MCI 0820D

# MARINE CORPS INSTITUTE


# THE M198, 155MM TOWED HOWITZER STUDENT REFERENCE HANDBOOK

MARINE BARRACKS
WASHINGTON, DC

UNITED STATES MARINE CORPS
MARINE CORPS INSTITUTE
ARLINGTON, VA. 22222-0001

IN REPLY REFER TO
08.20d
3 Aug 92

STUDENT REFERENCE FOLDER FOR MCI 08.20d, THE M198, 155MM TOWED HOWITZER

1. Purpose. The Student Reference Folder for MCI course 08.20d, The M198, 155MM Towed Howitzer, contains excerpts from TM 9-1025-211-10, Operator's Manual for Howitzer, Medium, Towed, 155MM M198.

2. Scope. The Student Reference Folder is used to teach the student how to use the Operator's Manual for all purposes, and is used in conjunction with the course text to provide instruction in the duties of the section members in usual and unusual conditions. The Student Reference Folder is also used to teach the student how to conduct all fire control tests.

3. Applicability. This Student Reference Folder is intended for instructional purposes only and is not to be used as a reference for operating, testing or maintaining the howitzer.

4. Recommendations. Comments and recommendations on the contents of the Student Reference Folder are invited and will aid in subsequent revisions. Please complete the course evaluation questionnaire located at the end of the course text and return it to:

Director (CDD # 6)
Marine Corps Institute
Arlington, VA 22222-0001

H. L. HUGHES
Director of Education

## WARNINGS

All personnel that operate and/or maintain the howitzer must be aware of the following special precautions.

## RADIATION HAZARD

### Rules and Regulations

Copies of the following rules and regulations are maintained at HQ, AMCCOM, Rock Island, IL 61299-6000. Copies may be requested or information obtained by contacting the AMCCOM Radiological Protection Officer (RPO), AUTOVON 793-2964, Commercial (309) 782-2964.

10CFR Part 19—Notices, Instructions and Reports to Workers; Inspections.

10CFR Part 20—Standards for Protection Against Radiation.

NRC license, license conditions, and license application.

### Safety Precautions

The radioactive material used in this instrument is tritium gas ($H_3$) sealed in pyrex tubes. It poses no significant hazard to the repairman when intact. These sources illuminate the instrumentation for night operations. Tampering with or removal of the sources in the field is prohibited by Federal law. In the event there is no illumination, notify the local Radiological Protection Officer. Do not attempt to repair the level vials or the instrument in the field. If skin contact is made with any area contaminated with tritium, wash immediately with nonabrasive soap and water.

### Identification

Radioactive self-luminous sources are identified by means of radioactive warning labels (as above). These labels should not be defaced or removed, and should be replaced immediately when necessary. Refer to the local RPO or the AMCCOM RPO for instructions on handling, storage, or disposal.

### Storage

When radioactively illuminated instruments are defective, notify unit maintenance. These items must be placed in a plastic bag (item 1, appx D) and packaged in the shipping container. Spare equipment must be stored in the shipping container, as received, until installed on the weapon. Storage of these items is recommended to be in an outdoor shed-type storage or unoccupied building.

## AMMUNITION

Do not chamber ammunition except immediately prior to firing. When possible, fire or unload ammunition within 5 minutes after chambering. Ammunition left too long in a hot or warm weapon can result in cookoffs or inbore explosions which are hazardous to personnel. Use of ammunition other than that prescribed in this manual is prohibited.

## WARNINGS
(cont)

### HEARING PROTECTION

The M198 howitzer can generate blast overpressure which may damage hearing or cause injury to lungs or sinuses if proper protective measures are not followed. Supervised wearing of earplugs is required at all times, with the e-a-r type (plastic roll) preferred. The effects of blast can be reduced by moving farther to the rear of the weapon. For this reason, all crew members not required to fire the weapon should move away as far to the rear as practicable. Any crewman who experiences such problems as shortness of breath or bleeding from nose or mouth must be immediately transported to a medical facility for evaluation.

Properly worn foam earplugs provide adequate protection when firing all existing propellant charges, including M203 series, at all quadrant elevations according to the guidelines in the chart on page 2-84.

### HOWITZER

#### General

The procedures in this technical manual involve the use of a weapon system and live ammunition. All standard safety precautions governing the handling of live ammunition and operation of artillery weapons must be observed.

Elevating handwheel must be held firmly when depressing manual control lever to keep cannon from moving due to over- or underequilibration.

Make sure personnel are clear of cannon recoil path. Loss of nitrogen pressure can allow cannon to fall out of battery.

To prevent injury from air pressure, never disconnect hose assemblies before closing prime mover cutout cock.

Handbrakes must be set in garrison as well as during field emplacement.

When installing spade key in the firing position, drive in firmly using a sledge hammer.

Keep feet from under firing baseplate.

Prior to loading howitzer for actual firing, all personnel must be familiar with prescribed actions in the event of a misfire (p 2-115) and ensure prefiring checks (p 2-76) are performed.

When firing howitzer at night, personnel should avoid direct viewing of muzzle flash from their weapon or adjacent weapons when firing top zones. Temporary flash blindness can be caused by intense muzzle flash, resulting in potential reduction of crew efficiency.

Stickers may occur when firing charge 2. When stickers occur, the projectile lodges in tube and hot gasses under pressure are trapped in the chamber. Removal of the primer is dangerous as it will be shooting rearward when released. Do not stand behind the breech when removing the primer; the expelled primer may cause injury to personnel standing in its path or ricochet. Do not grasp the firing mechanism block assembly so that your hand is in the way of the expelling primer.

In case of a MISFIRE/HANGFIRE, follow the Misfire procedures for tube temperature. When breech is opened, to remove the powder charge and primer, if smoke/sparks are coming from the chamber area, do not attempt to remove the charge or close the breech, immediately evacuate the area and notify EOD.

Before attempting to shift direction of howitzer by using speed shift cylinder assembly, be sure weapon is free of all ammunition and WHEELS lever is in the OFF position.

Handbrakes are to remain locked if the howitzer is on any degree of an incline and are not to be released until the lunette is on the prime mover pintle. Release of handbrakes while howitzer is on incline may allow the howitzer to roll causing injury to personnel.

Personnel should stay clear of area between prime mover and howitzer.

The wheel and tire are heavy. To remove or install, use a hoist if available. If hoist is not available, two crewmen are required to remove or install wheel and tire. Use care to avoid injury.

For safety precautions, prior to beginning any painting operations, refer to TM 43-0139. Improper application or removal of CARC paint can be extremely hazardous to your health.

**FIRST AID**

For further information on first aid refer to FM 21-11.

Technical Manual
No. 9-1025-211-10*

TM 9-1025-211-10*
HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D.C., 14 January 1991

# OPERATOR'S MANUAL

# FOR

# HOWITZER, MEDIUM, TOWED: 155-MM, M198
# (1025-01-026-6648)

**REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS**

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Armament, Munitions and Chemical Command, ATTN: AMSMC-MAS, Rock Island, IL 61299-6000. A reply will be furnished to you.



## TABLE OF CONTENTS



*This manual supersedes TM 9-1025-211-10, dated 1 October 1979, including all changes in their entirety.

# HOW TO USE THIS MANUAL

## GENERAL

**a.** Whenever the masculine gender (i.e., crewman) is used in this manual, it includes both masculine and feminine genders.

**b.** The text is keyed to the illustrations by numbered callouts. When an item is called out in a procedure, a number in parentheses in the text corresponds with a circled number on the illustration.

**c.** Some illustrations of the howitzer may have equilibrator ballistic shields and the recoil mechanism ballistic shield removed for clarity.

**d.** The preventive maintenance checks and services table (p 2 10) includes equipment serviceability criteria. The information normally found in the For readiness reporting . . column is in the Procedures column.

**e.** Procedures for unmodified howitzers, where applicable, are provided before procedures for modified howitzers.

## INDEXES

**a. Front Cover Index.** A page reference index of often used portions of the manual.

**b. Table of Contents.** Lists all chapters and their sections, appendixes, and alphabetical index in order and gives page references to where they begin.

**c. Chapter Indexes.** All chapters contain indexes with page references.

**d. Section Indexes.** Lists each paragraph contained in the section and a page reference to the first page of the paragraph.

**e. Symptom Index.** This quick guide to troubleshooting lists common malfunctions in alphabetical order with a page reference to the test or inspection and corrective action

**f. Alphabetical Index.** At the back of the book tells you where in the manual to find a particular subject.

## NOMENCLATURE CROSS-REFERENCE LIST

Throughout this manual, most items are referred to by their official nomenclature. On page 1 2. the items referred to by their common names are listed alphabetically and are followed by their official nomenclature.

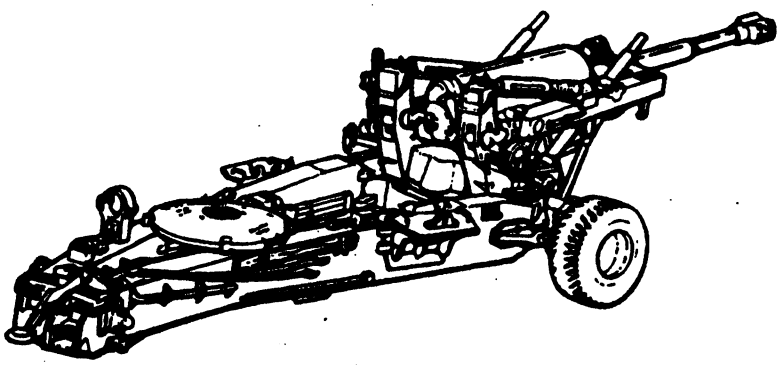
# CHAPTER 1
# INTRODUCTION

Chapter Index



## Section I. GENERAL INFORMATION





FULL EXTERNAL VIEW OF M198, 155MM, MEDIUM, TOWED HOWITZER

## 1-1. SCOPE

This manual tells the howitzer crew how to operate and maintain the howitzer in the field. It also includes training procedures.

a. **Type of Manual.** Operator's Manual.

b. **Model Number and Equipment Name.** Howitzer, Medium, Towed: 155-mm, M198.

c. **Purpose of Equipment.** To provide artillery fire in support of ground-gaining troops.

d. **Special Inclusions in Manual.** This manual includes section drill procedures on page 1-18.

## 1-2. MAINTENANCE FORMS AND RECORDS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, The Army Maintenance Management System (TAMMS).

## 1-3. HAND RECEIPT (HR) MANUALS

This manual has a companion document with a TM number followed by "-HR" (which stands for Hand Receipt). The TM 9-1025-211-10-HR consists of pre-printed hand receipts (DA Form 2062) that list end item related equipment (i.e., COEI, BII, and AAL) you must account for. As an aid to property accountability, additional -HR manuals may be requisitioned from the following source in accordance with procedures in Chapter 3, AR 25-30: Commander
US Army Publications Distribution
Center-St. Louis
ATTN: SFIS-APC-S-OC
1655 Woodson Road
St. Louis, MO 63114-6181

## 1-4. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR's)

If your M198 howitzer needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to us at Commander, Headquarters US Army Armament, Munitions and Chemical Command, ATTN: AMSMC-MAS, Rock Island, IL 61299-6000. We'll send you a reply.

## 1-5. CORROSION PREVENTION AND CONTROL

a. Corrosion prevention and control (CPC) of Army materiel is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent the problem in future items.

b. While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of these materials may be a corrosion problem. If a corrosion problem is identified, it can be reported using SF 368, Product Quality Deficiency Report. Use of key words such as "corrosion," "rust," "deterioration," or "cracking" will assure that the information is identified as a CPC problem. Submit the form to: Commander, US Army Armament, Munitions and Chemical Command, ATTN: AMSMC-QAD/Customer Feedback Center, Rock Island, IL 61299-6000.

## 1-6. NOMENCLATURE CROSS-REFERENCE LIST

This listing includes the nomenclature cross-reference list, list of abbreviations/acronyms, and explanation of terms (glossary) used in this manual.

| COMMON NAME | OFFICIAL NOMENCLATURE |
|---|---|
| Dipstick | Liquid gage rod-cap |
| Emergency hose assembly | Hose assembly |
| Handbrakes | Left and right manual brake assemblies |
| Pantel | M137 panoramic telescope |
| Service hose assembly | Hose assembly |
| Spade key | Machine key |
| SPEEDSHIFT lever | Selector valve handle |
| WHEELS lever | Selector valve handle |

## 1-7. LIST OF ABBREVIATIONS/ACRONYMS

The following alphabetical list gives definitions for the abbreviations and acronyms used in this manual.

ADAM . . . . . Area denial artillery munition
BCS . . . . . Battery computer system
BE . . . . . Base-ejection
CHG . . . . . Charge
CLGP . . . . . Cannon-launched, guided projectile
comp . . . . . Composition
CP . . . . . Concrete-piercing
CTA . . . . . Common table of allowances
DF . . . . . Deflection
EFC . . . . . Equivalent full charge
EOD . . . . . Explosive ordnance disposal
ET . . . . . Electronic time
FZ . . . . . Fuze
GB . . . . . Green bag
H . . . . . Mustard gas
HC . . . . . White chemical smoke mixture
HD . . . . . Distilled mustard gas
HE . . . . . High-explosive
HEAT . . . . . High-explosive, anti-tank
HERA . . . . . High-explosive, rocket-assisted
ICM . . . . . Improved conventional munitions
JTA . . . . . Joint table of allowance
MT . . . . . Mechanical time
MTOE . . . . . Modified tables of organization and equipment
MTSQ . . . . . Mechanical time and superquick
N-m . . . . . Newton meters
P . . . . . Requires removal of supplementary if present
PD . . . . . Point-detonating
prop . . . . . Propelling
prox . . . . . Proximity
QE . . . . . Quadrant elevation
RAAMS . . . . . Remote anti-armor mine system
RB . . . . . Red bag
RMK . . . . . Remarks
RPO . . . . . Radiological protection officer
SOP . . . . . Standard operation procedure
SQ . . . . . Superquick
suppl . . . . . Supplementary
TDA . . . . . Tables of distribution and allowances
TI . . . . . Time
TOE . . . . . Tables of organization and equipment
TWD . . . . . Thermal warning device
VT . . . . . Variable time
VX . . . . . Persistent toxic casualty nerve gas
WB . . . . . White bag
WP . . . . . White phosphorous
wpn . . . . . Weapon
WTR . . . . . Grease, aircraft, general purpose, wide temperature range

## 1-8. GLOSSARY

The following is an alphabetical listing of terms with definitions used in this manual. These terms need explanation and are not defined within the text.

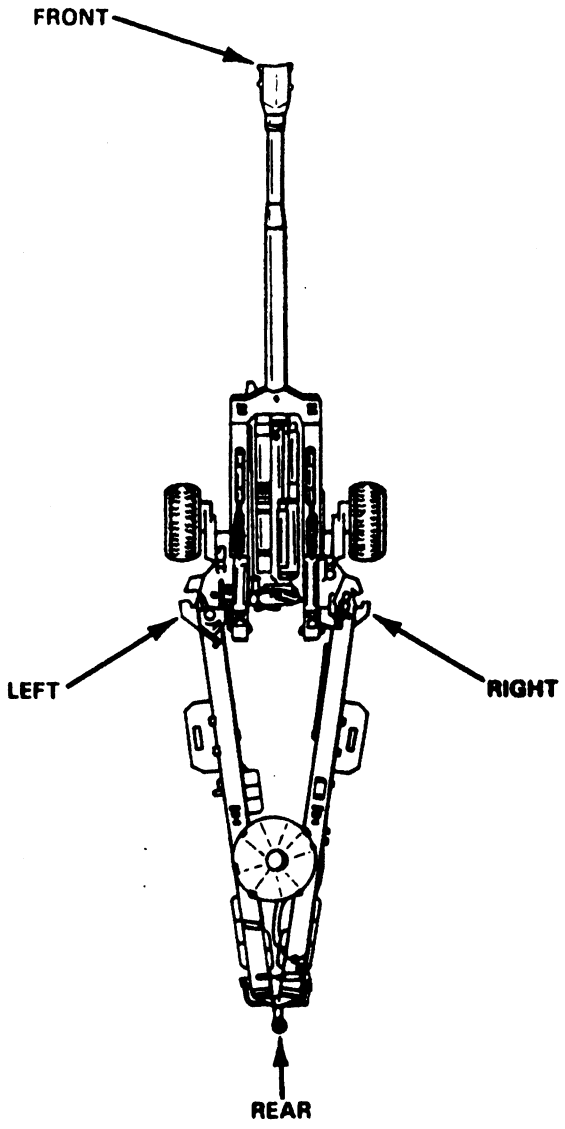
**a. Front of Weapon.** The muzzle end of the howitzer.

**b. Howitzer Section.** Those personnel specified by the current table of organization and equipment that make up a howitzer section.

**c. Left Side of Weapon.** At a person's left-hand side when standing at the breech end of the weapon, facing toward the cannon muzzle.

**d. Rear of Weapon.** The breech end of the howitzer.

**e. Right Side of Weapon.** At a person's right-hand side when standing at the breech end of the weapon, facing toward the cannon muzzle.




# Section II. EQUIPMENT DESCRIPTION

**Section Index**

## 1-9. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

a. The M198 howitzer provides general support field artillery firing for the light divisions by providing both nuclear and nonnuclear firing.

**NOTE**

A modified travel lock (to be fabricated by direct support maintenance) will be installed on all howitzers being airlifted by the CH47/CH47D helicopter. The modified travel lock will prevent damage to the helicopter and is to be used for airlift only, and not for towing the howitzer.

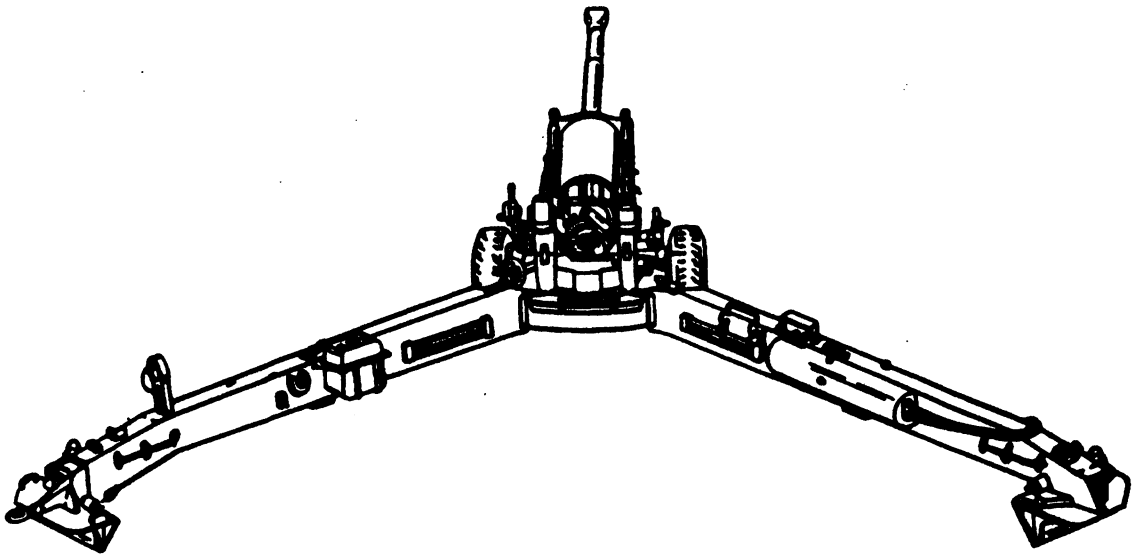
b. The M198 is an extended range, split-trail weapon that can be towed by a vehicle or airlifted by a CH47/CH47D helicopter. The carriage has a retractable suspension system and a top carriage which can be rotated 3200 mils to decrease overall length for shipment or storage.

c. The fire control equipment may be used by one or two crewmen for direct or indirect fire. The gunner on the left side controls left and right (traversing) settings and the assistant gunner on the right side controls up and down (elevation) settings. The equipment can also be operated by a gunner on the left side controlling both traversing and elevation settings. All vials, reticles, and counters on the fire control and accessory equipment are radioactively illuminated.

d. The medium weight M198 howitzer has a low profile, may be emplaced rapidly, and has a 6400-mil speed shift assembly.

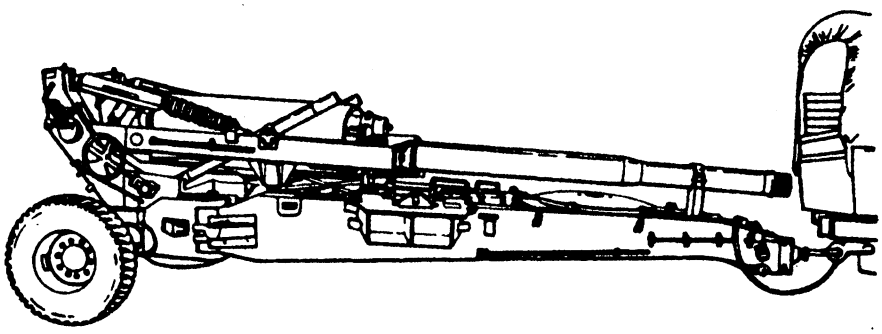
## 1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

a. **Howitzer Positions.** The firing, stowed, and towed positions for the M198 howitzer are as shown.



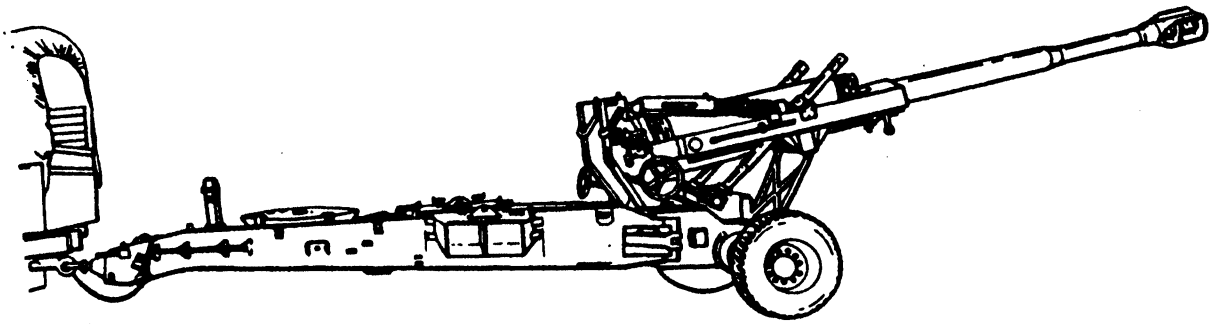
FIRING POSITION

## 1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont)



STOWED POSITION

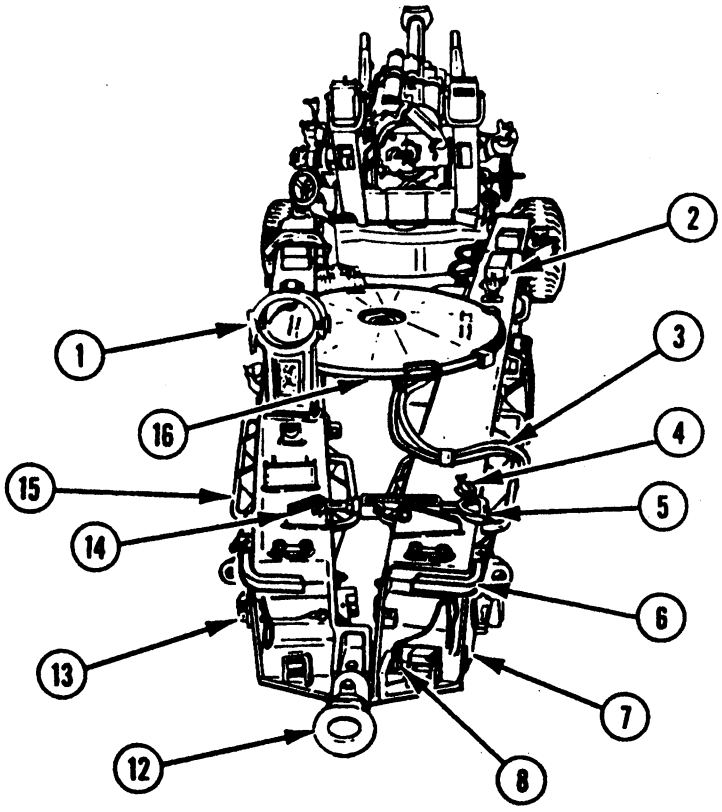
**NOTE**
The muzzle brake is removed to tow the weapon in the stowed position.



TOWED POSITION

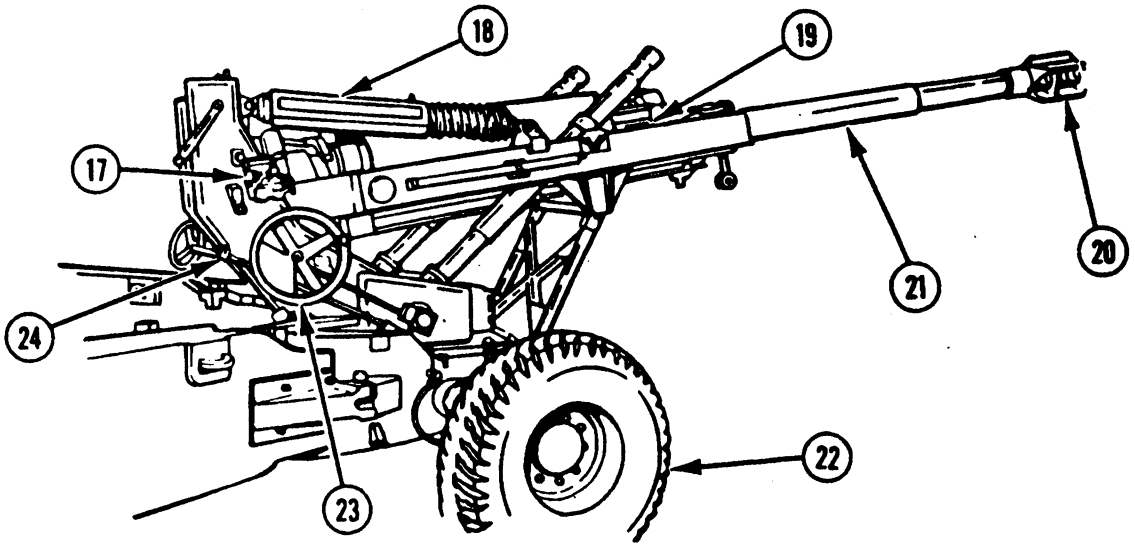
**b. Howitzer Components.** Familiarize yourself with the components of the M198 howitzer. Start with item number 1; then go to numbers 2, 3, 4, 5; and continue until you reach number 37. Go to page 2-1 for a detailed description of the controls and indicators.

| Item | Component |
|---|---|
| 1 | Gun tube travel lock |
| 2 | Brake precheck |
| 3 | Service and emergency hose assemblies |
| 4 | Cam lock |
| 5 | Trail lock handle assembly |
| 6 | Lifting handle |
| 7 | Right trail |
| 8 | Trail retaining pin |
| 9 | BCS gun assembly (GA) bracket |
| 10 | Spade |

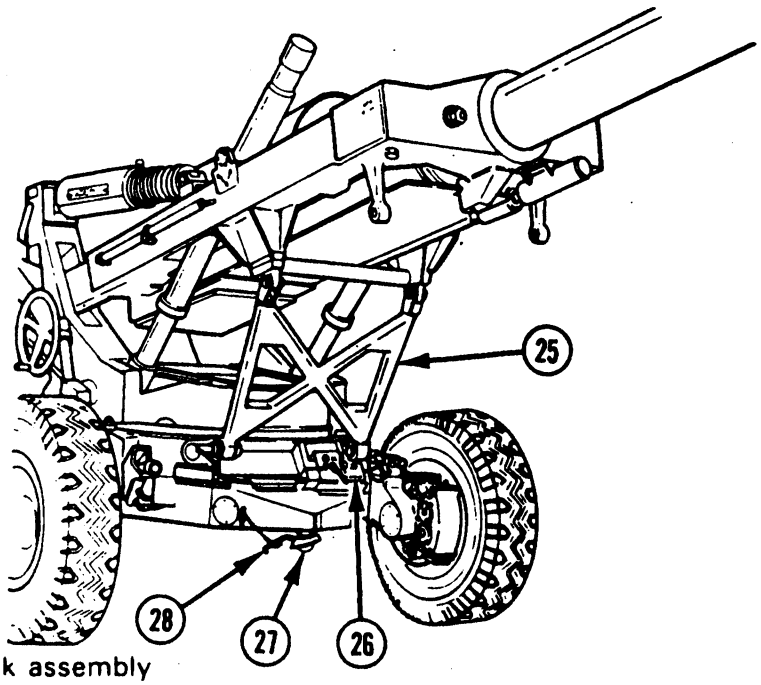



11 Drain cock
12 Lunette
13 Left trail
14 Trail lock
15 Lifting handle
16 Firing baseplate

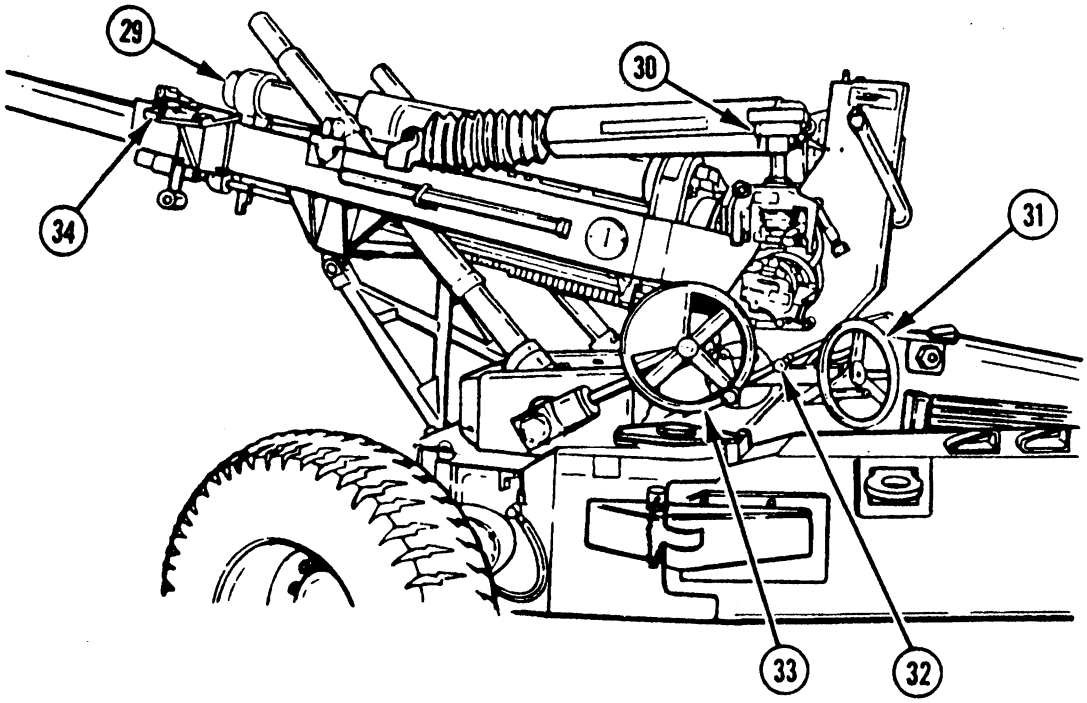
## 1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont)



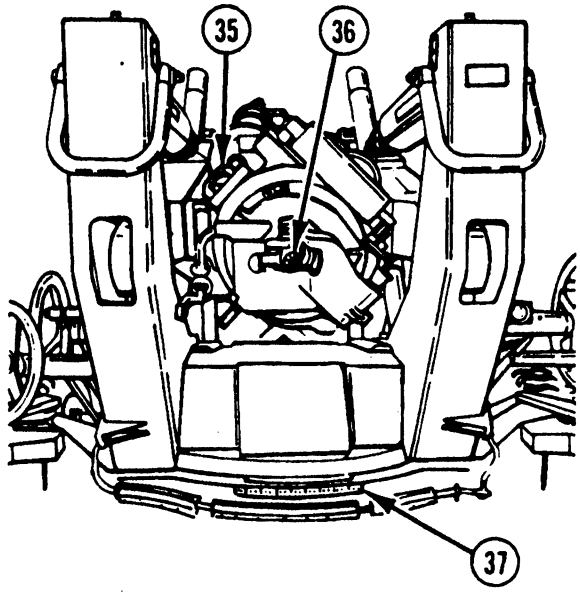

17 M172 telescope and quadrant mount
18 Equilibrator cylinder (both sides)
19 Oil reserve indicator
20 Muzzle brake
21 Cannon tube
22 Wheel (both sides)
23 Elevating handwheel (both sides)
24 Manual control lever (both sides)




25 Travel lock assembly
26 Manifold assembly
27 Ball
28 Lock release lever




29 Recoil mechanism
30 M171 telescope and quadrant mount
31 Traversing handwheel
32 Manual control lever (both sides)
33 Elevating handwheel (both sides)
34 M90 chronograph antenna mounting bracket




35 Thermal warning device
36 Firing mechanism
37 Coarse azimuth scale

## 1-11. MODIFICATION AND SYSTEM IMPROVEMENT PACKAGE

**NOTE**

This manual covers both modified and unmodified M198 howitzers. Illustrations and procedures are for the modified howitzer, unless procedures for both modified and unmodified components or assemblies are required for clarity. Procedures that are for the modified howitzer and do not pertain to the unmodified howitzer can be ignored.

All US Army M198 howitzers are scheduled to be equipped with a system improvement package (MWO 9-1025-211-50-3). This MWO will effect the M39 carriage assembly only. The following is a brief description of the MWO and areas affected.

a. Top Carriage Assembly.

(1) **Equilibrators:** Warnings on ballistic shields and a warning for repairmen that nitrogen pressure must be bled to zero PSI before performing maintenance.

(2) **Equilibrator adjustment screw:** Improved adjustment screw components, makes adjustment of equilibrators easier and adds a cover to keep debris from the screw and slide area.

(3) **Adjustment scales and pointers:** Moved to inside of top carriage uprights, eliminate entanglement of camouflage nets.

(4) **Top carriage:** Self contained automatic traverse lock, easier to engage and eliminates damage to hydraulic brake line.

(5) **Traverse mechanism shim:** Eliminating interference between traversing angle drive unit and actuator arm.

(6) **Universal joint bellows:** Help contain lubricants in their place.

(7) **Cradle assembly:** Gussets welded to travel lock area to strengthen the travel lock struts.

b. Bottom Carriage Assembly.

(1) **Suspension:** New axle bushings to help eliminate excessive friction while raising the howitzer to the towed position.

(2) **Firing base plate:** New lock mechanism easier to lock base plate in position.

(3) **Hydraulic brake system:** Brake precheck system, more efficient way to check brake condition prior to towing howitzers.

(4) **Snorkel breather system:** Connects power booster to trail to eliminate water intake into the power booster during fording operations.

(5) **New drain cock:** Provides crew easier access to bleed pressure in the emergency air tank.

(6) **Covers and standoffs for brake lines and brake hose assembly hookup diagram:** To help keep howitzer brakes system operable.

**(7) Lifting handle assemblies:** Located on either trail to provide extended lifting capacity to the howitzer.

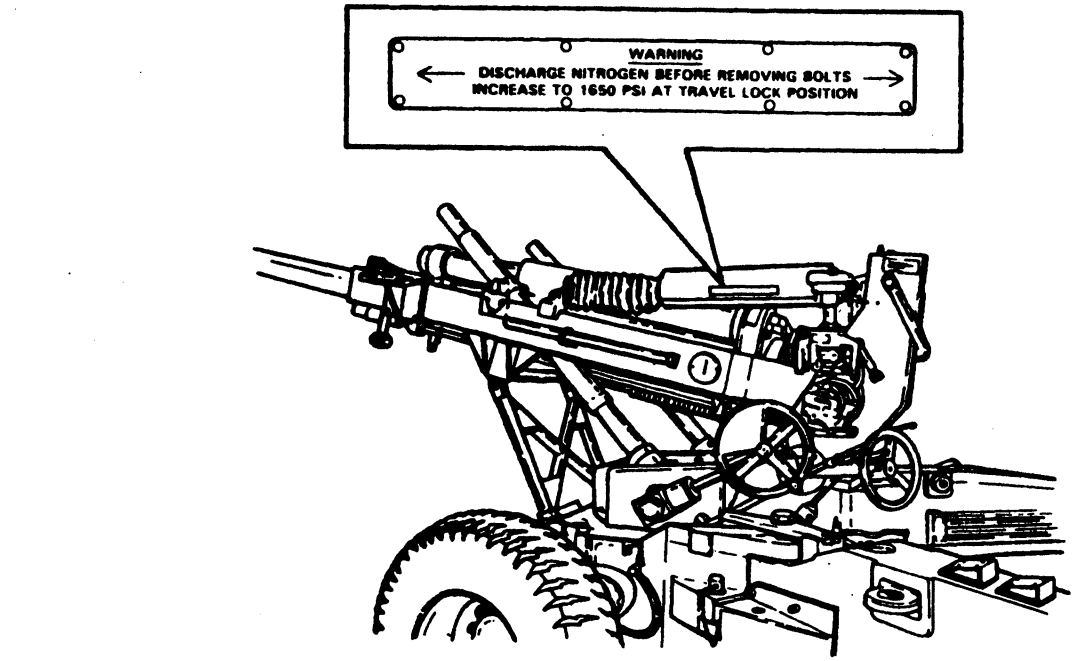
**(8) Retention assemblies:** Positive hold-downs for spade keys, airlift clevis assemblies, and receptacles for spade key and trail lock pins.

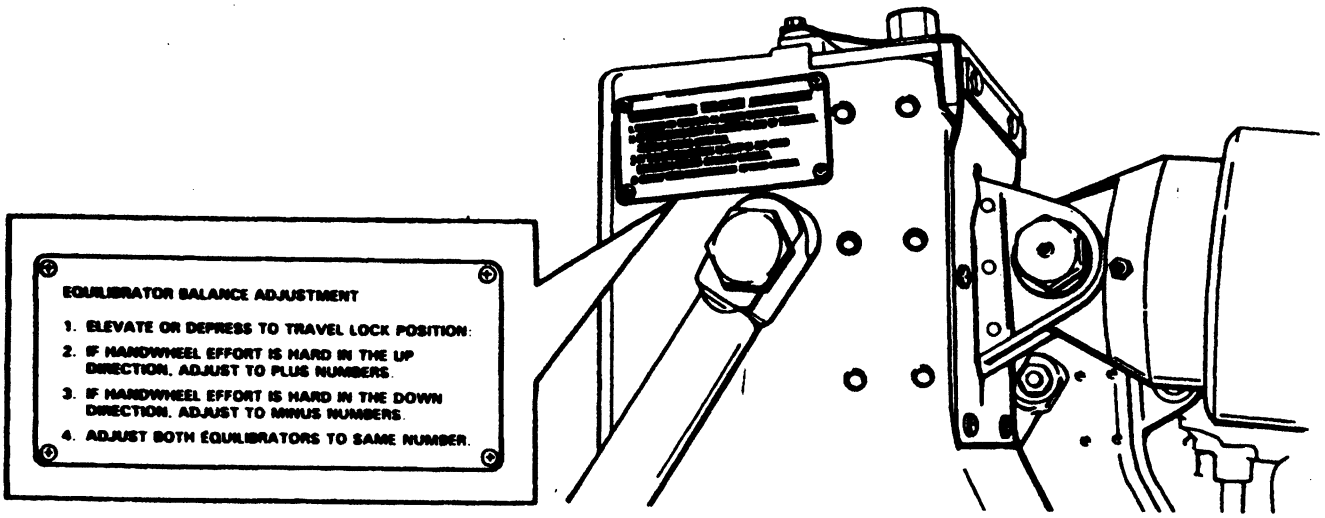
**(9) Cam lock assembly:** Provides a positive lock for the trail lock mechanism.

**(10) Spade bracket and airlift eye bolt weldments:** Provide protection to help eliminate damage to these areas.

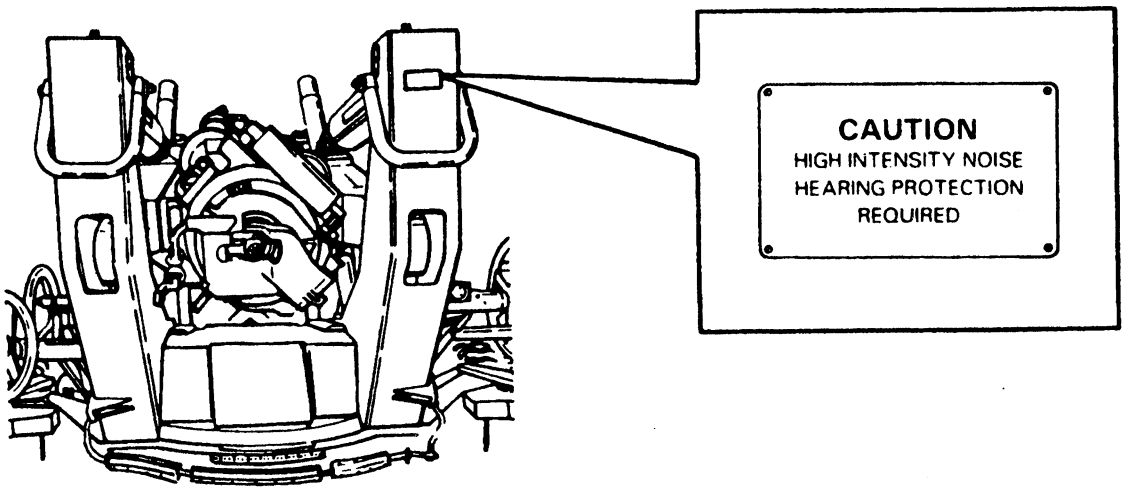
## 1-12. DATA PLATES

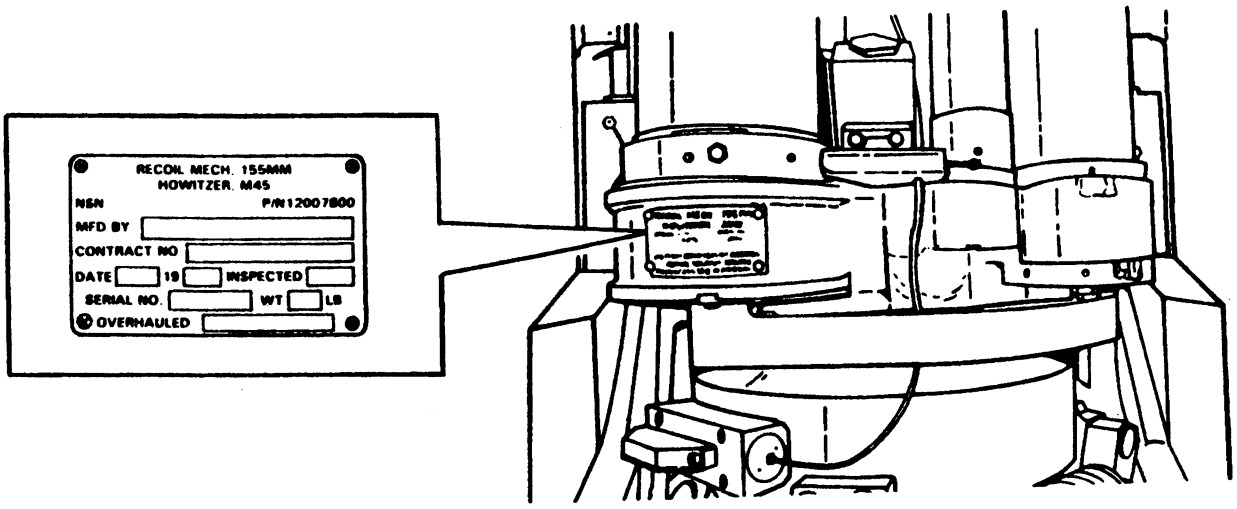
For location of data plates, refer to the following illustrations.

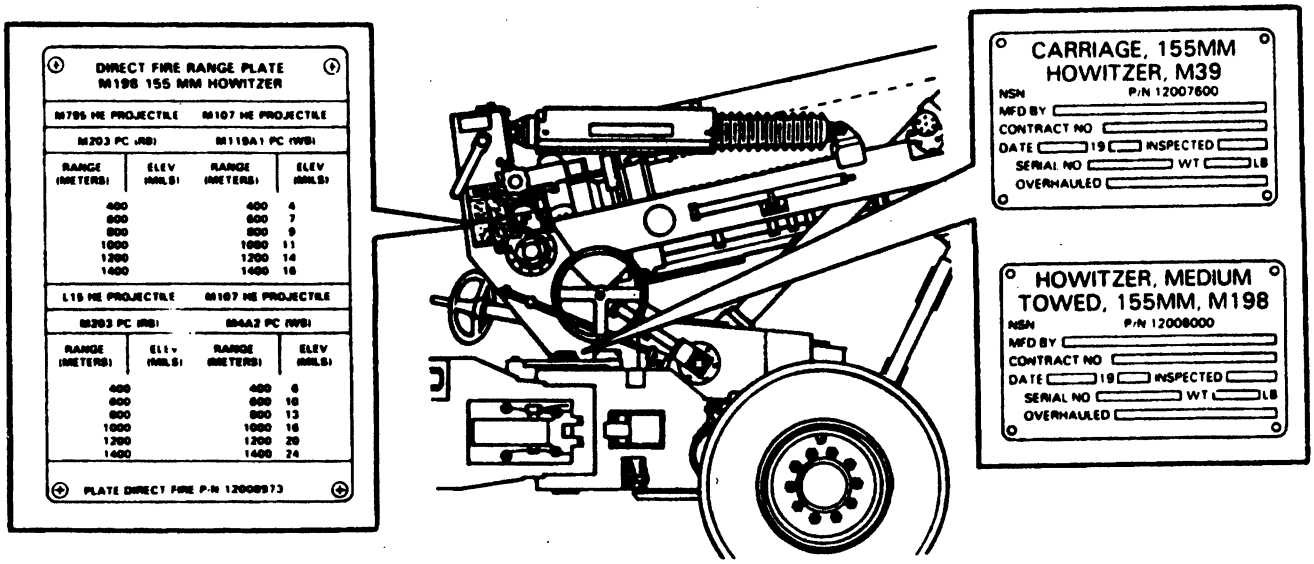


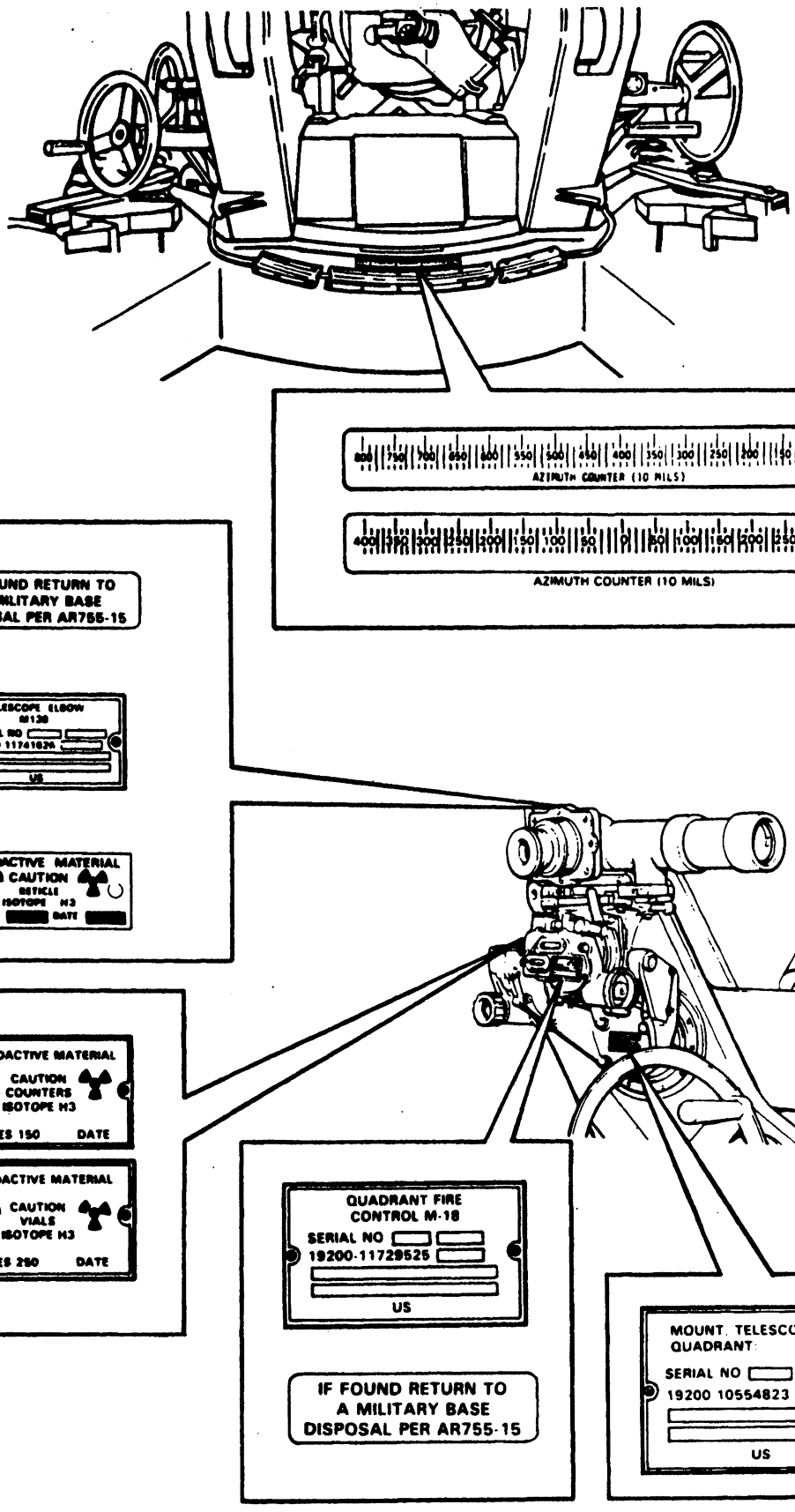



## 1-12. DATA PLATES (cont)

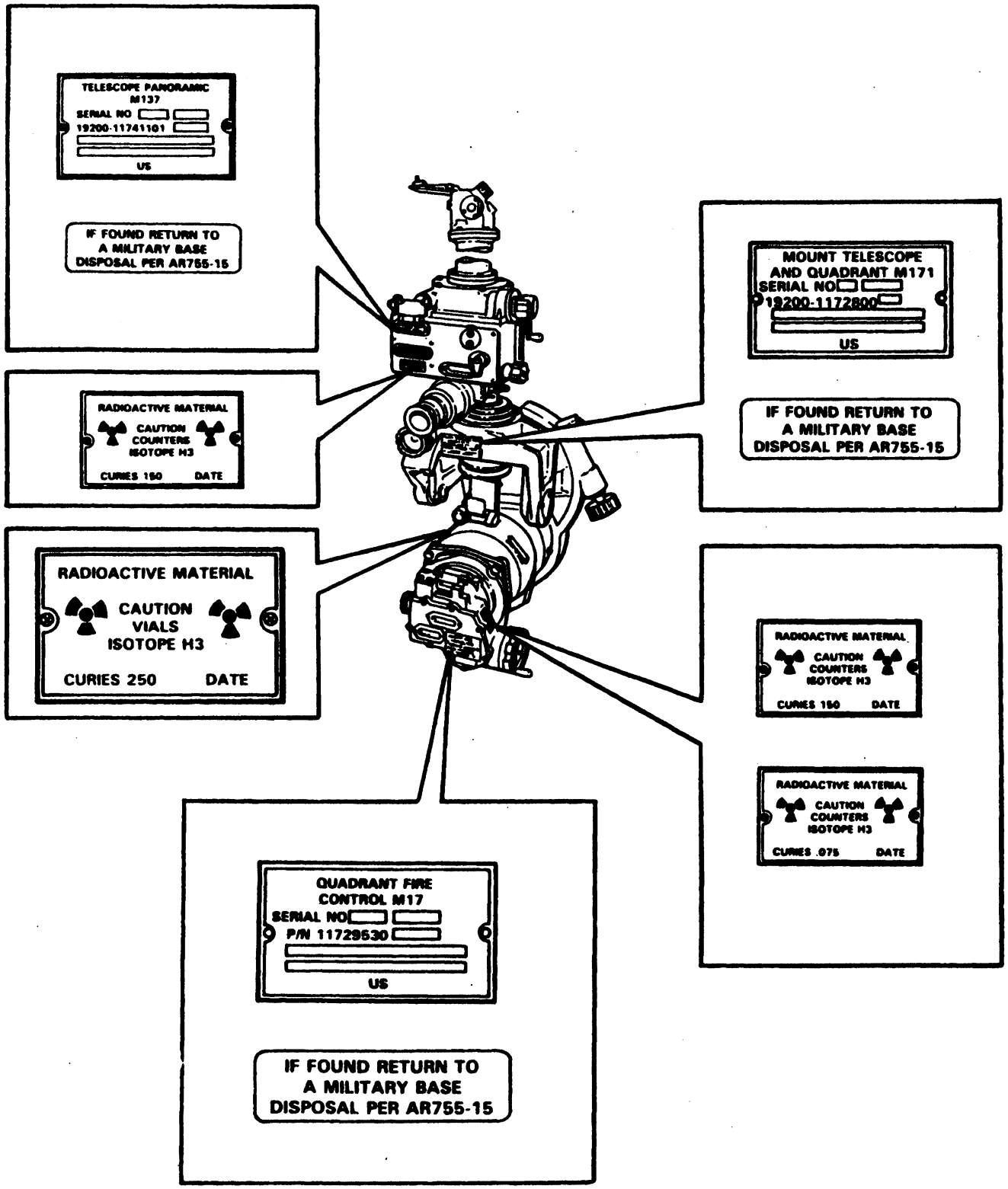



AZIMUTH COUNTER (10 MILS)
AZIMUTH COUNTER (10 MILS)
IF FOUND RETURN TO A MILITARY BASE DISPOSAL PER AR755-15
TELESCOPE ELBOW M138
SERIAL NO
US
RADIOACTIVE MATERIAL
CAUTION
RETICLE
ISOTOPE H3
CURIES
DATE
RADIOACTIVE MATERIAL
CAUTION
COUNTERS
ISOTOPE H3
CURIES 150
DATE
RADIOACTIVE MATERIAL
CAUTION
VIALS
ISOTOPE H3
CURIES 250
DATE
QUADRANT FIRE CONTROL M-18
SERIAL NO
19200-11729525
US
IF FOUND RETURN TO A MILITARY BASE DISPOSAL PER AR755-15
MOUNT, TELESCOPE AND QUADRANT M172
SERIAL NO
19200 10554823
US

## 1-12. DATA PLATES (cont)



## 1-13. EQUIPMENT DATA

### a. Howitzer Performance Data.

Brakes:
- Parking . . . . . Manually operated disk
- Service . . . . . Air/oil power disk

Breech life . . . . . Original and five tubes

Breech type . . . . . Screw block, interrupted thread

Dimensions (travel conditions):
- Ground clearance at ball of firing baseplate . . . . . 13 in. (0.33 m)
- Height at muzzle brake (towed position) . . . . . 9 ft 6 in. (2.89 m)
- Length:
  - Firing position (without spades) . . . . . 36 ft 2 in. (11.02 m)
  - Stowed position . . . . . 24 ft 5 in. (7.44 m)
  - Towed position . . . . . 40 ft 6 in. (12.34 m)
- Tread (center-to-center) . . . . . 7 ft 9 in. (2.36 m)
- Width (towed position) . . . . . 9 ft 2 in. (2.79 m)

EFC rating . . . . . TM 9-1000-202-14

| Zone | EFC |
|---|---|
| 8S | 1.00 |
| 8 | .33 |
| 7 | .10 |
| 3-6 | .05 |

Handwheel load:
- Elevating . . . . . 180 in.-lb (20.37 N-m)
- Traversing . . . . . 120 in.-lb (13.50 N-m)

Length of recoil (zone 8 (M203)):
- Min to 500 mils . . . . . 65 in. ±6 (165.10 cm ±15.24)
- 501 to 800 mils . . . . . 56 in. ±7 (142.24 cm ±17.78)
- 801 to max mils . . . . . 50 in. ±2 (127.0 cm ±5.08)

Lunette load (30 in. (76.20 cm)):
- Stowed position . . . . . 3500 lb (1587.60 kg)
- Towed position . . . . . 500 lb (226.80 kg)

Maximum ranges . . . . . 30,000 m w/M203 propelling charge, charge 8 (w/RAP rd, M549A1)
5000 to 9900 m w/M3 propelling charge using charges 2 thru 5

Maximum terrain slope . . . . . 10-degree cant

Maximum towing speed:
- Cross country . . . . . 15 mph (8.04 km/hr)
- Improved roads . . . . . 45 mh (72.40 km/hr)
- Secondary roads . . . . . 30 mph (48.27 km/hr)

## 1-13. EQUIPMENT DATA (cont)

### a. Howitzer Performance Data. (cont)

| | |
|---|---|
| Mils of movement per turn of handwheel: | |
| Elevating | 10 mils |
| Traversing | 10 mils |
| Muzzle brake | Double baffle |
| On-carriage elevating range | -75 to +1275 mils |
| Prime mover | 5-ton (4536-kg) truck |
| Rate of fire | 4 rounds/minute maximum, 2 rounds/minute sustained or as determined by thermal warning device |
| Recoil mechanism | Hydropneumatic, variable, dependent |
| Speed shift range | 6400 mils |
| Tires (radial) | |
| Pressure | 110 psi (758 kPa) |
| Size | 11.0 to 20.0, 16 ply |
| Traversing range | 400 mils left and 400 mils right of center |
| Tube life | Based on wear factor (pullover gage reading) (Refer to TM 9-1000-202-14.) |
| Weight (including basic issue items) | 16,000 lb (7264.0 kg) |

### b. Fire Control Equipment Performance Data.

| | |
|---|---|
| M17 Fire Control Quadrant: | |
| Correction | ±95 mils |
| Elevation | -280 to +1433 mils |
| Least increment reading (counters) | 1 mil |
| Radioactive material: | |
| Max surface radiation | 0 millirad per hour |
| Tritium $H_3$ | 1.86 curies |
| Weight | 7.50 lb (3.40 kg) |
| M18 Fire Control Quadrant: | |
| Correction | ±95 mils |
| Elevation | -280 to +1433 mils |
| Least increment reading (counters) | 1 mil |
| Radioactive material: | |
| Max surface radiation | 0 millirad per hour |
| Tritium $H_3$ | 1.95 curies |
| Weight | 7.50 lb (3.40 kg) |

M171 Telescope and Quadrant Mount:
- Cross level adjustment:
  - Left . . . 178 mils
  - Right . . . 178 mils
- Elevation . . . -270 to +1333 mils
- Pitch level adjustment:
  - Aft . . . 178 mils
  - Fore . . . 178 mils
- Radioactive material:
  - Max surface radiation . . . 0 millirad per hour
  - Tritium $H_3$ . . . 0.15 curies
- Weight:
  - Adapter assembly . . . 3.25 lb (1.47 kg)
  - Mount . . . 75 lb (34.02 kg)
  - Optical instrument support . . . 2 lb (0.91 kg)

M172 Telescope and Quadrant Mount:
- Boresighting:
  - Azimuth . . . ±18 mils
  - Elevation . . . ±15 mils
- Cross level adjustment . . . ±34 degrees
- Weight:
  - Adapter assembly . . . 4.75 lb (2.15 kg)
  - Mount . . . 27.50 lb (12.47 kg)

M137 Panoramic Telescope:
- Field of view . . . 10 degrees
- Movement:
  - Azimuth counter . . . (increasing clockwise) 6400 mils
  - Azimuth (deflection) . . . 6400 mils
  - Correction (AZ) . . . ±95 mils
  - Elevation . . . ±300 mils
  - Least increment reading (AZ) . . . 0.25 mil
- Power . . . 4X
- Radioactive material:
  - Max surface radiation . . . 0 millirad per hour
  - Tritium $H_3$ . . . 5.10 curies
- Weight . . . 19 lb (8.62 kg)

M138 Elbow Telescope:
- Elevation . . . 60 mils
- Field of view . . . 8 degrees
- Power . . . 8X
- Radioactive material:
  - Tritium $H_3$ . . . 4.4 curies
  - Max surface radiation . . . 0 millirad per hour
- Weight . . . 8 lb (3.63 kg)

**c. Auxiliary Equipment Performance Data**

M139 Alinement Device:
- Radioactive material:
  - Max surface radiation . . . 0 millirad per hour
  - Tritium $H_3$ . . . 3 curies
- Weight . . . 1.60 lb (0.73 kg)

## Section III. TECHNICAL PRINCIPLES OF OPERATION

Section Index



### 1-14. PRINCIPLES OF OPERATION

a. The M198 is a medium weight, split trail weapon.

b. For firing, a hydraulically operated actuator cylinder assembly raises the wheels clear of the ground and the baseplate then supports the weapon.

c. For large shifts in direction, a hydraulically operated speed shift assembly quickly lifts the weapon and firing baseplate clear of the ground, rotates or shifts the weapon to the new direction, and then lowers it back onto the ground.

d. The traversing and elevating mechanisms are manually operated.

e. The two pneumatic pull-type equilibrator cylinders are charged with compressed nitrogen gas.

f. The recoil mechanism is a hydropneumatic dependent type with a variable recoil length.

g. The cannon is equipped with a muzzle brake to reduce recoil.

h. The breech mechanism assembly is manually operated, and the weapon is manually loaded.

i. The weapon is equipped with an air-over-hydraulic brake system.

## Section IV. SECTION DRILL

Section Index



### 1-15. GENERAL

The purpose of section drill is to improve the howitzer section through execution of assigned tasks and cross-training of section personnel.

## 1-16. INSTRUCTIONS

**a.** Section drill must be conducted in silence, except for commands and reports. The section must be drilled until reaction to commands is quick, automatic, and correct.

**b.** Battery officers will supervise the drill. Errors will be corrected immediately.

**c.** Duties should be rotated during training so that each crewman of the section can perform all duties within the section. Battery overhead personnel should also take part in section drill so that they can perform with a howitzer section, if required.

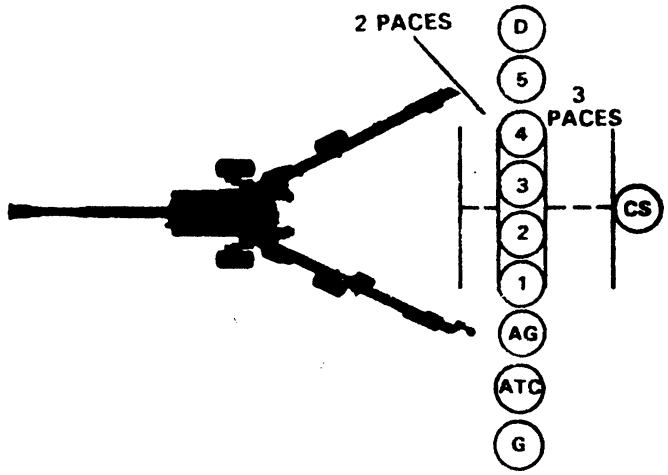
**d.** If the number of available personnel falls below the standard 10-man crew, the reduced crew drill (p 1-22) will be used.

## 1-17. EXECUTION OF COMMAND TO FALL IN

**a.** To Fall In. The chief of section takes his assigned post. The preparatory command may indicate the place and direction in which the section is to form. At the first formation for a drill or exercise, the caution, HOWITZER SECTION, precedes the command. The commands are 1. FALL IN or 2. IN FRONT (REAR) OF YOUR PIECE, FALL IN.

**NOTE**
The formation for IN REAR OF YOUR PIECE is illustrated.

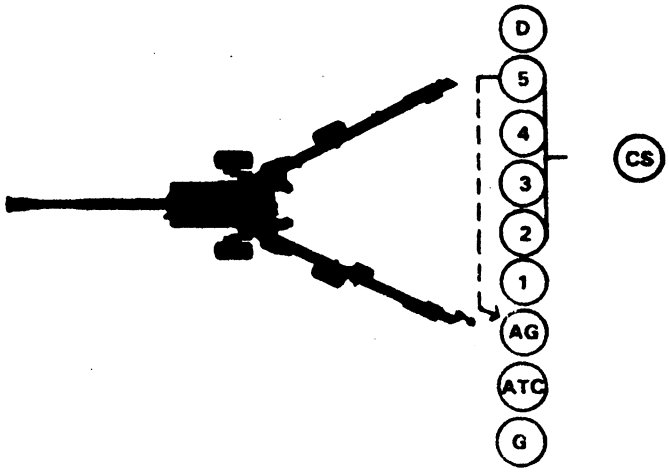
**b.** At the command, the section moves at double time and forms a single rank, at close intervals, guiding on the gunner. The numbered cannoneers should be in order between the assistant gunner and the driver of the prime mover. The section stands at attention, centered on and facing the chief of section at a distance of three paces.




## 1-18. EXECUTION OF COMMAND TO CHANGE POSTS

**a.** To Change Posts. To have the assistant gunner and numbered cannoneers change posts, the command is 1. CHANGE POSTS, 2. MARCH.

**b.** At the command, the assistant gunner and numbered cannoneers, except for cannoneer no. 5, take two steps left, taking the position of the next higher numbered cannoneer. At the same time, cannoneer no. 5 moves at double time to the rear of the rank to the post of the assistant gunner. All other crewmen stand fast.



## 1-19. EXECUTION OF COMMAND TO CHANGE POSTS (ENTIRE SECTION)

a. To have the entire section change posts, the command is 1. SECTION CHANGE POSTS; 2. MARCH.

b. At the command, all crewmen of the section take two steps left, except for the crewman at the extreme left. That crewman moves at double time to the rear of the rank and takes the post of the gunner.

## 1-20. EXECUTION OF COMMAND TO CALL OFF

a. To Call Off. The command is CALL OFF.

b. All crewmen in rank, except the gunner, execute eyes right.

c. The section calls off in sequence, GUNNER, AMMUNITION TEAM CHIEF, ASSISTANT GUNNER, 1, 2, 3, 4, 5, DRIVER. Each crewman calls out and turns head smartly to the front.

## 1-21. EXECUTION OF COMMAND TO MOUNT

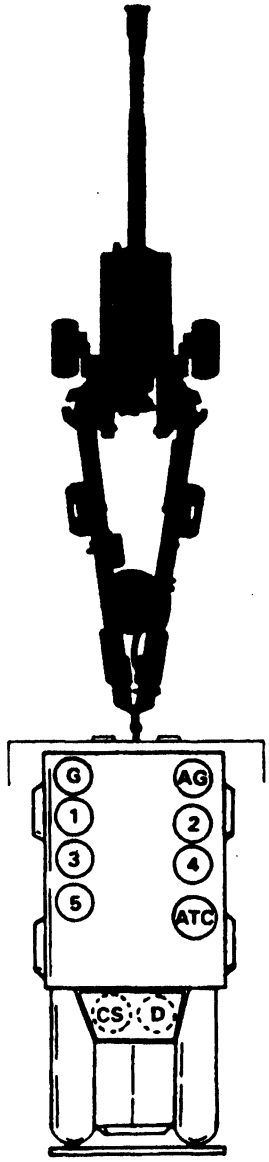
a. To Mount. To mount, the commands are 1. MOUNT or 2. PREPARE TO MOUNT, MOUNT. If any crewmen of the section are to remain dismounted, their designations are announced with the caution, STAND FAST, given between the preparatory command and the command of execution; for example, 1. PREPARE TO MOUNT; DRIVER STAND FAST, 2. MOUNT.

b. At the command, MOUNT, the section crewmen take positions as shown.

c. At the command of execution, the driver and chief of section take their positions at the rear of the prime mover, on the left and right, respectively, where they can observe and assist in loading.

d. The two columns mount in order from front to rear and take seats as shown. Each cannoneer is assisted in mounting by the person directly behind (or in front in the case of the last cannoneer in column) to ensure promptness and prevent injuries.

e. Before mounting, the chief of section and driver check that the howitzer is properly coupled, the personnel and equipment are aboard, and the tailgate and safety straps are secure.



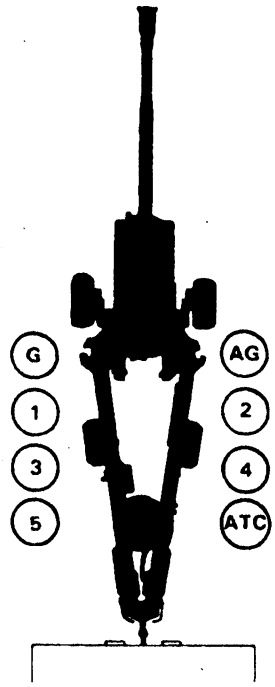
## 1-22. EXECUTION OF COMMAND TO DISMOUNT

**a.** To Dismount. The commands are DISMOUNT or 1. PREPARE TO DISMOUNT, 2. DISMOUNT.

**b.** At the preparatory command, the personnel in the prime mover unlatch and open the tailgate of the prime mover.

**c.** All crewmen of the section assume positions from which they can dismount properly.

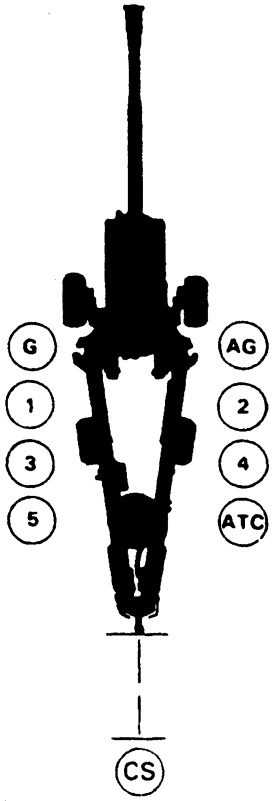
**d.** At the command of execution, they dismount and, at double time, take the posts shown.




## 1-23. EXECUTION OF COMMAND TO POST

**a.** To Post. The command is 1. CANNONEERS, 2. POST. This general command applies whether the section is in or out of ranks, at a halt, or marching.

**b.** At the command, the section moves at double time and takes the positions shown. The section then stands at attention.

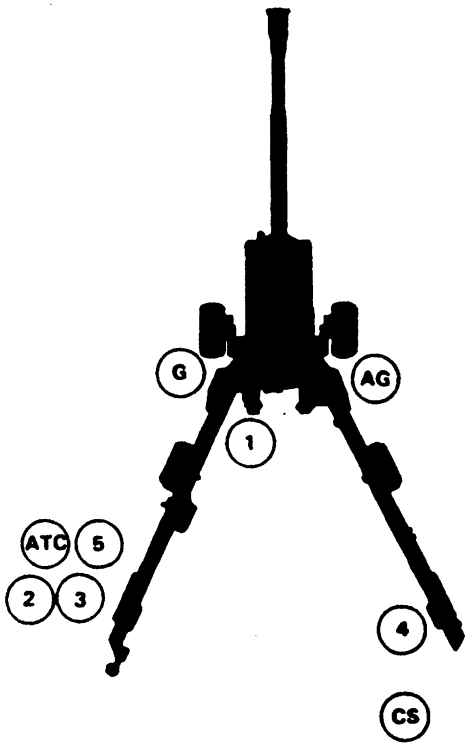



PIECE UNCOUPLED, NOT PREPARED FOR ACTION

## 1-24. BREAK PERIODS DURING TRAINING OR FIRING

**a. At Drill.** When it is desired to give the personnel a rest from drill or to relieve them temporarily from formation or posts, the command, FALL OUT, is given. The command may be given at any time and means that the section is to remain in the drill area.

**b. When Firing.** When firing has been suspended temporarily, but the section is to remain in the vicinity of the prime mover, the command, FALL OUT, is given. Crewmen stand clear of the howitzer so that settings remain undisturbed. During these periods, the chief of section may direct the crewmen to improve their position, to replenish ammunition, or to do other necessary work.




PIECE PREPARED FOR ACTION

## 1-25. REDUCED CREW DRILL

**NOTE**

Procedures for operating with a reduced crew have been standardized under the Department of the Army Standardization Program.

**a.** It is normal to expect gun crews to be reduced to less than the prescribed TOE strength due to illness, casualties, battery taskings, and the need to rest personnel. To meet the need of these occasions and the need to maintain operations of the section in as orderly a manner as possible, the duties of the individuals of the section have been combined as shown.

| 9-Man | 8-Man | 7-Man |
|---|---|---|
| CS | CS | CS |
| G | G | G |
| ATC | ATC | ATC |
| AG | AG | AG/1 |
| 1 | 1 | 2 |
| 2 | 2 | 3/5 |
| 3/5 | 3/5 | 4/D |
| 4 | 4/D | |
| D | | |

**b.** The section chief will assign duties to crew members when the number of available personnel falls below the level shown above.

# Section III. OPERATION UNDER USUAL CONDITIONS

**Section Index**



## 2-12. GENERAL

a. The personnel of the howitzer section consist of the following:

(1) A chief of section (CS) whose duties and responsibilities are the following:

(a) Training and efficiency of personnel.

(b) Performance of his section in training; firing, testing, and adjusting fire control equipment; and inspection and maintenance of all section equipment, including the prime mover.

(c) Observance of safety precautions.

(d) Preparation of field fortifications for protection of equipment, ammunition, and personnel.

(e) Camouflage discipline and local security, and radiological, biological, and chemical security discipline.

(f) Maintenance of forms in the equipment record folder.

(g) Policing the section area.

## 2-12. GENERAL (cont)

(2) A gunner (G) who assists the chief of section in carrying out the duties specified in subparagraph (1). The gunner's specific duties are described in this manual.

(3) An ammunition team chief (ATC) who leads and directs the handling of ammunition and assists chief of section in the supervision of howitzer section. The ATC also performs duties as listed in this manual and other duties as directed.

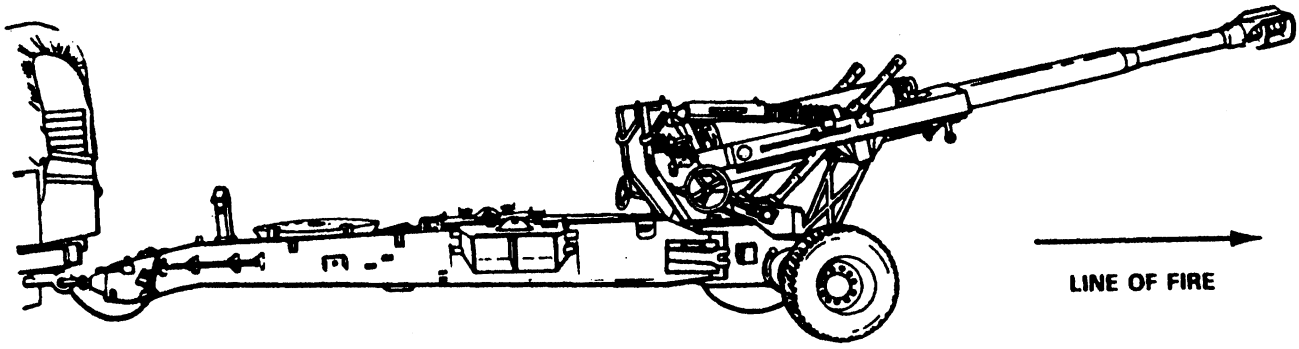
(4) An assistant gunner (AG) who assists the gunner and, in an emergency, acts as the gunner. The assistant gunner's specific duties are described in this manual.

(5) Five cannoneers, numbered 1 to 5, who perform duties as listed in this manual and other duties as directed.

(6) A prime mover driver (PMD) whose primary duty is to drive the prime mover of the section. Maintenance and other duties are described by this manual or directed by the chief of section.

b. Section equipment is listed in the appropriate tables of organization and equipment (TOE's) and appendix B of this manual.

## 2-13. EMPLACING THE HOWITZER




**CAUTION**

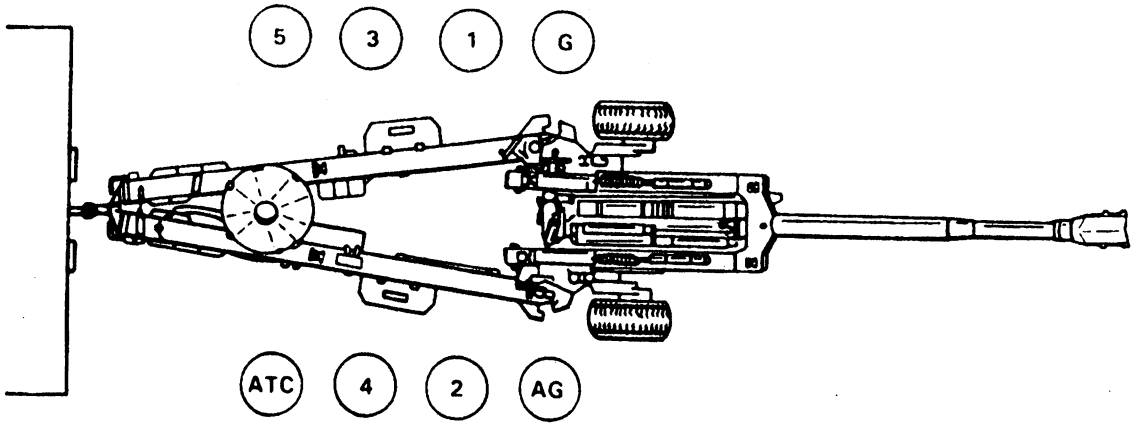
Do not use the firing baseplate and detent assembly as a speed shift assembly. The bottom carriage could be damaged, which would require replacing the entire howitzer.

**NOTE**

The chief of section supervises the occupation of the firing section position. The prime mover driver should drive the prime mover into the firing position opposite the line of fire.

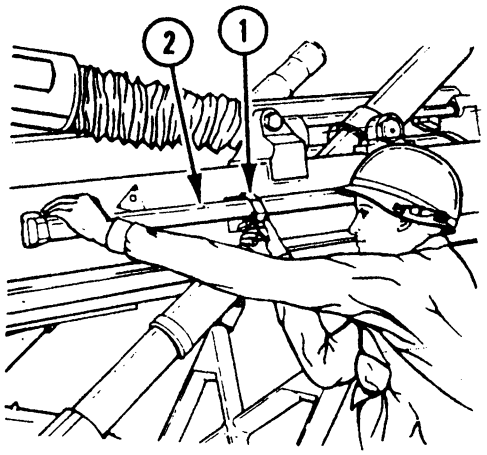
Procedures for preparation for firing have been standardized under the Department of the Army Standardization Program.

1 After prime mover comes to a complete stop, the chief of section commands, DISMOUNT. Upon hearing the command, the section exits through rear of prime mover.




**2** All section members take positions as illustrated.

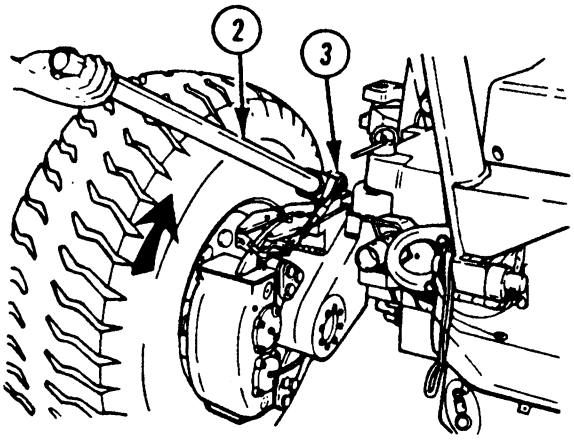
**3** The chief of section commands, PREPARE FOR ACTION.




**4** The assistant gunner unlatches holder (1) on right side and removes pump handle (2). Gunner unlatches holder on left side and removes pump handle.

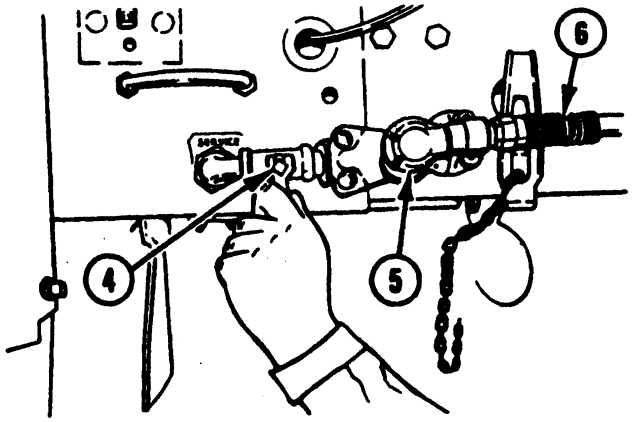
**WARNING**

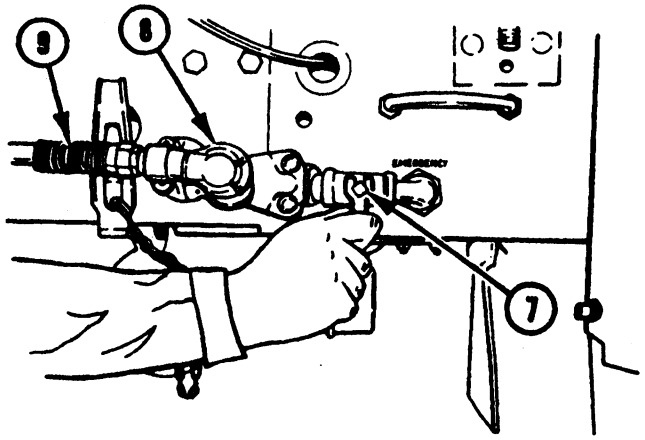
**Handbrakes must be set in garrison as well as during field emplacement.**




**5** The gunner and assistant gunner set left and right handbrakes by inserting pump handles (2) into handbrakes sockets (3) and raising up to the locked position.

## 2-13. EMPLACING THE HOWITZER (cont)



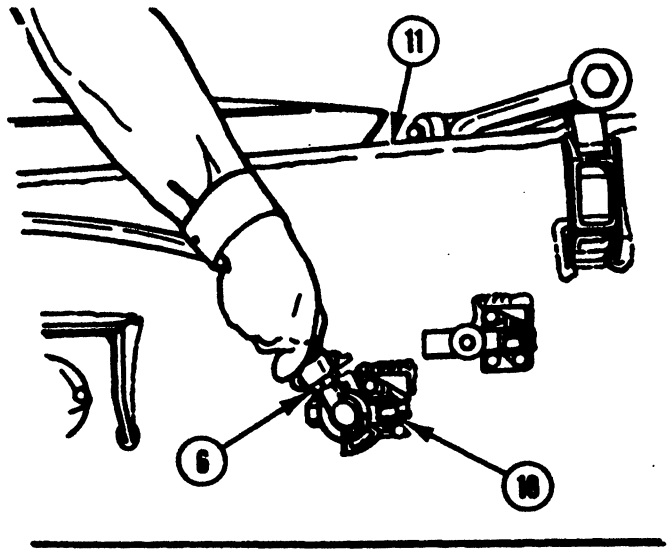



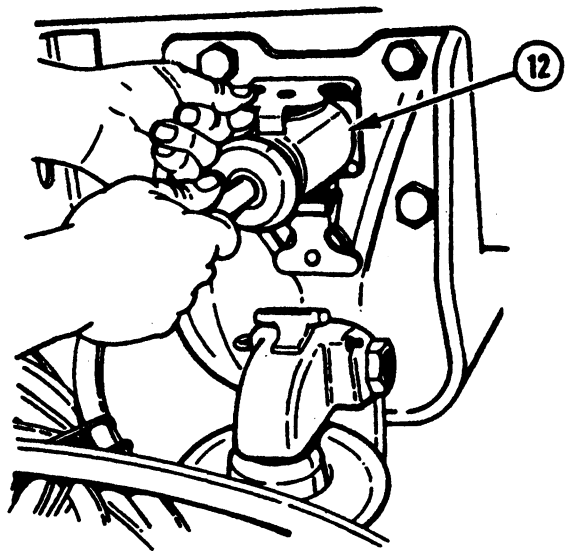

**WARNING**

**To prevent injury to personnel, never disconnect hose before closing prime mover cutout cock.**

6 Cannoneer no. 4 closes service air line cutout cock (4) at prime mover, uncouples service air line coupling (5), and passes service hose assembly (6) to cannoneer no. 2.

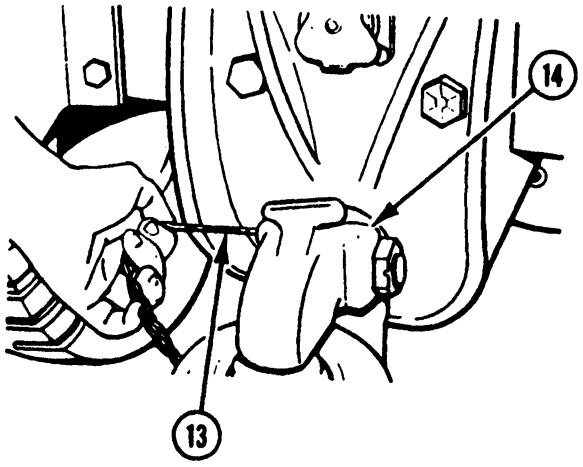
7 Cannoneer no. 5 closes emergency air line cutout cock (7) at prime mover, disconnects emergency air line coupling (8), and passes emergency hose assembly (9) to cannoneer no. 2.



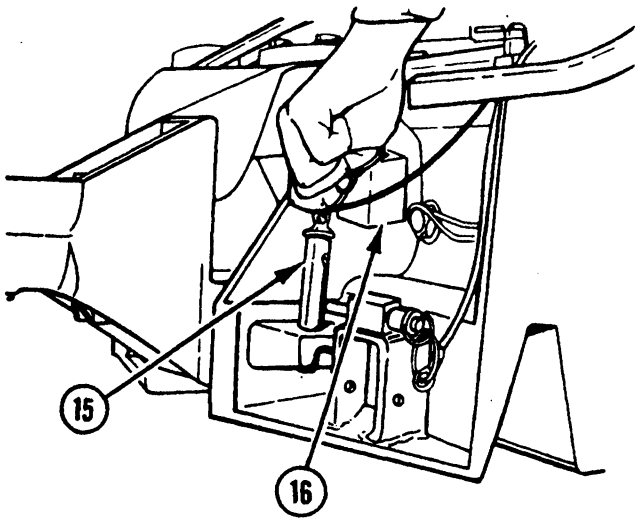




8 Cannoneer no. 2 connects service hose assembly (6) to dummy coupling (10) on right trail (11). The emergency hose assembly is connected to other dummy coupling.

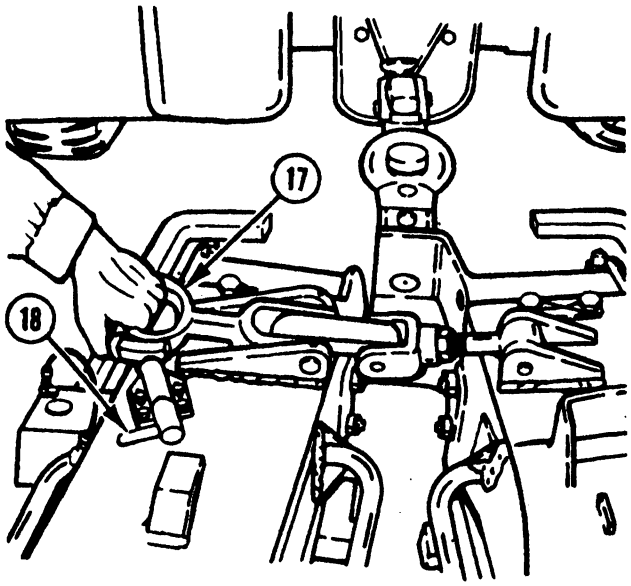
9 Cannoneer no. 5 disconnects cable assembly (12) from prime mover, if connected.



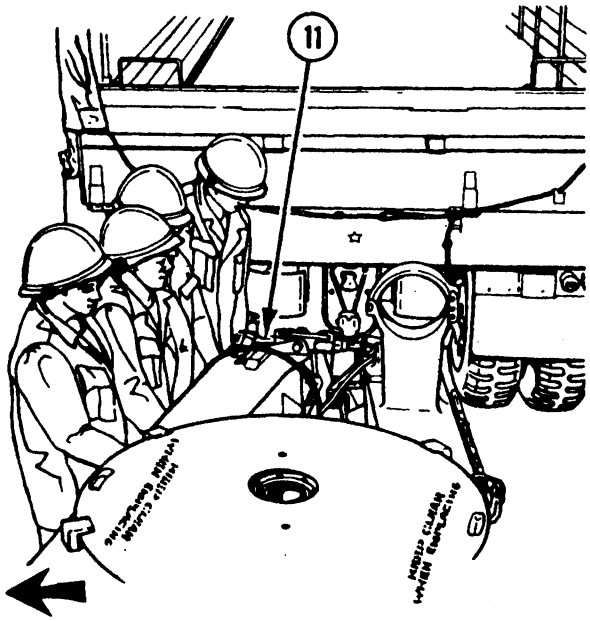

**10** Cannoneer no. 4 removes cotter pin (13) and unlatches pintle (14) on prime mover.




**11** Cannoneer no. 4 removes trail retaining pin (15) and inserts in top block (16).

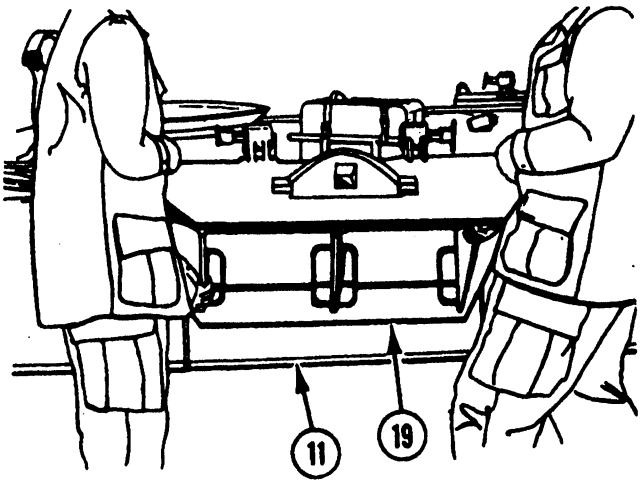


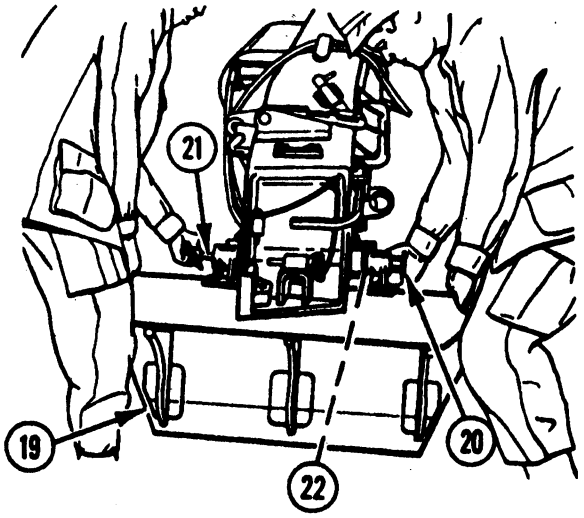

**12** Cannoneer no. 4 unlocks trail lock (17) by rotating cam handle (18) clockwise to disengage trail lock handle. Pull trail lock handle straight up.




**13** Cannoneers no. 2 and 4, the ammunition team chief, and the assistant gunner then open right trail (11).

## 2-13. EMPLACING THE HOWITZER (cont)




14 Cannoneers no. 2 and 4 remove right spade (19) and attach it to right trail (11) as follows:

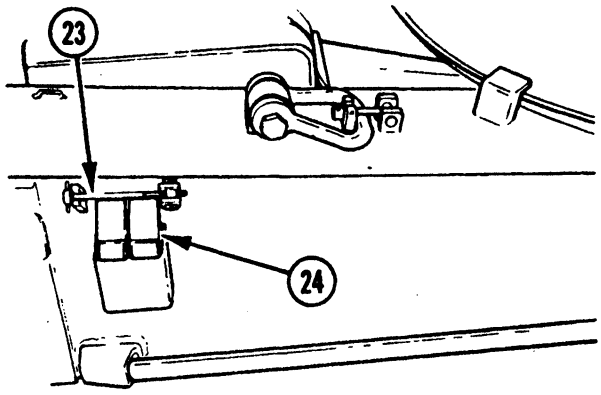
**CAUTION**

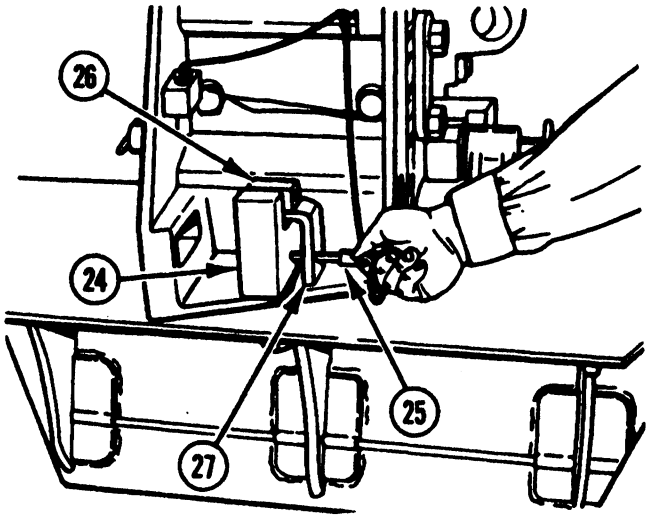
Do not use hammer on plunger handles (20) when inserting pins (21). A hammer would damage the pins.

a. Pull out plunger handles (20) and lift right spade (19) straight up until pins (21) can be inserted in spade brackets (22). Push in plunger handles (20).

**NOTE**

If necessary, use hand hammer (6-lb sledge) to drive spade key far enough into position so that spade retaining pins can be inserted.



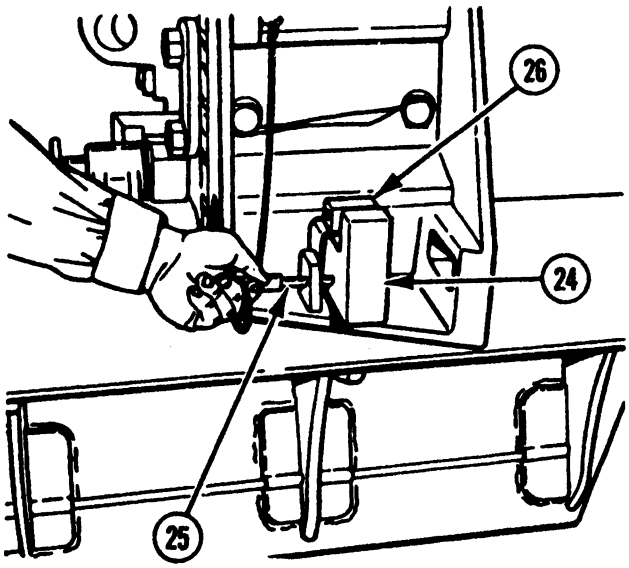




b. Unscrew and lift screw assembly (23) to remove ade key (24) from left trail.

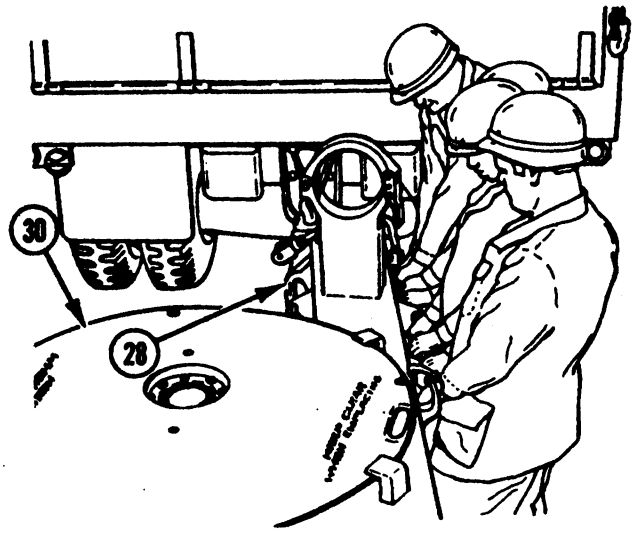
c. Cannoneers no. 2 and 4 hold right spade in position until the ammunition team chief inserts spade key (24), removes spade retaining pin (25) from block (26), and inserts spade retaining pin (25) in right spade key.

**CAUTION**
Do not fire howitzer without spade retaining pin (25) installed.

**15** Cannoneers no. 1 and 3 remove left spade, bring spade to trail end and pass it under trail to cannoneer no. 2. Cannoneers no. 1 and 2 attach spade to left trail while cannoneer no. 5 inserts spade key (24), removes pin (25) from block (26), and inserts spade retaining pin (25) in left spade key.

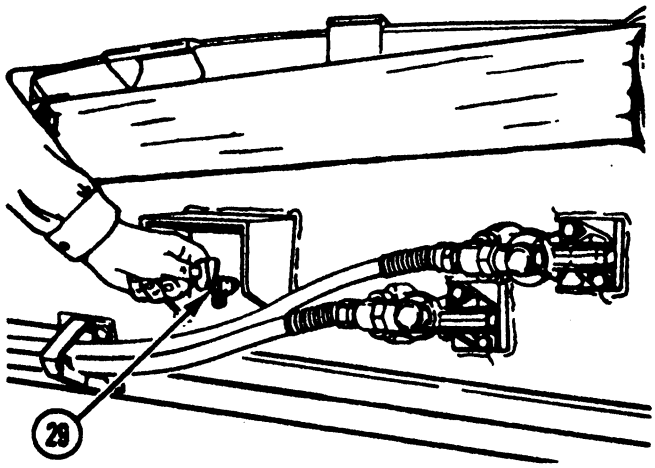



**16** Cannoneers no. 1, 3, and 5 and gunner (at left trail (28)), and the assistant gunner, the ammunition team chief, and cannoneers no. 2 and 4 (at right trail) raise lunette from pintle when the chief of section commands, LIFT. The chief of section then commands the driver to move prime mover forward. The left trail is spread, and then trails are lowered to the ground.

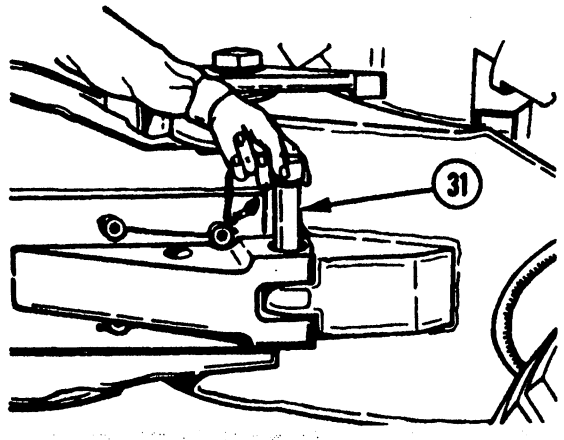



**17** Cannoneer no. 4 opens drain cock (29) on emergency reserve air tank.

**18** Cannoneers no. 3 and 4 remove firing baseplate (30) from left trail (28) and place it in front of howitzer.



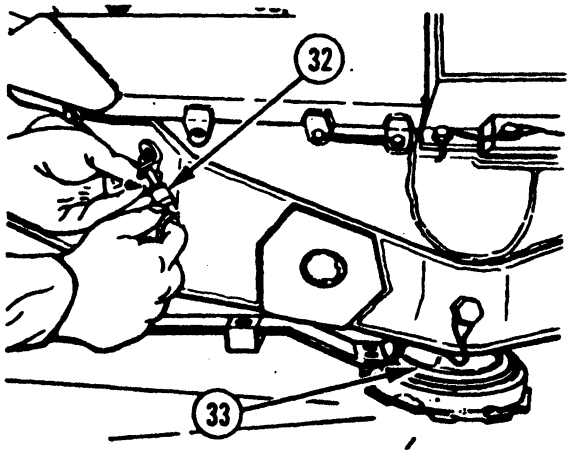
## 2-13. EMPLACING THE HOWITZER (cont)



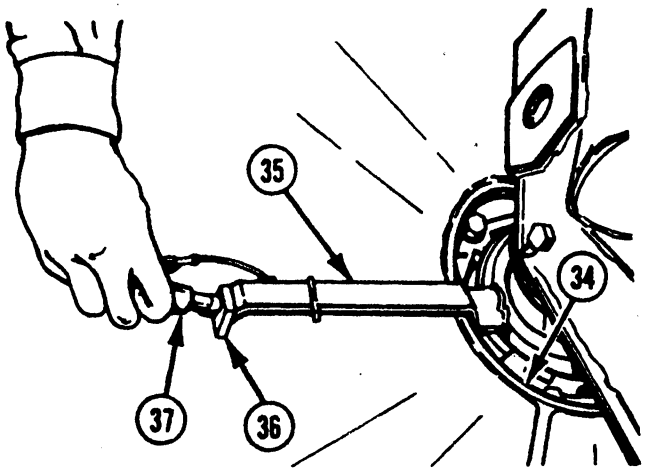

**WARNING**

**When installing trail locking plug (31) in the firing position, drive plug in firmly using a sledge hammer. Undesirable displacement may occur, causing inaccurate firing and injury to personnel.**

**19** The gunner removes left trail locking plug (31) and the assistant gunner removes right trail locking plug from the stowed position (rear) and installs it in the firing position (front).



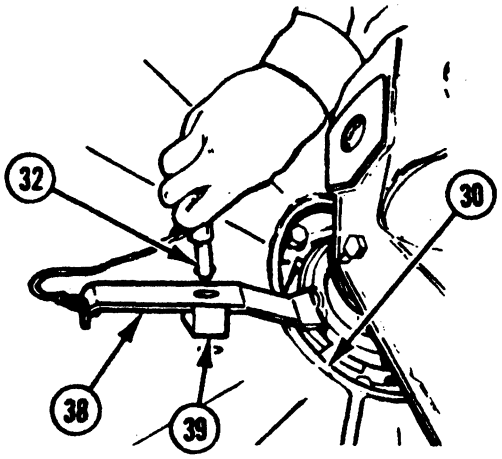

**20** Cannoneer no. 4 removes quick release pin (32) and, with cannoneer no. 3, lifts firing baseplate and positions it on ball (33).




**NOTE**

Step 21 applies to howitzers that have not been modified.

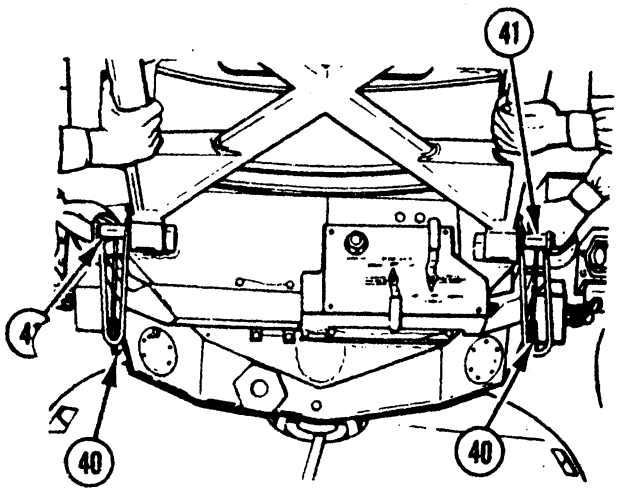
**21** Cannoneer no. 3 then locks firing baseplate (34) in place by positioning lock release lever (35) with locking bracket (36). Cannoneer no. 3 then inserts quick release pin (37) in locking bracket.



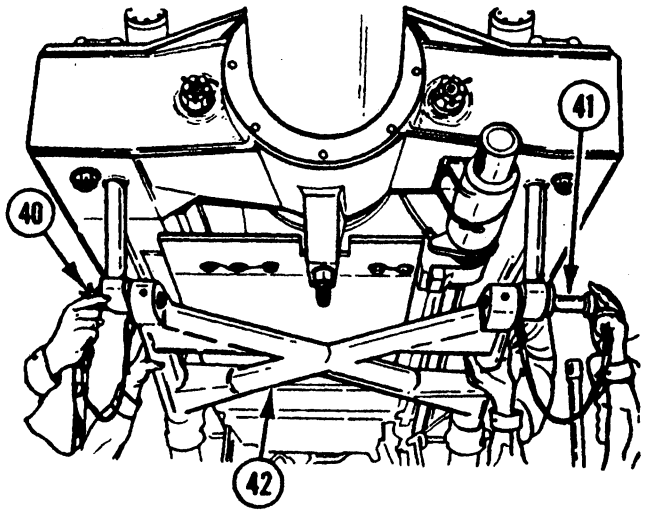

**NOTE**

Step 22 applies to modified howitzers.

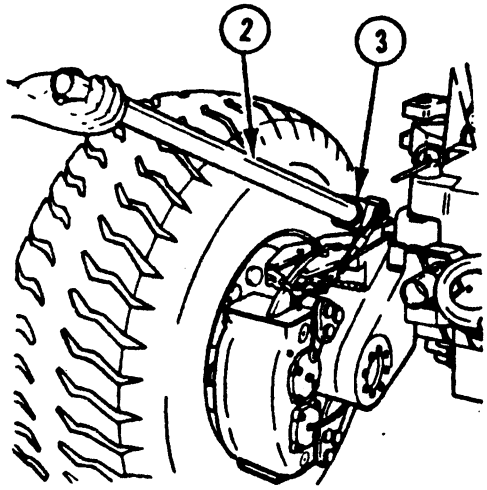
**22** Cannoneer no. 3 then locks firing baseplate (30) in place by rotating lock-release lever (38) until locking bracket (39) is positioned over hole in baseplate. Cannoneer no. 3 then inserts quick release pin (32) through locking bracket and into firing baseplate hole.



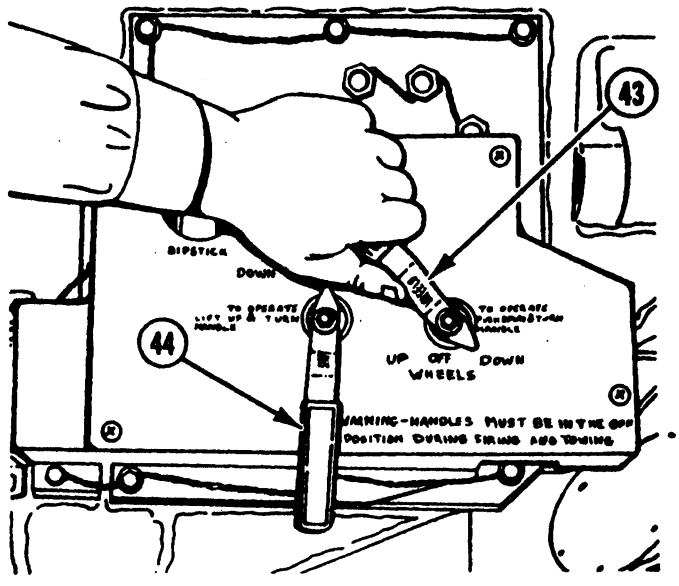

23 Cannoneers no. 3 and 4 remove retaining pins (40) and travel lock pins (41).




24 Cannoneers no. 3 and 4 swing travel lock assembly (42) up and insert travel lock pins (41) and retaining pins (40).




25 Cannoneer no. 3 releases left handbrake and cannoneer no. 4 releases right handbrake by inserting pump handle (2) in handbrake socket (3) and pulling down.

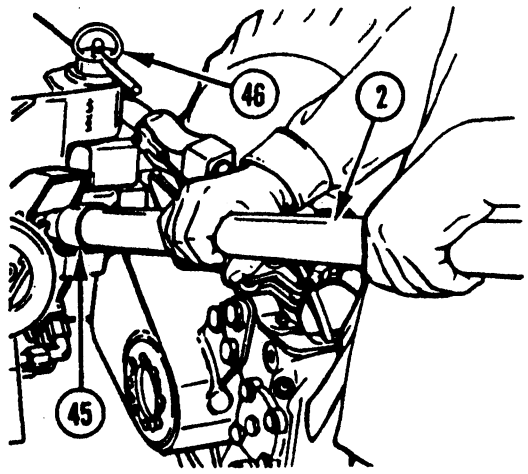



**NOTE**

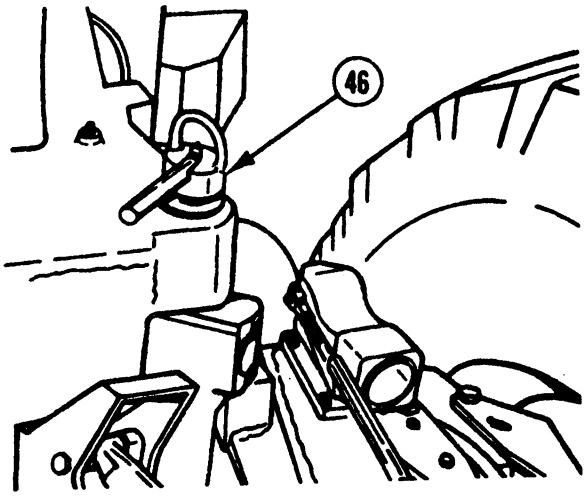
Be sure to move WHEELS lever (43) all the way to the desired position.

26 Cannoneer no. 3 ensures SPEEDSHIFT lever (44) is in the OFF position and then pushes down and moves WHEELS lever (43) to the DOWN position.

## 2-13. EMPLACING THE HOWITZER (cont)

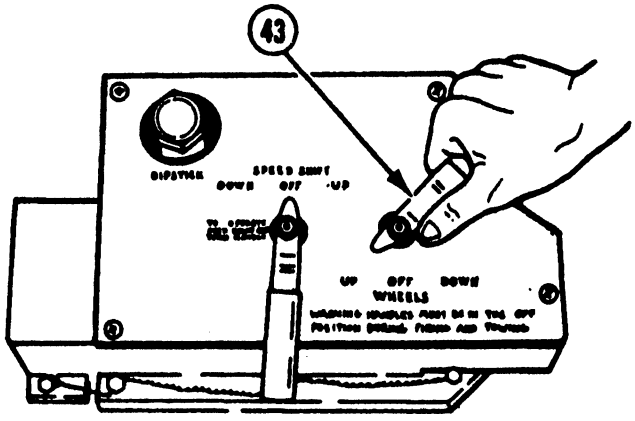



27 Cann ır no. 4 inserts pump handle (2) into r hydraulic adapter (45), and cannoneer no. 3 inserts pump handle into left hydraulic adapter. They pump up and down until pressure is off wheel lock handles (46).



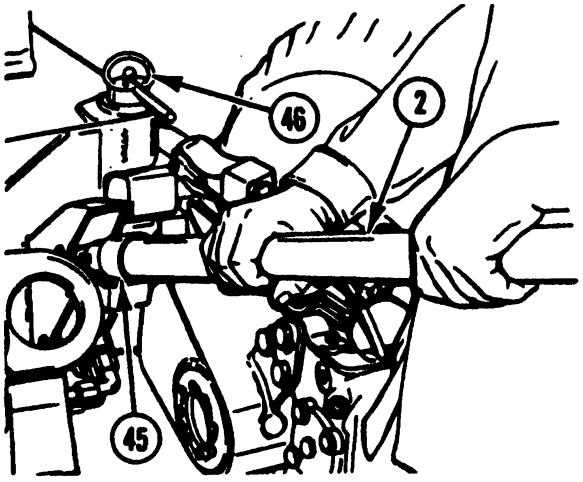

**WARNING**
**Keep feet from under howitzer and firing baseplate.**

28 Cannoneer no. 4 moves right wheel lock handle (46) and cannoneer no. 3 moves left wheel lock handle (46) to the released position by lifting up and turning handle towards center of howitzer.



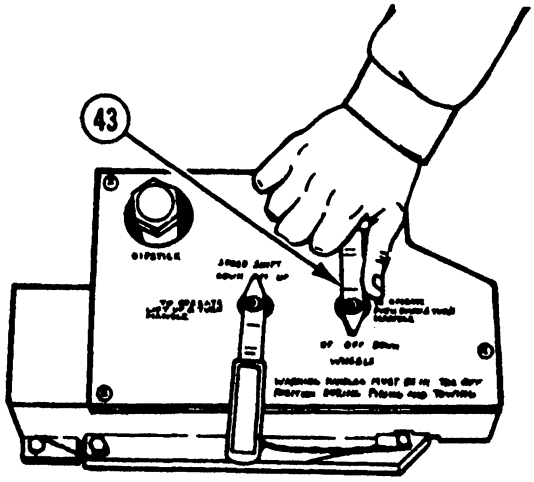

**WARNING**
**Keep feet from under howitzer and firing baseplate.**

29 Cannoneer no. 3 pushes down and moves WHEELS lever (43) slowly to the UP position, allowing howitzer to settle on firing baseplate. Cannoneers no. 3 and 4 relock handbrakes by inserting pump handles in handbrake sockets and raising up to the locked position.



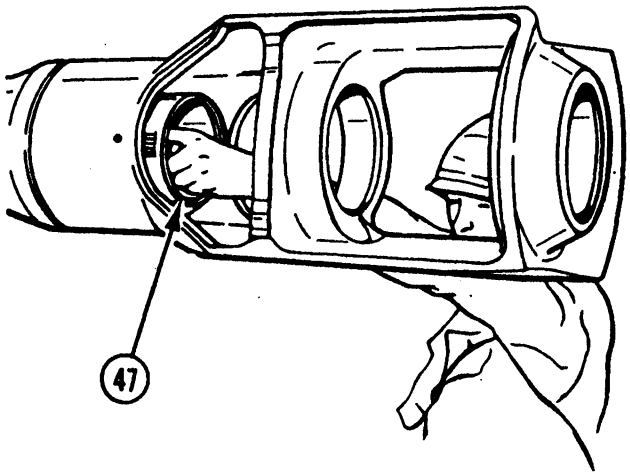

30 Cannoneers no. 3 and 4 then insert pump handles (2) into hydraulic adapters (45) and pump up and down until wheels are fully up.

31 Cannoneer no. 3 moves left wheel lock handle (46) and cannoneer no. 4 moves right wheel lock handle (46) towards wheels to the locked position.

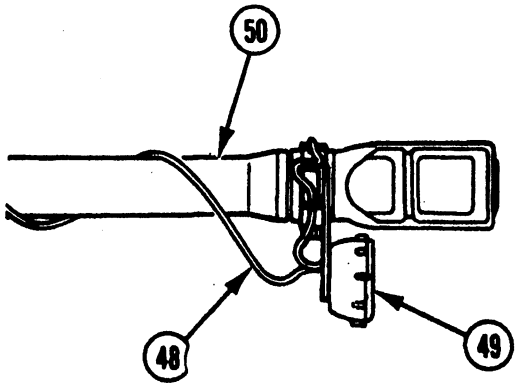



**NOTE**
Move WHEELS lever back and forth on either side of OFF mark to relieve pressure on the hydraulic system.

**32** Cannoneer no. 3 pushes down and moves WHEELS lever (43) to the OFF position.

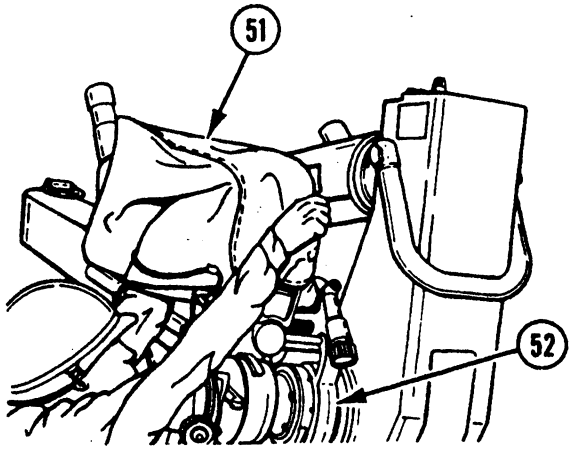



**33** Depress cannon tube within reach. The ammunition team chief removes muzzle plug (47).




**34** Cannoneer no. 3 then disconnects cable assembly (48) from vehicular taillight (49) and removes vehicular taillight from cannon tube (50), if installed.

**35** The assistant gunner elevates or depresses cannon tube to 0 mils (or other elevation dictated by unit SOP).




**36** The gunner removes fire control equipment carrying case from left trail.

**37** The gunner removes telescope and mount cover (51) from M171 telescope and quadrant mount (52).

## 2-13. EMPLACING THE HOWITZER (cont)

**WARNING**

**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

38 The gunner levels M171 telescope and quadrant mount as follows:

a. Roll back the protective covers on the cross level vial (53), pitch level vial (54), and elevation level vial (55).

b. Turn cross level control knob (56) to center bubble in cross level vial (53).

c. Turn pitch level control knob (57) to center bubble in pitch level vial (54).

d. Turn elevation correction knob (58) to zero elevation correction counter (59).

39 Loosen two wingnuts (60), remove protective cover (61), open fire control equipment carrying case, and stow protective cover in carrying case.

40 The gunner removes M137 pantel from fire control equipment carrying case and installs as follows:

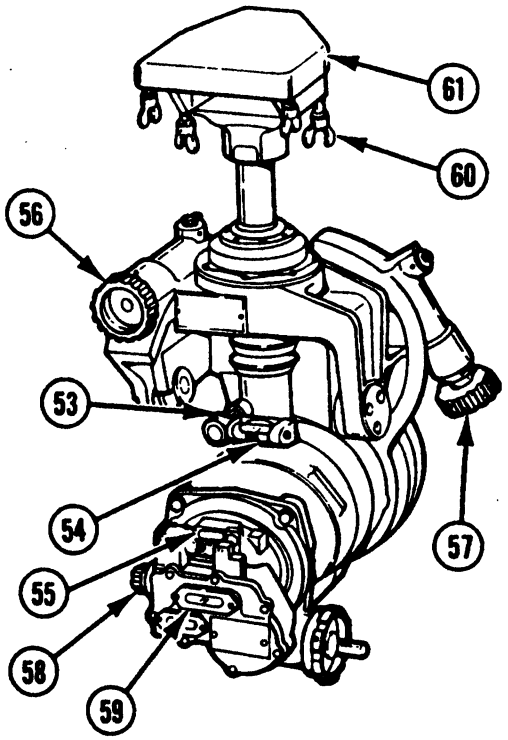
a. Depress locking pin (62) of eyepiece (63). Swing eyepiece and lock in position, approximately 90 degrees to telescope pantel.

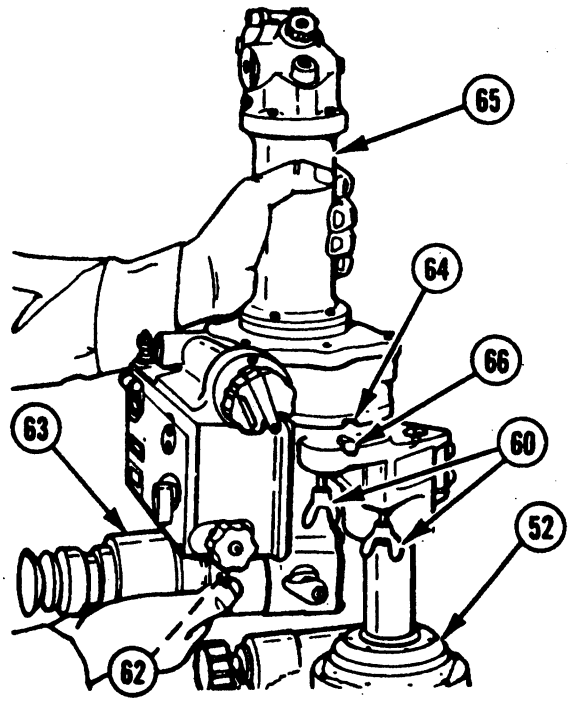
b. Aline keyways (64) on each side of M137 pantel (65) with alinement keys (66) on each side of M171 telescope and quadrant mount (52). Seat M137 pantel on mount.

c. Tighten wingnuts (60) to secure M137 pantel (65) on M171 telescope and quadrant mount (52).

**CAUTION**

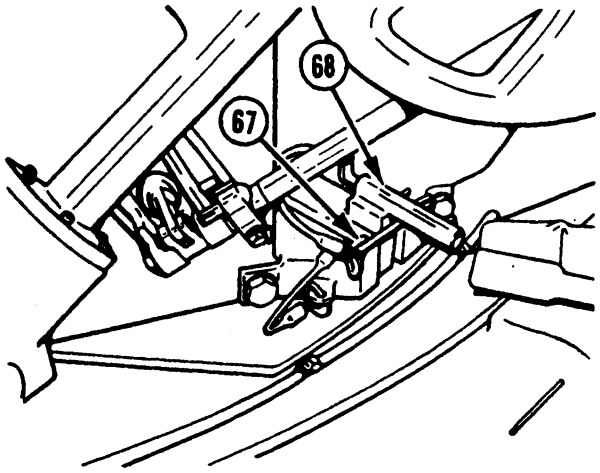
Do not use the firing baseplate and detent assembly as a speed shift assembly. Trails must be shifted before howitzer is lowered onto firing baseplate, otherwise speed shift



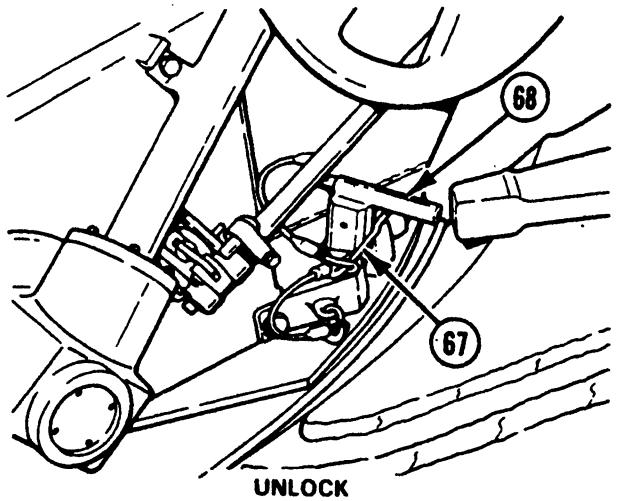




41 The gunner obtains initial reading from aiming circle. If reading from aiming circle differs more than 10 mils, the gunner then directs the crew to shift trails until readings between pantel and aiming circle are less than 10 mils. All crewmen lift both trails and shift them to the desired position.

**NOTE**
Step 42 and CAUTION apply to howitzers that have not been modified.



LOCK

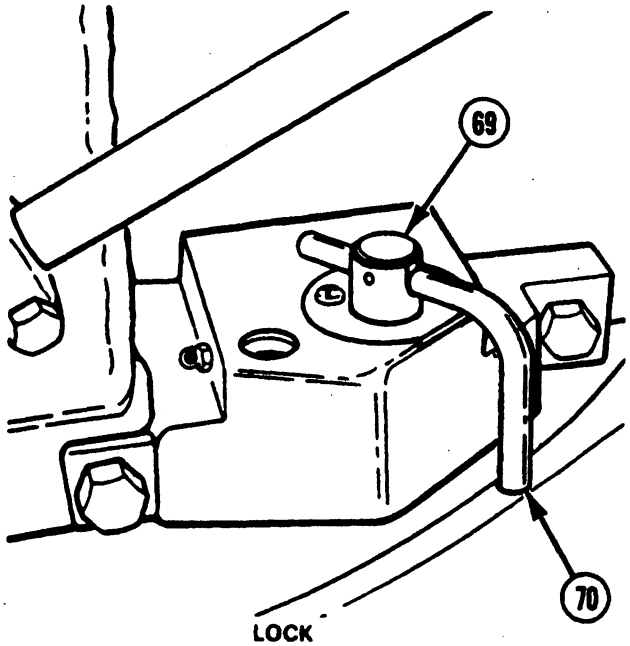


UNLOCK

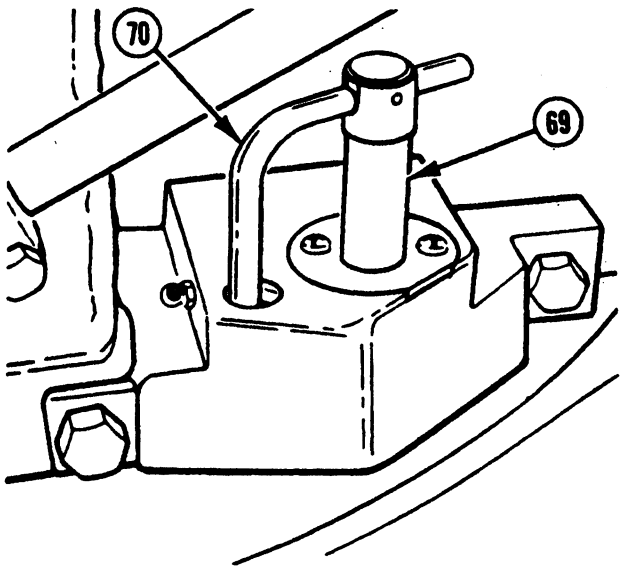
**CAUTION**
Do NOT traverse the top carriage unless the wheels are locked in the up (firing) or down (towed) position.

**42** The gunner removes retaining pin (67) from top carriage locking pin (68), pulls up on top carriage locking pin to the unlocked (up) position and secures top carriage locking pin with retaining pin.

**NOTE**
Step 43 applies to modified howitzers.



LOCK



UNLOCK

**43** The gunner unlocks the top carriage by lifting up on the retaining pin (69) and rotating retaining pin (69) until handle (70) is positioned in counterbore hole.

## 2-13. EMPLACING THE HOWITZER (cont)

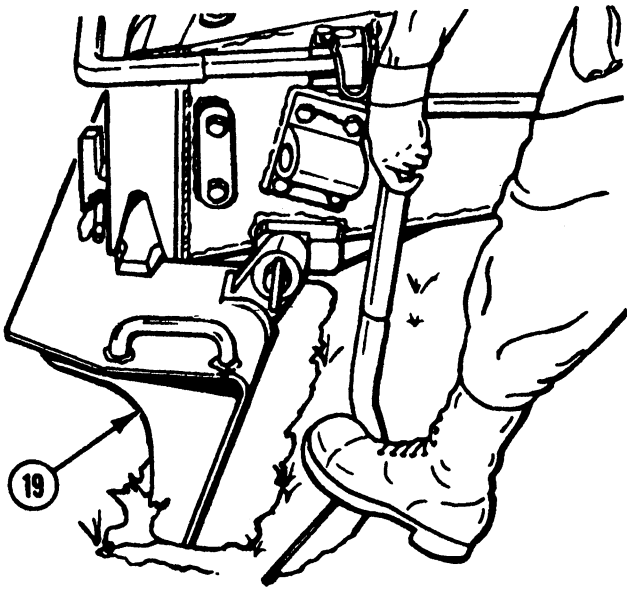
**CAUTION**

Spades must be dug in a minimum of 6 inches (15.24 cm). Dirt must not be removed from rear of spade.

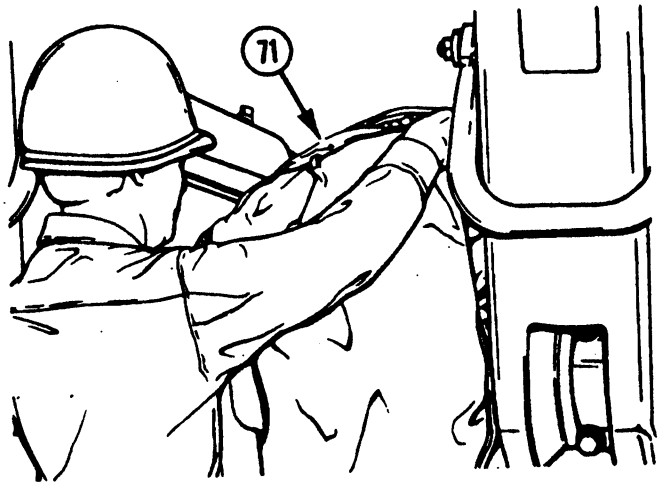
**NOTE**

The howitzer may be laid at this time. Laying instructions begin on page 2-64.

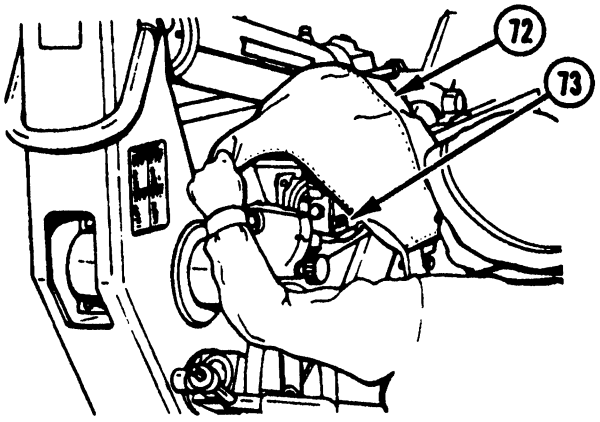
If ground is hard, remove trail locking plugs, insert handling bar into socket on trail with spade installed, slide trail in the width of spade, dig hole, slide trail back into hole, and reinstall trail locking plugs.




**44** Cannoneer no. 4 digs in right spade (19) while cannoneer no. 3 digs in left spade.




**45** Cannoneer no. 1 removes breech cover (71).



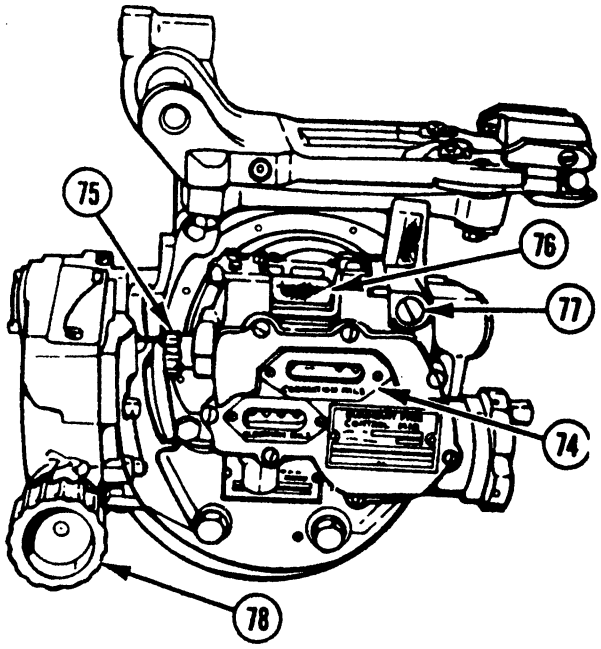

**46** The assistant gunner removes telescope and mount cover (72) from M172 telescope and quadrant mount (73).

47 The assistant gunner levels M172 telescope and quadrant mount as follows:

a. Zero elevation correction counter (74) by turning elevation correction knob (75).

b. Roll back protective covers on elevation level vial (76) and cross level vial (77).

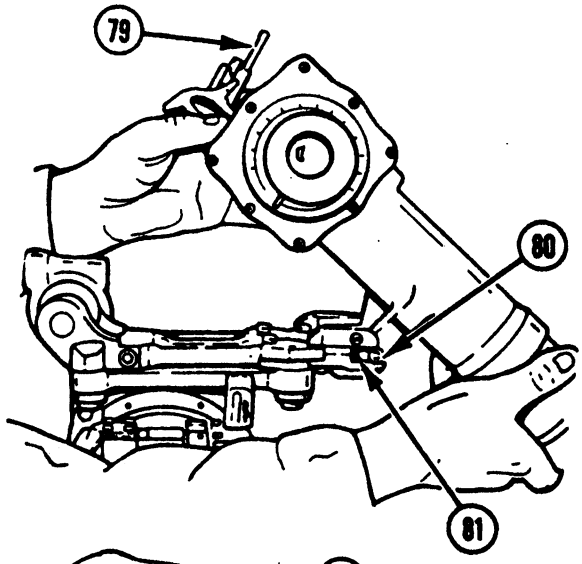
c. To center bubble in cross level vial (77), turn cross level control knob (78).




**NOTE**

Each time weapon is traversed, elevated, or depressed, M172 telescope and quadrant mount must be checked to make sure it is level.

48 The assistant gunner removes M138 elbow telescope from fire control equipment carrying case.



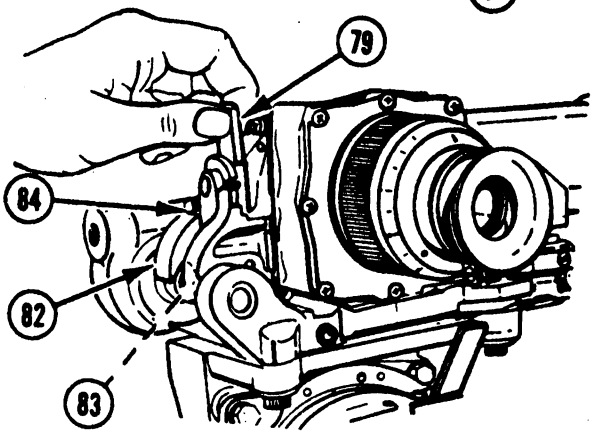

49 The assistant gunner installs M138 elbow telescope as follows:

a. Push down on locking latch (79).

b. Insert telescope T-rod (80) into keyway (81) on M172 telescope and quadrant mount with eyepiece end raised.

c. Lower eyepiece end of telescope until latch assembly (82) engages mount shaft (83).

d. Pull locking latch (79) up to a vertical position and turn lock-release lever (84) clockwise until snug.




50 Cannoneer no. 1 gets swab and bucket of water.

## 2-14. LAYING THE HOWITZER USING M2 AIMING CIRCLE

**WARNING**

**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

**NOTE**

Lay the howitzer under the direction of the gunnery sergeant when he announces, BATTERY ADJUST, AIMING POINT THIS INSTRUMENT.

1 Upon the command, ADJUST, the gunner lifts door (1) which covers azimuth counter (2) on pantel.

2 The gunner checks to ensure that:

a. Bubbles in pitch level vial (3) and cross level vial (4) on M171 telescope and quadrant mount are centered.

b. Azimuth knob bar (5) reads INDIRECT.

c. Correction counter (6) on M137 pantel is set at zero.

d. Elevation correction counter (7) on M17 fire control quadrant is set at zero.

e. Elevation counter (8) on M17 fire control quadrant is set at zero (or another elevation dictated by unit SOP).

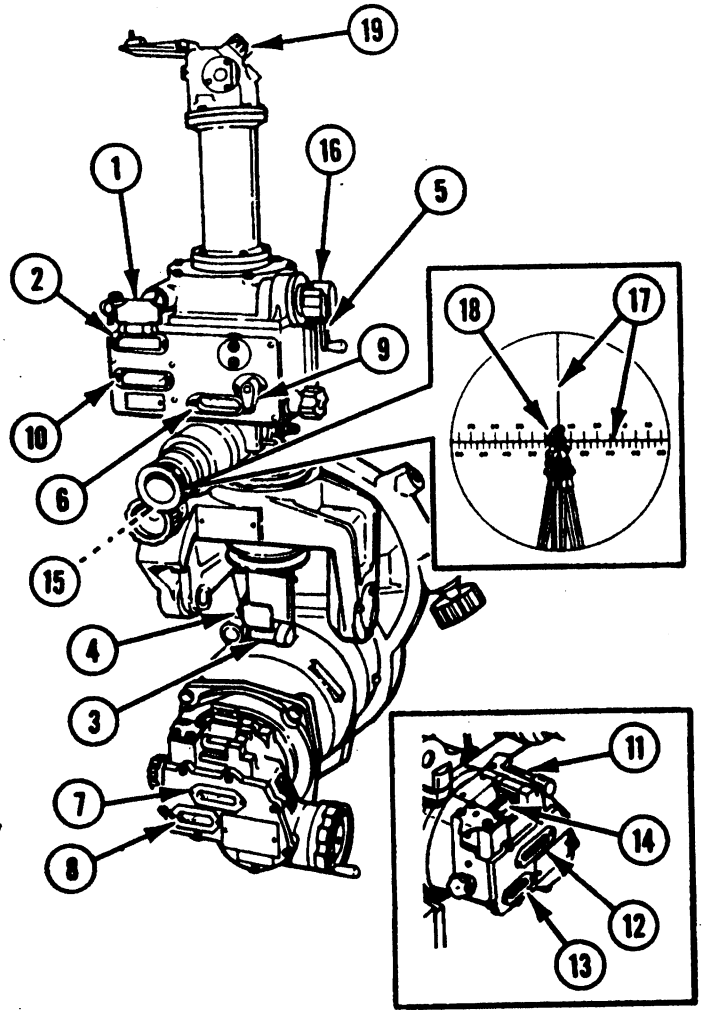
f. The gunner engages deflection knob (9), sets deflection counter (10) at 3200, and then disengages deflection knob.

3 The assistant gunner checks M18 fire control quadrant to ensure that:

a. Cross level vial (11) is centered.

b. Elevation correction counter (12) is set at zero.

c. Elevation counter (13) is set at zero (or another elevation dictated by unit SOP).




4 The assistant gunner depresses or elevates cannon tube until bubbles center in M18 fire control quadrant elevation level vial (14), and recenters cross level vial and elevation level vial as required.

5 Sighting through eyepiece (15), the gunner rotates head of M137 pantel by turning azimuth knob (16) until pantel crosshairs (17) are centered on reflector (18) of aiming circle. Pantel horizontal crosshair alinement is obtained by turning elevation knob (19).

6 When pantel crosshairs (17) are alined on reflector (18) of aiming circle, the gunner announces to the gunnery sergeant, NUMBER (SO-AND-SO), AIMING POINT IDENTIFIED.

7 The gunnery sergeant determines the aiming circle reading to pantel and announces, NUMBER (SO-AND-SO), DEFLECTION (SO MUCH).

8 Upon announcement of the azimuth, the gunner repeats the deflection reading to the gunnery sergeant by announcing, NUMBER (SO-AND-SO), DEFLECTION (SO MUCH), and turns azimuth knob (16) until the announced azimuth appears on azimuth counter (2).

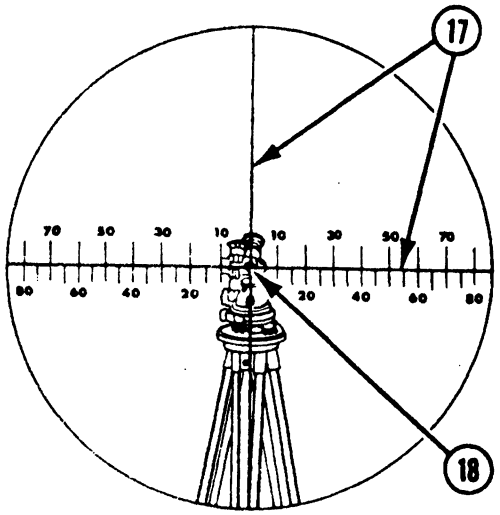
9 Operating traversing handwheel and sighting through eyepiece (15), the gunner traverses the howitzer until pantel crosshairs (17) are centered on reflector (18) of aiming circle with bubbles centered in pitch level vial (3) and cross level vial (4). Horizontal crosshair alinement is obtained by turning elevation knob (19).

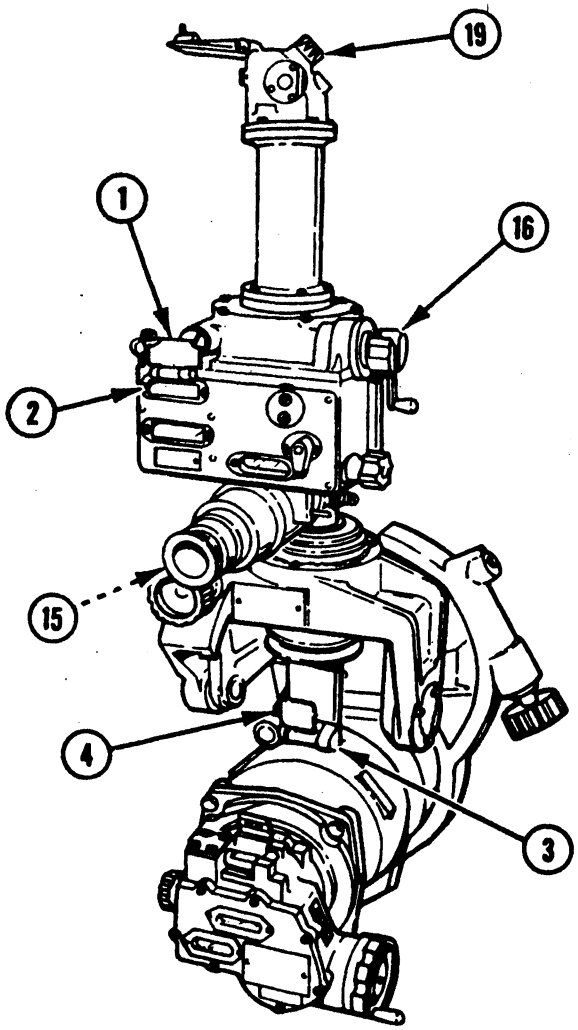
10 The gunner announces to the gunnery sergeant, NUMBER (SO-AND-SO), READY FOR RECHECK.

11 The gunnery sergeant determines a new aiming circle reading to pantel and announces, NUMBER (SO-AND-SO), DEFLECTION (SO MUCH).

12 Upon announcement of the new azimuth, the gunner repeats the deflection reading and the difference between the new deflection reading and the reading on azimuth counter (2) to the gunnery sergeant by saying, NUMBER (SO-AND-SO), DEFLECTION (SO MUCH), (SO MANY) MILS.

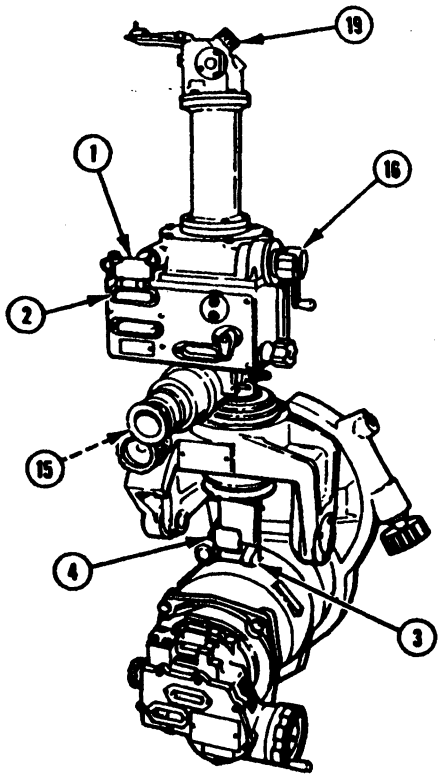
13 The gunner then turns azimuth knob (16) until the new deflection appears on azimuth counter (2).



## 2-14. LAYING THE HOWITZER USING M2 AIMING CIRCLE (cont)

14 Operating traversing handwheel and sighting through eyepiece (15), the gunner traverses the howitzer until pantel crosshairs are centered on the reflector of aiming circle with bubbles centered in pitch level vial (3) and cross level vial (4). Horizontal crosshair alinement is obtained by turning elevation knob (19).




15 The gunner and gunnery sergeant repeat steps 10 thru 14 above until the difference between the announced aiming circle reading to pantel and the reading on azimuth counter (2) (step 12) is 0 mils. When the difference announced by the gunner in step 12 is 0 mils, the gunnery sergeant announces, NUMBER (SO-AND-SO) IS LAID.

**WARNING**

**Position of M171 telescope and quadrant mount and cannon tube must not be disturbed until M1A1 collimator and/or aiming posts have been emplaced.**

16 Upon command, LAID, the gunner records reading on azimuth counter (2). The gunner then lays collimator.

## 2-15. EMPLACING THE M1A1 COLLIMATOR

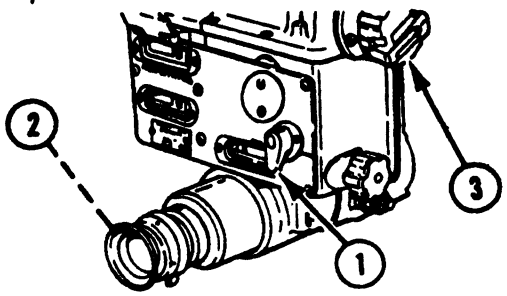
**WARNING**

**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

**NOTE**

Collimator is emplaced immediately after laying operations.

The collimator is the primary reference aiming point for the M198 howitzer. The collimator is normally placed on left rear side of weapon to facilitate its maximum use. Emplacement distances away from weapon will vary due to type of terrain but must be between 4 and 15 meters. Optimum distance is between 5 to 12 meters. The collimator should not be emplaced more than 4 meters above or below M137 pantel.




1 With deflection counter set at 3200 mils, the gunner disengages deflection knob (1) and then sights through eyepiece (2). The gunner turns azimuth knob (3) until a convenient place to locate collimator is sighted.

**WARNING**

**The collimator is radioactively illuminated and should be checked for illumination before using in a dim light. If not illuminated, follow radioactive materials procedures listed in the front of this manual.**

2 Under directions from the gunner, cannoneer no. 2 emplaces collimator (4) as follows:

a. Unfasten strap (5) holding legs.

b. Extend legs (6) as necessary. Lock by tightening locking knobs (7).

c. Rotate legs (6) to the down position. Point one leg toward the M137 pantel. Set each leg firmly into the ground and place a sandbag on each leg.

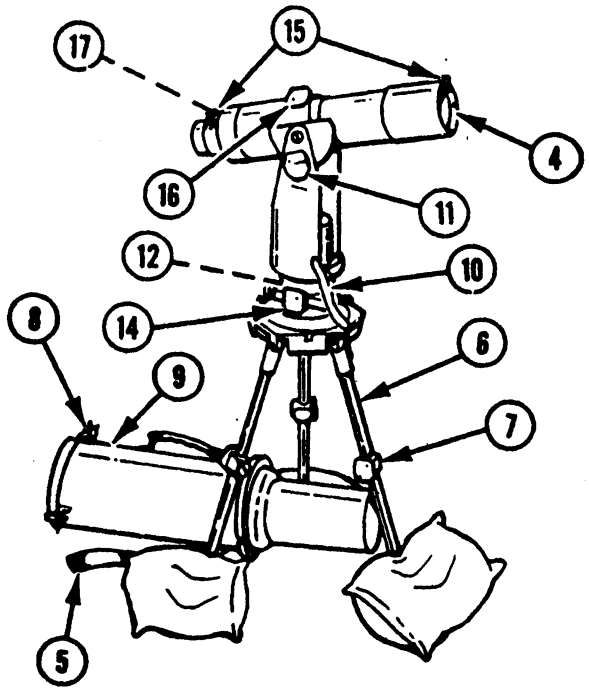
d. Release latches (8) holding cover (9). Remove cover from collimator and place between collimator legs with closed end toward muzzle.

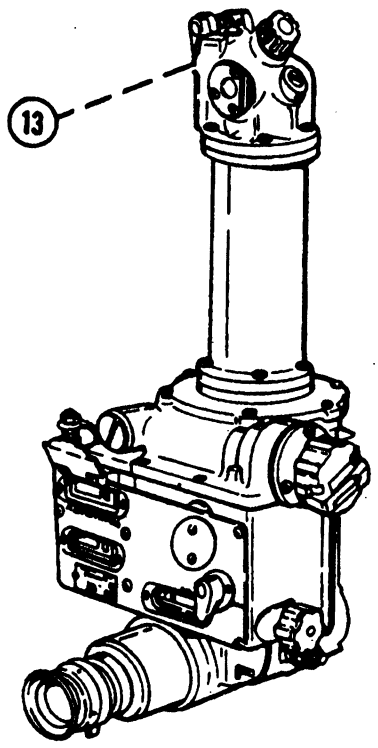
e. Unfasten strap (10). Loosen elevation clamping knob (11) and rotate collimator (4) to a horizontal position.

f. Ensure azimuth adjustment is in center of traversing capabilities by operating azimuth adjustment knob (12).

**NOTE**

During night operation, pantel objective lens (13) may not be visible from collimator. To increase visibility, place green aiming post light to pantel eyepiece.



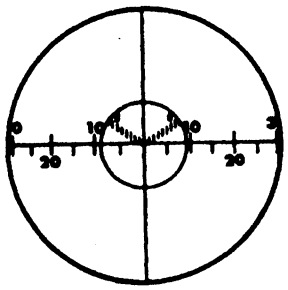

g. Loosen azimuth clamping knob (14). Sighting down front and rear sights (15), rough lay collimator on pantel objective lens (13). Tighten azimuth clamping knob (14). Adjust collimator elevation as required and tighten elevation clamping knob (11).

h. Loosen cross level clamping knob (16). Rotate collimator (4) until bubble of cross level vial (17) centers. Tighten cross level clamping knob (16).

## 2-15. EMPLACING THE M1A1 COLLIMATOR (cont)

**NOTE**

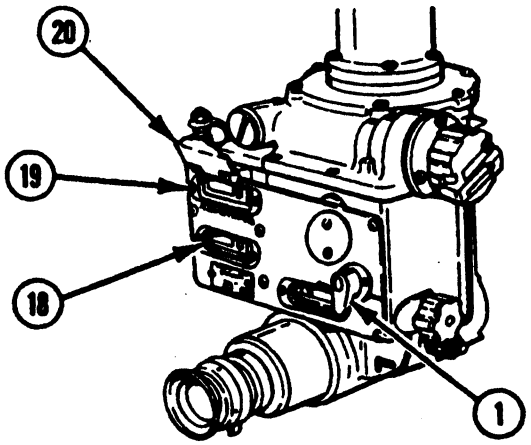
To ensure accurate laying and referring, the gunner, when sighting through M137 pantel, should view a minimum of 11 mils of collimator reticle area.



3 Sighting through M137 pantel, the gunner turns pantel azimuth knob, commands cannoneer no. 2 to turn collimator azimuth adjustment knob until pantel crosshairs are centered with collimator reticle center, and announces to cannoneer no. 2, SET.

4 With collimator emplaced, the gunner engages deflection counter (18) by turning deflection knob (1) counterclockwise to the ENGAGE position.

5 The gunner records the value appearing on azimuth counter (19), and closes azimuth counter door (20).




## 2-16. EMPLACING THE M1A2 AIMING POSTS

**NOTE**

The M1A2 aiming posts are the alternate aiming reference for the howitzer and are emplaced, time permitting, immediately after the collimator is emplaced.

1 With howitzer laid on initial azimuth of fire, the gunner checks to ensure that:

a. Pantel pitch and cross level vial bubbles are centered.

b. Pantel correction counter is set at zero.

**NOTE**

Two aiming posts are used for each howitzer. To ensure equal spacing of aiming posts, the same cannoneer should pace the distance from howitzer.

2 Cannoneer no. 5 emplaces aiming posts as follows:

a. Remove aiming post cover and aiming posts from stowage brackets on right trail.

b. Remove aiming posts from cover and assemble.

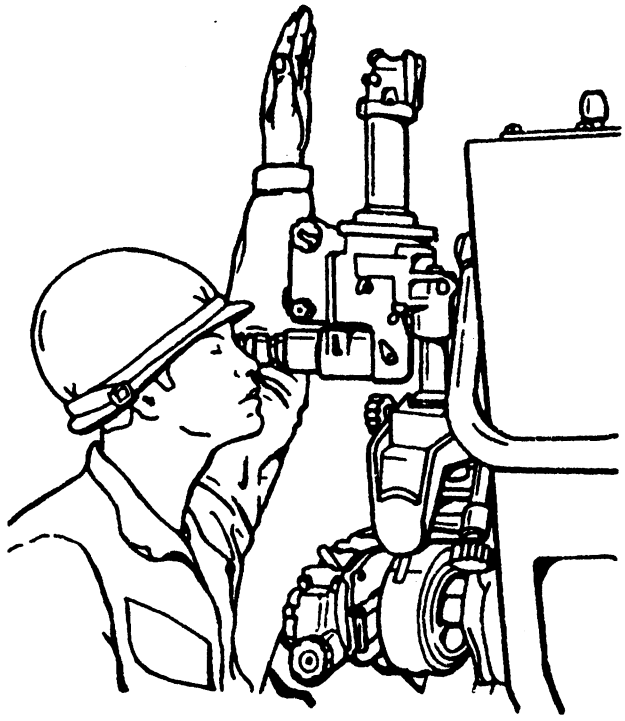
**NOTE**

Unit SOP should state which light will be used on near post and which will be used on far post and should give instructions for aiming post location.

c. At night, remove M14 aiming post lights from storage chest and install on aiming posts.

3 Cannoneer no. 5 runs out approximately 50 meters with both aiming posts and sticks the near post (short post) in the ground. He continues an additional 50 meters, stops and faces the gunner, and emplaces the far aiming post (long post) alined with the body. Cannoneer returns to the near aiming post and positions it by observing hand signals of the gunner.

4 Sighting through M137 pantel, the gunner rotates the azimuth knob until proper site picture is obtained on far aiming post. By extending his left hand above his head (right hand if posts are to rear of weapon) and having the cannoneer move the post as directed by the following movements:



a. Move aiming post left or right as directed by direction of hand movement.

b. Up and down movement represents emplace.

c. Clenched fist represents stop.

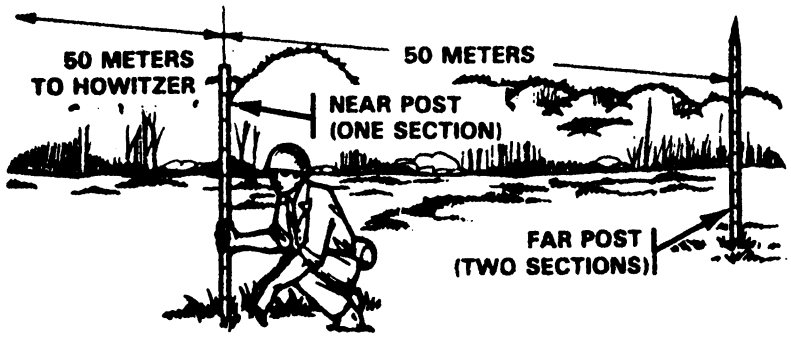
d. Tapping on top of helmet and moving hand (left or right) represents movement of top of aiming post.

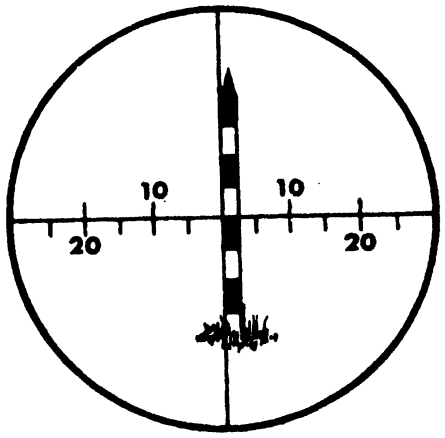
e. Hand waved in a circular motion means for cannoneer to come in.

**NOTE**

At night, this method can be used with a flashlight in the on/off mode.

## 2-16. EMPLACING THE M1A2 AIMING POSTS (cont)




5 After aiming posts are emplaced, sight picture should be as illustrated (no displacement). The gunner then records the value indicated on azimuth counter.

## 2-17. MEASURE SIGHT-TO-CREST

1 The chief of section sights along the bottom edge of the bore and directs the gunner to traverse left or right and the assistant gunner to elevate or depress the cannon tube until the bottom edge of the bore clears the highest crest in the field of fire.

2 The chief of section directs the assistant gunner to MEASURE THE QUADRANT.

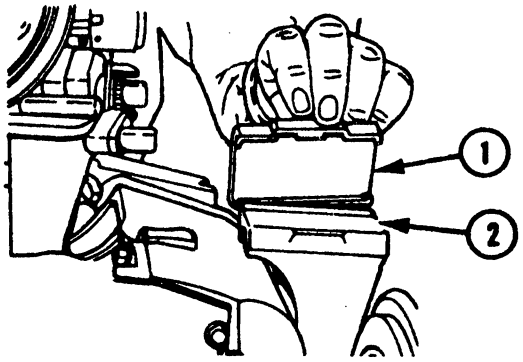
3 The assistant gunner centers the cross level bubble by turning the cross level control knob, centers the elevation level bubble by turning the elevation control knob, and reports the reading that appears on the elevation counter.

**NOTE**

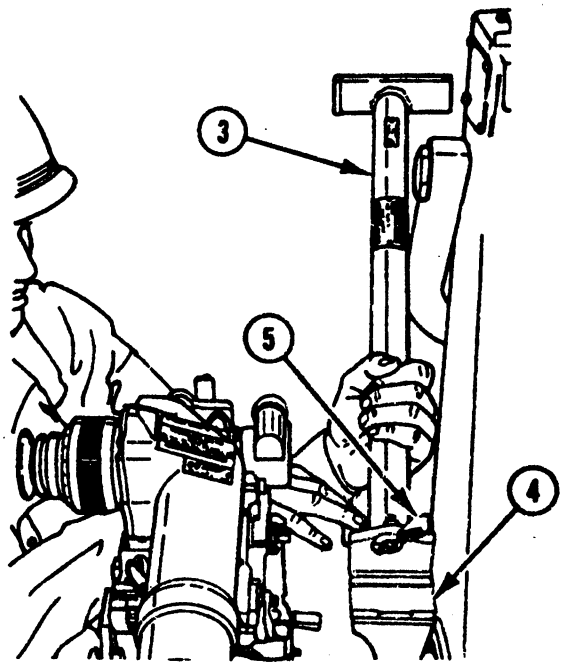
The quadrant can also be measured using the gunner's quadrant by placing the gunner's quadrant on the M18 fire control quadrant seats with the LINE-OF-FIRE arrow pointing toward the muzzle, moving radial arm index up or down and turning the micrometer knob until the bubble centers. The distance to the crest is measured in 100 meter increments.

## 2-18. CHECKING ALINEMENT OF M137 PANTEL USING M139 ALINEMENT DEVICE

**WARNING**
When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.

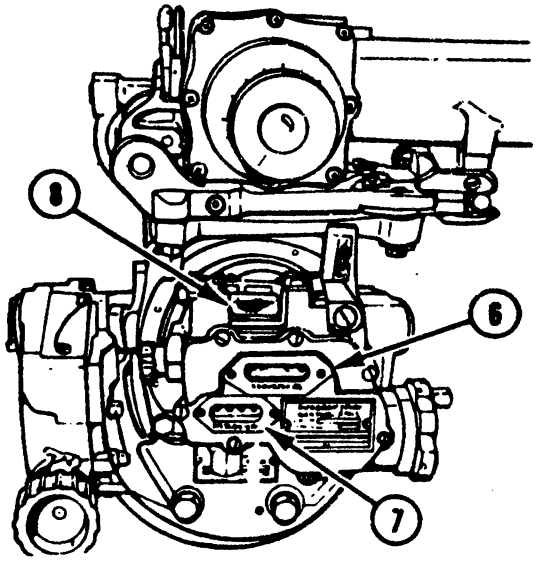



1 The assistant gunner removes protective cover (1) from dovetail (2) on right trunnion and ensures dovetail is clean by wiping with a clean rag (item 24, appx D).



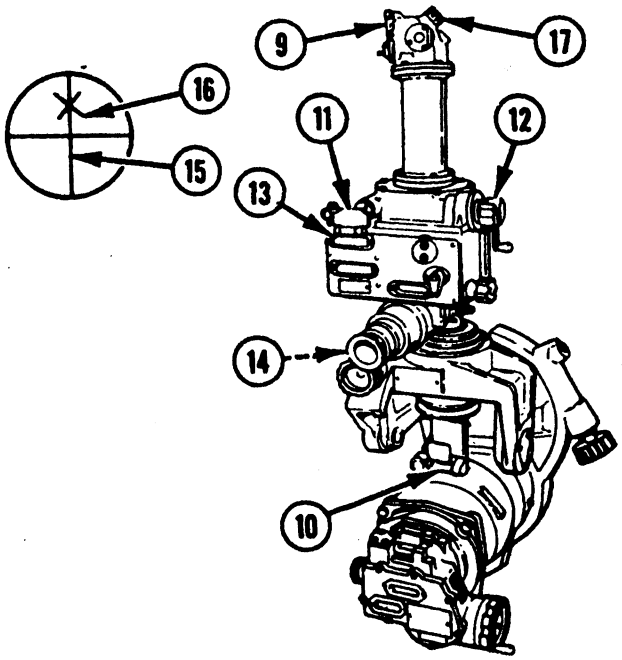

2 The assistant gunner removes alinement device (3) from carrying case and ensures mating surface (4) is clean by wiping mating surface with a clean rag (item 24, appx D). Remove protective plastic caps from head of alinement device and store in carrying case.

3 The assistant gunner mates alinement device (3) to dovetail of mounting bracket, ensuring that the mating surface of alinement device fits dovetail. The assistant gunner then turns alinement device latch (5) to lock device in place.




4 The assistant gunner sets M18 fire control quadrant elevation correction counter (6) at 00 and elevation counter (7) at 0000. The assistant gunner levels cannon tube by turning elevating handwheel until bubble in elevation level vial (8) centers.

## 2-18. CHECKING ALINEMENT OF M137 PANTEL USING M139 ALINEMENT DEVICE (cont)




5 The gunner levels M171 telescope (p 2-64) and quadrant mount and closes parallax shield (9). After leveling mount, the gunner ensures that bubble in pitch level vial (10) remains centered until alinement check of pantel is complete.

6 The gunner lifts azimuth counter door (11) and turns azimuth knob (12) until a 4800-mil reading is obtained on azimuth counter (13).

7 The gunner sights through eyepiece (14). The vertical pantel azimuth crosshair (15) should aline with crosshairs (16) of alinement device.

**NOTE**
To center crosshair for elevation, turn elevation knob (17).

8 If pantel crosshair (15) does not aline with alinement device crosshairs (16) when azimuth counter (13) reads 4800 mils ±0.5, the assistant gunner proceeds as follows:

a. Remove alinement device (3) from dovetail (2).

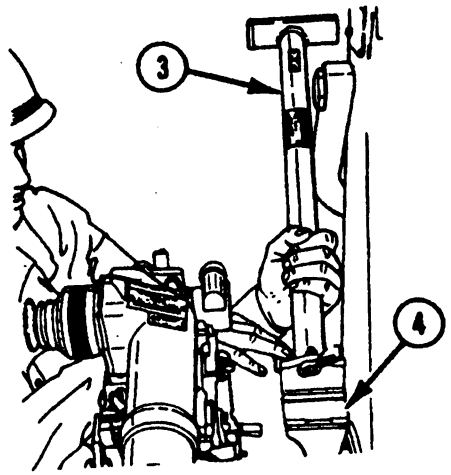
b. Reclean mounting surfaces (4) and reinstall alinement device (3). If pantel crosshair does not aline, obtain another alinement device and recheck alinement.

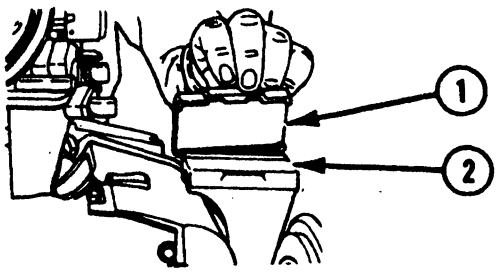
c. If alinement is still not obtained, notify unit maintenance.

9 The gunner opens the parallax shield (9) and closes azimuth counter door (11).

**CAUTION**
Failure to remove alinement device during firing may damage device.

10 The assistant gunner removes and stores alinement device (3).




**CAUTION**
Failure to install protective cover on dovetail may result in damage to dovetail.

11 The assistant gunner installs protective cover (1).

## 2-19. BORESIGHTING M138 ELBOW TELESCOPE USING DISTANT AIMING POINT

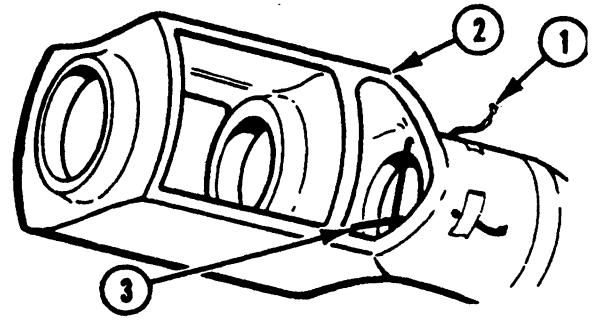
**WARNING**

**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

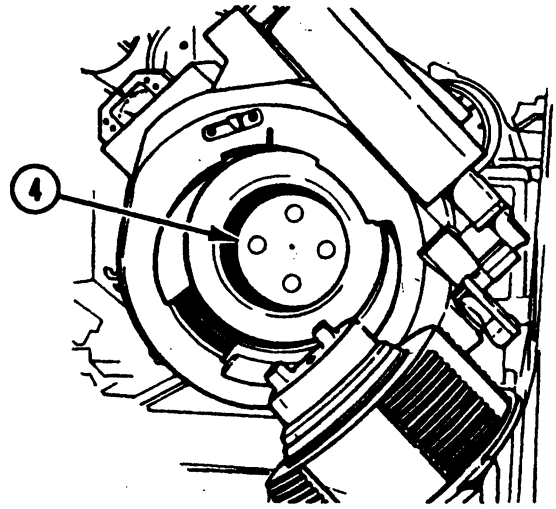
**NOTE**

**Boresighting the M138 elbow telescope is not mandatory when occupying a new position, but should be done as soon as time permits. The M138 elbow telescope and M172 telescope and quadrant mount reduce the need to boresight after installing and removing the telescope. Boresight M138 elbow telescope by the distant aiming point method.**

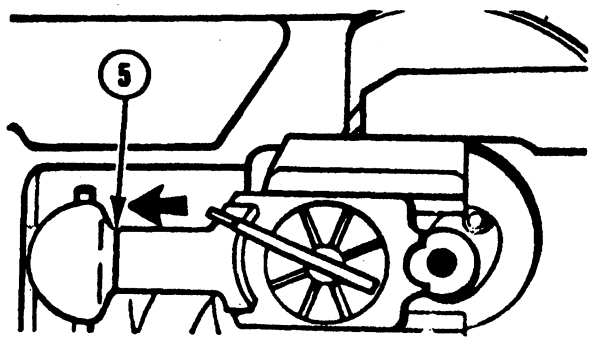
**1** The assistant gunner cross-levels M172 telescope and quadrant mount by centering bubble in cross level vial on M18 fire control quadrant.




**2** The assistant gunner stretches a cord (1) (item 11, appx D) tightly through drilled holes in muzzle brake (2) and fastens it in place, forming muzzle boresights (3).

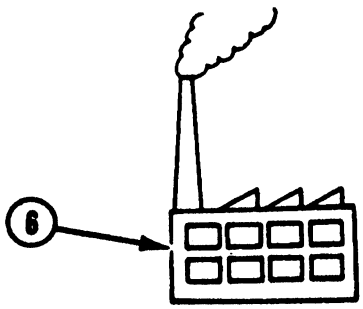



**3** Cannoneer no. 1 opens breech and installs breech boresight disk (4). If disk is not available, cannoneer no. 1 slides firing mechanism block assembly (5) left to the open position.



## 2-19. BORESIGHTING M138 ELBOW TELESCOPE, USING DISTANT AIMING POINT (cont)

4 The chief of section selects a distant aiming point (6) with a well defined vertical and horizontal axis, ideally at least 1500 meters from the weapon. If such an aiming point is not available, the chief of section boresights at engagement range for direct fire.

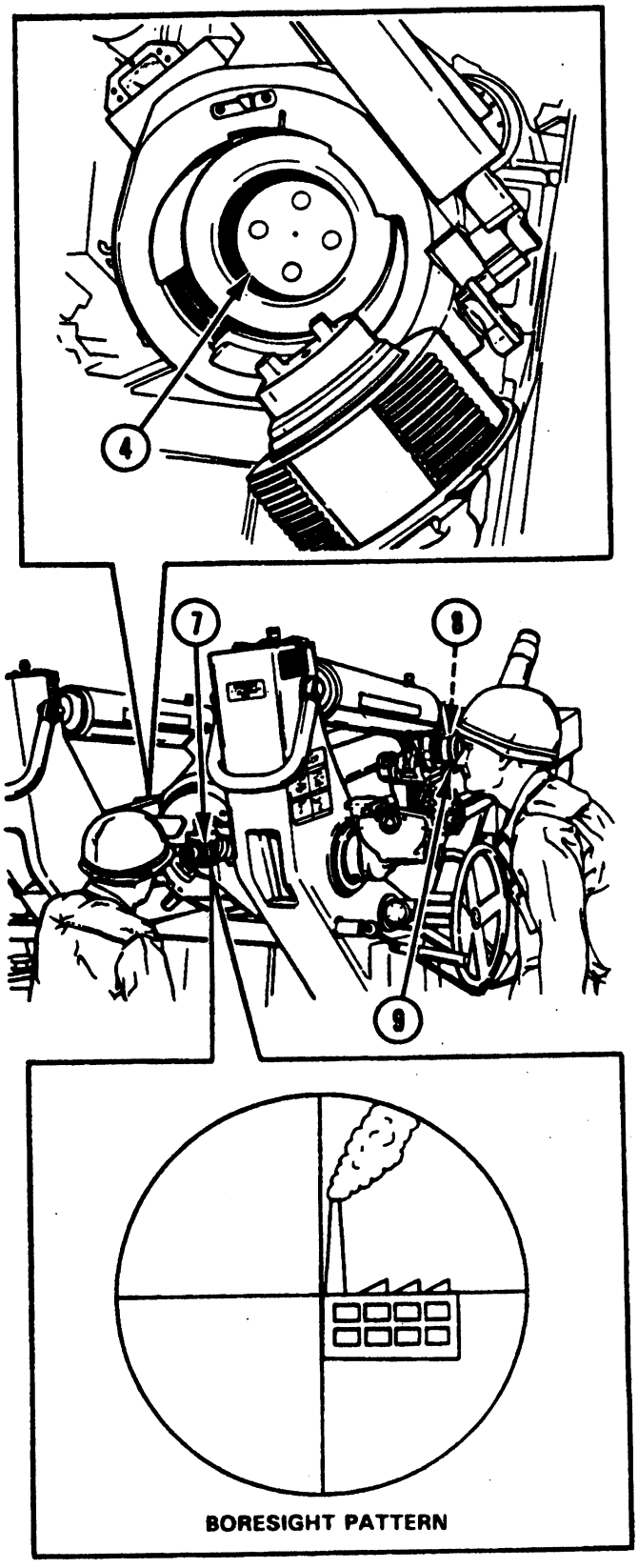



5 The chief of section, looking through breech boresight disk (4) (or primer cavity (7)) directs the elevation, depression, or traversing of cannon tube until muzzle boresights are alined on distant aiming point.

**NOTE**

If breech boresight disk is not available, perform step 6. If breech boresight disk is available, proceed to step 7.

6 The assistant gunner, looking through eyepiece (8), adjusts diopter scale (9). Using a calibrated gunner's quadrant and the quadrant seats on the M172 telescope and quadrant mount, the assistant gunner measures the elevation to the distant aiming point and elevates the muzzle 2.3 mils. The assistant gunner checks cross level of the M172 telescope and quadrant mount and adjusts if necessary.

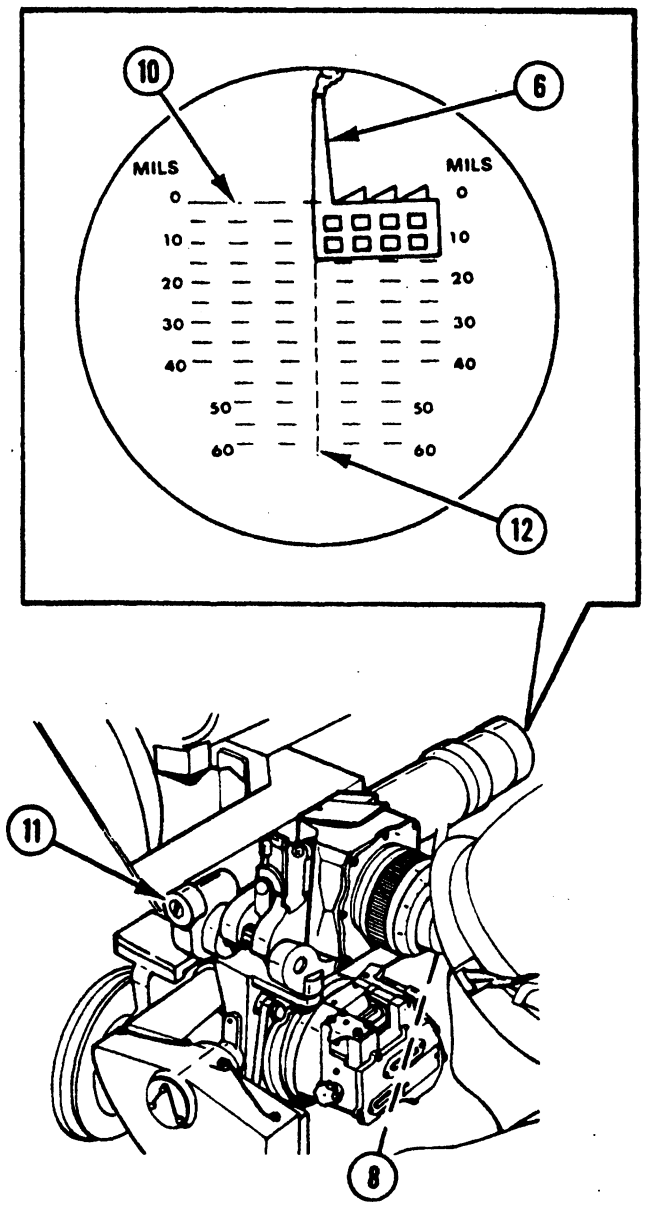


7 The assistant gunner sights through eyepiece (8). If elevation line (10) is alined with distant aiming point (6), M138 elbow telescope is in boresight.

8 If elevation line is not alined with distant aiming point, the assistant gunner turns elevation adjusting screw (11). If elevation line is misalined by more than 0.5 mils, repeat steps 1 thru 7 prior to adjustment.

9 The vertical reticle line (12) should be on distant aiming point (6). If line is not in alinement, repeat steps 1 thru 7. If azimuth correction is still required, notify unit maintenance.

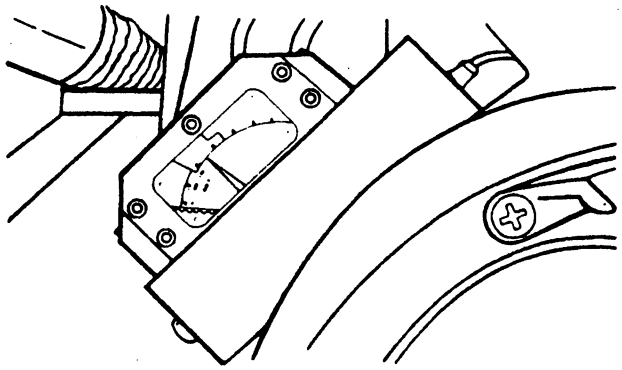
10 The assistant gunner removes cord from muzzle brake; cannoneer no. 1 removes breech boresight disk, if installed.




## 2-20. USING THE THERMAL WARNING DEVICE

**NOTE**

The thermal warning device shows the temperature of the cannon tube so that you may take the proper action in the event of a misfire or checkfire. Use the chart on page 2-76 as a guide.



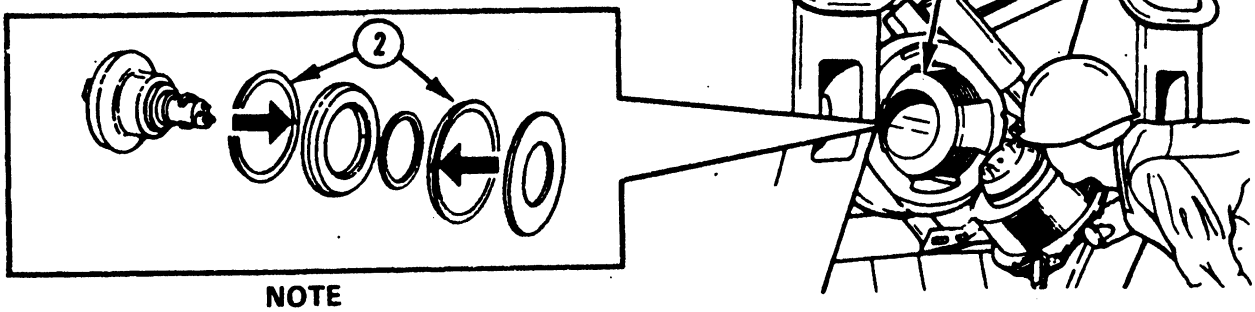
## 2-20. USING THE THERMAL WARNING DEVICE (cont)

| Temperature/Color Code | Tube Condition | Crew Must Do the Following |
|---|---|---|
| 0° to +170°F (-18° to +77°C)/Green | Cold | In case of misfire or check fire, go to page 2-115. |
| +170° to +350°F(+77° to +177°C)/Yellow | Warm | Notify fire direction center that cannon tube is warm. In case of misfire or check fire, go to page 2-115. |
| +170° to +300°F (+77° to 149°C)/Yellow | Warm/Hot Weather | Notify fire direction center that cannon tube is warm under hot weather conditions. In case of misfire or check fire, go to page 2-115. |
| Above +350°F (+177°C)/Red | Hot | Fire combat emergency missions only. In case of misfire or check fire, go to page 2-115. |

**NOTE**

Hot weather is any weather in which the outside temperature is expected to exceed 100°F (38°C) during the day.

## 2-21. PREFIRING CHECKS



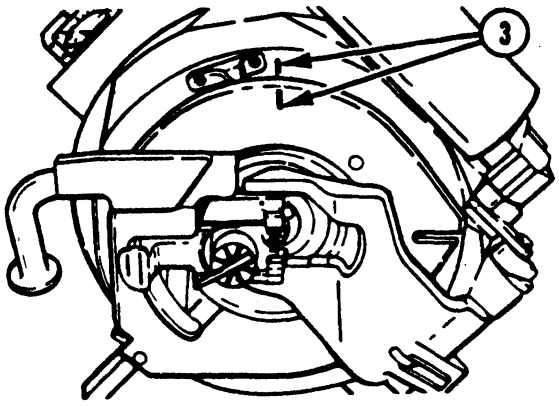

**NOTE**

After a move, make the following checks before firing the first round.

1 Cannoneer no. 1 looks through cannon tube (1) to ensure no foreign matter is present.

2 Ensure that splits on split rings (2) are 180° apart.

3 Cannoneer no. 1 ensures witness marks (3) are alined.



**NOTE**

The optimum number of reserves before firing is four. This allows recoil oil to expand during the heat of firing.

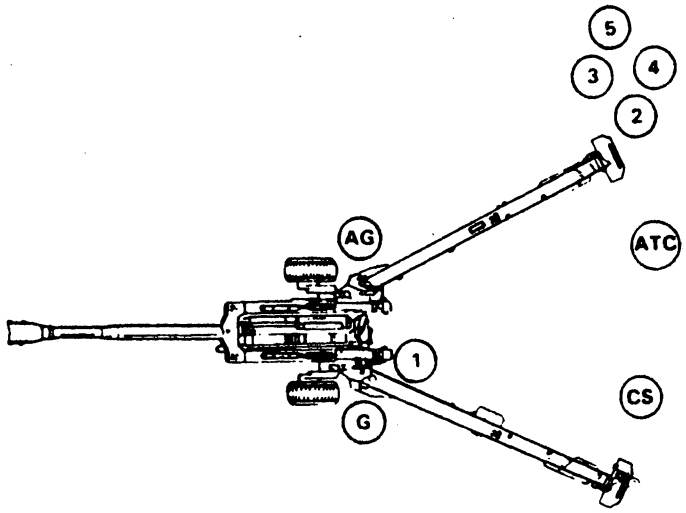
4 The assistant gunner checks to see if oil reserve indicator shows between two and ten reserves.

## 2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS

**NOTE**

Procedures for firing drills have been standardized under the Department of the Army Standardization Program.

To eliminate backlash when laying for direction and elevation, make sure the last motion of all control and leveling knobs is in a clockwise direction.




1 At the command, FIRE MISSION, from the chief of section, the section takes positions as shown above. The chief of section then relays the fire mission to the crew.

**WARNING**

**Prior to loading howitzer for actual firing, all personnel must be familiar with prescribed actions in the event of a misfire (p 2-115) and ensure prefiring checks (p 2-76) are performed.**

**CAUTION**

Do not fire weapon when speed shift cylinder assembly is supporting howitzer.

2 Cannoneer no. 4 repeats PROJECTILE, and selects and prepares projectile (p 4-34). (For preparation of M712 projectile (Copperhead), see p 4-60.)

3 Cannoneer no. 3 repeats PROPELLING CHARGE, and selects and prepares propelling charge (p 4-49).

4 Cannoneer no. 2 repeats FUZE, and selects and prepares fuze (p 4-37).

5 Cannoneer no. 1 opens breechblock assembly.

**WARNING**

**When using radioactively illuminated fire control equipment, follow radiation procedures in the front of this manual.**

## 2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS (cont)

6 The gunner lays for direction as follows:

**NOTE**
If a collimator is used, the gunner performs the following:

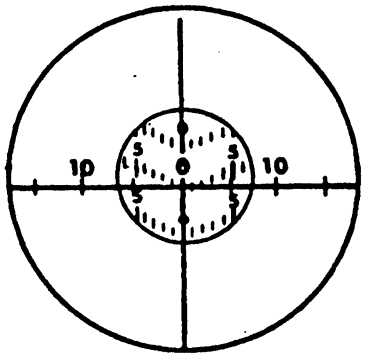
a. On the command, DEFLECTION (SO MUCH), the gunner turns azimuth knob until deflection appears in deflection counter. He then reads the setting to the chief of section.

**NOTE**
Each time howitzer is traversed or cannon is elevated or depressed, level the M171 telescope and quadrant mount.

b. While sighting through eyepiece, the gunner traverses weapon until a proper sight picture on collimator is obtained.

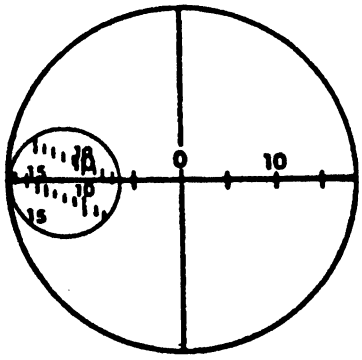
c. The gunner then levels M171 telescope and quadrant mount and rechecks sight picture.

d. If the weapon has not been displaced, the sight picture will appear as shown.



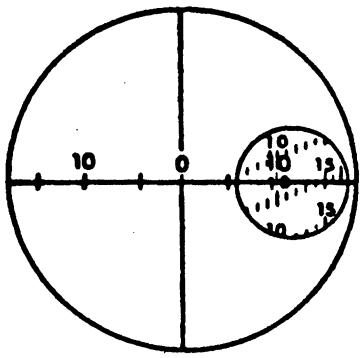
NO DISPLACEMENT

e. If the weapon has experienced right displacement (collimator reticle pattern slopes upward to the left), the gunner traverses the weapon until the left portion of the pantel reticle is matched with the collimator reticle. For example, the 10- and 15-mil marks are alined as shown.



RIGHT DISPLACEMENT

f. If the weapon has experienced left displacement (collimator reticle pattern slopes upward to the right), the gunner traverses the weapon until the right portion of the pantel reticle is matched with the collimator reticle. For example, the 10- and 15-mil marks are alined as shown.



LEFT DISPLACEMENT

**NOTE**
If aiming posts are used, the gunner performs the following:

g. On the command, DEFLECTION (SO MUCH), the gunner turns azimuth knob until deflection appears in deflection counter. He then reads the setting to the chief of section.

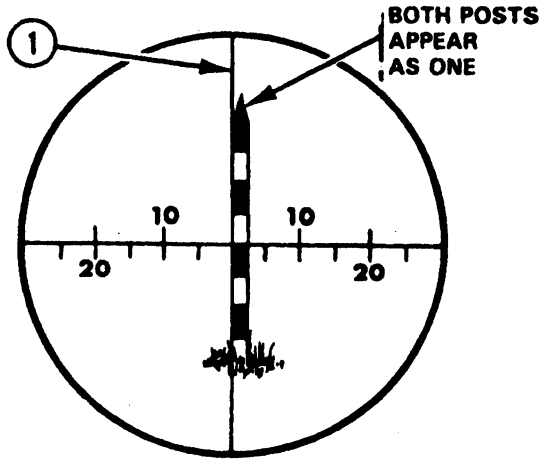
h. While sighting through eyepiece, the gunner traverses weapon until a proper sight picture on aiming posts is obtained.

i. The gunner then levels M171 telescope and quadrant mount and rechecks sight picture.

**NOTE**

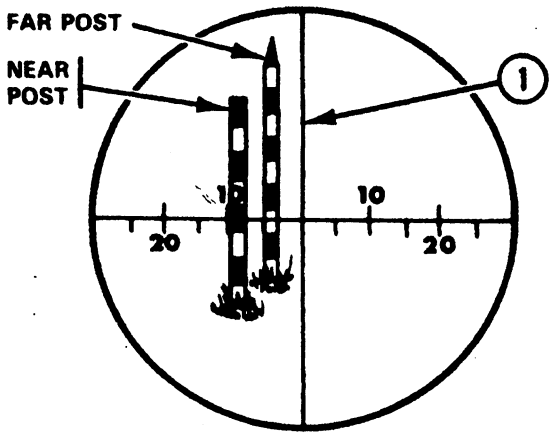
At night aiming posts are identified as near or far by color of aiming post lights. Unit SOP will dictate which color goes on which aiming post.

j. If the weapon has experienced no displacement, the sight picture will appear as shown.




NO DISPLACEMENT

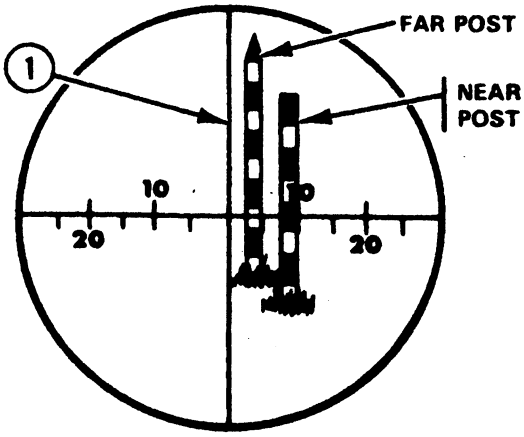
k. If the weapon has experienced right displacement (the far aiming post is to the right of the near aiming post), the gunner traverses the weapon until the far aiming post is exactly halfway between the near aiming post and the pantel vertical reticle line (1) as shown.




CORRECTED FOR
RIGHT DISPLACEMENT

l. If the weapon has experienced left displacement (the far aiming post is to the left of the near aiming post), the gunner traverses the weapon until the far aiming post is exactly halfway between the near aiming post and the pantel vertical reticle line (1) as shown.

m. The gunner then relevels M171 telescope and quadrant mount (if necessary), rechecks and adjusts sight picture (if necessary) by traversing, and announces READY to the chief of section.




CORRECTED FOR
LEFT DISPLACEMENT

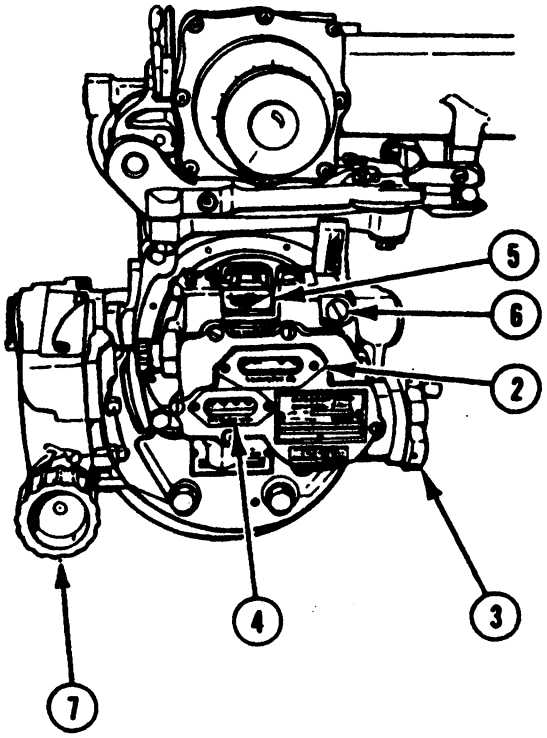
## 2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS (cont)

**NOTE**

During normal operation, the assistant gunner lays the howitzer for elevation using the M18 fire control quadrant. However, during one-man indirect fire operations, the gunner lays the howitzer for elevation using the M17 fire control quadrant.

7 Using the M18 fire control quadrant, the assistant gunner lays the howitzer for elevation as follows:

a. On the command, QUADRANT (SO MUCH), the assistant gunner ensures elevation correction counter (2) reads 00 and rotates elevation control knob (3) until announced quadrant appears in the elevation counter (4). He then reads the setting to the chief of section.




b. The assistant gunner elevates or depresses the cannon tube until bubble in the elevation level vial (5) centers. The assistant gunner centers the bubble in the cross level vial (6) by turning the cross level control knob (7). The assistant gunner rechecks and adjusts both bubbles (if necessary), and announces SET to the chief of section.

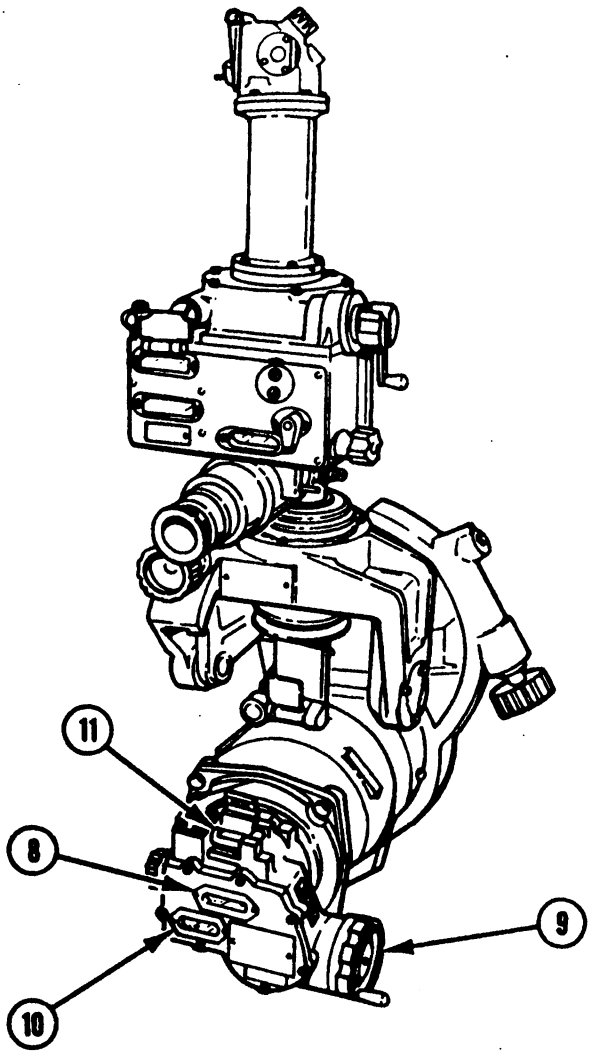
c. The gunner's quadrant can also be used to lay for quadrant. The chief of section sets the announced quadrant on the gunner's quadrant using the radial arm index and micrometer knob. He places and holds the gunner's quadrant firmly on the M18 fire control quadrant seats with the LINE-OF-FIRE arrow pointing toward muzzle. The chief of section directs the assistant gunner to elevate or depress until the bubble is centered.

8 Using the M17 fire control quadrant (during one-man indirect fire operations) the gunner lays the howitzer for elevation as follows:

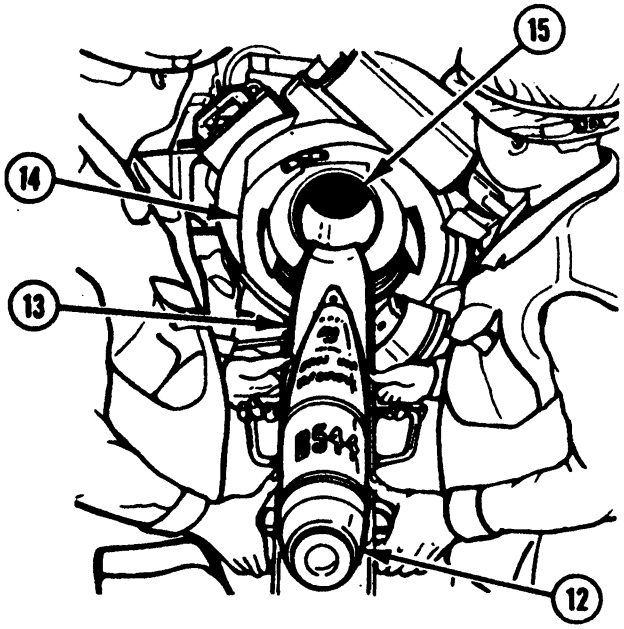
a. On the command, QUADRANT (SO MUCH), the gunner ensures elevation correction counter (8) reads 00 and rotates elevation control knob (9) until announced quadrant appears in elevation counter (10). He then reads setting to chief of section.

b. The gunner elevates or depresses cannon tube until bubble centers in elevation level vial (11).

c. The gunner rechecks the M171 telescope and quadrant mount pitch and cross level vials, pantel sight picture, and adjusts as necessary. The gunner then announces READY to the chief of section.




9 Cannoneers no. 4 and 5 place projectile (12) on loading tray (13). They lift upward and place loading tray on breech ring assembly (14) so that front edge of loading tray rests against rear face of cannon tube (15).



## 2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS (cont)

10 Cannoneer no. 1 places loading rammer assembled on staff sections against base of projectile and pushes projectile into breech until the rotating band clears the Swiss notch recess. Cannoneer no. 5 removes loading tray.

**NOTE**

Ramming at low gun elevations will be done using two 4-foot (1.22-m) cleaning staff sections. If the gun is elevated to the extent that two staff sections cause interference with the ground, one staff section may be removed and replaced with a 2-foot (0.61-m) staff section. Do not use only a single staff section.

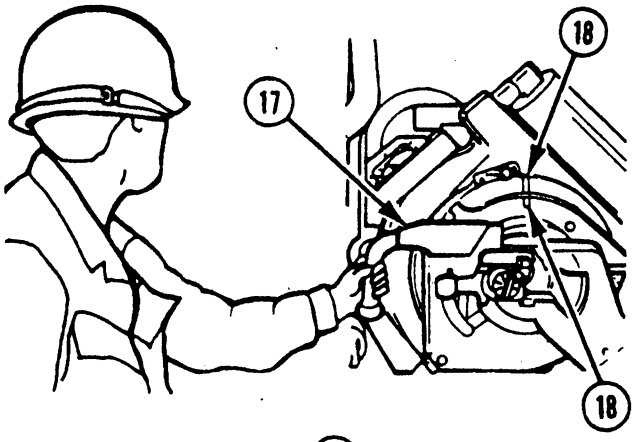
11 Upon the command, READY, RAM, from cannoneer no. 4, the projectile is rammed into place by cannoneers no. 1 and 4, using loading rammer and staff.

**WARNING**

**Do not leave a propelling charge in chamber longer than necessary before firing. Temperature changes affect performance characteristics of a powder charge. Those changes occur rapidly in a hot chamber.**

12 Cannoneer no. 3 hands prepared propelling charge (16) to cannoneer no. 1 who checks the charge and then announces CHARGE (SUCH-AND-SUCH) to the chief of section. Cannoneer no. 1 then inserts the charge into the chamber with red igniter base to rear. The propelling charge is pushed in until the base is approximately 3 inches (7.62 cm) from rear face of cannon tube into Swiss notch recess.

13 Cannoneer no. 1 announces, I SEE RED, and closes breechblock assembly (17), making sure it is locked in placed and that witness marks (18) are alined.

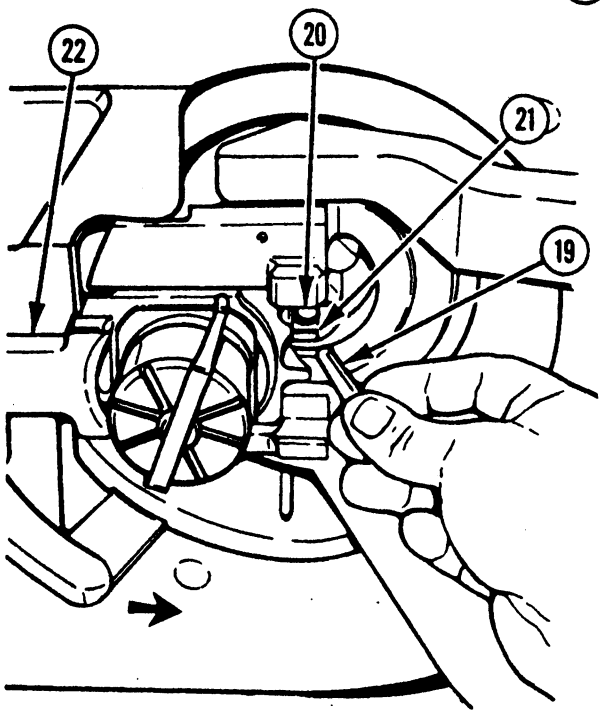



**WARNING**

**Don't force primer into primer chamber. If primer will not go in, chamber is probably dirty. Forcing primer into primer chamber may cause primer to prematurely ignite powder charge which will cause the howitzer to recoil prematurely and cause serious injury to crew.**

14 Cannoneer no. 1 inserts primer (19) into primer cavity (20) until it seats against cartridge extractor (21).

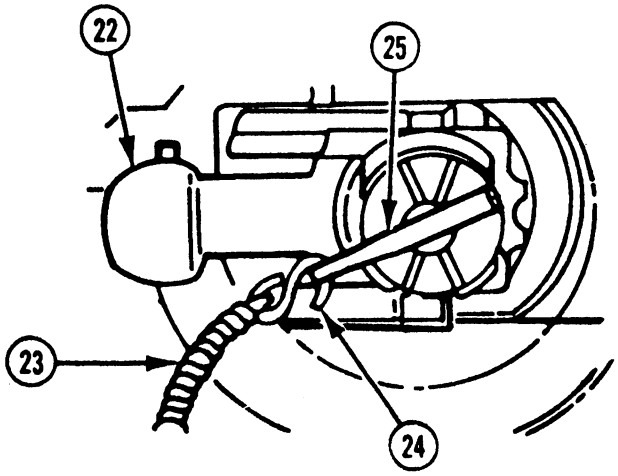
15 Cannoneer no. 1 slides firing mechanism block assembly (22) closed.




**NOTE**

The lanyard lever can be repositioned by pushing in on "hole end" of lever and rotating.

16 Cannoneer no. 1 attaches lanyard (23) by inserting S-hook (24) through hole in lanyard lever (25) and announces, PRIMED.



## 2-22. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING INDIRECT FIRE MISSIONS (cont)

**WARNING**

When firing, personnel in the area will stay clear of the recoil path.

When firing howitzer at night, personnel should avoid direct viewing of muzzle flash from their weapon or adjacent weapons when firing top zones. Temporary flash blindness can be caused by intense muzzle flash, resulting in potential reduction of crew efficiency.

**WARNING**

The M198 howitzer can generate blast overpressure which may damage hearing or cause injury to lungs or sinuses if proper protective measures are not followed. Supervised wearing of earplugs is required at all times, with the e-a-r type (plastic roll) preferred. The effects of blast can be reduced by moving further to the rear of the weapon. For this reason, all crew members not required to fire the weapon should move away as far to the rear as practicable. Any crewman who experiences such problems as shortness of breath or bleeding from nose or mouth must be immediately transported to a medical facility for evaluation.

The degree of hearing protection required is based on propelling charge used and number of rounds fired daily by the crew. For training missions, earplugs provide adequate protection if M4A2 (WB), zone 6, or lower charges are used. When firing higher zones, consult the following chart.

Properly worn foam earplugs provide adequate protection when firing all existing propellant charges, including M203 series, at all quadrant elevations according to the guidelines in the following chart.

**Maximum Firings in 24-Hour Period with Hearing Protection Required**

**NOTE**

These recommended limits are mutually exclusive; e.g., 12 rounds M203 series, or 32 rounds M119 series, or 144 rounds M4 series, or 1000 rounds M3 series per 24 hour continuous time period.

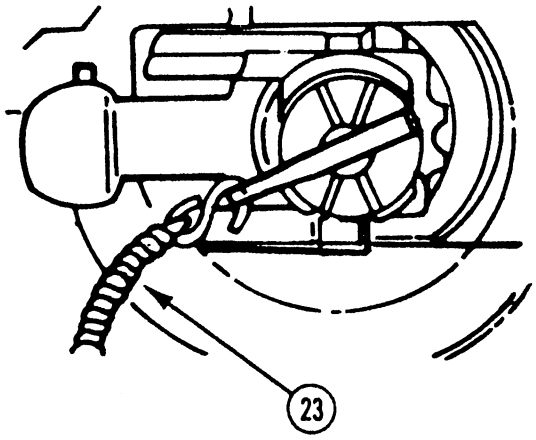
| Propellant charge | No. of rounds |
|---|---|
| M3 series | 1000 |
| M4 series | 144 |
| M119 series | 32 |
| M203 series | 12 |

**NOTE**

When firing more than 12 M203 series propellant charges in a 24-hour period, all personnel must stand 25 feet (7.62 m) or more behind rear of cannon and 25-foot (7.62-m) lanyard must be used.

**NOTE**

When cannoneer no. 1 has announced, PRIMED, the assistant gunner has announced, SET, and the gunner has announced, READY, the chief of section may command, FIRE, unless restricted by the fire command.



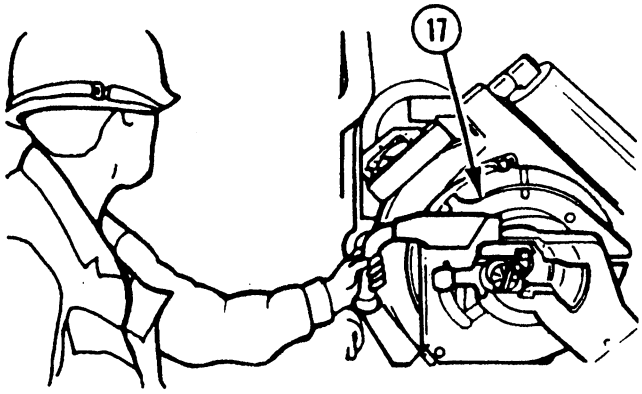

**17** When the chief of section commands, FIRE, or drops raised arm, cannoneer no. 1 pulls lanyard (23) with a steady pull.

**WARNING**

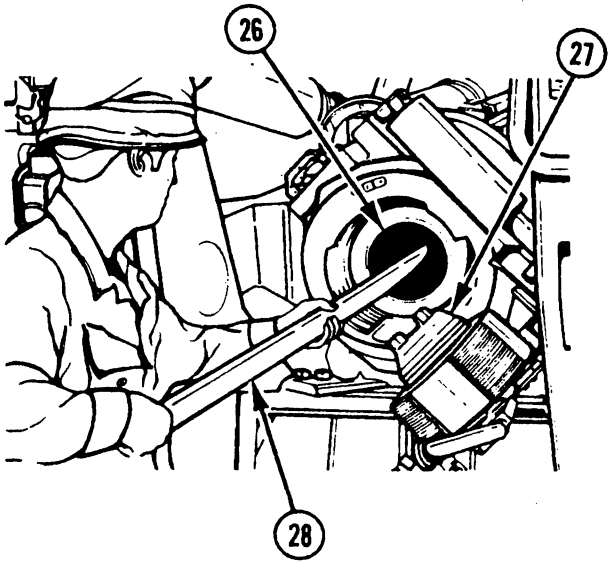
In case of a failure to fire, refer to misfire and check firing procedures (p 2-115).

**NOTE**

The primer is ignited by impact of hammer against firing pin. The firing mechanism assembly returns automatically to the ready position when lanyard is released.




**18** When cannon tube returns to the in-battery position, cannoneer no. 1 opens breechblock assembly (17).



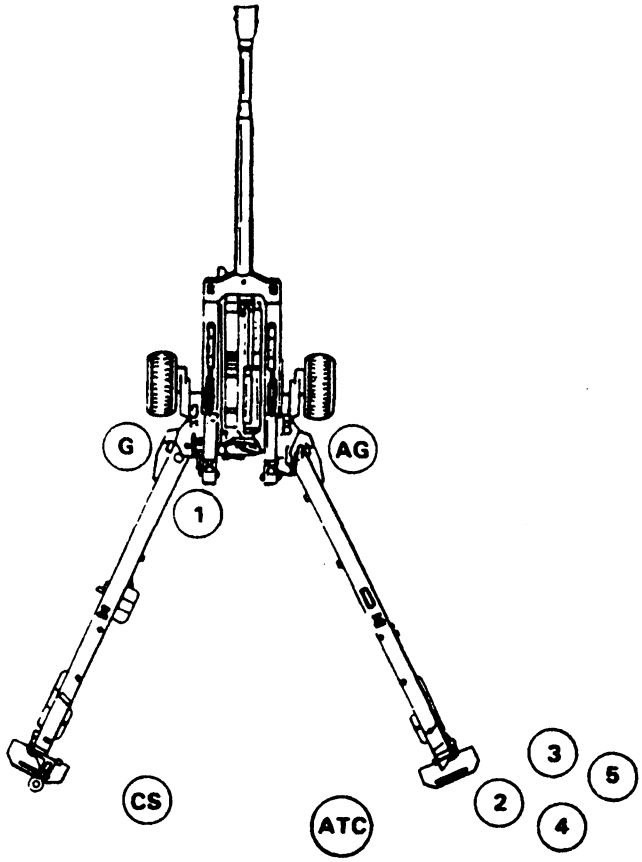

**19** Cannoneer no. 1 swabs powder chamber (26), spindle assembly (27), and gas check seat using chamber swab (28); inspects cannon tube; and announces, BORE CLEAR.

## 2-23. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING DIRECT FIRE MISSIONS

**WARNING**

Direct fire on targets closer than 800 meters from the howitzer during combat situations only. Lethal fragments can travel up to 600 meters from point of burst.

The one-person sight system should only be used when the target and the howitzer are at the same elevation, with no mask (sight-to-crest) obstacles in between. Firing at targets above or below the howitzer position requires adjustments to the quadrants listed on the range chart. Adjustments must be computed by the Fire Direction Center in accordance with TC 6-40, paragraph 6-17c thru 6-17i. For this reason, the primary means of direct fire will be the two-person sight method.

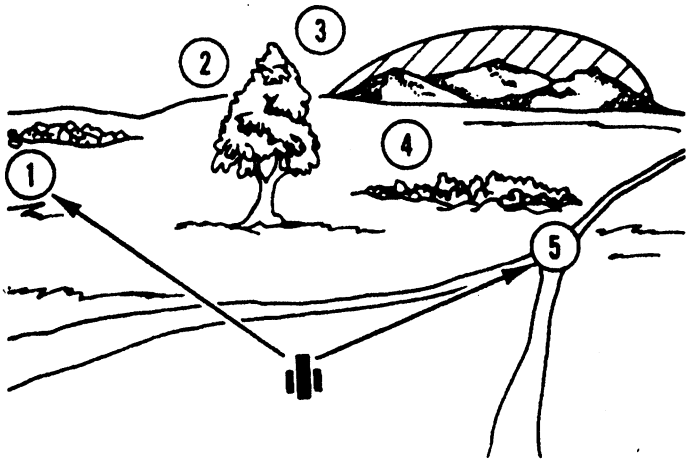



**NOTE**

Procedures for firing drills have been standardized under the Department of the Army Standardization Program. The following procedures are for two-person operations. For one-person, one-sight operations, the gunner assumes duties of the assistant gunner and performs them on left side of howitzer.

**a. Duties of the Chief of Section.** Upon receipt of the order to fire direct fire, the chief of section does the following:

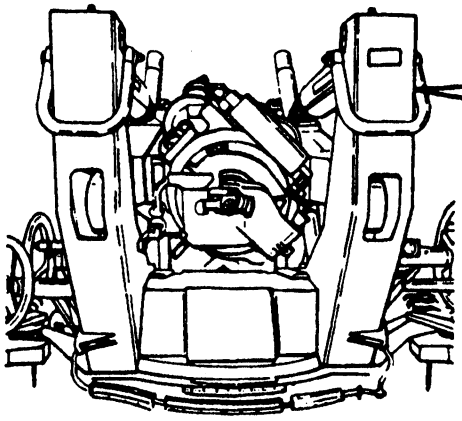
(1) Commands the section to take positions as illustrated above.




| NO. | SHELL | CHG | FZ | TI | DF | QE | RANGE | DESCRIPTION | RMK |
|---|---|---|---|---|---|---|---|---|---|
| 1 | HE | 7 | Q | | 3800 | 4 | 200 | ROCK PILE | |
| 2 | HE | SGB | Q | | 3015 | 6 | 150 | TREE | |
| 3 | ICM | 1 | T1 | 2.0 | 2800 | 1000 | 900 | DEAD SPACE | SWEEP 200 m |
| 4 | HE | 1 | T1 | 2.0 | 2447 | 30 | 400 | HEDGE ROW | KJ |
| 5 | HE WP | 1 | T1 | 2.0 | 1831 | 30 | 400 | RD JCT | KJ |

(2) Announces target to section, i.e., TARGET, ROCK PILE.

(3) Determines quadrant of target from range card, i.e., 4 mils. If range card is not prepared, quadrant may be obtained from direct fire range plate.



DIRECT FIRE RANGE PLATE
M198 155 MM HOWITZER

| M795 HE PROJECTILE | | M107 HE PROJECTILE | |
|---|---|---|---|
| M203 PC (RB) | | M118A1 PC (WB) | |
| RANGE (METERS) | ELEV (MILS) | RANGE (METERS) | ELEV (MILS) |
| 400 | | 400 | 4 |
| 600 | | 600 | 7 |
| 800 | | 800 | 9 |
| 1000 | | 1000 | 11 |
| 1200 | | 1200 | 14 |
| 1400 | | 1400 | 16 |
| L15 HE PROJECTILE | | M107 HE PROJECTILE | |
| M203 PC (RB) | | M4A2 PC (WB) | |
| RANGE (METERS) | ELEV (MILS) | RANGE (METERS) | ELEV (MILS) |
| 400 | | 400 | 6 |
| 600 | | 600 | 10 |
| 800 | | 800 | 13 |
| 1000 | | 1000 | 16 |
| 1200 | | 1200 | 20 |
| 1400 | | 1400 | 24 |

PLATE DIRECT FIRE P/N 12008973

**NOTE**

The M795 HE projectile and L15 projectile are not available.

(4) Determines and announces lead, in mils, by estimating speed of target for particular shell and charge. Approximate leads are as follows:

0 to 5 mph (0.00 to 8.05 km/hr) ..... 5 mils
6 to 10 mph (9.65 to 16.09 km/hr) ..... 10 mils
11 to 15 mph (17.69 to 24.13 km/hr) ..... 15 mils

(5) Gives the fire commands as follows:

(a) TARGET (DESCRIPTION/LOCATION)

(b) SHELL (TYPE)

(c) CHARGE (TYPE)

(d) FUZE (TYPE)

(e) LEAD (LEFT OR RIGHT SO MUCH)

(f) RANGE (SO MUCH)

(g) FIRE AT WILL (unless otherwise notified)

(6) Gives the following subsequent commands based on observed effect:

(a) CHANGE IN LEAD (RIGHT OR LEFT SO MUCH)

(b) CHANGE IN QUADRANT (ADD OR DROP)

## 2-23. LAYING FOR DIRECTION AND ELEVATION AND LOADING AND FIRING THE HOWITZER DURING DIRECT FIRE MISSIONS (cont)

**WARNING**

**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

**b. Duties of the Assistant Gunner.** The assistant gunner lays the howitzer for elevation as follows:

**NOTE**

To eliminate backlash when laying for direction and elevation, make sure the last motion of all control and leveling knobs is in a clockwise direction.

**(1)** Cross-levels M172 telescope and quadrant mount by centering bubble in cross level vial.

**(2)** Using direct fire range plate, determines elevation based on announced range, charge, and projectile and elevates or depresses cannon tube to keep appropriate mil line of elbow telescope on center mass of target, then announces, SET.

**(3)** Continues to announce, SET, as long as target is being tracked.

**(4)** For subsequent rounds, changes the mil line based on commands from the chief of section.

**c. Duties of the Gunner.** The gunner lays the howitzer for direction as follows:

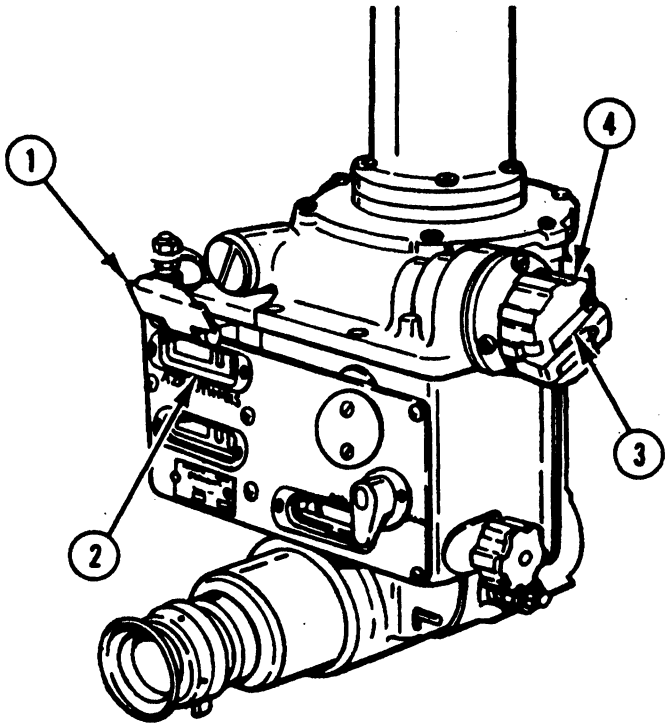
**NOTE**

To eliminate backlash when laying for direction and elevation, make sure the last motion of all control and leveling knobs is in a clockwise direction.

**(1)** Cross-levels M171 telescope and quadrant mount by centering bubble in cross level vial

**NOTE**

Central laying is the preferred method for direct fire.



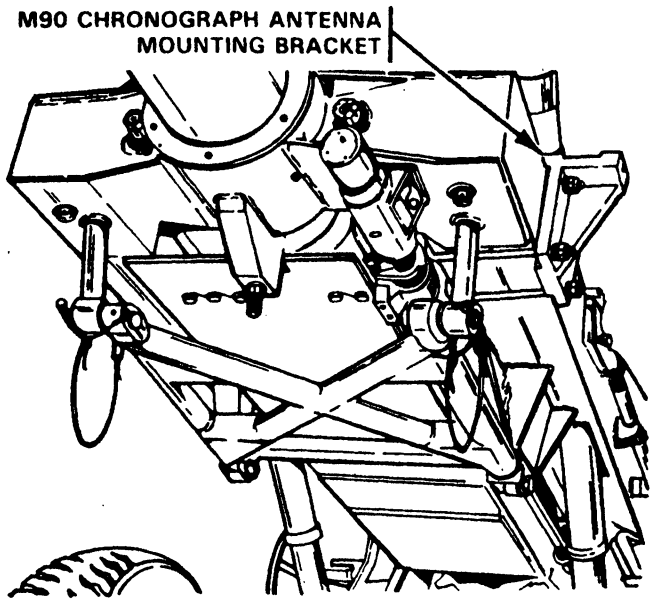

**(2)** Opens azimuth counter door (1), sets azimuth counter (2) to 3200 by turning azimuth knob (3), and turns azimuth bar knob (4) to DIRECT.

**(3)** Tracks target (if moving) by traversing weapon. If a lead is announced by the chief of section, it can be applied with azimuth knob (3). With azimuth bar knob (4) on DIRECT, azimuth counter (2) will click every 5 mils. The lead can also be applied with reticle lead. The gunner should use appropriate mil line of reticle pattern to obtain desired lead.

(4) When proper sight picture exists and cannoneer no. 1 announces, PRIMED, the assistant gunner announces, SET, continuously until the gunner commands, FIRE.

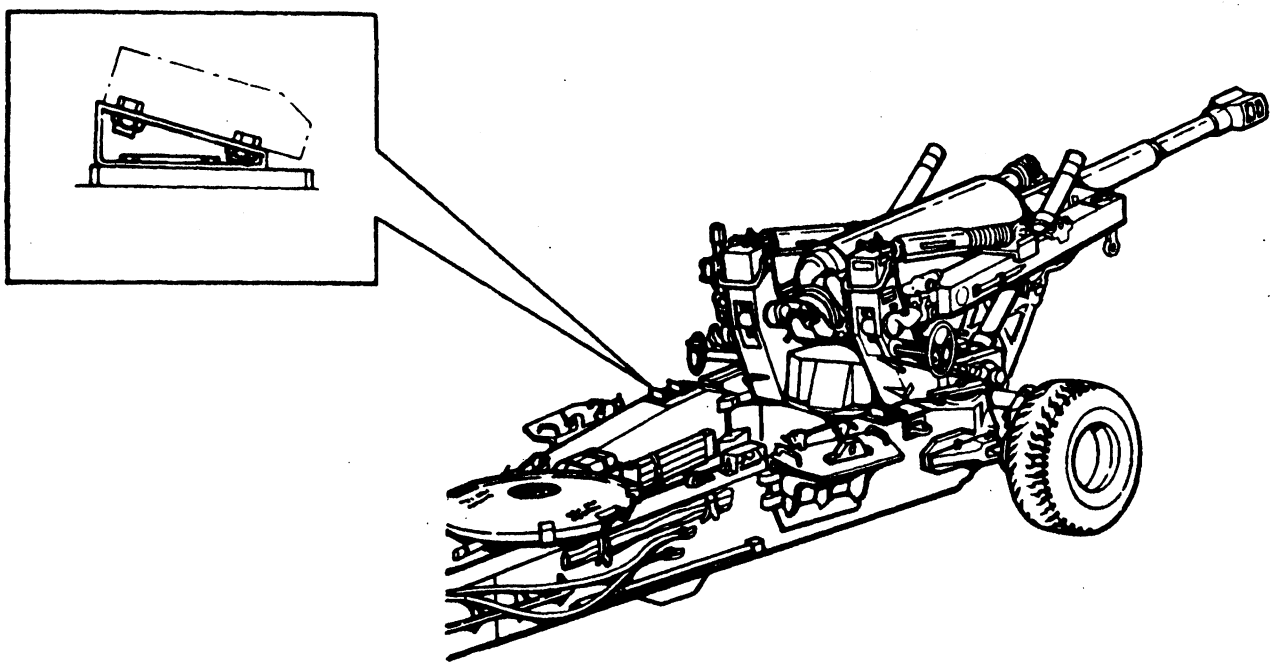
**d. Duties of Remainder of Section.** Performs duties as in indirect fire until END OF MISSION or CHECK FIRING is commanded by the chief of section.

## 2-24. M90 CHRONOGRAPH




The M90 chronograph antenna mounting bracket mounted on the cradle assembly is for installation of the M90 chronograph antenna bracket assembly. Instructions for the operation of the M90 chronograph are in TM 9-1290-359-12&P.

## 2-25. BATTERY COMPUTER SYSTEM (BCS) GUN ASSEMBLY

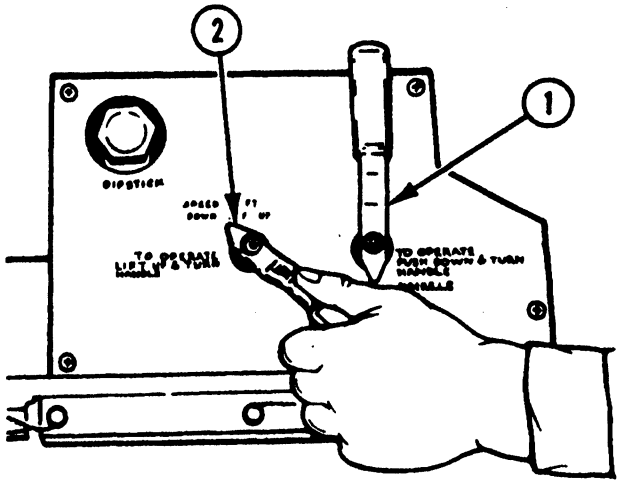


Three gun assembly (GA) brackets are mounted on top of trails, immediately forward of the spade stowage brackets. One GA bracket is on the right trail; two GA brackets are on the left trail. Instructions for operation of the BCS gun assembly are in TM 11-7440-283-12-1, TM 11-7440-283-12-2, and TM 11-5820-882-10.

## 2-26. TRAVERSING BEYOND CARRIAGE TRAVERSE LIMITS AND OPERATING SPEED SHIFT SELECTOR VALVE

**CAUTION**

Do not use the firing baseplate and detent assembly as a speed shift cylinder assembly.




1 Upon receipt of the command DEFLECTION (SUCH-AND-SUCH), the gunner determines the deflection to be out of normal traverse limits. The gunner then announces SPEED SHIFT, MUZZLE RIGHT or MUZZLE LEFT as required.

**WARNING**

**Before attempting to shift direction of howitzer by using speed shift selector valve, be sure weapon is free of all ammunition and WHEELS lever (1) is in the OFF position.**

2 Cannoneer no. 3 lifts up and moves SPEED SHIFT lever (2) to the DOWN position.

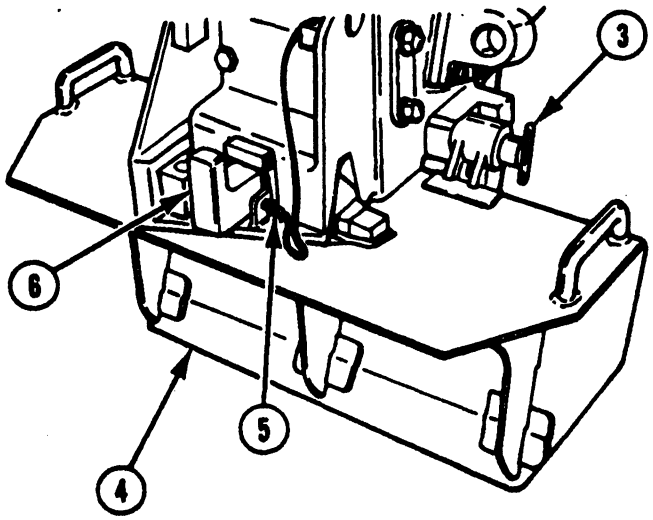
**NOTE**

The 800-mil elevation provides the balance point for speed shifting howitzer. Higher elevations will produce a higher load at the ends of trails, while lower elevations will produce a negative (no load) condition.

3 The assistant gunner elevates or depresses cannon tube as required to position cannon tube at approximately 800-mil elevation.

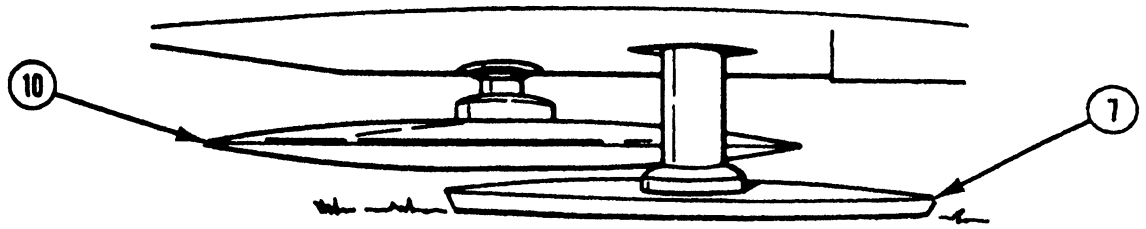
**NOTE**

Be sure that plunger handles (3) on spades (4) are inserted into trails so that spades can hang loose and pivot.




4 Remove spade retaining pins (5) and spade keys (6).

5 When speed shift (7) is being lowered, cannoneers no. 1 and 5, and driver should hold down left trail, and cannoneer no. 2, the ammunition team chief, and the assistant gunner should hold down right trail.



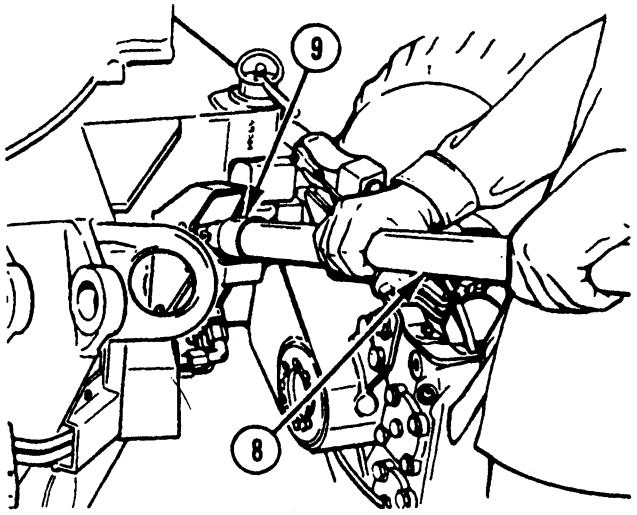

**NOTE**

When speed shifting the weapon on soft soil, such as mud or sand, place logs, ammunition packing material, or other similar supports under speed shift assembly (7) for stabilization.

6 Cannoneers no. 3 and 4 insert pump handles (8) into hydraulic adapters (9) and pump up and down to lower speed shift (7) until clearance is obtained beneath firing baseplate (10).

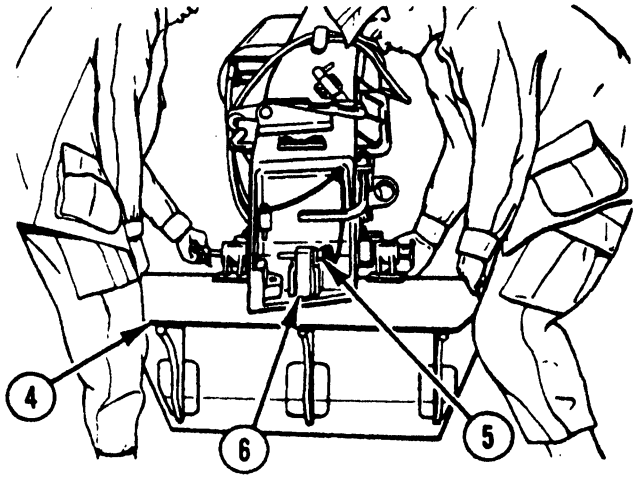
**CAUTION**

Never fire howitzer while speed shift is supporting weapon.

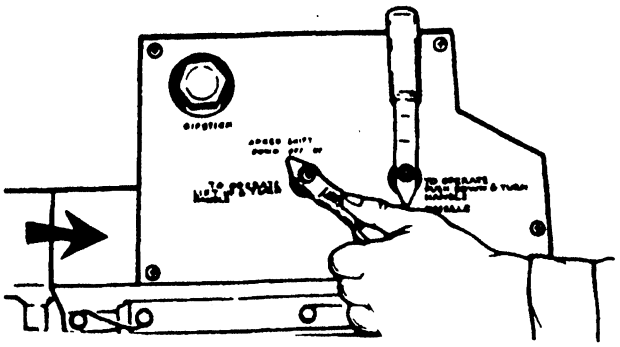


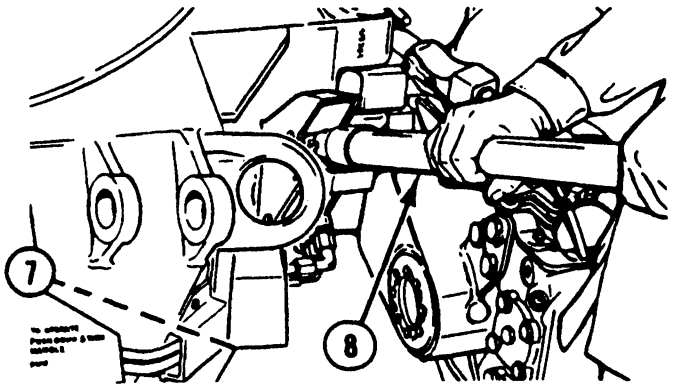

7 When gunner or chief of section commands, TRAILS UP, cannoneers no. 1, 3, 5, and the driver lift left trail and cannoneers no. 3 and 4, the ammunition team chief, and the assistant gunner lift right trail and move trails in direction indicated by the gunner. When pantel vertical hairline is alined or close to azimuth marker, the gunner commands, TRAILS DOWN.

8 The assistant gunner and the ammunition team chief pivot spades (4) to firing position and reinstall spade keys (6) and spade retaining pins (5).



## 2-26. TRAVERSING BEYOND CARRIAGE TRAVERSE LIMITS AND OPERATING SPEED SHIFT SELECTOR VALVE (cont)






**WARNING**
**Keep feet from under firing baseplate.**

9 Cannoneer no. 3 lifts up SPEED SHIFT lever and moves it to the UP position to allow howitzer to lower to the ground.

10 Cannoneers no. 3 and 4 pump up and down on pump handles (8) to raise speed shift (7). Cannoneer no. 3 lifts up SPEED SHIFT lever and moves it to the OFF position.

11 All emplace weapon.

## 2-27. PREPARATION OF HOWITZER FOR TOWING

**CAUTION**
Towing restrictions are limited to: 15 mph (25 km/h) maximum over cross-country roads, 30 mph (48 km/h) maximum over secondary roads, and 45 mph (72 km/h) maximum over improved roads.

During scheduled stops, check the howitzer brakes to ensure lugnuts are tight. Check the temperature of the hubs and brakes. If hubs and brakes are too hot to touch, let them cool before continuing.

**NOTE**
Procedures for march order have been standardized under the Department of the Army Standardization Program.

For preparation of the howitzer for airlift, refer to FM 55-450-1, Army Helicopter External Load Operations.

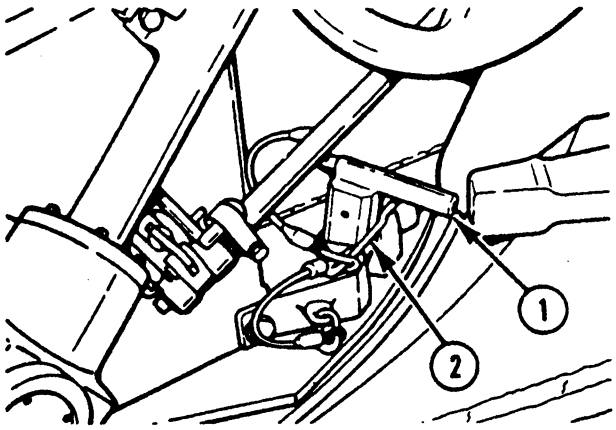
The airlift travel lock will be installed on all howitzers being airlifted by the CH-47D helicopter to prevent damage to the helicopter. Fabrication is done at direct support maintenance. (The airlift travel lock is to be used for airlift only and not for towing the howitzer.)

1 Check tires for damage and correct inflation pressure.

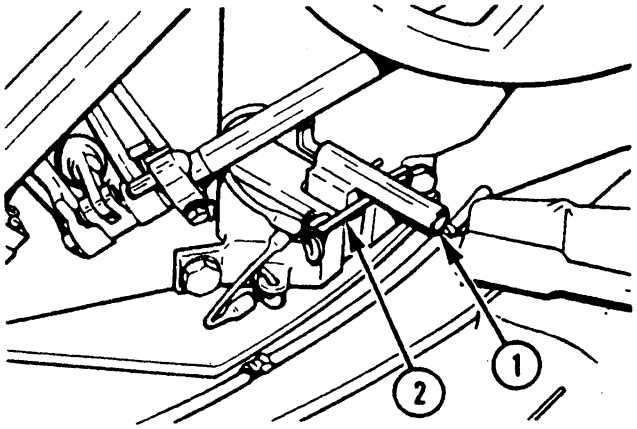
2 The chief of section ensures there is no ammunition in cannon tube.

3 After depressing cannon tube within reach, cannoneer no. 4 installs muzzle plug.

4 Cannoneer no. 3 installs vehicular taillight on cannon tube, connects cable assembly, and then wraps cable assembly around the cannon tube several times to eliminate the slack and to aid in the securing of taillight.




UNLOCKED




LOCKED

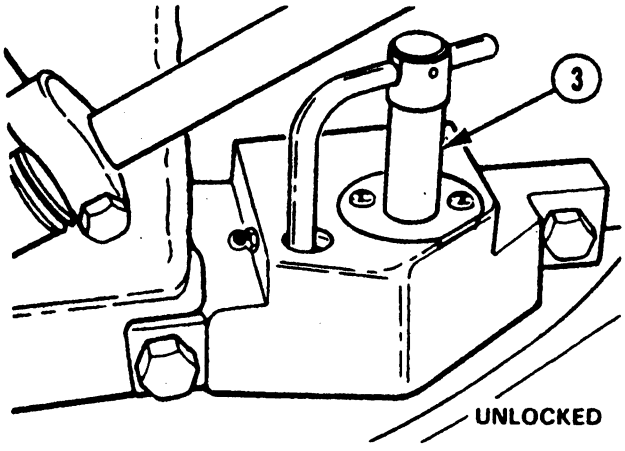
**CAUTION**
Do not move howitzer if top carriage locking pin is disengaged.

**NOTE**
Step 5 and CAUTION apply to howitzers that have not been modified.

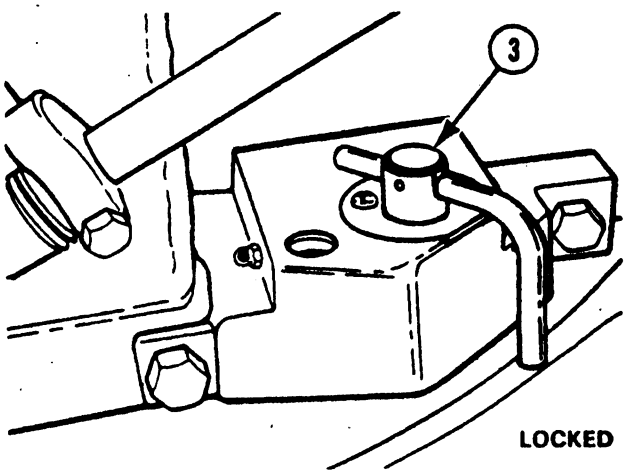
**CAUTION**
Do not traverse the top carriage unless the wheels are locked in the up (firing) position or down (towed) position.

5 The gunner engages top carriage locking pin (1) by removing retaining pin (2) and pushing down on top carriage locking pin. The gunner then inserts retaining pin to secure top carriage locking pin.

**NOTE**
The top carriage locking pin should remain in the unlocked position during normal use. Rotate pin to the locked position just prior to centering top carriage for attaching the travel lock.




UNLOCKED




LOCKED

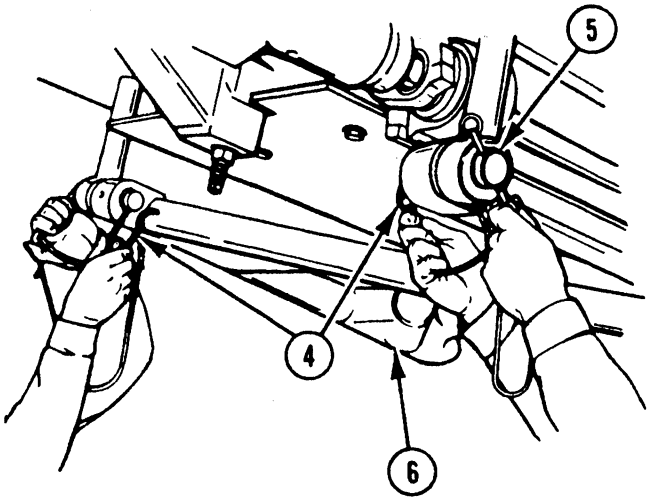
**NOTE**
Steps 6, 7, and 8 apply to howitzers that have been modified.

6 The gunner disengages top carriage locking pin (3) by lifting and rotating the top carriage locking pin to the unlocked position.

7 The gunner engages the top carriage locking pin (3) by lifting and rotating to the lock position. Then traverse top carriage until top carriage locking pin (3) engages in the bottom carriage.

8 The gunner and assistant gunner elevate the cannon tube to approximately 250 mils.

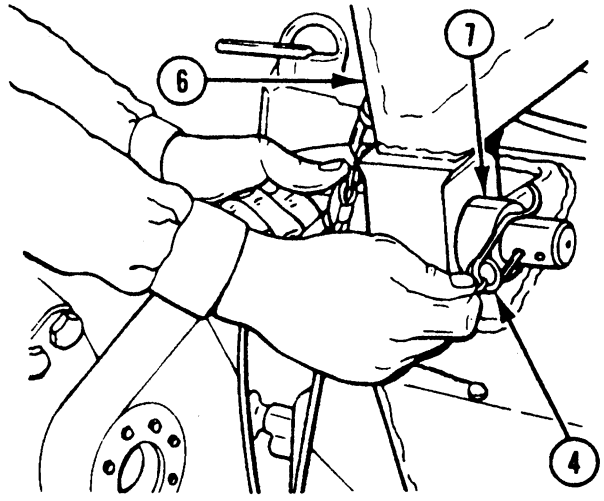
## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)



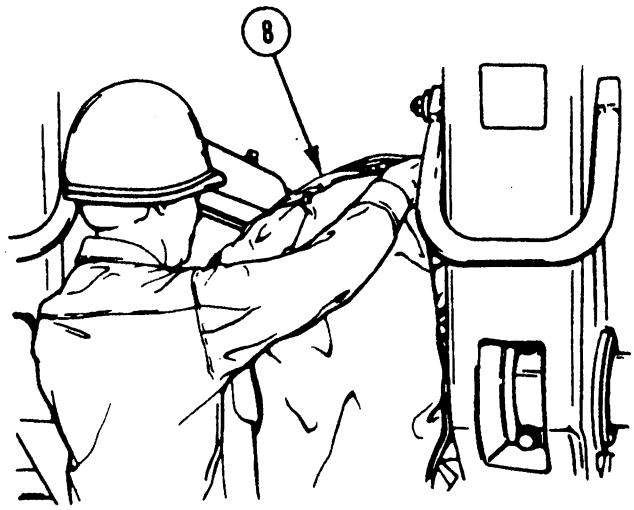

9 Cannoneers no. 3 and 4 remove retaining pins (4) and travel lock pins (5) and lower travel lock assembly (6).

**CAUTION**

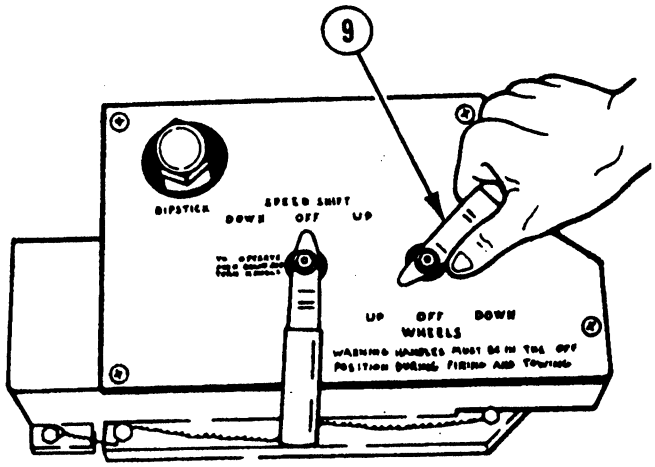
Both travel lock pins (5) must be installed in lower travel lock assembly (6) before moving howitzer.




10 The gunner elevates or depresses cannon tube until travel lock assembly (6) is aligned in brackets (7). Cannoneers no. 3 and 4 then insert travel lock pins (5) and retaining pins (4).



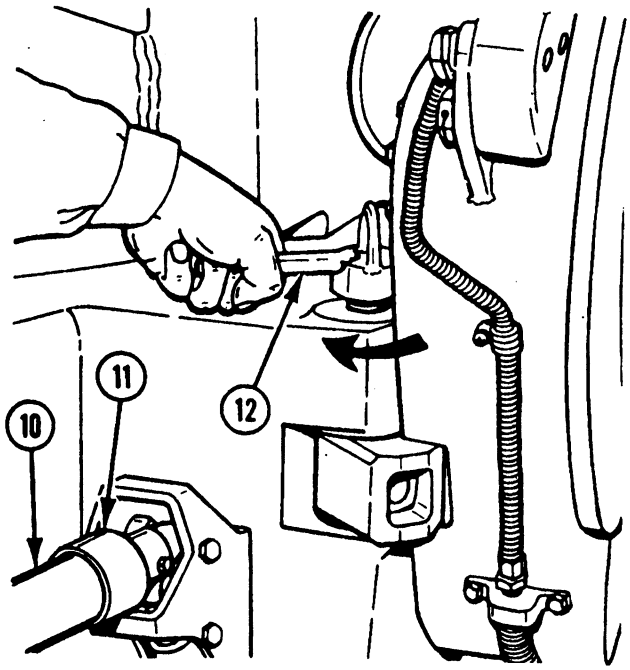

11 Cannoneer no. 1 installs breech cover (8).



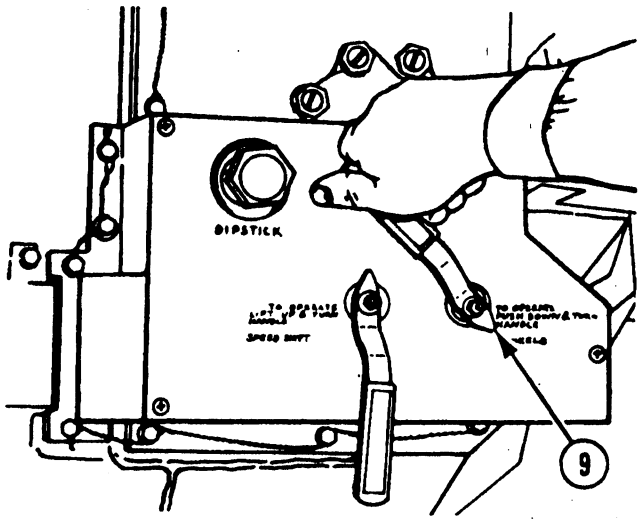

12 Cannoneer no. 3 pushes down and turns WHEELS lever (9) to the UP position.

13 Cannoneers no. 3 and 4 place pump handles (10) in hydraulic adapters (11) and pump until pressure is off of wheel lock handles (12).

14 Cannoneers no. 3 and 4 then turn wheel lock handles (12) in (toward center of howitzer).



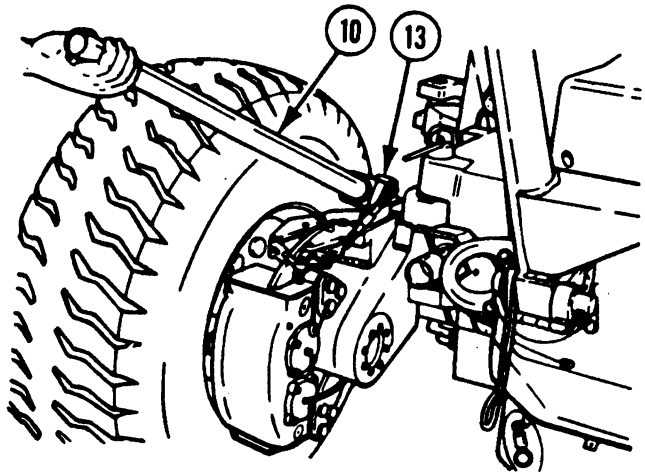

15 Cannoneer no. 3 pushes down and turns WHEELS lever (9) to the DOWN position.



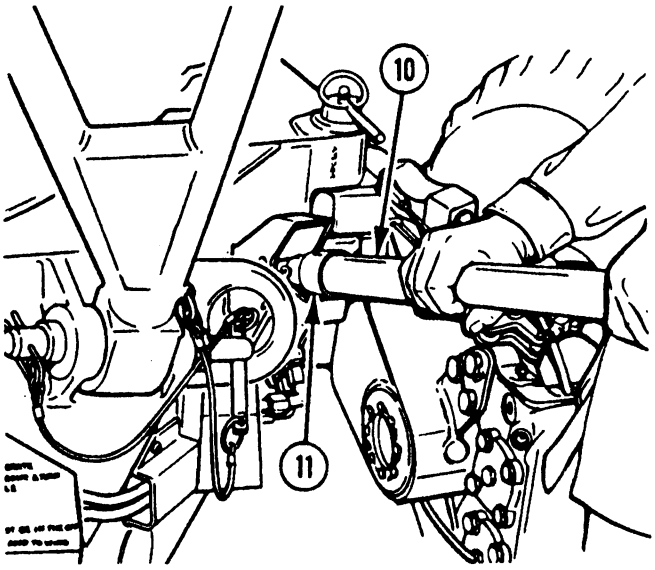

**WARNING**

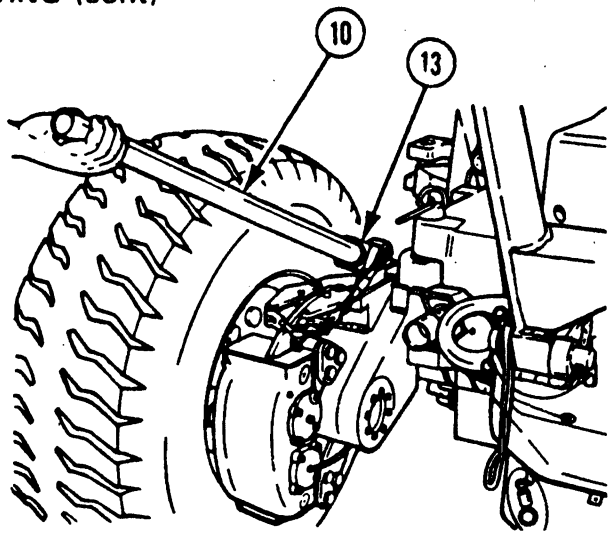
**Handbrakes are to remain locked if the howitzer is on any degree of an incline and are not to be released until the lunette is on the prime mover pintle. Release of handbrakes while howitzer is on incline may allow the howitzer to roll causing injury to personnel.**

16 Cannoneers no. 3 and 4 release handbrakes by inserting pump handles (10) in handbrake sockets (13) and pulling downward.



## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)

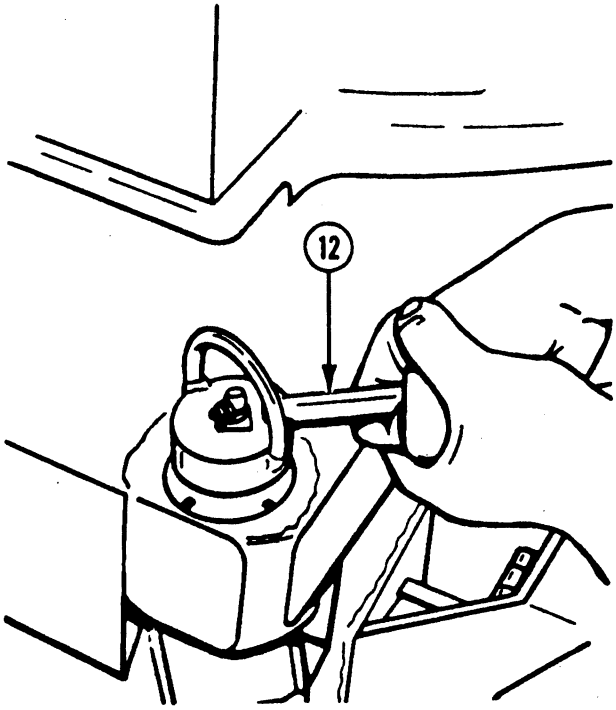


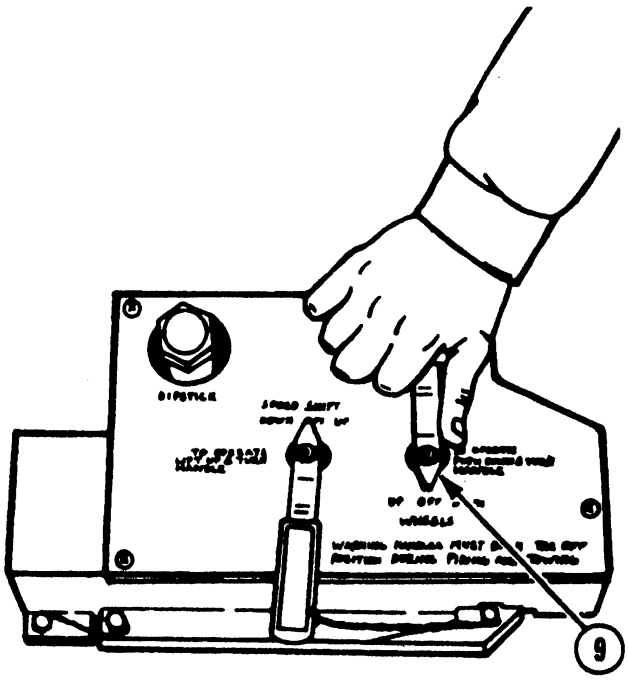




**WARNING**
Keep feet from under firing baseplate.

17 Cannoneers no. 3 and 4 insert pump handles (10) in hydraulic adapters (11) and pump up and down until carriage is up.

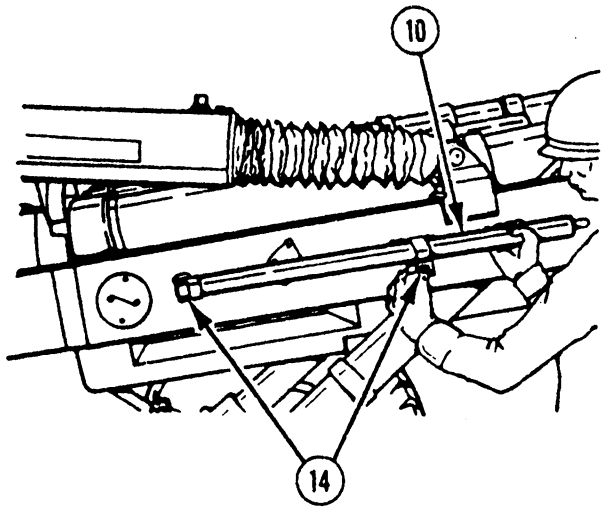
18 If handbrakes were released in step 15, cannoneers no. 3 and 4 engage handbrakes by inserting pump handles (10) in handbrake sockets (13) and raising up to the locked position.



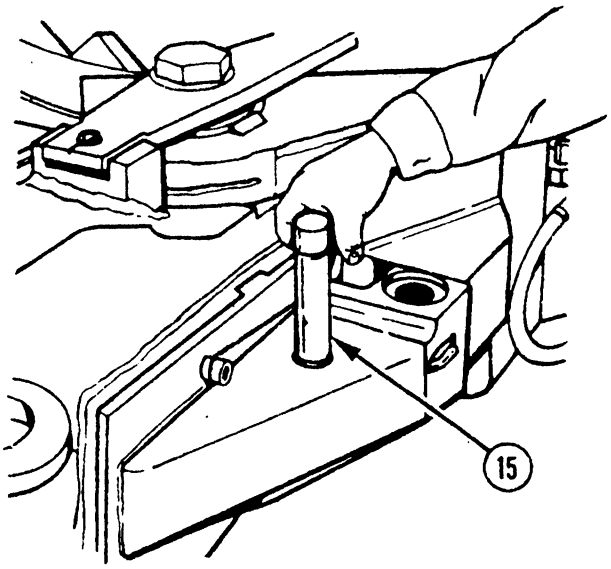

19 Cannoneers no. 3 and 4 turn wheel lock handles (12) (toward wheels).

20 Cannoneer no. 3 pushes down and turns WHEELS lever (9) to the OFF position.



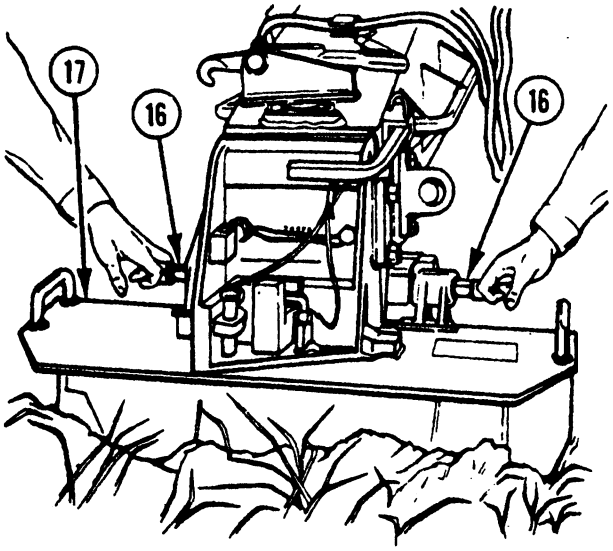

**NOTE**
Move WHEELS lever back and forth on either side of the OFF mark to relieve pressure on the hydraulic system.

**21** Cannoneers no. 3 and 4 replace pump handles (10) in their holders (14).

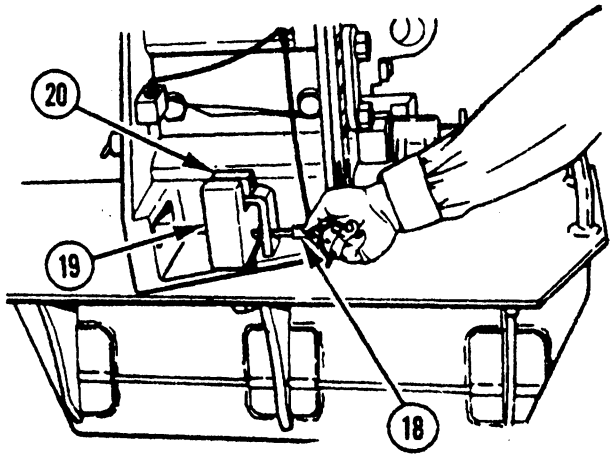



**NOTE**
Drive out locking plugs (15) with a sledge hammer.

**22** The gunner and assistant gunner move left and right trail locking plugs (15) from the firing position (front) to the stowed position (rear).



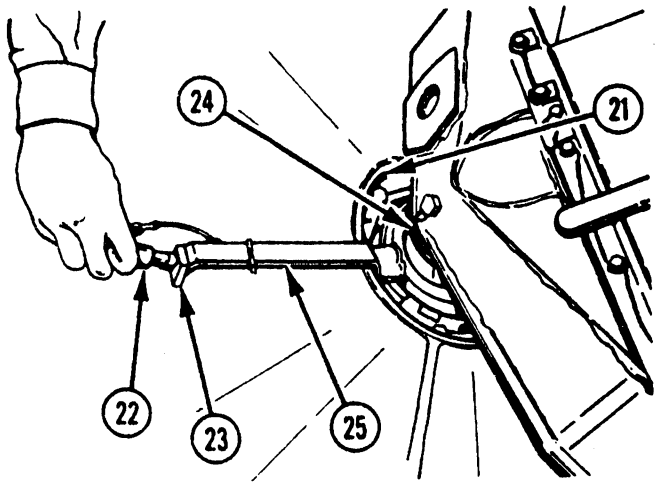

**23** Cannoneer no. 2 and the assistant gunner pull out plunger weldment handles (16) on right spade (17). Cannoneers no. 1 and 3 pull out plunger weldment handles on left spade.




**NOTE**
It may be necessary to use weapons handling bar or sledge hammer to loosen spade keys.

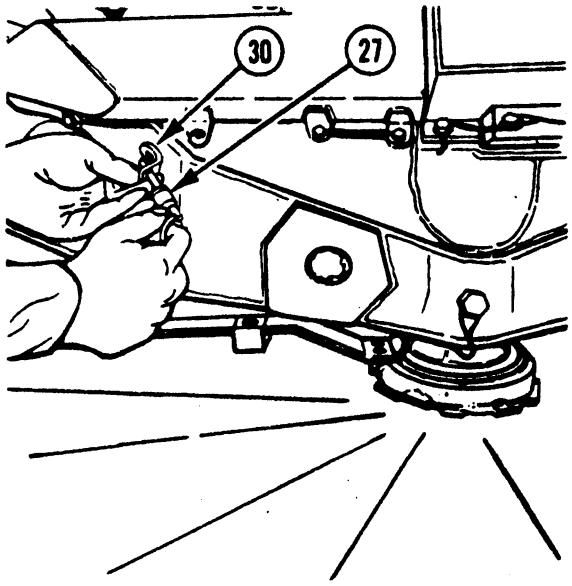
**24** Cannoneer no. 5 removes left and right spade retaining pins (18) and spade keys (19). Stow spade retaining pins (18) in blocks (20) and spade keys on left trail.

## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)

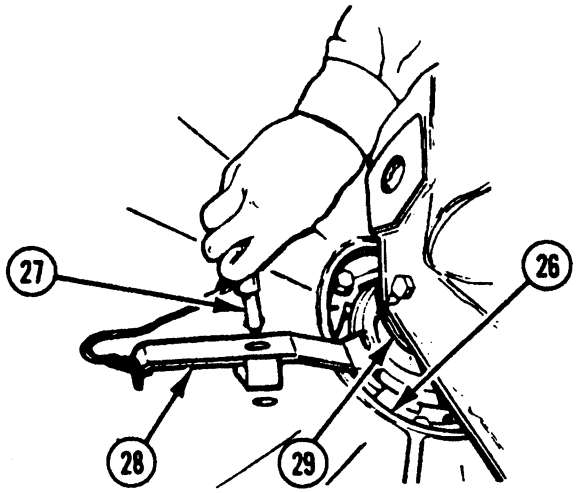



**NOTE**
Step 25 applies to howitzers that have not been modified.

**25** Cannoneers no. 3 and 4 support the firing baseplate (21), while cannoneer no. 4 removes quick release pin (22) from locking bracket (23) and unlocks firing baseplate (21) from ball (24), using cam lock lever (25).

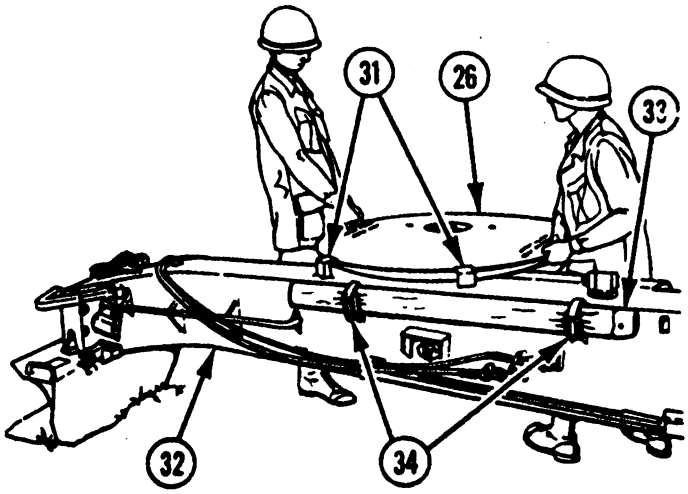



**27** Cannoneer no. 4 places quick release pin (27) in stowage bracket (30).



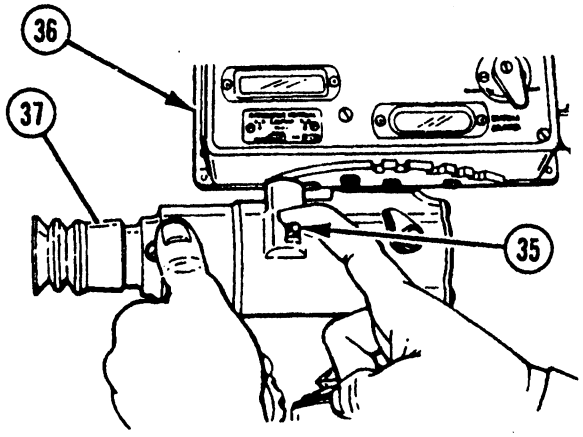

**NOTE**
Step 26 applies to modified howitzers.

**26** Cannoneers no. 3 and 4 support firing baseplate (26), while cannoneer no. 4 removes quick release pin (27) from handle assembly (28) and unlocks firing baseplate (26) from ball (29) using handle assembly (28).




**28** Cannoneers no. 3 and 4 place firing baseplate (26) in stowage brackets (31) on right trail (32).

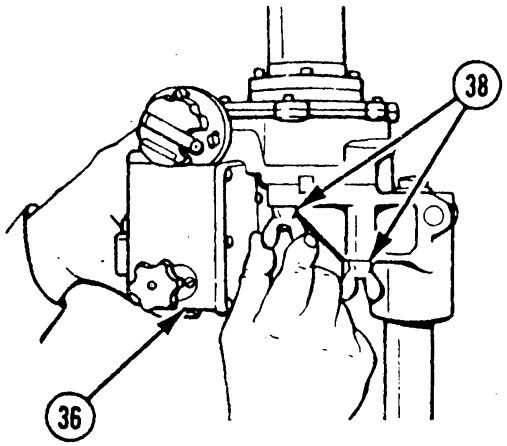
**29** After putting aiming posts in aiming post cover (33), the ammunition team chief places cover and aiming posts in stowage brackets (34) on right trail (32).



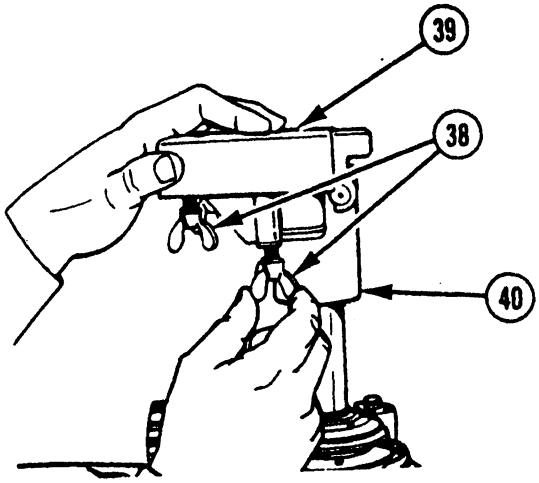

**WARNING**

**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

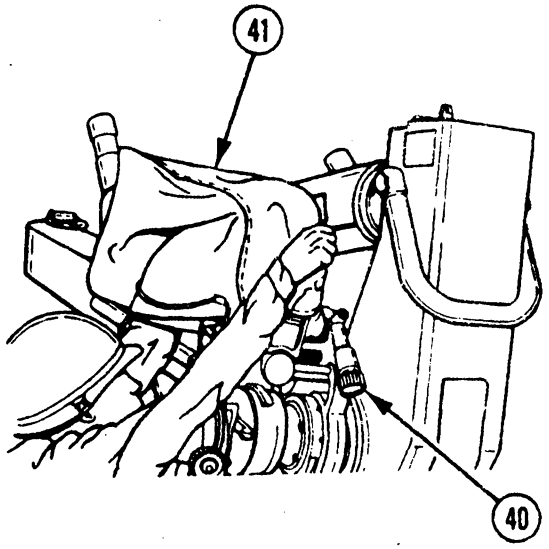
**30** The gunner releases locking pin (35) on pantel (36) and moves elbow (37) with eyepiece to the stowed position.




**31** The gunner loosens four wingnuts (38), removes pantel (36), and places it in fire control equipment carrying case.

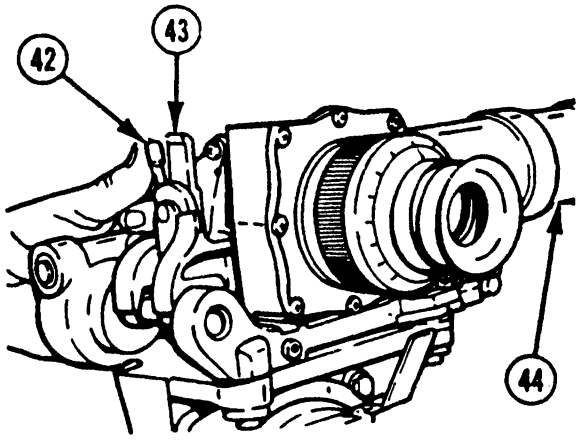



**32** The gunner places protective cover (39) on M171 telescope and quadrant mount (40) and tightens two wingnuts (38). He then rotates the protective covers on the cross level vial, pitch level vial, and elevation level vial to the closed position.

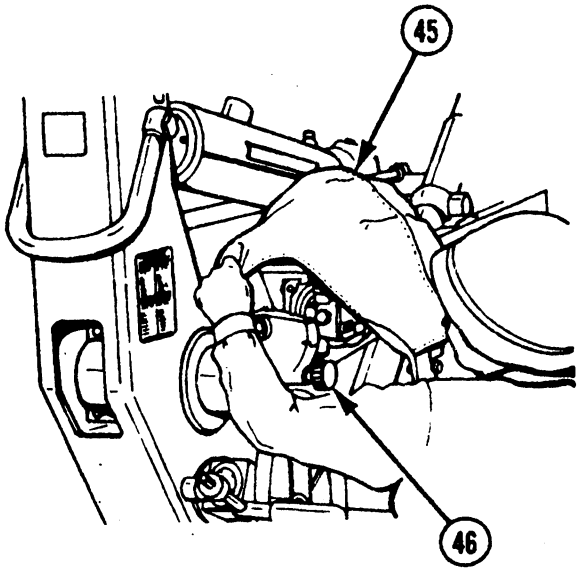



**33** The gunner places cover (41) over M171 telescope and quadrant mount (40). He then secures the cover with the draw-string provided.

## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)




**34** The assistant gunner rotates lock-release lever (42) counterclockwise and pulls locking latch (43) down, removes elbow telescope (44), replaces the protective cover assembly, and places it in fire control equipment carrying case.

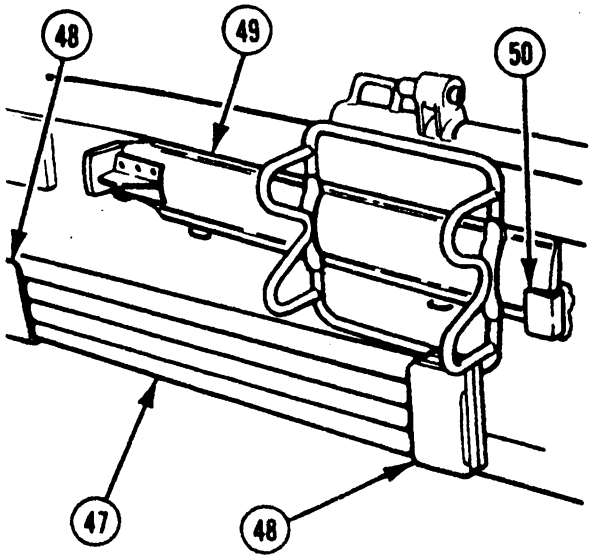


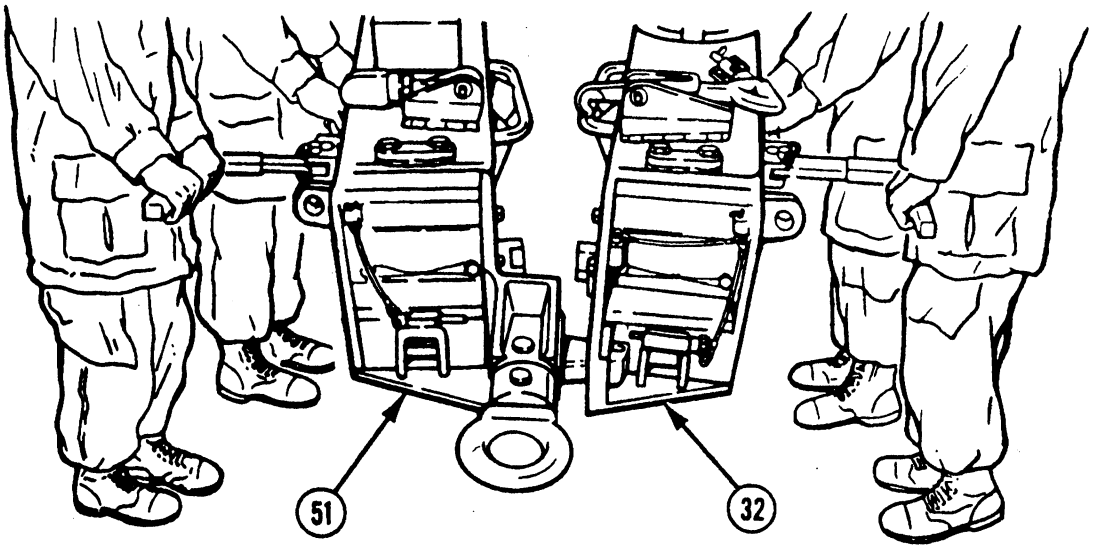

**35** The assistant gunner rotates the protective covers on the elevation level vial and cross level vial to the closed position. The assistant gunner places cover (45) on M172 telescope and quadrant mount (46) and secures it with drawstrings provided.

**36** The gunner ensures that all fire control equipment is properly placed within the fire control equipment carrying case and that the case is securely latched. The gunner places fire control equipment carrying case in its stowage rack on the left trail. He then secures the case to the trail with two web straps provided.

**37** Cannoneer no. 2 disassembles rammer staff, places staff sections (47) in stowage brackets (48) on both trails and places bell (if used) rammer in its stowage bracket on left trail. (Illustration is of right trail.)

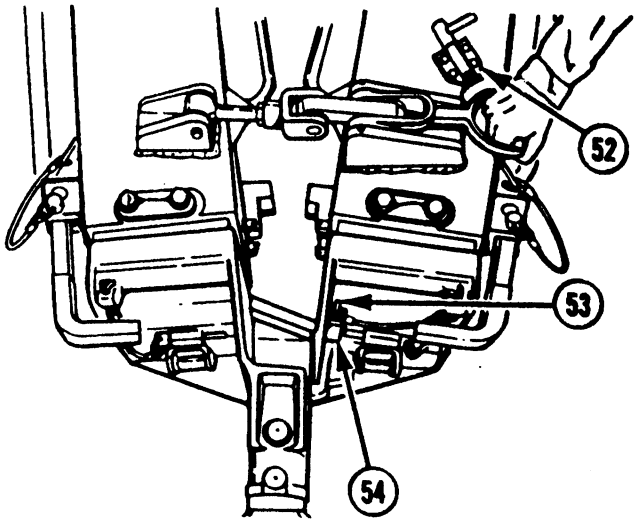
**38** Cannoneer no. 3 places loading tray (49) in its stowage brackets (50).

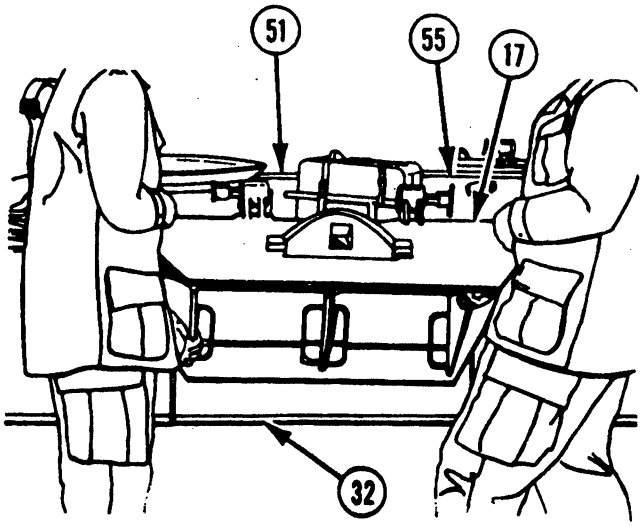




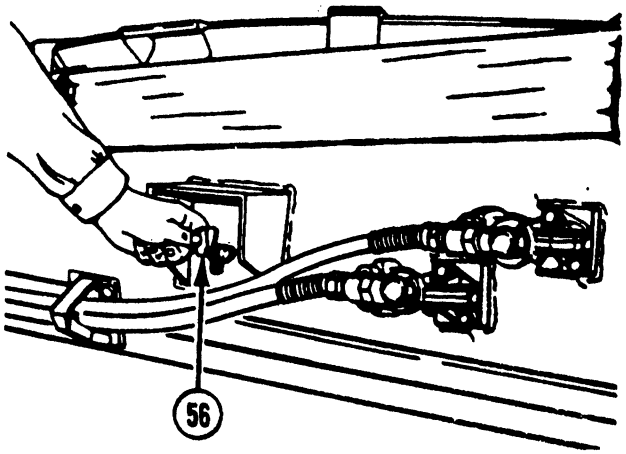

**39** When the chief of section commands, LIFT, the gunner and cannoneers no. 1, 3, and 5 lift left trail (51), the assistant gunner, cannoneers no. 2 and 4, and the ammunition team chief lift right trail (32), and all personnel close trails.

**40** The chief of section connects trail latch mechanism, lowers handle toward trail, and engages trail cam lock (52). He then removes trail retaining pin (53) from stowage block (54) and places pin (53) in position.




**41** Cannoneers no 3 and 5 return left spade (55) to the stowed position on left trail (51). Cannoneers no. 2 and 4 return right spade (17) to right trail (32).



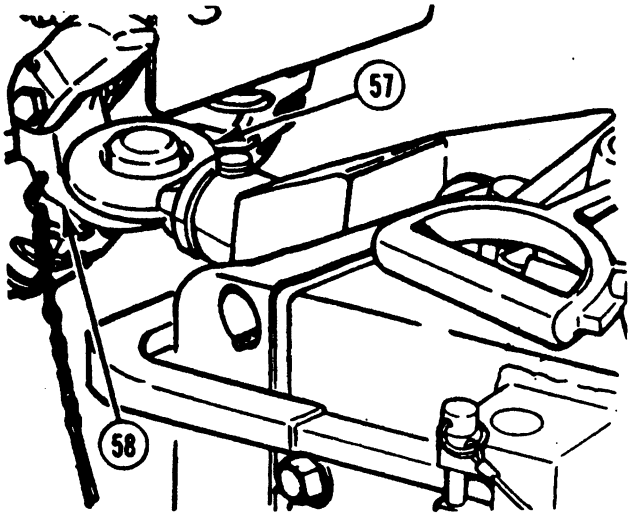

**42** The assistant gunner closes air drain cock (56) on emergency reserve air tank.

## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)

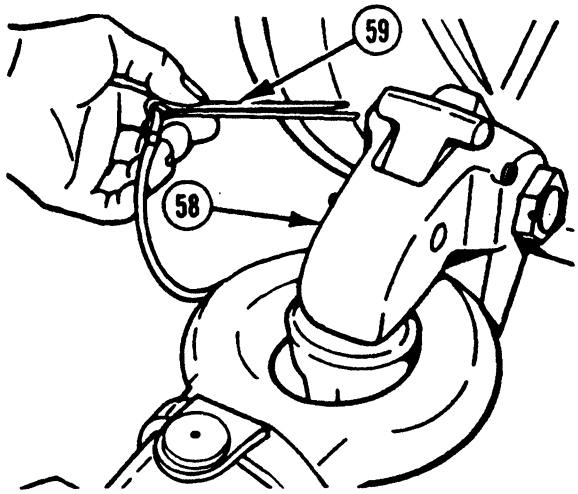
**WARNING**
**Personnel should stay clear of area between prime mover and howitzer.**

**43** The chief of section directs the driver to back prime mover close to howitzer.

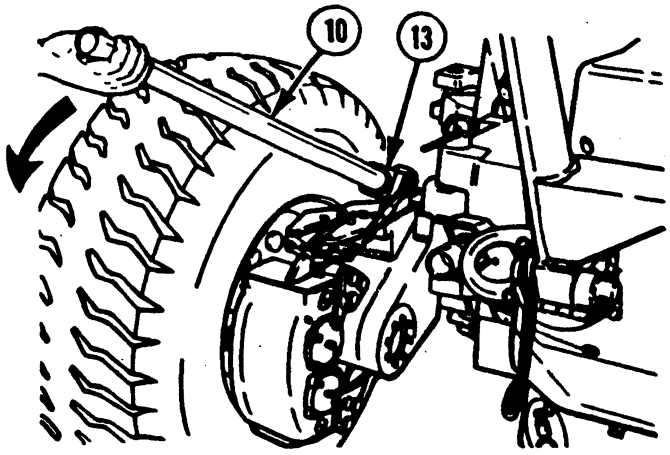
**44** When the chief of section commands, LIFT, the assistant gunner, cannoneers no. 2 and 4, and the ammunition team chief lift right trail, and the gunner and cannoneers no. 1, 3, and 5 lift left trail to raise lunette (57). The chief of section directs the driver to back until pintle (58) is under lunette (57), and all personnel lower lunette on pintle.



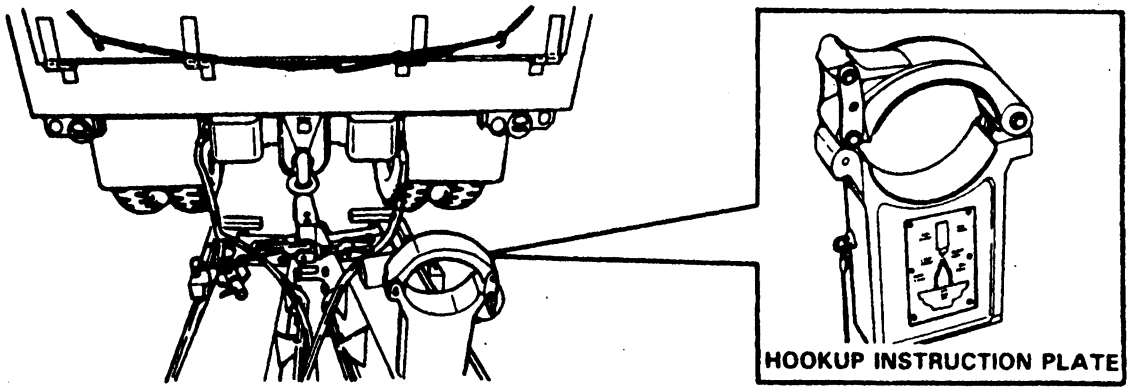

**45** The ammunition team chief latches pintle (58) and secures it with cotter pin (59).




**46** Cannoneers no. 3 and 4 release handbrakes by inserting pump handles (10) in handbrake sockets (13) and pulling downward.



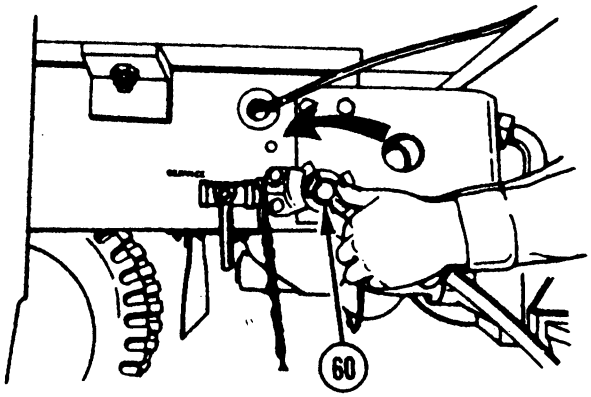

**CAUTION**
Make sure service hose assembly is connected to service coupling (left side) of prime mover and emergency hose assembly is connected to emergency coupling (right side) of prime mover. Hose assemblies are identified by a metal band. When hose assemblies are properly attached, they will cross each other.



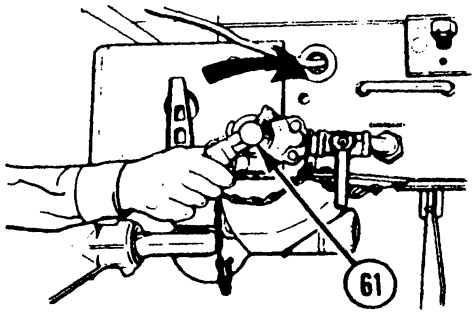

**NOTE**

The hose couplings should be color-coded the same as the prime mover: yellow for service and red for emergency.

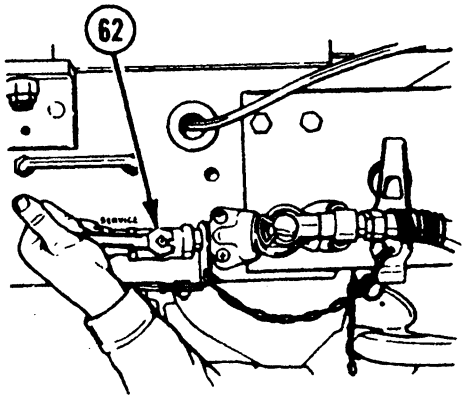
**47** Cannoneer no. 4 disconnects service hose assembly (60) from dummy coupling and passes it to the ammunition team chief who connects it to prime mover.




**48** Cannoneer no. 4 disconnects emergency hose assembly (61) from dummy coupling and passes it to cannoneer no. 5, who connects it to prime mover.

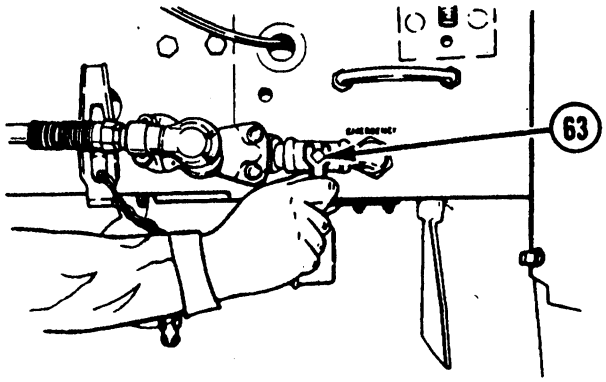



**49** The ammunition team chief opens service air line cutout cock (62).



## 2-27. PREPARATION OF HOWITZER FOR TOWING (cont)

**50** Cannoneer no. 5 opens emergency air line cutout cock (63).




**CAUTION**

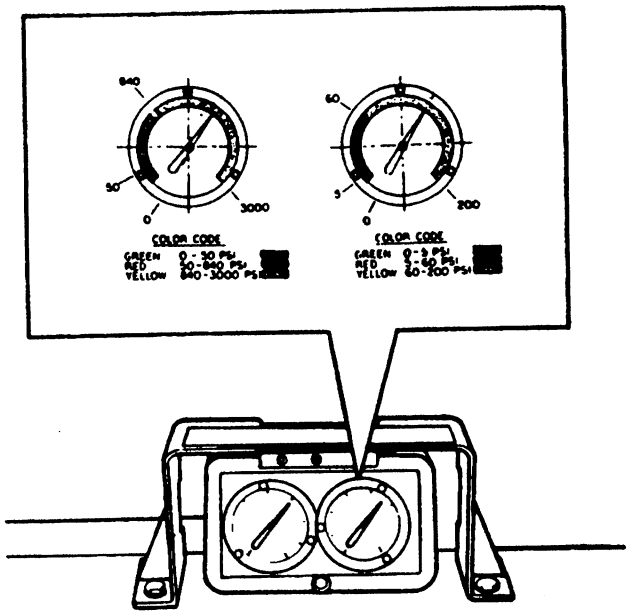
Failure to check power booster indicator rod could result in damage to the disk brake carrier and lining assembly.

**NOTE**

The driver should start and run the prime mover long enough to charge its air tank and howitzer air tank to make sure brakes are operating correctly.

**51** The driver applies brakes on prime mover, and cannoneer no. 5 checks power booster indicator rod to ensure it does not protrude more than 1-3/4 in. (4.45 cm). If rod extends more than 1-3/4 in., notify unit maintenance.

**52** The driver releases brakes on prime mover, and cannoneer no. 5 checks power booster indicator rod to ensure it does not protrude more than 1/2 in. (1.27 cm).

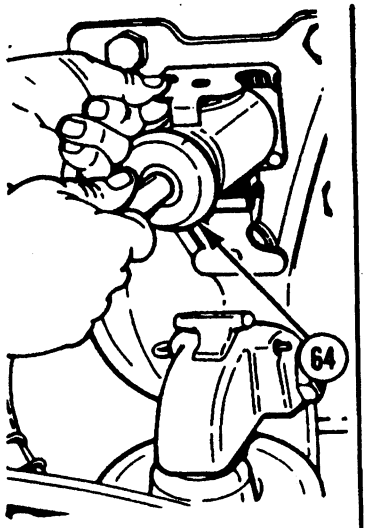


**NOTE**

Step 53 applies to howitzers that have been modified.

**53** The driver applies brakes. The chief of section ensures that both pointers move to yellow zones on gage. The driver releases the brake and both pointers return to green area.

**54** If required, cannoneer no. 5 connects cable assembly (64) to prime mover.

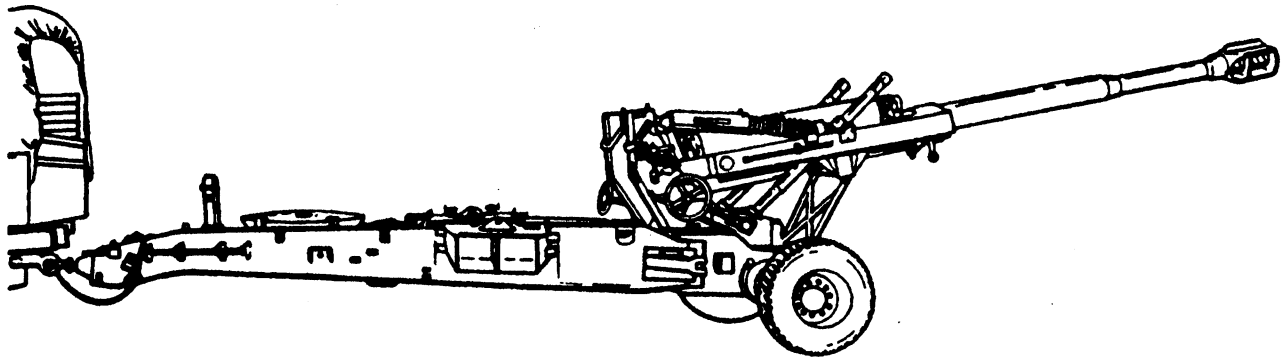



**WARNING**

**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

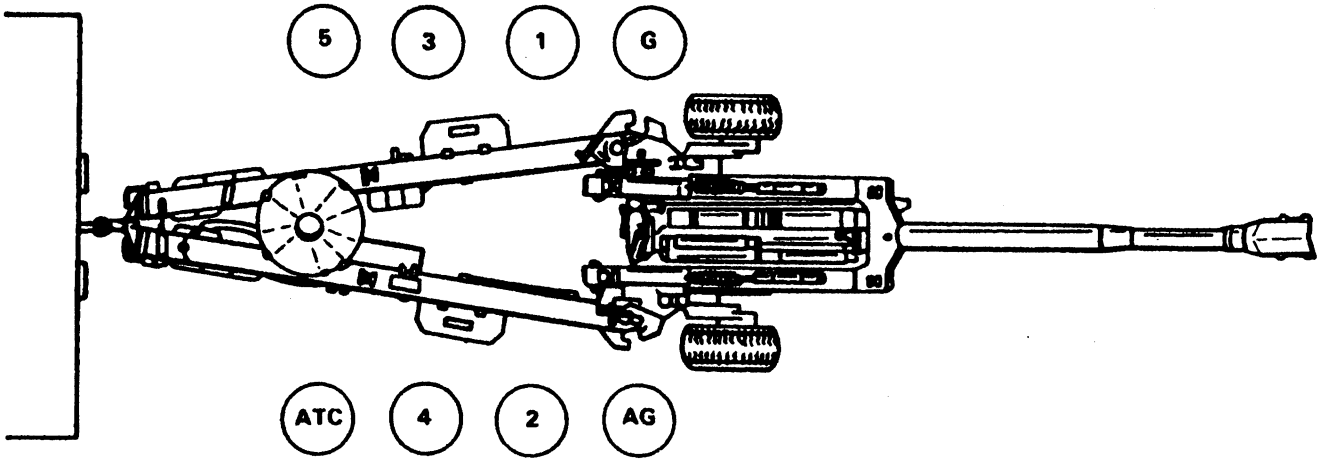
**55** Cannoneer no. 2 recovers collimator (65) and sandbags.

## 2-28. PLACING HOWITZER IN STOWED POSITION



**NOTE**

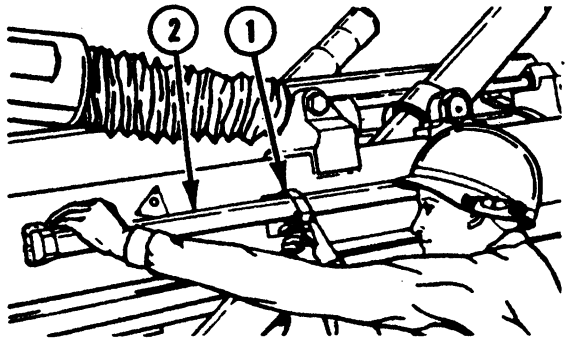
Ensure howitzer is on level ground and elevated to approximate travel lock position to when traversing gun into stowed position.



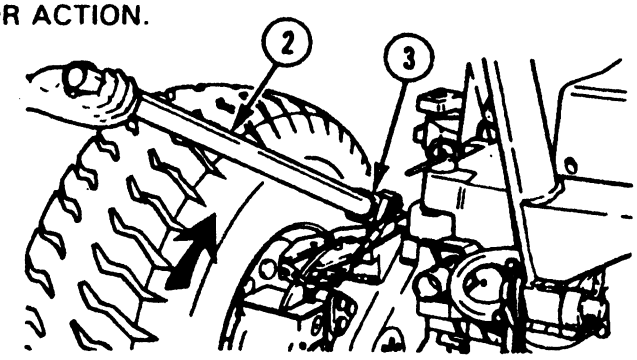

1 After prime mover comes to a complete stop, the chief of section commands, DISMOUNT. Upon hearing the command, the section exits through rear of prime mover.

2 All section members take position as illustrated.

3 The chief of section commands, PREPARE FOR ACTION.

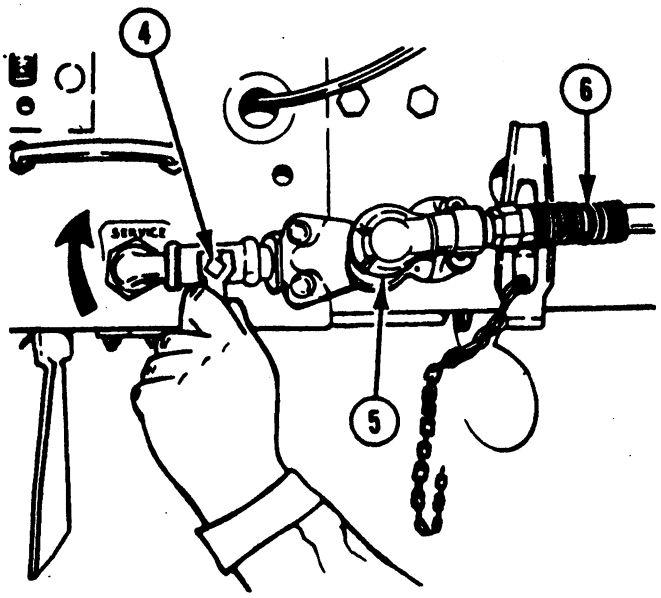


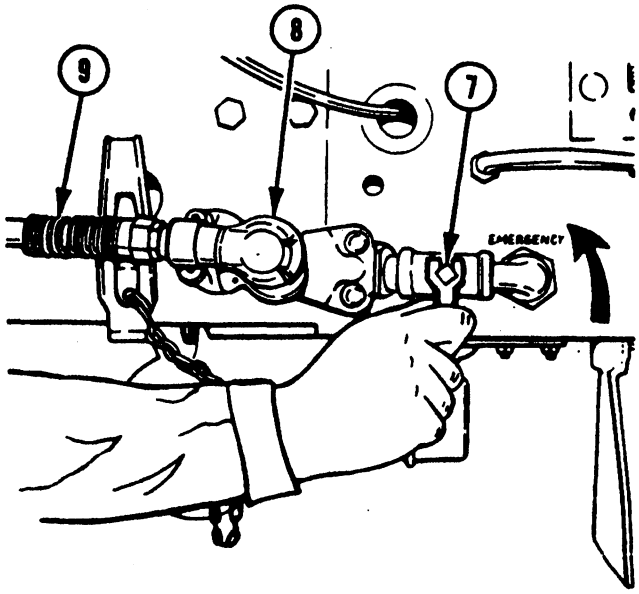

4 Assistant gunner unlatches holder (1) on right side and removes pump handle (2). Gunner unlatches holder on left side.




5 The gunner and assistant gunner set left and right handbrakes by inserting pump handles (2) into handbrake sockets (3) and raising up to locked position.

## 2-28. PLACING HOWITZER IN STOWED POSITION (cont)



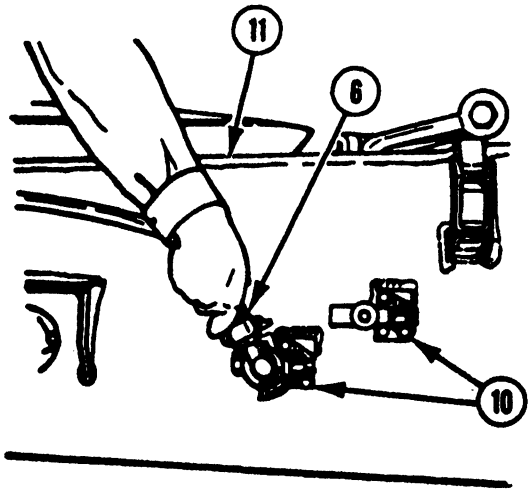



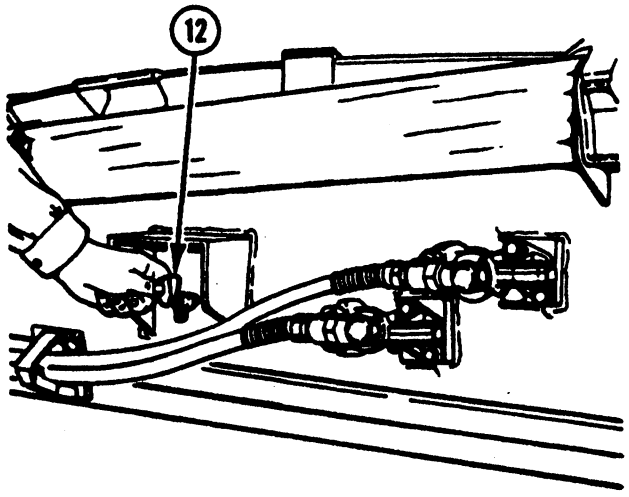

**NOTE**

Precheck gages should indicate EMERGENCY brakes are set when service and emergency lines are disconnected.

6 The ammunition team chief closes service air line cutout cock (4) at prime mover, uncouples service air line coupling (5), and passes service hose assembly (6) to cannoneer no. 4.

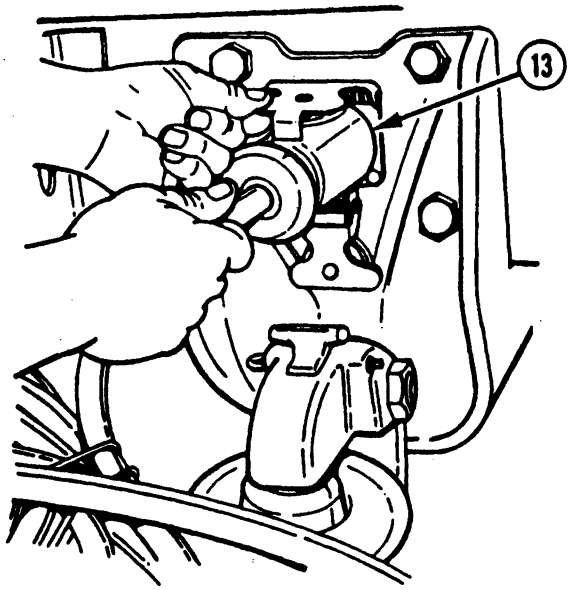
7 Cannoneer no. 5 closes emergency air line cutout cock (7) at prime mover, disconnects emergency air line coupling (8), and passes emergency hose assembly (9) to cannoneer no. 4.



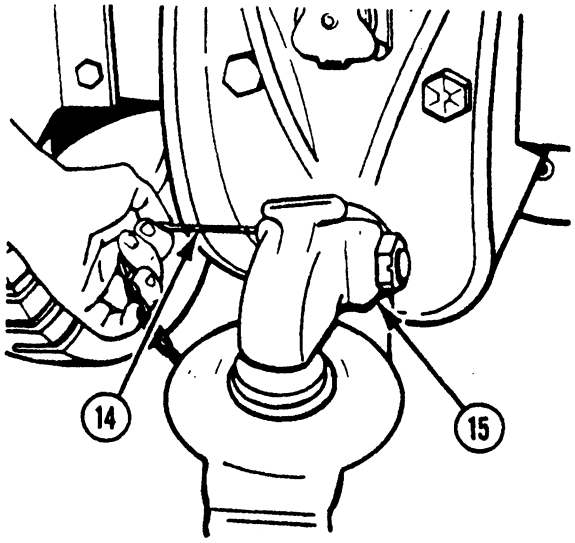




8 Cannoneer no. 4 connects service hose assembly (6) to dummy coupling (10) on right trail (11). The emergency hose assembly is connected to other dummy coupling (10).

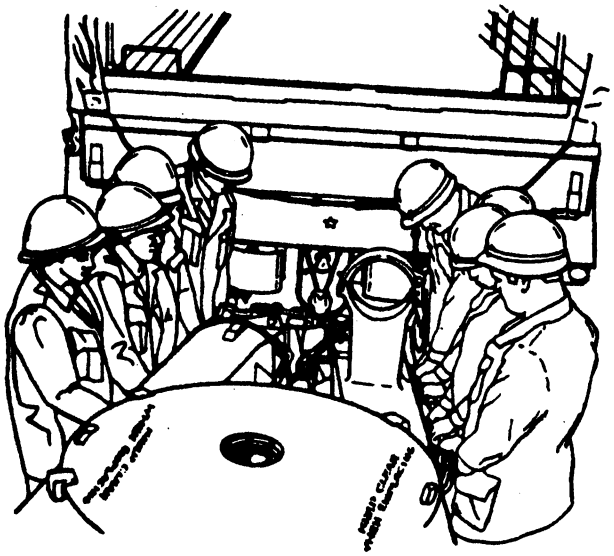
9 Cannoneer no. 4 opens drain cock (12) on emergency reserve air tank. Both pointers on gage should return to 0 psi.



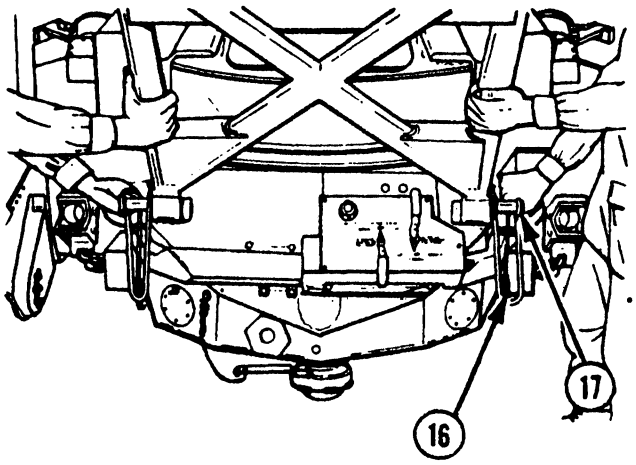

**10** Cannoneer no. 5 disconnects cable assembly (13) from prime mover, if connected.




**11** The ammunition team chief removes cotter pin (14) and unlatches pintle (15) on prime mover.



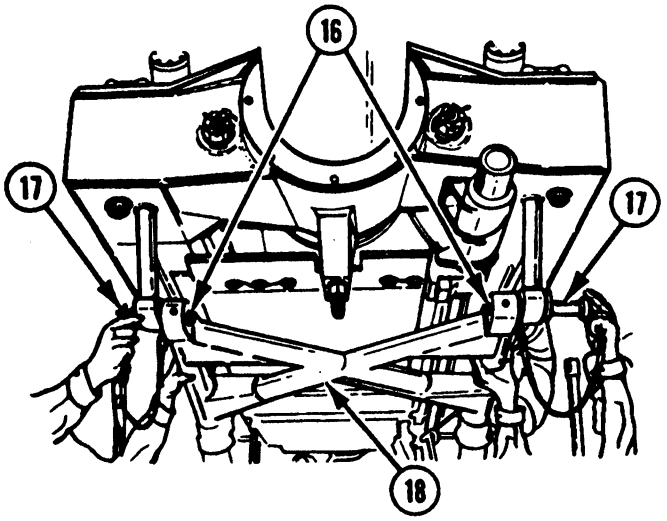
**12** With cannoneers no. 1, 3, and 5, and the gunner at left trail lifting handle and the assistant gunner, the ammunition team chief and cannoneers no. 2 and 4 at the right trail, raise lunette from pintle when chief of section commands LIFT. The chief of section then commands the driver to move prime mover forward. Trails are then lowered to the ground.




**13** Cannoneer no. 3 removes left retaining pin (16) and travel lock pin (17). Cannoneer no. 4 removes right retaining pin and travel lock pin.

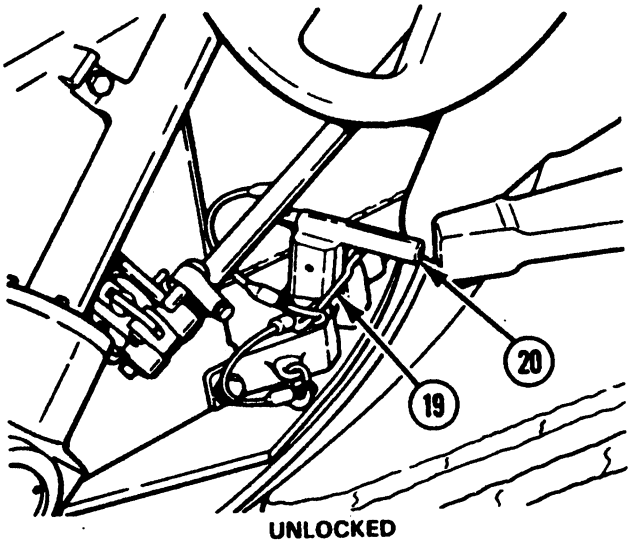
## 2-28. PLACING HOWITZER IN STOWED POSITION (cont)

14 Cannoneers no. 3 and 4 swing travel lock assembly (18) up and insert travel lock pins (17) and retaining pins (16).




**NOTE**
Step 15 applies to howitzers that have not been modified.

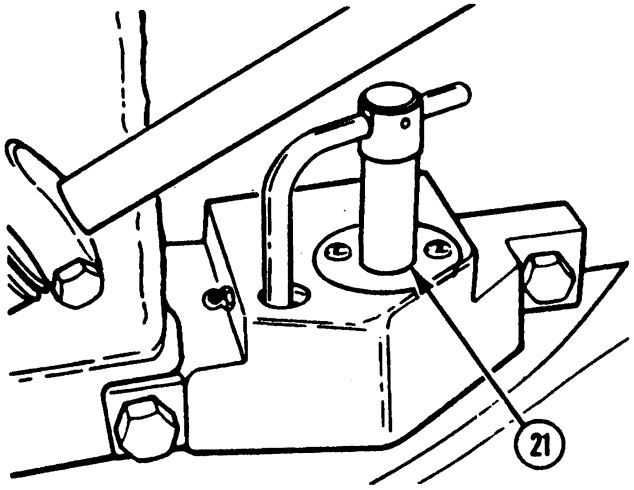
15 The gunner removes retaining pin (19) from top carriage locking pin (20), pulls up on top carriage locking pin to the disengaged (up) position and secures top carriage locking pin with retaining pin.



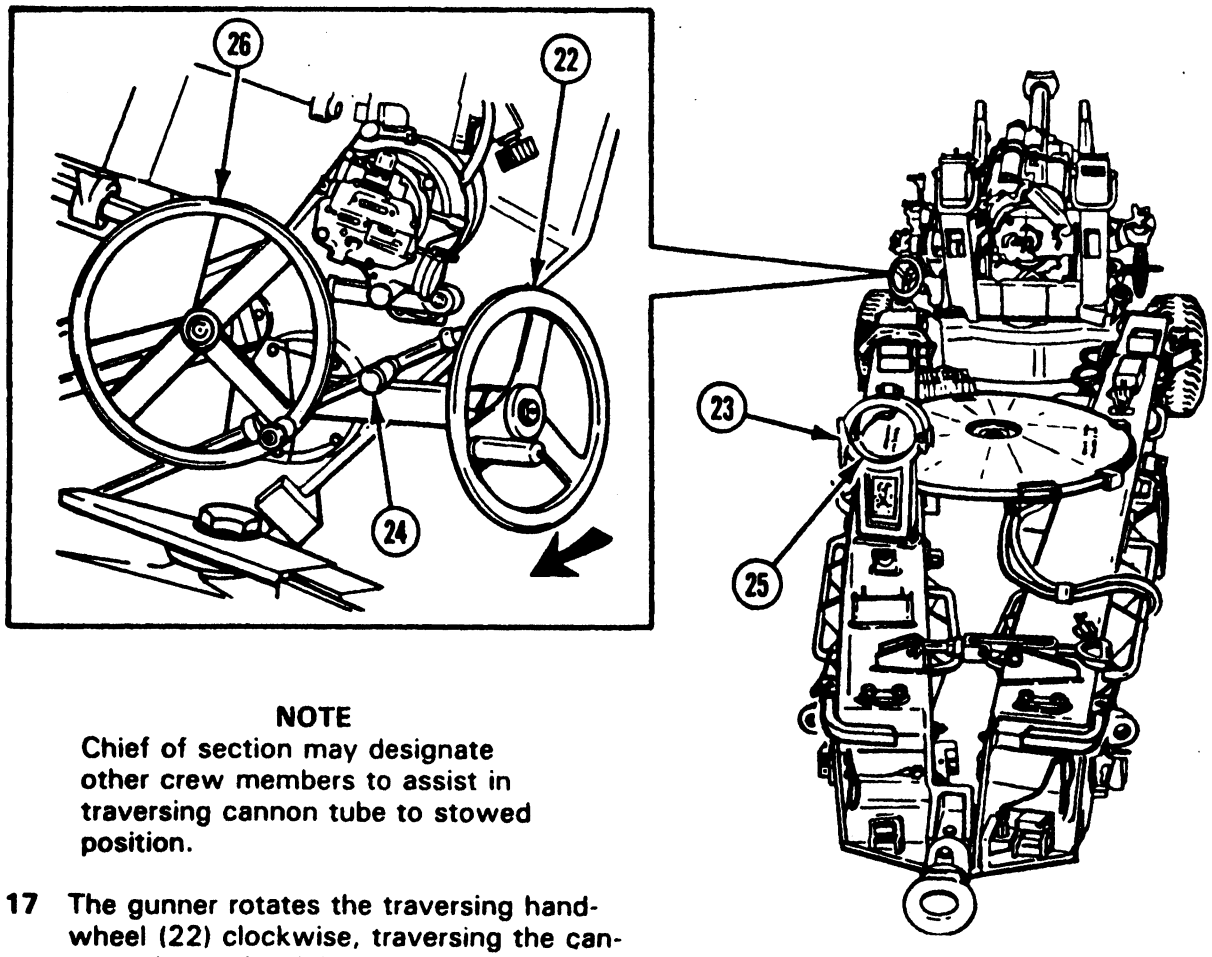

UNLOCKED

**NOTE**
Step 16 applies to howitzers that have been modified.

16 The gunner pulls up locking pin (21) to disengage pin from bottom carriage and rotate pin to unlocked position.




UNLOCKED




**NOTE**

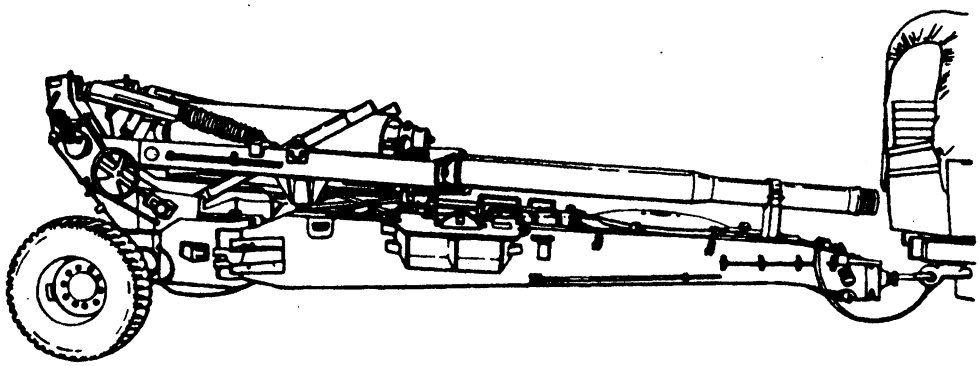
Chief of section may designate other crew members to assist in traversing cannon tube to stowed position.

**17** The gunner rotates the traversing handwheel (22) clockwise, traversing the cannon tube to the right until the tube is directly over the gun tube travel lock on the left trail.

**18** Cannoneer no. 5 opens the lock release lever (23). The gunner depresses the manual control lever (24) and lowers the cannon tube onto the travel lock cradle (25) by rotating the elevating handwheel (26) counterclockwise, then secures the lock release lever completing the stow.

**CAUTION**

The muzzle brake must be removed to tow weapon in the stowed position. Notify unit maintenance for removal.



# Section IV. OPERATION UNDER UNUSUAL CONDITIONS

**Section Index**



## 2-29. GENERAL

This section contains special instructions for operating and servicing the weapon under unusual conditions. Take special care in cleaning and lubricating when extremes in temperature, humidity, and terrain conditions are present or anticipated, in addition to performing all normal preventive maintenance services. Proper cleaning, lubrication, and storage and handling of oil and lubricants not only ensure proper operation and functioning but also guard against excessive wear of the working parts and deterioration of the materiel.

## 2-30. EXTREME COLD WEATHER CONDITIONS

**WARNING**

**Do not grasp metal parts, such as knobs, levers, covers, etc. with bare hands.**

**a. General Problems.**

(1) Extensive preparation of materiel scheduled for operation in extreme cold weather is necessary. Generally, extreme cold will cause lubricants to thicken or congeal.

**CAUTION**

It is important that the approved practices and precautions be followed. FM 9-207 contains general cold weather information applicable to the M198 howitzer. It must be considered an essential part of this technical manual.

(2) For description of operation in extreme cold, refer to FM 31-70, FM 31-71, and FM 9-207.

**b. Equilibrators.** Extreme cold temperatures will cause a corresponding decrease of nitrogen pressure in the equilibrators, making it difficult to elevate the cannon tube. Manually adjust the equilibrators (p 3-34) to develop equal handwheel loads while elevating and depressing. If equilibrators cannot be manually adjusted properly, notify unit maintenance.

**c. Tires.** Tires should be inflated to their respective pressures (p 1-16) at ambient temperature.

**d. Fire Control Equipment.**

(1) When not in use, keep fire control equipment covered in the proper carrying cases or properly stowed.

(2) Do not let snow or ice accumulate on equipment. Keep moving parts free of moisture.

(3) Use only dry rags (item 24, appx D) and dry lens paper (item 21, appx D) for cleaning.

(4) Working parts may operate or function sluggishly. The operator should be able to differentiate between sluggishness and lack of movement because of built-in stops. Do not force movements beyond their stops.

(5) Do not expose M137 pantel, M138 elbow telescope, or M139 alinement device to sudden changes in temperature by moving them from very cold to warm or warm to very cold areas. Lenses, windows, or prisms may fracture.

## 2-31. EXTREME HOT WEATHER CONDITIONS

**a. General Problems.**

(1) In hot climates, the film of oil necessary for operation and preservation will quickly disappear. Inspect the cannon and carriage daily, paying particular attention to hidden surfaces, such as bore and chamber, springs, spring seats, firing pin, and other likely places where corrosion might occur and not be quickly noticed.

(2) Perspiration from the hands can help cause rusting. After handling, clean, wipe dry, and lubricate per LO 9-1025-211-13.

**b. Ammunition Problems.**

(1) Since explosives are adversely affected by high temperatures, ammunition must be protected from sources of high temperatures, including the direct rays of the sun. Elements in primers and fuzes are particularly sensitive to high temperatures.

**WARNING**

**Do not fire WP projectiles which are known to have been stored in other than a base down position. Firing of such projectiles could contribute to inbore or close-in premature malfunctions.**

(2) Whenever practicable, store white phosphorous-loaded smoke projectiles at temperatures below the melting point (+111.4°F (+44.11°C)) of the white phosphorous filler. If not practicable, white phosphorous projectiles should be stored on their bases so that if the white phosphorus filler melts, it will resolidify with void spaces in the normal position (in the nose of the projectile) when the temperature falls below its melting point. Prematures have been caused by voids in the base end of the white phosphorous projectile, and erratic performance may result from voids in its side. Refer to page 4-53 for precautions in handling ammunition in high temperatures.

**c. Tires.** Cover tires with available materials to protect them from the direct rays of the sun, to keep them from overinflating, and to keep the rubber from deteriorating. Inflate tires to their respective pressures at ambient temperature.

**d. Equilibrators.** Extreme hot temperatures will cause a corresponding increase of nitrogen pressure in the equilibrators, making it difficult to depress the cannon tube. Manually adjust the equilibrators to develop equal handwheel loads while elevating and depressing. If equilibrators cannot be manually adjusted properly, notify unit maintenance.

## 2-32. OPERATION IN HOT, DAMP, AND SALTY ATMOSPHERE

**a.** Inspect materiel daily when it is being operated in hot, moist, and salty areas.

**b.** When the weapon is active, clean and lubricate the bore and exposed metal surfaces daily per LO 9-1025-211-13.

**c.** Moist and salty atmospheres can destroy the rust-preventive qualities of oils and greases. Inspect parts daily for corrosion. Keep covers in place as much as firing conditions permit.

**d.** When the weapon is inactive, cover the unpainted parts with a film of PL-S (item 17, appx D). All covers should be in place.

**e.** Do not break moisture-resistant seals of ammunition containers until the ammunition is to be used.

**f.** Keep ammunition dry and free from mud, corrosion, or foreign matter. Provide proper drainage around the area to keep the ammunition as dry as possible.

**g.** Protect proximity (VT) fuzes must be protected against dampness. Although the fuzes are nearly waterproof, any exposure to dampness may increase the number of duds. Rain or immersion in water will speed up deterioration. Especially in tropical climates, the storage time of unpacked fuzes should be kept to a minimum. Store fuzes in their original sealed containers as long as it is practical.

**h.** Optical instruments are protected against moisture by pressurized nitrogen. If moisture is present, notify unit maintenance.

**i.** Salt deposits are especially harmful to optical surfaces. Loosen deposits by sponging with a clean wiping rag (item 24, appx D). Do not rub deposits.

## 2-33. UNUSUAL TERRAIN CONDITIONS

**a. Soft or Rough Terrain.** When traveling on soft or rough terrain, such as mud, sand, or snow, use care when backing weapon attached to prime mover.

**b. Sand, Dust, and Dirt.** Inspect and lubricate the materiel per LO 9-1025-211-13, except exposed lubricated parts, frequently when operating in sandy or unusually dusty areas. Be careful to keep sand and dust out of mechanisms and oil receptacles when inspecting and lubricating and when making adjustments and repairs. Keep all covers in place as much as firing conditions permit. Shield parts from flying sand and dust with tarpaulins or with the telescope and mount covers during disassembly and assembly operations. When beginning an action in sandy or dusty areas, remove lubricants from recoil rails and any other exposed lubricated parts, situation permitting. Sand and dirt on lubricants will form an abrasive which will cause rapid wear. Dry surfaces wear less than do surfaces coated with lubricant contaminated with sand or dirt. Clean and lubricate all exposed parts per LO 9-1025-211-13 after the action is over.

## 2-34. FORDING OPERATIONS

**a. Deep-Water Fording.** Refer to TM 9-238 for general information, description, and methods of using deep-water fording kits.

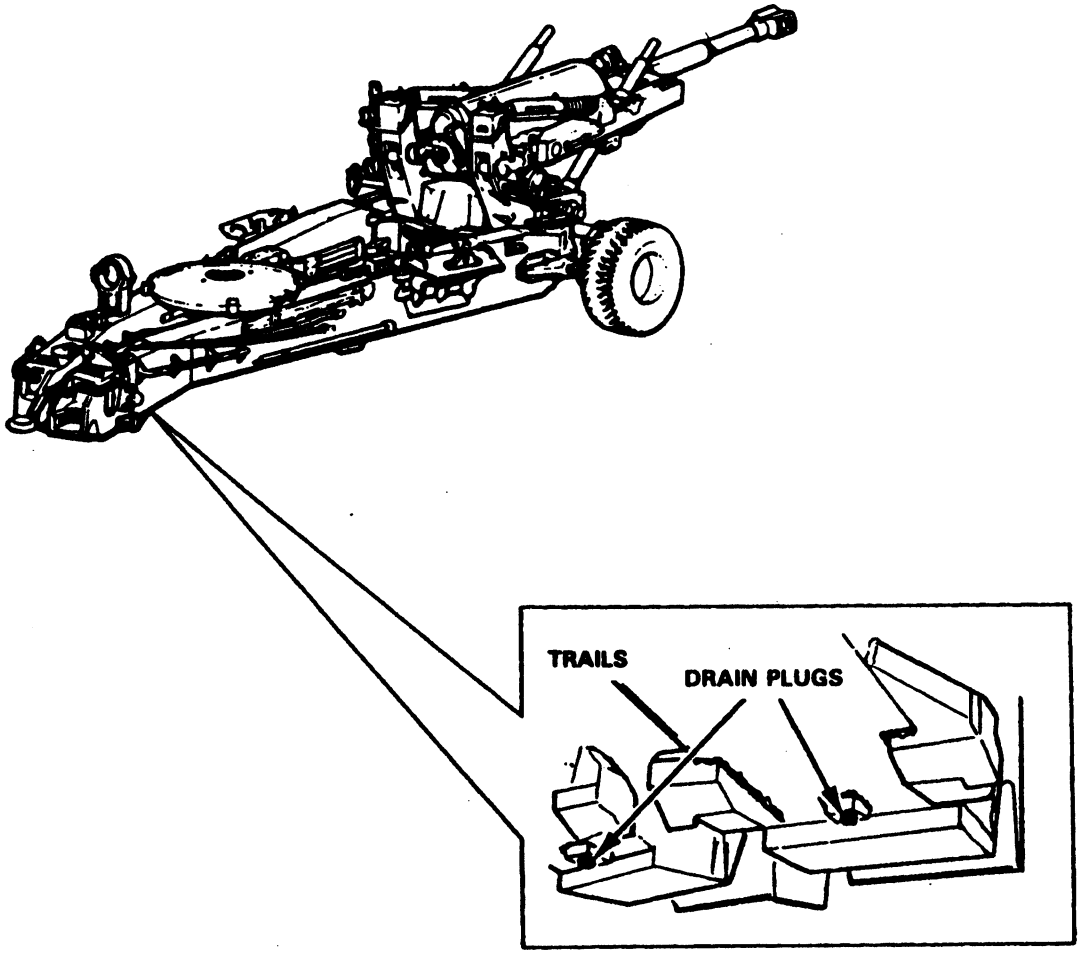
**b. After-Fording Operations.** Immediately after weapon is towed from the water, if tactical situation permits, perform the following services:

(1) Notify unit maintenance to remove the wheels with hubs and thoroughly clean with cleaning compound (item 5, appx D) and dry all working parts of the handbrakes and wheel bearings, and lubricate the handbrakes per LO 9-1025-211-13.

(2) Empty any water from the materiel and clean, dry, and apply the proper lubricant per LO 9-1025-211-13 to all exposed unpainted surfaces, paying special attention to the bore and chamber, the recoil rails, and the equilibrator rod. Notify unit maintenance for necessary disassembly, cleaning, and lubrication.

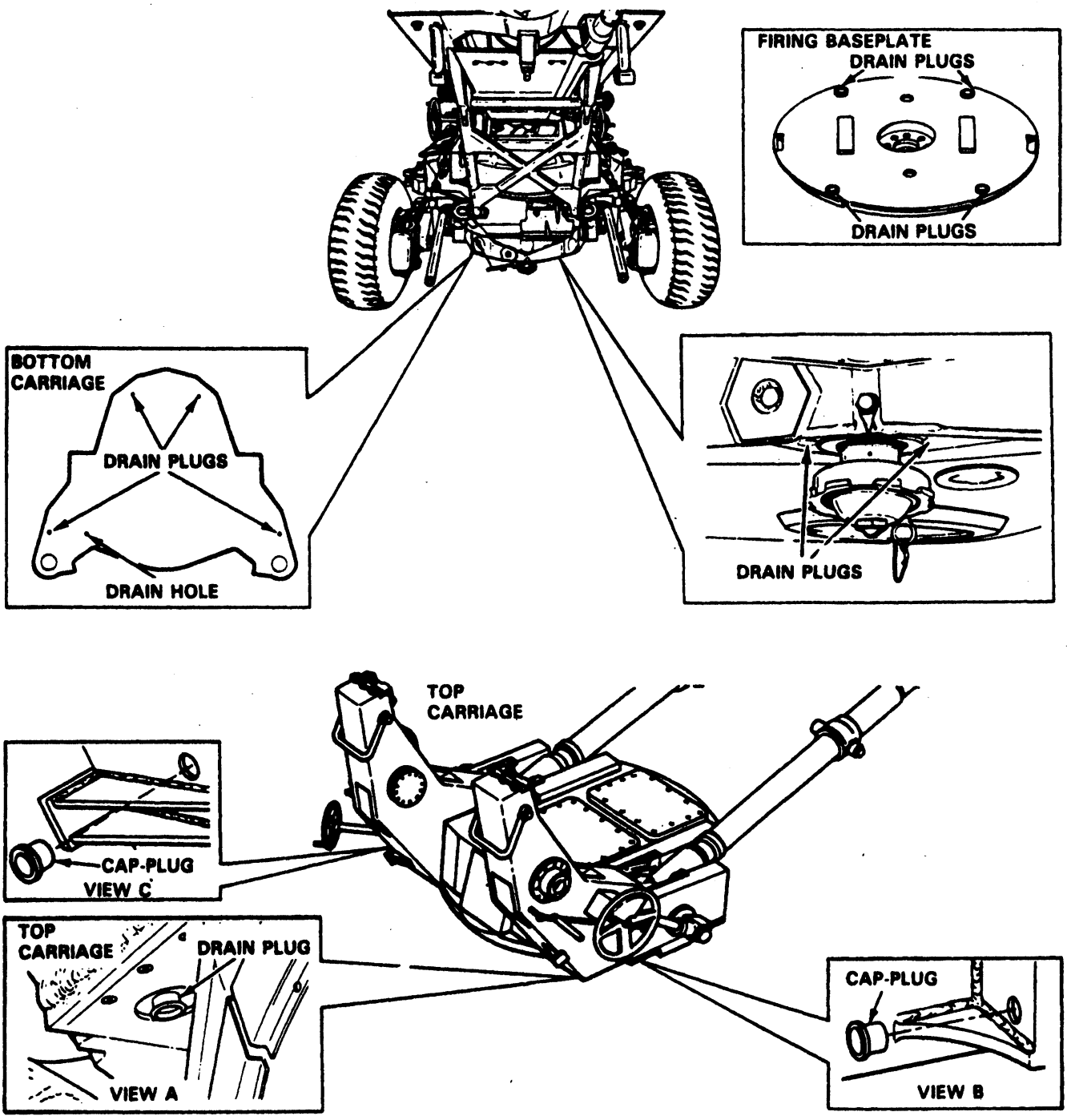
(3) Saltwater immersion greatly increases rusting and corrosion, especially on unpainted surfaces. Remove all traces of saltwater and salt deposits from every part of the cannon and carriage. Apply PL-S (item 17, appx D) and notify unit maintenance so that the cannon and carriage are disassembled, cleaned, and lubricated as soon as possible.

(4) Two drain plugs, one on each trail, are located toward the end of bottom side of trail. To remove these plugs, notify unit maintenance.

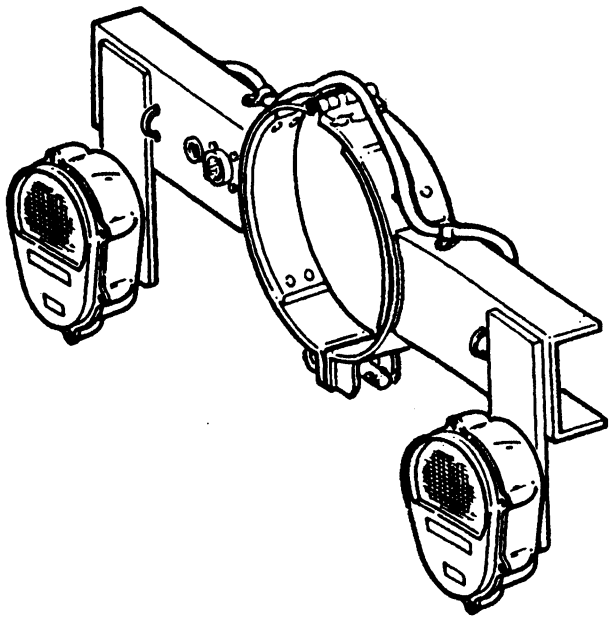


## 2-34. FORDING OPERATIONS (cont)

(5) Four drain plugs are located on the bottom carriage, one plug by the trail hinge points and one on each side by the ball where the firing baseplate attaches. Six drain plugs are located on the top carriage: two on the underside (view A), one on the left and right side (view B), and one on the rear left and right trunnion posts (view C). (See page 2-113 for additional drain plug location.) For removal of drain plugs on trails, notify unit maintenance. Make sure all drain plugs are reinstalled after all moisture is removed.



## 3-46. VEHICULAR TAILLIGHT MAINTENANCE



### INSPECTION

1 Connect cable assembly (item 6, appx B) to prime mover.

**NOTE**
Cable assembly 12009266 must be used with vehicular taillight 12009284.

2 Make sure all lamps operate.

# Section IX. FIRE CONTROL ALINEMENT TESTS AND MEASUREMENTS

**Section Index**



## 3-47. PURPOSE

The fire control alinement tests and measurements determine if the on-carriage fire control, gunner's quadrant, and the alinement device are in correct adjustment. Send equipment that fails these tests to unit maintenance.

## 3-48. FREQUENCY

Recommended intervals for the following tests are:

a. Once each year if weapon is used for nonfiring training.
b. Once every 3 months if weapon is fired.
c. As soon as possible after extensive use.
d. Following accidents.
e. After traveling over extremely rough terrain.
f. When fire control mounts have been replaced.
g. Whenever the weapon fires inaccurately for no apparent reason.
h. After replacement of cannon tube.

## 3-49. TEST OF GUNNER'S QUADRANT

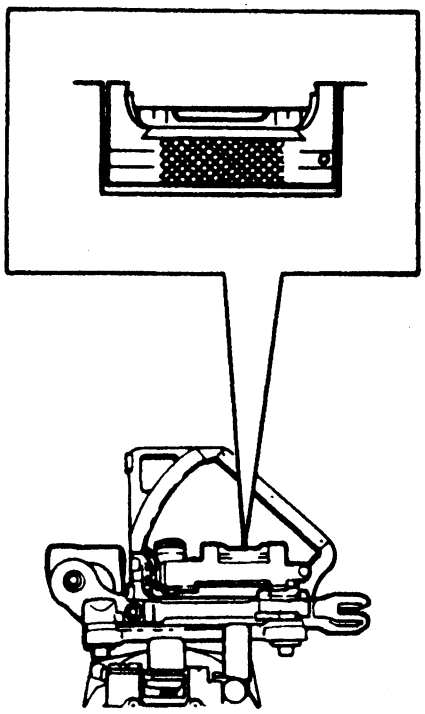
**WARNING**
**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

**NOTE**
Before testing the gunner's quadrant, inspect the quadrant shoes and seats for dirt or defects.

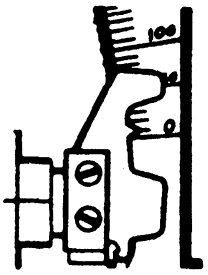
### MICROMETER TEST

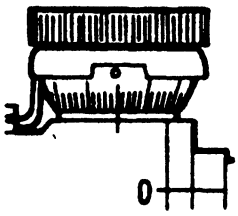
1 Set index at + 10.

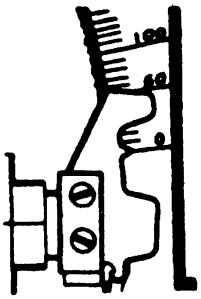
2 Zero the micrometer.



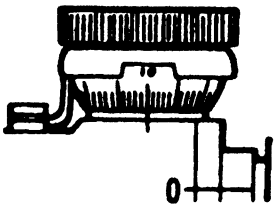
3 Point gunner's quadrant to muzzle end of cannon tube and elevate cannon tube to center bubble.



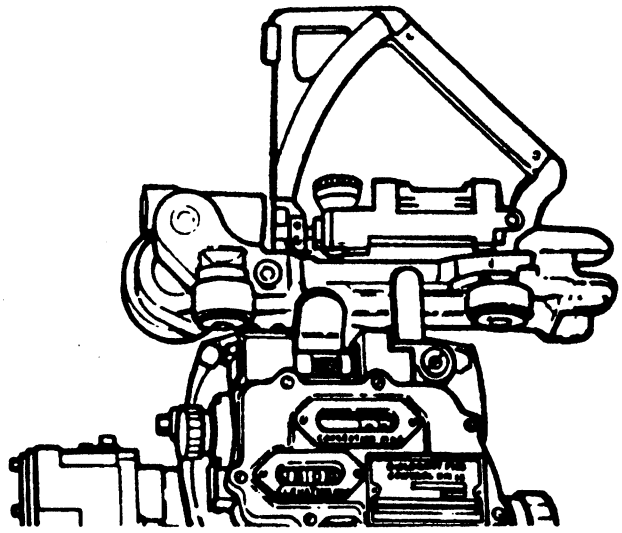


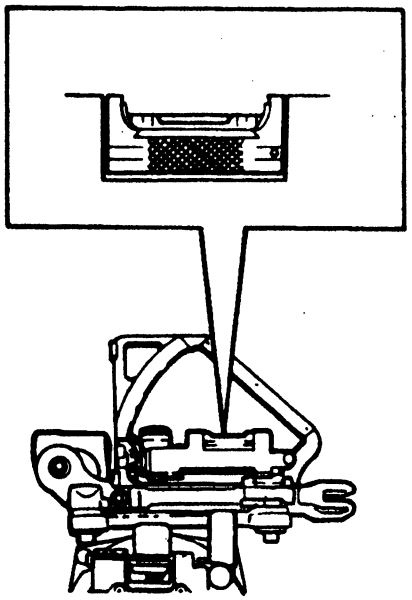
4 Set index at 0.




5 Set micrometer at 10.



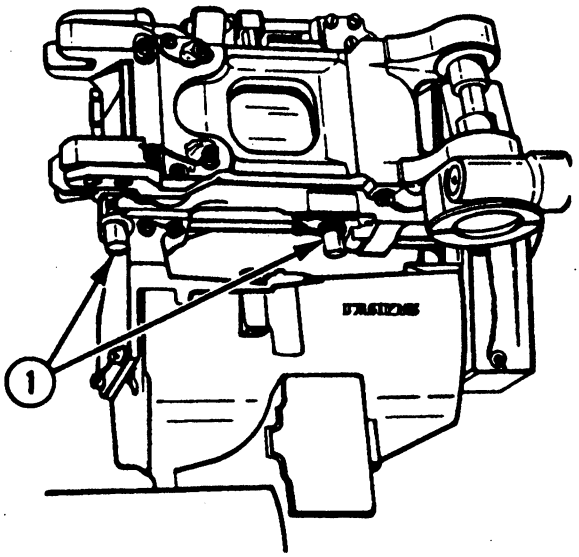
6 Point gunner's quadrant to muzzle end of cannon tube.



7 Bubble should center.

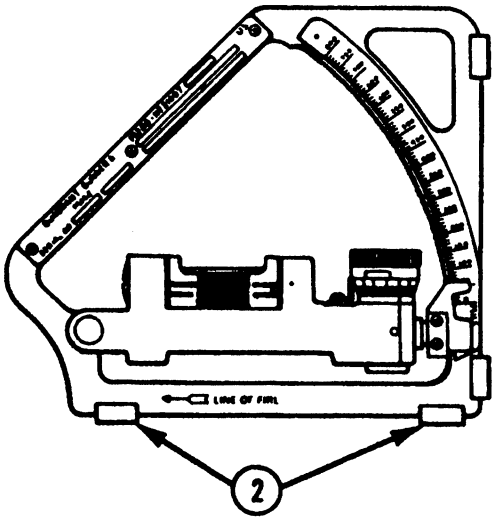
8 If bubble does not recenter, the micrometer is in error. Send the gunner's quadrant to unit maintenance.

**END-FOR-END TEST**



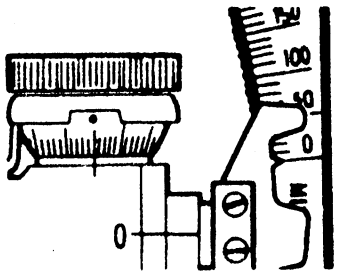

**NOTE**
Maximum allowable tolerances are +0.4 or −0.4 mil.

1 Inspect elevation quadrant seats (1).

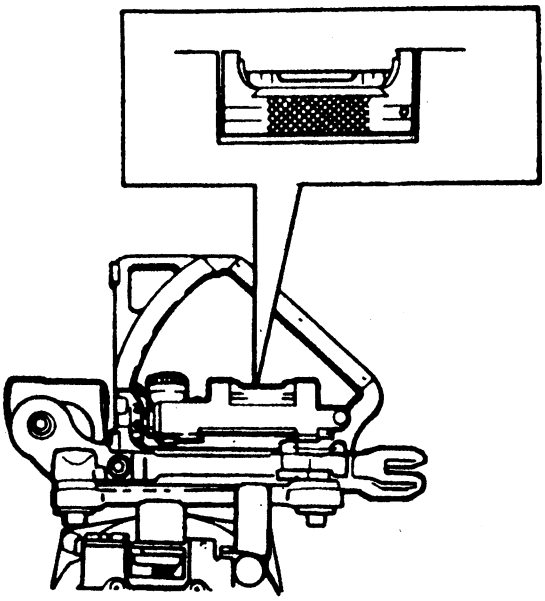



2 Inspect quadrant shoes (2).

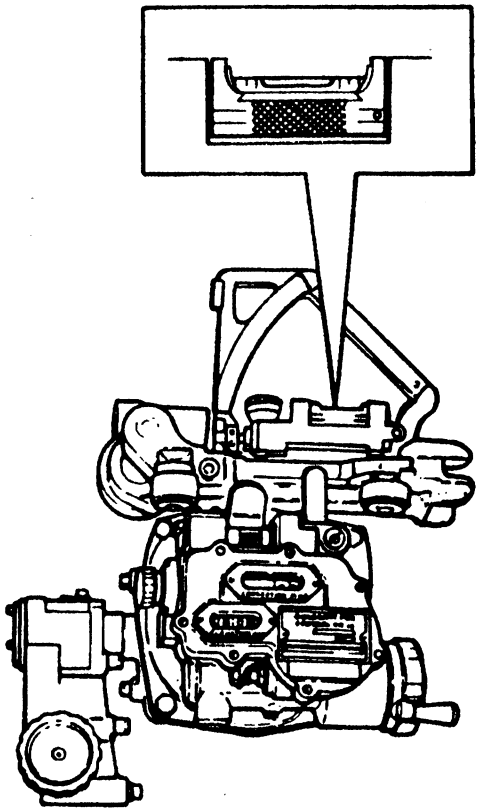
## 3-49. TEST OF GUNNER'S QUADRANT (cont)



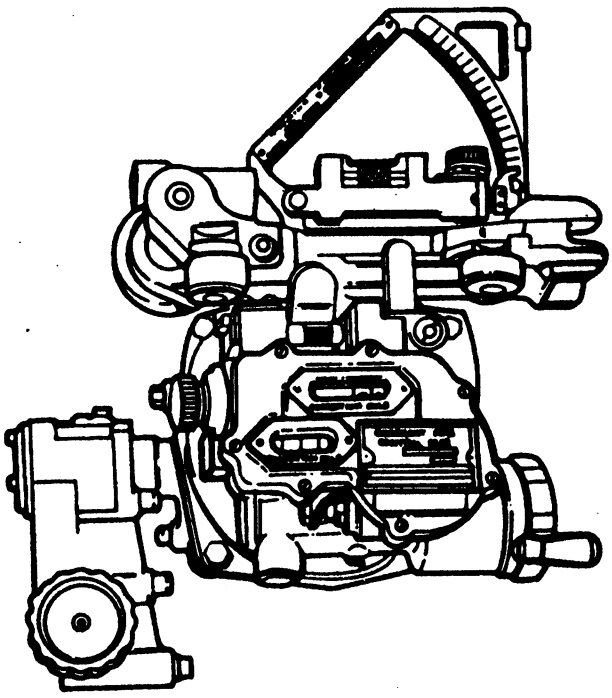

3 Zero the scales.



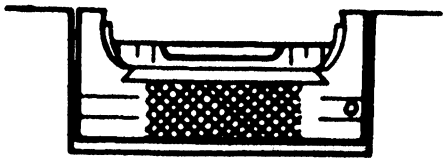
4 Point gunner's quadrant toward muzzle end of cannon tube.



5 Elevate cannon tube to center bubble.

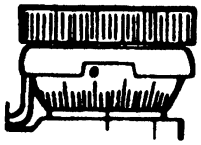


6 Reverse direction of gunner's quadrant.



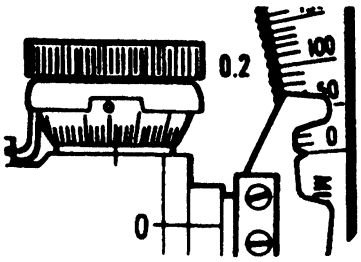
7 If bubble centers, test is complete. If bubble does not center, go to step 8.

**POSITIVE CORRECTION**

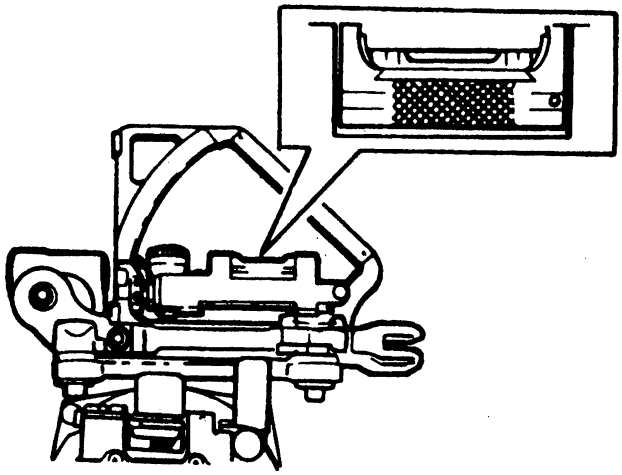



**NOTE**
Each short line on micrometer equals 0.2 mil.

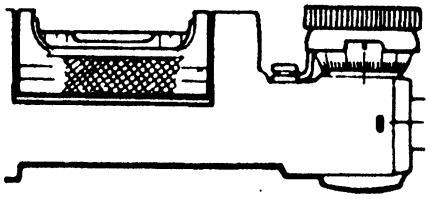
9 Divide micrometer reading by 2.



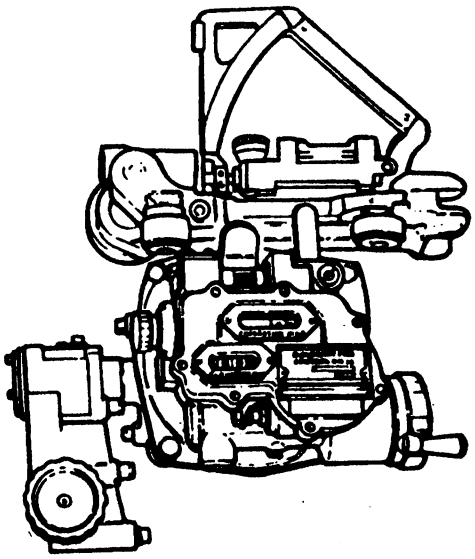

10 Put result on micrometer scale.



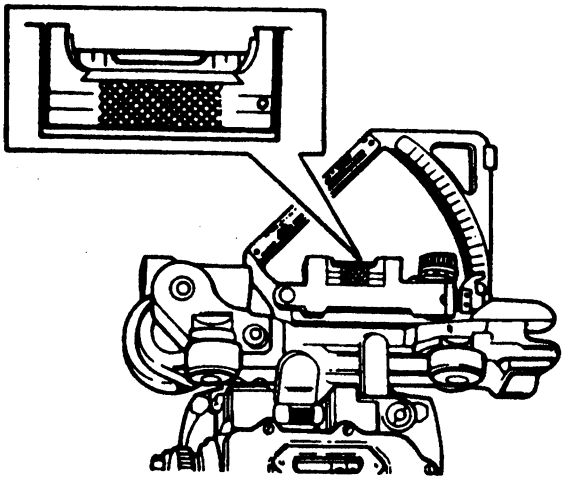
12 Elevate cannon tube to center bubble.



8 Center bubble with micrometer knob. If bubble centers, go to step 9. If it does not, go to step 15.

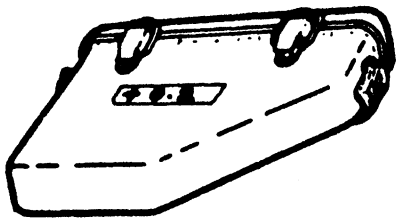


11 Point gunner's quadrant toward muzzle end of cannon tube.

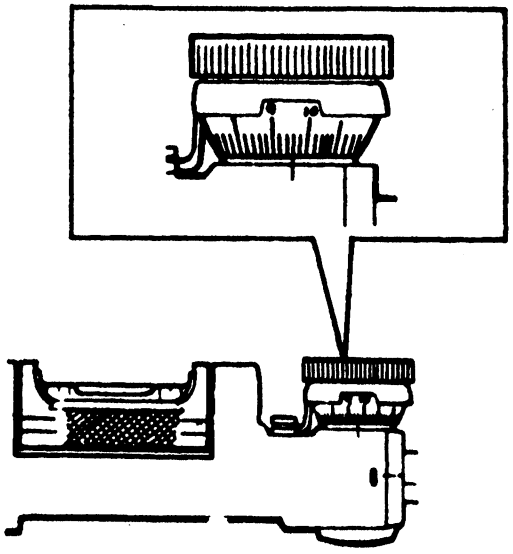


13 Reverse direction of gunner's quadrant. Bubble should center.

## 3-49. TEST OF GUNNER'S QUADRANT (cont)



14 Record end-for-end correction.

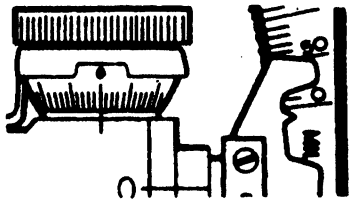


16 Center bubble with micrometer knob.

$$\frac{19.6}{2} = 9.8$$

18 Divide sum by 2.

NEGATIVE CORRECTION
(Bubble did not center at step 8.)

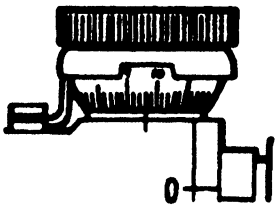


**NOTE**

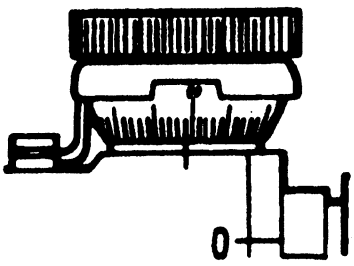
If bubble did not center at step 8, the following tests should be made:

15 Set index at -10.

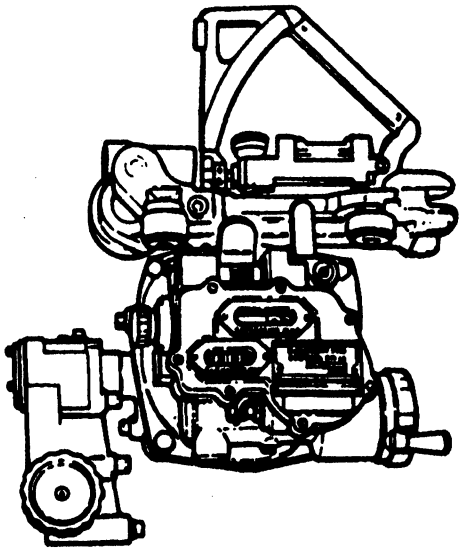
$$\begin{array}{r} 10.0 \\ +\ 9.6 \\ \hline 19.6 \end{array}$$



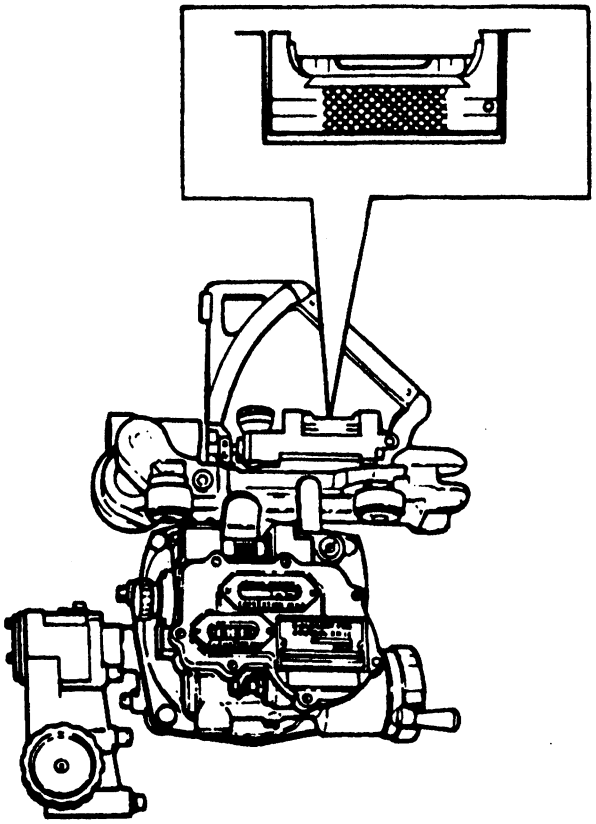
17 Add 10 to micrometer reading.



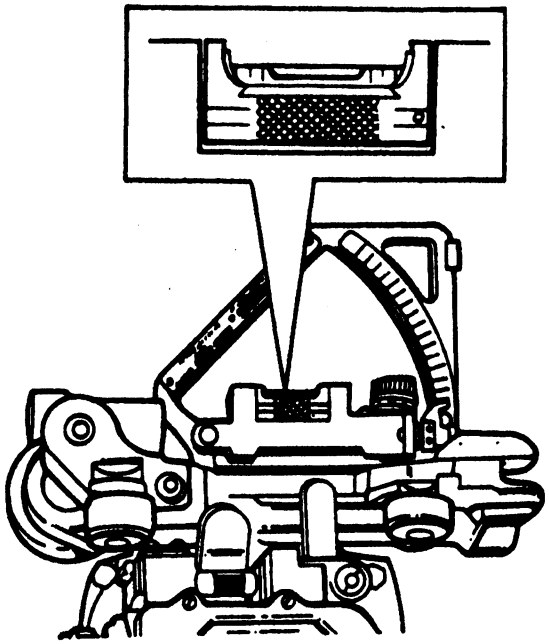
19 Place answer on micrometer scale.



20 Point gunner's quadrant toward muzzle end of cannon tube.



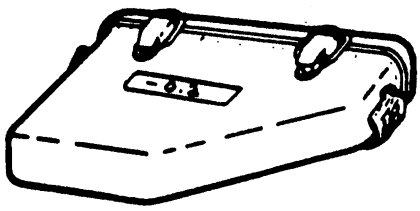
21 Elevate cannon tube to center bubble.



22 Reverse direction of gunner's quadrant. Bubble should center.

$$\begin{array}{rr} & 10.0 \\ - & 9.8 \\ \hline - & 0.2 \end{array}$$

23 Subtract micrometer reading from 10.



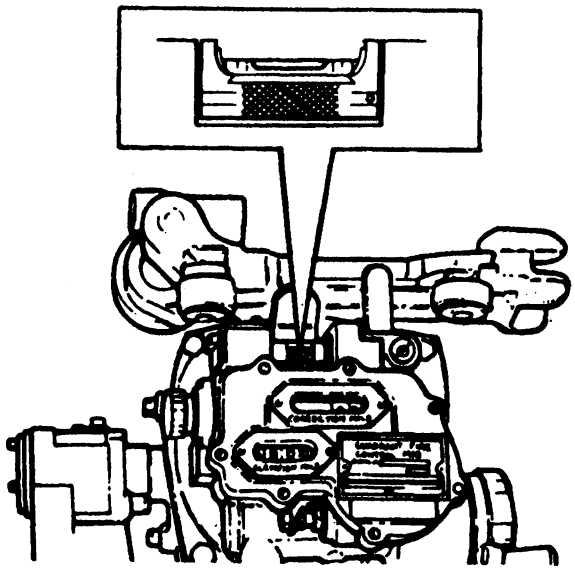
24 Record end-for-end correction.

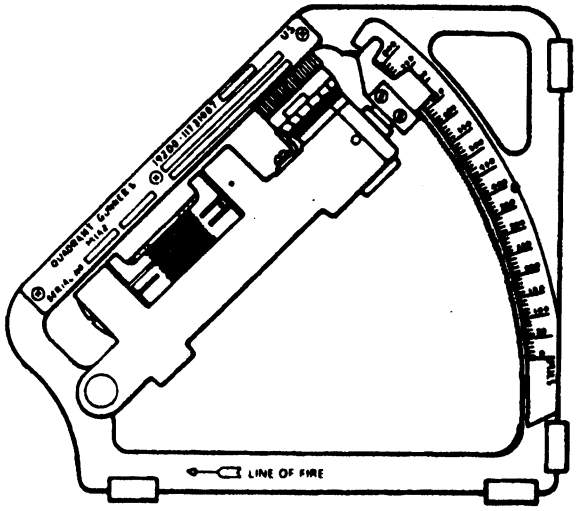
## 3-49. TEST OF GUNNER'S QUADRANT (cont)

### VERTICAL SHOE TEST

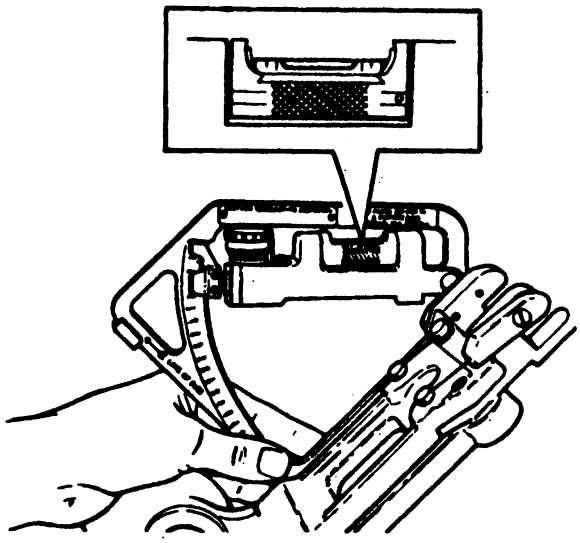
High Angle 800-1600 mil scale

1 Set M18 quadrant to 800 mils, elevate cannon until elevation level bubble is centered, and cross level M18 quadrant as required.

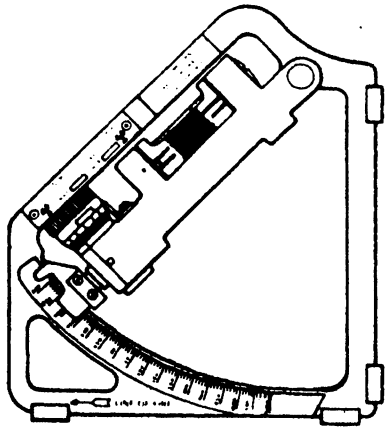





2 Set 800 mils on gunner's quadrant 0-800 mil coarse scale. If there is a correction factor for the horizontal shoes, set corresponding micrometer scale to correction factor; otherwise, set micrometer scale to 0.

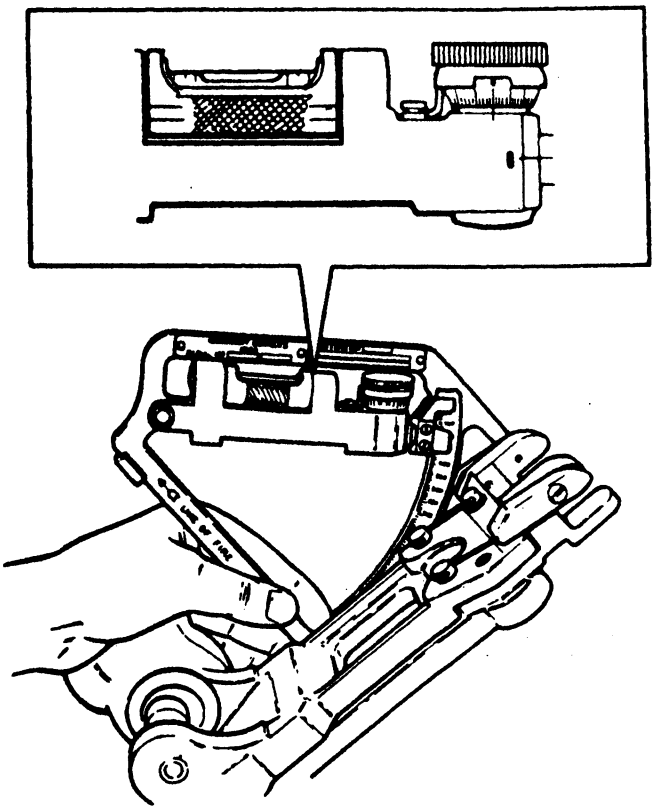


3 Set gunner's quadrant on M172 telescope and quadrant mount quadrant seats, with gunner's quadrant LINE OF FIRE arrow toward muzzle end of cannon tube. If gunner's quadrant level bubble is not centered, elevate or depress cannon until the bubble is centered.



4 Remove gunner's quadrant from M172 telescope and quadrant mount.

5 Set 800 mils on gunner's quadrant 800-1600 mil coarse scale.



6 Place gunner's quadrant vertical shoes on M172 telescope and quadrant mount quadrant seats, with gunner's quadrant LINE OF FIRE arrow toward muzzle end of cannon tube.

7 Center level bubble on gunner's quadrant with micrometer knob. Gunner's quadrant should read 800 mils ±0.4 mil.

8 If gunner's quadrant reading deviates more than ±0.4 mil, the gunner's quadrant is defective. Send the gunner's quadrant to unit maintenance.

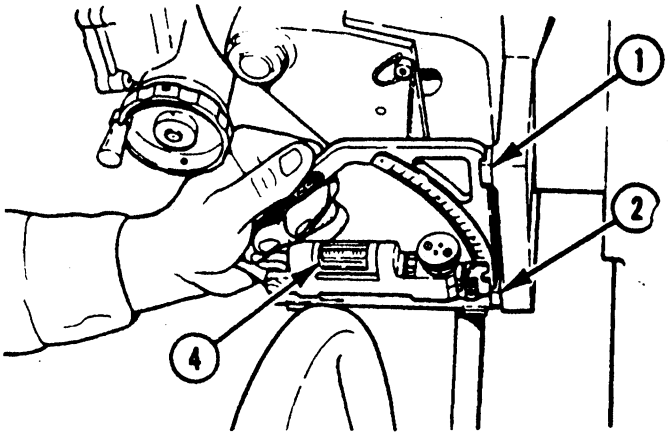
## 3-50. LEVELING TRUNNIONS

**WARNING**

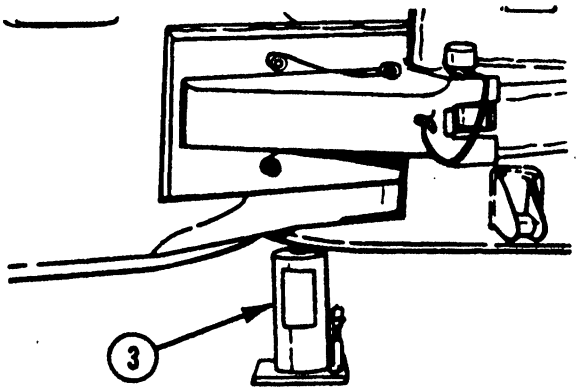
**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

1 Place the howitzer in firing position on a hard surface, such as concrete or asphalt, if possible; if not, place it on solid ground. Spades must be installed, but do not need to be dug in.

## 3-50. LEVELING TRUNNIONS (cont)

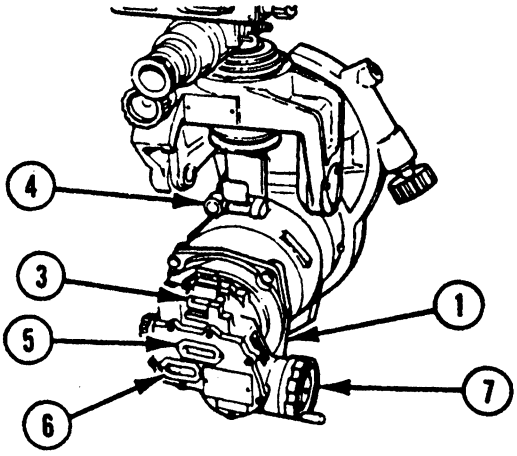



2 Set a pretested gunner's quadrant (1) on the cross level pads (2) with any corrections applied.




3 Using prime mover jack (3), jack up the howitzer on whichever side is necessary to center the gunner's quadrant bubble (4). Trunnions are now level.

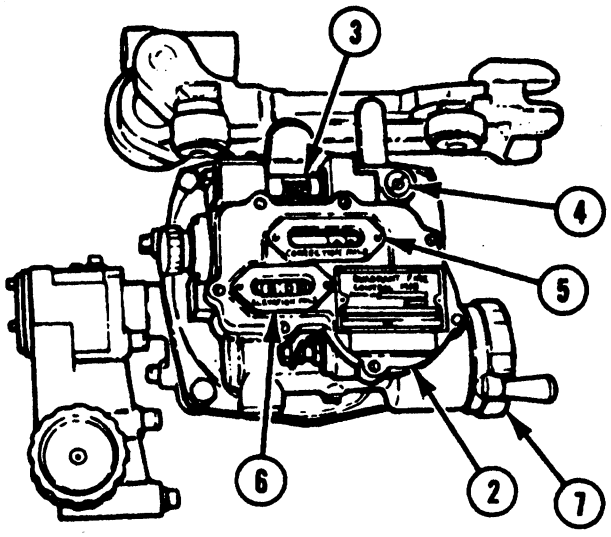
## 3-51. TESTING M17 AND M18 FIRE CONTROL QUADRANTS




**WARNING**

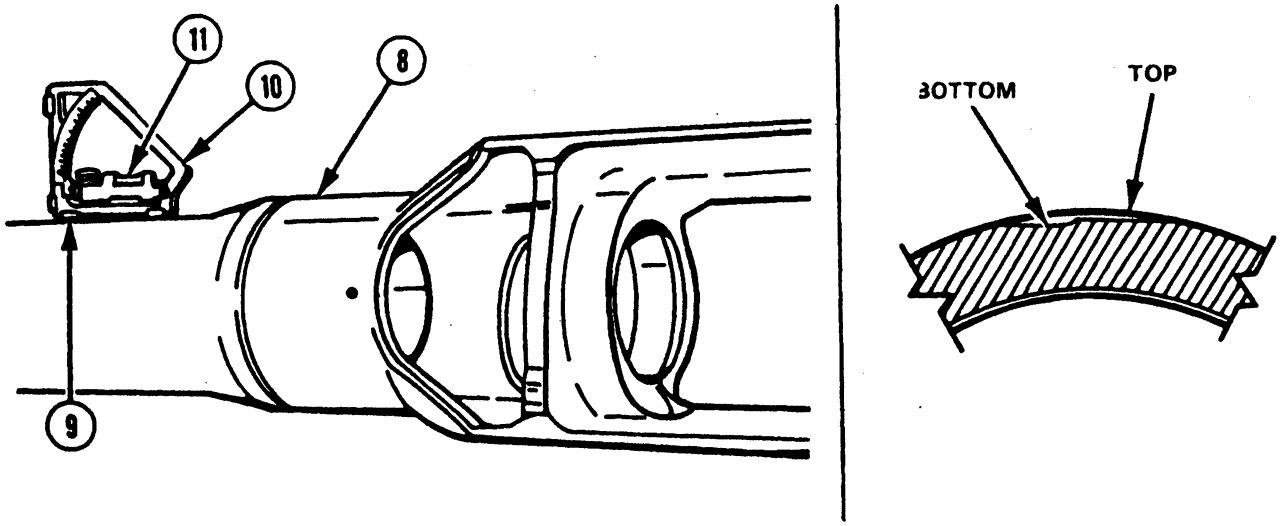
**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

1 Before starting, make sure there are no obvious defects on the M17 fire control quadrant (1) or the M18 fire control quadrant (2). Check the M17 and M18 fire control quadrants for looseness or wobble in their mounting on the trunnions. Also check that the markings on the elevation level vials (3) and cross level vials (4) are legible.




2 Place the howitzer in firing position on a hard surface, such as concrete or asphalt, if possible. Spades must be installed but do not need to be dug in. Trunnions must be level.

3 Set M17 and M18 elevation correction counters (5) to 00, and set elevation counters (6) to 0000. To eliminate backlash, rotate elevation control knob (7) with the last motion in a clockwise direction.




4 Elevate the cannon tube (8) to 0 mils, using the M17 fire control quadrant.

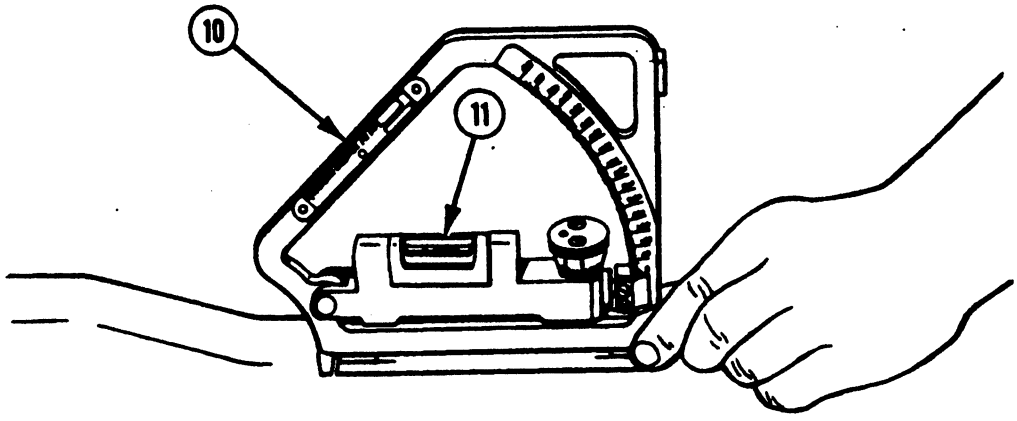
5 Ensure cannon leveling pads (9) are clean.

**NOTE**

**Be sure to place gunner's quadrant on the top surface of the cannon tube leveling pad; use of the bottom surface may lead to erroneous readings.**

6 Place the pretested gunner's quadrant (10), with corrections applied, on cannon leveling pads (9), alining with edge of top surface as shown, with the LINE OF FIRE arrow pointed toward the muzzle end of cannon tube.

7 Elevate the cannon tube (8) with the elevating handwheel until the gunner's quadrant bubble (11) centers.




8 Rotate the gunner's quadrant (10) end-for-end. The gunner's quadrant bubble (11) should recenter. If the gunner's quadrant bubble does not recenter, verify the gunner's quadrant correction factor and repeat steps 5 through 7.

**NOTE**

**To eliminate backlash during leveling, last motion of pitch/elevation and cross level control knobs will be in a clockwise direction.**

## 3-51. TESTING M17 AND M18 FIRE CONTROL QUADRANTS (cont)

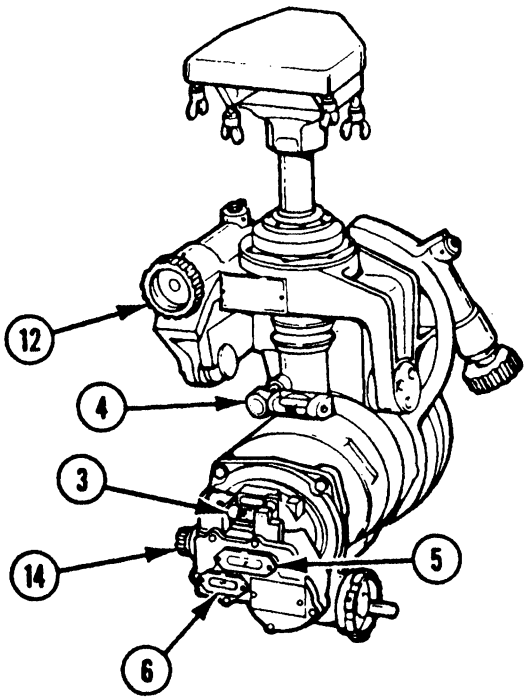
9 Level the M17 and M18 fire control quadrants (2) by turning the cross level control knobs (12) until the cross level vials (4) center. With M17 and M18 elevation counters (6) set at 0000, the bubbles in the elevation level vials (3) should be centered. If the bubbles in the elevation level vials are not centered, either the counters or the level vials are out of adjustment. Notify unit maintenance.

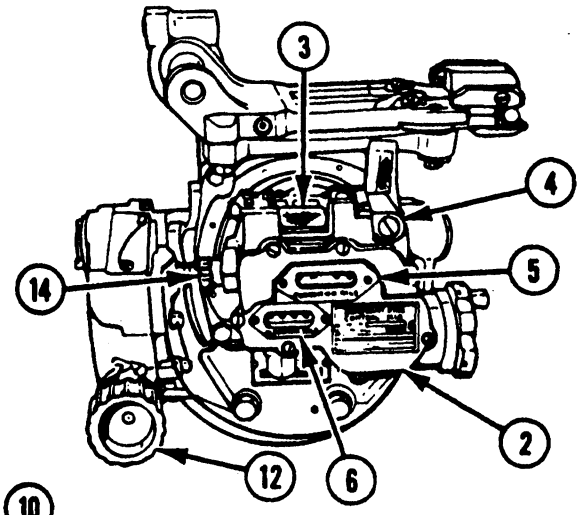
10 With the bubbles in each elevation level vial and cross level vial still centered, place the gunner's quadrant (10) on the quadrant seats (13) with the LINE OF FIRE arrow towards the muzzle.

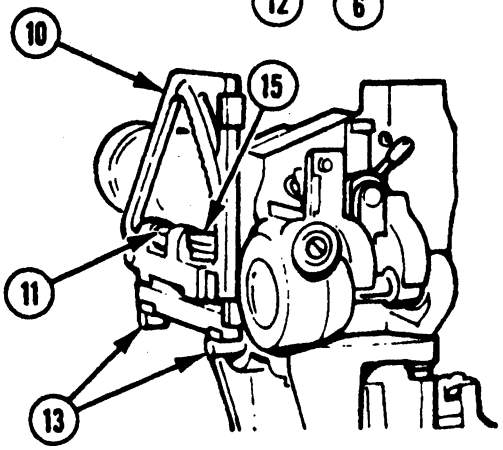
11 Center the gunner's quadrant bubble (11) and record the reading. The quadrant seats (13) are out of adjustment if the reading changes over 1 mil. Notify unit maintenance.

**NOTE**
Do not forget the gunner's quadrant correction factor when taking these readings.

12 Using the elevation correction knobs (14), insert a +5-mil correction in both elevation correction counters (5). The reading in each elevation counter (6) should now read 9995. Set each elevation counter back to zero. Elevate the cannon tube until the bubble in the elevation level vial (3) of the M18 fire control quadrant centers. Center the gunner's quadrant bubble (11). The micrometer (15) should show an increase of 5 mils. When the bubble in the M18 fire control quadrant elevation level vial is centered, the bubble in the M17 fire control quadrant elevation level vial (3) should center ±1 graduation.



**13** Set elevation counter (6) and elevation correction counter (5) on each fire control quadrant back to zero.

**14** Insert corrections 10 mils at a time, up to 50 mils, on each elevation correction counter (5) and observe the following:

**a.** The reading in each elevation counter (6) should have decreased by the amount of correction applied within ±0.5 mil.

**b.** The bubble in each elevation level vial (3) should still be centered. If either the M17 or M18 fire control quadrant does not perform properly, it is defective. Notify unit maintenance.

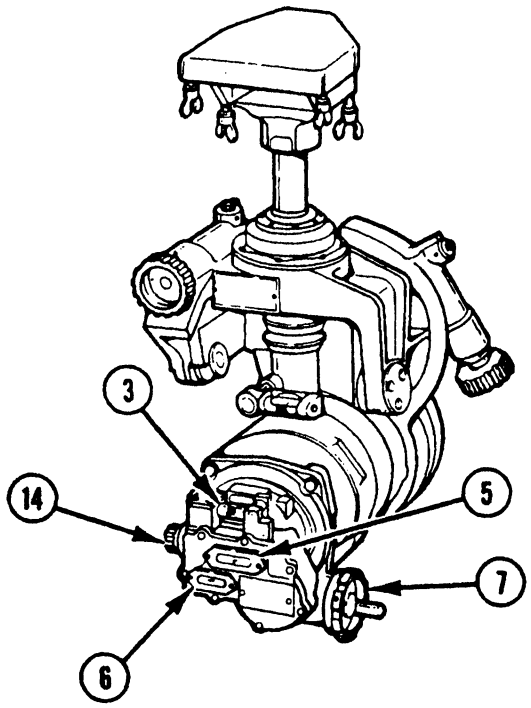
**15** Return each elevation correction counter (5) to zero using elevation correction knobs (14).

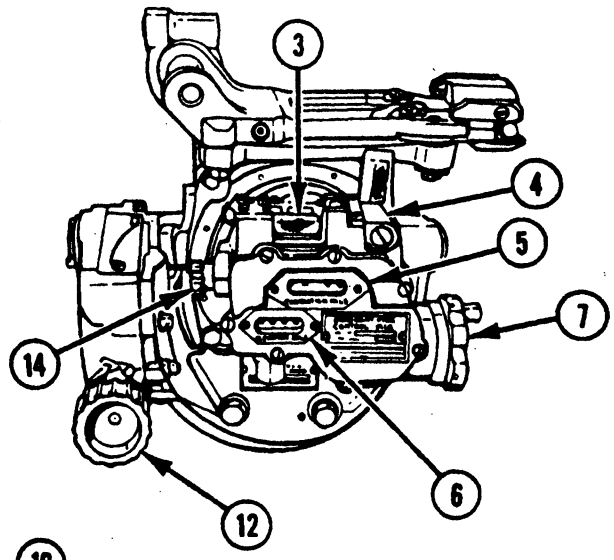
**16** Set 400 mils on each elevation counter (6) using the elevation control knobs (7).

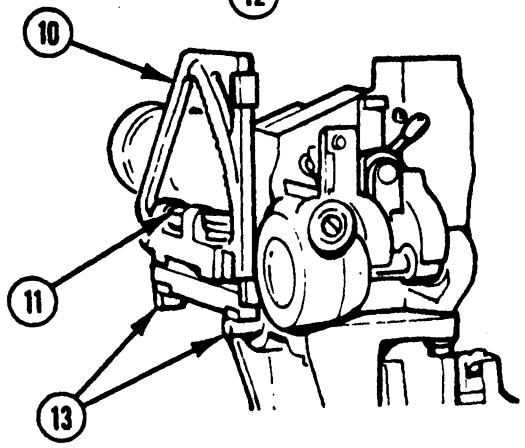
**17** Using the elevating handwheel, elevate the cannon tube to center the bubble in the elevation level vial (3) on the M18 fire control quadrant. Center the bubble in the cross level vial (4) using the cross level control knob (12). When the bubble in the M18 fire control quadrant elevation level vial is centered, the bubble in the M17 fire control quadrant elevation level vial (3) should center within ±1 graduation.

**18** Place 400 mils plus or minus any correction factor on the gunner's quadrant (10). Set gunner's quadrant with LINE OF FIRE arrow towards the muzzle on the quadrant seats (13). The gunner's quadrant bubble (11) should center within ±1 mil. If not, the M18 fire control quadrant is defective. Notify unit maintenance.

**19** Repeat steps 15 thru 17 at 900 mils. The M17 and M18 fire control quadrant tests are now completed.



## 3-52. RELIABILITY TEST OF M137 PANTEL

**WARNING**

**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**

1 Level the cannon tube using the M17 fire control quadrant. Set the M137 pantel correction counter (1) to zero using the gunner's aid knob (2).

2 Level the M171 telescope and quadrant mount.

3 Sighting through the M137 pantel, aline the crosshairs (3) on a sharply defined aiming point (4) at least 50 to 100 meters away. (If less than 50 meters distance, use parallax shield.) Be careful not to move the crosshairs. Record the reading from the azimuth counter (5) and deflection counter (6).

**NOTE**

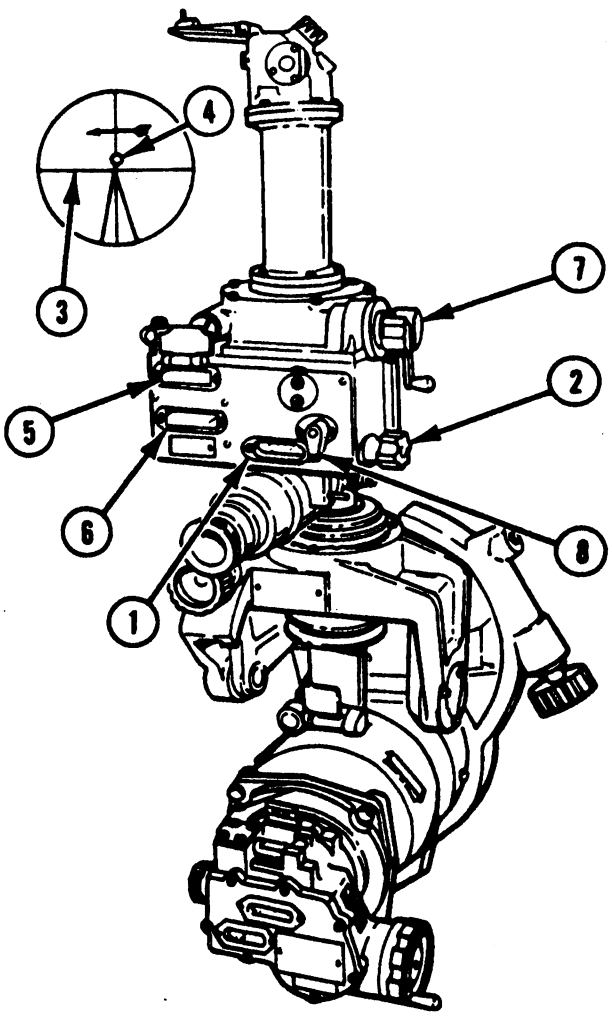
Eliminate backlash by making the last movement of the pantel head from left to right.

4 Using the azimuth knob (7), rotate the pantel head through two complete clockwise revolutions, and realine the crosshairs on the aiming point. Record the readings from the azimuth counter (5) and deflection counter (6). Be sure the last motion is from left to right..

5 Compare the azimuth and deflection counter readings obtained in steps 3 and 4. If the difference between the counter readings is greater than 1 mil, the M137 pantel is defective. Notify unit maintenance.

6 Repeat steps 4 and 5 by rotating the pantel head counterclockwise. Be sure the last motion is from right to left.

7 Using gunner's aid knob (2), insert corrections 10 mils at a time, up to 50 mils, on the correction counter (1) and observe the following:




a. The crosshairs (3) should not move from the aiming point (4).

b. Reading on azimuth counter (5) should not change.

c. The reading from the deflection counter (6) should change by the amount of correction applied.

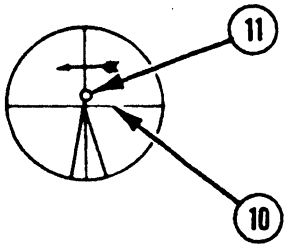
8 Repeat step 7, applying corrections in the opposite direction. If the M137 pantel does not perform as stated in step 7, it is defective. Notify unit maintenance.

9 Disengage the deflection clutch (8). Turn the azimuth knob (7). The deflection counter (6) should not move.

10 Engage the deflection clutch (8).

## 3-53. ALINEMENT TEST OF M171 TELESCOPE AND QUADRANT MOUNT AND M137 PANTEL

**WARNING**
**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**




1 Elevate the cannon tube to 0 mils using the M18 fire control quadrant.

2 Level trunnions (p 3-57).

**CAUTION**
Do not disturb traverse or move the weapon for any reason when conducting this test.

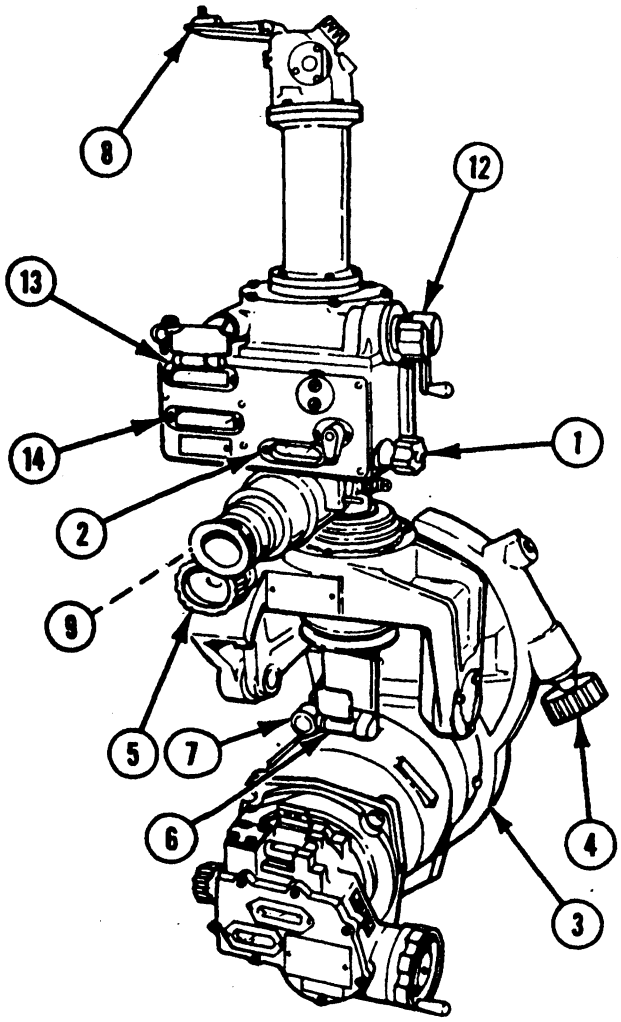
3 Use the correction knob (1) to set the correction counter (2) on the M137 pantel to zero.

4 Carefully level the M171 telescope and quadrant mount (3) by turning the pitch level control knob (4) and cross level control knob (5) until the bubbles in the pitch level vial (6) and cross level vial (7) center.

5 Select a stationary aiming point as far away as possible to the left side of the howitzer so that it will be visible during steps 6, 8, and 11.

**NOTE**
Eliminate backlash by making the last movement of the pantel head from left to right.

6 Close the parallax shield (8) and, with bubbles in pitch level vial (6) and cross level vial (7) still centered, sight through the eyepiece (9) and aline the telescope crosshairs (10) on a sharply defined stationary aiming point (11) by turning the azimuth knob (12). Record the readings from the azimuth counter (13) and deflection counter (14).



## 3-53. ALINEMENT TEST OF M171 TELESCOPE AND QUADRANT MOUNT AND M137 PANTEL (cont)

7 Slowly elevate the cannon tube to 400 mils, and recenter the bubbles in the pitch level vial (6) and cross level vial (7) on the M171 telescope and quadrant mount (3).

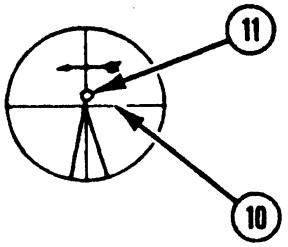
8 Sighting through eyepiece (9), realine the crosshairs (10) on the aiming point (11). Record the readings from the azimuth counter (13) and deflection counter (14).

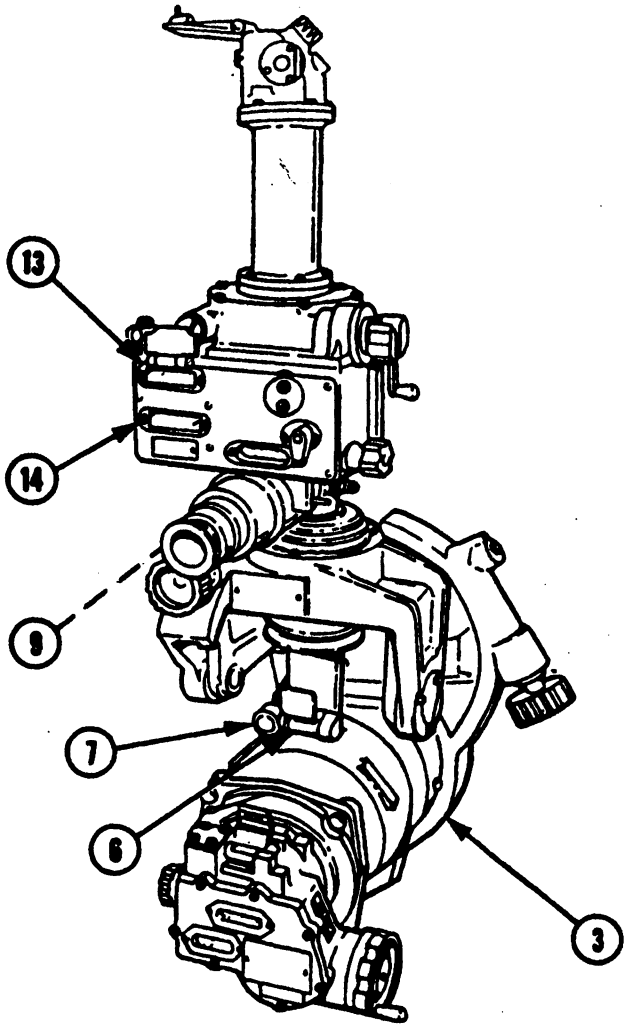
9 Compare the readings from the azimuth counter (13) and deflection counter (14) recorded in steps 6 and 8. If the difference between the readings is greater than 1 mil, the M171 telescope and quadrant mount is defective. Notify unit maintenance.

10 Slowly elevate the cannon tube to 900 mils and recenter the bubbles in the pitch level vial (6) and cross level vial (7).

11 Sighting through eyepiece (9), realine the crosshairs (10) on the same aiming point (11). Record the readings of the azimuth counter (13) and deflection counter (14).

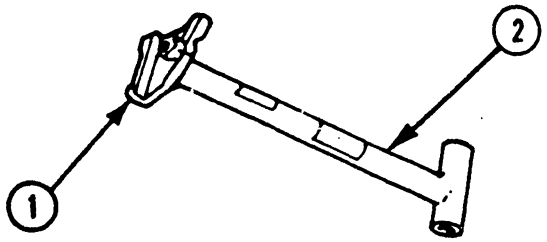
12 Compare the readings of the azimuth counter (13) and deflection counter (14) recorded in steps 6 and 11. If the difference between the counter readings is greater than 3 mils at 401 to 900 mils elevation, the M171 telescope and quadrant mount is defective. Notify unit maintenance.



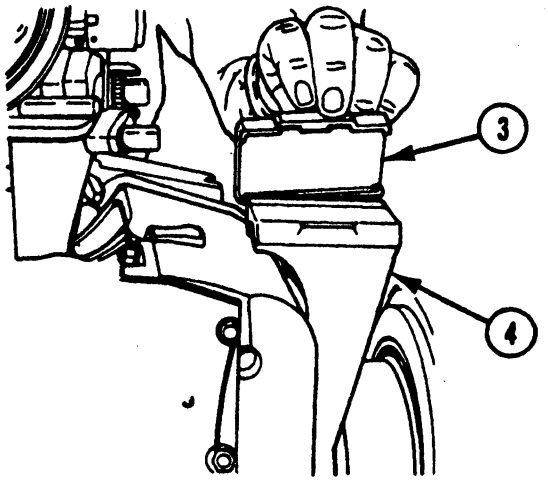
## 3-54. M139 ALINEMENT DEVICE COMPARISON TEST

**WARNING**
**When using radioactively illuminated fire control equipment, follow radiation hazard procedures in the front of this manual.**




1 Get two M139 alinement devices from other howitzer sections.

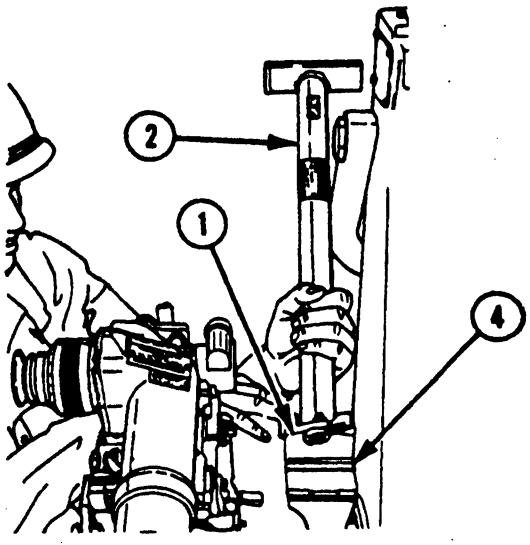
2 Inspect mating surfaces (1) of the alinement device (2) for nicks, burrs, and dirt. If dirty, clean with a rag (item 24, appx D). Request unit maintenance to remove any nicks or burrs. If nicks or burrs cannot be removed, perform test to determine if alinement device is defective.




3 Remove protective cover (3) from dovetail (4) and check the surface as you did for the alinement device in step 2. Wipe dovetail clean with a rag (item 24, appx D). Notify unit maintenance to remove any nicks or burrs.

4 Level the cannon tube using the M18 fire control quadrant.

5 Install the alinement device (2). Make sure the mating surface (1) matches with dovetail (4).




6 Level the M171 telescope and quadrant mount.

## 3-54. M139 ALINEMENT DEVICE COMPARISON TEST (cont)

**CAUTION**
After leveling the M171 telescope and quadrant mount, be careful not to disturb the pitch level setting.

7 Aline the crosshairs (5) of the M137 pantel with the crosshairs (6) of the alinement device by turning azimuth knob (7). Center the crosshairs for elevation; turn the elevation knob (8). Last movement of azimuth knob should be clockwise.

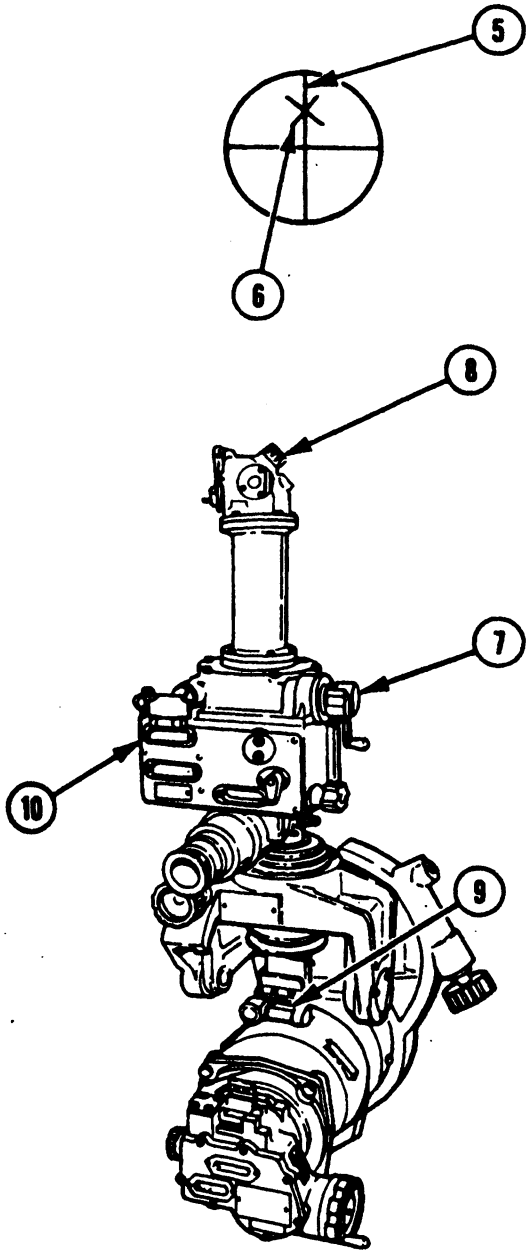
8 With the pantel and alinement device crosshairs alined, the bubble centered in the pitch level vial (9) of the M171 telescope and quadrant mount, and the cannon tube at zero elevation, record the reading of the pantel azimuth counter (10).

9 Remove the alinement device and install a second alinement device. Make sure dovetail and mating surfaces match.

10 Repeat steps 7 and 8 with a second and third alinement device.

11 Compare the three azimuth counter readings. If readings from the alinement devices fall within + or −0.5 mil of each other, the alinement devices are serviceable. Any alinement device that exceeds the + or −0.5 mil tolerance is defective. Notify unit maintenance.

12 Remove and store the M139 alinement device.



# ALPHABETICAL INDEX

Subject Page

## C



## D



## E

Subject Page

E (cont)



F

Subject Page

## G



## H



## I



## L

Subject Page

M (cont)

LUBRICATION ORDER

22 January 1991

# LO 9-1025-211-13

(Supersedes LO 9-1025-211-13, 14 March 1989)

# HOWITZER, MEDIUM, TOWED: 155-MM, M198 (1025-01-026-6648)

References: TM 9-1025-211-10, TM 9-1025-211-20&P, and TM 9-1025-211-34

## REPORTING OF ERRORS

You can improve this publication by calling attention to errors and by recommending improvements and by stating your reasons for the recommendations. Your letter or DA Form 2028, Recommended Changes to Publications and Forms, should be mailed directly to Commander, US Army Armament, Munitions and Chemical Command, ATTN: AMSMC-MAS, Rock Island, IL 61299-6000. A reply will be furnished directly to you.

## NOTES

Intervals are based on normal operation. You should lube more during constant use and lube less during inactive periods. Relubricate after washing, fording (fresh or salt water) or contact with salt water spray. Clean fittings before lubricating. Clean parts with cleaning compound. Dry before lubricating. DO NOT overlubricate; wipe off excess lubricant.

Dotted lines indicate lubrication points on both sides of the equipment. The level of maintenance responsible for each lube instruction is shown, and the lube order is divided into six sections based on lubrication intervals (DAILY, WEEKLY, MONTHLY, QUARTERLY, SEMI-ANNUALLY, AND ANNUALLY). An overall view showing lubrication points precedes each set of detailed notes for each interval.

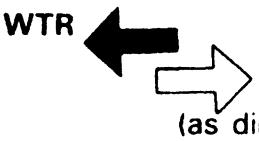
Daily lubing means once each day after weapon has been fired.

## KEY

### MAINTENANCE LEVEL

| | |
|---|---|
| C | Operator/Crew |
| O | Unit Maintenance |
| F | Direct Support |

### LUBRICATION POINTS



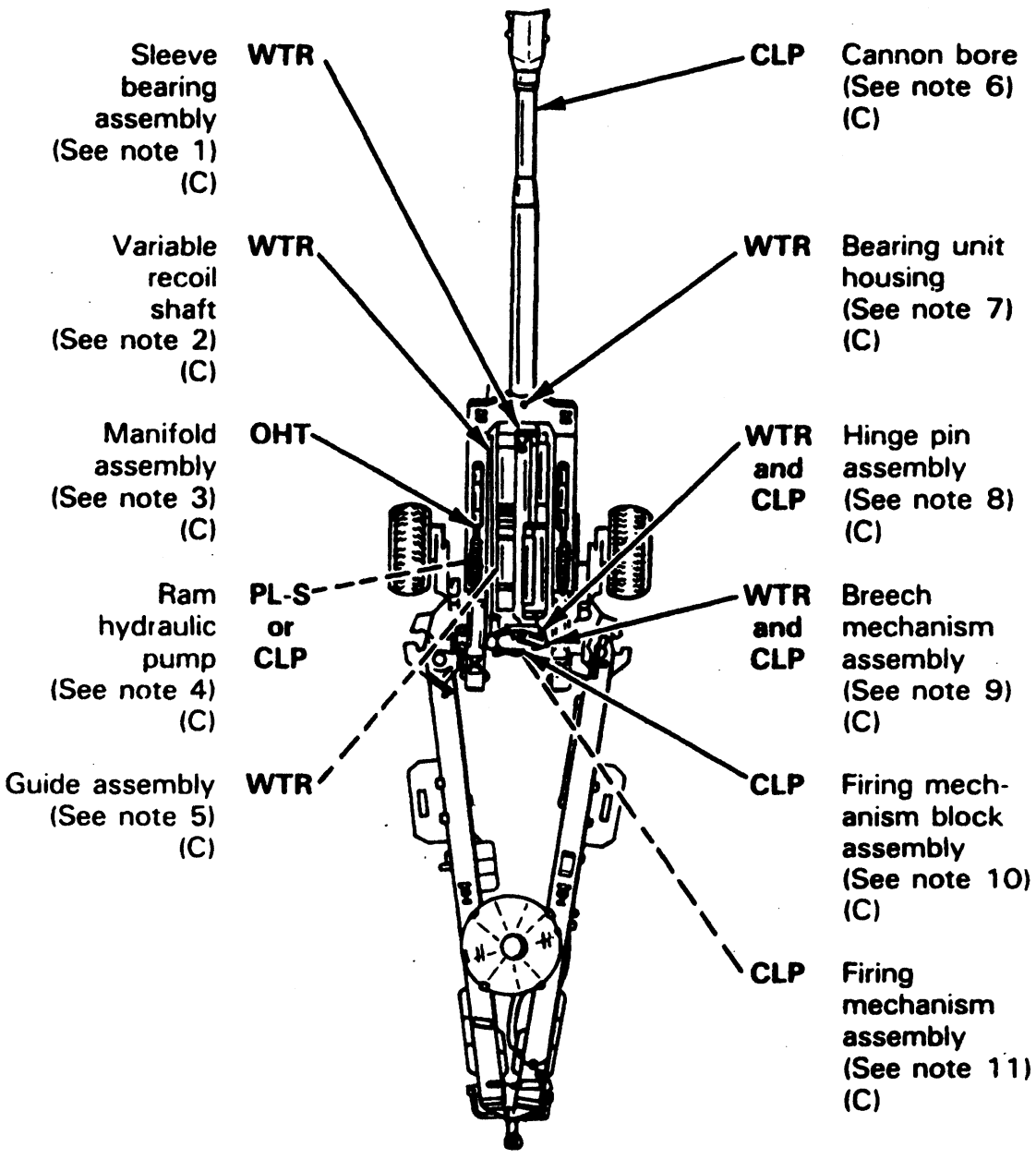

PL-S or CLP
(as directed in procedure)

### LUBRICANTS

| | |
|---|---|
| CLP | Cleaner, Lubricant and Preservative, MIL-L-63460 |
| WTR | Grease, Aircraft, General Purpose, Wide Temperature Range, MIL-G-81322 |
| PL-S | Lubricating Oil, General Purpose, Special Preservative, VV-L-800 |
| BFS | Brake Fluid, Automotive, Silicone, MIL-B-46176 |
| OHT | Hydraulic Fluid, Petroleum Base, MIL-H-6083 |
| GMD | Grease, Molybdenum Disulfide, MIL-G-21164 |

# DAILY

## HOWITZER, MEDIUM, TOWED: 155-MM, M198

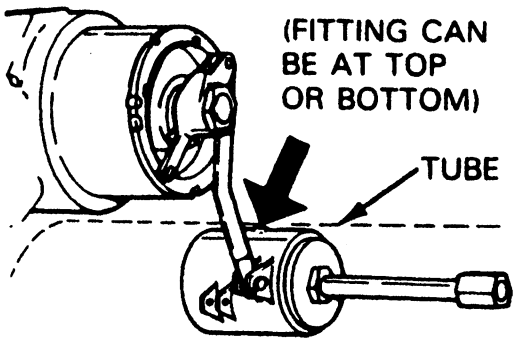



TOP VIEW

## DAILY NOTES

### NOTE 1

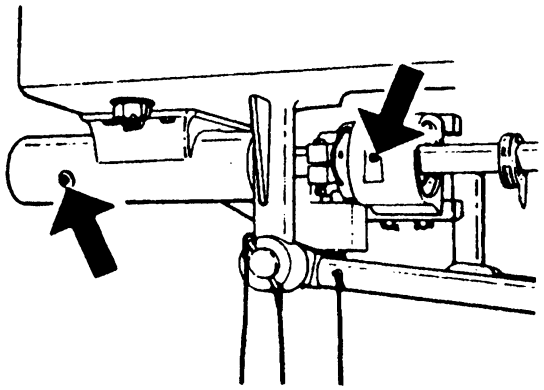
SLEEVE BEARING ASSEMBLY (C)




Lube with WTR.

### NOTE 2

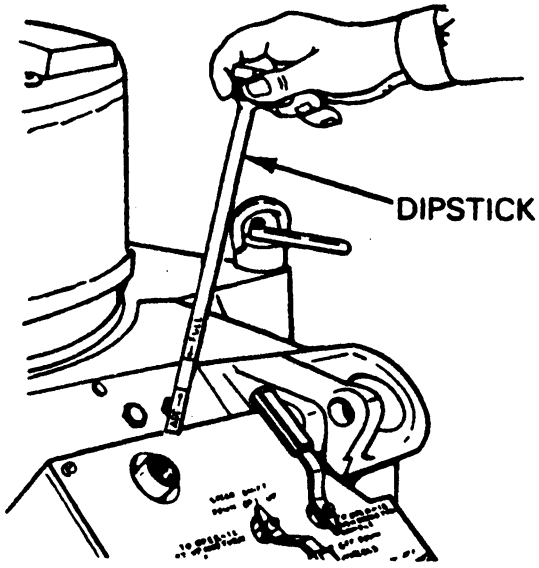
VARIABLE RECOIL SHAFT (C)



Lube with WTR.

### NOTE 3

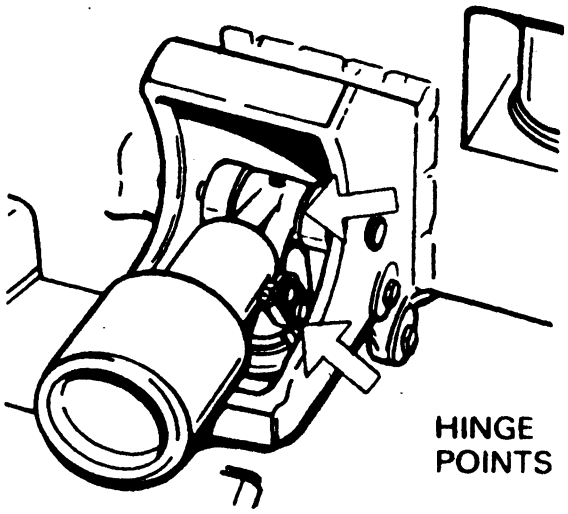
MANIFOLD ASSEMBLY (C)




Check OHT level at DIPSTICK and fill as required.

### NOTE 4

RAM HYDRAULIC PUMP (C)



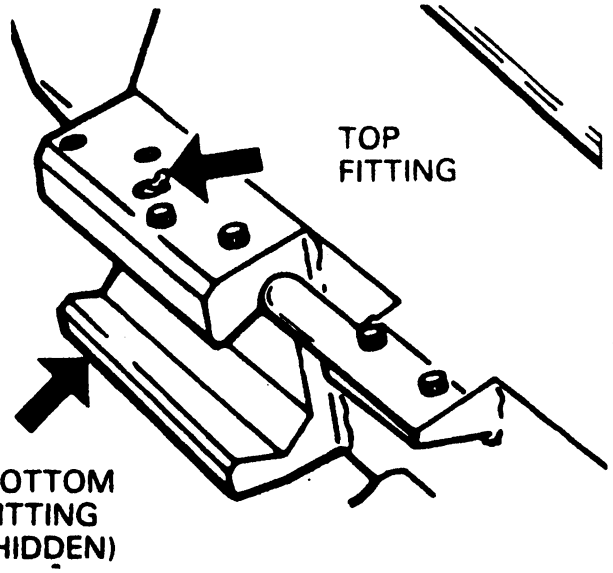

Apply PL-S or CLP to HINGE POINTS.

LO 9-1025-211-13

**DAILY NOTES (cont)**

**NOTE 5**

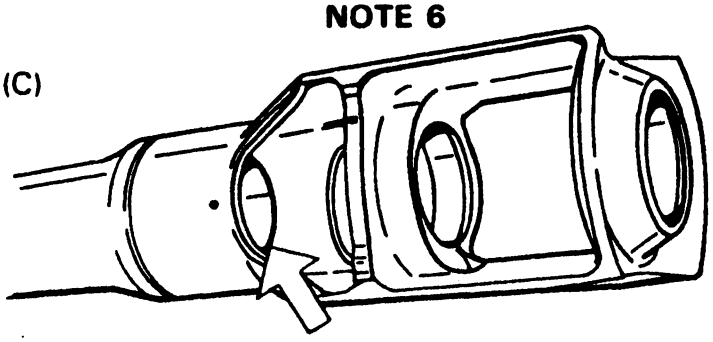
GUIDE ASSEMBLY (C)




Lube four fittings with WTR. (Cannon and recoil mechanism removed for clarity.)

**NOTE 6**

CANNON BORE (C)



**NOTE**

The new nylon bore brush is flexible enough that a scrubbing action (back and forth motion) can be used to clean the cannon tube. Work on short sections of the cannon tube (approx 2 ft (0.6 m)) starting at the breech and working toward the muzzle following either kit instructions or using CLP without the kit. Whichever method is used, cleaning begins immediately after firing is completed and continues until all steps are performed.

For non-firing periods, the cannon tube and breech mechanism are cleaned and lubricated on a weekly basis.

If using CLP cleaner, lubricant, and preservative (without kit), proceed as follows:

ON DAY OF FIRING:

Attach bore brush assembly to rammer staff. Inspect breech and tube and clear obstructions.

**DAILY NOTES (cont)**

**NOTE 6 (cont)**
Shake (mix) CLP well before each use.

Apply 1 to 2 ounces of CLP to bore brush and thoroughly wet punch cannon bore three times. Wrap clean wiping rags around bore brush and dry punch the bore two times. Wrap clean wiping rags around bore brush, soak with CLP and punch cannon bore one time.

ON DAY AFTER FIRING:

Repeat the steps for day of firing.

Wrap bore brush with clean wiping rags and dry punch tube once forward and once back. Wrap bore brush with clean wiping rags and pour on 2 ounces CLP and wet punch entire tube once forward and once back. Repeat last step with 2 more ounces of CLP.

OR

If using the artillery cleaning kit, proceed as follows:

ON DAY OF FIRING:

Attach nylon bristle bore brush assembly to rammer staff. Inspect breech and tube and clear obstructions. Wet punch the tube as follows:

**NOTE**
Shake (mix) CLP well before each use.

Pour 1/4 of the premeasured bottle (3.5-ounce (99.225 g) bottle) of CLP onto brush and punch the tube once forward and once back.

Pour second 1/4 of the premeasured bottle of CLP onto brush and scrub back and forth the entire length of the tube.

Repeat above step with third 1/4 of premeasured bottle of CLP.

Pour final 1/4 of the premeasured bottle of CLP onto brush. Wet punch the entire length of the tube once forward and once back.

ON DAY AFTER FIRING:

Attach nylon bristle bore brush assembly to rammer staff. Wet punch the tube following the procedures for DAY OF FIRING above.

## DAILY NOTES (cont)

### NOTE 6 (cont)

Wrap the brush with a new disposable cleaning sleeve and dry punch the entire length of the tube once forward and back. Remove and dispose of the sleeve.

Wrap the brush with a new disposable cleaning sleeve and pour on 1/2 of the premeasured bottle of CLP. Wet punch the entire length of the tube once forward and once back. Remove and dispose of the sleeve.

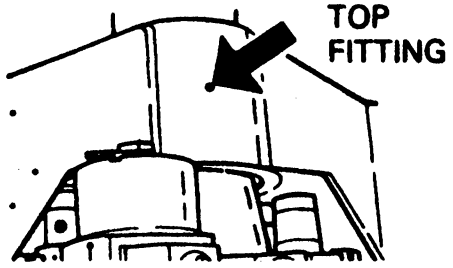
Repeat above step with the last 1/2 of the premeasured bottle of CLP.

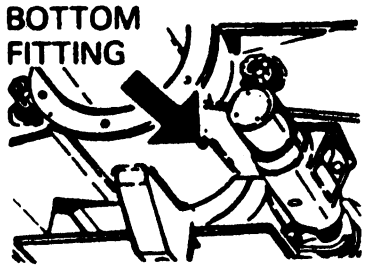
**NOTE**

If the tube has not been previously cleaned with CLP and there is a heavy buildup of coppering or carbon deposits, or severe heat cracking, it may be necessary to repeat cleaning instructions until the tube has been thoroughly cleaned with CLP.

### NOTE 7

BEARING UNIT HOUSING (C)

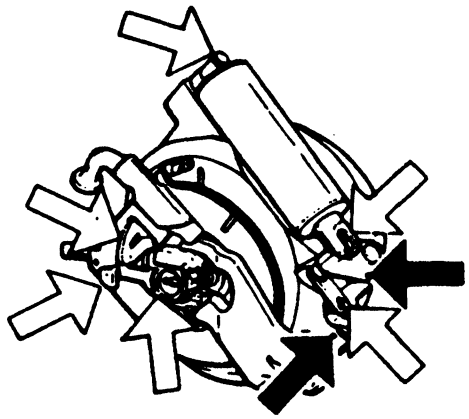



Lube with WTR.

### NOTE 8

HINGE PIN ASSEMBLY (C)



Apply WTR to two lube fittings and CLP to all surfaces.

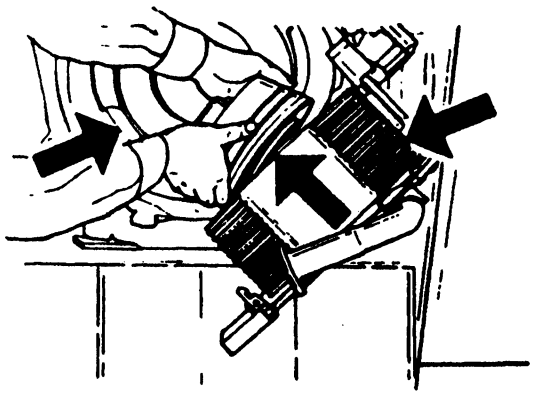
## DAILY NOTES (cont)

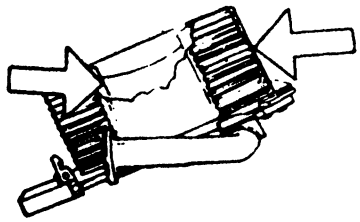
## NOTE 9

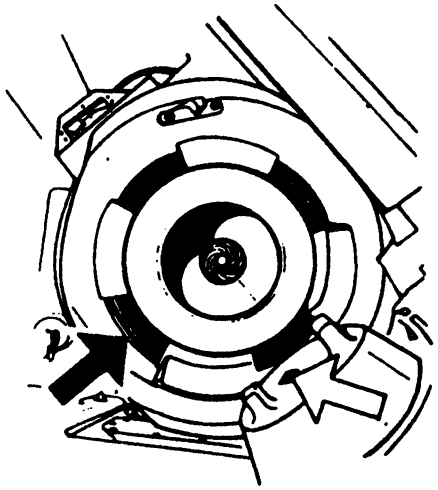
BREECH MECHANISM ASSEMBLY (C)

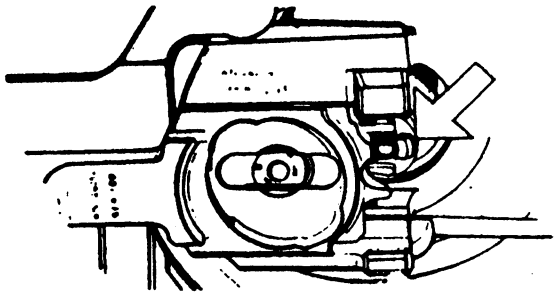
**NOTE**

**The breech mechanism assembly may be cleaned and lubricated using the artillery cleaning kit or using CLP without the kit. Whichever method is used, cleaning begins immediately after firing is completed.**









**CAUTION**

**DO NOT clean obturator pad with CLP.**

## DAILY NOTES (cont)

### NOTE 9 (cont)

If using CLP cleaner, lubricant, and preservative (without kit), proceed as follows:

Remove and disassemble obturator spindle assembly, and clean obturator pad with soap and water. Clean remaining parts with CLP. Wipe clean and reapply a light coat of CLP. Soak a small piece of wiping rag or primer vent brush with CLP and thoroughly clean primer cavity and vent hole. With a dry wiping rag, wipe primer cavity and vent hole clean, and leave dry. Coat breechblock assembly with CLP and let stand for 10 to 15 minutes. Wipe or brush breechblock assembly clean and apply a light coat of CLP to all metal surfaces. Apply WTR on all threaded surfaces and between breechblock assembly and disk of obturator spindle assembly.

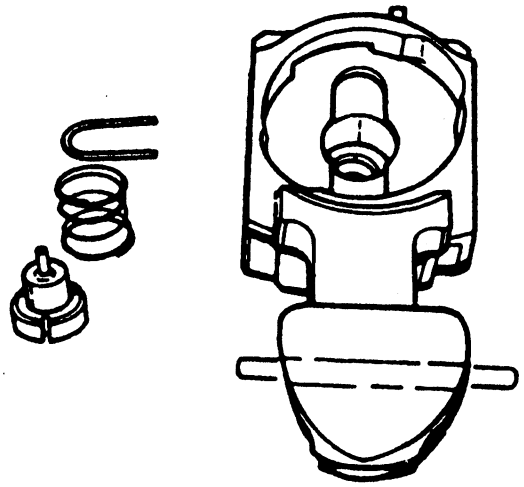
OR

If using the artillery cleaning kit, proceed as follows:

Remove and disassemble obturator spindle assembly, and clean obturator pad with soap and water. Using the trigger sprayer bottle (liter size) of CLP, thoroughly wet all breech components with CLP. Let soak for 10 to 15 minutes and then wipe off. Reapply a light coat of CLP. Spray all exposed metal surfaces with CLP. Apply CLP to primer vent and thoroughly brush with primer vent brush. Apply WTR on all threaded surfaces and between breechblock assembly and disk of obturator spindle assembly.

### NOTE 10

FIRING MECHANISM BLOCK ASSEMBLY (C)

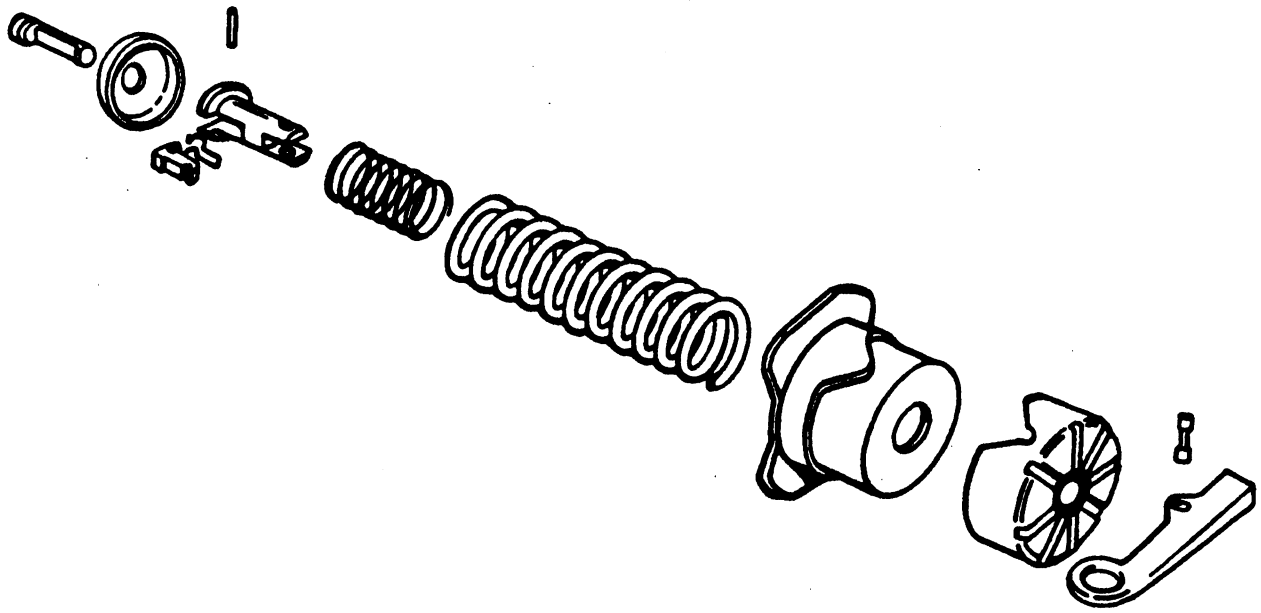


Remove, disassemble, and clean all parts with CLP. Let stand for 10 to 15 minutes. Wipe dry and apply a light coat of CLP.

**DAILY NOTES (cont)**

**NOTE 11**

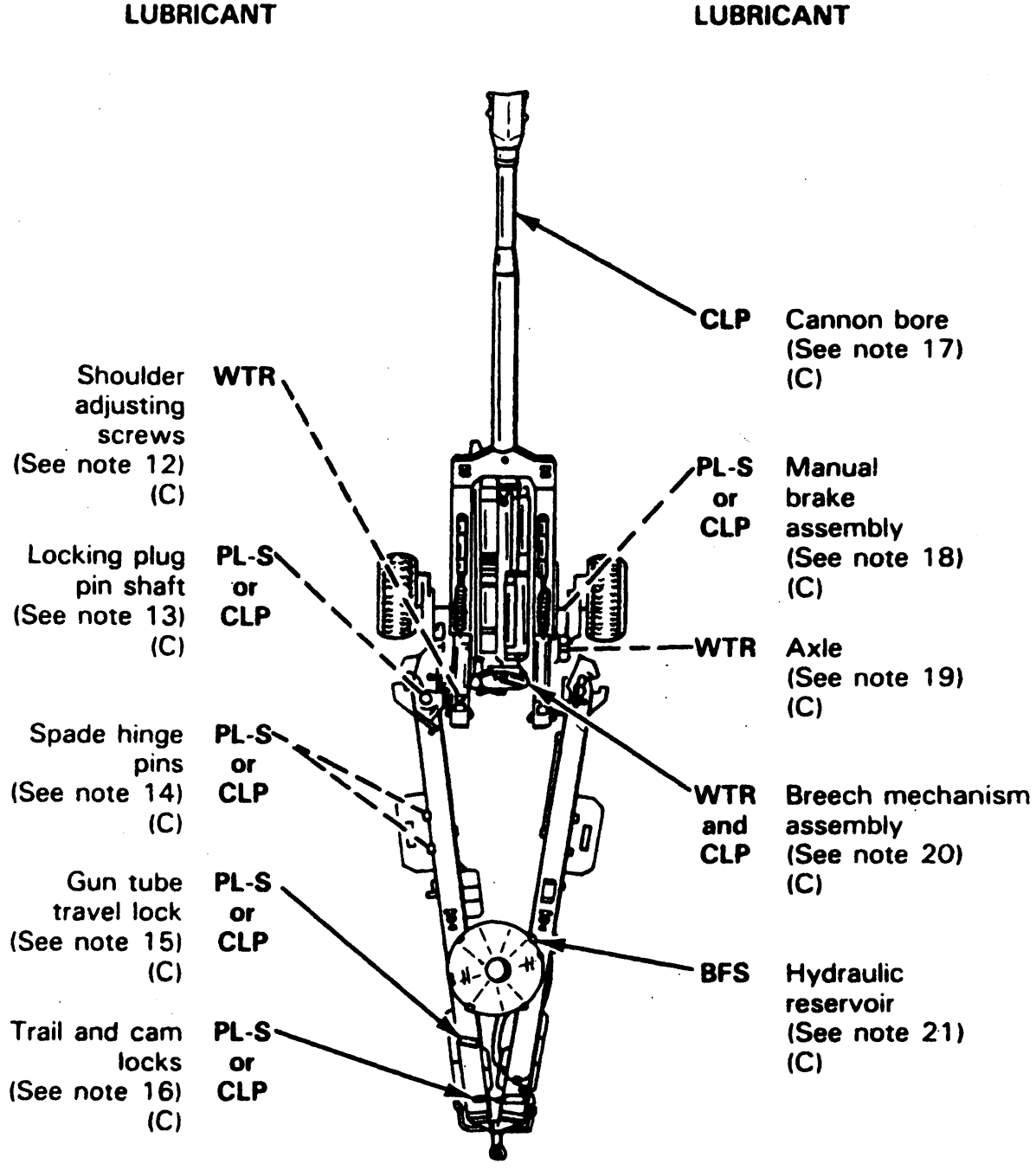
FIRING MECHANISM ASSEMBLY (C)



Remove and disassemble firing mechanism assembly, clean with CLP, wipe dry, and apply a light coat of CLP to all parts.

# WEEKLY

## HOWITZER, MEDIUM, TOWED: 155-MM, M198

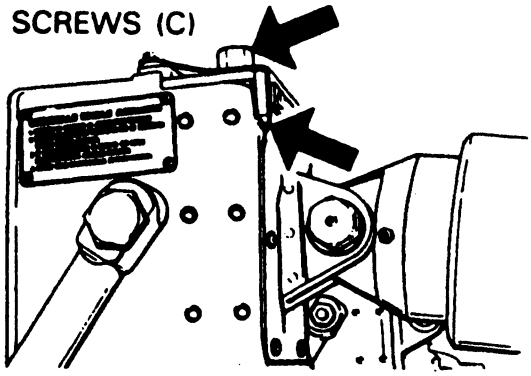



TOP VIEW

## WEEKLY NOTES

### NOTE 12

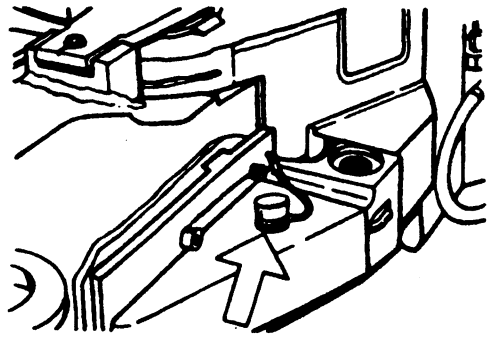
SHOULDER ADJUSTING SCREWS (C)



Apply WTR to pin shaft and on slide assembly guide (unmodified howitzers only).

### NOTE 13

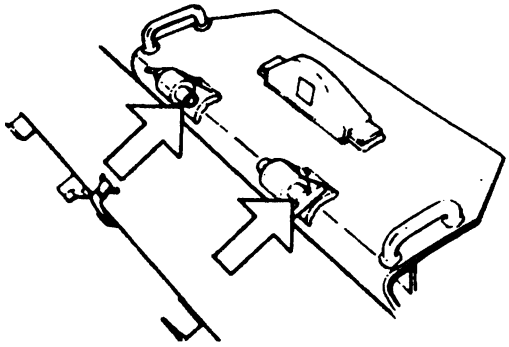
LOCKING PLUG PIN SHAFT (C)



Apply PL-S or CLP to pin shaft of locking plug.

### NOTE 14

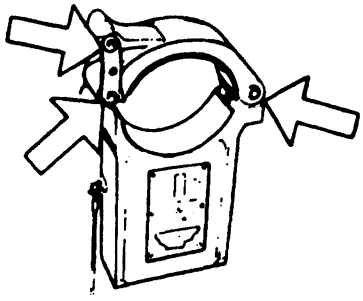
SPADE HINGE PINS (C)



Wipe with PL-S or CLP

### NOTE 15

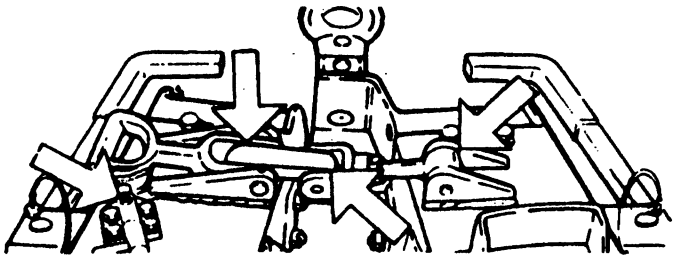
GUN TUBE TRAVEL LOCK (C)



Apply a couple drops of PL-S or CLP on all hinge points.

### NOTE 16

TRAIL AND CAM LOCKS (C)

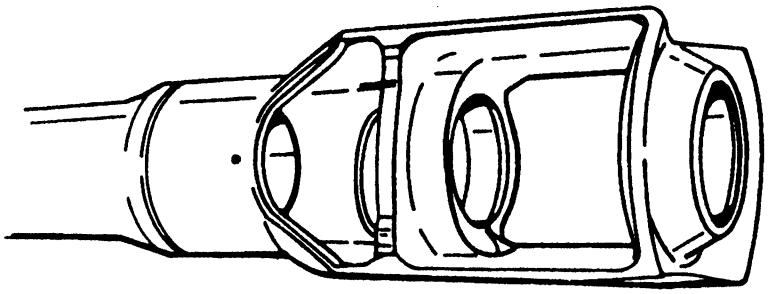


Apply a couple drops of PL-S or CLP to all joints on trail lock and oil cup on cam lock.

## WEEKLY NOTES (cont)

### NOTE 17

CANNON BORE (C)



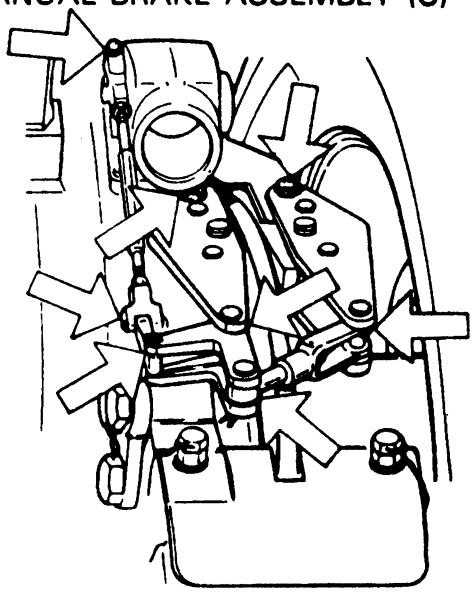
When weapon is not being fired, clean cannon bore with CLP, wipe dry, reoil with CLP, and install muzzle plug.

OR

Inspect cannon bore for cleanness and corrosion. If required, dry punch bore with clean wiping rag, then wet-punch bore with wiping rags soaked with CLP.

### NOTE 18

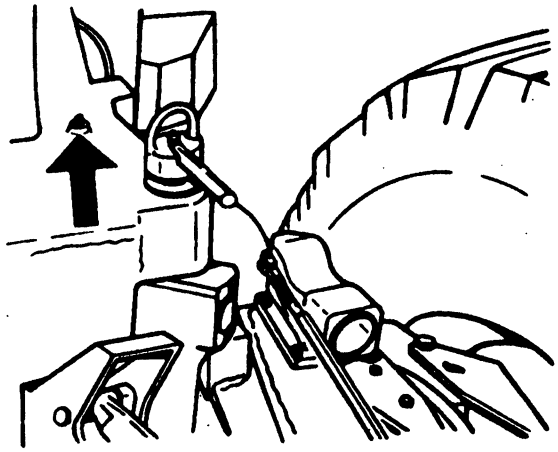
MANUAL BRAKE ASSEMBLY (C)



Apply a couple drops of PL-S or CLP on hinge points (both sides).

### NOTE 19

AXLE (C)



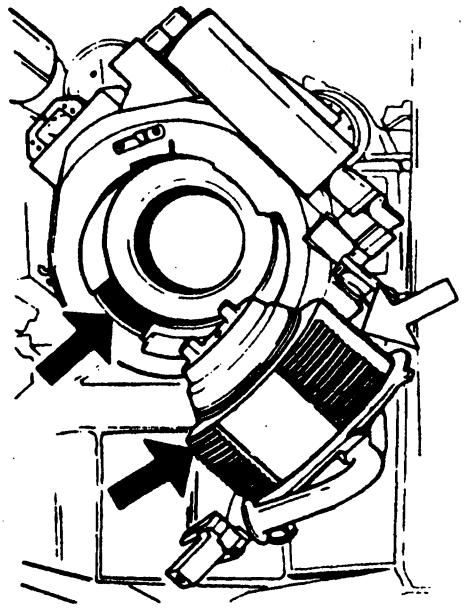
Place howitzer on firing platform and raise wheels to full up position. Lube with WTR (both sides). While applying WTR to axle, cycle the wheels through the down and up positions.

## WEEKLY NOTES (cont)

### NOTE 20

BREECH MECHANISM ASSEMBLY (C)

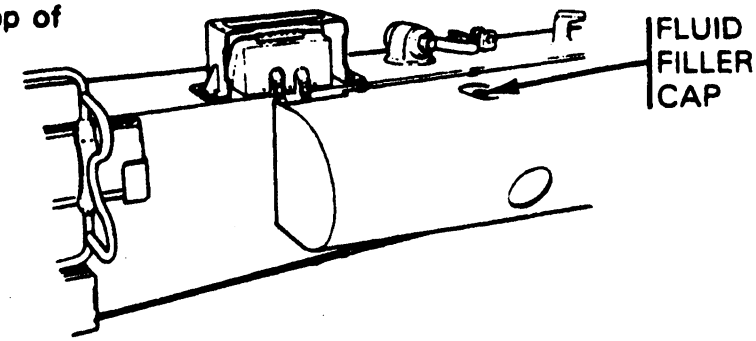
Remove breechblock assembly from carrier, clean with CLP, and wipe dry. Lube with CLP. Apply WTR to threads of breech and breechblock assembly.



### NOTE 21

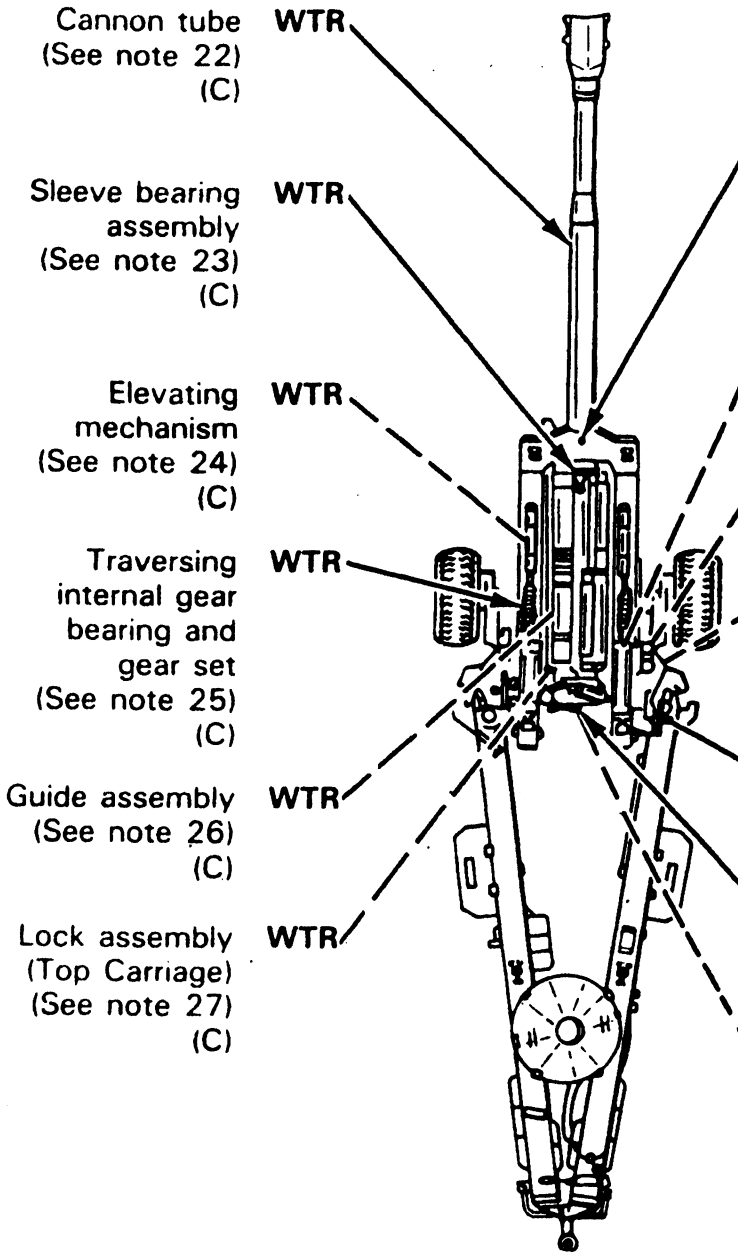
HYDRAULIC RESERVOIR (C)

Remove FLUID FILLER CAP and fill with silicone brake fluid (BFS) to within 3/4 inch (1.90 cm) from top of filling hole.



# MONTHLY

## HOWITZER, MEDIUM, TOWED: 155-MM, M198

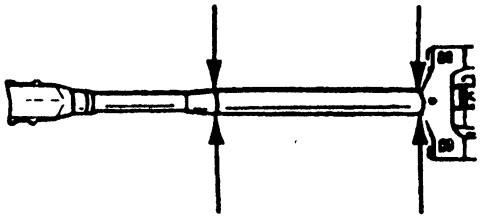



TOP VIEW

## MONTHLY NOTES

### NOTE 22

CANNON TUBE (C)

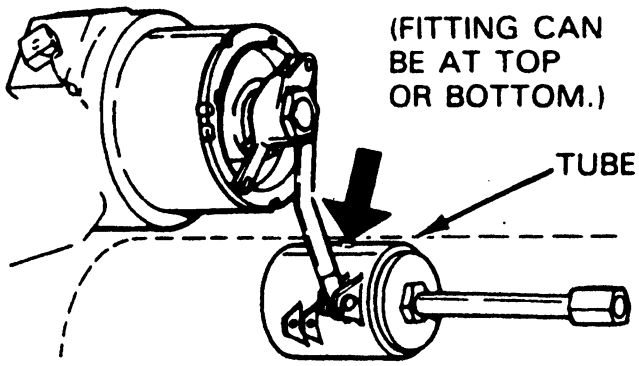


(AREA TO BE INSPECTED.)

Inspect cannon tube for presence of dark film lubricant. If loose or flaking, clean only the affected area with a crocus cloth. Apply WTR to exposed areas where the dry film lubricant was removed or is missing.

### NOTE 23

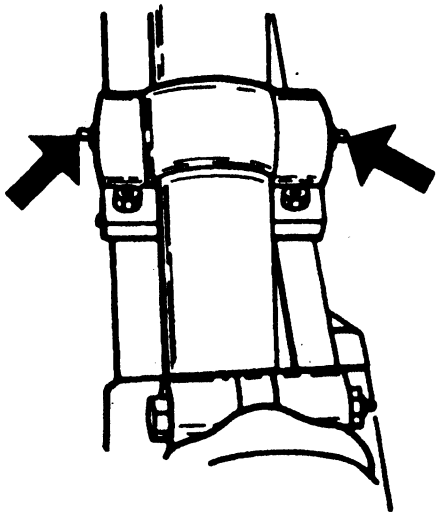
SLEEVE BEARING ASSEMBLY (C)




Lube with WTR.

### NOTE 24

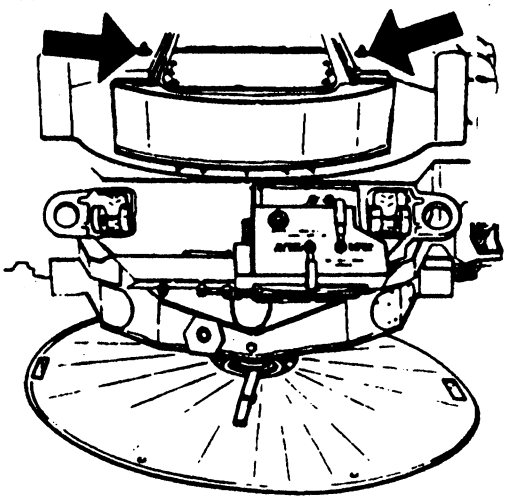
ELEVATING MECHANISM (C)



Lube with WTR (both sides).

### NOTE 25

TRAVERSING INTERNAL GEAR BEARING AND GEAR SET (C)



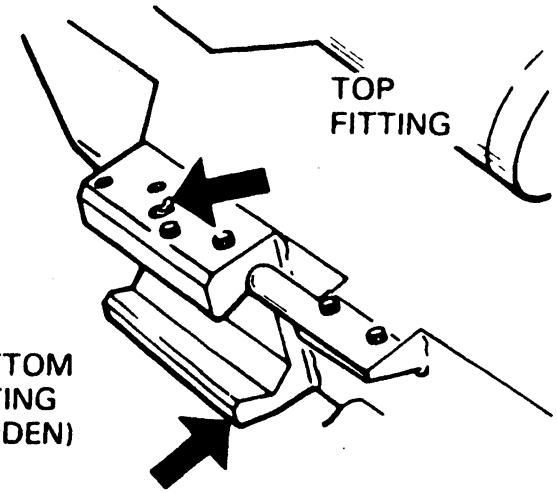
Lube with WTR while traversing.

## MONTHLY NOTES (cont)

**N 26**

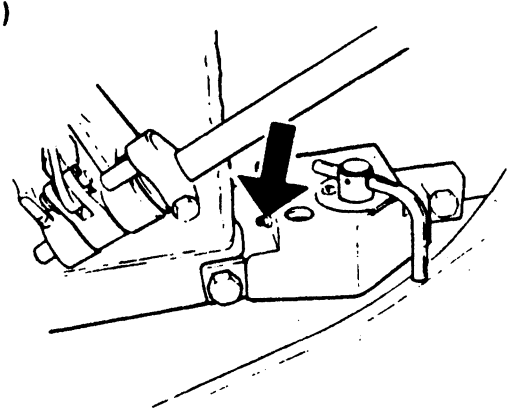
GUIDE ASSEMBLY (C)

Lube four fittings with WTR. (Cannon and recoil mechanism removed for clarity.)




**NOTE 27**

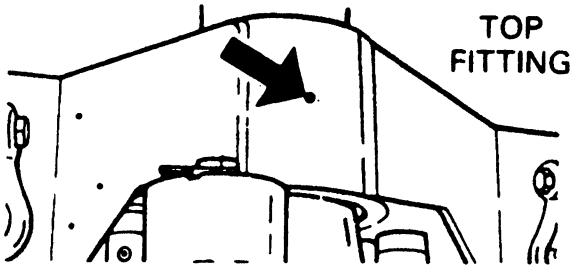
LOCK ASSEMBLY (TOP CARRIAGE) (C) (modified howitzer only)



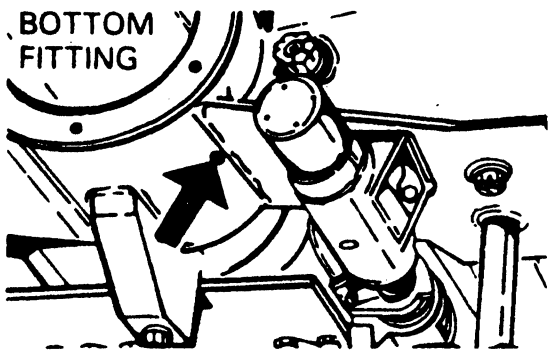
Lube fittings with WTR.

**NOTE 28**

BEARING UNIT HOUSING (C)



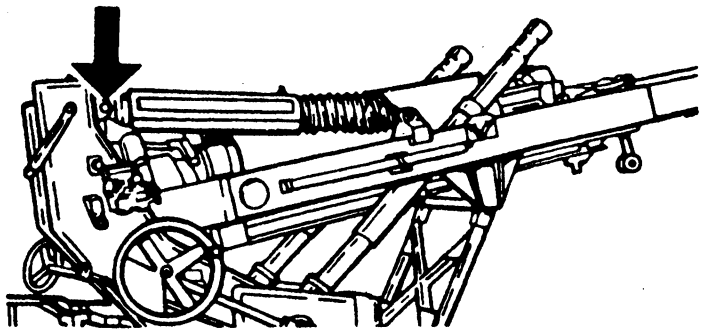

Lube with WTR.



## MONTHLY NOTES (cont)

### NOTE 29

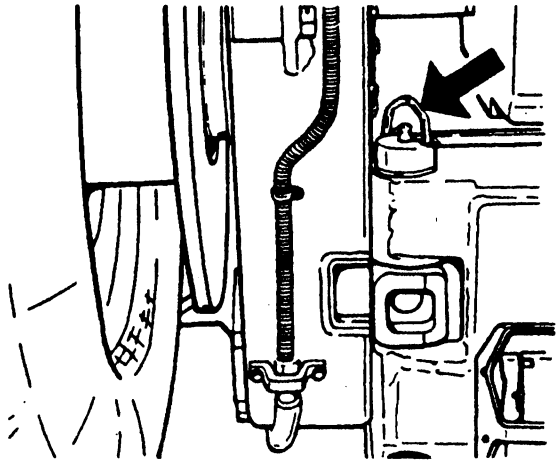
EQUILIBRATOR BOLTS (C)



Lube with WTR (both sides).

### NOTE 30

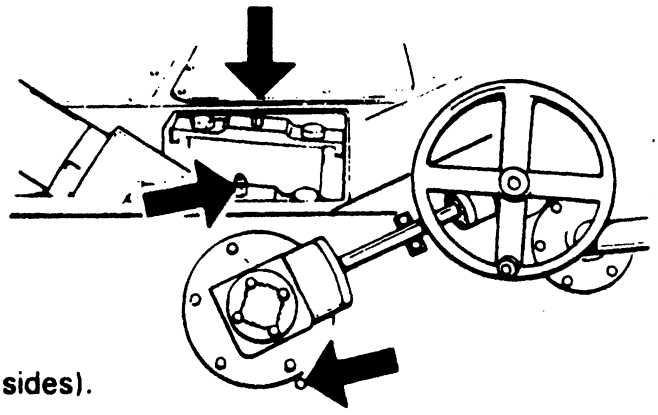
WHEEL LOCK HANDLES (C)



Lube sparingly with WTR (both sides).

### NOTE 31

LOWER ELEVATING MECHANISM BEARINGS (C)

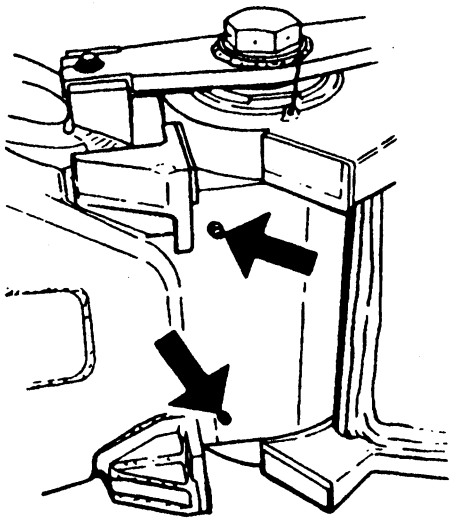


Lube with WTR (both sides).

## MONTHLY NOTES (cont)

### NOTE 32

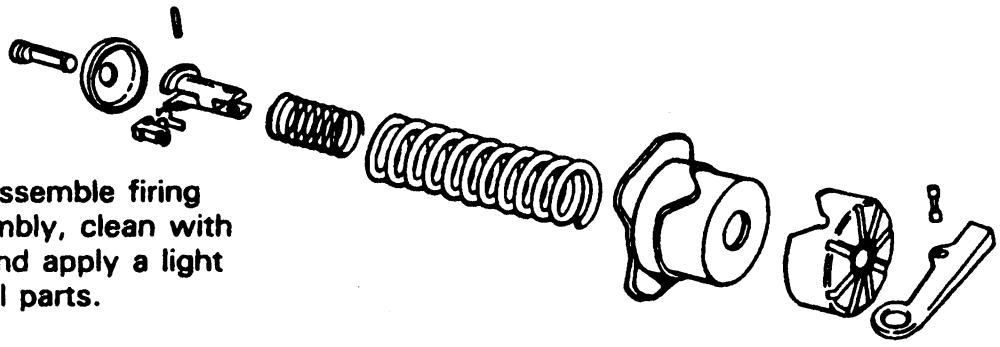
TRAIL HINGE PIN AND BUSHINGS (C)



Lube with WTR (both sides).

### NOTE 33

FIRING MECHANISM ASSEMBLY (C)

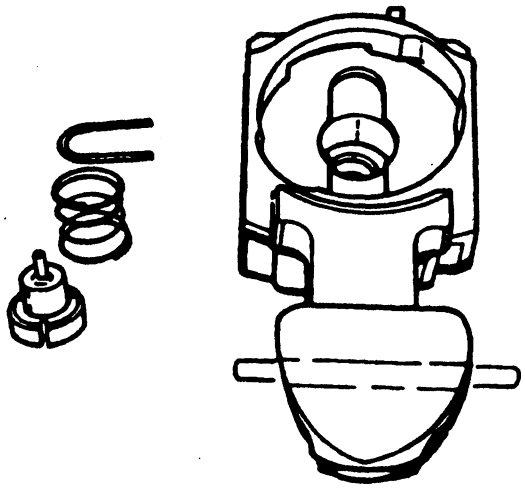


Remove and disassemble firing mechanism assembly, clean with CLP, wipe dry, and apply a light coat of CLP to all parts.

### NOTE 34

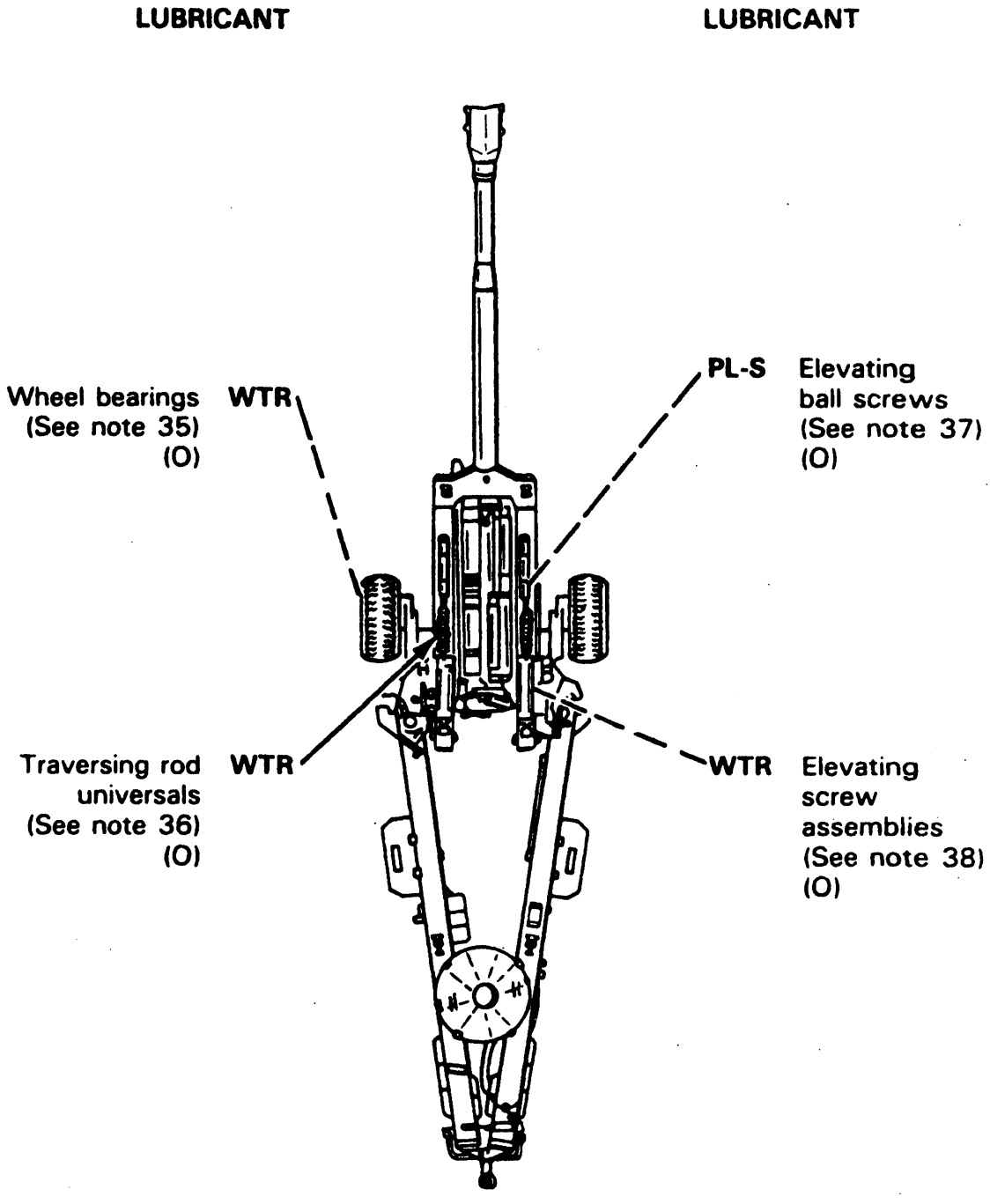
FIRING MECHANISM BLOCK ASSEMBLY (C)

Remove, disassemble, and clean all parts with CLP. Let stand for 10 to 15 minutes. Wipe dry and apply a light coat of CLP.



# QUARTERLY

## HOWITZER, MEDIUM, TOWED: 155-MM, M198

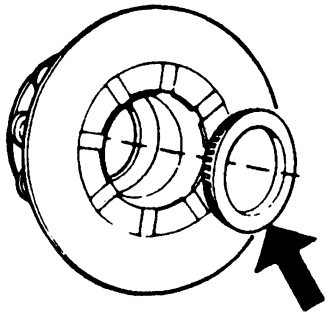



TOP VIEW

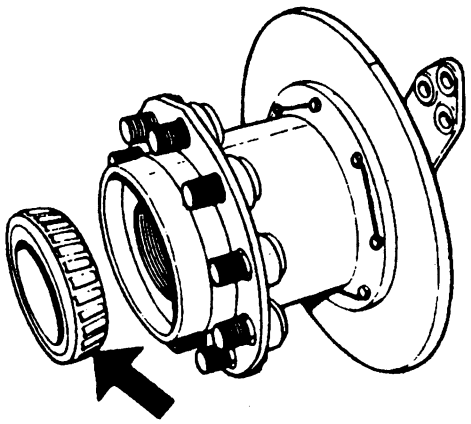
## QUARTERLY NOTES (cont)

### NOTE 35

WHEEL BEARINGS (O)



INNER BEARING



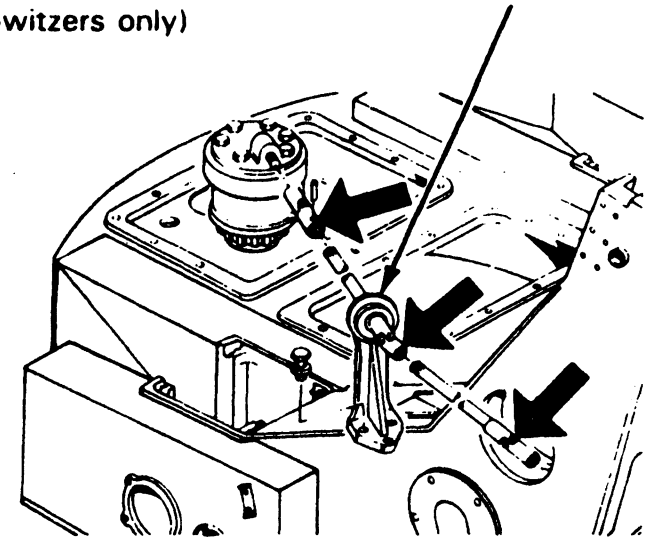
OUTER BEARING

Lube with WTR (both sides).

### NOTE 36

TRAVERSING ROD UNIVERSALS (O)
(Bellows removed for clarity; modified howitzers only)

**DO NOT LUBRICATE**



**CAUTION**

Do not lube torque limiter.

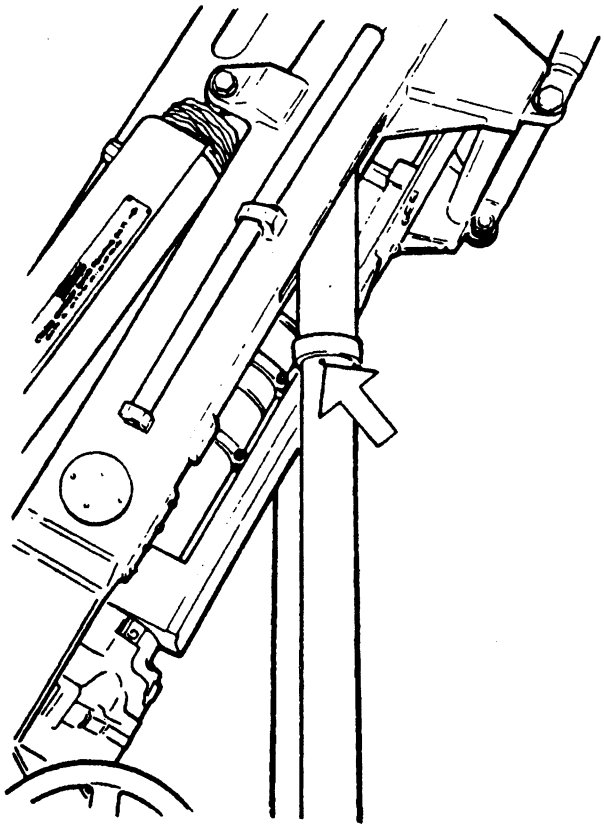
Move bellows to one side of universals if necessary to lube three universals with light coat of WTR.

## QUARTERLY NOTES (cont)

### NOTE 37

ELEVATING BALL SCREWS (O)

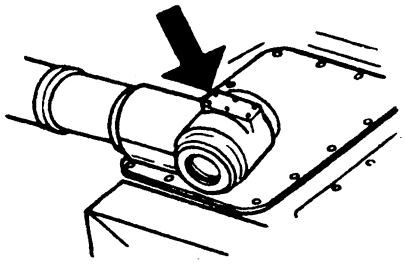
Elevate gun tube to approximately 1100 mils to expose two breather holes. Apply 2-4 oz (56.7 - 113.4 g) of PL-S to screw threads using both holes on both elevating screw assemblies. Depress and elevate gun tube several times to distribute PL-S.



### NOTE 38

ELEVATING SCREW ASSEMBLIES (O)

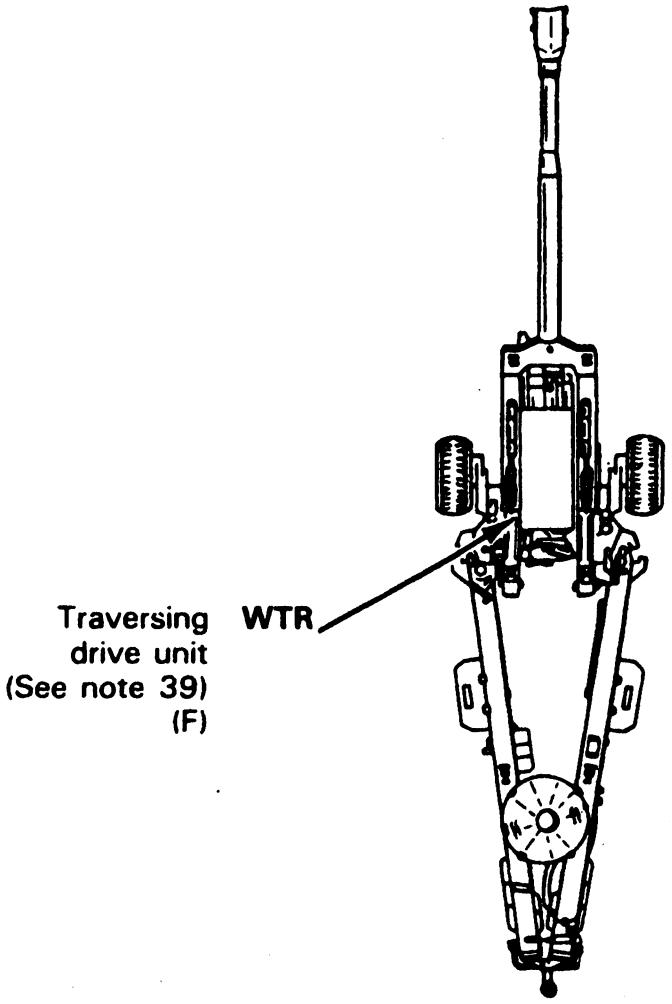
Remove cover from lower gear housing. Using a wiping rag, remove any excess lubricant which may have collected from lubing elevating ball screws. Lube exposed gears with WTR (both sides).



# SEMI-ANNUALLY

## HOWITZER, MEDIUM, TOWED: 155-MM, M198

**LUBRICANT** **LUBRICANT**




TOP VIEW

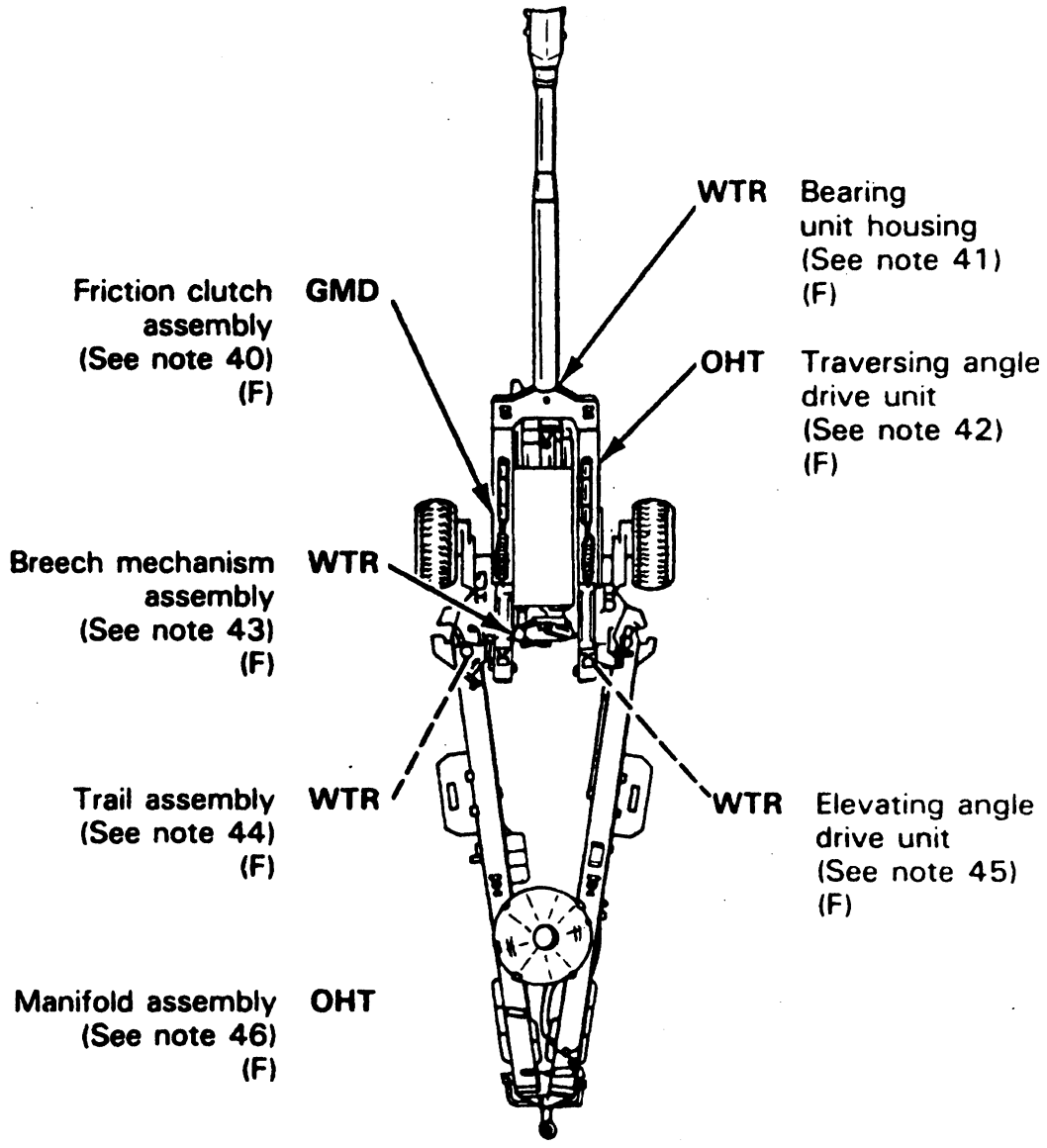
**NOTE 39**

TRAVERSING DRIVE UNIT (F)

Remove, disassemble, clean, lube with WTR, and reassemble.

# ANNUALLY

## HOWITZER, MEDIUM, TOWED: 155-MM, M198

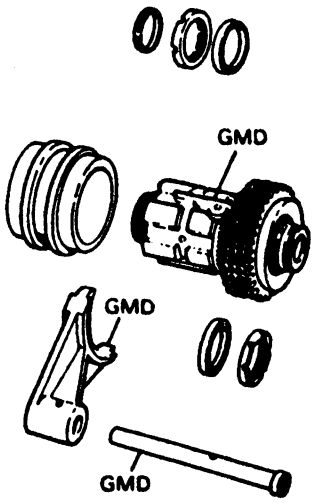



TOP VIEW

## ANNUAL NOTES (cont)

### NOTE 40

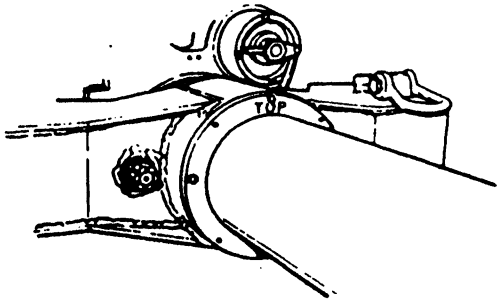
FRICTION CLUTCH ASSEMBLY (F)




Lube with GMD.

### NOTE 41

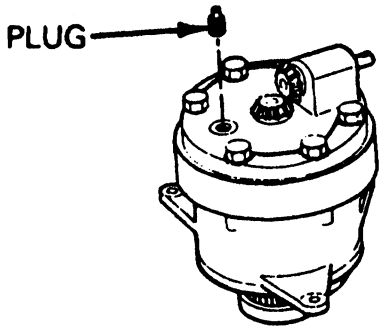
BEARING UNIT HOUSING (F)




Remove, disassemble, clean, lube with WTR, and reassemble.

### NOTE 42

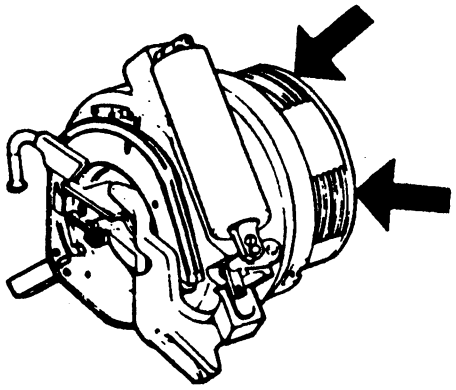
TRAVERSING ANGLE DRIVE UNIT (F)




Remove PLUG and add 1/2 pint (237 ml) of OHT.

### NOTE 43

BREECH MECHANISM ASSEMBLY (F)

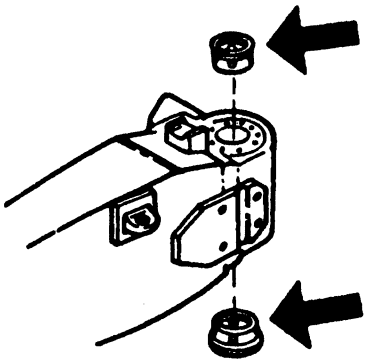


Remove M199 cannon assembly. Clean threads on breech mechanism and rear yoke. Lubricate threads with WTR.

## ANNUAL NOTES (cont)

### NOTE 44

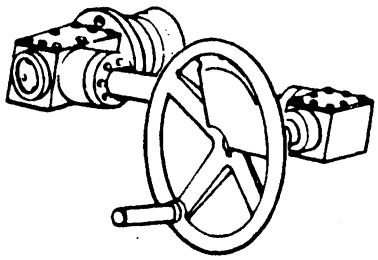
TRAIL ASSEMBLY (F)



Remove trail and pull bushing. Clean bushing making sure grease grooves are free of old grease and lube with WTR. Install bushing and reassemble trail to howitzer (both sides).

### NOTE 45

ELEVATING ANGLE DRIVE UNIT (F)

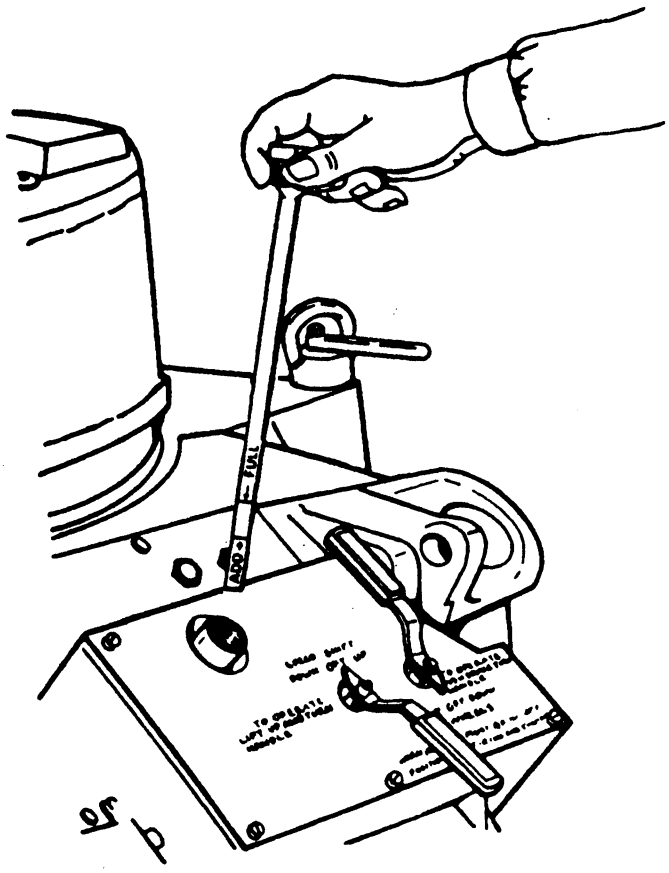


Remove, disassemble, clean, lube with WTR, and reassemble (both sides).

### NOTE 46

MANIFOLD ASSEMBLY (F)

Drain OHT from reservoir, actuate selector valves and ram pumps to ensure all OHT is removed. Add uncontaminated OHT and purge the complete hydraulic system.



Copy of this lubrication order will remain with the equipment at all times; instructions contained herein are mandatory.

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