FM 4–126

WAR DEPARTMENT

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF THE PIECE
90-MM ANTIAIRCRAFT GUN ON M1A1 MOUNT

25 OCTOBER 1943

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FIELD MANUAL

FM 4–126
C 4

SERVICE OF THE PIECE
90-MM ANTIAIRCRAFT GUN ON M1A1 MOUNT

CHANGES No. 4

WAR DEPARTMENT
WASHINGTON 25, D. C., 28 June 1946

FM 4–126, 25 October 1943, is changed as follows:

22.1. TARGET, VT FUZE (Added). When ordered to engage using VT ammunition, the gun drill described in paragraph 22 will be as follows:

GC commands, **TARGET, VT FUZE.**

G, 2, 5, 7, 8, 9, 10, 11, 12 perform duties as prescribed in Antiaircraft Artillery Drill.

1 takes round from **6**, who has received it from **8**, and relays it to **4** (1 hands round to **4** with left hand under rear of round and right hand on fuze. (See fig. 17).)

3 stands by ready to function in the event mechanical time fuze ammunition is subsequently ordered.

4 holds round at loading position at the breech where **G** can ram it home; as soon as round has been loaded, steps back with right foot and stands ready to receive next round from **1**; continues loading until **CEASE FIRING** is given or the prescribed number of rounds has been fired.

6 relays ammunition to **1**.

AC supervises ammunition squad and the replenishing of ammunition at gun position.

Caution. VT fuzes must not be inserted in the fuze setter.

23. FIRE (As changed by C2) (Superseded).

GC at command **FIRE**, repeats command for first round only, succeeding rounds being fired without further command; if a limited number of rounds has been prescribed, he cautions "(So many) rounds only."

4 removes round from fuze setter and holds it at loading position at the breech where **G** can ram it home; as soon as

round has been loaded, pivots on right foot, steps back with left, and stands ready to remove next round from fuze setter; continues loading until **CEASE FIRING** is given or the prescribed number of rounds has been fired.

G when 4 places round in breech, rams round "home" with front of his left clenched fist; when his fist is knocked clear by the rising breechblock, pivots back on his right foot and fires gun; continues ramming and firing until **CEASE FIRING** is given, or the prescribed number of rounds has been fired; kicks empty cartridge cases clear of platform; in case of misfire, calls "Misfire" to **GC** and keeps all cannoneers clear while the prescribed safety precautions are taken. (See par. 40.)

5 continues to match pointers on fuze setter.

1 continues to load fuze setter; trips release lever and keeps pressure on base of round as each round is set.

3 turns fuze setter, setting crank each time release lever is tripped by **1**; calls "Set" each time setting crank hits stop.

2 continues to watch elevation lagmeter pointer, or, if operating gun manually, continues to match pointers.

7 continues to watch azimuth lagmeter pointer or, if operating gun manually, continues to match pointers.

6, 8 continue to relay ammunition to **1**.

9 clears away empty shell cases from gun emplacement, being careful to avoid getting behind gun when it is in action.

10, 11, 12 maintain ammunition supply under supervision of **AC**.

AC supervises ammunition squad.

26. TARGET, DIRECT FIRE (Superseded).

GC commands: **TARGET, DIRECT FIRE**; designates target and sights along gun tube to assist azimuth and elevation setters to point the gun.

2, with handwheels engaged and transfer valve plunger in the **OUT** position, sights through elevation telescope and operates gun manually to get target on proper range line; calls "**ON**" when he is on target.

7, with handwheels engaged and transfer valve plunger in the **OUT** position, sights through azimuth telescope and operates gun manually to get target on proper deflection line; calls "On" when he is on target.

G opens breech by bearing down on breech operating handle; returns breech operating handle to latched position; after 4

places round in breech, rams round home with front of left clenched fist; watches **GC** for signal to fire.

4 receives round from **1** and holds it in the loading position at the breech where **G** can ram it "home," as soon as round has been loaded, steps back to receive the next round from **1.**

1 relays ammunition to **4.**

6 relays ammunition to **1.**

8 relays ammunition to **6.**

3 takes post about 5 yards away from gun, at right of elevation setter, to observe and spot bursts.

5 takes post about 5 yards away from gun, at left of azimuth setter, to observe and spot bursts.

9 removes protective covers from ammunition stacks and makes ammunition available to **8.**

54. 90-MM GUN M1 ON MOUNT M1A1 (as added by C1). Items number 21, 30, 31, 32, 33, 52, and 53 are rescinded.

56. DAILY MAINTENANCE CHECK LIST (as added by C1). Item number 21 is rescinded.

57. WEEKLY MAINTENANCE CHECK LIST (as added by C1). Items number 30, 31, 32, and 33 are rescinded.

58. MONTHLY MAINTENANCE CHECK LIST (as added by C1).

Items number 52 and 53 are rescinded.

[AG 300.7 (19 Jun 46)].

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:
EDWARD F. WITSELL
Major General
The Adjutant General

DWIGHT D. EISENHOWER
Chief of Staff

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For explanation of distribution formula, see FM 21–6.

U. S. GOVERNMENT PRINTING OFFICE: 1946

RESTRICTED

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF THE PIECE, 90-MM ANTIAIRCRAFT GUN ON M1A1 MOUNT

CHANGES No. 3

WAR DEPARTMENT
WASHINGTON 25, D. C., 19 March 1945

FM 4–126, 25 October 1943, is changed as follows:

CHAPTER 3

DRILL PROCEDURES

* * * * *

SECTION VII (Added)

INDIRECT GROUND FIRING DRILL

29.1 ORIENTATION.—In preparing the battery for indirect and firing the procedures below are followed:

a. Guns are emplaced, leveled, and oriented at 200 mils elevation. (Special attention must be given to prevent jump and shifting of gun due to low-angle fire.)

b. Azimuth sights M24 are installed and collimated at the most distant range possible.

c. The battery executive officer sets up the aiming circle over battery executive's stake (stake about 30 yards in front of gun line). When aiming circle is oriented, the executive points it at the gun azimuth sight and the azimuth setter sights on aiming circle.

d. Executive calls off back azimuth of aiming circle and azimuth setter sets reading on mechanical dial by means of toothed wheel in azimuth indicator regulator. This setting is checked by having the gun commander boresight on aiming circle while the executive points aiming circle at gun tube. The reading at the gun and the back azimuth of the aiming circle should agree.

e. After the gun is oriented it is traversed to some *even azimuth* in the center of the field of fire. Two poles are placed in line, one about 60 yards and the other about 70 yards in front of the azimuth scope. If the poles are properly placed the azi-

muth setter will see only one pole when looking through the scope. The *even azimuth* is marked on the gun and is used as a rapid orientation check during firing. A third pole is placed at a distance of approximately 60 yards in front of and in line with the axis of the gun tube.

NOTE.—The purpose of the two poles for the azimuth sight is to check any lateral shift of the gun. The purpose of the third pole for the gun tube is to check that the sight has stayed in collimation.

29.2 FIRE COMMANDS.—*a.* Fire commands to each gun in an indirect ground firing role come from the battery executive. His normal position during firing is at a point where he can be heard (voice control) by all guns. He is assisted by a phone operator, the phone wire being long enough to facilitate any necessary movement from gun to gun. He is also assisted by a recorder who records each command as given by him. Fire commands originate at the AAA FDC and are relayed by phone to the battery executive. The battery executive's phone is a direct line from the FDC, *NOT TO THE GUNS.*

b. Upon moving into a tactical position, the executive reports the following to FDC:

(1) Battery oriented and ready to fire.

(2) Minimum elevation.

(3) Base piece (Gun No. ——) and distance from DP in yards.

(4) Width of battery front in yards.

(5) Ammunition (type and amount) on hand.

c. The sequence of commands given by the battery executive to the guns is as follows:

(1) Type of adjustment, such as: **BATTERY ADJUST** or **GUN No. —— ADJUST.**

(2) Projectile, such as: **SHELL HE**

(3) Fuze, such as: **FUZE M43A3** or **FUZE PD M48.**

(4) Fuze setting, such as: **TIME 11.1; DELAY; QUICK.**

(5) Azimuth, such as: **AZIMUTH (SO MUCH).**

(6) Pieces to fire, such as: **BATTERY** or **GUN No. ——.**

(7) Method of fire, such as **RIGHT (LEFT); (SO MANY) ROUNDS;** or **BY PIECE AT MY COMMAND.**

(8) **QUADRANT (SO MUCH)** or **ELEVATION (SO MUCH).** If the command **QUADRANT (SO MUCH)** is given, the QE is set on the gun with the gunner's quadrant. If, however, the command **ELEVATION (SO MUCH)** is given, the

QE setting is set with the elevation indicator regulator mechanical dials.

NOTE.—Changes in azimuth, fuze, number of rounds to be fired are announced as needed. If they are not repeated there is no change from the last command. The word "Azimuth" should be repeated with each new azimuth. The word "Quadrant" or "Elevation," once given, need not be repeated during any one problem. Gunner's quadrant settings are normally used during registrations.

d. **ON No. ——, CLOSE (or OPEN) ——.** The battery executive receives this command from the AAA FDC and aided by his recorder—computes the azimuth for each gun. He then calls each azimuth individually to each gun. The object is to converge or widen the sheaf. For example:

(1) The command received by the executive from the FDC being—**AZIMUTH 4380, ON No. 1, CLOSE 2,** the commands to the guns are:

AZIMUTHNo. 1, 4380
AZIMUTH No. 2, 4382 (2 mils)
AZIMUTH No. 3, 4384 (2 mils for No. 3 and 2 mils for No. 2)
AZIMUTH No. 4, 4386 (2 mils for No. 2, 2 mils for No. 3, and 2 mils for No. 4)

(2) If a center gun was used to close, the command received by the executive from the FDC might be—**AZIMUTH 4380, ON No. 2, CLOSE 2,** the commands to the guns are:

AZIMUTH No. 1, 4378
AZIMUTH No. 2, 4380
AZIMUTH No. 3, 4382
AZIMUTH No. 4, 4384

29.3 DRILL

GC at command **BATTERY ADJUST** or **GUN NUMBER —— ADJUST,** repeats the command—sees that all personnel take post on the run if not already at posts—places carrying strap of gunner's quadrant case over his shoulder. Takes position on gun platform to left rear of 2. Other positions are the same for AA drill.

G opens breech by bearing down on breech operating handle until breech block is locked open—returns breech operating handle to latched position and then sees that breech operating cam lever is set for "Automatic."

AC at command for type of projectile and fuze, sees that ammunition squad secures the required amount and proper type ammunition.

9, **10**, 11, 12 relay ammunition to 1.

1, **3**, **5** proceed to set fuze as in AA fire. If PD fuze is used is is set with proper tool.

4 and G load as in AA fire.

7 at command **AZIMUTH** ——, turns azimuth hand crank until mechanical dials read the azimuth announced by executive officer—reports, *"Azimuth Set"*, and maintains this azimuth reading on the dial until a new azimuth is announced.

GC at command **QUADRANT** ——, sets the announced elevation on the gunner's quadrant. The gun being loaded, GC places the quadrant on the quadrant seat, with the words "line of fire" at the bottom and the arrow pointing toward the muzzle. GC must be sure to use the arrow which is on on the same side of the quadrant as the scale which he is using. GC stands squarely opposite the side of the quadrant holding it firmly on the quadrant seat, parallel to the axis of the bore. It is important that GC take the same position and hold the quadrant in the same manner for each setting, so that he will view the quadrant bubble from the same angle each time.

2 elevates gun as directed by GC until quadrant bubble is centered—reports, *"Elevation set."* The last movement of the gun must be in the direction of elevating. GC warns 2 when the bubble is approaching the center, in order that the final centering may be performed accurately.

---

2 at command **ELEVATION** ——, turns elevating hand crank until the elevation indicator regulator mechanical dials read the elevation announced by the executive officer—reports, *"Elevation set."*

G, when the gun is loaded, 7 has reported *"Azimuth set"*, and 2 has reported *"Elevation set"*, reports, *"Ready"* to GC.

GC, as soon as G reports, *"Ready"*, indicates to the executive that the piece is ready to fire by raising his right arm

vertically. When the executive cannot see the arm signal, GC reports verbally to the executive, *"No. ——, ready".*

GC, when executive gives the command to fire, drops his right arm smartly to his side. When G cannot see his arm signals, GC commands: **No. ——, FIRE.**

G fires at the command of GC.

GC when firing is completed, reports to executive officer, *"No. —— Gun fired —— rounds".*

GC at command: **CEASE FIRING, END OF MISSION** (or **REGISTRATION**), commands: **CHECK ORIENTATION**—When orientation is correct, commands: **REST.**

[AG 300.7 (15 Mar 45)]

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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Refer to FM 21–6 for explanation of distribution formula.

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FM 4–126
C 2

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF THE PIECE 90–MM ANTIAIRCRAFT GUN ON M1A1 MOUNT

CHANGES No. 2

WAR DEPARTMENT,
WASHINGTON 25, D. C., 14 September 1944.

FM 4–126, 25 October 1943, is changed as follows:

■ 6. INSTRUCTIONS.

* * * * *

(Page 4)

NOTE (Added).—*To provide for battle emergencies all men of the gun section must be trained in the duties of the other members so that a rapid shift of personnel is possible. In addition, battery personnel not assigned specific duties during firing, such as truck drivers, clerks, cooks, etc., must be trained in the fundamentals of the drill so that, if necessary, they can be used as replacements.*

■ 13. EMPLACEMENT OF GUN WITHOUT PRIME MOVER.

* * * * *

(Page 10)

5 removes equilibrator piston stop from equilibrator and inserts in holder on top of equilibrator cylinder.

NOTE (Added).—*Most guns have a protective wooden "doughnut" in the equilibrator cylinder, and the equilibrator piston stop is not supplied or used.*

1, 3, 5, 7 extend and pin left outrigger

* * * * *

(Page 12)

5, 6, 7, 8 at rear outrigger assist in crushing mount by pulling up on rear outrigger to center gun over wheels.

* * * * *

NOTE.—*IF COUNTERPOISE CYLINDER RODS ARE NOT RETRACTED FAR ENOUGH TO PERMIT PUTTING THE GEAR BOXES IN PLACE, THE MOUNT MUST BE CRUSHED FURTHER BY SEVERAL MEN STANDING ON EACH SIDE OUTRIGGER TO INCREASE THE DOWNWARD FORCE.*

AGO 318D 598804°—44

1, 2 loosen locking * * * to loosening them.

1, 6 with gun tube horizontal, place wrench on gun jack screw and jack gun out of battery approximately 2 inches; retract gun jack screw and note whether the breech ring remains in contact with the gun jack screw. ***Caution:*** **RETURN JACK SCREW TO ITS REARMOST POSITION AFTER TEST.** If it does not, the oil reserve and gas pressure must be checked before proceeding with the emplacement.

2 elevates gun to maximum.

3, 4, 7, 8 crank bogie down until the pedestal rests on the ground.

5, 6 place fuze setter * * * fuze setter junction box.

---

* * * * *

(Page 14)

G moves trail lock * * * trail is lowered.

NOTE.—It may be necessary to dig out under entire length of trail to permit it to be locked in lower position. **The trail must not contact the ground until it is locked in its lower position.**

---

* * * * *

(Page 15)

G tightens auxiliary leveling screw by screwing it down as soon as the mount has been leveled.

NOTE (Added).—*The gun tube should be horizontal over the trail to facilitate this tightening operation.*

GC verifies leveling of mount.

* * * * *

■ 14. EMPLACEMENT OF GUN USING PRIME MOVER.

* * * * *

(Page 18)

G, 1 unpin traveling lock brace, lower traveling lock, and pin it to the trail.

1, 6 with gun tube horizontal, place wrench on gun jack screw and jack gun out of battery approximately 2 inches; retract gun jack screw and note whether the breech ring remains in contact with the gun jack screw. If it does not,

the oil reserve and gas pressure must be checked before proceeding with the emplacement.

2 elevates gun to maximum.

* * * * *

(Page 19)

7, 8 crank bogie down until the pedestal rests on the ground.

3, 4 assist **7, 8** crank bogie down.

* * * * *

G moves trail lock * * * the swing bolt.

NOTE.—*It may be necessary to dig out under entire length of trail to permit it to be locked in the lower position.* ***The trail must not contact the ground until it is locked in its lower position.***

* * * * *

(Page 20)

G tightens auxiliary leveling screw by screwing it down as soon as the gun has been leveled.

NOTE (Added).—*The gun tube should be horizontal over the trail to facilitate this tightening operation.*

GC verifies level of gun.

* * * * *

■ 15. MARCH ORDER WITHOUT PRIME MOVER.

* * * * *

(Page 21)

5, 6 remove fuze setter from its firing position and put it in traveling bracket. **Place fuze setter seat in traveling position.**

* * * * *

(Page 22)

5 removes the equilibrator * * * piston stop pin.

2, 4, 6, 8 put right platform * * * it in position.

* * * * *

■ 16. MARCH ORDER USING PRIME MOVER.

* * * * *

(Page 25)

5, 6 remove fuze setter from its firing position, and put it in traveling bracket. **Place fuze setter seat in traveling position.**

* * * * *

(Page 26)

1, 2 with the trail * * * bogie securing bolts.

G, 1, 2, 3, and 4 at trail and 5, 6, 7, and 8 at rear outrigger tip the mount gently forward on the trail.

5, 6, 7, and 8 break rear outrigger at its outer joint.

G, 1 raise traveling lock brace.

* * * * *

(Page 27)

3, 4, 5, 6, 7, 8 extend and pin the rear outrigger.

GC directs prime mover to back up to couple mount.

* * * * *

G plugs electric brake cable into prime mover and connects breakaway chain.

1, 2, 4, 7, 8 place rear outrigger in traveling position.

* * * * *

G pulls out on latch * * * as it will go.

5, 6 put canvas covers on counterpoise cylinders.

---

* * * * *

■ 17. EXAMINE GUN.

* * * * *

(Page 29)

3 assists 5 in examining, * * * in fuze setter.

7 checks oil level * * * oil if necessary.

* * * * *

(Page 30)

7 manually traverses gun * * * no excessive backlash.

1, 6 with gun at zero elevation, place wrench on gun jack screw and jack gun out of battery approximately 2 inches; retract gun jack screw about ¼ inch and note whether the breech ring remains in contact with the gun jack screw. ***Caution:*** **RETURN JACK SCREW TO ITS REARMOST POSITION AFTER TEST.** If gun does not maintain contact with gun jack screw, notify GC who then commands: **CHECK RECOIL SYSTEM.**

1, 6 with gun still at zero elevation, remove oil filling plug—insert liquid release tool and bleed off oil reserve—connect screw filler, and reestablish oil reserve—remove screw filler and connections with replace oil filling plug.

NOTE: *IF NO OIL RESERVE IS PRESENT IT IS NECESSARY TO FILL THE RECOIL CYLINDER BEFORE REESTABLISHING AN OIL RESERVE. NEVER ADD TO AN EXISTING RESERVE.*

1, 6 charge gas pressure into recuperator cylinder to 830 pounds per square inch. If the gun still fails to return as the screw is retracted—**CALL QUALIFIED PERSONNEL TO REMEDY THE TROUBLE.**

2, if gun returns as gun jack screw is retracted with gun at zero elevation, elevates gun to maximum elevation. Cleans and oils elevating rack. *Caution:* **UNDER SANDY OR DUSTY CONDITIONS, ELEVATION RACK SHOULD BE CLEANED, OILED AND WIPED DRY.**

1, 6, retract gun jack screw completely to original position. If gun fails to return to battery, direct 2 to depress gun slowly. If gun does not return to battery by the time it has been depressed to 710 mils, notify GC who then commands: **CHECK RECOIL SYSTEM.**

This check is performed as outlined in the preceding step. If this check was already performed in preceding step, or if after checking, the gun still fails to return to battery by the time it is depressed to 710 mils, **CALL QUALIFIED PERSONNEL TO REMEDY THE TROUBLE.**

NOTE: ***In addition to the tests as may be required in EXAMINE GUN, the recoil system is checked at such intervals as are determined by the battery commander.***

2 depresses gun at direction of 1 or 6 to determine if gas pressure in recuperator is sufficient. Then elevates and depresses (gun should elevate and depress with equal effort); with 7 examines gun junction box.

7 with 2, examines gun junction box.

* * * * *

19. CHECK ORIENTATION.

* * * * *

(Page 31)

8 places vertical and horizontal cross hairs across muzzle of gun.

---

* * * * *

G sights through hole in breechblock bushing and lines up vertical and horizontal cross hairs on muzzle with * * * on orienting point.

2 elevates or depresses gun as directed by G.
7 traverses gun right * * * adjustment can be made.
(Page 32)

Caution: *Never attempt to zero lagmeter mechanically while data transmission system is energized.*

GC commands: CHECK ALIGNMENT.
7 checks alignment of azimuth direct-fire sight.
2 checks alignment of elevation direct-fire sight.
G checks sighting of gun and replaces firing mechanism in breechblock.

GC commands: CHECK ELEVATION ORIENTATION.

* * * * *

2 elevates gun until G calls, "Hold"; * * * (a small screw cover must be removed before this adjustment can be made).

* * * * *

■ 20. CHECK SYNCHRONIZATION.

(Page 34)
GC commands: CHECK SYNCHRONIZATION.
2 sees that transfer valve plunger is OUT; sets selector switch on elevation indicator on AUTOMATIC.
7 sees that motor switch is OFF at gun junction box and that transfer valve plunger is OUT; sets selector switch on azimuth indicator on AUTOMATIC.
GC verifies that selector switches are on AUTOMATIC, and transfer valves are OUT; notifies range officer that gun is ready for power, after power is applied and director prepared, secures quadrant elevation, firing azimuth, and fuze range values from range officer and gives the information to 2, 7, and 5, respectively.

NOTE (Added).—*Power must be applied with regard to the particular equipment combination being used. After the range officer has been notified that all guns are ready for power, he will check the associated radar and director to see that they are ready to receive power. When all equipment is ready, the range officer directs the power plant operator to start generator and idle until warm, set generator voltage to the minimum possible by turning rheostat on power plant control panel clockwise to stop, then close power plant switch to energize system, run*

generator speed up to 1,200 rpm, or 60 cycles depending on generator used, and increase voltage by means of the rheostat until the voltage at director reads 115 volts. The voltage at the power plant should not be raised above 125.

2. raises sliding cover * * * gun junction box.

* * * * *

(Page 35)

GC checks oil level as switch on gun junction box is turned on; if oil level rises or disappears from the glass, orders motor turned off immediately and notifies qualified personnel.

* * * * *

2 if lagmeter pointer is not at zero position, directs G to turn adjusting screw on amplifier marked EL until lagmeter is zeroed (this balances the amplifier).

* * * * *

7 if lagmeter pointer is not at zero position, directs G to turn adjusting screw on amplifier marked AZ until lagmeter is zeroed. (This balances the amplifier.)

* * * * *

■ 23. FIRE.

* * * * *

(Page 39)

G *without power rammer* * * * safety precautions are taken (see par. 40).

NOTE (Added).—*If hand ramming is used instead of the spring rammer, the spring rammer should not be removed but may be made inoperative by either of the two following methods:*

(1) Removal of rammer hook. This operation consists merely of removing the upper rammer hook pin nut and lifting the hook from the pivot pin. (See TM 9–1370A.)

(2) Disengaging rammer hook from the plunger rack. By use of a pinch bar, force the rammer hook to the left away from the plunger rack, thereby compressing the plunger spring and disengaging the rammer hook from the rack. Spring tension acting against the plunger rack forces the rack forward about ¼ inch, preventing the rammer hook from reengaging the rack. This operation will completely disengage the rammer hook from the plunger rack, thereby allowing the gun to recoil and counter-recoil without operating the spring rammer.

To save time in reengaging rammer hook with the plunger rack and to prevent any danger of losing or misplacing removed parts, the second method is more practical. After the rammer

hook has been disengaged from the plunger rack by this method, it can be reengaged by merely forcing the plunger rack rearward ¼ inch, thereby allowing the rammer hook to reengage the rack.

5 continues to match pointers on fuze setter.

* * * * *

■ 27. FIRE.

* * * * *

(Page 43)

5 spots bursts, calls "Right (so many mils)", "Left (so many mils)", or "Hit", as the case may be.

* * * * *

■ 36. TRACKING.—Manual operation of * * * of the reticle. The center of this reticle should always point ahead of a moving target **moving in azimuth,** and at a stationary target. The elevation setter * * * estimated range line.

■ 37. FIRE CONTROL.—The gun commander * * * spotters (3 and 5). Nos. 3 and 5 observe the bursts and call "Right (so many mils)" or "Left (so many mils)" for the azimuth observer and "Over" or "Short" for the range observer. For a full discussion of fire control using direct-fire sights, see **FM 44–10** (4–110) and **FM 44–21** (4–121).

■ 40. GENERAL.—Safety precautions to be observed are prescribed in AR 750–10 and **TM 44–234 (4–234).** The more important * * * under combat conditions.

[A. G. 300.7 (6 Sep 44).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

DISTRIBUTION:

As prescribed in paragraph 9a, FM 21–6 except D44 (5), AA Sch (500); T of Opns (5); Base Cs (5); Island Cs (5); Def Cs (5), Sectors (5), Sub-sectors (5); Base Sectors (5); HD (5); B44 (5); R44 (5); Bn44 (5); IC44 (15); AAATC (100); AARTC (100).

IC 44: T/O & E 44–17; 44–117.

For explanation of symbols, see FM 21–6.

U. S. GOVERNMENT PRINTING OFFICE: 1944

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ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF THE PIECE, 90-MM ANTIAIRCRAFT GUN ON M1A1 MOUNT

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON 25, D. C., 21 August 1944.

FM 4–126, 25 October 1943 is changed as follows:

CHAPTER 7 (ADDED)

PREVENTIVE MAINTENANCE, 90-MM GUN M1 ON MOUNT M1A1 AND REMOTE CONTROL SYSTEM M2

SECTION I

GENERAL

■ 52. REFERENCES.—For detailed information on maintenance and adjustment of the M1 gun on the M1A1 mount, see TM 9–370; and for Remote Control System M2, see TM 9–2642. For lubrication, see War Department Lubrication Order No. 62.

■ 53. GENERAL INSTRUCTIONS.—Maintenance as discussed herein is concerned only with first and second echelon maintenance.

a. First echelon maintenance is maintenance performed by the operating personnel with tools supplied with the equipment.

b. Second echelon maintenance is performed by qualified battery specialists or men who have completed a recognized course of instruction.

c. The maintenance lists following have been grouped into two sections. Section II lists the maintenance necessary for each part and the references for more detailed instructions. Section III has the information of section II in the form of ready check lists.

d. The numbers of the items on the check lists correspond with the numbers in section II to permit ready reference.

e. Symbols used herein are as follows: "O," operating personnel or those men who habitually work with the equipment; "M," maintenance personnel of the battery (qualified technicians); "D," daily items of maintenance; "W," weekly maintenance; and "M," monthly maintenance.

SECTION II

DESCRIPTION OF MAINTENANCE ITEMS

■ 54. 90-MM GUN M1 ON MOUNT M1A1.

	Item	Echelon	Maintenance crew	Interval	Maintenance required
1	Gun and assembly	1	O	D	Note general appearance, and check for burs. Check for tight nuts and bolts, and see that all operating parts are lubricated properly and move freely.
2	Gun mount	1	O	D	Elevate and depress by hand between upper and lower stops. Traverse 6400 m to check freedom of movement. Report undue binding or backlash to Ordnance.
3	Gun tube	1	O	D	Clean and oil bore and chamber. After firing, clean with sponging solution, oil with appropriate seasonal lubricant.
4	Exposed recoil slides	1	O	D	Keep exposed surface coated with oil. Clean and oil before firing. If atmosphere is dusty, clean slides of all oil before firing.
5	Recoil mechanism	1	O	D	Test oil reserve and gas pressure by the gun jack method, replace oil reserve and add nitrogen if necessary.
6	Recoil piston rod retainer	1	O	D	See that the piston rod retainer is screwed tightly into the breech ring.
7	Recoil valve control bar follower screw.	1	O	D	See that the recoil valve control bar follower screw and its jam nut at the rear of the recoil valve control bar are tight.

8	Counterrecoil valve	1	O	D	Check to see that valve is functioning properly.
9	Recoil throttling valve guides	1	O	D	Lubricate as required.
10	Counterrecoil buffer	1	O	D	Check oil level while gun is at zero degrees and level, add oil if necessary. Note action of buffer when gun is jacked out of battery. Notify Ordnance in case of leakage.
11	Breechblock	1	O	D	Disassemble, clean, and lubricate (also after firing). Check for burs, see that screw heads are flush or below front and rear surfaces. Check for smoothness of action.
12	Breech recess	1	O	D	Check for scoring and burs.
13	Breech operating shaft gears	1	O	D	Clean and lubricate as required.
14	Breech closing spring chain	1	O	D	Clean and oil as necessary.
15	Firing mechanism	1	O	D	Disassemble, clean and oil. Check action of sear on firing pin. Check action of firing pin and see if pin protrudes beyond breech block.
16	Spline shaft	1	O	D	Check that spline shaft is fully seated, that detent pin is home, and that shaft is flush with crank arm.
17	Breechblock crank, chain terminal crank and operating crank.	1	O	D	Check that all cranks are properly in place and operating smoothly.
18	Equilibrator	1	O	D	Check for proper tension and adjust if necessary. If maximum adjustment is reached notify Ordnance. Clean and lubricate chain. Check equilibrator for dents.

	Item	Echelon	Maintenance crew	Interval	Maintenance required
19	Elevating rack and pinion	1	O	D	Clean with solvent and lubricate lightly. If firing in a dusty or gritty atmosphere, wipe rack dry before firing.
20	Fuze setter	1	O	D	Clean rings thoroughly. Lightly oil pawls and guides. Lightly grease other surfaces. Check orientation and synchronization.
21	Power rammer	1	O	D	See that rammer arm latches in vertical position properly. Check oil in spring rammer buffers. Also before firing.
22	Auxiliary leveling screw	1	O	D	Check to see that the screw is fully extended and secure. Oil as necessary.
23	Direct fire sights	1	O	D	Clean optical parts carefully. Wipe brackets before attaching sights. Check alignment.
24	Miscellaneous	1	O	D	Lubricate following oil can points as required: Handbrake levers, pedestal carriage bolts, clevises, hinges, bogie engaging eyebolts, platform support assemblies, seat hinges and pins, leveling jack ratchet wrenches, lock assembly, lunette shaft and pin, handwheel handles, outrigger latches, trail lock linkage, gun jack, bogie buffer latch, etc.
25	Gun and assembly	1	O	W	Clean external parts. Wash with water or solvent, dry cleaning as necessary.
26	Recoil slides	1	O	W	Lubricating as required.

27	Recoil valve control cam and slide.	2	M	W	Check to see that there is no binding and observe gun during firing to see that the recoil is proper upon elevation. Notify Ordnance if necessary for adjustment.
28	Breech operating intermediate gear stud.	1	O	W	To reach oiler, pull lever to rear. Oil with correct seasonal lubricant.
29	Operating handle latch plunger.	1	O	W	Lubricate as required.
30	Rammer rack guide	1	O	W	Lubricate as required. Fittings above and below.
31	Rammer buffer rod bearing	1	O	W	Lubricate as required.
32	Rammer cylinders	1	O	W	Lubricate as required. (***Caution:*** grease sparingly).
33	Rammer arm bearings	1	O	W	Lubricate as required.
34	Direct fire sights (M24 and M26).	1	O	W	Oil cup, clamps, and pivots as necessary. Avoid an excess of oil.
35	Tires	1	O	W	Maintain 70#/sq. in. air pressure, keep free of grease and oils.
36	Handbrake	1	O	W	Adjust if necessary. (Normally no adjustment is necessary).
37	Electric brake	1	O	W	Check wiring for loose or broken connections or wires, clean sockets and plugs. Check brake current with ammeter. Clean drum and magnetic facings if necessary. Check shoes and magnet operation.
38	Lights (dials, fuze, breech, tail).	1	O	W	Clean and replace if necessary.
39	Tools and accessories	1	O	W	Check for completeness and availability, that parts are clean and serviceable.
40	Control bar hinge	1	O	M	Lubricate as required.

	Item	Echelon	Maintenance crew	Interval	Maintenance required
41	Recoil valve control cam and slide.	1	O	M	Lubricate with grease, OD.
42	Firing lever shaft bearing	1	O	M	Lubricate as required.
43	Breech operating plunger bearing and cam shaft.	1	O	M	Inner bearings reached from under breech.
44	Elevating gear case shaft bearings and indicator drive mechanism.	1	O	M	Lubricate as required.
45	Elevating shaft lower bearing	1	O	M	Do.
46	Elevating gear shaft bearing	1	O	M	Do.
47	Elevating remote drive gear case and elevating worm gear case.	1	O	M	Do.
48	Traversing gear case shaft bearings and indicator drive mechanism.	1	O	M	Do.
49	Traversing vertical shaft lower bearing.	1	O	M	Do.
50	Cradle trunnion bearing	1	O	M	Do.
51	Top carriage bushing	2	M	M	Do.
52	Rammer trip shaft bearing	1	O	M	Do.
53	Rammer trip latch	1	O	M	Do.
54	Leveling rack bearing—left jack.	1	O	M	Do.
55	Leveling mechanism, support bearing.	1	O	M	Do.

56	Leveling mechanism, right and left.	1	O	M	Do.
57	Leveling mechanism clamp bearing.	1	O	M	Do.
58	Leveling jack handle bearing	1	O	M	Do.
59	Ratchet drive rear bushing, right and left.	1	O	M	Do.
60	Leveling socket bearing	1	O	M	Do.
61	Bogie guide roller	1	O	M	Do.
62	Buffer trunnion bearing	1	O	M	Do.
63	Buffer roller	1	O	M	Do.
64	Bogie buffer cylinder	1	O	M	Lubricate sparingly.
65	Counterpoise gear box and cylinder walls.	1	O	M	Lubricate as required and after moving.
66	Counterpoise connecting rod bearing.	1	O	M	Lubricate as required.
67	Bogie frame support bearing	1	O	M	Do.
68	Outrigger	1	O	M	Raise to traveling position; inspect joints and surfaces for rust.
69	Outrigger hinge pins	1	O	M	Lubricate as required.
70	Trail hinge shaft	1	O	M	Do.
71	Trail lock lever bearing	1	O	M	Do.
72	Trail latch slide	1	O	M	Do.
73	Trail lock link pin	1	O	M	Do.
74	Traveling lock	1	O	M	Do.
75	Traversing rack, thrust and clip bearings.	2	M	M	Do.
76	Wheel bearing	2	M	6M	Lubricate once every 6 months; clean and grease oftener if wheels have been under water.

55. REMOTE CONTROL SYSTEM M2.

	Item	Echelon	Maintenance crew	Interval	Maintenance required
77	Hydraulic speed gear	1	O	D	Keep oil level at line on window of A-end housing.
78	Lag meter	1	O	D	Zero lag meter with power off. *Caution:* Do not force.
79	Metal surfaces	1	O	D	Clean with dry cloth. Unpainted surfaces should be cleaned with an oily cloth.
80	Plugs and receptacles	1	O	D	Keep clean and covered.
81	Whole system	1	O	D	Put into operation at least once every day. Check orientation, synchronization and operation.
82	Tubes and connections	1	O	W	Check for leaks; notify maintenance if leaks are found.
83	Elevation limit stops	1	O	W	Test to see if gun approaches stop at its full limit and moves off smoothly when signal is reversed.
84	Electrical	2	M	M	Check all external electrical connections for grounds, broken connections, soldered joints; see that soldered joints are covered with glyptal lacquer.
85	Amplifier shock mountings	2	M	M	Check and replace if worn.
86	Oil filter	2	M	6M	Clean filter.
87	Hydraulic speed gear	1	O	6M	Drain and refill.

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SECTION III

CHECK LISTS

■ 56. DAILY MAINTENANCE CHECK LIST.

BATTERY_____BATTALION_____MONTH_____

GUN SERIAL NO._____

No.	Item of maintenance	Day														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Gun and assembly															
2	Gun mount															
3	Gun tube*															
4	Exposed recoil slides*															
5	Recoil mechanism*															
6	Recoil piston rod retainer*															
7	Recoil valve control bar follower screw															
8	Counterrecoil valve															
9	Recoil throttling valve guides															

*To be inspected before each firing if possible.

No.	Item of maintenance	Day														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10	Counterrecoil buffer															
11	Breechblock															
12	Breech recess															
13	Breech operating shaft gears															
14	Breech closing spring chain*															
15	Firing mechanism															
16	Spline shaft*															
17	Breechblock crank, chain terminal crank and operating crank.															
18	Equilibrator															
19	Elevating rack and pinion															
20	Fuze setter															
21	Power rammer															

22	Auxiliary leveling screw																						
23	Direct fire sights																						
24	Miscellaneous																						
77	Hydraulic speed gear																						
78	Lag meter																						
79	Metal surfaces																						
80	Plugs and receptacles																						
81	Whole system																						

*To be inspected before each firing if possible.

Persons performing maintenance operation will enter check (✓) in proper column. For remarks use reverse side.

■ 57. WEEKLY MAINTENANCE CHECK LIST.

BATTERY _____ BATTALION _____ MONTH _____

GUN SERIAL NO. _____

No.	Item of maintenance	Week			
		1	2	3	4
25	Gun and assembly				
26	Recoil slides				
27	Recoil valve control cam and slide				
28	Breech operating intermediate gear stud				
29	Operating handle latch plunger				
30	Rammer rack guide				
31	Rammer buffer rod bearing				
32	Rammer cylinders				
33	Rammer arm bearings				
34	Direct fire sights (M24 and M26)				
35	Tires				

36	Handbrake				
37	Electric brake				
38	Lights (dials, fuze, breech, tail)				
39	Tools and accessories				
82	Tubes and connections				
83	Elevation limit stops				

Persons performing maintenance operation will enter check (√) in proper column. For remarks use reverse side.

■ 58. MONTHLY MAINTENANCE CHECK LIST.

BATTERY _____ BATTALION _____ YEAR _____

GUN SERIAL NO. _____

No.	Item of maintenance	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
40	Control bar hinge												
41	Recoil valve control cam and slide												
42	Firing lever shaft bearing												
43	Breach operating plunger bearing and cam shaft												
44	Elevating gear case shaft bearings and indicator drive mechanism												

No.	Item of maintenance	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
45	Elevating shaft lower bearing												
46	Elevating gear shaft bearing												
47	Elevating remote drive gear case and elevating worm gear case												
48	Traversing gear case shaft bearings and indicator drive mechanism												
49	Traversing vertical shaft lower bearing												
50	Cradle trunnion bearing												
51	Top carriage bushing												
52	Rammer trip shaft bearing												
53	Rammer trip latch												
54	Leveling rack bearing, left jack												
55	Leveling mechanism support bearing												
56	Leveling mechanism, right and left												
57	Leveling mechanism clamp bearing												

58	Leveling jack handle bearing													
59	Racket drive rear bushing, right and left													
60	Leveling socket bearing													
61	Bogie guide roller													
62	Buffer trunnion bearing													
63	Buffer roller													
64	Bogie buffer cylinder													
65	Counterpoise gear box and cylinder walls													
66	Counterpoise connecting rod bearing													
67	Bogie frame support bearing													
68	Outrigger													
69	Outrigger hinge pins													
70	Trail hinge shaft													
71	Trail lock lever bearing													
72	Trail latch slide													
73	Trail lock link pin													

No.	Item of maintenance	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
74	Traveling lock												
75	Traversing rack, thrust and clip bearings												
76	Wheel bearing (6 mos)												
84	Electrical												
85	Amplifier shock mountings												
86	Oil filter (6 mos)												
87	Hydraulic speed gear (6 mos)												

Persons performing maintenance and operation will enter check (✓) in proper column. For remarks use reverse side.

[A. G. 300.7 (16 Aug 44).]

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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IC 44: T/O & E 44-17; 44-117.
For explanation of symbols, see FM 21-6.

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RESTRICTED

FM 4-126

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF THE PIECE 90-MM ANTIAIRCRAFT GUN ON M1A1 MOUNT

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FM 4–126, Antiaircraft Artillery Field Manual, Service of the Piece, 90-MM Antiaircraft Gun on M1A1 Mount, is published for the information and guidance of all concerned.

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(For explanation of symbols see FM 21–6.)

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ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF THE PIECE

90-MM ANTIAIRCRAFT GUN ON M1A1 MOUNT

(This manual supersedes FM 4–126, 2 October 1942, including C 1, 28 October 1942, C 2, 28 November 1942, C 3, 23 January 1943, C 4, 19 March 1943; section II, Training Circular No. 48, and section I, Training Circular No. 81, War Department, 1942.)

CHAPTER 1

GENERAL

■ 1. SCOPE.—This manual prescribes a systematic procedure to be followed by the gun crew for service of the piece for the 90-mm antiaircraft gun M1 on mount M1A1. Included are drill procedures for emplacement and march order, preparation for fire and artillery drill. Description of matériel, care and preservation, malfunctioning and correction, and ammunition are covered in TM 9–370 and TM 9–2642. References are listed in the appendix; they are suggested for further study of matériel covered in the manual and allied topics.

■ 2. DECONTAMINATION.—For information on decontamination of matériel, see TM 9–850, FM 21–40, and 3-series TM's.

CHAPTER 2

ORGANIZATION OF GUN SECTION

■ 3. GUN SECTION.—*a.* The gun section consists of the gun commander, a gun squad of nine men, including the gunner, and an ammunition squad of six men, including the ammunition chief. The gun commander commands the gun section and also the gun squad. The ammunition chief is in charge of the ammunition squad.

b. The members of the gun section are designated as follows:

GC Gun commander.
G Gunner.
1 Fuze setter loader.
2 Elevation setter.
3 Fuze setter operator.
4 Loader.
5 Fuze range setter.
6 Ammunition relayer.
7 Azimuth setter.
8 Ammunition relayer.
AC Ammunition chief.
9 Ammunition handler.
10 Ammunition handler.
11 Ammunition handler.
12 Ammunition handler.
13 Chauffeur.

■ 4. DUTIES OF PERSONNEL.—*a.* The gun commander is in charge of the entire gun section and is responsible to the battery executive for the—

(1) Training and efficiency of the personnel in his section.

(2) Condition, care, and preparation for action of all matériel and ammunition under his charge.

(3) Observance of all safety precautions pertaining to the service of the piece.

(4) Police of gun position.

(5) Enforcement of camouflage and gas discipline.

(6) Record of number of rounds fired.

(7) Care and return of empty cartridge cases to the proper agency.

(8) Preparation of field fortifications for protection of the gun, personnel, and ammunition.

(9) Training of all members of gun section in taking alternate positions in the gun section.

(10) Performance of those duties set forth in the drill procedures.

b. The gunner is responsible for the—

(1) Observance of all safety precautions pertaining to the firing of the gun.

(2) Condition, care, and preparation for firing of the breech and firing mechanism.

(3) Performance of those duties set forth in the drill procedures.

c. The ammunition chief is in charge of the ammunition squad and is responsible to the gun commander for the—

(1) Training and efficiency of the personnel under his charge.

(2) Observance of all safety precautions in the storage, care, and service of ammunition.

(3) Proper care and preparation of ammunition for the gun.

(4) Correct recording of required ammunition data.

(5) Uninterrupted service of ammunition to the gun position during the course of action.

(6) Cleaning and disposition of empty cartridge cases.

(7) Enforcement of camouflage and camouflage discipline, and gas discipline at ammunition shelters.

(8) Performance of those duties set forth in the drill procedures.

d. The members of the gun squad are responsible for the duties as set forth in the drill procedures and such other duties as may be designated by the gun commander.

e. The members of the ammunition squad, with exception of No. 13, are responsible for the duties as set forth in the drill procedures and such other duties as may be designated by the ammunition chief or gun commander.

f. No. 13, the prime mover driver, is responsible for the care and maintenance of the prime mover, and will remain with the prime mover, unless other duties are designated by the ammunition chief or gun commander.

CHAPTER 3

DRILL PROCEDURES

SECTION I

GENERAL

■ 5. EXPLANATION.—The drills are presented in chronological sequence of action, with explanatory notes. Each action begins with the numbers or abbreviations signifying the members of the gun section concerned in that action; these numbers or abbreviations are at the left margin. Each main operation performed is separated from other main operations by _____. In emplacement of the gun and march order, the front of the mount is the towing or trail end. Left and right sides of the mount are determined by standing at the rear and facing the front.

■ 6. INSTRUCTIONS.—The drill prescribed herein will be adhered to strictly, both to prevent injury to matériel and to produce maximum operating efficiency of the gun section. Drill is conducted in silence except for commands and reports. The gun section must be drilled until all reactions to commands are automatic, instant, and effective. Errors are corrected instantly and on the spot. Drill is conducted at the fastest pace at which the gun section can operate smoothly. The ultimate in precision and speed is the goal. Battery officers must supervise and coach the gun commander to make sure that the foregoing instructions are carried out and that the maximum efficiency of the gun section is reached.

SECTION II

PRELIMINARY COMMANDS AND FORMATIONS

■ 7. FALL IN.

The gun section assembles in two ranks, with the gun squad on the right, facing GC. The interval is 4 inches between files and 40 inches between ranks. GC takes his post three paces in front of the center of the line on which the front rank is to form. The primary purpose of the command FALL IN (and subsequent commands COUNT OFF and CALL OFF) is to verify the gun section.

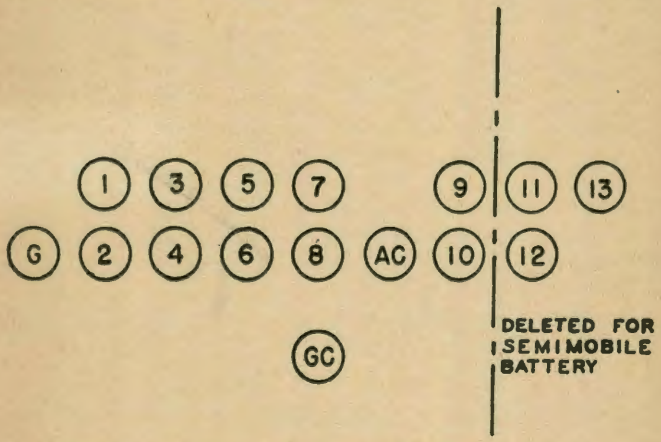

FIGURE 1.—Positions of personnel at command FALL IN.

GC commands: FALL IN.
G takes his post as guide on the right, facing GC.
2, 4, 6, 8, AC, 10, 12 form the front rank,
1, 3, 5, 7, 9, 11, 13 form the rear rank—(1, 3, 5, 7 cover off 2, 4, 6, 8; and 9, 11 cover off 10, 12).

NOTE.—GC *forms the gun section in this formation when required and locates the assembly point so as to suit the particular situation best.*

■ 8. COUNT OFF.

The gun section being in formation,
GC commands: COUNT OFF.
G reports "Gunner."
1 to 8 report their numbers consecutively.
AC reports "Ammunition chief."
9 to 13 report their numbers consecutively.

■ 9. CALL OFF.

The gun section being in formation,
GC commands: CALL OFF.
G reports "Gunner."
1 reports "Fuze setter loader."
2 reports "Elevation setter."
3 reports "Fuze setter operator."
4 reports "Loader."
5 reports "Fuze range setter."
6 reports "Ammunition relayer."
7 reports "Azimuth setter."
8 reports "Ammunition relayer."
AC reports "Ammunition chief."
9 reports "Ammunition handler."
10 reports "Ammunition handler."
11 reports "Ammunition handler."
12 reports "Ammunition handler."
13 reports "Chauffeur."

■ 10. CHANGE ORDER.

The gun section being in formation,
GC commands: CHANGE ORDER.
G falls out to rear and takes position of 13.
1 takes position of G.
AC takes position of 8.
9 takes position of AC.
2 through 8 take position of next lower number.
10 through 13 take position of next lower number.
All members move simultaneously to new positions.

■ 11. DETAILS, POSTS.

GC commands: DETAILS, POSTS.

1, 2, 3, 6, 7, 8 remove and fold gun cover and place it in a convenient place.

G places a wiper of cotton waste and a can of oil in a convenient place.

4 procures chamber and bore sponge and wiper of cotton waste.

3 removes muzzle cover and deposits it at designated place.

G, 4 remove breech cover and deposit it at designated place.

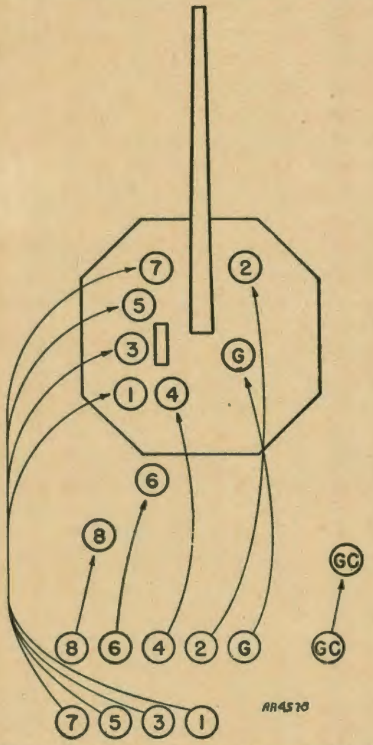

FIGURE 2.—Positions of personnel of gun squad at command DETAILS, POSTS.

G takes post at right rear of gun, opposite to and facing breech.
1 takes position immediately in the rear of the fuze setter, facing it, standing on gunner's platform.
2 takes post at elevation station, seated on elevation setter's seat, facing elevation indicator regulator.
3 takes post at right rear of fuze range setter, facing fuze setter.
4 takes post about 2 feet to left and rear of breech facing gunner.
5 takes post at fuze range setter's station, seated on fuze setter's seat facing fuze setter.
6 takes post directly in rear of fuze setter, standing on ground and facing 1.
7 takes post at azimuth station seated on azimuth setter's seat facing azimuth indicator regulator.
8 takes post on ground about 3 or 4 feet from gunner's platform and facing 6.
9 takes post at ammunition stack ready to remove protective covers.
AC posts 10, 11, 12 to insure a continuous supply of ammunition to gun position.
10, 11, 12 take positions to insure continuous supply of ammunition to gun position.
13 takes post at prime mover, unless ordered otherwise by AC or GC.

12. REST.

GC commands: REST, carries out instructions as to air guards, manning details, reliefs, gas discipline, camouflage, and local security. He makes sure that full advantage is taken of the opportunity by the gun section to improve position, prepare and replenish ammunition, perform maintenance, and make tests and adjustments. The gun section should be given a chance to relax and rest, but the command REST does not mean loaf.

SECTION III

EMPLACEMENT AND MARCH ORDER

13. EMPLACEMENT OF GUN WITHOUT PRIME MOVER.

NOTE.—Since a prime mover will be used whenever available, it is assumed in this section that the gun has already been uncoupled from the prime mover, and that the rear outrigger is extended and broken at the outer joint.

GC commands: PREPARE FOR ACTION.

AC during emplacement of the gun directs 9, 10, 11, 12, 13 in the unloading and placing of ammunition, gun tools, cables, camouflage equipment, and other material needed at gun position. 9, 10, 11, 12 prepare ammunition for service.

FIGURE 3.

G, 1, 2, 3, 4, 7, 8 take off gun cover—lay it at a convenient place, temporarily unfolded.

5, 6 remove canvas covers from counterpoise cylinders.

1, 2 check that hand brakes are set.
5, removes equilibrator piston stop from equilibrator and inserts it in holder on top of equilibrator cylinder.

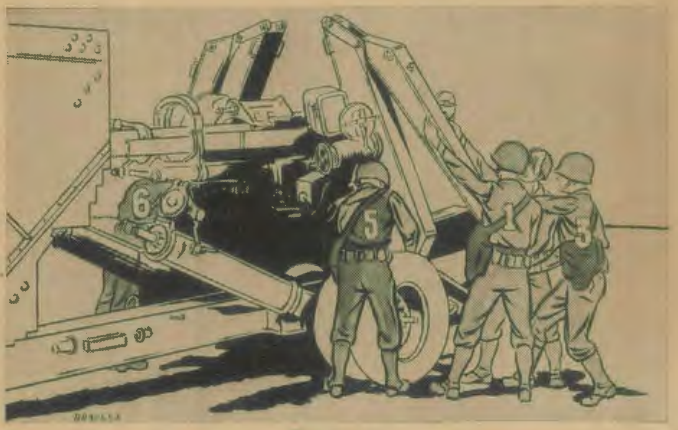

FIGURE 4.

1, 3, 5, 7 extend and pin left outrigger.
2, 4, 6, 8 extend and pin right outrigger.

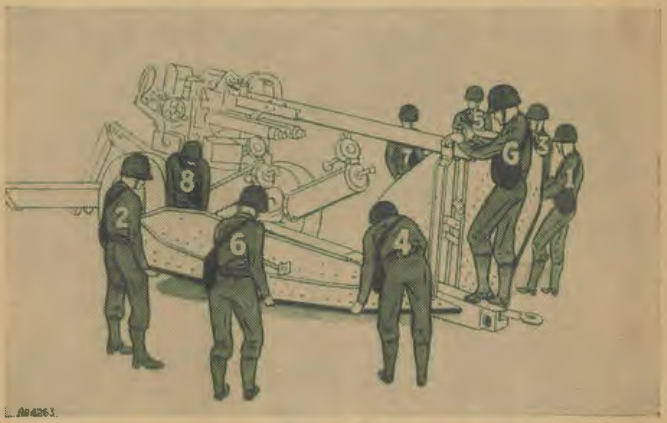

FIGURE 5.

1, 3, 5, 7 remove left platform and lay it aside.
2, 4, 6, 8 remove right platform and lay it aside.
G unfastens transom cap; removes muzzle cover.

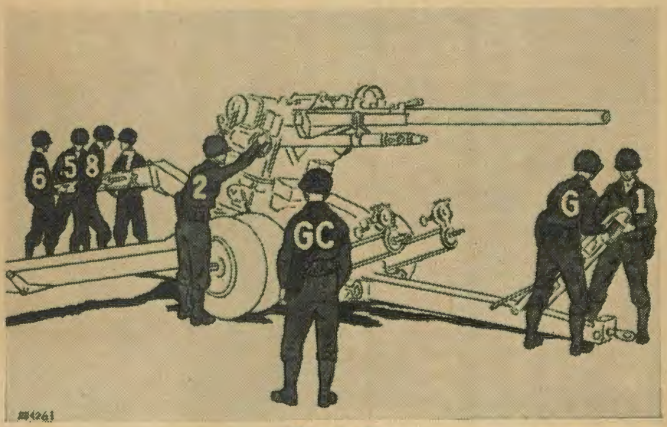

FIGURE 6.

2 elevates the gun slightly to clear traveling lock.
G, 1 unpin traveling lock brace and lower the traveling lock, pinning it to the trail.
5, 6, 7, 8 extend and pin the rear outrigger.

G retracts bogie buffer plunger, using socket wrench.
1, 3, 4 at the trail gently tip the gun back on the rear outrigger.
5, 6, 7, 8 at the rear outrigger, assist in tipping the gun back on the rear outrigger.

Caution.—The rear outrigger must be extended and pinned before the gun is tipped back.

G pulls out latch on side of buffer cylinder and swings the forward end of the buffer cylinder down. (The latch reengages when the cylinder has moved to the lower position.)
1, 2 release hand brakes.

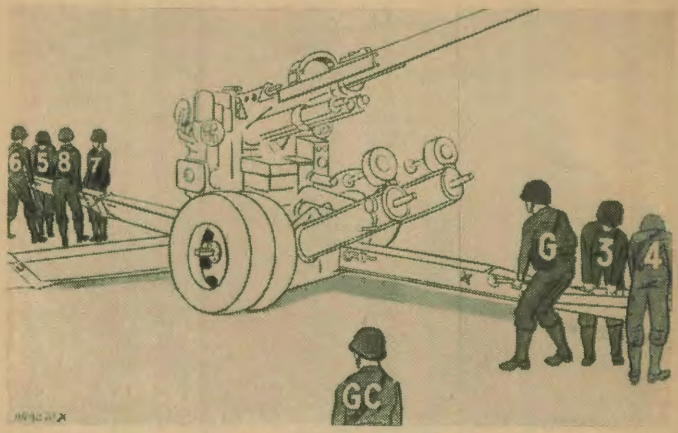

FIGURE 7.

G, 3, 4 at the trail partially crush mount by exerting downward pressure on trail, forcing it to ground.

5, 6, 7, 8 at rear outrigger assist in crushing mount by pulling up on rear outrigger.

7, 8 pull out on the crank handles of the gear boxes, and swing the gear boxes to the front over the ends of the cylinders, fastening them in place with the swing bolts and wing nuts.

NOTE.—*IF COUNTERPOISE CYLINDER RODS ARE NOT RETRACTED FAR ENOUGH TO PERMIT PUTTING THE GEAR BOXES IN PLACE, THE MOUNT MUST BE CRUSHED FURTHER BY SEVERAL MEN JUMPING ON EACH SIDE OUTRIGGER.*

1, 2 loosen locking nuts only on the bogie engaging eye hooks and place the socket wrenches on the bogie securing bolts preparatory to loosening them.

2 elevates gun to maximum.

3, 4, 7, 8 crank bogie down until the pedestal rests firmly on the ground, and the wheels can be turned.

FIGURE 8.

5, 6 place fuze setter bracket and seat in firing position and place the fuze setter in its bracket; connect cable to fuze setter junction box.

FIGURE 9.

1, 2 loosen and disengage bogie securing bolts.
1, 2, 3, 4, 5, 6, 7, 8 take positions at and support the trail.
G pulls out electric brake cable plug and places it in dummy socket; disengages trail lock rocker arm swing bolt, and then allows trail lock rocker arm to swing to maximum height as trail is lowered.
1, 2, 3, 4, 5, 6, 7, 8 lower trail to its lower position after trail lock rocker arm is loosened.
G moves trail lock rocker arm down and refastens it by means of swing bolt after trail is lowered.

NOTE.—It may be necessary to dig out under entire length of trail to permit it to be locked in lower position.

1, 2 loosen both nuts on each bogie engaging eye hook.
3, 4 push in on bogie engaging operating handles; put bogie hub wrenches on the wheels.

NOTE.—*It may be necessary for 7 and 8 to crank bogie up slightly until wheels contact ground before bogie engaging eye operating handles can be pushed in. Never force the operating handles.*

FIGURE 10.

G, 5, 6, 7, 8 roll out bogie.

3, 4 assist rolling bogie by turning wheels with bogie hub wrenches.

1, 2 ride the bogie, holding up on bogie engaging eye hooks until they clear the pedestal, then dropping them; manipulate hand brakes as directed by GC.

GC checks clearance between top of bogie frame and bottom of equilibrator cylinder before bogie is rolled out.

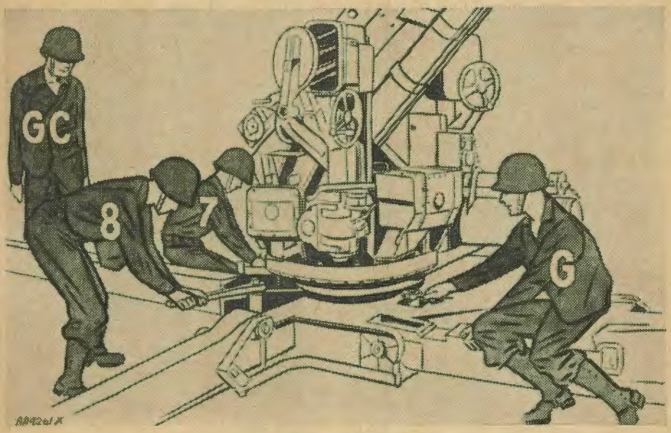

FIGURE 11.

G loosens auxiliary leveling screw at front of mount, using ½-inch rod, and keeps it free from binding as mount is leveled.

7, 8 level mount by means of the leveling jacks (a leveling vial is mounted on each jack). Call "Level" when gun is level.

G tightens auxiliary leveling screw by screwing it down as soon as the mount has been leveled.

GC verifies leveling of mount.

7, 8 tighten jack clamps and place jack ratchets in neutral position. (No. 7 places his jack handle as close to the rear outrigger as possible to prevent breakage of the handle by the platform reinforcing angle.)

5, 6 replace canvas covers on counterpoise cylinders.
2, 7 lower their seats to the firing position.
1, 3 lay cable from gun to main junction box—connect cable at main junction box.
7 connects cable to cable receptacle on left side of pedestal.

FIGURE 12.

1, 3, 5, 7 put left platform in place on outriggers and fasten it.
2, 4, 6, 8 put right platform in place and fasten it.

G, 1, 2, 3, 4, 5, 6, 7, 8, fold canvas cover and place it on bogie buffer cylinder and place dirt under those parts of the outriggers which do not touch the ground.

■ 14. EMPLACEMENT OF GUN USING PRIME MOVER.

GC commands: PREPARE FOR ACTION.
G, 2, 4, 6, 8 dismount from prime mover from the right side.
1, 5, 7 dismount from prime mover on left side.
3 walks out on gun tube.
8 tosses out lifting bar.
4, 7 bring out wheel wrenches.
1, 2 bring out bogie socket wrenches.

5, 6 bring out bogie ratchet wrenches.

AC during emplacement of gun directs 9, 10, 11, 12 in the unloading of ammunition, gun tools, cables, camouflage equipment, and other material needed at the gun position. 9, 10, 11, 12 prepare ammunition for service.

G, 1, 2, 3, 4, 5, 6, 7, 8 untie gun cover, take it off to the rear, and lay it on the ground.

1, 2 loosen the wing bolts holding the platform to the trail.

3 unfastens outrigger safety chain.

5, 6 remove canvas covers from counterpoise cylinders.

G takes position at the bogie buffer.

5, 6, 7, 8 unlatch, extend, and pin the rear outrigger in its extended position.

GC orders all men, except G at the bogie buffer, to stand clear of the gun; directs 13 to set the electric brakes and then to drive the prime mover forward, compressing the spring in the bogie buffer with the axle lug.

G screws down on bogie buffer plunger retracting handwheel as the bogie buffer spring is compressed.

GC when buffer spring has been sufficiently compressed, orders prime mover backed up until G can pull out on the latch on the side of the buffer cylinder and swing the forward end of the buffer cylinder down.

G pulls out on latch on side of buffer cylinder and swings forward end of the buffer cylinder down. (The latch reengages when the buffer cylinder has moved to lower position.)

GC orders prime mover to be driven forward again, partially crushing the gun mount, until the counterpoise cylinder rods have entered into the counterpoise cylinders far enough to allow 7 and 8 to pull out on the crank handles of the gear boxes, swing them over the front ends of the cylinders, and fasten them in place with the swing bolts and wing nuts.

7, 8 pull out on crank handles of gear boxes, swing the boxes to the front over the ends of the cylinders, and fasten them in place with the swing bolts and wing nuts.

GC directs the prime mover driver to release the bogie electric brakes.
1 unfastens the break-away chain and pulls the electric cables out of the truck and bogie, and inserts them in the dummy receptacle on the left side of the trail.
2 inserts lifting bar in the end of the trail.

G takes position immediately behind the lifting bar.
1, 2 take position at lifting bar.
G disconnects the trail from prime mover. (Gunner must not stand between prime mover and lifting bar.)
GC directs prime mover to move out.
1, 2 press down on trail.
3, 4, 5, 6, 7, 8 lift rear outrigger, lowering the trail to the ground.

2, 4, 6, 8 extend and pin the right outrigger.
1, 3, 5, 7 extend and pin the left outrigger.

2, 4, 6, 8 remove the right platform and lay it aside.
1, 3, 5, 7 remove the left platform and lay it aside.

G unfastens transom cap.
5 removes the equilibrator piston stop from the equilibrator and puts it in its holder on top of equilibrator.
2 takes position at elevating handwheel and elevates the gun slightly to clear the traveling lock.
G, 1 unpin traveling lock brace, lower traveling lock, and pin it to the trail.

---

2 elevates gun to maximum.
G, 1, 3, 4, 5, 6 at the trail, tip the gun gently back on the rear outrigger.
7, 8 at rear outrigger assist in tipping gun back on rear outrigger.

1, 2 loosen lock nuts only on bogie engaging eye hooks; place socket wrenches on bogie securing bolts preparatory to loosening them.

7, 8 crank bogie down until the pedestal rests firmly on the ground and the wheels can be turned.
3, 4 assist 7, 8 crank bogie down.
5, 6 place fuze setter bracket and seat in firing position and place fuze setter in its bracket; connect cable to fuze setter junction box.
1, 2 loosen and disengage bogie securing bolts.

1, 2, 3, 4, 5, 6, 7, 8 support weight of trail.
G disengages trail lock rocker arm swing bolt preparatory to lowering the trail; as trail is lowered allows trail lock rocker arm to swing up to its maximum angle.
1, 2, 3, 4, 5, 6, 7, 8 move trail down to its lower position.
G moves trail lock rocker arm down and refastens it by means of the swing bolt.

NOTE.—*It may be necessary to dig out under entire length of trail to permit it to be locked in lower position.*

1, 2 loosen both nuts on each bogie engaging eyebolt.
3, 4 push in on bogie engaging eye operating handles; put hub wrenches on the wheels.

NOTE.—*It may be necessary for 7 and 8 to crank bogie up slightly until wheels contact ground before operating handles can be pushed in. Never force the operating handles.*

G, 3, 4, 5, 6, 7, 8 roll the bogie out, 3 and 4 using bogie hub wrenches on wheels.
1, 2 ride the bogie, holding up on the bogie engaging eye hooks until they clear the pedestal, then dropping them and manipulating the brakes as directed by GC.
GC checks clearance between top of bogie frame and bottom of equilibrator cylinder before bogie is rolled out.

G loosens auxiliary leveling screw at the front of the mount, using the ½-inch rod, and keeps it from binding as the mount is leveled.
7, 8 level gun by means of the leveling jacks (a leveling vial is mounted on each jack). Call "Level" when gun is level.

G tightens auxiliary leveling screw by screwing it down as soon as the gun has been leveled.
GC verifies level of gun.
7, 8 tighten jack clamps and place jack ratchets in the neutral position (No. 7 places his jack handle as close to the rear outrigger as possible to prevent breakage of the handle by the platform reinforcing angle).
5, 6 replace canvas covers on counterpoise cylinders.
2, 7 lower their seats to the firing position.
1, 3 lay cable from gun to main junction box; connect cable at main junction box.
7 connects cable to cable receptacle on left side of pedestal.

1, 3, 5, 7 put left platform in place on outriggers and fasten it.
2, 4, 6, 8 put right platform in place on outriggers and fasten it.

G, 1, 2, 3, 4, 5, 6, 7, 8 fold canvas cover and place it on the bogie buffer cylinder; place dirt under those parts of outriggers which do not touch the ground.

■ 15. MARCH ORDER WITHOUT PRIME MOVER

GC commands: MARCH ORDER.
1, 3, 5, 7 remove, fold, and lay aside left platform.
2, 4, 6, 8 remove, fold, and lay aside right platform.

G loosens the auxiliary leveling screw and keeps it loose while the leveling jacks are centered.
7, 8 center leveling jacks and call "Center."

NOTE.—The center of jack travel is indicated by marks on the jack body.

G tightens auxiliary leveling screw by screwing it down, after jacks are centered.
7, 8 tighten jack clamping screws.
5, 6 remove canvas counterpoise covers.
3, 4 put on bogie hub wrenches preparatory to rolling bogie in.

---

2 elevates gun to maximum—folds his seat and footrest in the traveling position.

7 sets the gun to zero traverse (the position where the traverse pointer at the lower rear edge of the top carriage is directly in line with a groove in the top of the left jack slide cover); folds and pins the azimuth setter's seat and footrest in the traveling position; disconnects the cable from the cable receptacle on the left side of the pedestal and replaces cap on plug and receptacle.

5 disconnects cable from fuze setter junction box; unpins fuze setter bracket.

5, 6 remove fuze setter from its firing position and put it in traveling bracket.

G, 5, 6 roll bogie in, taking particular care not to bump any part of the mount.

1, 2 ride the bogie and hold the bogie engaging eye hooks clear of the pedestal.

3, 4 assist in rolling bogie in by manipulating the hub wrenches.

GC checks clearance between bottom of equilibrator cylinder and top of the bogie frame as the bogie is rolled in.

NOTE.—*Since the mount settles during firing, it may be necessary for 7 and 8 to crank bogie down or to dig a trench for the wheels to provide clearance when the bogie is rolled in.*

7, 8 crank bogie down until the bogie engaging eye operating handles can be pulled all the way out.

3, 4 pull out on bogie engaging eye operating handles until they are locked in place by the pawls.

1, 2 tighten by hand the lower nuts in the bogie engaging eye hooks, leaving sufficient clearance to permit engaging the bogie securing bolts when the trail is raised.

G loosens the wing nut and drops the swing bolt, disengaging the trail lock rocker arm; commands when to lift the trail and then pulls up on rocker arm as trail is raised, and lowers rocker arm again.

1, 2, 3, 4, 5, 6, 7, 8, at gunner's command, lift forward end of trail and hold it until trail is locked in the upper position.

G fastens the trail lock rocker arm again by means of swing bolt and wing nuts; plugs electric brake cable into socket of bogie.

1, 2, with the trail in the "up" position, engage the bogie securing bolts and tighten and lock the nuts on the bogie engaging eye hooks and on the bogie securing bolts; set hand brakes.

3, 4, 7, 8 crank bogie up until the gear boxes can be disengaged and locked in traveling position (by pushing in on crank handles).

G takes position at bogie buffer cylinder.

1, 2 release hand brakes at GC's command.

3, 4, 5, 6, 7, 8, as the brakes are released, give a strong upward push to the trail. (This causes the lug on the bogie axle to swing up against the rubber bumper on top of the bogie directly to the rear of the bogie buffer.)

GC commands: RELEASE BRAKES.

G pulls out on the latch shaft handle and swings the front end of the buffer cylinder up until the bogie buffer roller is directly in front of the axle lug; engages latch on side of buffer cylinder.

5, 6, 7, 8 at rear outrigger tip the mount gently forward.

1, 3, 4 at the trail assist in tipping mount forward.

2 depresses gun to 300 mils.

G loosens handwheel on bogie buffer, as the lug on the bogie axle comes forward against the bogie buffer plunger.

5, 6 break rear outrigger.

G, 1 raise traveling lock brace.

2 depresses gun into traveling lock.

G swings transom on top traveling lock over the gun tube, fastens it, and replaces muzzle cover.

5 removes the equilibrator piston stop from the holder on top of the equilibrator and inserts it in the equilibrator

cylinder head; fastens it with the equilibrator piston stop pin.

G plugs electric brake cable into the socket of the bogie.

2, 4, 6, 8 put right platform on the trail and fasten it in position.

1, 3, 5, 7 put left platform on the trail and fasten it in position.

2, 4, 6, 8 fold and latch the right outrigger in traveling position.

1, 3, 5, 7 fold and latch the left outrigger in traveling position.

G, 1, 2 take position at the trail.

5, 6 extend and pin rear outrigger.

3, 4, 5, 6, 7, 8 take positions at the rear outrigger.

GC directs prime mover to back up to couple mount.

G, 1, 2 couple mount to prime mover.

3, 4, 5, 6, 7, 8 at the rear outrigger maneuver mount as directed by GC to assist in coupling gun to prime mover.

5, 6, 7, 8 fold and latch rear outrigger.

3 climbs on top of mount, secures outriggers with outrigger chain, and remains there to help put canvas cover in place.

1 fastens the break-away chain to the prime mover, plugs brake cable into the prime mover; takes the lifting bar out of trail and puts it in the prime mover.

1, 2, 4, 5, 6, 7, 8 put the gun cover on the gun and fasten it in place.

3 carries the cover up over the tube from the rear by walking along the tube.

3, 8 disconnect cable at main junction box; reel up cable.

1, 2 place bogie socket wrenches in prime mover.

4, 7 place wheel wrenches in prime mover.

5, 6 place bogie ratchet wrenches in prime mover.

GC inspects gun for travel and checks electric brakes.

AC, 9, 10, 11, 12 while the gun is being prepared for travel, check to see that all rounds are set at SAFE; restore rounds to fiber containers and replace in wooden boxes; load ammunition on proper truck; load gun tools, cables, camouflage equipment, and other material in proper vehicle.

NOTE.—*Rounds that have been removed from their containers will be kept segregated when repacked and used first in subsequent firings.*

13 prepares prime mover for travel prior to bringing prime mover to gun position.

1, 3, 5, 7 take places in prime mover on left side.
G, 2, 4, 6, 8 take places in prime mover on right side.
GC, 13 take places in cab of prime mover. (See fig. 13.)
AC, 9, 10, 11, 12 take places in proper truck.

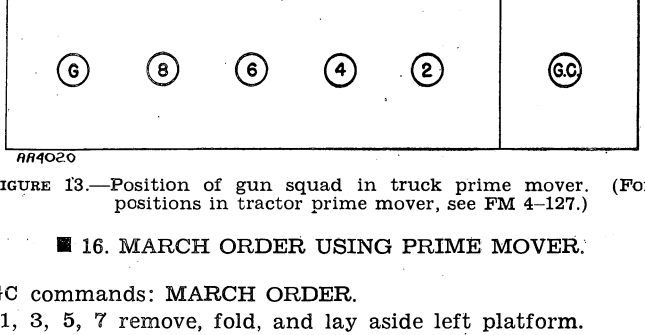

FIGURE 13.—Position of gun squad in truck prime mover. (For positions in tractor prime mover, see FM 4–127.)

16. MARCH ORDER USING PRIME MOVER.

GC commands: MARCH ORDER.
1, 3, 5, 7 remove, fold, and lay aside left platform.
2, 4, 6, 8 remove, fold, and lay aside right platform.

G loosens auxiliary leveling screw and keeps it loose while the leveling jacks are being centered.
7, 8 center leveling jacks and call "Center."

NOTE.—*The center of jack travel is indicated by marks on jack body.*

G tightens auxiliary leveling screw by screwing it down after jacks are centered.
7, 8 tighten jack clamping screws.
5, 6 remove canvas counterpoise covers.
3, 4 put on bogie hub wrenches preparatory to rolling bogie in.

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2 elevates gun to maximum; folds his seat and footrest in the traveling position.
5 disconnects cable from fuze setter junction box; unpins fuze setter bracket.
5, 6 remove fuze setter from its firing position, and put it in traveling bracket.
7 sets gun to zero traverse (the position where the traverse pointer at the lower rear edge of the top carriage is directly in line with a groove in the top of the left jack slide cover); folds and pins the azimuth setter's seat and footrest in traveling position; disconnects the cable from the cable receptacle on the left side of the pedestal and replaces the caps on the plug and receptacle.

G, 5, 6 roll bogie in, taking particular care not to bump any part of the mount.
1, 2 ride the bogie and hold the bogie engaging eye hooks clear of the pedestal.
3, 4 manipulate the hub wrenches.
GC checks clearance between bottom of equilibrator cylinder and top of bogie frame as the bogie is rolled in.

NOTE.—*Since the mount settles during firing, it may be necessary for 7 and 8 to crank bogie down or to dig a trench for the wheels to provide clearance when the bogie is rolled in.*

7, 8 crank bogie down until the bogie engaging eye operating handles can be pulled all the way out.
3, 4 pull out on bogie engaging eye operating handles until they are locked in place by the pawls.
1, 2 tighten by hand the lower nuts in the bogie engaging eye hooks, leaving sufficient clearance to permit engaging the bogie securing bolts when the trail is raised; set hand brakes.

G loosens the wing nut and drops the swing bolt, disengaging the trail lock rocker arm; commands when to lift the trail and then pulls up on rocker arm as trail is raised, and lowers rocker arm again.
1, 2, 3, 4, 5, 6, 7, 8, at gunner's command, lift forward end of trail and hold it until trail is locked in the upper position.
G fastens the trail lock rocker arm again by means of swing bolt and wing nuts; plugs electric brake cable into socket of bogie.
1, 2 with the trail in the "up" position, engage the bogie securing bolts and tighten and lock the nuts on the bogie engaging eye hooks and on the bogie securing bolts.
G, 1 raise traveling lock brace.
2 depresses gun into traveling lock.

G swings transom cap over tube and locks it; puts on muzzle cover.
5 removes equilibrator piston stop from holder on top of equilibrator and inserts it in equilibrator cylinder head; fastens it with equilibrator piston stop pin.

1, 3, 5, 7 put left platform on trail and fasten it in position.
2, 4, 6, 8 put right platform on trail and fasten it in position.

1, 3, 5, 7 fold and latch left outrigger in traveling position.
2, 4, 6, 8 fold and latch right outrigger in traveling position.

G, 1, 2 take positions at the trail.
3, 4, 5, 6, 7, 8 take positions at the rear outrigger.
GC directs prime mover to back up to couple mount.
G, 1, 2 couple mount to prime mover.
3, 4, 5, 6, 7, 8 at rear outrigger maneuver mount as directed by GC to assist in coupling gun to prime mover.
7, 8 crank bogie up until gear boxes can be disengaged and locked in traveling position.
1, 2 release hand brakes.

G plugs electric brake cable into prime mover and connects break-away chain. Plugs in electric plug on bogie.
5, 6 put canvas covers on counterpoise cylinders.
1, 2, 4, 7, 8 place rear outrigger in traveling position.
3 climbs on top of mount, secures outriggers with outrigger chain, and remains there to help put canvas cover in place.

GC directs prime mover driver to turn on electric brakes; directs prime mover driver to back up to raise bogie so that bogie buffer cylinder can be put in place against the axle lug; directs prime mover to stop when bogie buffer cylinder is in place.
G pulls out on latch shaft handle and swings the bogie buffer cylinder down in place against the axle lug on the bogie axle; engages latch on side of buffer cylinder; loosens bogie buffer handwheel as far as it will go.

1, 2, 4, 5, 6, 7, 8 put gun cover on gun and fasten it in place.
3 carries cover up over tube from the rear by walking along the tube.

3, 8 disconnect cable at main junction box; reel up cable.
1, 2 place bogie socket wrenches in prime mover.
4, 7 place wheel wrenches in prime mover.
5, 6 place bogie ratchet wrenches in prime mover.
GC checks gun for travel and checks electric brakes.

AC, 9, 10, 11, 12, while the gun is being prepared for travel, check to see that all rounds are set at SAFE; restore rounds to fiber containers and replace in wooden boxes; load ammunition on proper truck; load gun tools, cables, camouflage equipment, and other material in proper vehicle.

NOTE.—*Rounds that have been removed from their containers will be kept segregated when repacked and used first in subsequent firings.*

13 prepares prime mover for travel prior to bringing prime mover to gun position.

1, 3, 5, 7 take places in prime mover on left side.
G, 2, 4, 6, 8 take places in prime mover on right side.
GC takes place in cab of prime mover. (See fig. 13.)
AC, 9, 10, 11, 12 take places in proper truck.

SECTION IV

PREPARATION FOR FIRE

■ 17. EXAMINE GUN.—The gun is examined each time it is emplaced preparatory to firing, after each action, and at least once a day in the theater of operations. A schedule for EXAMINE GUN must be worked out so that only one gun in a battery will be out of action at any one time.

GC commands: EXAMINE GUN; inspects gun, carriage, and other matériel; checks to see that gun is properly emplaced and level; checks to see that all moving parts are properly lubricated; examines for leaks around recoil mechanism; supervises 6, 8 in determining that reserve oil and gas pressure in recoil and recuperator systems are sufficient.

4 assists G in examining, cleaning, and oiling breech mechanism; sees that breech operating cam lever is set for "Automatic"; if necessary, assists G in sponging and cleaning bore of gun.

G assisted by 4, examines, cleans, and oils breech mechanisms; removes, examines, cleans, and oils firing mechanism and replaces it in breech block; checks rammer to determine that it is operating properly; checks hand cocking lever and firing lever to determine that they are operating properly; checks proper seating of detent in spline shaft; examines bore and chamber of gun and, if necessary, sponges and cleans bore assisted by 1, 4, 6, and 8.

NOTE.—Check proper seating of detent in spline shaft by observation or *feel at night.*

1. Detent is present.
2. Detent is flush with bushing—bushing is flush with crank arm.
3. End of spline shaft is flush with crank arm.
4. Press larger end of ½" rod against end of spline shaft. It should not move.

5 assisted by 3, examines, cleans, and oils (when necessary) fuze setter, fuze range indicator, and connections.

3 assists 5 in examining, cleaning, and oiling fuze setter; checks to see that proper rings are in fuze setter.

6, 8 with gun at zero elevation, remove oil filling plug; insert liquid release tool and bleed off oil reserve; remove liquid release tool; connect screw filler, and reestablish oil reserve; remove screw filler and connections and replace oil filling plug.

NOTE.—*If no oil reserve is present, it is necessary to fill the recoil cylinder before reestablishing an oil reserve. The oil reserve should not be checked every time the gun is examined, but only at such intervals as determined by the battery commander. Normally, checking the oil reserve once a week will be sufficient. Never add to an existing reserve.*

7 checks oil level of remote control system and replenishes oil if necessary.

AC supervises 9, 10, 11, 12 in preparing ammunition for firing; sees that all rounds are properly crimped, loose fuzes staked, corrosion removed from rounds, lot num-

bers segregated; the emplacement cleared of obstacles, and ammunition dispersed and provided with protection.

9, 10, 11, 12 assist AC in duties as designated.

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7 manually traverses gun through 6,400 mils to insure that it strikes no obstructions and that the traversing mechanism is functioning properly; traverses gun a few mils in opposite direction to determine that there is no excessive backlash.

2 elevates gun manually to maximum elevation; cleans and oils elevating rack. ***Caution:*** Leave elevation rack free of oil under sandy or dusty conditions.

1, 6 with gun at maximum elevation, place wrench on gun jack screw and jack gun out of battery approximately 2 inches; retract gun jack screw to original position and if gun fails to return to battery, direct 2 to depress gun; if gun does not return to battery by the time it has been depressed to 710 mils, charge gas pressure into recuperator cylinder to 830 pounds per square inch.

2 elevates gun to maximum and then depresses (gun should elevate and depress with equal effort); with 7, examines gun junction box.

7 with 2, examines gun junction box.

■ 18. REPORT.

GC commands: REPORT.

G reports to GC, "Breech in order," or reports any defects he cannot remedy without delay.

2 reports to GC, "Elevation in order," or reports any defects he cannot remedy without delay.

5 reports to GC, "Fuze setter in order," or reports any defects he cannot remedy without delay.

6 reports to GC, "Oil reserve and gas pressure in order," or reports any defects he cannot remedy without delay.

7 reports to GC, "Azimuth in order," or reports any defects he cannot remedy without delay.

AC reports to GC, "Ammunition in order," or reports any defects he cannot remedy without delay.

■ 19. CHECK ORIENTATION.

GC commands: CHECK ORIENTATION; designates orienting point; checks level of gun—if necessary, directs G, 7, 8 to relevel gun; *checks to see that power plant switch is in the OFF position* (power plant may be running).

G if directed by GC, loosens auxiliary leveling screw; tightens screw again when gun has been leveled.

7, 8 if directed by GC, level mount by means of leveling jacks; call "Level" when gun is level.

G removes firing mechanism from breechblock.

8 places vertical cross hair across muzzle of gun.

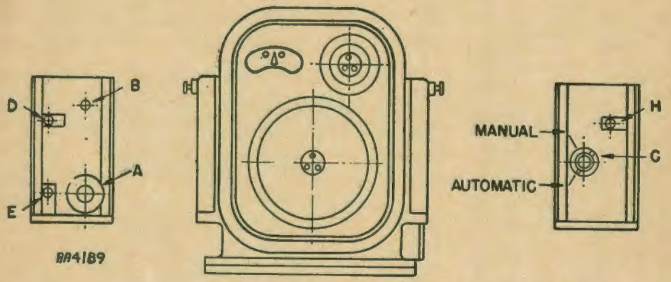


FIGURE 14.—Indicator regulator.

GC commands: CHECK AZIMUTH ORIENTATION; gives 7 correct azimuth to orienting point; supervises 7 in setting correct azimuth on indicator regulator after gun has been laid on orienting point.

G sights through hole in breechblock bushing and lines up vertical cross hair on muzzle with orienting point by giving directions to 2 and 7 to elevate or depress and traverse gun as necessary; calls, "Hold" when gun is on orienting point.

2 elevates or depresses gun as directed by G.

7 traverses gun right or left as directed by G; when gun is on orienting point as indicated by G, raises sliding cover on left side of azimuth indicator; turns toothed wheel

(A) (fig. 14) until mechanical (outer) pointer reads azimuth given orally by GC; checks lagmeter to see that it is in ZERO position; if necessary, removes cover cap under sliding cover and turns slotted shaft (B) (fig. 14) until lagmeter is zeroed (a small screw cover must be removed before this adjustment can be made); checks collimation of azimuth direct-fire sight.

Caution.—Never attempt to zero lagmeter mechanically while data transmission system is energized.

G replaces firing mechanism in breechblock.

GC commands: CHECK ELEVATION ORIENTATION.

G sets gunner's quadrant at 800 mils and places it on leveling plates on top of breech ring; directs 2 to elevate gun until level bubble in gunner's quadrant is at center position; calls, "Hold" when bubble is centered.

NOTE.—*The last movement of the gun should be in elevation.*

2 elevates gun until G calls, "Hold"; raises sliding cover on left side of elevation indicator; turns toothed wheel (A) (fig. 14) until mechanical (outer) pointer reads 800 mils elevation; checks lagmeter to see that it is in the ZERO position—if necessary, removes cover cap under sliding cover (on left side of indicator regulator) and turns slotted shaft (B) (fig. 14) until lagmeter is zeroed (a small screw cover must be removed before this adjustment can be made); checks collimation of elevation direct-fire sight.

Caution.—Never attempt to zero lagmeter mechanically while data transmission system is energized.

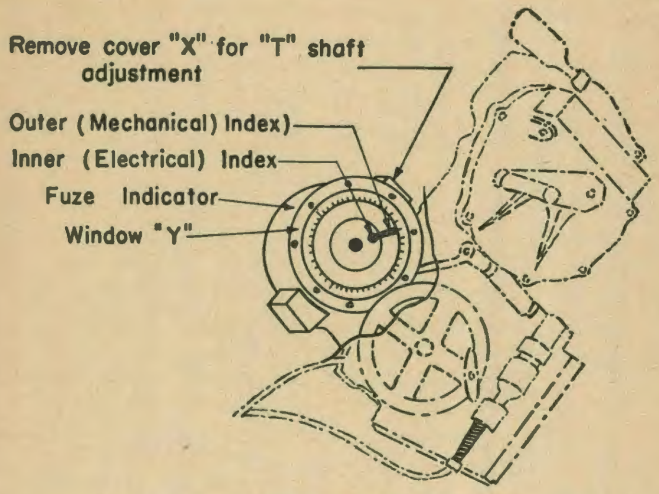


FIGURE 15.—Fuze setter, M13.

GC commands: CHECK FUZE SETTER ORIENTATION.

5 turns adjusting handwheel to set mechanical pointer at a definite value, such as 14; directs 1 and 3 to insert round in fuze setter and set the fuze.

1 inserts round in fuze setter; with right hand keeps steady pressure on base of cartridge case and with left hand trips the release lever.

3, as soon as 1 trips release lever, turns setting crank to set fuze; when setting crank comes to a stop, calls, "Set."

1 when 3 calls, "Set," removes round from fuze setter.

5 compares reading of the set fuze with the reading of the mechanical pointers on the fuze indicator—if there is a discrepancy, verifies it by setting at least two additional fuzes; unscrews and removes glass window (Y) (fig. 15) from face of fuze indicator, loosens six retaining screws on the fuze range scale clamping ring and slips fuze range scale around under clamping ring until the average value that was actually set on fuzes is opposite the mechanical index; sets not less than two new fuzes

at any desired setting; if check is correct, tightens six retaining screws on clamping ring; operates through a complete cycle to be sure that dials do not bind at any place; replaces window.

NOTE.—*When checking orientation of the fuze setter the fuzes should be set under the same conditions as when they are set during firing; that is, they should be set at the same speed, with the same pressure on the round as under firing conditions.*

■ 20. CHECK SYNCHRONIZATION.

GC commands: CHECK SYNCHRONIZATION.

2 sees that motor switch is OFF at gun junction box, and that transfer valve plunger is OUT; sets selector switch on elevation indicator on AUTOMATIC.

7 sees that transfer valve plunger is OUT; sets selector switch on azimuth indicator on AUTOMATIC.

GC verifies that selector switches are on AUTOMATIC, transfer valves are OUT, and power switch on generator is on OFF position; directs power plant operator to start generator and idle until warm, set generator voltage to the minimum possible by turning rheostat on power plant control panel clockwise to stop, then close power plant switch to energize system, run generator speed up to 1200 rpm, and increase voltage by means of the rheostat until voltage at director reads approximately 115 volts; secures quadrant elevation, azimuth, and fuze range values from the director and gives the information to 2, 7, and 5, respectively.

2 raises sliding cover on right side of elevation indicator; after power has been turned on, *slowly* turns selector switch to MANUAL; operates the gun manually until value of quadrant elevation received orally from GC is indicated by mechanical (outer) pointer of the elevation indicator; raises sliding cover on left side of elevation indicator and turns slotted shaft (E) (fig. 14) until electrical (inner) pointer matches mechanical (outer) pointer; sets selector switch at AUTOMATIC; directs 7 to turn on motor switch at gun junction box.

7 raises sliding cover on right side of azimuth indicator; after power has been turned on, *slowly* turns selector switch to MANUAL; operates the gun manually until value of angle of train received orally from GC is indicated by mechanical (outer) pointer of azimuth indicator; raises sliding cover on left side of azimuth indicator and turns slotted shaft (E) (fig. 14) until electrical (inner) pointer matches mechanical (outer) pointer; sets selector switch at AUTOMATIC; turns on motor switch at gun junction box when directed by 2.

GC checks oil level as switch on gun junction box is turned on; if oil level rises, orders motor turned off immediately and notifies qualified personnel.

2 if lagmeter is not at zero position, turns slotted shaft (D) (fig. 14) until lagmeter is at zero position; disengages the handwheel by pushing it toward the muzzle and depresses the transfer valve plunger.

NOTE.—*If, after the transfer valve plunger is pushed in, the gun does not come to a synchronous position, or the gun oscillates, notify qualified personnel.*

2 if lagmeter pointer oscillates, directs G to turn adjusting screw on amplifier marked EL until lagmeter is zeroed (this balances the amplifier.)

G turns adjusting screw marked EL on amplifier as directed by 2.

7 if, after power is turned on at gun junction box lagmeter is not at zero position, turns slotted shaft (D) (fig. 14) until lagmeter is at zero position; disengages the handwheel by pushing it toward the muzzle, and depresses the transfer valve plunger.

NOTE.—*If, after the transfer valve plunger is pushed in, the gun does not come to a synchronous position, or the gun oscillates, notify qualified personnel.*

7 if lagmeter pointer oscillates, directs G to turn adjusting screw on amplifier marked AZ until lagmeter is zeroed. (This balances the amplifier.)

G turns adjusting screw marked AZ on amplifier, as directed by 7.

5 turns adjusting handwheel on fuze setter until mechanical pointer indicates the fuze range received orally from the GC; if necessary, removes cover (X) (fig. 15) on fuze indicator and turns the slotted shaft until the electrical (inner) pointer is opposite the mechanical (outer) pointer; replaces lamp well cover.

NOTE.—*The operations of orienting and synchronizing are now completed. It should always be remembered in orienting and synchronizing that adjusting knobs or screws should never be forced beyond the mechanical stops, or moved more than necessary. The glass face on the azimuth or elevation indicator regulators should not be removed except in an emergency.*

21. CHECK OPERATION.

GC commands: CHECK AZIMUTH OPERATION.

7 with the transfer valve plunger in the OUT position and the handwheels engaged, operates the gun manually until it is approximately 400 mils from its synchronous position; disengages handwheels and pushes transfer valve plunger IN; observes to see if gun comes to rest at synchronous position with lagmeter at ZERO; makes same check 400 mils in the opposite direction.

GC commands: CHECK ELEVATION OPERATION.

2 with transfer valve plunger in the OUT position and handwheels engaged, operates the gun manually until the gun is approximately 400 mils from its synchronous position; disengages handwheels and pushes transfer valve plunger IN; observes to see if gun comes to rest at its synchronous position with lagmeter at ZERO; makes same check 400 mils in opposite direction.

NOTE.—In the above checks, if the gun returns to its synchronous position, the synchronizer and synchro-transformer are operating properly. If the gun fails to return to its synchronous position, call qualified personnel. If the gun comes to within 150 mils but not all the way to the synchronous position, the synchronizer is working properly but not the synchro-transformer. If the gun does not move at all when the transfer valve

plunger is pushed in, the synchronizer, and possibly the synchro-transformer, is not operating properly. In such a case, the synchro-transformer can be checked by moving the gun about 50 mils from its synchronous position and then seeing if the gun will return to the synchronous position.

SECTION V

ANTIAIRCRAFT ARTILLERY DRILL

■ 22. TARGET.

GC commands: TARGET.

G opens breech by bearing down on breech operating handle until breechblock is locked open; latches operating handle, and assumes a position with feet well braced, clear of recoil but convenient for loading.

7 turns motor switch at gun junction box to ON. Turns indicator regulator switch to AUTOMATIC. Disengages handwheels by sliding them toward muzzle of gun and then pushes IN on transfer valve. If lagmeter indicates remote control system is not working properly, returns to manual operation by raising transfer valve, turning indicator regulator switch to MANUAL, and engaging handwheels. Proceeds to match pointers, if operating on MANUAL.

Caution.—When turning switch from AUTOMATIC to MANUAL the switch must be turned slowly.

2 turns indicator regulator switch to AUTOMATIC, disengages handwheels by sliding them toward muzzle of gun and then pushes IN on transfer valve. If lagmeter indicates remote control system is not working properly, returns to manual operation by raising transfer valve, turning indicator regulator switch to MANUAL, and engaging handwheels. Proceeds to match pointers, if operating MANUAL.

Caution.—When turning switch from AUTOMATIC to MANUAL the switch must be turned slowly.

5 matches pointers on fuze setter.

---

1 takes round from 6, who has received it from 8, and inserts it in the fuze setter; presses down on base end of case with palm of right hand, brings left hand over, and strikes trip lever on top side of fuze setter.

3 places hand on handle so that as soon as the release lever is struck by 1, the crank will start; turns handle until it comes in contact with stop; calls, "Set" to signify that fuze is set and that round can be withdrawn.

1 relieves pressure on case and steps back so as to make room for 4.

4, as soon as round has been set, moves to No. 1 position and stands ready to remove the round.

9 removes protective cover from ammunition stacks and makes ammunition accessible to 8.

---

1 stands ready to receive another round from 6 and repeat procedure.

6, 8, 9, 10 keep 1 supplied with ammunition (6 hands round to 1 with left hand under rear of round and right hand on fuze).

■ 23. FIRE.

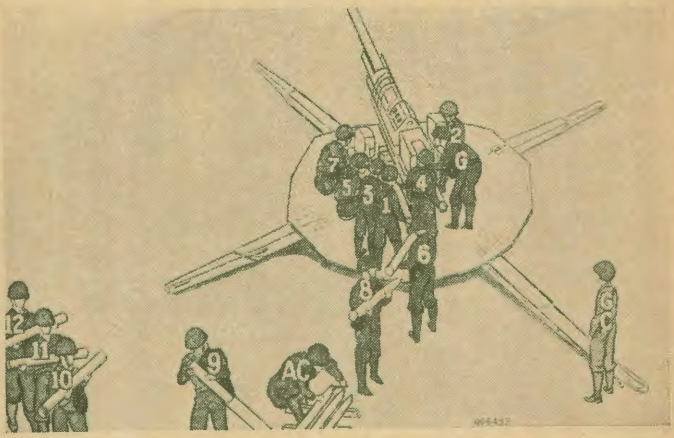


FIGURE 16.

GC, at command FIRE, repeats command for first round only, succeeding rounds being fired without further command; if a limited number of rounds has been prescribed, he cautions "(So many) rounds only."

4 *without power rammer,* removes round from fuze setter and holds it at loading position at the breech where G can ram it home; as soon as round has been loaded, pivots on right foot, steps back with left, and stands ready to remove next round from fuze setter; continues loading until CEASE FIRING is given or the prescribed number of rounds has been fired.

With power rammer, removes round from fuze setter and lays it into the breech recess, moving it into the chamber far enough to allow G to rotate rammer arm; after G has positioned the rammer arm, trips the rammer with his left hand, loading the round; as soon as round has been loaded, pivots on right foot, steps back with left, and stands ready to remove next round from fuze setter; continues loading until CEASE FIRING is given, or the prescribed number of rounds has been fired.

G *without power rammer,* when 4 places round in breech, rams round "home" with front of his left clenched fist; when his fist is knocked clear by the rising breechblock, pivots back on his right foot and fires gun; continues ramming and firing until CEASE FIRING is given, or the prescribed number of rounds has been fired; kicks empty cartridge cases clear of platform; in case of misfire, calls "Misfire" to GC and keeps all cannoneers clear while the prescribed safety precautions are taken (see par. 40).

With power rammer, when 4 places round into breech recess, rotates ramming arm into position behind cartridge; after 4 has tripped the rammer and the breechblock has closed, pivots back on his right foot and fires the gun; continues firing until CEASE FIRING is given or the prescribed number of rounds has been fired; kicks empty cartridge cases clear of platform; in case of misfire, calls "Misfire" to GC and keeps all cannoneers clear of recoil while prescribed safety precautions are taken (see par. 40).

5 continues to match pointers on fuze setter.

1 continues to load fuze setter; trips release lever and keeps pressure on base of round as each round is set.
3 turns fuze setter, setting crank each time release lever is tripped by 1; calls "Set" each time setting crank hits stop.
2 continues to watch elevation lagmeter pointer, or, if operating gun manually, continues to match pointers.
7 continues to watch azimuth lagmeter pointer or, if operating gun manually, continues to match pointers.
6, 8 continue to relay ammunition to 1.
9 clears away empty shell cases from gun emplacement, being careful to avoid getting behind gun when it is in action.
10, 11, 12 maintain ammunition supply under supervision of AC.
AC supervises ammunition squad.

24. CEASE FIRING

GC, at command CEASE FIRING, repeats the command; sees that all men remain at post on the alert and that gun continues to follow target.
2 continues to watch elevation lagmeter pointer, or, if operating gun manually, continues to match pointers.
7 continues to watch azimuth lagmeter pointer, or, if operating gun manually, continues to match pointers.
G stops firing and takes hand away from firing lever; if round remains in bore, signals 4 to remove round; when 4 is in position, opens breech to allow 4 to remove round.
4 stops loading but stands ready to resume loading should the command FIRE be given again; if round remains in bore, removes round at direction of G and passes it back to the ammunition squad.
AC sets fuzes to SAFE.
5 continues to match pointers on fuze setter.
1 loads fuze setter.
3 sets fuze to have fuze ready for immediate use.

NOTE.—*After the fuze is set the round is left in the fuze setter until the command* FIRE *is given. Once the fuze is SET, it will continue to be reset to new values as new fuze data come from the director.*

6, 8 stand ready to resume relaying ammunition to 1.
9 clears away empty cartridge cases.
AC supervises the replenishing of ammunition at gun position.
10, 11, 12 replenish ammunition at gun position.

■ 25. CEASE TRACKING.

GC, at command CEASE TRACKING, repeats command.
2 turns indicator regulator switch to MANUAL, stopping at the intermediate position for 5 seconds; raises transfer valve and engages handwheels; remains at post.
7 turns indicator regulator switch to MANUAL, stopping at intermediate position for 5 seconds; raises transfer valve and engages handwheels; turns off motor switch; remains at post.
G remains at post.
5 turns mechanical pointer on fuze setter to SAFE; supervises 1 and 3 in setting to SAFE all fuzes that have been SET, checking each fuze as it is removed from fuze setter; remains at post.
1, 3 assist 5 in setting all SET fuzes to SAFE and returning them to stacks; remain at posts.
9 clears away all empty cartridge cases; remains at post.
4, 6, 8 remain at posts.
AC supervises ammunition squad in replenishing stacks at gun position; checks ammunition to see that it is ready to be fired; remains at post.
10, 11, 12 replenish ammunition at gun position; remain at post.

SECTION VI

DIRECT FIRE DRILL

■ 26. TARGET, DIRECT FIRE.

GC commands: TARGET, DIRECT FIRE; designates target and sights along gun tube to assist azimuth and elevation setters to point the gun.
2, with handwheels engaged and transfer valve plunger in the OUT position, sights through elevation telescope and operates gun manually to get target on proper range line; calls "ON" when he is on target.

7, with handwheels engaged and transfer valve plunger in the OUT position, sights through azimuth telescope and operates gun manually to get target on proper deflection line; calls "On" when he is on target.

FIGURE 17.

G *without power rammer,* opens breech by bearing down on breech operating handle; returns breech operating handle to latched position; after 4 places round in breech, rams round home with front of left clenched fist; watches GC for signal to fire.

With power rammer, opens breech by bearing down on breech operating handle; returns breech operating handle to latched position; when 4 places round into breech recess, rotates ramming arm into position behind cartridge; after 4 has tripped the rammer and the breechblock has closed, pivots back on his right foot and watches GC for signal to fire.

4 *without power rammer,* receives round from 1 and holds it in the loading position at the breech where G can ram it "home", as soon as round has been loaded, steps back to receive the next round from 1.

With power rammer, receives round from 1 and lays it into the breech recess, moving it into the chamber far

enough to allow G to rotate rammer arm; after G has positioned the rammer arm, trips the rammer with his left hand, loading the round; as soon as round has been loaded, steps back to receive the next round from 1.

1 relays ammunition to 4.

6 relays ammunition to 1.

8 relays ammunition to 6.

3 takes post about 5 yards away from gun, at right of elevation setter, to observe and spot bursts.

5 takes post about 5 yards away from gun, at left of azimuth setter, to observe and spot bursts.

9 removes protective covers from ammunition stacks and makes ammunition available to 8.

■ 27. FIRE.

GC gives estimated range to 2 and estimated lateral lead in mils to 7.

2 tracks target until he has target on correct range line as given by GC; indicates he is on target by calling "Elevation"; after each shot, makes correction, resights target, and calls "Elevation."

7 tracks target until he has target on correct mil lead line, as given by GC; indicates he is on target by calling "Azimuth"; after each shot, makes correction, resights target, and calls "Azimuth."

GC commands: FIRE, as soon as 2 and 7 call "Elevation" and "Azimuth."

G, after command FIRE has been given by GC and both trackers have indicated they are on target, pulls firing lever to fire gun; kicks empty cartridge cases clear of platform; continues to fire succeeding shots as soon as 2 and 7 call "Elevation" and "Azimuth" for each shot, or until GC commands: CEASE FIRING.

4 continues to serve rounds to the breech.

1, 6, and 8 continue relaying ammunition.

3 spots bursts; calls "Over," "Short," or "Hit," as the case may be.

5 spots bursts; calls "Right," "Left," or "Hit," as the case may be.

9 clears away empty shell cases.

10, 11, 12 replenish ammunition supply at gun position.
AC supervises ammunition squad.

■ 28. CEASE FIRING.

GC commands: CEASE FIRING, when target has been disposed of. He may then assign a new target, have the men remain on the alert at their positions, or may command: CEASE TRACKING.
G ceases firing; stands ready to resume firing should a new target be assigned; if unfired round remains in bore, keeps all cannoneers clear of recoil.
4 ceases loading; stands ready to resume loading.
1, 6, and 8 stand ready to continue relaying ammunition.
2 continues tracking target in elevation; if target has been hit, keeps sight on target until new target is assigned.
7 continues tracking target in azimuth; if target has been hit, keeps sight on target until new target is assigned.
3 and 5 continue to act as observers.
9 clears away empty cartridge cases.
10, 11, and 12 replenish ammunition at gun position.
AC supervises ammunition squad.

■ 29. CEASE TRACKING.

GC commands: CEASE TRACKING.
G remains at post; if unfired round remains in bore, directs 4 to remove round, and opens breech when 4 is in position.
4 remains at post; if unfired round remains in bore, removes round at direction of GC and passes round back to 1.
1, 6, and 8 return ammunition to stacks; remain at posts.
2, and 7 cease tracking; remain at posts.
3 and 5 remain at posts.
9 clears away empty cartridge cases.
10, 11, 12 replenish ammunition at gun position.
AC supervises ammunition squad.

CHAPTER 4

NOTES ON MATÉRIEL

SECTION I

EMPLACEMENT

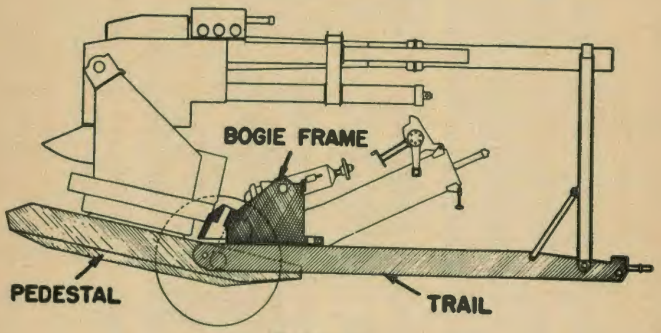


FIGURE 18.

■ 30. DESCRIPTION.—Figure 18 is a schematic diagram of the 90-mm AA gun M1 on Mount M1A1 in the traveling position.

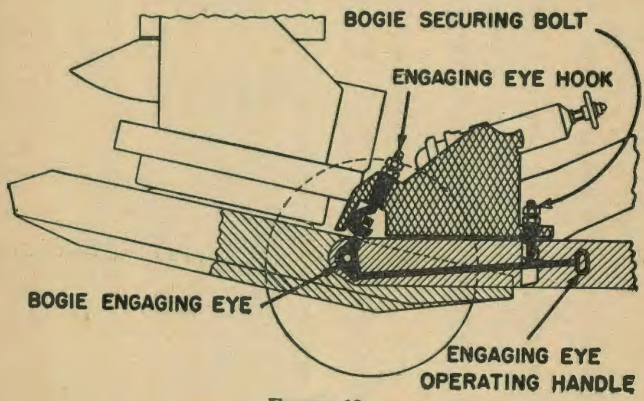


FIGURE 19.

The cross sectioning denotes the bogie frame, pedestal, and trail. From the diagram it can be seen that the pedestal and trail are underneath the bogie frame.

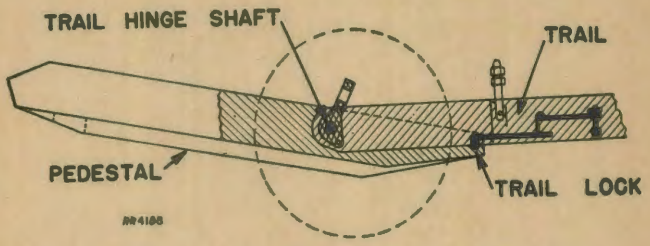


FIGURE 20.

The pedestal and trail are secured to the bogie frame by two engaging eye hooks (fig. 19), located in the rear of the bogie frame, which engage the bogie engaging eyes, and by two securing bolts, attached to the trail, that swing up into slots in the front part of the bogie frame.

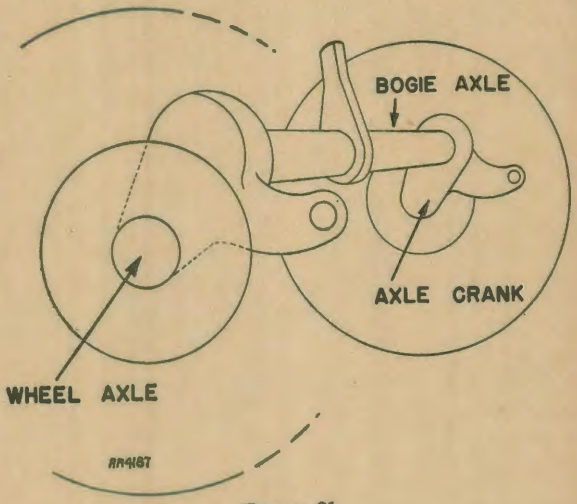


FIGURE 21.

The trail and pedestal are held rigidly together at one of two positions by the trail hinge shaft and the trail lock. In figure 20 the trail is in the upper or traveling position.

The bogie consists of an eccentric axle (fig. 21) which can best be described as a main axle (bogie axle) with an axle crank welded to each end. Each axle crank has a wheel spindle about which the wheel can revolve.

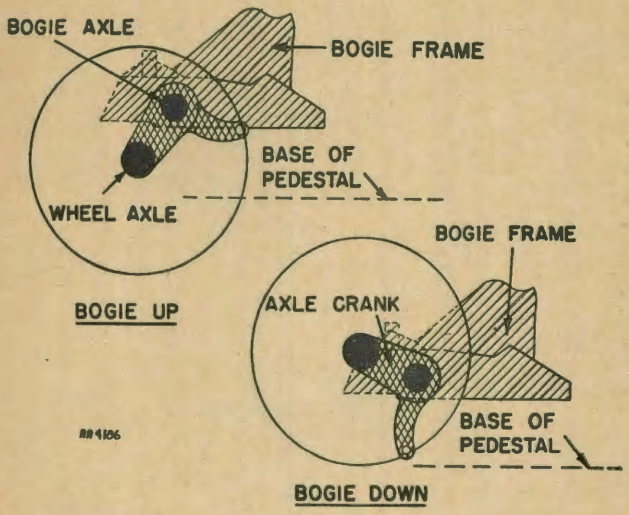


FIGURE 22.

Mounted on the bogie axle is the bogie frame (fig. 22.) The bogie frame is free to rotate about the bogie axle and always remains in a horizontal position. By rotating the bogie axle about the wheel spindles (wheel axles) the bogie frame is raised or lowered. Likewise, the pedestal is raised or lowered since it is hung underneath the bogie frame by the bogie eye hooks and bogie securing bolts.

Attached to the bogie frame are two counterpoise cylinders (fig. 23) which assist in raising and lowering the bogie frame to and from the traveling position and act as shock absorbers when the gun is traveling.

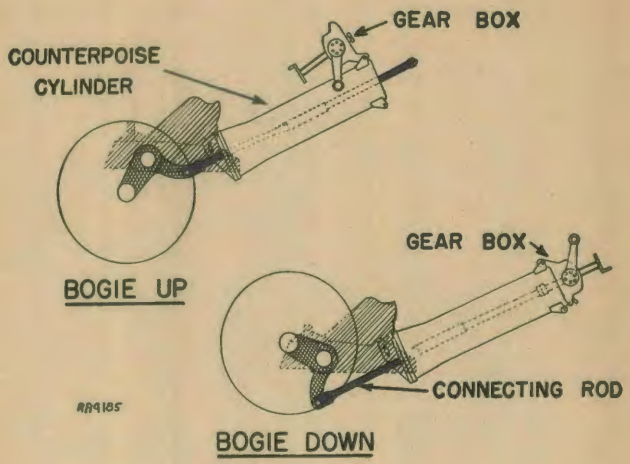


FIGURE 23.

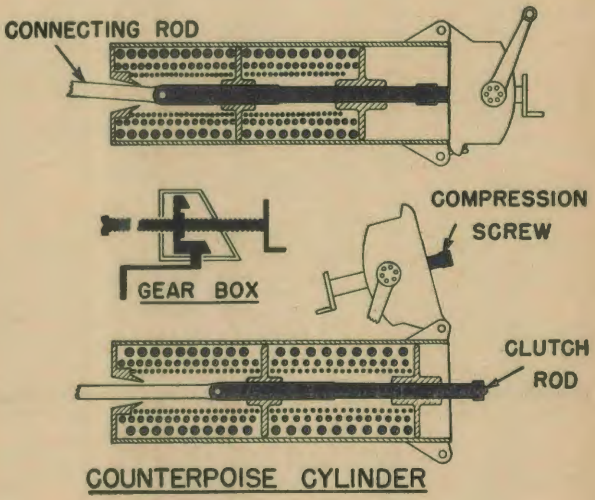


FIGURE 24.

Each counterpoise cylinder consists of a connecting rod, clutch rod, two groups of three springs each, and a compression screw. One end of the connecting rod is attached to the axle crank and the other end is attached to the clutch rod. When the gun is emplaced, the bogie axle rotating about the wheel axle pulls on the connecting rod which in turn pulls the clutch rod within the counterpoise cylinder (fig. 24) so that the counterpoise gear box, with the compression screw, can be fastened over the end of the counterpoise cylinder. The weight of the gun will rotate the bogie axle far enough to compress the counterpoise springs to such an extent that the counterpoise gear boxes can be engaged. At this point the forces exerted by the weight of the gun and the compressed springs are equal, and it is necessary to turn the compression screws to force the bogie axle down until the pedestal is resting firmly on the ground.

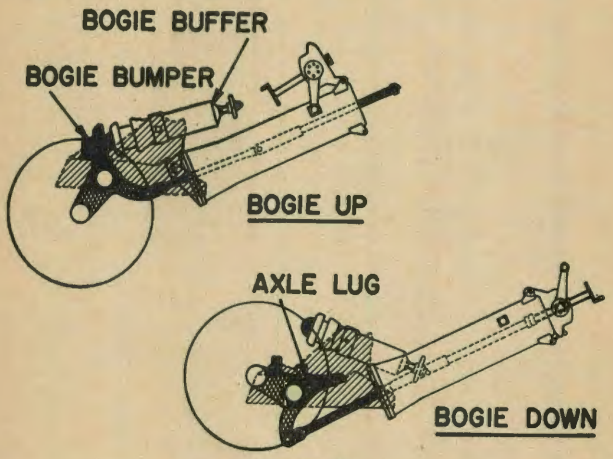
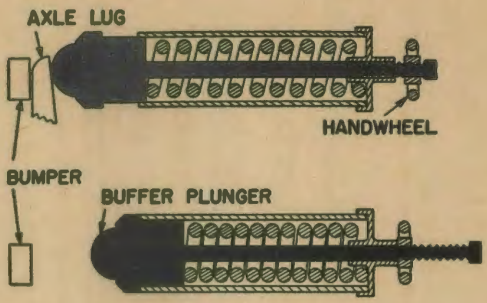


FIGURE 25.

To prevent the mount from emplacing itself while traveling, there is an axle lug welded to the bogie axle, which is held firmly in place between the bogie bumper and bogie buffer (fig. 25). To emplace the gun it is necessary to remove the bogie buffer from the path of the axle lug so that the bogie axle can rotate about the wheel axle.



BOGIE BUFFER

FIGURE 26.

The bogie buffer (fig. 26) consists of a cylinder pivoted to the bogie frame, a plunger, a spring, and a retracting handwheel. In the traveling position the spring holds the plunger against the axle lug. To emplace the gun, it is necessary to turn the handwheel to retract the plunger from the axle lug and swing the buffer out of the way.

■ 31. EMPLACEMENT WITH PRIME MOVER.—*a.* In figure 27 the gun is in the traveling position, the bogie axle is approxi-

90 mm MOUNT - TRAVELING POSITION

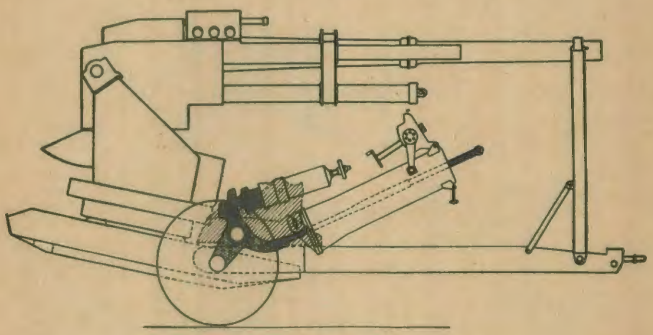


FIGURE 27.

mately over the wheel axles, the bogie buffer is holding the axle lug against the bogie bumper, and the counterpoise clutch rods are extending beyond the open end of the counterpoise cylinders.

b. To emplace the gun, the electric brakes are applied to prevent the bogie wheels from turning and the prime mover pulls forward several feet. This action pulls on the trail, bogie frame, and bogie axle, and causes the bogie axle to rotate forward and down about the wheel axle. As the bogie axle moves forward, it forces the axle lug against the bogie buffer plunger and forces the plunger into the cylinder, compressing the spring. This permits the handwheel on the bogie buffer to be run down to hold the buffer plunger in the retracted position. The prime mover then backs up several feet, causing the axle lug on the bogie axle to be rotated away from the buffer plunger so that the buffer can be tipped out of the path of the axle lug. If the prime mover is again pulled forward, the bogie axle rotates about the wheel axles and lowers the pedestal to the ground. This action compresses the counterpoise springs and since the springs act to raise the mount to the traveling position, it is necessary to engage the counterpoise gear boxes over the ends of the cylinder to keep the springs compressed before uncoupling the trail from the prime mover.

c. With the counterpoise gear boxes engaged, the prime mover is uncoupled from the trail, the platforms removed from their brackets on the trail, the transom cap unfastened from the gun tube, and the tube elevated to maximum elevation (fig. 28). The tube is elevated at this point to transfer the preponderance of weight of the gun to the rear of the pedestal to facilitate lowering the trail. With the tube elevated, the mount is completely crushed by turning the cranks on the counterpoise cylinders in the direction of **BOGIE DOWN**, until the pedestal is resting firmly on the ground and none of the weight is supported by the bogie (fig. 29). The trail is then lowered from its upper position as shown in figure 29 to the lower position as shown in figure 30. To lower the trail (fig. 30), the bogie securing bolts are disengaged from the front of the bogie, the nuts on the engaging eye hook are loosened, the swing bolt from the trail lock

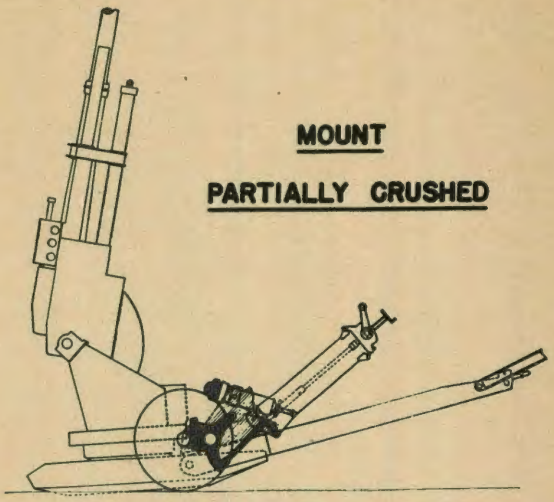


FIGURE 28.

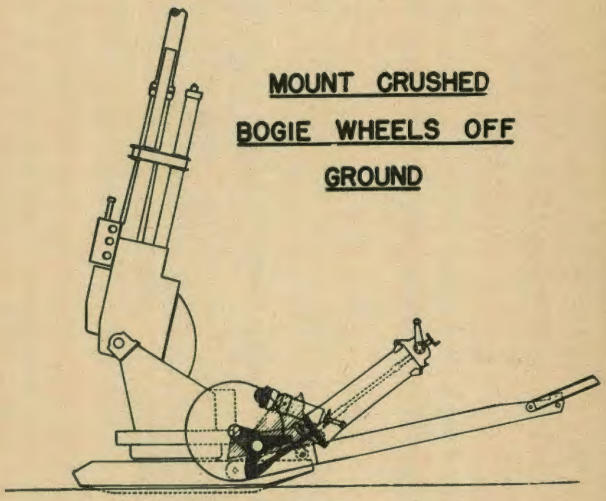


FIGURE 29.

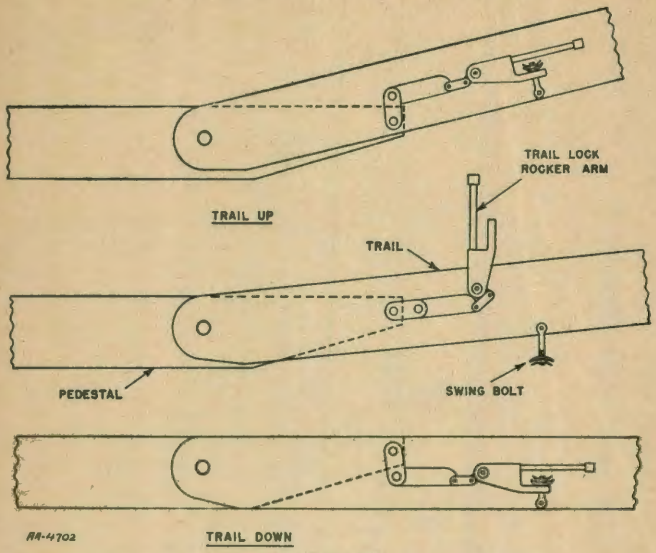


FIGURE 30.

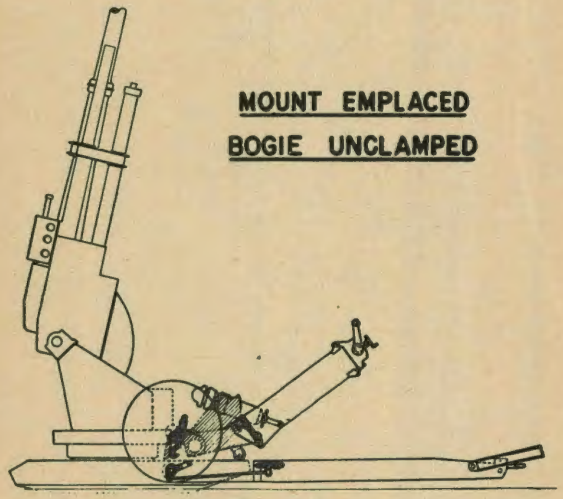


FIGURE 31.

rocker arm is unfastened, and the rocker arm pulled up. This unlocks the trail from the front of the pedestal and allows the trail to be lowered until it is in the same plane with the pedestal, where it is locked in the lower position by pulling down on the trail lock rocker arm and securing it with the swing bolt.

d. After the trail is lowered, the bogie engaging eye operating handles (fig. 31) are pushed in to disengage the eyes from the eye hooks and the bogie is rolled out to the end of the trail. This accomplishes emplacement with the exception of leveling which is taken up elsewhere in the manual.

SECTION II

DIRECT FIRE SIGHTS

■ 32. GENERAL.—Antiaircraft artillery may be used effectively against ground and water-borne targets. For this purpose direct-fire telescopic sights have been provided for the 90-mm gun in firing at ranges up to 3,000 yards. One telescope is used for tracking in azimuth and one for tracking in elevation.

■ 33. DESCRIPTION.—*a. Mounts.*—Mount M28 is used for mounting the elbow telescope M24 to the left side of the gun. It is attached to the top carriage above the azimuth handwheels and rotates with the gun in azimuth only. Telescope mount T65 is used for mounting elbow telescope M26 to the right side of the gun. It is attached to the side of the cradle, back of the indicator regulator; it moves with the gun in azimuth as well as in elevation.

b. Telescopes.—Except for their reticle patterns the two elbow telescopes, M24 for azimuth and M26 for range, are similar. Each is a three-power, erect image instrument with a field of view of 13°20′ or $\frac{1}{27}$ of a full circle.

c. Azimuth reticle.—The reticle of the azimuth telescope has a single horizontal scale marked in mils lead (fig. 32). The minimum graduation is 5 mils and the numbered graduations are multiples of 10.

d. Range reticle.—Across the bottom half of the range telescope's reticle are seven horizontal range lines for aiming at the following ranges: point blank, 500 yards, 1,000 yards, 1,500 yards, 2,000 yards, 2,500 yards, and 3,000 yards (see fig. 33).

FIGURE 32.—Azimuth reticle, elbow telescope M24.

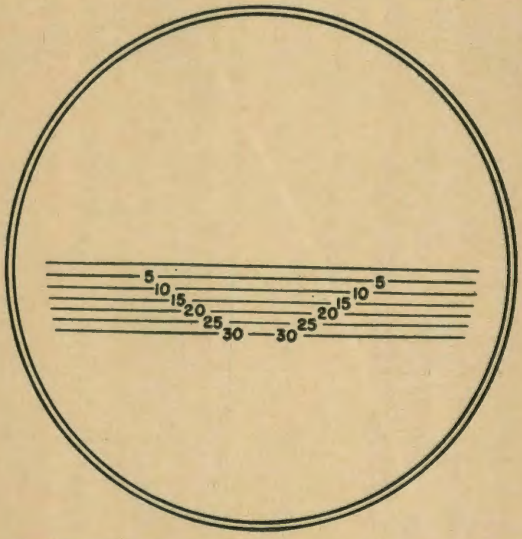


FIGURE 33.—Range reticle, elbow telesope M26.

■ 34. ALINEMENT.—*a*. The telescopes are in alinement and properly adjusted when the line of sight of the telescopes are parallel to axis of the gun bore, and the horizontal deflection scale and range lines of the reticles are in the horizontal position.

b. To check alinement and adjustment of the telescopes, place the bore sights in the gun and accurately point it at a celestial body or the most distant distinct point available. This point should appear on the zero mark on the deflection

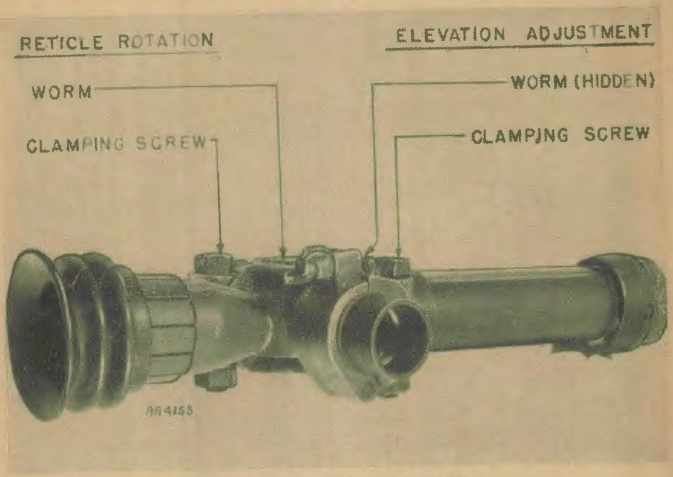


FIGURE 34.—Telescope M26.

scale of the azimuth reticle and on the center of the zero range line of the elevation reticle. The horizontal deflection scale of the azimuth reticle and the range lines of the elevation reticle should be in a horizontal position. If these conditions do not exist, one or more of the following adjustments are made:

(1) The reticle lines are placed in a horizontal position. A reticle rotation worm screw, secured by a clamping screw, on top of the telescope's elbow angle is provided for this purpose. (See figs. 34 and 35.) To bring the reticle line to the horizontal position, loosen the clamping screw; turn the worm,

the head of which has a screw driver slot, until the reticle line is satisfactorily positioned; then tighten the clamping screw.

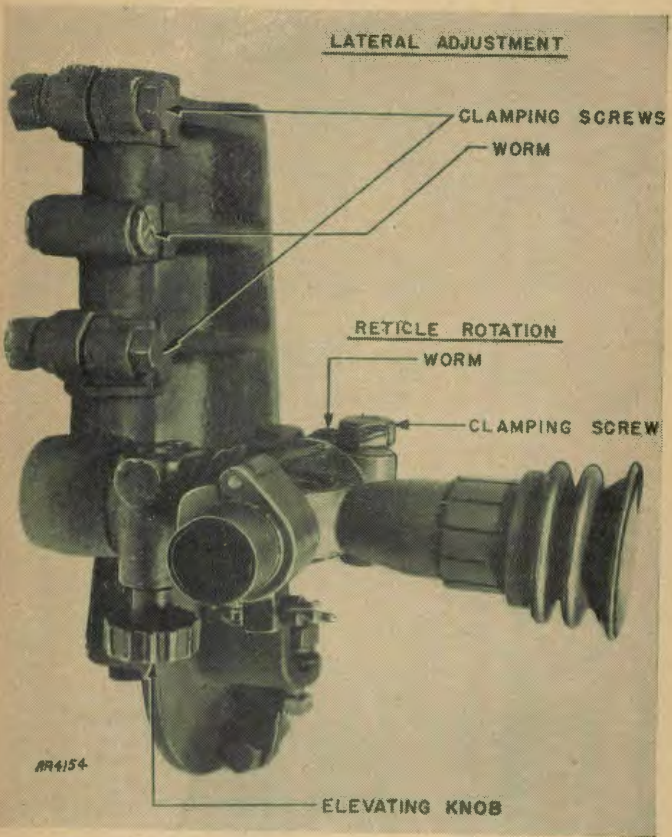


FIGURE 35.—Telescope mount M28 with telescope M24.

(2) The orienting point must be brought to the zero range line of the range reticle and to the top of the deflection scale of the azimuth reticle.

(*a*) In the range telescope, raise or lower the point to the zero range line by loosening the clamping screw and turning the elevation adjusting worm (fig. 34) on top of the telescope. When the adjustment is complete, tighten the clamping screw.

(*b*) In the azimuth telescope, raise or lower the orienting point to the horizontal line by turning the elevating knob (fig. 35) under the elbow angle.

(3) The orienting point must be centered on the horizontal line of each telescope. To do this, loosen the two clamping screws (fig. 35) on the telescope mount, turn the worm between them until the sight is adjusted accurately, and then tighten the two collar screws.

NOTE.—After tightening the clamping screw of any worm adjustment, always check to see that alinement has not been altered by the screw's pressure.

■ 35. DUTIES OF PERSONNEL.—When using direct-fire sights, only four members of the gun crew remain on the platform. The fuze setter operator (3) and the fuze range setter (5) take spotting posts to the right and left, respectively, about 5 yards from the edge of the platform. No 1 moves off the platform and becomes an ammunition relayer, relaying the ammunition from 6 directly to 4. Nos. 8 and 6 relay ammunition to No. 1. No. 4 holds each round in readiness at the breech for the gunner to ram home. The gunner, instead of firing immediately, waits for the signal from the gun commander to fire. The gun commander gives the signal to fire the first round only when both azimuth setter and elevation setter signify they are on target.

■ 36. TRACKING.—Manual operation of the gun is required while using direct-fire sights. The azimuth setter observes through his telescope with his left eye, following the target by turning the azimuth handwheel. If necessary, he simultaneously twists the telescope's elevation knob with his left hand to keep the target within the limits of the reticle. The center line of this reticle should always point *ahead* of a moving target and *at* a stationary target. The elevation setter observes through his telescope with his left eye, following the target in range by turning the elevation handwheels. In

tracking targets with the elevation telescope, carry the vertical center of the target on the correct or estimated range line.

■ 37. FIRE CONTROL.—The gun commander estimates the target speed and range, and calls the lateral lead and range to the azimuth and elevation trackers. From these data the trackers set the initial lateral lead and range. As the first and succeeding shots are fired, they observe the bursts or impacts and make corrections on their own initiative. They are aided in their sensings by the sensings of the spotters (3 and 5). Nos. 3 and 5 observe the bursts and call "Right" or "Left" for the azimuth observer and "Over" or "Short" for the range observer. For a full discussion of fire control using direct-fire sights, see FM 4–110 and FM 4–121 (when published).

■ 38. AMMUNITION.—Armor-piercing shot M77 and projectile M82 with armor-piercing cap are provided for fire against armored targets. Both types contain a tracer element for the observation of fire. In addition, the regular high-explosive shell M71 for firing against thin-skinned targets is available.

■ 39. CARE.—*a*. There are oil cups on both telescope mounts for the lubrication of the principal bearing surfaces. Oil is applied as required by service conditions. Clamp pivots on the telescope brackets are oiled occasionally with only a few drops of oil. All excess oil is wiped off to prevent any accumulation of dust and grit.

b. The lenses of the telescope are cleaned only with alcohol and a camel's-hair brush, and then wiped dry with lens tissue. The rubber eyeshields are removed occasionally and washed in warm water.

c. When the telescopes are placed in their mounts, all dust and grit must be wiped off the contact surfaces of both telescope and mount. The projecting lug of the telescope is fitted into its mated opening on the mount and the wing nut should be securely tightened.

d. The elbow telescopes are placed in their carrying case when not in use. The adapter and eyeshield are pushed along the telescope tube until the shield is flush with the end of the tube. This prevents the shield from being flattened or crushed.

CHAPTER 5

SAFETY PRECAUTIONS

■ 40. GENERAL.—Safety precautions to be observed for training are prescribed in AR 750–10 and FM 4–118 (when published). The more important safety precautions relating to the gun section are summarized in the following paragraphs. These precautions will be followed as closely as the situation permits, even under combat conditions.

■ 41. AMMUNITION.—*a.* All ammunition at the firing point must be placed so as to be protected against explosion in case of accident at the gun position. It should be in a dry place and protected against direct rays of the sun by a tarpaulin or other suitable covering. Erratic shots and dangerously high powder pressures may result from overheated ammunition.

b. No attempt will be made by battery personnel to disassemble the round or fuze. This is dangerous and is strictly prohibited.

c. If for any reason a round is not fired after the fuze has been set, the fuze will be reset at SAFE before putting the round away.

d. In case of a misfire, two attempts are made to fire the round before opening the breach and removing the round.

e. If a live round cannot be extracted in the normal manner, it is fired, safety precautions permitting. If this is impossible, it is removed under the supervision of an officer, a rammer being used which bears only on the projectile and provides for clearance around the fuze.

■ 42. MATÉRIEL.—*a.* In coupling or uncoupling the gun with the prime mover, no one should be between the prime mover and the lifting bar of the trail. Sudden movements of the prime mover would crush anyone caught between.

b. In emplacing the gun it is necessary to compress the counterpoise springs *before* loosening the nuts of the bogie engaging eye hooks. This must be done to prevent the equilibrator cylinder from resting on the bogie frame and thus supporting the entire weight of the mount less bogie.

c. When the leveling packs are manipulated, the auxiliary leveling screw must be manipulated at the same time to prevent damage as a result of the auxiliary leveling screw binding.

d. When preparing the gun for traveling and the mount is lifted up to permit the bogie buffer cylinder to be rotated down against the axle lug, the rear outrigger must *not* be unpinned from the pedestal to facilitate the operation. When this is done there is danger of the mount overturning. If necessary, dirt should be dug out from under the rear outrigger instead.

■ 43. DRILL AND FIRING.—*a.* The gun is unloaded except when it is being fired or when about to be fired.

b. Members of the gun section always pass in rear of the gun, clear of the recoil, when going from one side of the gun to the other.

c. Personnel must keep at a safe distance from the rear of the breech to prevent injury when the gun recoils.

d. The gunner keeps clear of the firing lever until the piece has been loaded and is ready to be fired. Care must be taken to prevent accidental contact with the firing lever during the loading operation. *In addition, the gunner makes sure that he does not fire the piece until he has pivoted on his right foot away from the rear and to the side* of the gun.

e. The gun platform should be kept in such condition that its surface offers the maximum frictional resistance to the footgear of personnel. It should be kept free of oil and grease, and sprinkled with sand during rainy weather. Hobnailed shoes should not be worn by personnel on the gun platform.

CHAPTER 6

DESTRUCTION OF MATÉRIEL

■ 44. GENERAL.—*a.* Tactical situations may arise when, due to limitations of time or transportation, it will become impossible to evacuate all equipment. In such situations it is imperative that all matériel which cannot be evacuated be destroyed to prevent—

(1) Its capture intact by the enemy.

(2) Its use by the enemy, if captured, against our own or allied troops.

b. The working principles to be followed are:

(1) Methods for the destruction of matériel subject to capture or abandonment in the combat zone must be adequate, uniform, and easily followed in the field.

(2) Destruction must be as complete as the available time, equipment, and personnel will permit. If thorough destruction of all parts cannot be completed, the most important features of the matériel should be destroyed, and parts essential to the operation or use of the matériel and which cannot be easily duplicated, ruined or removed. The same essential parts must be destroyed on all like units to prevent the enemy constructing one complete unit from several damaged ones by "cannibalization."

(3) **THE DESTRUCTION OF MATÉRIEL IS A COMMAND DECISION TO BE IMPLEMENTED ONLY ON AUTHORITY DELEGATED BY THE DIVISION OR HIGHER COMMANDER.**

c. To accomplish adequate and uniform destruction of matériel, it is essential that—

(1) All echelons prepare plans for the destruction of matériel in the event of imminent capture. Such plans must be flexible as to the available time, equipment, and personnel.

(2) All echelons be trained to effect the desired destruction of matériel issued to them. Training will not involve the actual destruction of matériel.

■ 45. METHODS.—*a.* The destruction procedures outlined are arranged in order of effectiveness. Destruction should be accomplished by method No. 1, if possible. If method No. 1

cannot be used, destruction should be accomplished by one of the other methods outlined, in the priority shown.

b. Whichever method is used, the sequence outlined should be adhered to. Uniformity of destruction will then be obtained, whether or not the method is carried to completion.

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

■ 46. TUBE, BREECH, AND RECOIL MECHANISM.—*a. Sights.*—Detach all optical sights. If evacuation is possible, carry the sights; if evacuation is not possible, thoroughly smash the sights.

b. Method No. 1.—(1) Open drain plug on recoil mechanism, allowing recoil fluid to drain. It is not necessary to wait for the recoil fluid to drain completely before firing the gun in (4) below.

(2) Place an armed (safety pin removed) M9A1 antitank grenade, HE, or armed (safety pin removed) M6 antitank rocket in the tube about 6 inches in front of and with the ogive nose end toward the HE shell in (3) below.

(3) Insert an unfuzed HE complete round into the gun and close the breech.

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

(5) The danger zone is approximately 200 yards.

c. Method No. 2.—Insert TNT blocks in the bore near the muzzle and in the chamber of the gun. Close the breechblock as far as possible without damaging the safety fuze. Plug the muzzle tightly with earth to a distance of approximately three calibers from muzzle. Detonate the TNT charges simultaneously. The following number of ½-pound TNT blocks will be needed for effective demolition: bore, 3 to 5; chamber, 8 to 10. If it is not possible to plug the bore, a larger number of TNT blocks will be needed for effective demolition.

d. Method No. 3.—(1) Fire adjacent guns at each other at point-blank range, using HE or AP shells. Two or more direct hits from a weapon of the same caliber, on a vital spot such as the breech mechanism, recoil mechanism, or tube should adequately destroy the gun. Fire from cover, using lanyard. Danger space is from 200 to 500 yards.

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

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

e. Method No. 4.—(1) Insert four unfuzed M14 incendiary grenades end to end midway in the tube at 0° elevation. Ignite these four grenades by a fifth equipped with a 15-second Bickford fuze. Elapsed time, 2 to 3 minutes.

(2) The metal from the grenades will fuse with the tube and fill the grooves.

■ 47. CARRIAGE.—Whenever possible, artillery carriage destruction should be accomplished in conjunction with the destruction of the tube, breech, and recoil mechanism in paragraph 46. When this cannot be done, destruction of the tube, breech, and recoil mechanism will have priority.

a. Method No. 1.—(1) Place two unfuzed, boostered point detonating HE shells between the right and left wheels and the bogie. Set shells upright and place a ½-pound TNT block over the booster in each shell. Detonate TNT blocks simultaneously, using detonating cord, tetryl nonelectric caps, and at least 5 feet of safety fuze. Electric detonation methods may be used if available.

(2) If possible, combine this method with the destruction of the tube, breech, and recoil mechanism in paragraph 46*c*, using simultaneous detonation.

b. Method No. 2.—(1) Place six ½-pound TNT blocks in the battery receptacle on the trail. Detonate TNT charges simultaneously, using detonating cord, tetryl nonelectric caps, and at least 5 feet of safety fuze. Electric detonating methods may be used if available.

(2) This method of destruction may be combined wi destruction of the tube, breech, and recoil mechanism, outlined in paragraph 46*c*, by simultaneous detonations.

c. Method No. 3.—See paragraph 46*d*.

■ 48. TRUCKS.—*a. Method No. 1.*—Remove and empty portable fire extinguisher. Puncture the fuel tank. Open the hood and place a 2-pound charge of TNT on top of the clutch housing. Place another 2-pound charge on the left side of the engine as low as possible. Insert tetryl nonelectric caps with at least 5 feet of safety fuze in each charge. Ignite the fuzes and take cover. Elapsed time, 1 to 2 minutes if charges are prepared beforehand and carried in the vehicle. In this case, keep the caps and fuzes separated from the charges until used.

b. Method No. 2.—Remove and empty the portable fire extinguisher. Puncture the fuel tank. Smash all vital elements, such as distributor, carburetor, radiator, engine block, air and oil cleaners, generator, control levers, crankcase, and transmission, with a heavy ax, pick, or sledge. Pour spare gasoline, oil, or distillate over entire unit and ignite.

c. (1) Whenever time and materials are available, combine the vehicle destruction in *a* and *b* above with the armament destruction in paragraph 46.

(2) If possible, detach and evacuate all machine guns mounted in vehicles prior to destroying the vehicle.

■ 49. PNEUMATIC TIRES.—*a. General.*—(1) Rubber is such a critical item, that whenever matériel is subject to capture or abandonment, an attempt to destroy pneumatic tires must always be made, even if time will not permit destruction of the remainder of the vehicle.

(2) With adequate planning and training, however, the destruction of tires may be accomplished in conjunction with destruction of the vehicle without increasing the time necessary.

b. Method No. 1.—(1) Ignite an M14 incendiary grenade under each tire.

(2) To insure the best results when this method is combined with the destruction by TNT of the gun and carriage and of the trucks, be certain that the incendiary fires are well started before detonating the TNT.

c. Method No. 2.—(1) Damage the tires with an ax, pick, or caliber .50 machine gun fire. (If time permits, deflate the tires before damaging them.) Pour gasoline on the tires, dousing each one, and then ignite.

(2) When used in conjunction with truck destruction, the ensuing fire will usually destroy the vehicle adequately.

■ 50. CABLES.—All cables from the junction box to the gun are heaped in a pile, doused with gasoline, and burned. If time is available, cut the cable into short lengths before burning. Smash all receptacles and plugs.

■ 51. AMMUNITION.—*a. General.*—(1) Time will not usually permit the destruction of all ammunition in forward combat zones.

(2) When sufficient time and materials are available, ammunition may be destroyed as indicated in *b* and *c* below. At least 30 to 60 minutes will be required to destroy adequately the ammunition carried by combat units.

(3) In general, the methods and safety precautions outlined in TM 9–1900 should be followed whenever possible.

b. Unpacked complete round ammunition.—(1) Stack ammunition in small piles. Stack or pile most of the available gasoline in cans and drums around the ammunition. Throw onto the pile all available inflammable material such as rags, scrap wood, and brush. Pour the remaining available gasoline over the pile. Sufficient inflammable material must be used to insure a very hot fire. Ignite the gasoline and take cover.

(2) An alternate method is by sympathetic detonation, using TNT. Stack the ammunition in two stacks, about 3 inches apart, with the fuzes in each stack toward each other. Place TNT charges between the stacks. Use a minimum of 1 pound of TNT per four to five rounds of ammunition. Detonate all TNT charges simultaneously from cover.

c. Packed complete round ammunition.—(1) Stack the boxed or bundled ammunition in small piles. Cover with all available inflammable materials, such as rags, scrap wood, brush, and gasoline in drums or cans. Pour gasoline over the pile. Ignite the gasoline and take cover. (Small-arms ammunition must be broken out of the boxes or cartons before burning.)

(2) (*a*) The destruction of packed complete round ammunition by sympathetic detonation with TNT is not advocated for use in forward combat zones. To insure satisfac-

tory destruction involves putting TNT in alternate cases or bundles of ammunition, a time-consuming job.

(*b*) In rear areas or fixed installations, sympathetic detonation may be used to destroy large ammunition supplies if destruction by burning is not feasible. Stack the boxes, placing in alternate boxes in each row sufficient TNT blocks to insure the use of 1 pound of TNT per four to five rounds of ammunition. Place the TNT blocks at the fuze end of the rounds. Detonate all TNT charges simultaneously. See FM 5–25 for details or demolition planning and procedure.

APPENDIX

LIST OF REFERENCES

Cleaning, preserving, lubricating, and welding materials	TM 9–850.
Defense against chemical attack	FM 21–40.
Gunnery for aintiaircraft artillery	FM 4–110.
Formations, inspections, AAA	FM 4–120.
Fire control, AA guns	FM 4–121 (when published).
90-MM antiaircraft gun matériel M1 and M1A1	TM 9–370 and TM 9–1370.
Reference data	FM 4–118 (when published).
Remote control system M2	TM 9–1642 and TM 9–2642.
Safety precautions in firing	AR 750–10.

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