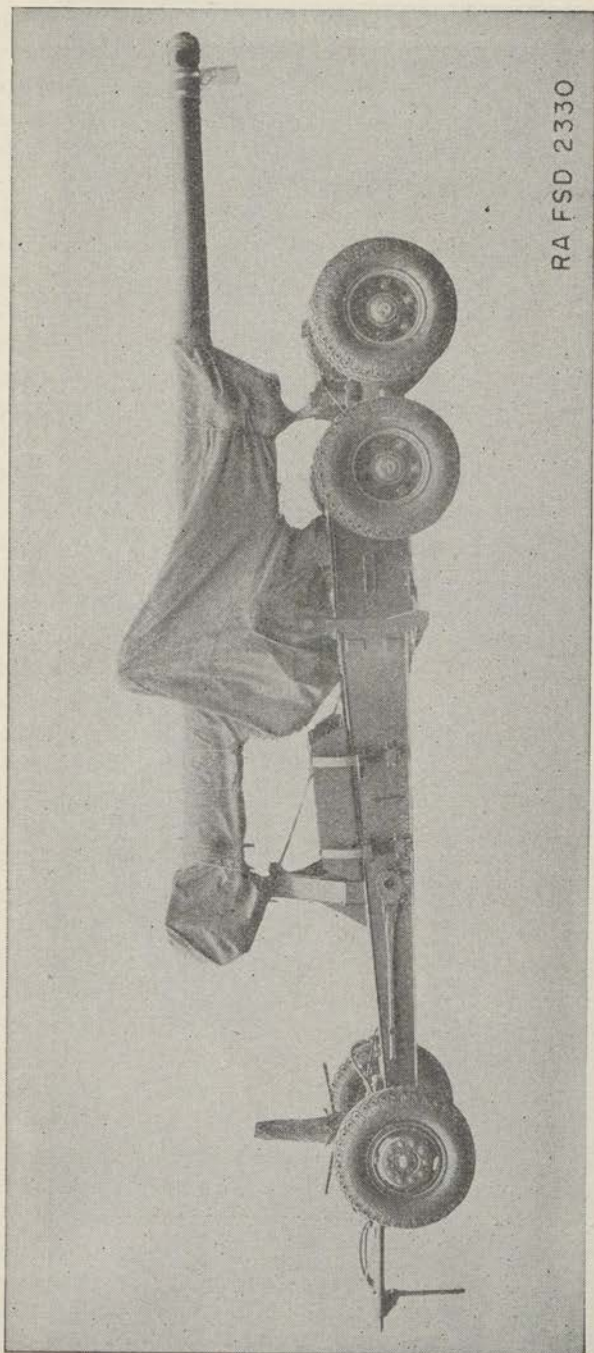


FIGURE 37.—155-mm carriage M1, covered, traveling position—left side view.



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FIGURE 38.—155-mm gun carriage M1, covered, traveling position—right side view.

(6) The oil gun should be worked slowly and the parts oiled and greased should be maneuvered to insure proper distribution of the lubricant.

(7) Should an oiler valve stick and prevent the passage of oil, it



FIGURE 39.—155-mm gun carriage M1, covered, traveling position—front view.

may be loosened with a piece of wire pushed through the hole. Care should be taken not to damage the valve.

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

(9) Operating personnel are cautioned, when cleaning the gun, to refrain from playing water directly against the trunnion bearing or trail pin housings, as water may enter the bearings and cause malfunction of the operating parts. Always lubricate the gun and carriage after washing.

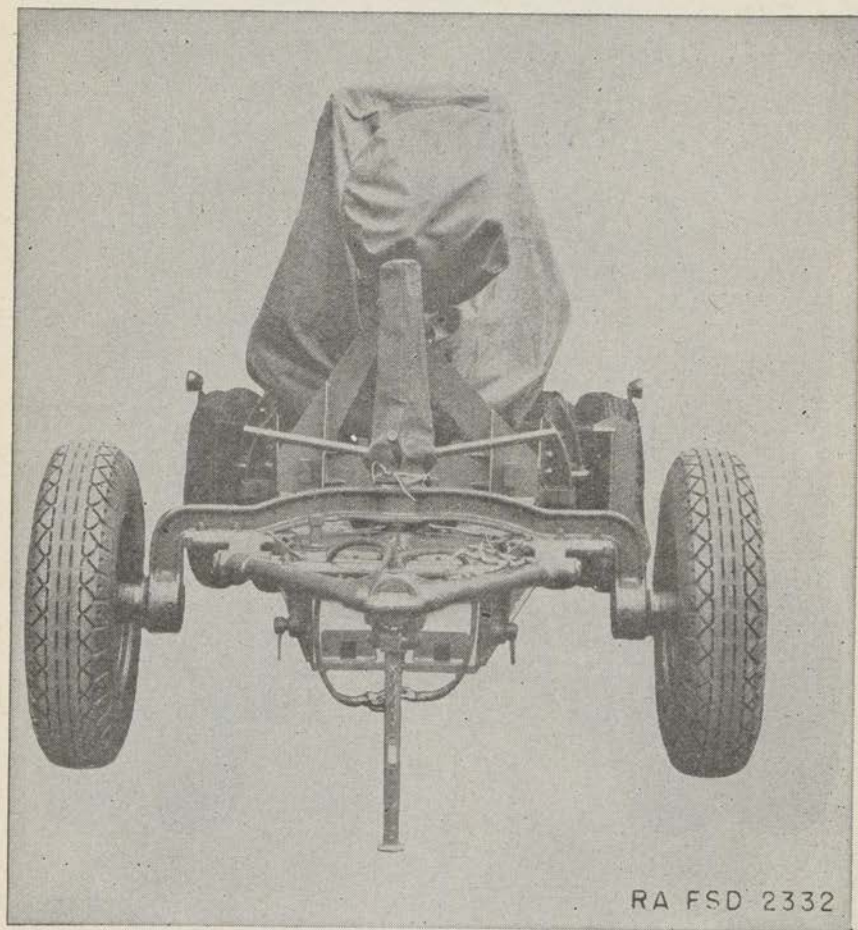


FIGURE 40.—155-mm gun carriage M1, covered, traveling position—rear view.

b. Lubricating the gun.—(1) The exposed surfaces of the recoil slides are to be kept coated with oil. They should be cleaned and oiled before firing.

(2) All moving parts and exposed metal surfaces of the breech and firing mechanism should be oiled and cleaned daily, and before and after firing.

Caution: To avoid misfiring when the temperature is below freezing, remove the firing mechanism and dip it in dry-cleaning solvent. Operate the firing pin in the solvent. Then lubricate with lubricating oil for aircraft instruments and machine guns, and replace the mechanism.

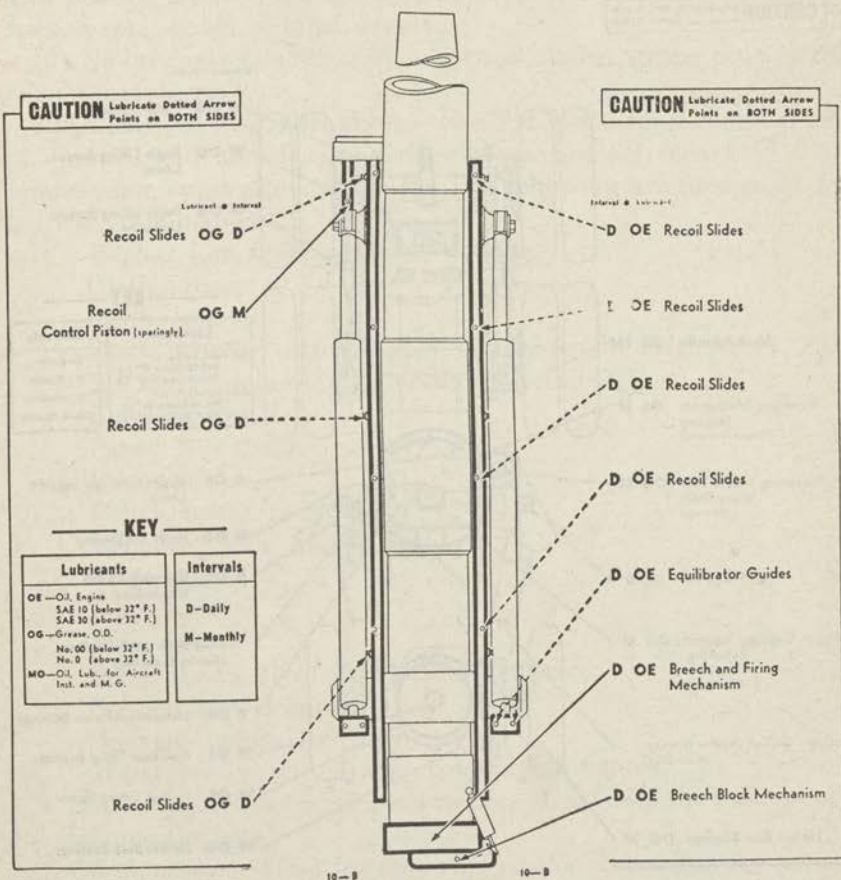


FIGURE 41.—155-mm gun M1 and M1A1—lubrication guide.

(3) The bore of the gun should be cleaned and coated with oil after firing. Inspect daily and oil if necessary. Use SAE 30 engine oil if the temperature is above 32° F., and SAE 10 if it is below.

c. *Lubricating the carriage.*—(1) The elevating and traversing rack and pinion gears should be cleaned and oiled daily. The teeth of these racks and gears require no lubrication but as a protection against rust they must be covered with a thin coat of oil. If considerable dust is present when the gun is operated, the oil should

be removed from the gear teeth and they should remain dry until action is over. When the surfaces are dry, there is less wear than when they are coated with a lubricant contaminated with grit.

(2) The drain plug in the upper carriage support housing should be removed weekly and the accumulated water drained.

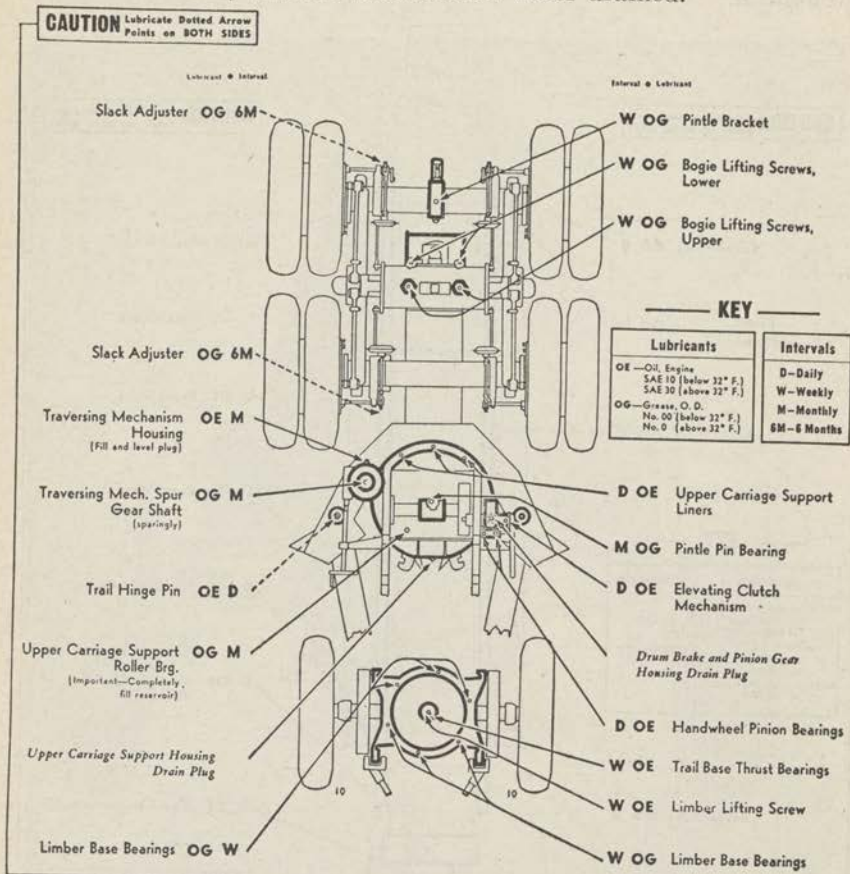


FIGURE 42.—Bogie, carriage and limber—lubrication guide.

(3) The plug beneath the brake drum housing should be removed weekly to drain the accumulated oil from the brake drum and pinion gear housing.

(4) The bogie lifting screws are to be kept covered except when operated. They should be cleaned and oiled every time they are used.

(5) When lubricating the limber lifting tube, loosen the locking pin, raise the lock, and partially fill the chamber with oil. This should be done weekly.

(6) The limber base and trail bearing surfaces, the limber hole support lock, clevises, hinges, and latches should be oiled weekly.

(7) The recoil control piston should be lubricated sparingly each month, with the gun at zero elevation.

(8) The parts to be oiled with the oil can, the limber base and trail bearing surface, the limber hole support locks, clevises, hinges, latches, etc., should be oiled weekly.

(9) No lubrication is required on springs, limber spring pins, or the bogie torque arms.

32. Cleaners and abrasives.—See TM 9-850 for a complete list of cleaners and abrasives and detailed particulars regarding their composition, application, and use. The following are prescribed for use with this matériel:

Burlap, jute, 8-ounce, 40 inches wide.

Cloth, crocus.

Cloth, emery.

Cloth, wiping, cotton, mixed, sterilized (for machinery).

For decontaminating materials see section XV.

Lime, hydrated.

Paper, lens tissue.

Paper, flint.

Polish, metal, paste.

Remover, paint and varnish.

Soap, castile.

Soap, saddle.

Soda ash

Soda, caustic (lye) for cleaning purposes.

Solvent, dry-cleaning.

Sponge (natural).

Waste, cotton (two grades, colored and white).

a. Burlap, jute, 8-ounce, 40 inches wide.—Used over the bore sponge for cleaning the bore.

b. Cloth, crocus.—Used for removing rust or stains, and for polishing parts of the breech mechanism, the firing mechanism, and other finished surfaces of metal. It may be used on steel shanks of sight mounts and steel seats of range quadrants, but should not be used on other parts of sighting equipment.

c. Cloth, emery.—Used for cleaning finished and unfinished external surfaces where wear of the parts cleaned will not affect the functioning of the mechanism. This material should positively not be used on the surfaces of the firing mechanism and breech mechanism. Care will be taken to insure that none of the fine emery dust is

allowed to enter the working parts of the breech mechanism, recoil mechanism, or rotor bearings. Cloth, emery, No. $\frac{1}{2}$ is the coarsest material that will be permitted.

d. Cloth, wiping, cotton, mixed, sterilized (for machinery).—Used in lieu of cotton waste for cleaning parts of the breech and firing mechanism. This material is preferable to cotton waste in all operations where deposits of lint are likely to plug oilholes or create stoppages that would lead to trouble.

e. Lime, hydrated.—Used in a solution with lye for the removal of paint from metal parts. For further particulars regarding its use see TM 9-850.

f. Paper, lens tissue.—A white tissue paper used for cleaning lenses and other optical elements of sighting instruments. Special care should be taken to keep the paper free from grit, dirt, or dust, which might scratch the glass surface. In using this paper, optical surfaces may first be moistened by the breath and the surface then cleaned with the paper. Avoid hard rubbing. The use of all other materials, including chamois skin, on optical parts of instruments is prohibited.

g. Paper, flint.—A common variety of sandpaper used for finishing surfaces of wood before applying paint or varnish, for smoothing preliminary coats of paint to a very fine finish before applying a final coat, for removing old paint, and for smoothing surfaces in bad condition.

h. Polish, metal, paste.—Used to supplement the work of crocus cloth and for cleaning and polishing brass, bronze, german silver, aluminum, and other bright unlacquered parts. Its use for polishing on instruments, sights, scales, and surfaces which are painted, varnished, lacquered, or given special finish such as browning or parkerizing is prohibited.

i. Remover, paint and varnish.—Used for removing paint and varnish in lieu of a lime-soda solution, especially on wood, where the latter solution has a damaging effect.

j. Soap, castile.—Used in preparing a solution for sponging the bore of the cannon. This sponging solution is prepared by dissolving 1 pound of soap in 4 gallons of water. (See solution, sponging, TM 9-850.)

k. Soap, saddle.—Used for cleaning leather equipment.

(1) When leather articles become soiled, carefully remove oil-hardened grease with a sliver of wood (not glass or knife) and wash with a sponge saturated with a heavy lather made of saddle soap and clean tepid water. Do not use hot water nor allow the leather to soak in water. Rinse thoroughly and rub vigorously with a dry

cloth until the leather is dry. Articles of unvarnished leather which become dry and brittle should be cleaned in this manner and, while the leather is still slightly moist, given an exceedingly light coat of neat's-foot oil, by rubbing with a soft cloth moistened (not saturated) with the oil. Wipe off any oil that the leather does not absorb. In cold weather the oil may be heated lukewarm (never hot) before using, and the article, after being oiled, hung in a warm place.

(2) Articles of black leather may be cleaned with saddle soap. Clean and rinse as above, and when nearly dry lightly sponge with a mixture of 1 teaspoonful of lampblack in 1 pint of neat's-foot oil, first stirring the mixture until it has a glossy appearance. Rub the mixture well into the leather.

(3) Leather equipment which has become wet should be dried in the shade. Wet leather exposed to the sun or to a high temperature becomes hard and brittle.

l. Soda ash.—Used in solution for cleaning the bore and breech mechanism and for removing grease and dirt from surfaces preparatory to painting. To prepare the solution, dissolve $\frac{1}{2}$ to 1 pound soda ash (depending upon the strength desired) in 1 gallon of boiling water.

m. Soda, caustic (lye), for cleaning purposes.—Used with lime to remove paint. It is very caustic, attacks the bare skin and clothing, and is poisonous.

n. Solvent, dry-cleaning.—Used for cleaning all bright metal surfaces preparatory to the application of rust-preventive compound. It is used to loosen rust and to remove grease and oil. Care is required in handling and storing dry-cleaning solvent on account of the fire hazard. It should not be allowed to stand in open containers near a fire. Smoking should be prohibited in the vicinity of, or while handling solvents.

o. Sponge (natural).—Used with water and very mild cleaning solutions (such as soap and water) for washing and rinsing.

p. Waste, cotton (two grades, colored and white).—Used for general cleaning purposes. The colored cotton waste will be used on the exterior of the equipment or for calking cracks from which it is desired to exclude dust and dirt. White waste is used for cleaning all finished surfaces. Where clean rags are not available for use on the breech mechanism, white waste may be substituted.

33. Preservatives.—*a. General.*—See TM 9-850 for information on rust, corrosion, inspection for corrosion, rust preventives, preparation of metal surfaces for slushing, method of slushing, inspection of grease films, and storage conditions.

b. Naphthalene, flake.—This is a flaked form of moth ball. It is used as a moth repellant to preserve the gun sponges and paint and varnish brushes. It is sprinkled thickly on the articles, which if possible, should then be wrapped in paper covers and tightly boxed. The material should be thoroughly brushed and aired before packing and should be periodically inspected. If there are any signs of devastation by the moth larvae, the articles must be unpacked, cleaned, and recharged with naphthalene. Naphthalene should be used in airtight receptacles in order to obtain a concentrated naphthalene vapor.

34. Painting.—*a. General.*—(1) Ordnance matériel 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 matériel will be painted with lusterless olive-drab, synthetic enamel. The enamel may be applied over old coats of long oil enamel and oil paint previously issued by the Ordnance Department if the old coat is in satisfactory condition for repainting.

(2) Paints and enamels are usually issued ready for use and are applied by brush or spray. They may be brushed on satisfactorily when used unthinned in the original package consistency or when thinned no more than 5 percent by volume with thinner. The enamel will spray satisfactorily when thinned with 15 percent by volume of this thinner. (Linseed oil must not be used as a thinner since it will impart a luster not desired in this enamel.) If sprayed, it dries hard enough for repainting within $\frac{1}{2}$ hour, and dries hard in 16 hours.

(3) Certain exceptions to the regulations concerning painting exist. Fire-control instruments, for instance, which require a crystalline finish, will not be painted with olive-drab enamel.

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

b. Preparation for painting.—(1) If the base coat on the matériel is in poor condition and it is desirable to strip the old paint from the surface rather than use sanding and touch-up methods, it will be necessary to apply a primer coat.

(2) Primer, ground, synthetic, should be used on wood as a base coat for synthetic enamel. It may be applied either by brushing or spraying. It will brush satisfactorily as received, or after the addition of not more than 5 percent by volume of thinner. It will be dry enough to touch in 30 minutes, and hard in 5 to 7 hours. For spraying, it may be thinned with not more than 15 percent by volume of thinner. Lacquers must not be applied to the synthetic ground primer, within less than 48 hours.

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

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

c. Painting metal surfaces.—Metal parts may be washed in a liquid solution consisting of $\frac{1}{2}$ pound of soda ash in 8 quarts of warm water, then rinsed in clear water and wiped thoroughly dry. Wood parts may be treated in the same manner but the alkaline solution must not be left on for more than a few minutes and the surfaces should be wiped dry as soon as they are washed clean. When artillery or automotive equipment is in fair condition and only marred in spots, the bad places should be touched with lusterless olive-drab synthetic enamel, and permitted to dry. The whole surface should then be sandpapered with No. 1 flint paper, and a finish coat of the same enamel applied and allowed to dry thoroughly before the matériel is used. If the equipment is in bad condition, all parts should be thoroughly sanded with No. 2 flint paper, given a coat of synthetic ground primer, and permitted to dry for at least 16 hours. Sandpaper with No. 00 flint paper, wipe free from dust and dirt, and apply a final coat of enamel. Allow the matériel to dry thoroughly before it is used.

d. Paint as a camouflage.—Camouflage is now the major consideration in painting ordnance matériel, with rust prevention secondary. The camouflage plan at present employed utilizes three factors: color, gloss, and stenciling.

(1) *Color.*—Matériel is painted with lusterless olive-drab synthetic enamel, which was chosen to blend in reasonably well with the average landscape.

(2) *Gloss.*—The new lusterless enamel makes the matériel difficult to see from the air or from great distances over land. Matériel painted with ordinary glossy paint can be detected more easily and at greater distances.

(3) *Stenciling.*—White stencil numbers on matériel have been eliminated because they can be photographed from the air. A blue-drab stencil enamel is now used which cannot be so photographed. It is illegible at distances exceeding 75 feet.

(4) *Preserving camouflage.*—(a) Since continued friction or rubbing will smooth the surface and produce a gloss, it must be avoided. The matériel should not be washed more than once a week. Care should be taken to see that the washing is done entirely with a

sponge or a soft rag. The surface should never be rubbed or wiped, except while wet, or a gloss will be developed.

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

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

(d) Tests indicate that repainting will be necessary once yearly in the case of the olive-drab and twice yearly in the case of the blue-drab enamel.

e. *Removing paint.*—After repeated paintings the paint may become so thick as to scale off in places and present an unsightly appearance. If such is the case, remove the old paint by use of a lime and lye solution (see TM 9-850 for details), or paint and varnish remover. 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. It is preferable that the use of lye solutions be limited to iron or steel parts. If used on wood, the lye solution must not be allowed to remain on the surface for more than 1 minute before being thoroughly rinsed off and the surface wiped dry with rags. Crevices or cracks in wood should be filled with putty and the wood sandpapered before finishing. The surfaces thus prepared should be painted according to directions above.

f. *Painting lubricating devices.*—Oil cups, grease gun fittings, oilholes, and similar lubricating devices, as well as a circle about $\frac{3}{4}$ inch in diameter at each point of lubrication, will be painted with water-resisting red enamel in order that they may be readily located.

35. Miscellaneous materials and tools.—For the purpose for which they are used, see TM 9-850. They are—

Brushes:

Artist, camel's-hair, round, No. 1.

Flowing, skunk hair, No. 3 (2-inch).

Sash tool, oval, No. 1 ($2\frac{7}{32}$ by $1\frac{3}{4}$ inches).

Sash tool, oval, No. 3 ($1\frac{3}{32}$ by $2\frac{1}{8}$ inches).

Scratch, painter's, handled (14 by $\frac{7}{8}$ inches).

Varnish, oval, ($1\frac{7}{8}$ inches).

Needle, sacking.

Palm, sailmakers'.

Twine, jute.

a. Care of brushes.—The bristles of brushes are subject to attack by moths. Brushes in storage should be protected by naphthalene.

b. *Camel's-hair brushes*.—After being thoroughly cleaned with turpentine, camel's-hair brushes should be laid flat on a horizontal surface (not in water). Other paint brushes should be cleaned after using and kept with bristles submerged in fresh water.

SECTION VI

INSPECTION AND ADJUSTMENT

	Paragraph
Inspection of gun.....	36
Inspection of carriage.....	37
Brake mechanism.....	38
Equilibrators.....	39

36. **Inspection of guns.**—The following instructions should be scrupulously observed:

*Parts to be inspected in
order of inspection*

Points to observe

- a.* The gun.
- b.* Breech recess and breech threads.
- c.* Breechblock carrier assembly and its attached parts.
- d.* Percussion hammer.
- e.* Obturator spindle.
- a.* Note the general appearance and smoothness of operation of the breech mechanism in both opening and closing. Test the firing mechanism by firing two primers. Disassemble the breech mechanism and see that it is thoroughly clean. Note the condition of the bore and breech. Look for copper deposits on the lands and in the grooves, erosion at the origin of rifling, bruises in the gas check seat, burs or roughness on the leveling plates. The slides of the gun should fit the rails snugly.
- b.* Note any scores or bruises in the threads of the breech recess and on the breechblock.
- c.* Note roughened or scored condition of pintle, firing mechanism housing, and hinge pin.
- d.* Note the safety lug to see if it is burred or worn and if it performs its function properly.
- e.* Note erosion of the vent hole and primer chamber. Note the condition of the obturator spindle plug, and the threads

*Parts to be inspected in
order of inspection*

f. Counterbalance.

g. Recoil marker.

37. Inspection of carriage.—The following instructions should be scrupulously observed:

*Parts to be inspected in
order of inspection*

a. The carriage.

b. Recoil mechanism.

c. Elevating mechanism.

d. Traversing mechanism.

Points to observe

on the end of the spindle. Look for a bruised split ring, torn gas check pad, broken or weakened obturator spindle spring. Try several primers in the obturator spindle plug. The primers should extend more than $\frac{1}{8}$ inch when pressed in hard with the thumb or finger.

f. Test the mechanism and see that it functions properly at different degrees of elevation.

g. Note condition of spring.

Points to observe

a. Note the general appearance, whether the oil and grease fittings are painted red, the carriage painted in accordance with regulations, and whether or not all moving parts are properly lubricated

b. See that the proper amount of oil is in both recoil and recuperator cylinders. Note whether or not the oil index and the replenisher piston function correctly. See that the recoil and recuperator piston rod nuts are screwed tight. When the gun is fired, see that the relief valve in the counter-recoil cylinder front head is functioning properly and allowing the air trapped in the cylinder to escape. See that air is escaping from the replenisher piston guide assembled in the rear end of the replenisher.

c. Elevate and depress the gun through the full extent of its travel. Note whether or not the mechanism operates without binding or undue backlash.

d. Traverse the carriage throughout its complete movement. Note smoothness of operation. There should be no binding or undue backlash.

*Parts to be inspected in
order of inspection**Points to observe*

e. Bottom carriage.

e. Examine the bottom carriage for broken or cracked welds. Note that all heavy bearing surfaces are lubricated.

f. Bogie.

f. Note any scores or bruises on the threads of the lifting mechanism. Note ease of turning the lifting screws. Note condition of ratchet wrenches. Check odometer.

g. Wheels.

g. Note the disk and rims to see if they are distorted or dented. Look for stones wedged between the disk and rims. See if the tread of the tires is taking the wear evenly and if the tires are properly inflated.

h. Brakes.

h. Note condition of air hose. Apply air to the brakes and note if they function properly. Apply hand brake and see if it needs adjustment. Break the emergency connection between the prime mover hose and the carriage to see that it functions properly.

38. Brake mechanism.—*a. Power brakes.*—(1) *Inspection.*—The power brake mechanism should be inspected at frequent intervals to discover air leaks. All air line connections must be tight. In case leakage tests show a 3-inch soap bubble in 3 seconds, ordnance personnel should be notified.

(2) *Relay emergency valve.*—(a) *Leakage test.*—With brakes released, cover the exhaust port with soapsuds. Leakage is caused by the supply valve not seating properly. With brakes applied, cover the exhaust port with soapsuds. Leakage is caused by the diaphragm not seating properly.

(b) *Emergency test.*—**Caution:** This is the safety feature which applies the brakes automatically in case of a break between the two vehicles and should be tested daily, when traveling, to insure proper functioning in case of an emergency.

Be sure there is sufficient pressure in the bogie air reservoir. Disconnect emergency hose between prime mover and bogie. The brakes should apply automatically. Cover the emergency hose connection with soap suds. Leakage is caused by the diaphragm not seating properly. Cover the exhaust port with soapsuds. Evident excess leakage is in the valve.

(3) *Brake chamber.*—(a) Coat the edges of the diaphragm and the bolt holes with soapsuds. Leakage is not permissible. In case of leakage, tighten the bolts uniformly until the leakage is stopped. Do not tighten the bolts so that the diaphragm is distorted.

(b) Check the push rod travel by measuring the push rod with the brakes released and then with the brakes applied. If the push rod travel is in excess of $\frac{7}{8}$ inch adjust the slack adjuster. The most efficient brake action is obtained when the slack adjuster arm travel is held to a minimum so that the full length of the lever is used. The adjustment is accomplished by jacking up each wheel and tightening the slack adjuster until the brakes drag and then loosening it until the wheel just turns freely.

(4) *Reservoir.*—The air reservoir should be drained of accumulated condensation every 8 hours of travel in order to insure satisfactory functioning of the brake mechanism.

b. *Hand brakes.*—Hand brake levers are mounted on the extra long camshaft of the two front bogie wheel brakes. The levers pivot on the shaft and are provided with a lug which contacts and rotates the slack adjuster and the cam which expands the brake shoe. The levers are retained in position by a latch engaging a toothed segment.

c. *Air line hook up.*—(1) The couplings on the two air lines and the air outlet on the prime mover are marked "Emergency" and "Service," respectively. In addition, the emergency line hose coupling is distinctly marked from the service line coupling by a round projection cast on the back of the coupling body.

(2) Both air lines from the front end of the limber are coupled at the rear end of the prime mover. The ends of the lines at the rear end of the limber are coupled to the air tubes at the spade end of the carriage and also to the inner side of each trail. The emergency line is connected with the bottom port of the relay emergency valve, and the service line to the top port.

(3) The emergency line is coupled to the "Emergency" outlet of the prime mover (which usually is on the right-hand side when facing the rear end of the prime mover) and the service line is coupled to the "Service" outlet on the opposite side. The emergency line leads to the front of the limber on the side where it is attached to the prime mover, and crosses to the opposite side of the limber to connect with the trail coupling on that side.

(4) To prevent dust or dirt from entering the air lines and thereby causing malfunctioning of the air brake system, both ends of the lines, when not in use, should be coupled together. Also, the ends of the hose on the spade ends of the trail should be assembled in the dummy coupling provided.

(5) The screens in the air lines, mounted on the inside of the trails, should be removed and washed in dry-cleaning solvent periodically.

d. Adjustment.—Each wheel brake is equipped with an adjustment for wear of the brake lining. This is a small notched wheel, which is assembled in the brake mechanism, located underneath a backing plate. Clockwise movement of the notched wheel by means of a special wrench or a screw driver inserted through the opening will expand the brake band and tighten the brake.

39. Equilibrators.—The nitrogen pressure in the equilibrators is to be checked only by ordnance personnel. If the elevating hand-wheel is difficult to operate when the equilibrator temperature adjustment is set properly and it appears that the equilibrators are not compensating for the unbalanced weight of the gun tube, ordnance personnel should be notified.

SECTION VII

MALFUNCTION AND CORRECTION

	Paragraph
Malfunction of gun.....	40
Malfunction of carriage.....	41

40. Malfunction of gun.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
a. Fails to fire after several percussions on primer.	a. (1) Firing mechanism not screwed home. (2) Fouled firing pin.	a. (1) Screw the firing mechanism in as far as it will go. (2) Remove the firing mechanism and disassemble. Wash all parts with dry-cleaning solvent. Dry thoroughly and lubricate with engine oil, SAE 10.
	(3) Deformed point on firing pin.	(3) Remove firing mechanism, disassemble, and replace firing pin.
	(4) Weak pull on the lanyard.	(4) Pull lanyard with considerable force.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
b. Fails to fire when proper percussion on primer is obtained.	b. Defective primer.	b. After 3 percussions wait at least 2 minutes before replacing primer, if a special device for removing the primer is available. Otherwise wait 10 minutes.
c. Fails to fire after the primer has discharged.	c. (1) Damp or fouled vent hole through obturator. (2) Damp charge.	c. (1) If a special device is available which permits lifting the latch, wait at least 2 minutes before removing the primer and cleaning the vent hole with vent cleaning bit. If special device is not available, wait at least 10 minutes. (2) Wait at least 10 minutes before opening the breech to remove the charge.
d. Mechanism does not operate freely.	d. Lack of lubrication and the formation of scores in the threads of the breechblock carrier or in the breech recess.	d. Disassemble the breechblock and clean thoroughly. If the threads are scored, repair must be made by ordnance personnel.
e. Percussion hammer not working freely.	e. Lack of lubrication and roughness on percussion hammer pin.	e. Disassemble, clean, and remove roughness.

41. Malfunction of carriage.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
a. Air in recoil cylinder.	a. (1) Replenisher empty.	a. (1) Remove the filling and drain plug and fill the replenisher with the prescribed amount of oil. Let set for 10 minutes and replace filling and drain plug.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
	(2) Imperfect replenisher connections.	(2) Replenisher connections should be kept tight, and free of dust or dirt.
b. Oil index projects less than 5 mm (0.20 inch)	b. (1) Loss of reserve oil. (2) Loss of gas pressure either through the recuperator cylinder front head or past the floating piston.	b. (1) Drain the remainder of the reserve and refill. (2) Gas escaping by the floating piston is indicated by an emulsified condition of reserve oil drained off. If, when proceeding to fill the counterrecoil system in the ordinary manner, the oil index does not move out and the pump works easily, the gas pressure has probably been lost. Substantiate this by an attempt to drain the counterrecoil system; oil will not spurt from a mechanism without at least some pressure. Report to ordnance personnel.
c. Oil index remains stationary when the reserve is pumped in against evident pressure.	c. The packing is too tight, or the index is broken or locked by some foreign substance.	c. Drain off all reserve oil and refill. While injecting the oil, tap the oil index gently with each stroke of the pump or each turn of the oil screw filler. If the oil index fails to move after 30 strokes of the pump or 1½ charges with the oil screw filler, refer the matter to ordnance personnel.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
d. Oil drips from counterrecoil rod, recoil rod, or control rod stuffing boxes in excess of 3 drops per minute.	d. (1) Broken springs. (2) More compression required on springs. (3) Damaged packing.	d. (1) Report to ordnance personnel. (2) Report to ordnance personnel. (3) Report to ordnance personnel.
e. Oil leaks from forward end of counterrecoil cylinder.	e. Black oil appearing in front of the counterrecoil piston is a normal condition due to lubrication. Clear oil is an indication of a leak due to broken packing springs or lack of compression on the springs.	e. Report a leak of clear oil to ordnance personnel.
f. Excessive leaks from recuperator filling and drain valve.	f. Sticking of valve or defective packing.	f. Remove the filling and drain plug and insert a piece of ¼-inch drill rod into the hole against the end of the valve stem and tap it lightly with a hammer. If this does not stop the leak, report it to ordnance personnel.
g. Gun will not return to battery.	g. (1) Too much oil in the replenisher. (2) Insufficient oil in the counterrecoil system.	g. (1) Drain the replenisher until the end of the piston projects approximately 5¼ inches beyond the face of replenisher. (2) Drain off the reserve oil and refill.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
	(3) Insufficient air pressure.	(3) Report to ordnance personnel for investigation.
<i>h.</i> Gun returns to battery with too great a shock.	<i>h.</i> (1) Insufficient oil in the replenisher. (2) Excess oil in counterrecoil system. (3) Change of viscosity of oil due to rapid firing. (4) Friction of various packings too low.	<i>h.</i> (1) Fill replenisher until the piston projects $5\frac{3}{4}$ inches beyond the face of replenisher. (2) Drain the reserve oil off and refill to normal. (3) Allow mechanism to cool. (4) Report to ordnance personnel.
<i>i.</i> Gun slow to return to battery when oil indication is normal.	<i>i.</i> Insufficient oil pressure.	<i>i.</i> Report to ordnance personnel.
<i>j.</i> Uneven and jerky counterrecoil.	<i>j.</i> Lack of lubrication or scoring of sliding heavy surfaces.	<i>j.</i> Report to ordnance personnel.
<i>k.</i> Gun in counterrecoil does not cause a hissing sound like air escaping.	<i>k.</i> Air vent is stopped up.	<i>k.</i> Clean the vent in the replenisher guide by disassembling the valve and washing in dry-cleaning solvent. If air is not escaping from the counterrecoil cylinder head, notify ordnance personnel.
<i>l.</i> Gun recoils more than the maximum distance allowed.	<i>l.</i> (1) Insufficient oil in the replenisher. (2) Insufficient gas pressure in recuperator.	<i>l.</i> (1) Fill replenisher until the piston projects $5\frac{3}{4}$ inches beyond the face of the replenisher. (2) Report to ordnance personnel.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
	(3) Insufficient friction.	(3) Report to ordnance personnel.
	(4) Malfunction of variable recoil mechanism.	(4) Report to ordnance personnel.
<i>m.</i> Gun does not recoil full distance.	<i>m.</i> (1) Low viscosity of oil due to low temperature.	<i>m.</i> (1) After firing two or more rounds, the recoil will become normal.
	(2) Scoring of various bearing surfaces.	(2) Report to ordnance personnel.
<i>n.</i> Slow pressure build-up in brake mechanism reservoir.	<i>n.</i> (1) Leaking application or brake valve.	<i>n.</i> (1) Report to ordnance personnel.
	(2) Leaking compressor discharge valve.	(2) Report to ordnance personnel.
	(3) Leaking lines or connections.	(3) Replace tubing and fittings or tighten fittings.
	(4) No clearance on unloader valves.	(4) Report to ordnance personnel.
	(5) Clogged air cleaner.	(5) Clean.
	(6) Worn piston and rings, carbon in discharge line.	(6) Report to ordnance personnel.
<i>o.</i> Quick loss of brake mechanism reservoir pressure when motor is stopped.	<i>o.</i> (1) Worn and leaking compressor discharge valves.	<i>o.</i> (1) Report to ordnance personnel.
	(2) Tubing or connections leaking.	(2) Replace tubing or tighten fittings.
	(3) Leaking valves.	(3) Report to ordnance personnel.
	(4) Leaking governor.	(4) Report to ordnance personnel.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
<i>p.</i> Brake mechanism reservoir compressor not unloading.	<i>p.</i> (1) Broken unloader diaphragm. (2) Too much clearance on unloader valves.	<i>p.</i> (1) Report to ordnance personnel. (2) Report to ordnance personnel.
<i>q.</i> Slow brake application.	<i>q.</i> (1) Low brake line pressure (brake valve to chambers). (2) Brake chamber push rod travel excessive. (3) Restriction in line. (4) Leaking brake chamber diaphragm. (5) Brake lining or drum condition. (6) Leaking brake valve diaphragm.	<i>q.</i> (1) Adjust pressure through valve. (2) Adjust the slack adjuster. (3) Clean or replace tubing or hose. (4) Report to ordnance personnel. (5) Report to ordnance personnel. (6) Report to ordnance personnel.
<i>r.</i> Slow brake release.	<i>r.</i> (1) Brake valve lever not returning fully to stop. (2) Binding cam or camshafts. (3) Brake chamber push rod travel excessive. (4) Restriction in tubing or hose. (5) Improper seating of valves.	<i>r.</i> (1) Adjust operating rod. (2) Lubricate and align properly. (3) Adjust brakes. (4) Clean or replace. (5) Report to ordnance personnel.
<i>s.</i> Inefficient brakes.	<i>s.</i> (1) Low brake line pressure. (2) Excessive push rod travel on brake chambers. (3) Lining and drum condition. (4) Brake chamber diaphragm leaking.	<i>s.</i> (1) Adjust pressure through brake valve. (2) Adjust brakes. (3) Report to ordnance personnel. (4) Report to ordnance personnel.

SECTION VIII

DISASSEMBLY AND ASSEMBLY

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42. General.—*a.* Wear, breakage, cleaning, and inspecting make necessary the occasional disassembly of various parts of the weapon and carriage. This work comes under two headings, that which can be performed by the battery personnel, and that which must be performed by ordnance personnel.

b. The battery personnel may, in general, do such dismounting as is required for the assembly of parts indicated in SNL D-24. Such work should be done in the manner prescribed. Any difficulty which cannot be overcome must be brought to the attention of ordnance personnel.

c. The battery personnel will not attempt to disassemble any part of the recoil mechanism it is not authorized to disassemble, nor do any filing on the sights or gun parts other than that outlined. Such work will be done only by order of the battery commander.

d. The use of wrenches which do not fit snugly on the parts should be avoided. Failure of the wrenches will not only damage the corners of nuts and bolt heads, but may also damage the wrench.

e. Before attempting to put together the larger assemblies which compose the weapon, the assembly of subassemblies should be completed. In this work all bearings, slide surfaces, threads, etc., should be cleaned and lubricated.

43. Disassembly of operating lever.—Remove the breechblock operating catch spring block retaining pin from the breechblock operating lever. Remove the breechblock operating lever catch retaining spring block and spring. Remove the lever catch.

44. Assembly of operating lever.—Assemble the lever catch in position. Assemble the breechblock operating lever catch retaining

spring and block. Insert the breechblock operating lever catch block retaining pin in position.

45. Percussion hammer.—Remove the straight steel pin that retains the percussion hammer pin. Remove the percussion hammer pin. The percussion hammer may then be removed by unlocking the percussion hammer locking pin. Assemble by performing the above operations in reverse order.

46. Disassembly of firing mechanism.—Remove the safety setscrew from the primer holder and unscrew the primer holder. Remove the firing pin guide, the firing pin spring, and the firing pin. Remove the safety setscrew and unscrew the firing pin housing with the wrench provided. The firing mechanism block plunger spring and handle may be disassembled by driving the straight steel retaining pin to the end of the handle.

47. Assembly of firing mechanism.—Place the firing pin guide in its seat in the block and screw the primer holder in its seat, which will hold the guide in position. Lock the primer holder with the safety setscrew. Place the firing pin spring into the firing pin guide and the firing pin into the spring. Screw the firing pin housing into the rear end of the firing mechanism block and assemble the safety setscrew. Insert the firing mechanism block plunger spring followed by the plunger. Line up the holes in the shaft of the plunger and the firing mechanism block handle and insert straight steel pin.

48. Disassembly of counterbalance.—Withdraw the cotter pin from the end of the regulating screw. Remove the counterbalance screw nut and unscrew the counterbalance regulating screw from the counterbalance regulating nut. Remove the counterbalance cylinder headscrews and unscrew the counterbalance cylinder piston rod head. Withdraw the counterbalance piston rod spring, piston, and the counterbalance cylinder piston rod head. Unscrew the counterbalance cylinder head from the counterbalance cylinder. Remove the cotter pin from the piston rod and remove nut.

49. Assembly of counterbalance.—Screw the counterbalance cylinder head in the end of the cylinder from which it was removed. Lock it in place by the counterbalance cylinder headscrew. Assemble in the order named the following parts over the counterbalance piston rod: counterbalance cylinder head, counterbalance spring, counterbalance piston, counterbalance piston rod nut, and the cotter pin. Place this assembly within the counterbalance cylinder, assemble the counterbalance head to the counterbalance cylinder, and lock in place by the counterbalance cylinder headscrew.

50. Disassembly of breech mechanism.—*a.* Before removing the breech mechanism the breechblock must be opened and swung into the loading position. Remove the firing mechanism by unlocking the firing mechanism block plunger and unscrewing it. Drive out the detent which holds the counterbalance bracket collar to the counterbalance bracket. Remove the counterbalance bracket collar. Open the breechblock until the large part of the eye of the piston rod is directly over the nut, then lift off the counterbalance cylinder and allied parts.

b. Remove the firing mechanism safety plunger housing assembly by removing machine screw BCKX2EH. Unscrew the firing mechanism housing and remove the obturator spindle spring. Withdraw the obturator spindle, pad, and rings as a unit from the front end of the breechblock. Remove the cotter pin and the breechblock roller axis pin and withdraw the breechblock roller. Remove the setscrew BCTX1DF and nut from the crankshaft and withdraw the operating lever. Remove the cotter pin and the breech mechanism lever bearing securing bolt and withdraw the bearing and crankshaft from the breechblock carrier. At the same time, from the inside of the carrier, remove the crosshead from the inner end of the crankshaft. Remove the cotter pin from the hinge pin and withdraw the latter, then remove the breechblock carrier and carrier bearing washer.

51. Assembly of breech mechanism.—Place the breechblock carrier washer on the hinge lugs of the breech ring. Place the breechblock carrier on top of the washer and between the hinge lugs of the breech ring. Center the hinge pin holes of the breechblock carrier with those in the breech ring. Insert the hinge pin through the top lug of the breech ring and through the carrier, being careful to lower it slowly and guide it over the breechblock carrier key. Insert the cotter pin through the hinge pin. Insert the crosshead in its socket in the breechblock. Assemble the crankshaft within the breech mechanism lever bearing and insert this assembly crank end first into the breechblock carrier, guiding the crosshead over the crank end of the crankshaft. Lock the breech mechanism lever bearing in position by means of the breechblock operating lever bearing retaining bolt and insert the cotter pin. Assemble the operating lever by guiding it over the key of the crankshaft. Assemble the crankshaft nut on the crankshaft and insert the setscrew. Place the breechblock on the front end of the breechblock carrier and slide it to the rear of the carrier as far as it will go. Assemble the following parts, in the order named, on the obturator spindle: obturator front split ring, obturator gas check pad, obturator inner ring, obturator rear split

ring and filling-in disk. Insert the threaded end of the obturator spindle assembly through the spindle opening of the breechblock and breechblock carrier. Assemble the obturator spindle spring over the threaded end of the obturator spindle and screw the firing mechanism housing in place. Assemble the counterbalance cylinder into position by inserting the lug of the front head over the projection of the bracket. Move the breechblock carrier until the counterbalance regulating nut is directly under the large part of the eye of the piston rod and lower the counterbalance cylinder into place. Assemble the counterbalance bracket collar, and drive in the detent. Close the breech and assemble the percussion hammer pin and the percussion hammer locking pin. Assemble the firing mechanism safety plunger housing assembly. Assemble the firing mechanism by screwing it into the firing mechanism housing until it is locked in position by the firing mechanism block plunger.

52. Disassembly and assembly of recoil mechanism.—The complicated recoil mechanism is not suited for successful disassembling except by ordnance personnel. The high pressure present in the system at all times makes it extremely dangerous to attempt disassembly. It is therefore forbidden to perform any disassembling of the inside parts of the recoil mechanism.

53. Disassembly and assembly of equilibrators.—The equilibrators are not to be removed or replaced except by ordnance personnel.

54. Removal and assembly of wheels and hub.—*a. Removal.*—(1) *General.*—The wheels may be raised clear of the ground by means of the jack provided, or by lowering the carriage to the ground and raising the bogie wheels by means of the lifting mechanism.

(2) *Outside wheels.*—Remove cap nuts A157225 and/or A174196. Note right- and left-hand thread feature of the nuts.

(3) *Inside wheels.*—Remove outside wheel as described. Remove cap nuts B158086 and/or B108227. Note left- and right-hand thread feature of the nuts.

(4) *Hubs.*—Remove wheels as described. Remove hub cap C72917 and hub cap gasket B159927 by removing six cap screws BCAX1DD. Remove nut B166563. Remove washer C67935 and nut with dowel A174195. Remove roller bearing A174084. Remove hub, taking care at this time not to damage the large inside roller bearing CAHX2AS, and oil retainer B166564.

b. Assembly.—To mount the wheel and hub assembly, proceed as follows: Thoroughly clean all component parts of the assembly. As-

semble the brake drum to the hub. Place oil retainer with lip of the sealing member toward the antifriction bearings. Lubricate the antifriction bearings with sufficient wheel bearing grease to cover the rollers. Adjust nut A174195 to permit free rotation of the wheel without lost motion. Place washer C67935 in the keyway on the axle end and make necessary adjustment of the nut A174195 so that the dowel in the nut engages one of the holes in the washer, thereby locking the nut. Assemble the lock nut B166563, the hub cap and the gasket, and the rims and tires.

SECTION IX

SIGHTING EQUIPMENT

	Paragraph
Light, aiming post, M14.....	55
Mount, quadrant, M1.....	56
Light, instrument, M12.....	57
Mount, telescope, M18A1 and telescope, panoramic, M5A5.....	58
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Sight, bore.....	62
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55. Light, aiming post, M14.—This light is a device for illuminating ranging poles for night survey. It is a replacement for aiming lanterns M1 and M2.

a. The light (figs. 43 and 44) consists of a battery case for two BA-30 batteries (one in each end to obtain a parallel circuit) with a lamp housing and a toggle switch. A metal hood is provided for the lamp, which is carried around the battery case when not in use. Illumination is furnished by a 3-volt aircraft instrument panel lamp of the type with which standard instrument lights are now equipped. A reflector is mounted in the back of the lamp and a color filter can be attached to the front of the lamp housing.

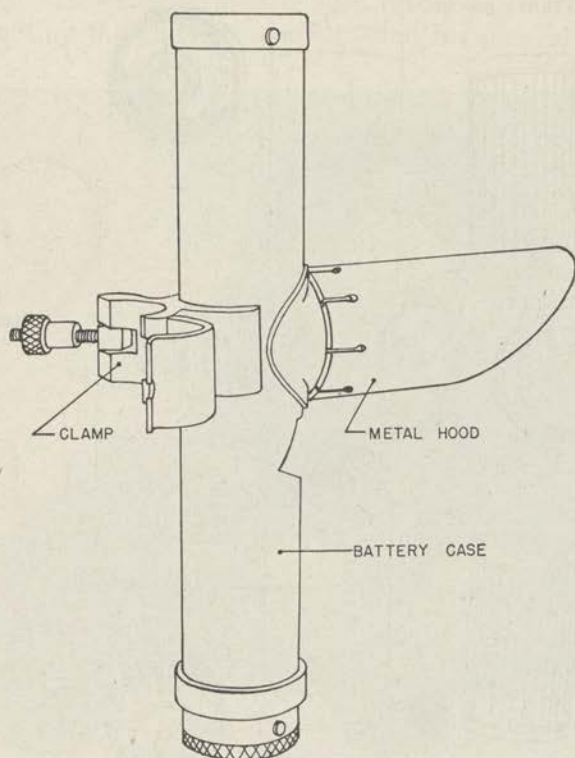
b. A clamp is provided to secure the lamp to the aiming post.

c. A chest is provided to carry a section set comprising two aiming post lights (one with red, one with green filters) eight BA-30 batteries, and two spare lamps.

d. The batteries should always be removed from the battery case when not in use in order that their deterioration on long standing will not damage the light. When not in use, the various parts of the light should be kept in the chest provided.

56. Mount, quadrant, M1.—*a. Description and operation.*—The quadrant mount M1 (fig. 45) is used in conjunction with a gunner's

quadrant for laying the gun in elevation. It is attached to the right cradle trunnion of the carriage. Any motion of the gun in elevation causes the mount to rotate a like amount about the trunnion axis. To operate the quadrant mount, turn the cross level knob until the bubble in the cross level vial is centered. Set the gunner's quadrant to the required angle of elevation and, holding it in position on the



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FIGURE 43.—Light, aiming post, M14.

shoes of the mount, elevate the gun until the bubble in the level vial of the quadrant is centered. Remove the gunner's quadrant from the quadrant mount before firing the gun.

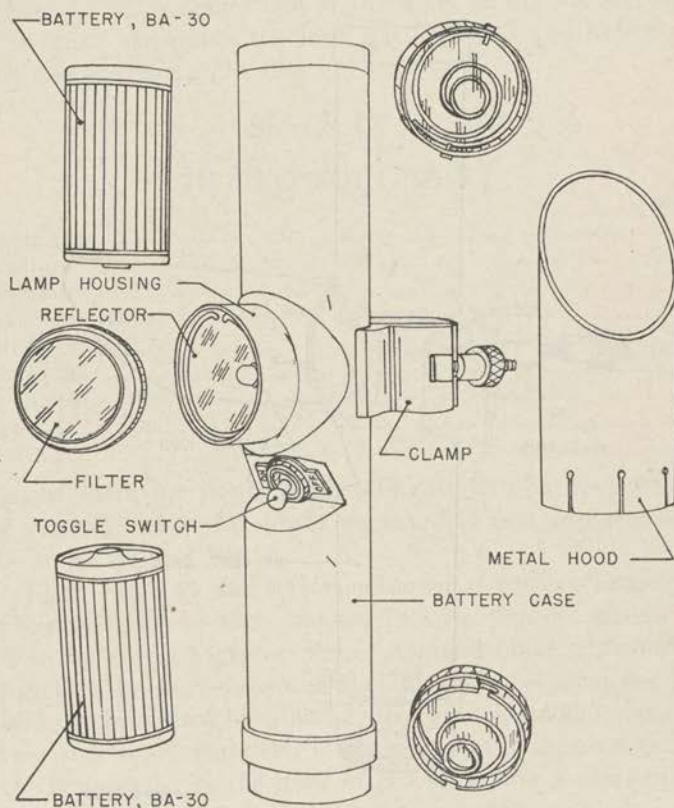
b. Care and preservation.—(1) Refer to paragraph 66 on the care and preservation of instruments.

(2) Adjustment of the quadrant mount by the using arm is not permitted.

(3) The motion of the cross leveling mechanism is limited by stops in the segment and no attempt should be made to force the mechanism

beyond their limits. Care should be exercised to avoid bumping the segment or knob.

(4) Keep the shoes lightly greased when the quadrant mount is not in use. Lubricate the worm gear teeth occasionally by applying a few drops of oil in the track. Wipe off excess lubricant to prevent accumulation of dust and grit.



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FIGURE 44.—Light, aiming post, M14.

57. Light, instrument, M12.—*a. General.*—The instrument light M12 (fig. 45) is used with the quadrant mount M1 to illuminate the cross level on the mount and gunner's quadrant for night operation.

b. Description.—(1) The instrument light M12 is a compact light complete with battery, switch, and a hand light connected to the battery by means of a rubber-covered wire.

(2) The instrument is attached to the mount as shown in figure 45, by slipping the bracket over the cross level and the lug adjacent to

the level on the mount. It is secured by tightening the thumb screw in the end of the bracket against the level housing.

(3) The level vial on the mount is exposed through a rectangular opening in the top of the instrument and is illuminated by a 3-volt special aircraft type lamp in the lamp housing. The hand light is equipped with a similar lamp wired in parallel with the level illuminating lamp. It is encased in a molded rubber case and is provided for illuminating the gunner's quadrant and for general use around

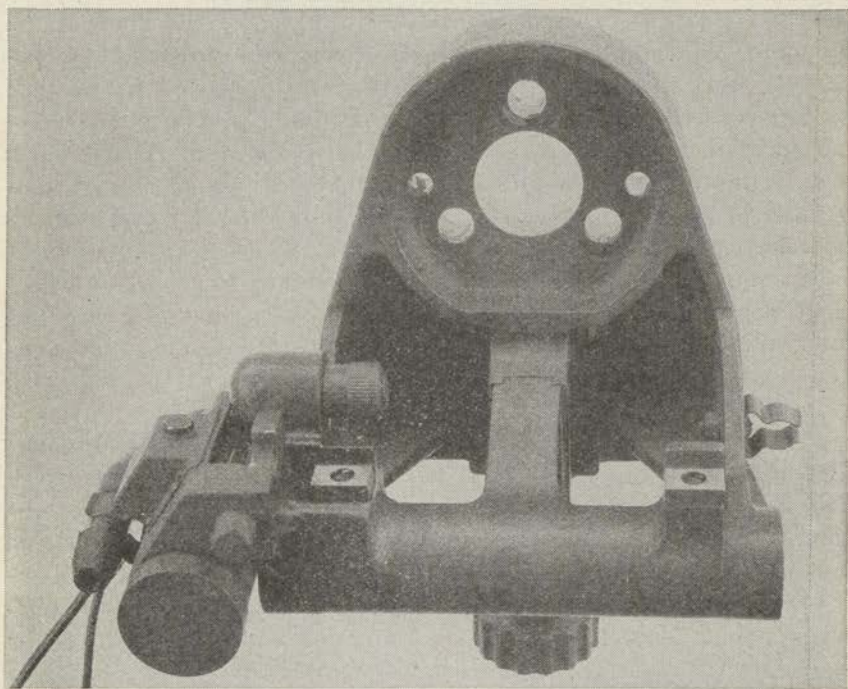


FIGURE 45.—Quadrant mount M1 with instrument light M12.

the mount. A standard flashlight battery, type BA-30, supplies power for the lamps at 1.5 volts. The life of the cell is normally about 3 hours.

58. Mount, telescope, M18A1 and telescope, panoramic, M5A5.—*a. Description.*—(1) The telescope mount M18A1 (fig. 46), equipped with the panoramic telescope M5A5 (fig. 47), is the sighting element for laying the gun in azimuth. No provision is made in this mount for setting off quadrant elevation or range, as this is accomplished by means of a gunner's quadrant placed on the quadrant mount M1 which is mounted on the right side of the gun carriage.

(2) The telescope mount is of the azimuth compensating type which automatically applies azimuth correction when the gun is elevated with the trunnions out of level. It is mounted on the left side of the gun carriage. Provision is made for cross leveling and longitudinal leveling, a level vial and knob being provided for each motion. The panoramic telescope fits into the sight socket, as shown, and is secured by means of the wing knob.

(3) The panoramic telescope has cylindrical locating surfaces at the top and bottom for centering the telescope in its socket. The line of sight is elevated or depressed by means of the knob at the top, and coarse and fine index graduations are provided for the normal (zero elevation) position. The head is moved in azimuth by means of the azimuth worm knob, which has a throwout lever to permit disengagement for rapid motion when required. The azimuth scale is graduated in 100-mil intervals, numbered progressively from 0 to 32 in two consecutive semicircles. Indications of the azimuth micrometer index on the deflection knob, which is graduated in 1-mil intervals, supplement those on the azimuth scale. The deflection knob is assembled to a detent which causes a click at each 1-mil interval as the knob is rotated. Rotation of the deflection knob does not change a deflection previously set, but changes the indicated value thereof.

(4) Some weapons have been equipped with the telescope mount M18 and the telescope M5A2. These instruments are being replaced. The main difference in these combinations is that the socket of the mount and the rotating head of the telescope M5A5 which seats in mount M18A1 are offset 45°.

(5) The standard combination of sighting instruments is the telescope mount, M18A1, and the panoramic telescope M12. The latter instrument is not at present available for this weapon. It is different in appearance from the telescope M5A5 in that the lateral deflection scales and micrometer are changed, a lateral correction scale has been added, and the eyeshield is changed.

b. Operation.—For operation of the sighting equipment see paragraph 24.

c. Tests and adjustments.—Only the adjustments specifically authorized may be performed by the using arm.

(1) *Preliminary settings.*—Level the gun and carriage transversely (axis of cradle trunnions) and longitudinally (axis of bore). Place the testing target in position, alining it with the bore by means of the bore sights. Center the bubbles in the cross and longitudinal levels.

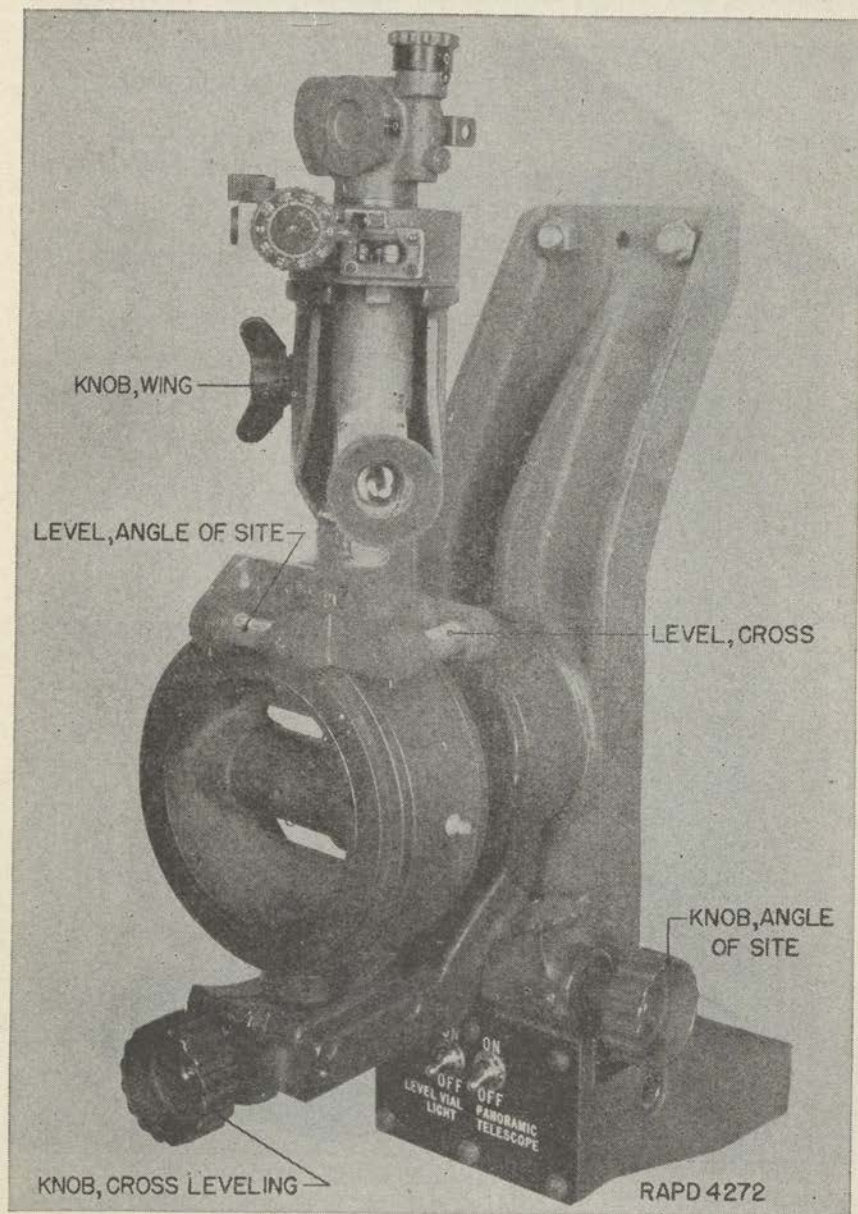


FIGURE 46.—Telescope mount M18A1 with panoramic telescope M5A5.

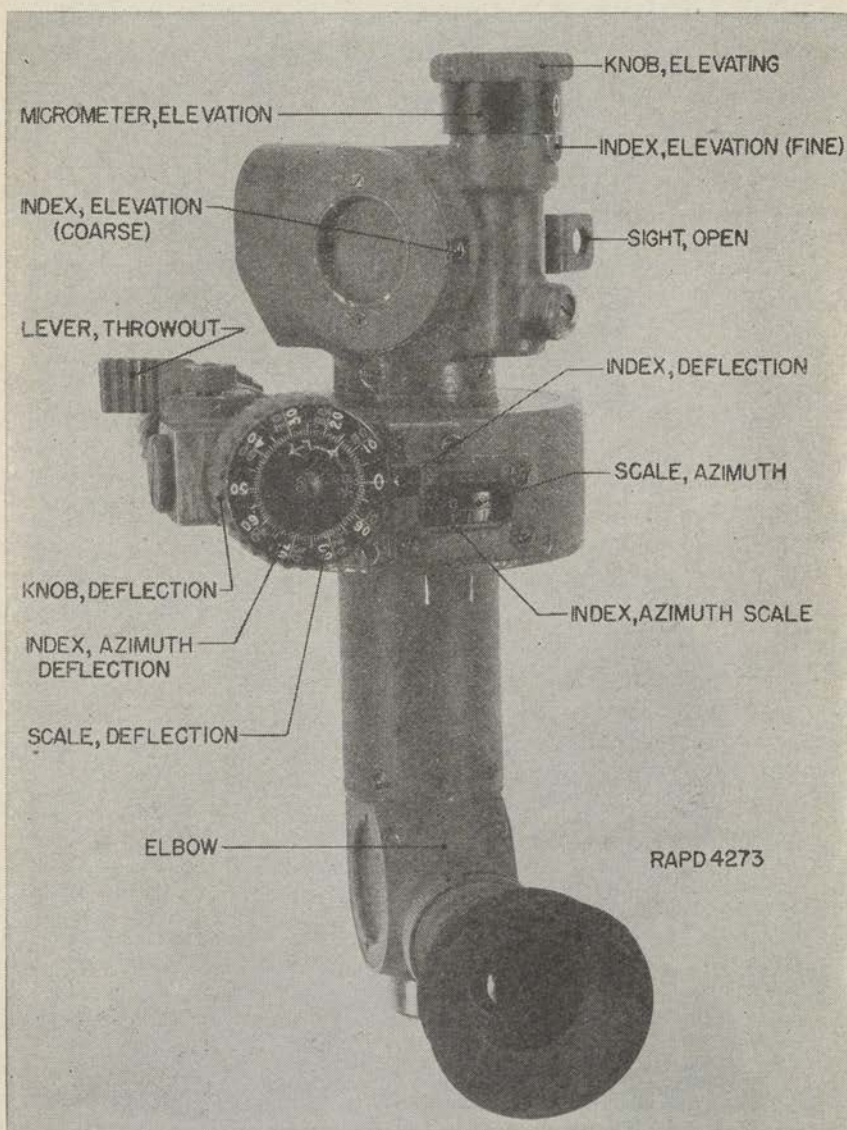


FIGURE 47.—Panoramic telescope M5A5.

Set the scales and micrometers of the panoramic telescope to their zero positions. These settings will then apply for all subsequent operations.

(2) *Verification of cross level and longitudinal level.*—Remove the panoramic telescope from the telescope mount. Use the gunner's

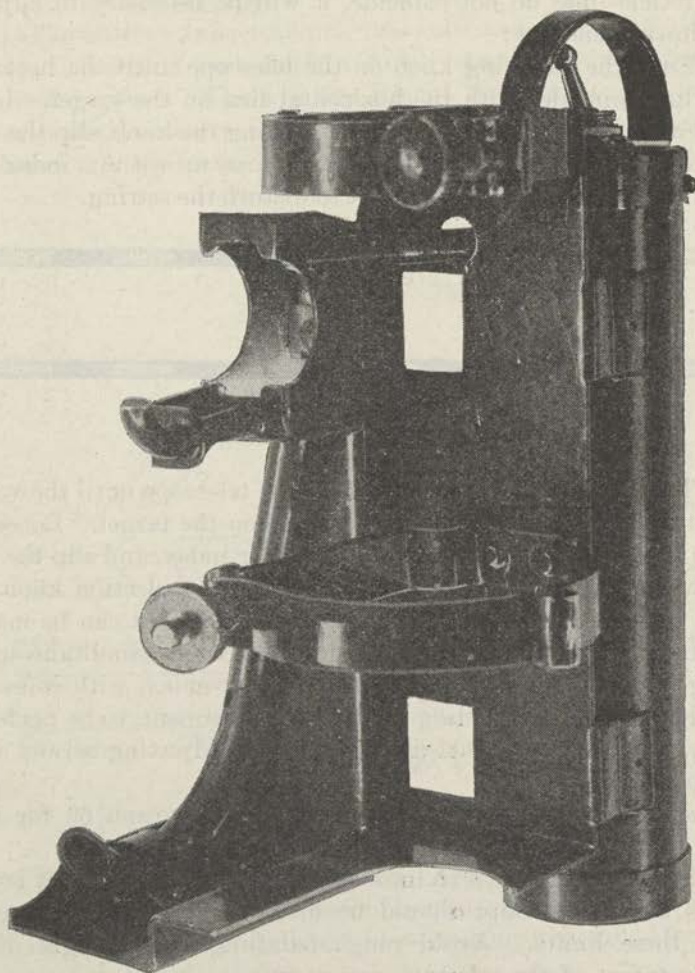


FIGURE 48.—Instrument light M5.

quadrant as a test level, placing it on the top surface of the telescope socket parallel to the respective level axis of the telescope mount. The gunner's quadrant should show the surface to be level along both axes. An error not in excess of one division on the telescope mount level vial is acceptable. If the error along either axis is beyond this

limit, it will be necessary to adjust the corresponding level vial. The adjustment is to be performed only by authorized ordnance personnel.

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

(a) Turn the elevating knob on the telescope until the horizontal reticle line coincides with the horizontal line on the target. Loosen the screws in the end of the knob and, holding the knob, slip the elevation micrometer until the zero graduation lines up with its index; then tighten the screws, being careful not to disturb the setting.

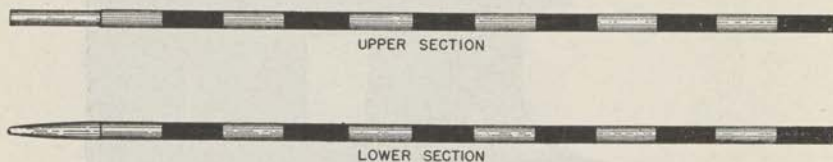


FIGURE 49.—Aiming post M1.

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(b) Turn the azimuth worm knob on the telescope until the vertical reticle line coincides with the vertical line on the target. Loosen the locking screw in the center of the micrometer index, and slip the index until the arrow is in line with the zero of the deflection knob, then tighten the locking screw. Only a small adjustment can be made in this manner, since a large adjustment will prevent simultaneous zero reading of the azimuth scale and micrometer index, with consequent possibility of error in reading. Further adjustment, to be performed only by ordnance personnel, is by means of adjusting screws in the telescope socket.

d. Care and preservation.—(1) Refer to paragraph 66 for information on the care and preservation of instruments.

(2) Stops are provided to limit the longitudinal and cross leveling motions and no attempt should be made to force the mechanisms beyond these limits. Avoid rough handling which might disturb the adjustment of the telescope and mount.

(3) Fittings are provided for lubrication of the principal bearings and *oil only* is to be applied. Wipe off all lubricant that seeps from the moving parts to prevent accumulation of dust and grit.

59. Light, instrument, M5.—*a. General.*—The instrument light M5 (fig. 48) is used with the panoramic telescope M5A5 and telescope mount M18A1 to illuminate the reticle, azimuth scale, azimuth

micrometer, and indexes in the telescope and the cross level and longitudinal level of the mount.

b. Description.—(1) The main body of the instrument is held firmly against the telescope socket by two clamps in such a position that the horizontal leg of the telescope fits into the semicircular notch in the lamp housing.

(2) The battery tube contains two standard flashlight cells, type BA-30, in series from which a 3-volt special aircraft type lamp is supplied power. The average life of the cells is approximately 8 hours' continuous service. The life of the lamp is approximately 400 hours. A switch is built into the bottom cover of the battery tube.

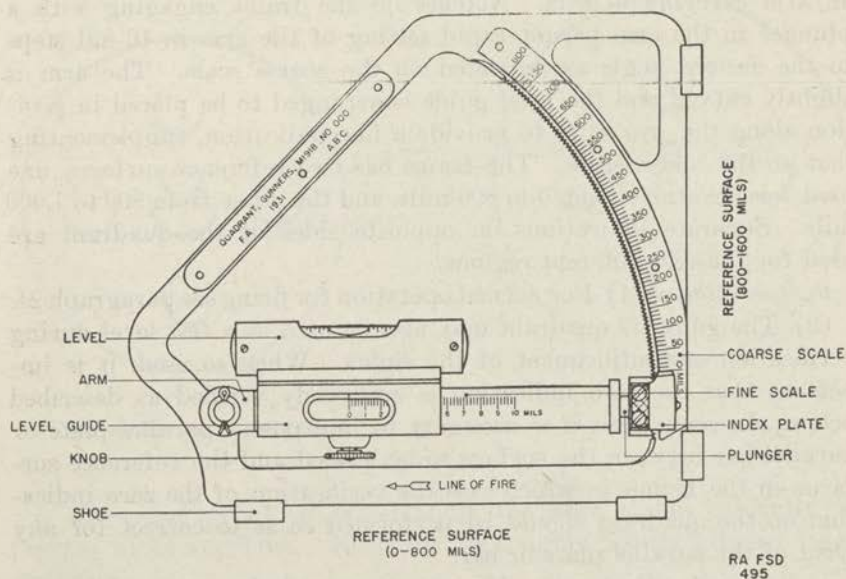


FIGURE 50.—Gunner's quadrant M1918.

(3) The reticle of the telescope is illuminated directly by the lamp through a window in the horizontal leg of the telescope. The cross level is illuminated directly by the lamp through a hole in the bottom of the lamp housing.

(4) The azimuth micrometer on the telescope and the longitudinal level on the mount are illuminated by two light transmission tubes containing rods of a clear plastic which possess the property of transmitting light along its length. The tubes are cut away and the rod is sand blasted so that the light is transmitted to the point to be illuminated.

60. Post, aiming, M1.—Two of these aiming posts are furnished with each gun and carriage. Each aiming post (fig. 49) consists of two tubular sections, each approximately 4 feet long. The lower section has a metal point for embedding in the ground and the upper section is provided with a joint and catch fitting in the upper end of the lower section. The parts are painted with alternate 4-inch red and white bands. A canvas cover holding both sections is provided. Should it be necessary to drive the lower section into the ground, interpose a wood block or use other means to insure that the surface which mates with the upper part is not injured.

61. Quadrant, gunner's, M1918.—*a. Description.*—This quadrant (fig. 50) 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 placed in position along the arm so as 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) For normal operation for firing see paragraph 24.

(2) The gunner's quadrant may also be used as a test level during verification and adjustment of the sights. When so used, it is important that the zero indication is accurately verified as described below. In some cases it is necessary to interpose a parallel plate or parallel bar between the surface to be leveled and the reference surfaces on the frame, in which case the verification of the zero indication on the quadrant should be performed so as to correct for any error of the parallel plate or bar.

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 gun 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) Refer to paragraph 66 for general instructions pertaining to the care and preservation of instruments.

(2) Exercise particular care to prevent burring, denting, or nicking of the reference surfaces and of the notched portion of the frame.

(3) Do not leave the quadrant on the piece when firing.

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

62. Sight, bore.—*a. Description.*—The bore sight (fig. 51) consists of a breech bore sight and muzzle bore sight designed for insertion in the corresponding parts of the gun.

b. Operation.—With the two elements in place, look through one of the large holes in the breech bore sight and move the gun until the aiming point can be seen through the muzzle bore sight, then look through the small hole and move the gun until the object appears in the opening at the center of the straight edge.

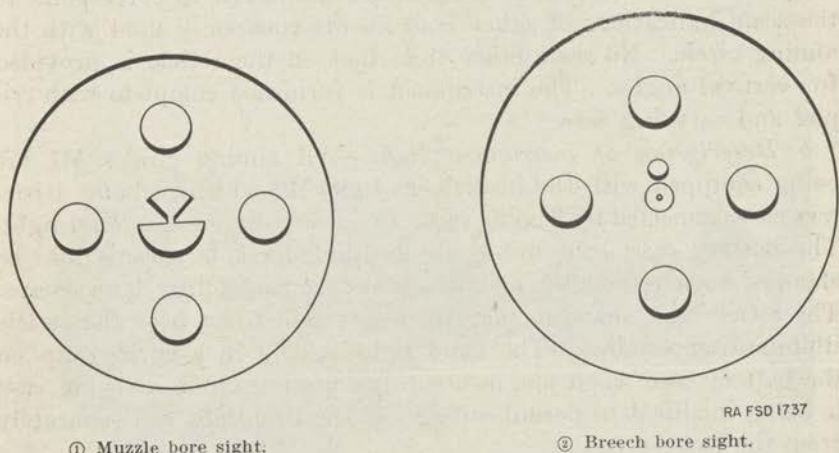


FIGURE 51.

c. Care and preservation.—Handle the bore sights carefully to prevent nicks and burs. Keep the bore sights lightly greased when not in use.

63. Target, testing.—The testing target is used during the bore sighting operation for the alinement of sights and subcaliber equipment with the axis of the bore of the gun. The aiming points are plainly designated. It is essential that the proper aiming points are selected for the matériel and equipment employed, and that the target is positioned vertically and in a vertical plane when in use. The normal distance from the gun at which the target should be located is about 50 yards.

SECTION X

FIRE-CONTROL EQUIPMENT

	Paragraph
Circle, aiming, M1-----	64
Telescope, battery commander's, M1915A1-----	65
Care and preservation-----	66

64. Circle, aiming, M1.—*a. Description.*—This instrument (fig. 52) is used for measuring angles in azimuth and site and for general topographic work. It includes a 4-power telescope with a laterally and vertically graduated reticle, 2 levels, a declinator, elevating, orienting, and azimuth mechanisms, and azimuth scales and micrometers. Azimuth indications are in mils, numbered to correspond to the scale indications of other instruments commonly used with the aiming circle. No scale other than that on the reticle is provided for vertical angles. The instrument is furnished complete with tripod and carrying case.

b. Description of instrument light.—All aiming circles M1 are being equipped with the instrument light M2 which includes a battery case connected by flexible cords to a reticle unit and a hand light. The battery case, containing one flashlight cell, is arranged to be clamped to a tripod leg and has a switch controlling both lamps. The reticle unit snaps in place in a dovetailed slot over the reticle illuminating window. The hand light is held in a spring clip on the battery case when not in use. The aiming circle carrying case is being modified to permit storage of the flashlight cell separately from the battery case.

c. Operation.—(1) To set up the instrument, clamp the tripod legs at the desired length and embed them firmly in the ground. Clamp the sliding support of the tripod at the desired height. Level the instrument using the circular level and the ball-and-socket joint. Focus the telescope as required, using the sleeve on the eyepiece.

(2) To orient the instrument, either a datum point of known azimuth or magnetic bearings may be used.

(a) To orient on a datum point of known azimuth, set the main azimuth scale (100-mil steps) and micrometer (1-mil steps) to the azimuth of the datum point and turn one of the orienting knobs until the datum point appears on the vertical cross line of the reticle. The instrument may also be relocated on the tripod spindle, using the orienting clamping screw for large angular changes. The telescope may be elevated or depressed as required to bring the point in the field of view.

(b) To orient on magnetic north, set the main azimuth scale and micrometer to indicate zero. Press the plunger releasing the magnetic needle and turn one of the orienting knobs until the north-

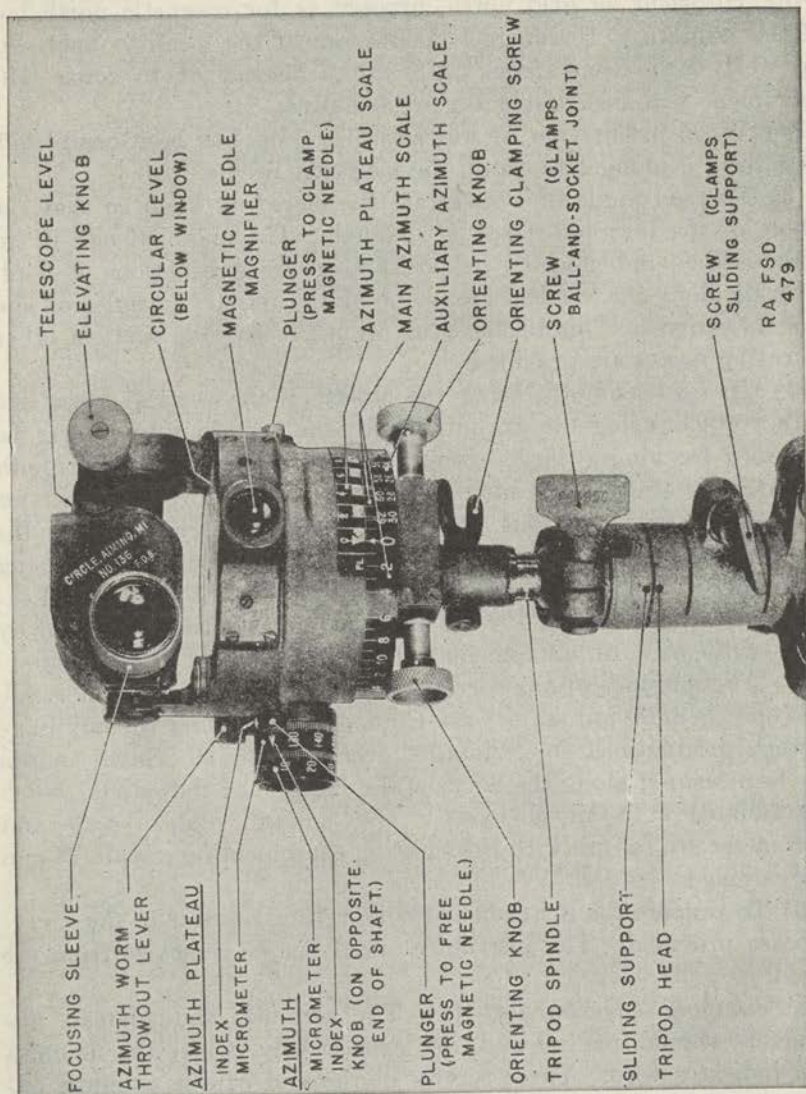


FIGURE 52.—Aiming circle M1, without instrument light.

seeking (knife-edge) end of the magnetic needle appears approximately opposite the "N" index at the front of the instrument, then refine the setting so that the south-seeking (rectangular) end of the needle is centered in the reticle, viewed through the magnifier. The

instrument may also be relocated on the tripod spindle, using the orienting clamping screw for large angular changes. The aiming circle will then indicate magnetic azimuths.

(c) To orient on grid north, proceed as for magnetic north but set the azimuth to the magnet declination of the locality (subtracting west declinations from 6,400 mils) instead of to zero. The instrument will then indicate grid azimuths.

(d) When orientation by magnetic bearings has been completed, press the red plunger to clamp the magnetic needle.

(3) To read angle of site, rotate the elevating knob so that the bubble of the telescope level is centered. The angle of site of an object is then indicated by its position on the graduations at 5-mil intervals along the vertical cross line of the reticle. Angles of site thus measured are limited to plus or minus 85 mils and no other indicating means are provided.

(4) To read azimuth, bring the object on the vertical cross line of the reticle, using the azimuth knob; the throwout lever may be depressed for aiming large azimuth changes rapidly. The azimuth indication of this instrument may be read either directly in mils or in terms of the indications on the panoramic telescope. Azimuths from 0 to 6,400 mils are read directly on the azimuth scale, using the main (upper) graduations for values above 3,200 mils. Indications on this scale are at 100-mil intervals and are supplemented by those on the azimuth micrometer, which is graduated at 1-mil intervals. Angular indications corresponding to those of the panoramic telescope (0-3,200 mil scales) are similarly read, using the auxiliary (lower) graduations for azimuths over 3,200 mils. Small angles may be measured along the horizontal cross line of the reticle, which is graduated at 5-mil intervals. The azimuth plateau scale and micrometer are for use with the sighting equipment on certain 75-mm gun carriages.

(5) To prepare the instrument for traveling, place it in the carrying case provided. The instrument need not be removed from the tripod.

d. Tests and adjustments.—(1) The azimuth and plateau micrometers should read 0 and 100, respectively, when the azimuth scale indicates zero. Three screws in the end of the azimuth micrometer may be temporarily loosened for this adjustment.

(2) The telescope level should indicate the line of sight determined by the center of the reticle to be horizontal. This may be verified by sighting on a distant point at the same level as the telescope, the error, if any, being read on the reticle. No corrective

adjustment by the using arm is permitted. A celluloid strip is provided on the front of the instrument, on which any correction should be recorded.

(3) To check the accuracy of the declinator, it is necessary to set up the instrument in a position not subject to local magnetic attraction and sight on one or preferably more points of known azimuth. The average error should be noted and the necessary correction recorded on the celluloid strip. No adjustment by the using arm is permitted.

e. Care and preservation.—(1) Refer to paragraph 66.

(2) Exposed moving parts should be oiled occasionally. Interior parts are not to be lubricated by the using arm. Keep excessive lubricant that seeps from the mechanisms wiped off to prevent accumulation of dust and grit.

(3) When storing aiming circles equipped with instrument lights, remove the flashlight cell from the battery case and place it in the compartment of the aiming circle carrying case.

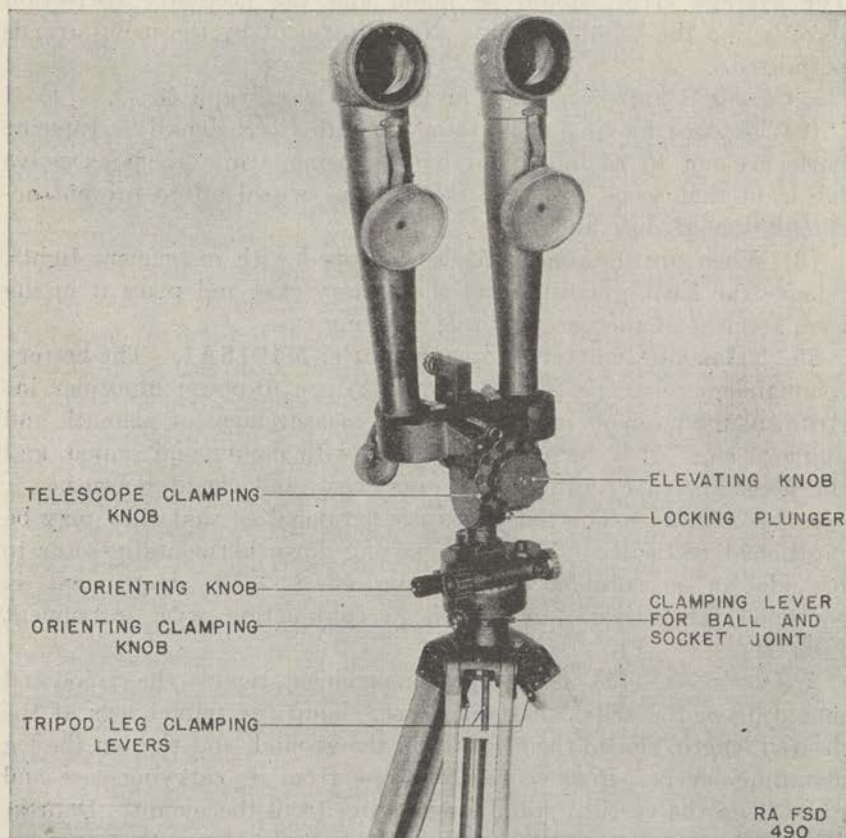
65. Telescope, battery commander's, M1915A1.—The battery commander's telescope (fig. 53① and ②) is a 10-power binocular instrument used for observation and for measurement of azimuth and angle of site. It is furnished complete with mount and tripod, and the necessary carrying cases, storage chest, and cleaning brushes.

a. Description.—The telescopes are arranged so that they may be positioned vertically as shown, or swung down horizontally so as to provide an accentuated stereoscopic effect. The instrument is equipped for reticle illumination in conjunction with instrument light M1.

b. Operation.—(1) To set up the instrument, remove the tripod and mount from the tripod carrying case, clamp the tripod legs at the desired length, embed them firmly in the ground, and tighten the leg clamping levers. Remove the telescope from its carrying case and place it on the vertical spindle extending from the mount. Depress the locking plunger and turn the telescope until the mating surfaces of telescope and mount engage properly, then release the plunger. Level the mount by using the circular level and the ball-and-socket joint at the bottom of the mount, and clamp with the lever when the level bubble is centered.

(2) To prepare the telescope, remove the caps from the eyepieces and objectives. If required, place the sunshades over the objectives and the amber filters over the eye lenses. Sunshades and filters are carried in compartments of the telescope case. Release the telescope clamping knob and turn the telescopes to the vertical or horizontal

position as required, at the same time setting the proper interpupillary distance in millimeters on the associated scale, and clamp in place. If the interpupillary distance for the observer is not known, it may be found by observing the sky and moving the eyepieces apart or together until the field of view changes from two overlapping circles to one sharply defined circle. Focus each eyepiece independ-

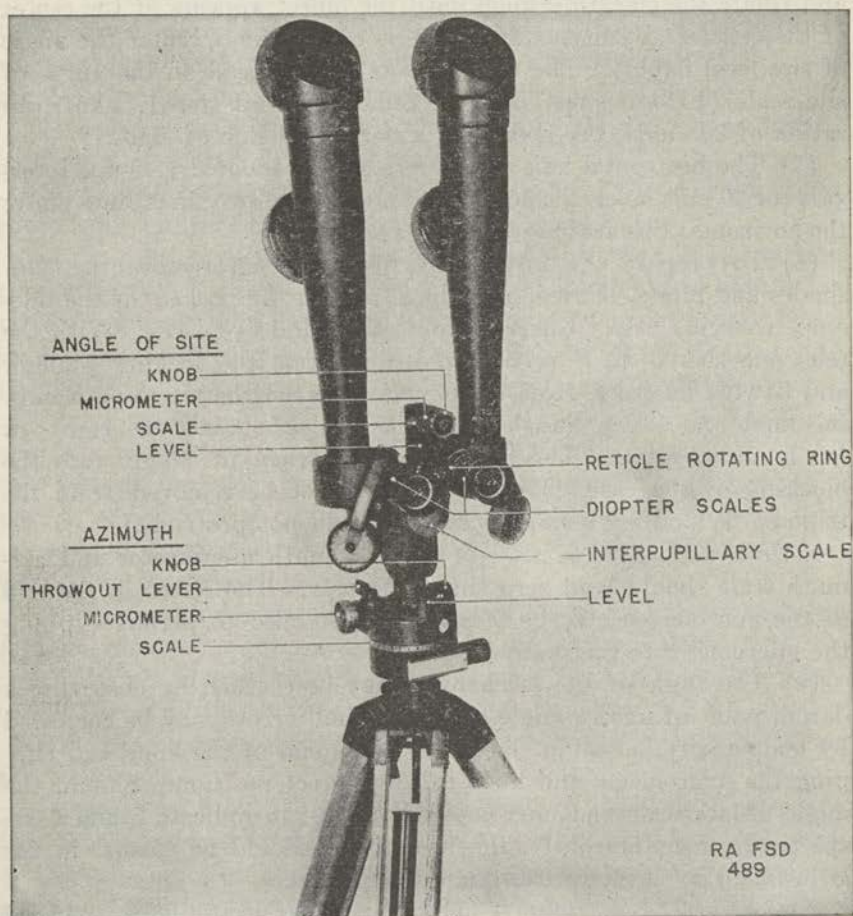


① Front view.

FIGURE 53.—Battery commander's

ently, looking through the telescope with both eyes open at an object several hundred yards away, covering the front of one telescope and turning the diopter scale until the object appears sharply defined, then repeating for the other eye. A diopter scale is provided for each eye and if the observer remembers the values for his own eyes, the settings may be made directly on the scales. Turn the reticle rotating ring until the reticle appears erect.

(3) To orient the instrument, select a datum point of known azimuth and set this value on the azimuth scale (100-mil steps) and micrometer (1-mil steps). The throwout lever may be used for making large changes in azimuth rapidly. Turn the telescope by



© Rear view.

telescope M1915A1.

means of the orienting knob until the datum point appears at the center of the reticle of the right-hand telescope. The orienting clamping knob may be temporarily released for making large angular changes rapidly. Thereafter, use only the azimuth knob, or for large changes the azimuth throwout lever, and the correct azimuth of the point observed will be indicated. For azimuths in the 3,200-6,400

mil region, additional numbers (0-3,200 mils) are provided, corresponding to the azimuth scale on the panoramic telescope.

(4) To read angle of site, swing the angle of site mechanism into a substantially vertical plane. Direct the telescope on the object and rotate the elevating knob until the object appears at the center of the reticle. By means of the angle of site knob, center the angle of site level bubble. The angle of site is then read on the angle of site scale (100-mil steps) and micrometer (1-mil steps). An indication of 300 mils corresponds to a horizontal line of sight.

(5) The horizontal axis of the reticle is graduated at 5-mil intervals for 30 mils on each side of the center. The two short lines above the horizontal line are spaced 3 mils apart.

(6) To prepare the instrument for traveling, remove the sunshades and filters, if used, and place them in the pockets of the telescope carrying case. Cover the objectives and eyepieces. With the telescope shanks in a vertical position, press the locking plunger and lift the telescope from the mount. Loosen the telescope clamping knob and swing the elevating mechanism against the right- or left-hand telescope. The instrument will then fit snugly into the blocking of the case. The mount need not be removed from the tripod. Tripod leg clamping levers should not protrude.

c. Tests and adjustments.—(1) The azimuth micrometer and azimuth scale should read zero simultaneously. The screw in the end of the micrometer may be temporarily loosened to permit slipping the micrometer to the desired position.

(2) The angle of site mechanism may be checked by observing a datum point of known angle of site. Small errors may be corrected by temporarily loosening the screw in the end of the knob and slipping the micrometer and knob to the correct position. Should the angle of site scale and micrometer then fail to indicate 3 and 0 respectively, simultaneously, the instrument should be turned in for adjustment by authorized ordnance personnel.

d. Care and preservation.—(1) Refer to paragraph 66 for general instructions pertaining to the care and preservation of instruments.

(2) Exposed moving parts should be oiled occasionally. Interior parts are not to be lubricated by the using arm. Keep excess lubricant that seeps from the mechanisms wiped off to prevent accumulation of dust and grit.

66. Care and preservation.—*a. General.*—(1) The instructions given below supplement instructions pertaining to individual instruments included in preceding paragraphs and the previous section.

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

(3) 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.

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

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

(6) Any instruments which indicate incorrectly or fail to function properly after the authorized tests and adjustments have been made are to be turned in for repair 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 or sighting 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 lever be fully depressed to prevent injury to the worm and gear teeth.

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

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

b. Leather articles.—For care and preservation of leather articles see TM 9-850.

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

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

(3) For wiping optical parts use only tissue 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 instru-

ments an additional brush with coarse bristles is provided for cleaning mechanical parts; it is essential that each brush is used only for the purpose intended.

(4) Exercise particular care to keep optical parts free from oil and grease. Do not wipe the lenses or windows with the fingers. To remove oil or grease from optical surfaces, apply 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.

d. Lubrication.—Only external exposed metal surfaces are to be lubricated. Use lubricating oil for aircraft instruments and machine guns. The internal mechanism is to be lubricated only by authorized ordnance personnel.

SECTION XI

AMMUNITION

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General.....	67
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67. General.—Ammunition for the 155-mm gun M1 and M1A1 is of the separate loading type. The components of a complete round—projectile, propelling charge, primer, and fuze—are shipped separately. The fuze is assembled to the projectile just prior to firing. The loading of a complete round requires three operations: loading the projectile, the propelling charge, and the primer.

68. Firing tables.—For applicable firing tables see the appendix.

69. Classification.—Dependent upon the type of filler, projectiles for the 155-mm gun M1 and M1A1 are classified as high-explosive, chemical, or dummy. High-explosive projectiles are filled with a high explosive bursting charge. Chemical shells contain a chemical filler which produces either a toxic or an irritating physiological effect, a screening smoke, an incendiary action, or a combination of these. Dummy or drill ammunition, which is always inert, is provided for practice in loading and handling.

70. Identification and marking.—Ammunition, including components, is completely identified by means of painting, marking, accompanying ammunition data cards, and linen tags. Other essential information, such as weight zone, kind of filler, weight of igniter, and muzzle velocity, may also be obtained from the marking and data cards. (See figs. 54 and 55 and *a* to *e* below.)

a. Mark or model.—Each item is assigned a model designation which is included in its marking. 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. 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, HE, Mk. I. The first modification of a model was indicated by the addition of MI to the mark number, the second by MII, etc. The present system of model designation consists of the letter M followed by an Arabic numeral. Modifications are indicated by adding the letter A and appropriate Arabic numerals. Thus M1A1 indicates the first modification of an item for which the original model designation was M1.

b. Ammunition lot number.—(1) For separate loading ammunition a lot number is assigned and marked on each of the components. It is required for all purposes of record, including reports on condition, functioning, and accidents in which ammunition is involved. To insure uniform functioning, all components in any one lot of separate loading ammunition are manufactured under as nearly identical conditions as possible and assigned a lot number. The complete round consists of—

- (a) Projectiles of one lot number (one type and one weight zone).
- (b) Fuzes of one lot number.
- (c) Primers of one lot number.
- (d) Propellant powder of one lot number.

(2) Therefore, to obtain the greatest accuracy in firing, successive rounds should be from the same ammunition lot, whenever practicable.

c. Ammunition data card.—This 5- by 8-inch card is placed in each packing box with the ammunition components. However, the card is not attached to projectiles shipped unboxed or uncrated. A linen tag containing essential data is attached to propelling charges in lieu of a data card. When required, assembling and firing instructions are printed on the reverse side of the card.

d. Painting and marking.—(1) *Painting.*—All projectiles are painted to prevent rust and, by means of the color, to provide a ready means for identification as to type. The color scheme is as follows:

High-explosive and AP Yellow; marking in black.
shell with HE.

Chemical----- -- Blue-gray; one green band indicates
nonpersistent gas; two green
bands, persistent gas; one yellow
band, smoke. Marking on the
projectiles is in the same color as
the band.

Practice----- Blue; marking in white. (Projec-
tiles are inert.)

Target practice shell AP Black; marking in white.
solid shot dummy or
drill (inert).

(2) *Marking.*—For purposes of identification, the components of parate loading ammunition are marked as follows:

(a) *On projectile.*

Caliber and type of cannon in which fired.
Kind of filler, for example TNT, CN GAS, etc.
Mk. or model of projectile.
Weight zone marking.
Lot number.

(b) *On propelling charge.*

Designation of section—BASE on base section; INCREMENT
on increment section.
Powder lot number.
Caliber and type of cannon in which fired.
Weight of igniter charge.

(c) *On fuze (stamped on body).*

Type and model of fuze.
Loader's initials.
Month and year loaded.
Loader's lot number.

(d) *On primer (stamped in metal).*

Initials of loader.

Loader's lot number.

Year of loading.

Mk. number.

e. *Weight zone markings.*—Because it is not practicable to manufacture projectiles within the narrow weight limits required for the desired accuracy of fire, they are grouped into weight zones so that appropriate ballistic corrections given in the firing tables may be applied. The weight zone of the projectile is indicated thereon by squares with a prick punch in the center of each. There are one, two, three, four, or more punch marks, dependent upon the weight of the projectile. For 155-mm projectiles, four squares indicate normal weight. The color of the squares is the same color as the marking.

71. Authorized rounds.—Being chambered alike, the 155-mm guns M1 and M1A1 fire the same ammunition (figs. 54 and 55). The ammunition authorized for use in these guns is listed in table I.

72. Projectiles.—a. *General.*—The projectiles for 155-mm guns are of two general design types, those of earlier design and those of current design; however, only those of current design are authorized for use in the 155-mm guns M1 and M1A1. These are distinguished by a broad rotating band approximately 2 inches wide, as compared with the projectiles of earlier design which have two narrow rotating bands, each approximately 0.60-inch wide. The particular models of projectiles authorized for use in the 155-mm guns M1 and M1A1 are listed in table I. Note that shrapnel is not authorized for use in these guns.

b. *Description.*—The projectiles of current design (figs. 54 and 55), authorized for use in the 155-mm M1 and M1A1, and distinguished by the 2-inch wide rotating band as described above, are adapted for the new standard contour fuzes with booster, such as the fuze, PD M51. It should be noted that in projectiles of current design the booster, instead of being a component of the projectile, is assembled to the fuze. These projectiles, which are boat-tailed (surface to the rear of the rotating band is conical) and have ogives of nearly 11 calibers, are similar in size and shape to other 155-mm projectiles, although readily distinguished therefrom by their marking and rotating bands. Projectiles for the 155-mm howitzers are marked 155 H; those for the 155-mm guns, 155 G. The howitzer projectiles have one narrow rotating band 0.60 inch wide; the gun projectiles have bands as described above. The weight zone is included in the marking on each projectile as described in paragraph 70. Explosive and chemical pro-

jectiles are shipped with an eyebolt lifting plug in the fuze cavity and a grommet to protect the rotating band.

73. Propelling charges.—*a. General.*—The propelling charge for the 155-mm gun M1 and M1A1 is of the base and increment type, approximately 6½ inches in diameter by 37 inches long over-all.

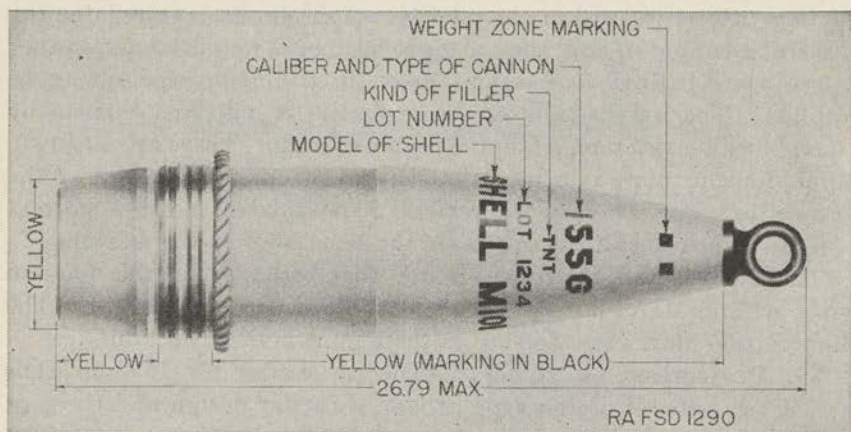


FIGURE 54.—Shell, HE, M101, unfuzed, 155-mm gun (adapted for fuze, PD M51).

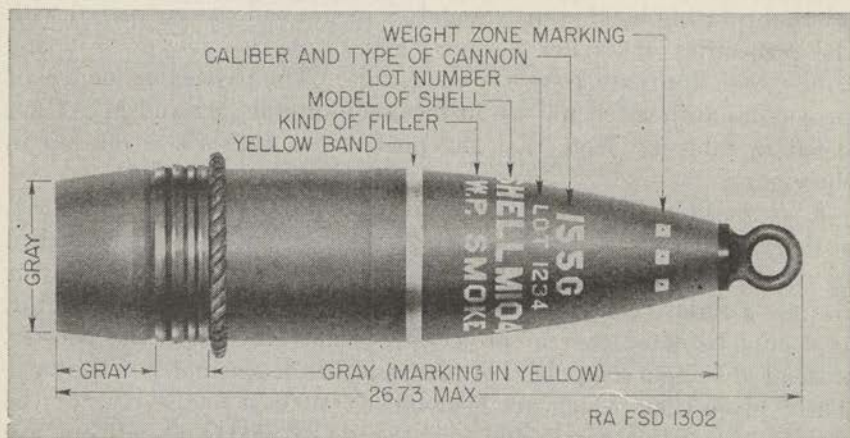


FIGURE 55.—Shell, smoke, phosphorus, WP, M104, unfuzed, 155-mm gun (adapted for fuze, PD M51).

This charge should not be confused with the 155-mm gun propelling charge M1917-17A1-18MI, which is of approximately the same over-all length but somewhat smaller in diameter (approximately 5¾ inches). The base section of the charge for the 155-mm guns M1 and M1A1 is approximately 25¼ inches long; the increment section,

TABLE I.—Ammunition for 155-mm gun M1 and M1A1

Projectile	Propelling charge ¹ Mk. or type	Prescribed fuzes		Primer
		Model	Action	
SERVICE AMMU- NITION				
Shell, gas persistent, HS, M104, unfuzed, 155-mm gun (adapted for fuze, P. D., M51).	B and I	M51	SQ and Del. ²	Mk. IIA1 ³
Shell, HE, M101, un- fuzed, 155-mm gun (adapted for fuze, P. D., M51).	B and I	M51	SQ and Del.	Mk. IIA1 ³
Shell, smoke, FM, M104, unfuzed, 155- mm gun (adapted for fuze, P. D., M51).	B and I	M51	SQ and Del.	Mk. IIA1 ³
Shell, smoke, phospho- rus, WP, M104 unf- uzed, 155-mm gun (adapted for fuze, P. D., M51).	B and I	M51	SQ and Del.	Mk. IIA1 ³
DUMMY AMMU- NITION				
Projectile, dummy 95- pound Mk. I, 155- mm gun.	Mk. I, dummy (B and I).	M1907M		Mk. IIA1 ⁴ (inert).

¹ Service charge is designated, charge, propelling, NH powder, 155-mm gun M1 and M1A1.² SQ, superquick. Del., delay.³ Primer, percussion, 21-grain, Mk. II or Mk. IIA. authorized for use when primer, percussion, 21-grain Mk. IIA1, is not available.⁴ A fired service primer is used for drill purposes.



FIGURE 56.—Charge, propelling, NH powder, 155-mm gun M1 and M1A1.

11 $\frac{3}{4}$ inches. The charge consists of smokeless powder in wrapped cloth bags and weighs approximately 33 $\frac{1}{2}$ pounds—23 pounds for the base section, 10 $\frac{1}{2}$ pounds for the increment section. An igniter

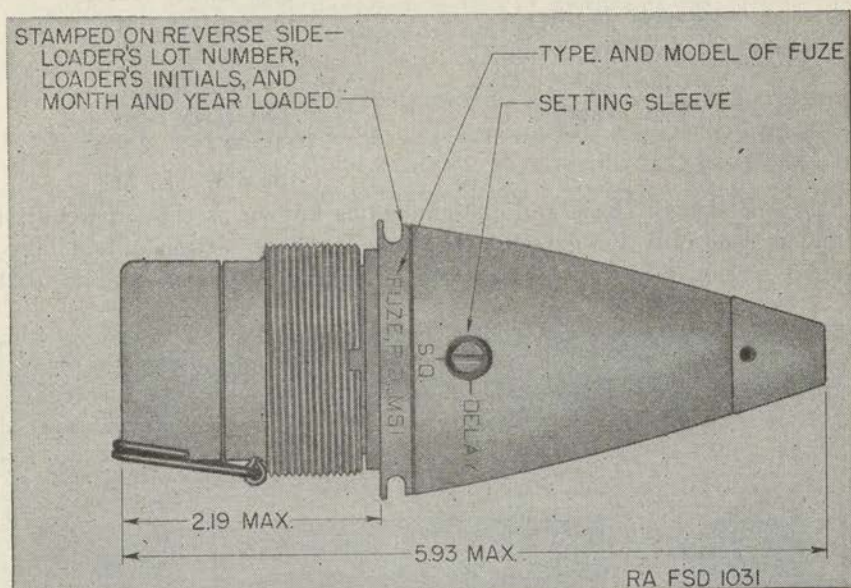


FIGURE 57.—Fuze, PD M51.

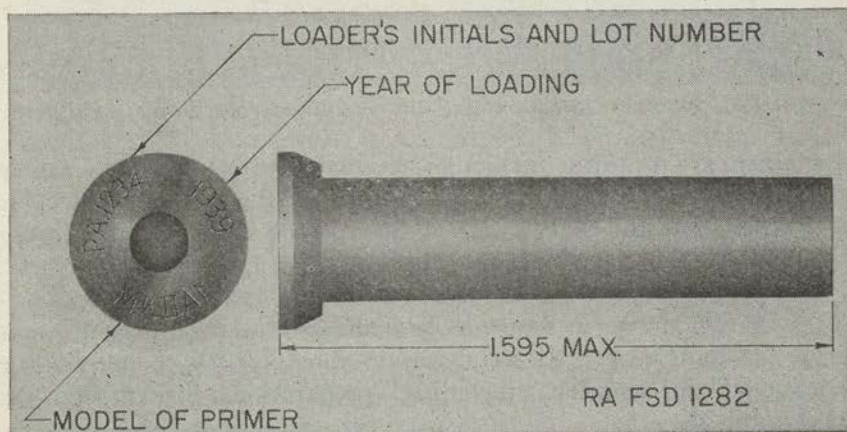


FIGURE 58.—Primer, percussion, 21-grain, Mk IIA1.

containing an igniter charge of 10 ounces of black powder is sewed to the rear end of the base section. The increment section is attached to the base section by means of four tying straps. The following identifying markings are stenciled on the charge:

(1) *On base section.*

Rear end
IGNITER

10 oz. Gr. A-1

155-mm. G., M1

(2) *On increment section.*

Rear end
Unmarked

Front end
BASE

PDR. LOT XXX

155-mm. G., M1

Front end

INCREMENT

PDR. LOT XXX

155-mm. G., M1

The full charge (base and increment) is known as the supercharge and is used only for extreme ranges. The base section only (increment section removed) is known as the normal charge and is used

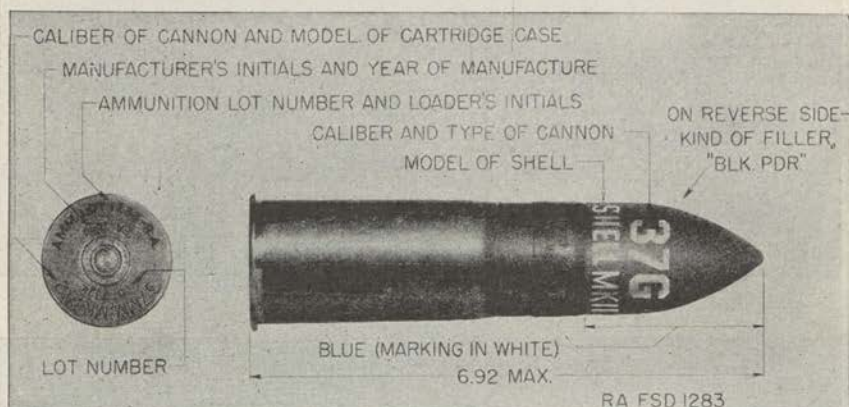


FIGURE 59.—Shell, fixed, practice, Mk. II, with fuze, practice, M38, 37-mm gun M1916.

for all ranges up to the maximum obtainable with it. All necessary data concerning the charge are contained on the data tag (see par. 70) attached to the charge. An igniter protector cap is placed over the igniter to protect it during shipment.

b. Charge, propelling, NH powder, 155-mm gun M1 and M1A1.—This charge, shown in figure 56, is standard for use in the 155-mm guns M1 and M1A1. It weighs approximately 33½ pounds. For additional information, including preparation for firing, see paragraph 76.

74. Fuzes.—A fuze is a mechanical device used with a projectile to explode it at the time and under the circumstances desired. Point detonating artillery fuzes of current design conform to a standard weight and contour, hence are ballistically interchangeable. They are known as standard contour fuzes to distinguish them from older

types. In the case of standard contour fuzes for 155-mm projectiles, the booster is assembled to the fuze as shipped.

NOTE.—No attempt will be made to disassemble any fuze. The only authorized assembling or disassembling operation is that of assembling the fuze to the projectile or, if not fired, unscrewing the fuze from the projectile. (See also par. 77.)

a. Types.—(1) Fuzes may be classified into two principal types: those which function by time action a certain number of seconds after firing, and those which function as a result of impact with a resistant object such as earth, water, or structural material.

(2) Further subdivision of the impact types is based upon quickness of action, classifications being superquick, nondelay and short delay.

b. Boresafe and nonboresafe fuzes.—(1) Dependent upon the manner of arming, certain fuzes are considered to be boresafe as distinct from those which are not boresafe. A boresafe fuze is one in which the explosive train is so interrupted that, prior to firing and while the projectile is in the bore of the gun, premature action of the bursting charge cannot occur even though the more sensitive explosive elements in the fuze should function prematurely.

(2) The fuze, PD M51, described herein, is classified as a boresafe fuze.

c. Fuze, PD M51.—In this fuze (fig. 57), the booster, instead of being a component of the loaded projectile, is permanently attached to the fuze at the time of manufacture. The fuze contains two actions, superquick and delay. Although both actions are initiated on impact, the functioning of the shell depends upon the setting of the fuze. (When the fuze is set for delay, the superquick action is so interrupted that the projectile functions with delay action rather than be a dud.) On the side of the fuze near the base is a slotted setting sleeve and two registration lines; the one parallel to the axis is marked SQ, the one perpendicular to the axis, DELAY. As shipped, the fuze is set SQ. To set the fuze for delay action, it is only necessary to turn the setting sleeve so that its slot is alined with DELAY. (A delay pellet, 0.05 second, incorporated in delay action train, provides for the delay action.) The setting may be made or changed at will with a screw driver or other similar instrument any time before firing, even in the dark, by noting the position of the slot—parallel to the fuze axis for superquick action, at right angles thereto for delay. A cotter pin with pull ring is assembled to the booster to prevent accidental movement of the detonator

during shipment. This cotter pin is to be withdrawn just prior to assembling the fuze with booster to the projectile.

75. Primers (separate loading ammunition).—*a.* Primer, percussion, 21-grain, Mk. IIA1 (fig. 58) is standard for use in the 155-mm guns and howitzers. It consists of a brass case containing a percussion element and 21 grains of black powder. The percussion element in the head of the primer contains a sensitive explosive and should be protected from any blows which might cause accidental functioning.

b. Primer, percussion, 21-grain, Mk. II and primer, percussion, 21-grain, Mk. IIA are similar to, and authorized for use in lieu of primer, percussion, 21-grain, Mk. IIA1 until present stocks are exhausted.

76. Preparation for firing.—*a. Projectiles.*—Prior to loading, it is necessary to assemble the fuze to the projectile. Proceed as follows:

(1) Remove the eyebolt lifting plug from the projectile.

(2) Visually inspect the fuze cavity and threads. There should be no foreign matter present which might interfere with the proper assembly or action of the fuze.

(3) Remove the cotter pin from the booster.

(4) Screw the fuze into the projectile. Tighten with a fuze wrench.

(5) Set the fuze. If the delay action is required, align the slot in the setting sleeve with DELAY; if superquick, align the slot with SQ setting as shipped. The fuze may be reset as required.

b. Propelling charge.—When firing the supercharge, it is only necessary to remove the igniter protector cap and data tag prior to loading. When firing the normal charge, it is also necessary to untie the tying straps and remove the increment section.

Caution: When loading the charge, be sure the igniter end is to the rear (breech end). If the igniter end is loaded first the charge will not burn properly, and it might result in a serious accident, should a hangfire occur.

77. Care, handling, and preservation.—*a.* Ammunition components are packed to withstand conditions ordinarily encountered in the field. For shipment, all 155-mm projectiles are fitted with an eyebolt lifting plug and a grommet, hence a shipping crate is not required. Fuzes, charges, and primers are packed in moisture-resistant containers. Nevertheless, since explosives are adversely affected by moisture and high temperature, due consideration should be given to the following:

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

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

b. Do not attempt to disassemble any fuze.

c. Do not remove the eyebolt lifting plug from the unfuzed shells until the fuze is to be assembled thereto. The eyebolt lifting plug is provided for convenience in handling and to keep the fuze opening free of foreign matter.

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

e. Handle fuzes and primers with care. The explosive elements are particularly sensitive to undue shock and high temperature.

f. Each of the separate loading components should be free of foreign matter—sand, mud, grease, etc.—before loading into the gun.

g. Do not remove protection or safety devices from fuzes until just before use.

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

78. Packing.—Complete packing data covering dimensions, volume, and weights of the various components of the ammunition described herein are published in SNL P-1, SNL P-3, and SNL P-6.

a. High-explosive shells are shipped unfuzed with eyebolt lifting plugs and grommets to protect the rotating band. The propelling charges are packed in airtight metal cartridge storage cases. The primers are packed in sealed or moisture-resistant containers. The fuzes with booster are packed in individual waterproof or moisture-resistant containers which are packed in wooden or metal-lined boxes.

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

	Weight (pounds)	Volume (cubic feet)
155-mm projectile:		
Projectile as shipped	95	0. 65
Over-all dimensions (inches)—26.8 by 7.3 diameter.		
Propelling charge for 155-mm guns M1 and M1A1:		
Charge without packing material	32 $\frac{1}{4}$	
3 charges in bundle packing	127	¹ 5. 15
Over-all dimensions of 3-round bundles (inches)— 40 $\frac{3}{4}$ by 15.41 by 14.38.		
Fuze, PD M51:		
Packed in individual fiber containers, 25 per box	77 $\frac{1}{4}$	1. 46
Over-all dimensions of box (inches)—17 $\frac{7}{16}$ by 15 $\frac{1}{8}$ by 9 $\frac{1}{32}$.		

¹ When quantities of bundles are shipped or stored, the actual volume required may be reduced to approximately 70 percent of the calculated gross volume, provided advantage is taken of the nesting characteristics of the bundles.

79. Subcaliber ammunition.—a. General.—The shell, fixed, practice, Mk. II, with fuze, practice, M38, 37-mm gun, M1916, is authorized for use in the 37-mm gun M1916 when used for subcaliber purposes with the 155-mm gun M1 and M1A1. This ammunition is issued in the form of fixed complete rounds. The projectile is fitted with a base fuze and contains a low explosive filler of black powder. When used for target practice purposes, the low explosive serves as a spotting charge. The complete round is shown in figure 59, and may be identified by the marking indicated thereon.

b. Packing.—Two standard packings of 60 rounds each are provided: one, a wooden box with metal liner for oversea shipments, the other a wooden box without metal liner for domestic shipments. Data for these packings are as follows:

	Weight (pounds)	Volume (cubic feet)
Complete round without packing material	1. 62	
Oversea shipments:		
Box with metal liner (60 rounds)	127. 66	1. 99
Over-all dimensions of box (inches)—23 $\frac{3}{16}$ by 13 $\frac{3}{16}$ by 11 $\frac{1}{16}$.		
Domestic shipments:		
Box without metal liner (60 rounds)	114. 5	1. 60
Over-all dimensions of box (inches)—21 $\frac{1}{2}$ by 12 $\frac{1}{16}$ by 10 $\frac{5}{32}$.		

80. Field reports of accidents.—Any serious malfunctions of ammunition must be promptly reported to the ordnance officer under whose supervision the material is maintained and issued (see AR 45-30).

SECTION XII

HEAVY CARRIAGE LIMBER M2

	Paragraph
General information and data.....	81
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Disassembly and assembly.....	83
Inspection and adjustment.....	84
Care and preservation.....	85

81. General information and data.—The heavy carriage limber M2, used with the 155-mm gun carriage M1 is a two-wheeled pneumatic-tired vehicle which forms the connection between the gun carriage and the prime mover. The limber mounts the limber lifting mechanism that secures the spade end of the trails of the carriage when in traveling position (figs. 60 and 64).

82. Description and operation of heavy carriage limber M2.—The principal parts of the limber are the axle D37524 which mounts the limber wheels on antifriction bearings, the base D37501, the trail base D37498, the limber lifting mechanism, and a standard type drawbar with prop and lunette (fig. 60).

a. Description.—(1) The axle is assembled with the two springs connected on each end by the spring shackle and lifting mechanism base pins, to bearings that are integral with the base. The base forms the seat for the trail base and is provided with bearings for assembly of the drawbar.

(2) The trail base, which turns in the base, forms the turning point between the carriage and prime mover and is held in place in the base by plate B159028 and secured by flat head machine screws. The trail base seats the lifting mechanism on a thrust bearing. The trail base is provided with guide arms to locate the trails of the carriage when in traveling position. The locking pins B167010 and B167011 are provided to help support the trails in traveling position.

(3) The locking pins are locked by a plate engaging a groove in the pin. To withdraw the pin, turn it until the flat on the pin is in line with the plate. To engage the pin, reverse the above operation.

(4) The lifting mechanism nut C73295 is threaded to fit center screw B167009. The lifting mechanism nut is operated by the hub handles B166602. The lifting mechanism center screw pin B166600, on the lower end of the center screw engages mating bearings on

the trail end and does not revolve when raising and lowering the trails. The trails are raised or lowered by rotating the lifting mechanism nut. A handwheel is connected with the center screw and is provided to guide the lifting mechanism center screw pin to facilitate engaging the bearings on the trails. Lifting mechanism lock C73297 actuated by locking pin B166607 seats on the hex nut A174256, thereby locking the lifting mechanism in position. A pipe plug must be removed to lubricate the mechanism. An oil seal is provided to seal the assembly (fig. 64).

(5) The lifting mechanism lock must be engaged when the carriage is in traveling position.

(6) Locking pin B166610 assembled to the drawbar when engaged, enters the tube B166604 on the base and thereby locks the drawbar to the base. This locking pin must be withdrawn when the carriage is in traveling position.

(7) Locking pin B166603 is provided to lock the trail base to the base. The engaged position is indicated (fig. 60) showing the washer, welded to the locking pin, in contact underneath plate A173453 and locked by a spring-actuated steel ball. To release the lock, turn the locking pin 180°. This lock must be disengaged when the carriage is in traveling position.

(8) The limber wheels are identical and interchangeable with the bogie wheels. The limber wheels are of the single disk and rim type, whereas the bogie wheels are of the dual disk and rim type.

b. Operation.—For operation of the heavy carriage limber as a unit, see paragraph 25.

83. Disassembly and assembly.—The limber parts that may readily be disassembled and assembled in the field are held in place with standard hardware. Such parts can be disassembled and assembled with the tools provided without detailed instructions. The procedure for the disassembly and assembly of the disk and rim wheels and hubs is the same as used for the bogie wheels. (See par. 54.) Note the left- and right-hand feature of the disk and rim wheel studs and nuts.

84. Inspection and adjustment.—Battery commanders should make frequent detailed inspections of vehicles. The heavy carriage limber is a ruggedly constructed vehicle well adapted for field use with a minimum amount of adjustment. However, in order to keep the vehicle in serviceable condition at all times, the proper attention must be given to cleaning, lubricating, and to loose or broken parts. Special attention should be given to sliding and bearing surfaces. These, together with screw threads and exterior

parts, must be kept as free from dirt and other foreign matter as possible. Extra precautions should be observed regarding the foregoing, particularly when proceeding with disassembly and assembly operations. The following should be observed:

Parts to be inspected

- a. The limber as a unit.
- b. Lifting mechanism.
- c. Trail base and lifting mechanism lock.
- d. Axle.
- e. Locking pins.
- f. Wheels.
- g. Air line clips.

Points to observe

- a. Note the general appearance and condition.
- b. Note ease of operation of the limber lifting mechanism. Examine the lifting mechanism center screw for burs or scores. See that the lifting screw functions smoothly through its full length of travel, and does not bind.
- c. See that the trail base swivels smoothly, and that the lifting mechanism lock functions without binding.
- d. Check the spring shackle and lifting mechanism base pins.
- e. Note ease of operation of the various locking pins, handles, handwheels, etc., and see that they perform their proper function without undue binding.
- f. Note condition of tires, tubes, tire air valve, disks, and rims. Check disk and rim nuts for tightness. Check disk and rim studs for body bruises or scored threads.
- g. Check for broken or loose air line clips.

85. Care and preservation.—The life of the vehicle depends to a great extent on proper lubrication. Particular attention should be given to the sliding and bearing surfaces, oil cups, oil holes, plugs, openings, or exposed surfaces, which provide means for lubricating the various parts. Care should be taken when cleaning oil and grease compartments to insure the complete removal of all residue and sediment. Be certain that no dirt or other foreign matter drops into any of the lubricating passages or on the bearing surfaces. The lubrication chart, provided for use as a guide, is combined with the lubrication chart for the carriage (fig. 42).

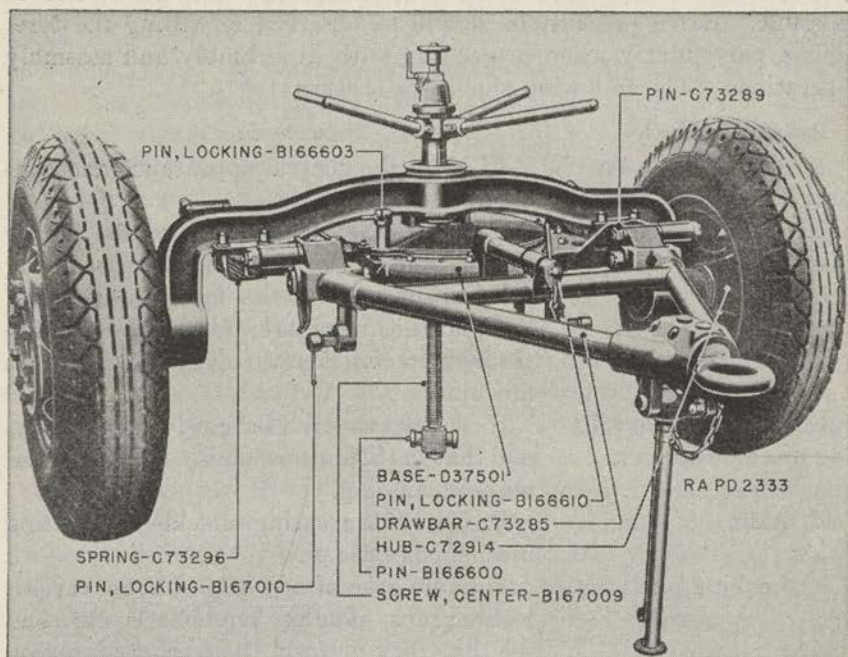


FIGURE 60.—Heavy carriage limber M2—front view.

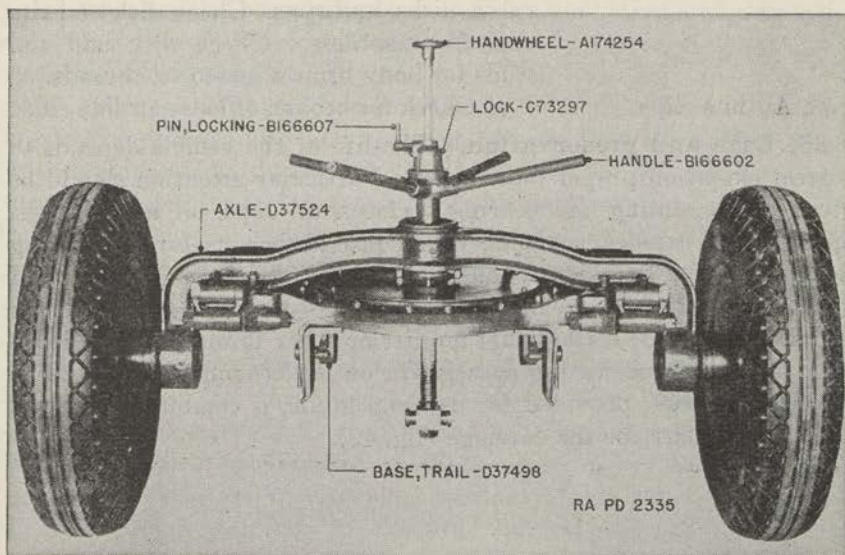


FIGURE 61.—Heavy carriage limber M2—rear view.

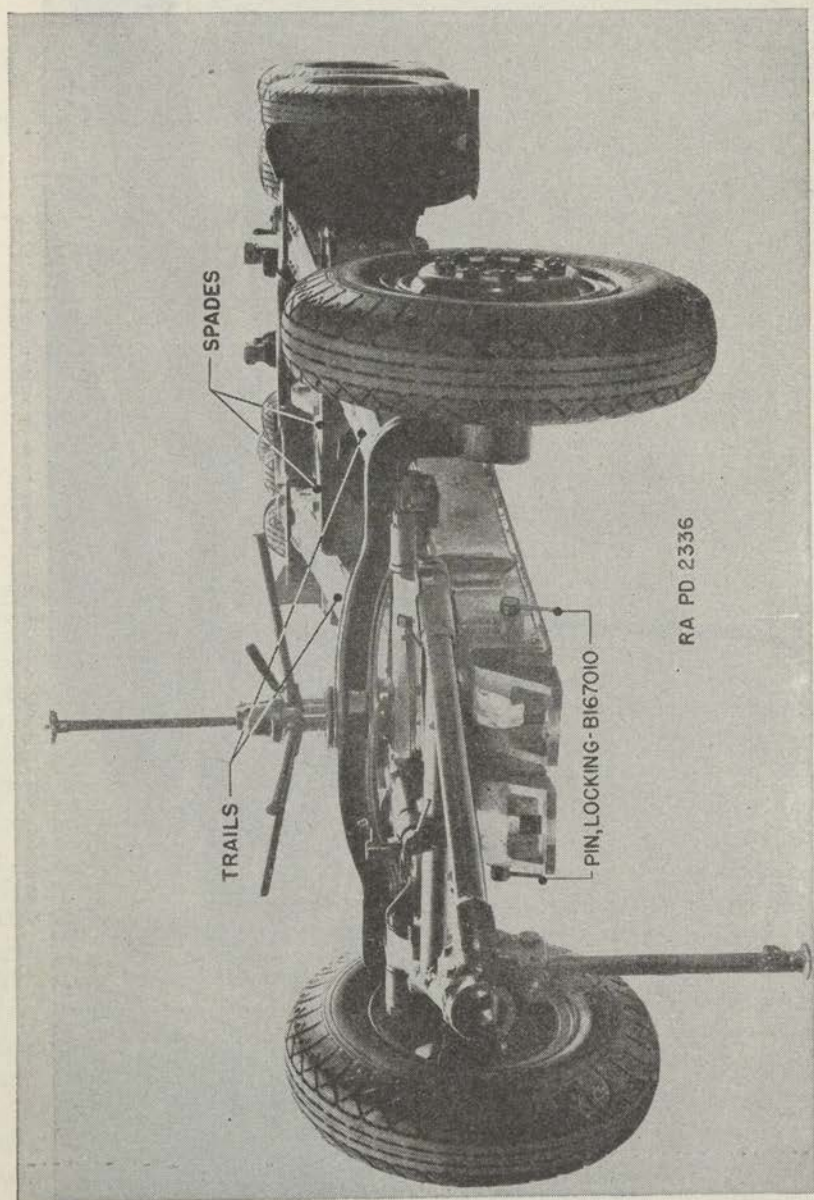


FIGURE 62.—155-mm gun carriage M1—limber hook-up.

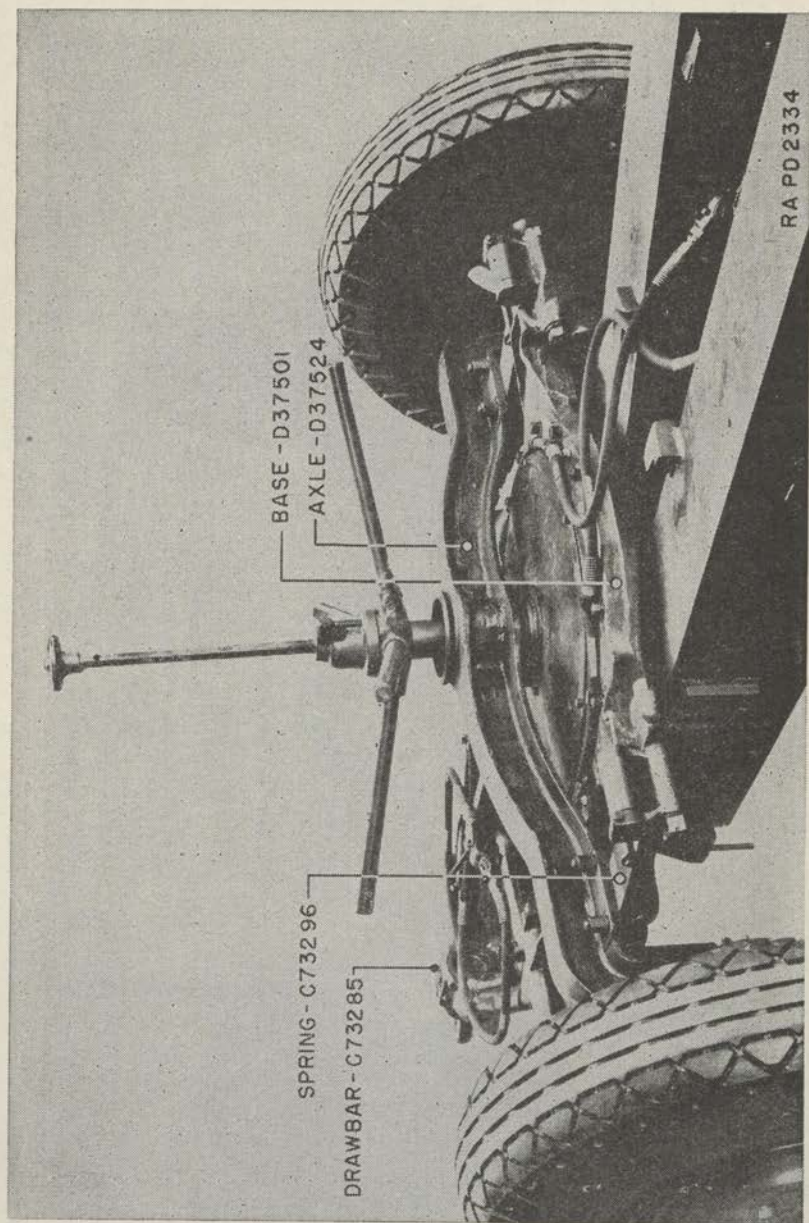


FIGURE 63.—155-mm gun carriage M1—limber hook-up with air lines.

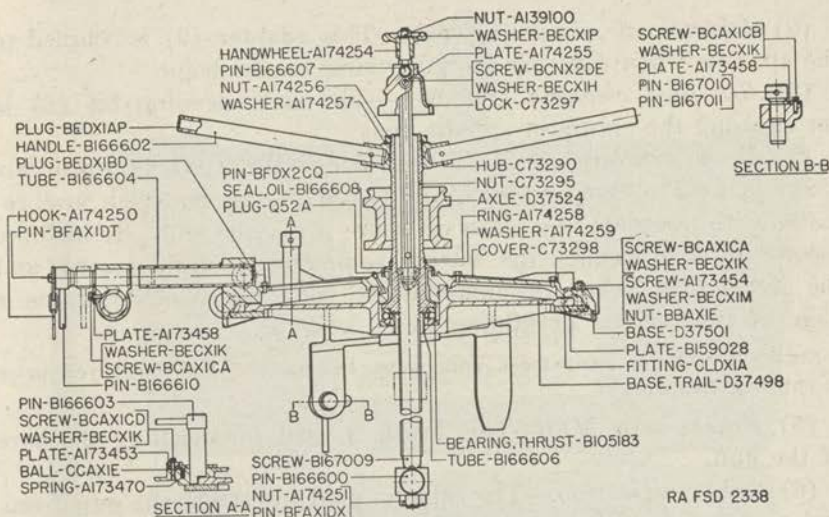


FIGURE 64.—Limber lifting mechanism.

SECTION XIII

ORGANIZATION SPARE PARTS AND ACCESSORIES

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Accessories.....	87

86. 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.

b. Care of organization spare parts is covered in section V.

87. 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 matériel when it is not in use, or when traveling. Accessories should not be used for purposes other than as prescribed, and when not in use should be properly stored.

b. 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:

(1) *Adapter* (fig. 65).—Adapters are provided for use when establishing the oil reserve. The adapter (3) provides a connection between the pressure gage and drain and filling valve release.

(2) *Adapter, air chuck* (fig. 66).—This adapter (9) is coupled to the air hose when inflating the inner tires on the bogie.

(3) *Bit, vent cleaning* (fig. 66).—The vent cleaning bit (8) is for cleaning the obturator spindle vent.

(4) *Book, artillery gun*.—The gun book (W. D., O. O. Form No. 5825) is used to keep an accurate record of the matériel, 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. The gun book contains a page of instructions pertaining to its use.

NOTE.—Records of assignment data must be removed and destroyed prior to entering combat.

(5) *Brush, bore, M13*.—This brush is used for cleaning the bore of the gun.

(6) *Cable, retracting*.—The cable is used to retract the gun from, and restore it to, traveling position. When used, one end of the cable is attached to the hook at the bottom of the breech mechanism, the other end slipped around the sheave on top of the cradle in the manner shown in figures 26 and 27 and then hooked to the prime mover.

(7) *Cradle guide filler*.—The cradle guide filler is a wood and metal filler which can be clamped in the cradle guides when the gun is in the retracted position. It is used when traveling to keep dirt, dust, and foreign material from accumulating on the cradle guides.

(8) *Filler, oil screw* (fig. 65).—The oil screw filler (4) is a high-pressure hand pump. It is used to reestablish the oil reserve of the recoil and counter recoil system whenever it is necessary in lieu of the oil pump. Its use is explained in paragraph 28e(3).

(9) *Lock, bogie, lifting screw*.—The lock is fitted over the two bogie elevating screws to prevent them from turning during travel.

(10) *Lock, traveling*.—The traveling lock is used during travel as a support for the breech end of the gun. The lock is secured in position on the trails by two keys and a cable which is hooked to the carriage as shown in figure 27. The keys are also used to hold the trail spades in position during firing.

(11) *Pump, oil, M2A1* (fig. 65).—The pump (1) is provided for filling the recoil and counterrecoil systems with oil. This pump is housed in a wooden chest which is clamped to the trail of the gun carriage when required. The pump is driven by a lever which is fulcrumed in a bracket. In the bracket are two holes which may be utilized to increase or decrease the leverage to suit the back

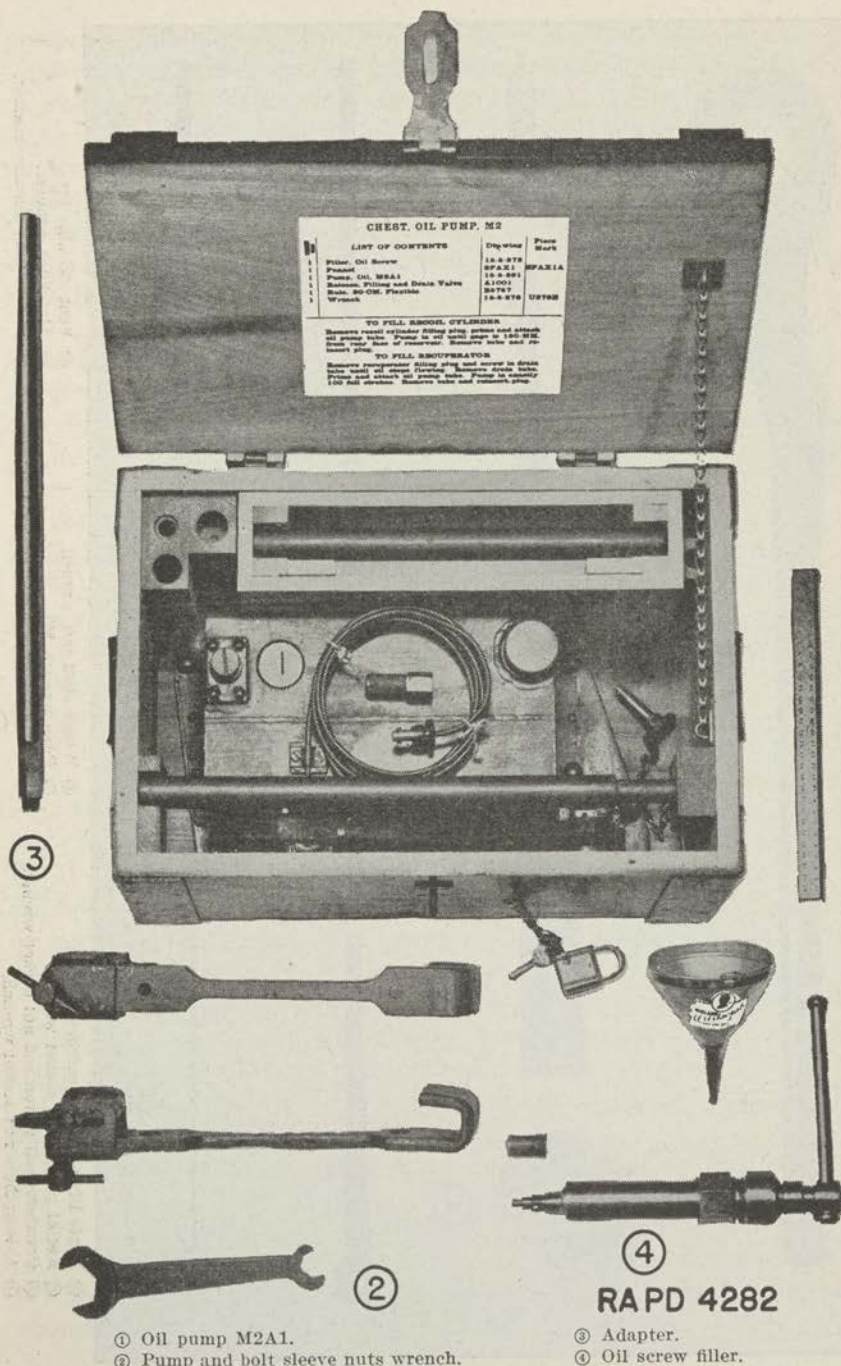


FIGURE 65.—Tools for maintaining oil reserves.

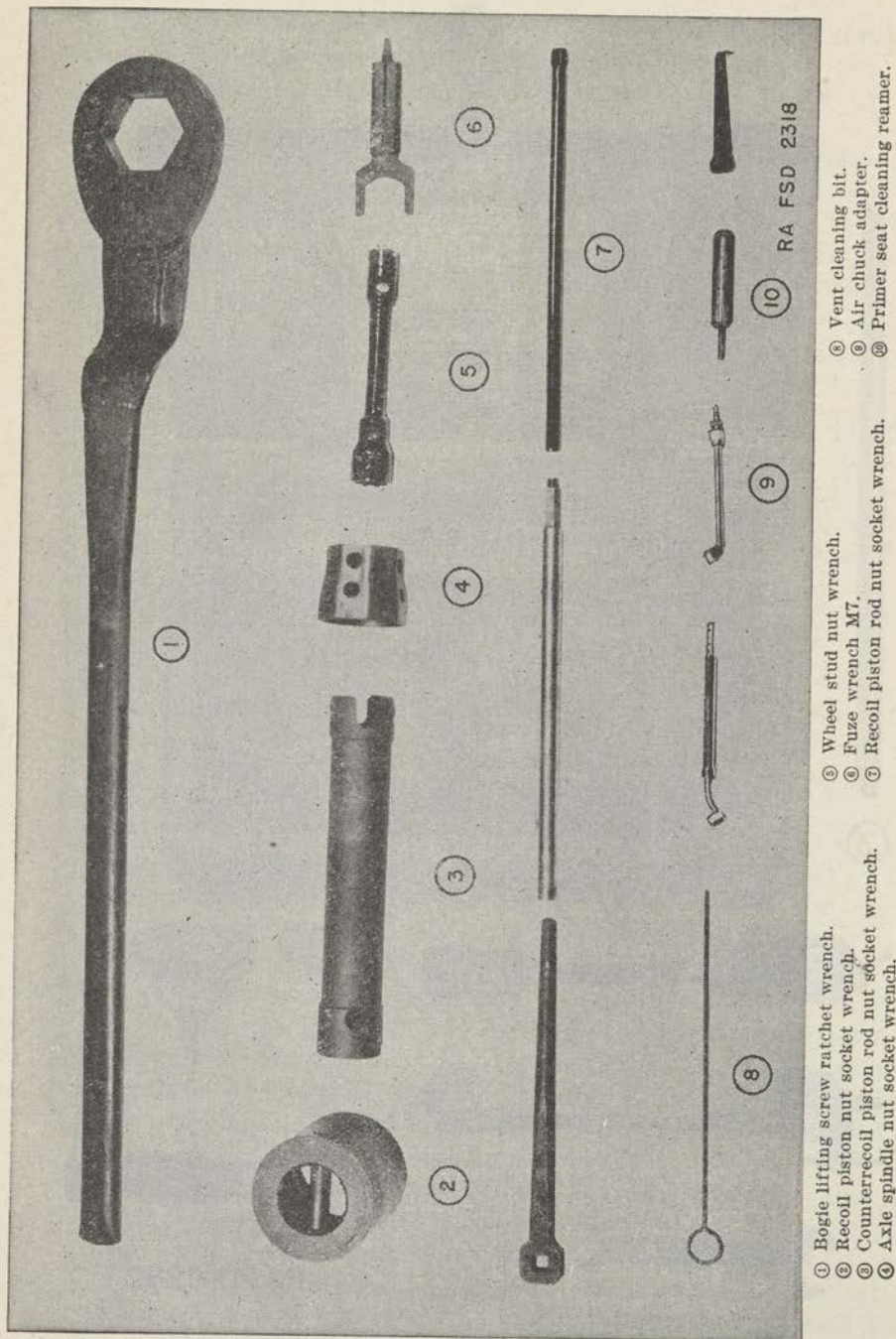


FIGURE 66.—Accessories for matériel, 155-mm gun M1.

pressure of the pump. Secured to the pump outlet valve is a coiled copper tubing which may be attached to the filling and drain valve of either the recoil or counterrecoil cylinder. When the pump is being filled, the oil must be strained through a clean cloth so that no foreign matter enters the pump reservoir.

(12) *Pump, oil, M3.*—This pump replaces the oil pump M2A1. It is used for the same purpose, housed in the same chest, and operated in the same manner, except that it is not clamped to the trails and the number of strokes per equivalent volume of oil is greater.

(13) *Rammer and staff.*—This consists of an unloading rammer, a loading rammer, and an 8-section staff assembly. The loading rammer is used for seating the projectile, and the unloading rammer for removing the projectile if for any reason it is not desired to fire it. Either of the rammers may be attached to the staff sections as required.

(14) *Reamer, cleaning, primer seat* (fig. 66).—The reamer (10) is used for removing fouling from the primer seat.

(15) *Release, filling and drain valve.*—The filling and drain valve release is used to drain the reserve oil from the recoil and counterrecoil systems.

(16) *Tray, loading, 155-mm M1.*—The loading tray is used to support the projectile during loading of the gun.

(17) *Wrenches* (fig. 66).—(a) *Axle spindle nut socket wrench* (4).—This wrench is used to adjust the wheel bearing outer jam nuts B166563, and nut and dowel assemblies A174195, when mounting the wheel and hub assemblies of the bogie or limber.

(b) *Bogie lifting screw ratchet wrench* (1).—This wrench is applied at the hexagon end of the bogie lifting screws for raising or lowering the bogie. Both screws must be operated in unison to prevent cramping of the mechanism.

(c) *Counterrecoil piston rod nut socket wrench* (3).—This wrench is used to assemble the counterrecoil piston rod nut to the counterrecoil piston rod when the gun is moved to firing position.

(d) *Fuze wrench M7* (6).—This wrench is used to tighten the fuze of the projectile before firing.

(e) *Pump and bolt sleeve nuts wrench* (fig. 65).—This wrench (2) is used to adjust the pump and bolt sleeve nuts of the oil pump.

(f) *Recoil piston rod nut socket wrench* (2).—This wrench is used in conjunction with pintle bolt head wrench (3) and wrench handle (7) to assemble the recoil piston rod nut to the recoil piston rod when the gun is moved to firing position.

(g) *Wheel stud nut wrench (5).*—This wrench is used to disassemble cap nuts from bogie or limber wheels.

SECTION XIV

SUBCALIBER EQUIPMENT

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88. Purpose.—Subcaliber equipment, which is used for training purposes only and is not taken into the theater of operations, consists of the 37-mm gun, M1916, the 37-mm subcaliber mount M10, and accessories. It is used to provide practice in laying and firing the 155-mm gun and matériel. The use of smaller bore ammunition prevents wear on the regular piece during practice and is less costly. The actual handling, loading, and range obtained are different. The subcaliber equipment is complete with recoil mechanism and does not operate the recoil mechanism of the 155-mm gun.

89. Description of breechblock and breech mechanism.—*a. General.*—The breechblock is the Nordenfeld type somewhat similar (except in size) to that of the 75-mm guns of the M1897 type. The breechblock screws into the breech ring and rotates through an angle of 156° about its axis. The axis of the breech recess is below the axis of the bore. The breechblock is operated by the breechblock lever which, when moved to the left, causes the breechblock to rotate, thus carrying the eccentric part to a position in line with the bore. The lever also operates the extractor, which extracts and ejects the cartridge case. The breechblock closes when the lever is moved to the right. This places the firing pin in line with the percussion cap in the base of the cartridge case, and releases the safety bolt.

b. Safety bolt.—The safety bolt prevents firing of the gun if the breechblock is not fully closed.

c. Firing mechanism.—The firing mechanism, which is housed in the breechblock, consists of firing pin, firing pin spring, rocker, rocker pin, rocker pin latch, and rocker plunger. When the trigger crank lever is pressed down the firing pin strikes the percussion cap, thus firing the gun.

90. Description of recoil mechanism.—*a.* The recoil mechanism is located in the cradle underneath the gun, and upon it the gun slides during recoil and counterrecoil. It consists of the recoil mechanism, the counterrecoil mechanism, and the counterrecoil buffer.

b. The recoil mechanism is for the purpose of controlling the force created by firing and to check movement of the gun in a gradual manner. The counterrecoil mechanism is for the purpose of returning the gun into battery in order that it may be fired again. The counterrecoil buffer is for the purpose of slowing down and stopping the counterrecoil action without injury to the system.

91. Breech mechanism.—*a. Operation.*—(1) *To cock.*—Place the palm of hand against cocking handle of striker and push it forward until it latches. After the first shot the mechanism is automatically cocked. If round is not to be fired, remove it from gun. Do not uncock while gun is loaded, as the mechanism must be cocked before it can be opened.

(2) *To open breech.*—(a) Rotate breechblock lever to left as far as it will go.

(b) The gun has no breechblock latch to hold breechblock in open or closed position. However, if the firing mechanism has been tripped, it will be necessary first to cock mechanism before breech may be opened.

(3) *To load.*—Insert round of ammunition, pushing cartridge case in as far as allowed by extractor.

(4) *To close breech.*—(a) Grasp breechblock lever and rotate it to right as far as it will go.

(b) During first part of movement a ramp on front of breechblock pushes cartridge case in flush with face of breechblock. It is pushed home by forward movement of breechblock in the breech ring threads.

b. Disassembly and assembly.—(1) *To dismount breechblock.*—(a) Cock piece with left hand by means of cocking handle on striker rod. Remove breechblock lever with right hand by grasping handle with the fingers and pressing breechblock lever release pin cap with the thumb.

(b) Take out extractor pin by pressing extractor pin latch toward breech with left forefinger and pulling it out to right with the right hand. Extractor will drop down until its heel clears extractor cam.

(c) Unscrew breechblock, grasping it firmly in right hand and supporting it with left hand, and remove it by unscrewing to left.

(2) *To replace breechblock.*—(a) See that breech recess, extractor, and threads of breechblock are thoroughly cleaned and lightly oiled. Set extractor in its seat but do not put in extractor pin.

(b) Cock.

(c) Screw breechblock home.

(d) Put breechblock lever in place.

(e) Raise extractor by pushing upward on its heel from under block and put extractor pin in from the right until extractor pin latch springs out and secures the pin.

(f) Uncock by pressing down trigger lever with right thumb while using pressure against cocking handle with left hand to prevent too fast movement of striker.

(3) *To dismount extractor.*—(a) Dismount breechblock as directed in (1) above.

(b) Withdraw extractor by inserting left forefinger in mortise in base of breech ring, raising extractor a little and grasping it with thumb and finger of right hand.

(c) To assemble extractor see (2) (e) above.

NOTE.—Do not attempt to unscrew or screw in breechblock without first removing extractor pin.

(4) *To dismount rocker, rocker plunger, and firing pin.*—(a) Mechanism should be cocked or breechblock dismounted.

(b) The rocker pin is retained in its seat by the free end of the spring entering the groove in outer end of rocker pin. This spring may become stuck with paint and should be freed by scraping paint around edge before attempting to remove rocker pin.

(c) Head of rocker pin projects at one side of the port. Place a small bronze drift against the projecting head and with light taps drive pin into the port. Rocker is then free and when removed exposes the firing pin, which will be pushed out by its spring, and the rocker plunger, all of which may then be taken out.

(5) *To assemble rocker, rocker plunger, and firing pin.*—(a) Clean and lubricate all parts; put in rocker plunger, firing pin spring, and firing pin.

(b) Hold rocker down in its seat with thumb until rocker pin can be started through. Push pin home and see that rocker pin latch springs into the groove.

(6) *To remove piston crosshead key.*—Disengage striker. Press up on piston crosshead key latch and push key out to left.

(7) *To assemble piston crosshead key.*—Clean, examine, and lubricate parts and push key in place with trigger crank lying in front of long arm of sear. See that safety bolt properly engages depending arm of sear before piston crosshead key is pushed fully home. Failure to have safety bolt in proper position will prevent crosshead key from being fully pushed in, and an attempt to force it will cause damage to the sear.

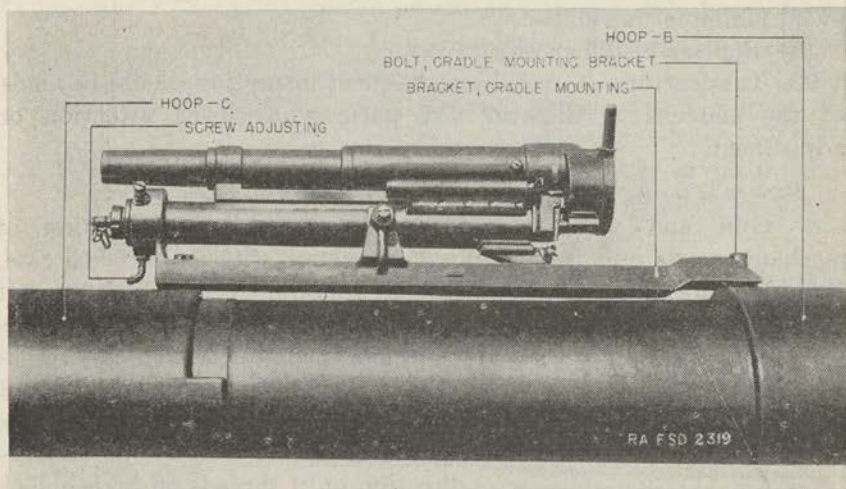


FIGURE 69.—Mount, subcaliber, 37-mm M10.

(8) *To disassemble striker mechanism.*—Having removed piston crosshead key, draw gun back about 8 inches and push striker to its extreme forward position to loosen striker rod nut setscrew and unscrew striker rod nut. Allow spring to expand slowly and push striker rod out. Clean all parts. Free height of the striker spring should be 6.81 inches. If it is as much as 0.5 inch less than this, replace it with a new spring.

(9) *To assemble striker mechanism.*—Thoroughly slush striker spring and striker rod with light lubricating oil. Place striker spring over rod and insert them in striker housing. Push striker to extreme forward position and screw nut until front edge of nut is about flush with front end of striker rod, taking care that striker rod nut setscrew comes opposite its keyway in the striker housing. The stroke of the striker rod may be lengthened by unscrewing

striker rod nut a few turns. The setscrew must not be omitted and must be well set in so that it does not strike the bottom of the keyway.

92. Gun and cradle disassembly and assembly.—*a. Disassembly.*—(1) Release striker and take out piston crosshead key by pressing up its latch and pushing it out to left.

(2) Draw gun back carefully off cradle by grasping muzzle with the left hand and breech with the right.

b. Assembly.—(1) See that gun slides and piston crosshead are thoroughly cleaned and lubricated.

(2) Insert gun from rear, carefully maintaining alinement to avoid jamming gun slides.

(3) Replace piston crosshead key.

93. Inspection.—Careful and frequent inspection should be made of the matériel to discover any parts which need attention or adjustment.

Parts to be inspected

a. Gun and recoil mechanism as a unit.

b. Breechblock.

Points to observe

a. General appearance. Condition of paint. Try ejection with empty shell case.

b. Rotate breechblock from right to left and back several times, noting whether there is any stiffness or binding. Depress breechblock lever release pin cap and pull out breechblock lever. Remove extractor pin. Then rotate breechblock in a counterclockwise direction until threads on breechblock are disengaged from threads in barrel and examine threads on breechblock for burs and rough surfaces. Note firing pin hole in face of breechblock, depress rocker plunger, and see how far firing pin protrudes. With rocker plunger fully depressed, firing pin should protrude approximately $\frac{1}{8}$ inch. Remove rocker pin, turn breechblock over and allow rocker plunger, firing pin, and firing pin spring to drop out. Note these parts for rust and burred surfaces. Tension of firing pin spring, free length, $2\frac{1}{2}$ inch. Try tension of breechblock lever latch spring.

*Parts to be inspected**Points to observe**c. Firing mechanism.*

c. Try tension of striker spring and sear plunger spring. Try action of trigger crank and trigger crank lever. Trigger crank plunger should have tension enough to hold trigger crank in place. Examine sear and sear notch for burs or worn surfaces.

d. Barrel.

d. Examine threads in breech for burs and rough surfaces. Chamber and barrel should be free from pits and rust. Remove piston crosshead key and slide barrel back to insure that jacket shoe and recoil ways are free from burs.

e. Recoil mechanism.

e. (1) Remove barrel assembly from recoil mechanism and examine front and rear caps for oil leaks, and leaks at piston rod packing washer. Check quantity of oil in recoil mechanism.

(2) Make a retraction test. A simple retraction test may be made by manually retracting the gun, blocking it with a piece of wood about 10 inches long, and then pulling out the block with a cord or wire. The gun should return to battery quickly, but without shock.

94. Malfunctions.—*a.* The gun may under certain conditions either fail to return completely to battery or may return too suddenly with a shock which will tend to destroy the aim. The firing mechanism may jam, or there may be a defective discharge, or failure to eject an empty cartridge case properly.

b. Incomplete return to battery is evident when the firing mechanism does not cock, or the cocking is not sufficient to produce discharge of the next shot. This may be caused by weakened counter-recoil springs, scored or scratched jacket shoe guides, a bent recoil cylinder, or an excess of oil in the recoil mechanism, which is due to expansion of the oil caused by excessive friction accompanying continued firing. In the latter case a little oil may be let out of the recoil mechanism by unscrewing the drain plug located on the rear right side of the cradle. If it is thought that the condition of the guides is causing the difficulty, the gun should be dismounted and the guides examined for traces of excessive friction, scratches, foul-

ing, etc. This may be remedied by careful use of a fine file and thorough cleaning and oiling. Test the operation of the gun in the slides before replacing the piston crosshead key.

c. Sudden return into battery position with a jarring impact is due to incomplete buffing at the end of counterrecoil or to insufficient oil in the recoil mechanism. Ordinarily, addition of a little oil will remedy both of these conditions. To do this, remove filling plug at front of cradle and inject sufficient oil by means of the oil gun.

d. Where trigger crank lever cannot be depressed sufficiently to operate firing mechanism, the malfunction can usually be attributed to incomplete closure of the breech, which causes the safety mechanism to lock the sear. The cartridge case should be examined for damaged rim or other defects tending to prevent its insertion in the chamber. Another shell may be tried. If the loading is not cause of the difficulty, examine chamber for dirt or fouling and trigger mechanism for broken or damaged parts or foreign matter which has become caught in the mechanism. Broken or damaged parts should be replaced.

e. Failure to fire is due either to a defective primer, a weakened striker spring, a worn or broken firing pin, or dirt in the firing pin recess. If two percussions are frequently necessary to produce discharge, the striker spring has either become weakened and should be replaced, or it is clogged with dirt and hardened grease so that it cannot function properly. If no defect can be found in the firing mechanism and the shell does not fire after three percussions, wait for 2 minutes, then replace it with another as the primer is defective.

f. Defective extraction may occur when cartridge case tends to stick in the chamber when edge of chamber is burred or fouled with powder, or when extractor is damaged or broken. A poor cartridge case may cause sticking in the chamber due to expansion, in which case the hand extractor should be used to complete extraction. Careful use of a fine file will correct sticking due to burring of chamber. If extractor is broken or damaged, it should be replaced.

g. The various causes of irregularity in operation are—

(1) *Failure to fire.*—(a) Breech not closed.

(b) Broken sear.

(c) Gun not cocked.

(d) Defective ammunition.

(e) Defective firing pin.

(f) Weak striker spring.

(2) *Failure to extract.*—(a) Breech opened slowly.

(b) Dirty chamber.

- (c) Extractor pin out.
- (d) Burred chamber.
- (e) Swollen cartridge case.
- (f) Defective extractor.
- (3) *Failure to return to battery.*—(a) Too much oil in recoil mechanism.
 - (b) Dirty slides.
 - (c) Bent shoes or slides.
 - (d) Burred shoes or slides.
 - (e) Defective cradle.
- (4) *Breech will not open.*—(a) Gun not cocked due to—
 - 1. Worn or broken sear.
 - 2. Worn or broken shoulder on striker rod.
 - 3. Defective sear plunger and springs.
 - 4. Gunner failed to release trigger crank lever.
- (b) Firing pin stuck in primer caused by—
 - 1. Burred rocker.
 - 2. Defective primer.

95. Care and preservation of gun and recoil mechanism.—

a. Gun.—The matériel should be kept in perfect condition and thoroughly cleaned and oiled. Only such cleaning and preserving materials as are issued for this purpose will be used. It is especially important that all parts of the gun be kept free from rust. The following instructions for cleaning these parts will be strictly observed:

(1) Bore and chamber of the gun require particular attention and will be thoroughly cleaned within 1 hour after firing. Wash until clean, then dry the bore thoroughly, using burlap or cloths, then oil the bore.

(2) The breechblock and firing mechanism will be thoroughly cleaned. All parts and recesses and breechblock threads will be lightly oiled.

(3) Trigger mechanism will be kept free from dust and foreign matter and, after use, all parts will be carefully wiped dry and a drop of oil put on striker bearings, trigger bearings, and safety bolt.

(4) Gun slides will be cleaned and freely oiled.

b. Recoil mechanism.—To fill an empty recoil mechanism $2\frac{3}{4}$ pints of oil, or 21 oil-gun fills, are required. Heavy recoil oil only is issued for use in the recoil mechanism.

(1) *Procedure.*—Rear end of cradle should be higher than the front.

(a) Fill oil gun.

1. Unscrew nozzle of oil gun.
2. Pull plunger back.
3. Fill oil gun with heavy recoil oil.
4. Replace nozzle.
5. Push up plunger gently to force out the air.

(b) Remove filling plug.

(c) Screw oil gun into filling hole.

(d) Remove drain plug.

(e) Push plunger of oil gun in slowly, and at the same time watch for the escape of oil from the drain hole. When oil runs out free of air bubbles, recoil mechanism is full.

(f) Remove oil gun. Before replacing the filling and drain plugs let about 2 teaspoonfuls of oil escape, then screw the two plugs in tightly. This is necessary as the expansion of oil during prolonged fire may interfere with the complete return of the gun to battery.

(2) *Adjustment*.—No adjustment of recoil mechanism by the using arm is permitted. Report to ordnance personnel.

96. Precautions.—The following precautions must be observed before, during, and after firing:

a. *Before firing*.—See that—

- (1) Bore is clean and dry.
- (2) Recoil mechanism is correctly filled.
- (3) Sight is clean, adjusted, and lock nuts tight.
- (4) All parts are functioning properly.
- (5) Spare parts set is complete.
- (6) All moving parts are oiled.
- (7) Retraction test is made (see par. 93e(2)).

b. *During firing*.—(1) In case of a misfire, recock, relay, and make three attempts to fire. If failure continues, wait 2 minutes before opening breech.

(2) Release trigger crank lever promptly.

c. *After firing*.—(1) Clean piece thoroughly within 1 hour after firing.

(2) Examine gun and cradle for worn, loose, or broken parts.

97. Practices to be avoided.—Certain practices which must be avoided in order to maintain efficient operation are—

a. No attempt should be made to repair or disassemble recoil mechanism except by ordnance personnel. Using arm may fill or drain it as necessity requires.

b. Avoid working trigger mechanism when there is no cartridge in the chamber, and do not attempt to force trigger crank lever

when breech is not completely closed as the sear is locked by the safety bolt on underside of breech ring.

c. Breechblock should not be moved when striker is not cocked.

d. Walls of recoil cylinder and of striker housing attached to cradle are relatively thin. Therefore dropping the cradle may dent them and cause internal interferences.

98. Lubrication instructions.—*a.* Proper lubrication of bearing surfaces is necessary if the mechanism is to function smoothly and give long service. The 37-mm gun matériel has very few oil holes or special lubricating fittings, yet it requires frequent oiling of certain bearings.

b. Table II gives locations where lubrication will be necessary, kind of lubricant, amount required, and frequency and method of application required for 37-mm gun matériel in active service.

TABLE II.—*Lubricating chart, 37-mm gun matériel, M1916*

Part	Method	Kind	Remarks
Bore.....	Slush.....	Oil, engine SAE 10 (below 32° F.) SAE 30 (above 32° F.)	After firing or weekly. First clean bore. See paragraph 95a (1).
Breechblock.....	Spread oil on threads.....	do.....	Daily. Unscrew breechblock.
Firing pin.....	Drops at contact surfaces.....	do.....	Daily. While breechblock is dismounted.
Extractor and extractor pin.....	do.....	do.....	Do.
Safety bolt.....	Drops at ends of bracket.....	do.....	Do.
Striker rod.....	do.....	do.....	Do.
Sear.....	Drops at bearing surface.....	do.....	Do.
Piston crosshead key.....	Drops at contact surfaces.....	do.....	At assembly.
Striker spring.....	Slush.....	do.....	Do.
Gun slides.....	Cover bearing surfaces.....	do.....	Dismount gun.
Trigger crank.....	One drop at each end of bearing.....	do.....	Once per week.

99. Description and operation of mount.—The subcaliber mount is composed of the cradle mounting bracket to which is affixed the cradle trunnion bracket. The trunnion bearings of the cradle mounting bracket are provided with cap screws and jam nuts which retain the tank cradle in position and provide a means of adjustment for deflection. The band at the front end of the cradle mounting bracket is equipped with three screws and jam nuts, their purpose being that of retaining and providing a means of adjusting the 37-mm subcaliber gun when bore sighting on a target. The cradle mounting bracket is retained in position by two cradle mounting bracket bolts.

100. Assembly and disassembly.—*a. Assembly.*—(1) Aline the holes on the bottom of the cradle mounting bracket with those on hoops B and C of the 155-mm gun and secure the cradle mounting bracket with the cradle mounting bracket bolts.

(2) Remove the cradle trunnion bracket from the cradle mounting bracket by removing the screw and two dowels. Lift the 37-mm gun with recoil mechanism to the top of the 155-mm gun and insert the front end of the recoil cylinder through the band on the front end of the cradle mounting bracket, meanwhile placing the trunnion of the recoil mechanism in the trunnion bearing of the cradle mounting bracket. Assemble the cradle trunnion bracket to the cradle mounting bracket and secure. Tighten the cap screws in the trunnion bearings and those in the band at the front end of the cradle mounting bracket just sufficiently to retain the 37-mm gun in position.

b. Disassembly.—Disassembling is accomplished by reversing the procedure required for assembling.

101. Bore sighting.—*a.* As the subcaliber gun is to be laid with the regular sighting and maneuvering mechanism of the 155-mm gun, the bores of the pieces must be parallel.

b. Verification of the 155-mm gun sights having been accomplished as described in section IX, it only remains to aline the bore of the 37-mm gun with that of the 155-mm gun. Procedure is as follows:

(1) Make a testing target by wrapping two pieces of black tape of equal width around the aiming post with the lower edges exactly 14.60 inches apart. By use of the aiming post as a testing target, it will not be necessary to level the 155-mm gun, as the aiming post may be canted to conform with the angle of the gun so that the vertical line of the bore of the gun will coincide with the side of the aiming post. The testing target should be placed about 50 yards from the gun.

(2) Use the bore sights to line up the bore of the 155-mm gun with the lower edge of the lower tape on the aiming post.

(3) Use the bore sights for the 37-mm gun and sight it on the lower edge of the upper tape on the aiming post.

(4) All adjustments of the 37-mm gun on the testing target are made by the adjusting screws in the band that encircles the recoil cylinder and by those screws in the trunnion bearings. When tightening the screws, care must be taken not to place strain upon the recoil cylinder of the 37-mm gun recoil mechanism, as it will become distorted and will not function properly, especially in not returning to full battery position.

(5) When proper adjustments have been made, set the jam nuts up tight, not one at a time, but all intermittently.

102. Care and preservation of mount.—Repairs to the 37-mm subcaliber mount will be minor in nature, and will involve only the removal of burs when necessary and the replacement of defective parts. When the subcaliber mount is dismantled, all screws, nuts, and lock washers should be assembled to the mount to prevent their being lost.

103. Operation.—The normal position for operating the subcaliber equipment is from the right side. The only need for caution is on the first round when the gunner is compelled to reach across the gun to cock the firing mechanism. Subsequent firing automatically cocks it. Further caution is required when firing at extreme positions of elevation and traverse, as the gunner must stand on the trunnion bearing cap and cradle.

104. Organization spare parts and accessories.—*a. Organization spare parts.*—A separate set of spare parts is supplied to the using arm for each subcaliber gun. After the initial issue, the set will be kept complete by requisitioning new parts to replace those used. Allowances are prescribed in the SNL's for the major equipment.

b. Accessories.—The accessories are tools and equipment issued to the using arm for cleaning and preserving the subcaliber gun and mount, and for keeping a complete record of their use.

SECTION XV

MATÉRIEL AFFECTED BY GAS

	Paragraph
Protective measures.....	105
Cleaning.....	106
Decontamination.....	107

105. Protective measures.—*a.* When matériel is in constant danger of gas attack, unpainted metal parts will be lightly coated with oil. Instruments are included among the items to be thus protected 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. Matériel 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.

106. Cleaning.—*a.* All unpainted metal parts of matériel that have been exposed to any gas except mustard and lewisite must be cleaned as soon as possible with dry-cleaning solvent or denatured alcohol and wiped dry. All parts should then be coated with engine oil or sperm oil.

b. Ammunition which has been exposed to gas must be thoroughly cleaned before it can be fired. Powder bags which have been exposed should be fired immediately or destroyed by ordnance personnel. Powder charges in sealed containers will be unaffected and it will be necessary to decontaminate the containers only. After cleaning, wipe all ammunition dry with clean rags. *Do not use dry powdered decontaminating agent (chloride of lime) (used for decontaminating certain types of matériel on or near ammunition supplies), as flaming occurs through the use of chloride of lime on liquid mustard.*

107. Decontamination.—For the removal of liquid chemicals (mustard, lewisite, etc.) from matériel, 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 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 matériel 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 matériel is coated with grease or heavy oil, this grease or oil should be removed before decontamination is begun. Dry-cleaning solvent or other available solvents for oil should be used with rags attached to ends of sticks. Following this, decontaminate the matériel with bleaching solution made by mixing one part decontaminating agent (chloride of lime) with one part water. This solution should be swabbed over all surfaces. Wash off with water, dry, and oil all surfaces.

(3) All unpainted metal parts and instruments exposed to mustard or lewisite must be decontaminated with noncorrosive decontaminating agent mixed 1 part solid to 15 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 tissue lens paper, using a small amount of ethyl alcohol. Coat all metal surfaces lightly with engine oil or sperm oil.

(4) In the event decontaminating agent (chloride of lime) is not available, matériel may be temporarily cleaned 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 matériel can be properly decontaminated. All mustard washed from matériel in this manner lies unchanged on the ground, necessitating that the contaminated area be plainly marked with warning signs before abandonment.

(5) The cleaning or decontaminating of matériel contaminated with lewisite will wash arsenic compounds into the soil, poisoning many water supplies in the locality for either men or animals.

(6) 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 matériel.

(7) Detailed information on decontamination is contained in FM 21-40, TM 9-850, and Training Circulars Nos. 38 and 50, War Department, 1941.

APPENDIX

LIST OF REFERENCES

1. Standard Nomenclature Lists.

a. Ammunition.

Separate loading projectiles----- SNL P-1

Propelling charges----- SNL P-3

Fuzes and primers----- SNL P-6

Ammunition instruction material----- SNL P-7

b. Material, cleaning and preserving.----- SNL K-1*c. Firing tables.*----- SNL F-69*d. Fire-control equipment.*

Sighting and fire-control equipment----- SNL F-1

e. Gun matériel.

Major items of heavy field artillery----- SNL D-1

Matériel, 155-mm gun M1----- SNL D-24

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

2. Firing tables.

a. Gun, 155-mm, M1 and M1A1:

Shell, HE M101 with fuze PD M51-----

Shell, chemical, M104 with fuze PD M51--

FT 155-S-1.
(Use provisional
FT 155-S-1
until other is
available.)

b. Gun, 37-mm, M1916 on subcaliber mount:

Shell, fixed, practice, Mk. II, with fuze,
practice, M38-----

FT 37-0-1
(abridged)

Current firing tables are as tabulated here. An up-to-date list of firing tables is maintained in--- SNL F-69

3. Explanatory publications.

a. Ammunition.

Ammunition, general----- TM 9-1900

Range regulations for firing ammunition
in time of peace----- AR 750-10

155-MM GUN MATÉRIEL M1

b. Gun and carriage.

Service of the piece, 155-mm gun (Coast
Artillery)----- FM 4-25

Service of the piece, 155-mm gun (Field
Artillery)----- FM 6-90

c. Cleaning and preserving materials----- TM 9-850

d. Lubrication.

Lubrication instructions for the 155-mm
gun and carriage----- OFSB 6-D-24

Gun, 155-mm, M1 and M1A1----- Lubrication guide

e. Miscellaneous.

Artillery gun book----- W. D., O. O. Form
No. 5825

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JANUARY 1, 1900

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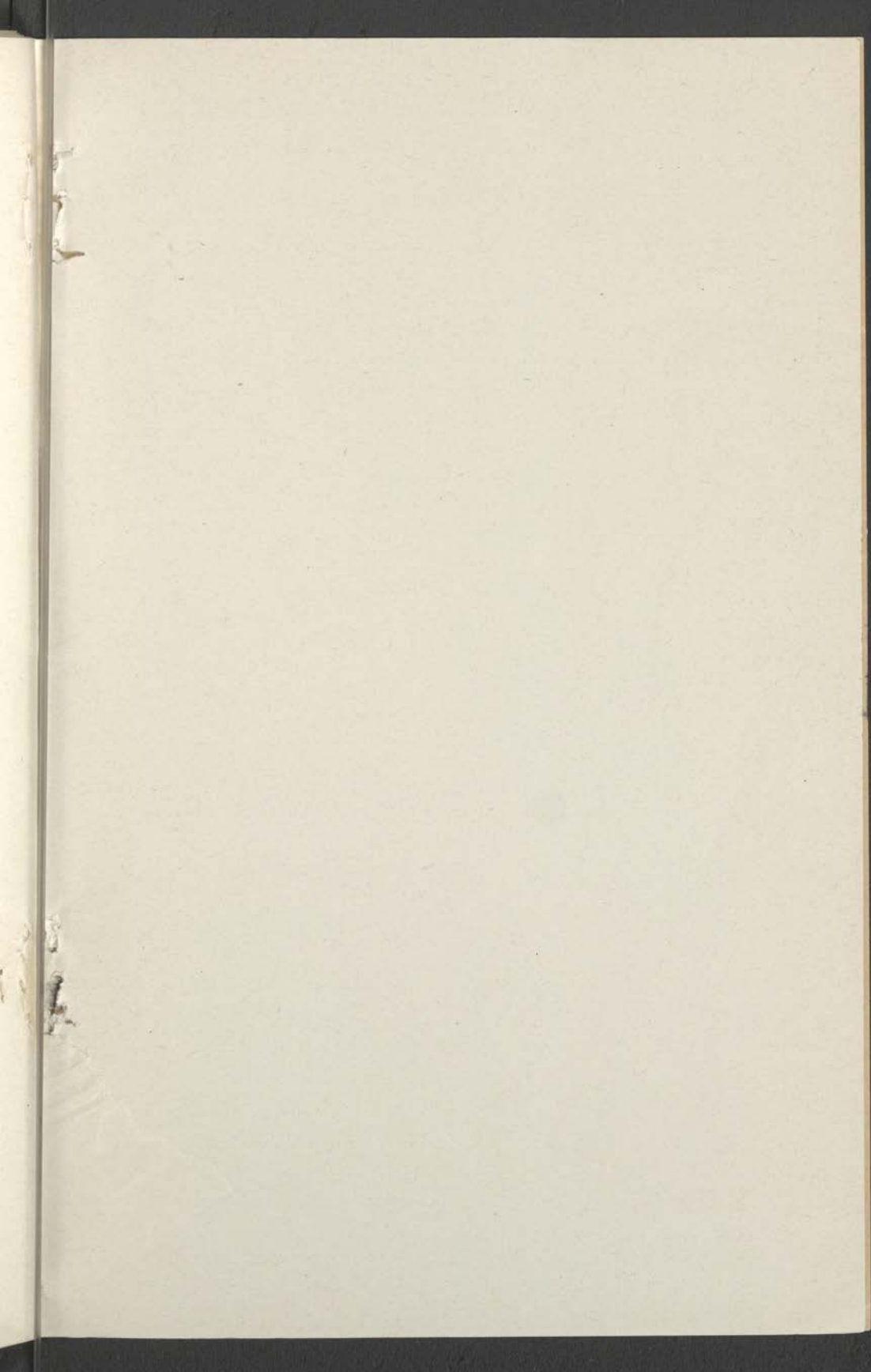
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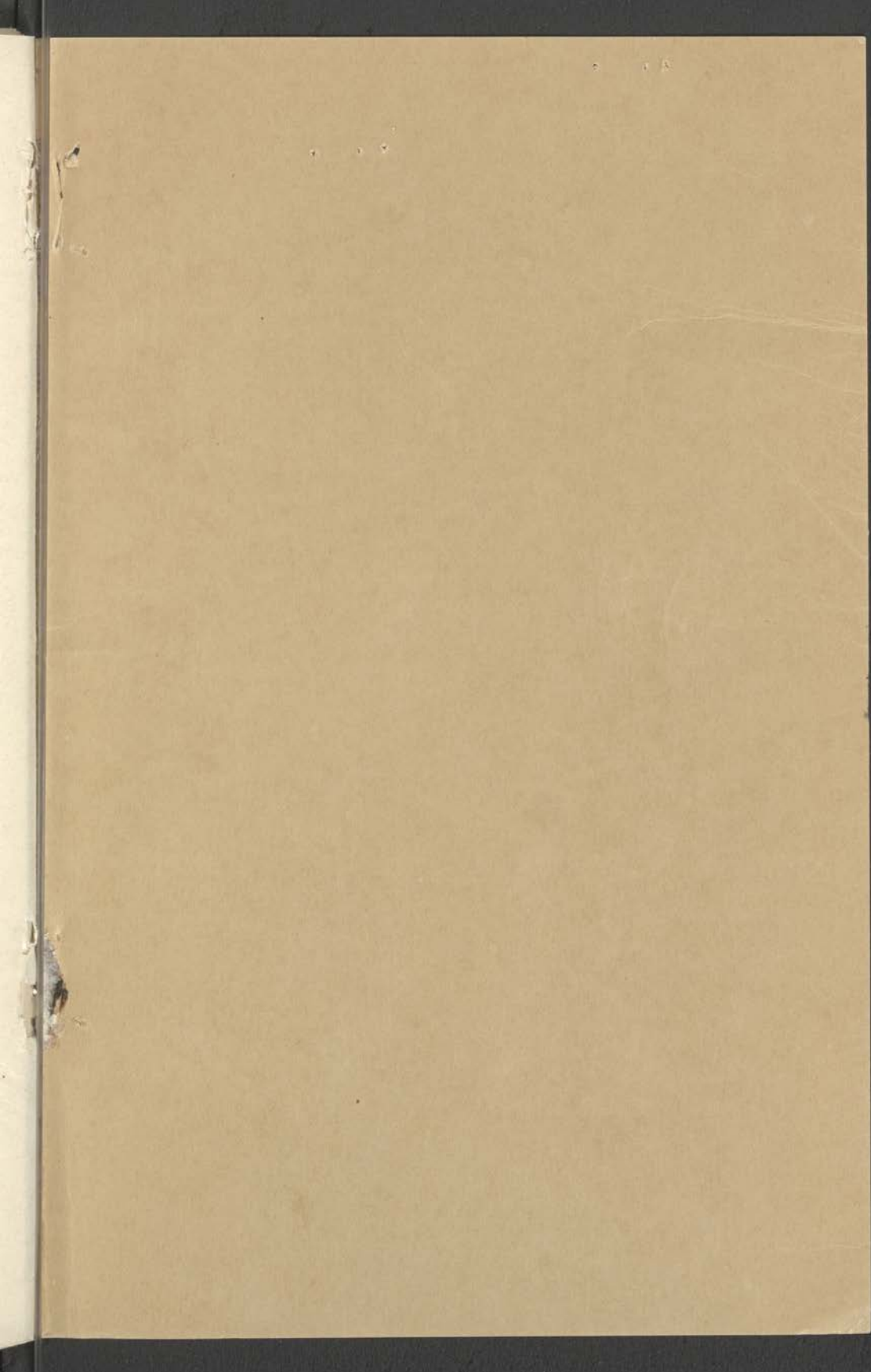
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