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FM 17-63

WAR DEPARTMENT

ARMORED FORCE FIELD MANUAL

SERVICE OF THE PIECE
105-MM HOWITZER SELF-PROPELLED

August 18, 1942



FM 17-63

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SERVICE OF THE PIECE

105-MM HOWITZER SELF-PROPELLED

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ARMORED FORCE FIELD MANUAL

SERVICE OF THE PIECE

105-MM HOWITZER, SELF-PROPELLED

SECTION I

GENERAL

■ 1. PURPOSE AND SCOPE.—This manual prescribes the duties to be performed in the service of the piece by the personnel normally assigned to one self-propelled howitzer section of the firing battery.

■ 2. REFERENCES.—*a. Description, operation, functioning, and care of matériel.*—TM 9-325; SNL C-21.

b. Description and operation of fire-control and sighting equipment.—TM 9-325; SNL F-1.

c. Ammunition.—TM 9-325; TM 9-1900; SNL R-1.

d. Cleaning and preserving materials.—TM 9-850; SNL K-1.

e. Automotive driver.—FM 25-10.

f. Maneuvers of battery.—Part Two, FM 6-5.

g. Safety precautions in firing.—AR 750-10; FM 6-40.

h. Firing battery.—FM 6-40.

i. Gunnery.—FM 6-40.

j. Reconnaissance, occupation, and organization of position.—FM 6-20.

k. Vehicle maintenance.—TM 9-710 and 9-750.

■ 3. DEFINITIONS AND TERMS.—*a. Section.*—Tables of Organization prescribe the personnel and matériel comprising a section of a battery. In this manual the term is frequently used to designate a section of the firing battery. In this restricted sense, a howitzer section is composed of one piece and the additional matériel and the personnel required to serve that piece.

b. Front.—The front in a section, is the direction in which the muzzle of a piece points.

c. Right (left).—The direction right (left) is the right (left) of one facing the front.

d. In battery.—A howitzer is said to be in battery when it is in its normal firing position.

SECTION II

ORGANIZATION

■ 4. COMPOSITION.—*a.* A howitzer section consists of the following:

1 chief of section.
1 gunner—corporal.
3 cannoneers (Nos. 1, 2, and 3).
1 basic (cannoneer No. 4).
2 ammunition servers (cannoneers Nos. 5 and 6).
1 driver of the howitzer.
1 driver of ammunition carrier.

b. Any additional cannoneers act as reliefs or are assigned to other duties as the chief of section may direct. When the section goes into position for drill or for firing, the chief of section remains at the position of the piece and commands the howitzer squad. Often the ammunition carrier will not accompany the self-propelled howitzer when occupying a firing position. Therefore, Nos. 5 and 6 will be used at the firing point only when available.

■ 5. FORMATION.—*a. Order of formation.*—A howitzer section is formed as shown in figure 1.

b. To form.—(1) The place of formation is indicated and the command given, for example: 1. IN FRONT (REAR) OF YOUR PIECES, 2. FALL IN. Each gunner repeats the command FALL IN and hastens to place himself, faced in the proper direction, at the point where the right of his section is to rest. The remainder of the section moves at the double time and assemblies at attention in their proper places. For the first formation of the howitzer section for any drill or exercise, the caution "As howitzer sections" precedes the command. The chief of section, if present, supervises the formation.

(2) To execute IN FRONT (REAR) OF VEHICLES the section falls in at its posts as shown in figure 2 or 3.

c. To call off.—(1) The command is: CALL OFF. The cannoneer on the left of the gunner calls off, "One"; the cannoneer on the left of No. 1, "Two," and so on.

(2) After having called off, if a subsequent formation is ordered, the cannoneers fall in at once in their proper order.

SECTION III

POSTS; MOUNTING AND DISMOUNTING

■ 6. POSTS OF HOWITZER SECTION.—*a. Dismounted.*—The howitzer section is posted as shown in figures 4 and 5.

b. Mounted.—See figures 6 and 7.

c. Prepared for action.—The piece having been halted in position and prepared for action, posts are taken as shown in figures 8 and 9.

■ 7. TO POST SECTION.—*a.* The command is: 1. DRIVERS AND CANNONEERS, 2. POSTS. Each gunner repeats the command POSTS. The drivers and cannoneers move at the double time to their posts.

b. For preliminary instruction the section on entering the park is first posted with its vehicle, and the section is then sent to its posts by the foregoing command. The command is general, however, and is applicable when the section is in or out of ranks, and at a halt or marching.

■ 8. TO MOUNT.—*a.* The command is: 1. PREPARE TO MOUNT, 2. MOUNT. At the first command, the section moves at the double time to positions shown in figures 4 and 5. At the second command, both columns mount in the order shown. Each cannoneer is assisted by the one directly behind (or in front, in the case of the last cannoneer in column) to insure promptness and prevention of injuries. If only the cannoneers are to be included in the movement, the command is: 1. CANNONEERS PREPARE TO MOUNT, 2. MOUNT.

b. If the command is: 1. MOUNT, the section executes, at the command MOUNT, all that has been prescribed for the commands 1. PREPARE TO MOUNT, 2. MOUNT. If only the cannoneers are to be included in this movement, the command is: 1. CANNONEERS, 2. MOUNT.

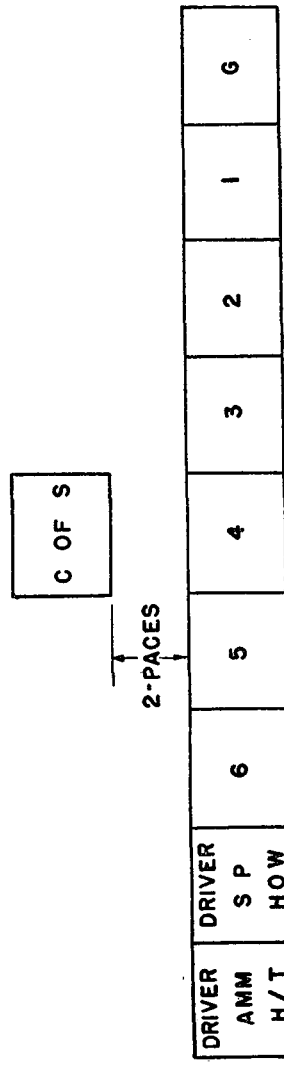


FIGURE 1.—Formation of howitzer section.

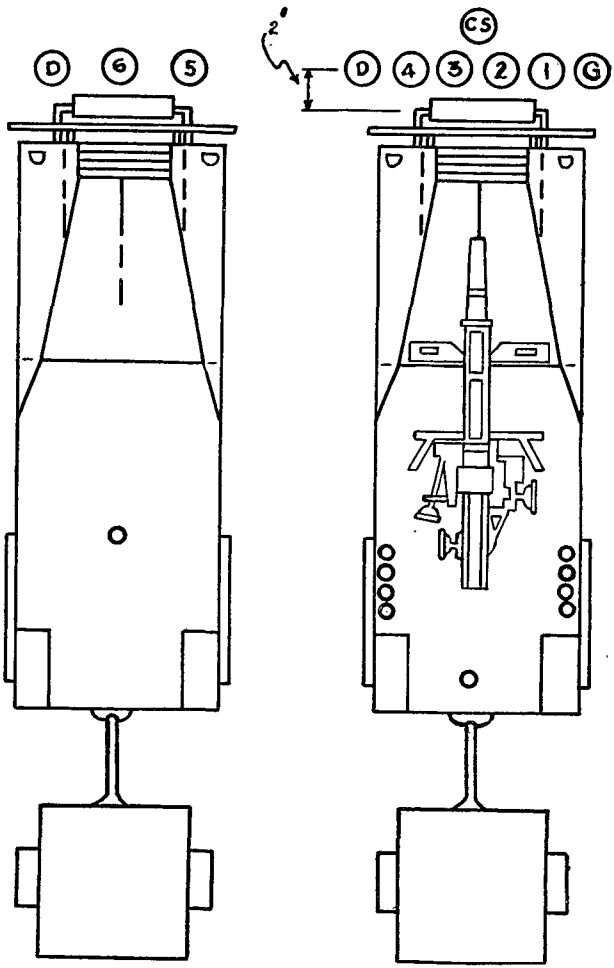


FIGURE 2.—Section in front of vehicles, 105-mm howitzer motor carriage, T–19.

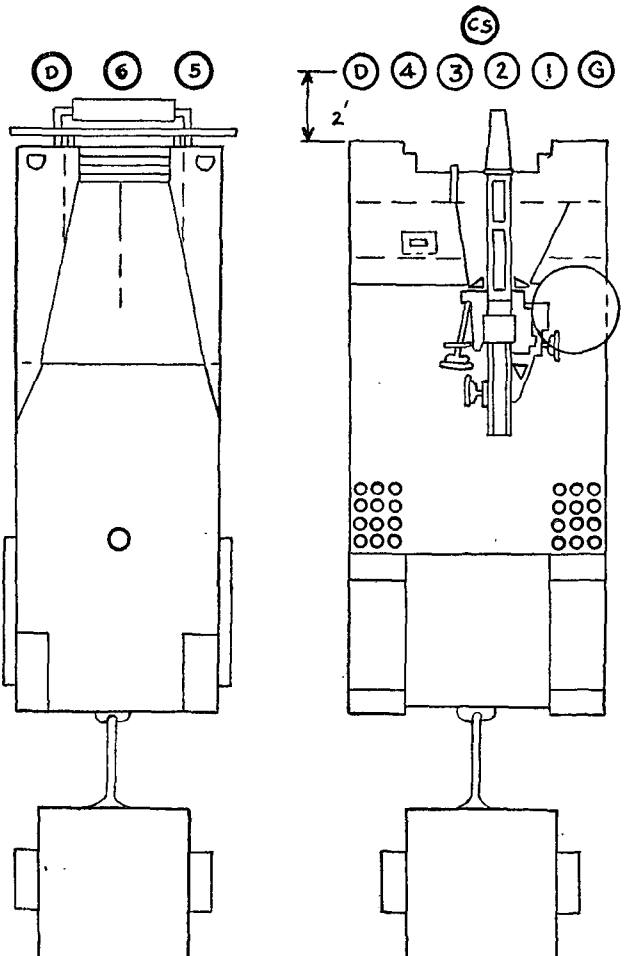


FIGURE 3.—Section in front of vehicles, 105-mm howitzer motor carriage, M–7.

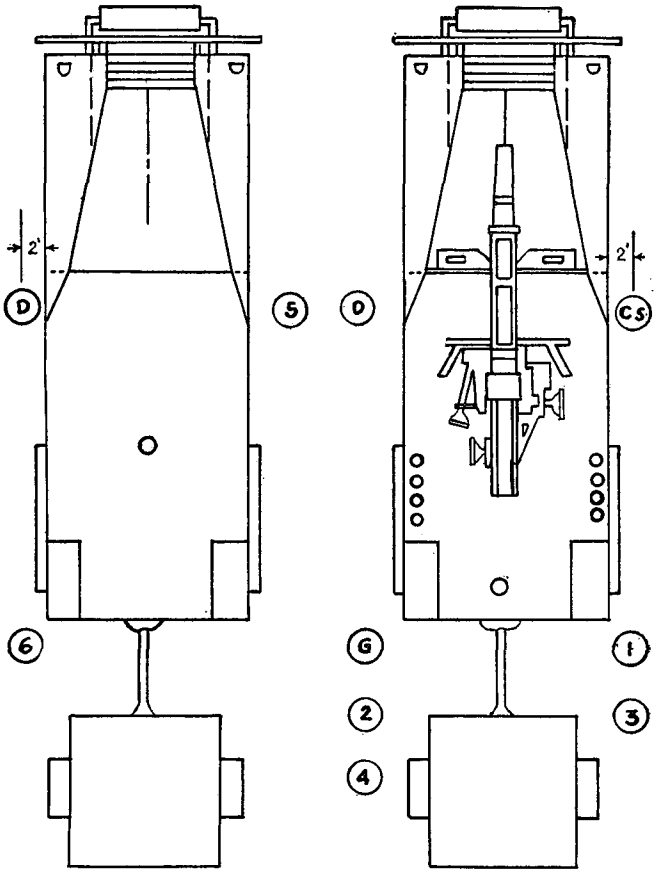


FIGURE 4.—Posts of section, dismounted, 105-mm howitzer motor carriage T–19.

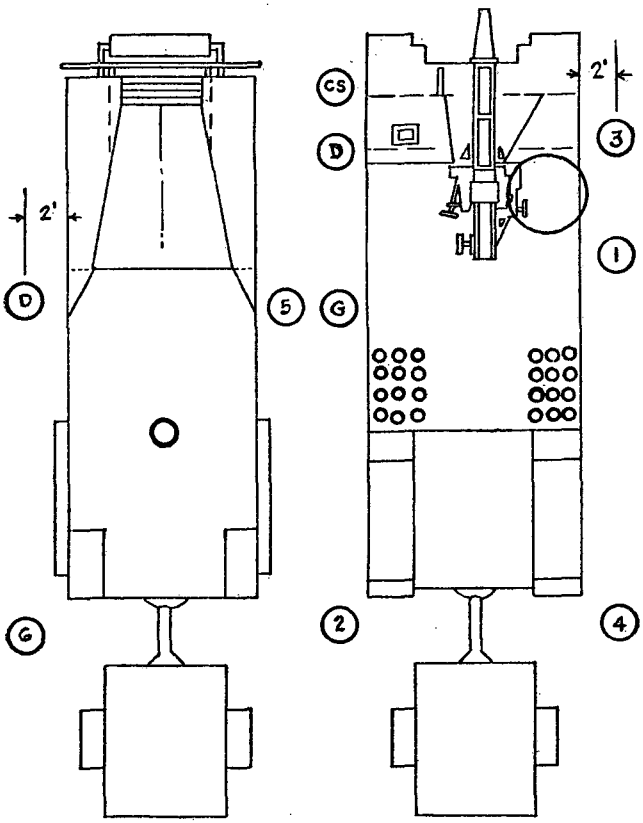


FIGURE 5.—Posts of section, dismounted, 105-mm howitzer motor carriage M–7. (Note that in mounting the driver precedes the chief of section and No. 1 precedes No. 3.)

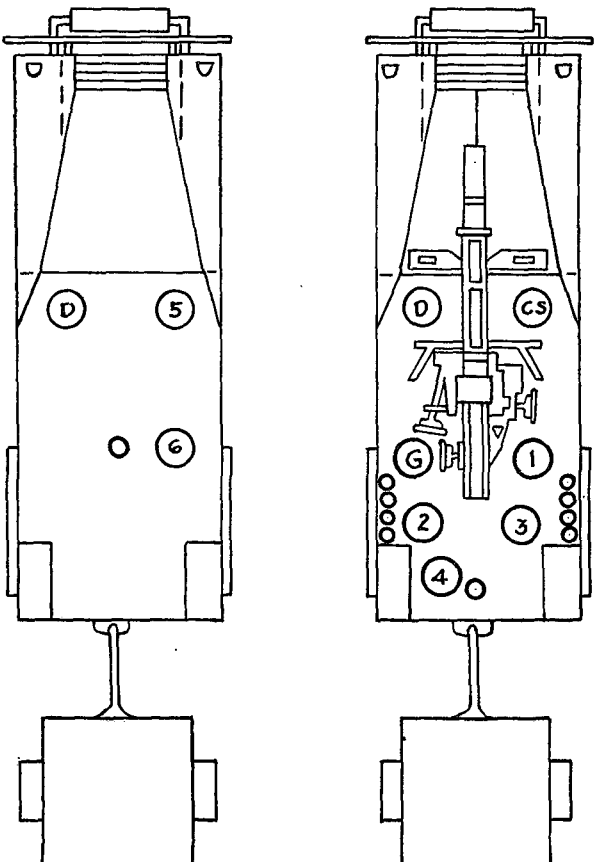


FIGURE 6.—Posts of section, mounted, 105-mm howitzer motor carriage T–19.

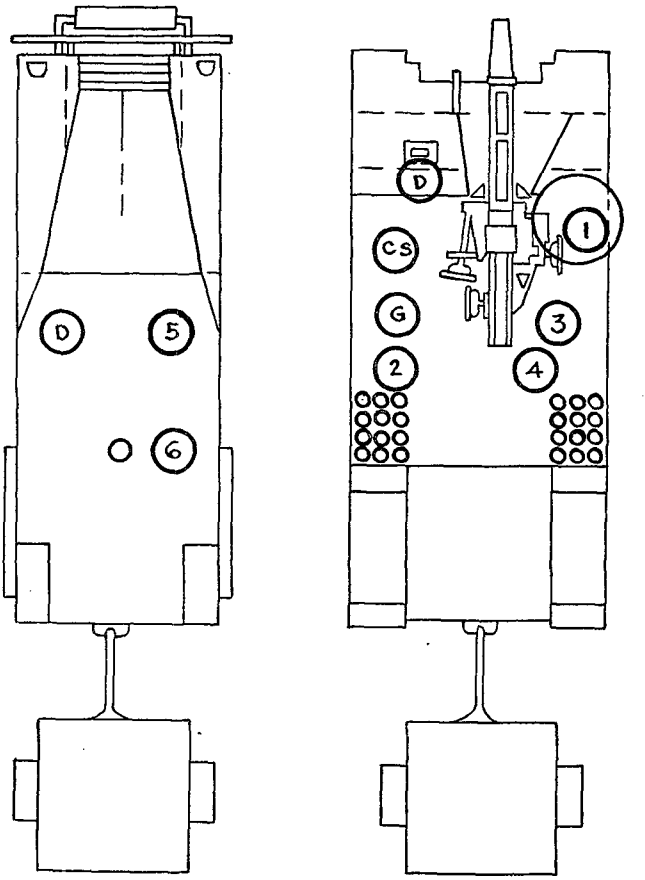


FIGURE 7.—Posts of section, mounted, 105-mm motor carriage M–7.

■ 9. To DISMOUNT.—*a.* The command is: 1. PREPARE TO DISMOUNT, 2. DISMOUNT. At the first command, the cannoneers assume standing positions; at the second command, they jump to the ground and at the double time take posts as shown in figures 4 and 5. Personnel mounted in the front seats of carrier, at the first command, unlatch their doors and hold them slightly open; at the second command, they promptly dismount, close their doors, and take posts. If only the cannoneers are to be included in this movement, the command is: 1. CANNONEERS PREPARE TO DISMOUNT, 2. DISMOUNT.

b. If the command is DISMOUNT, the section executes, at the command DISMOUNT, all that has been prescribed for the command 1. PREPARE TO DISMOUNT, 2. DISMOUNT. If only the cannoneers are to be included in this movement, the command is: 1. CANNONEERS, 2. DISMOUNT.

SECTION IV

PREPARE FOR ACTION AND MARCH ORDER, 105-MM HOWITZER MOTOR CARRIAGE T–19

■ 10. To PREPARE FOR ACTION.—*a.* The piece being in position, the command is: PREPARE FOR ACTION. Duties of individuals are as follows:

(1) *Chief of section.*—(*a*) Supervises the work of all members of the section.

(*b*) Commands the driver to cut motor when properly in position.

(*c*) Inspects the matériel, verifies the fact that the recoil mechanism contains the proper amount of oil and that all is in order; and, when the operations have been completed, reports to the executive, "Sir, No. (so and so) in order," or reports any defects that the section cannot remedy without delay.

(2) *Gunner.*—(*a*) Assisted by No. 1 removes breech end of the howitzer cover.

(*b*) Removes the panoramic telescope from its case and seats it on the telescope mount.

(*c*) Uncovers telescope mount bubbles, sets index of rotating head at zero, deflection at zero, and levels both bubbles.

(*d*) Takes his post.

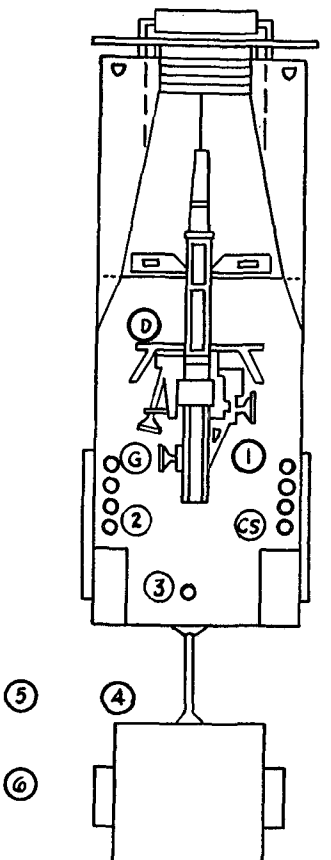


FIGURE 8.—Post of cannoneers prepared for action, 105-mm motor carriage T–19. (The ammunition carrier is placed for perimeter defense and the driver mans the caliber .30 machine gun.)

(3) *No. 1.*—(*a*) Assists the gunner in removing breech end of howitzer cover and places it in the chief of section's seat.

(*b*) Assists driver in releasing traveling lock.

(*c*) Uncovers range quadrant bubbles, if directed by the executive, replaces range drum for charge VII with the designated drum, sets site 300 and range 3,000 and levels the bubbles.

(*d*) Operates breech mechanism and examines breechblock, chamber, and bore, cleaning any parts requiring it, and leaves the breech open.

(*e*) When so directed, removes elbow telescope from its case and seats it in its mount.

(*f*) Takes fuze setter from the bracket and gives it to No. 3.

(*g*) Takes his post.

(4) *No. 2.*—(*a*) Removes rammer staff from its traveling position, assembles it to the rammer and places it in and along left side of vehicle.

(*b*) When so directed, assists No. 1 in cleaning breech mechanism, chamber, and bore of the howitzer.

(*c*) Takes his post.

(5) *No. 3.*—(*a*) Secures fuze setter from No. 1, places it in a convenient position.

(*b*) Removes aiming posts from brackets and stands them against right of the vehicle.

(*c*) Arranges ammunition and tools.

(*d*) Takes his post.

(6) *No. 4.*—(*a*) Rotates caliber .50 machine gun to point toward left front with maximum elevation.

(*b*) Removes muzzle end of howitzer cover assisted by the driver.

(*c*) Assists in uncoupling carrier ammunition trailer.

(*d*) Distributes waste to section.

(*e*) Takes his post.

(7) *Nos. 5 and 6.*—(*a*) Assist in uncoupling and placing carrier ammunition trailers.

(*b*) Assist No. 4 in preparing ammunition for firing.

(*c*) Take their posts.

(8) *Howitzer driver.*—(*a*) Releases traveling lock.

(*b*) Takes carrier out of gear and holds it in position with foot brake. Turns front wheels so they are in line with direction of the piece.

(*c*) Starts, stops, or continues the running of the engine at the direction of the chief of section.

(*d*) Assists No. 4 in removing muzzle end of howitzer cover.

(*e*) Folds cover and places it in chief of section's seat.

(*f*) Remains in his post.

(9) *Ammunition carrier driver.*—(*a*) If so directed, moves carrier to gun position for uncoupling ammunition trailer.

(*b*) Places carrier in position as directed for perimeter defense.

b. The howitzer may be partially prepared for action before reaching the firing position. The duties of the cannoneers are the same while moving, but only such operations as are practicable are carried out. Immediately after the piece is established in position, preparation for action is completed without command, and the cannoneers take their posts for firing the piece.

c. If PREPARE FOR ACTION has not been ordered before the piece is established in the firing position, the command is habitually given by the chief of section as soon as the vehicle is halted in position. If this is not desired, the caution "Do not prepare for action" must be given.

d. In drill and combat, higher-numbered cannoneers, if present, take posts as prescribed by the chief of section. For their protection all personnel should be trained to crouch behind the protection of the armored sides of the vehicle whenever it can be done without loss of efficiency in performance of duties.

e. In order to exercise the cannoneers in all the duties connected with the service of the piece and to lend variety to the drill, the posts of individual cannoneers should be changed frequently. The cannoneers being at their posts, the command is: 1. CHANGE POSTS, 2. MARCH. In each squad No. 1 quickly takes the post of No. 2, No. 2 of No. 3 and so on, No. 6 taking the post of No. 1. The gunner and higher-numbered cannoneers change only when specifically directed; the command is: 1. GUNNERS AND CANNONEERS CHANGE POSTS, 2. MARCH. In each squad, the gunner quickly takes the post of

No. 1, No. 1 of No. 2, and so on. The highest-numbered cannoneer takes the post of the gunner.

■ 11. MARCH ORDER.—*a.* The howitzer being prepared for action, to resume the order of marching, the command is: MARCH ORDER. Duties of individuals are as follows:

(1) *Chief of section.*—(*a*) Supervises work of the cannoneers.

(*b*) Inspects matériel; makes sure that the piece is not loaded and that the traveling lock and strut are locked in the traveling position; and when the operations have been completed, reports to the executive, "Sir, No. (so and so) in order," or reports any defects which the section cannot remedy without delay.

(*c*) Commands driver to start motor on signal from executive.

(2) *Gunner.*—(*a*) Places piece in center of traverse.

(*b*) Sets rotating head and deflection at zero and closes covers on the telescope mount leveling bubbles.

(*c*) Removes panoramic telescope from the mount, returns it to its case, and locks the case.

(*d*) Replaces breech end of howitzer cover assisted by No. 1.

(*e*) Takes his post.

(3) *No. 1.*—(*a*) Elevates howitzer to the proper elevation to permit the traveling lock to be engaged.

(*b*) Locks traveling lock.

(*c*) Inspects chamber to see that piece is unloaded and closes breech.

(*d*) Assists the gunner in replacing breech end of howitzer cover.

(*e*) Takes fuze setter from No. 3 and places it in traveling bracket.

(*f*) Takes his post.

(4) *No. 2.*—(*a*) Disassembles rammer staff; removes rammer (bore brush) and places it in section chest; the rammer staff in its traveling position.

(*b*) Takes his post.

(5) *No. 3.*—(*a*) Hands fuze setter to No. 1.

(*b*) Prepares ammunition and tools in vehicle for movement.

(*c*) Secures aiming posts and replaces them on vehicle.

(*d*) Takes his post.

(6) *No. 4.*—(*a*) Assisted by Nos. 5 and 6, returns unused ammunition to the trailers and couples trailer to ammunition carrier.

(*b*) Assists driver in replacing muzzle end of howitzer cover.

(*c*) Rotates machine gun to point to rear.

(*d*) Takes his post.

(7) *Nos. 5 and 6.*—(*a*) Assist No. 4 in returning unused ammunition to trailer and in coupling trailer to ammunition carrier.

(*b*) Take their posts.

(8) *Howitzer driver.*—(*a*) Assists No. 1 in locking howitzer in traveling position.

(*b*) Assisted by No. 4, replaces muzzle end of howitzer cover.

(*c*) Starts motor on chief of section's command.

(9) *Ammunition carrier driver.*—Moves carrier to facilitate coupling of ammunition trailer.

b. To resume fire in another position.—(1) If firing is to be resumed shortly in another position to which the piece must be ready to fire, the command MARCH ORDER is not given. In this case, at the command for displacement, only such of the operations incident to march order are performed as are necessary for the movement of the piece and for the care and security of the equipment.

(2) If the command MARCH ORDER is given while the piece is so disposed, the operations pertaining to march order are completed.

SECTION V

PREPARE FOR ACTION AND MARCH ORDER, 105-MM HOWITZER MOTOR CARRIAGE M–7

12. TO PREPARE FOR ACTION.—*a.* The piece being in position, the command is: PREPARE FOR ACTION. Duties of individuals are as follows:

(1) *Chief of section.*—(*a*) Supervises work of all members of the section.

(*b*) Commands driver to cut motor when properly in position.

(*c*) Inspects matériel; verifies fact that recoil oil reserve is at the proper level and that all is in order; when the operations have been completed, reports to the executive, "Sir, No. (so-and-so) in order," or reports any defects which the section cannot remedy without delay.

(2) *Gunner.*—(*a*) Assisted by No. 1, removes breech end of howitzer cover.

(*b*) Moves piece to assist Nos. 2 and 3 in releasing cradle lock.

(*c*) Removes panoramic telescope from its case and seats it in telescope mount.

(*d*) Uncovers telescope mount bubbles; sets index of rotating head at zero, deflection at zero, and levels both bubbles.

(*e*) Takes his post.

(3) *No. 1.*—(*a*) Assists gunner in removing breech end of howitzer cover and places it on rear dash of vehicle.

(*b*) Uncovers range quadrant bubbles; if directed by executive, replaces range drum for charge VII with designated drum; sets sight 300 and range 3,000 and levels the bubbles.

(*c*) Operates breech mechanism, and examines breechblock, chamber, and bore, cleaning any parts requiring it; leaves breech open.

(*d*) When so directed, removes elbow telescope from its case and seats it in its mount.

(*e*) Takes his post.

(4) *No. 2.*—(*a*) Unscrews cradle traveling lock and, assisted by No. 3, inclines traveling lock base to the front; pulls it upward and to the front, then removes braces, bottom first, so as to place it on rear deck of the vehicle.

(*b*) Unlocks aiming post and rammer staff sections from left side of vehicle; removes aiming posts from the traveling position (after No. 3 unlocks right sections); assembles and places posts on rear deck of vehicle.

(*c*) When so directed, assists No. 1 in cleaning breech mechanism, chamber, and bore of the howitzer.

(*d*) Takes his post.

(5) *No. 3.*—(*a*) Assists No. 2 in removing and placing traveling lock base on rear deck of vehicle.

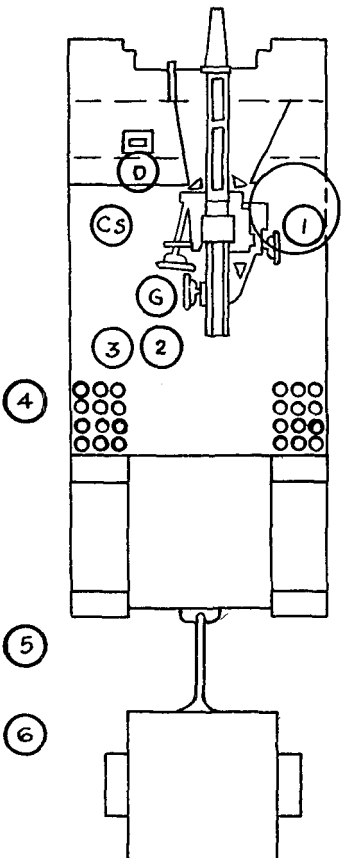


FIGURE 9.—Post of cannoneers prepared for action, 105-mm howitzer motor carriage M–7. (The ammunition carrier is placed for perimeter defense and the driver mans the caliber .30 machine gun.)

(*b*) Unlocks right aiming post and rammer staff sections; removes and assembles rammer staff and places it on rear deck of vehicle.

(*c*) Places fuze setter in convenient operating position.

(*d*) Arranges ammunition and tools.

(*e*) Takes his post.

(6) *No. 4.*—(*a*) Removes muzzle end of howitzer cover assisted by the driver and places it on rear deck of vehicle.

(*b*) Opens ammunition trailer, arranges ammunition (assisted by Nos. 5 and 6, if present).

(*c*) Assists in uncoupling ammunition carrier trailer.

(*d*) Distributes waste to section.

(*e*) Takes his post.

(7) *Nos. 5 and 6.*—(*a*) Dismount, proceed at double time to howitzer.

(*b*) Assist in uncoupling ammunition carrier trailer.

(*c*) Assist No. 4 in arranging ammunition.

(*d*) Take their posts.

(8) *Howitzer driver.*—(*a*) Starts, stops, or continues running the engine at the direction of the chief of section.

(*b*) Remains at his post.

(9) *Ammunition carrier driver.*—(*a*) If so directed, moves carrier to gun position for uncoupling ammunition trailer.

(*b*) Places carrier in position as directed for perimeter defense.

b. The howitzer may be partially prepared for action before reaching the firing position. The duties of the cannoneers are the same while moving, but only such operations as are practicable are carried out. Immediately after the piece is established in position, preparation for action is completed without command, and the cannoneers take their posts for firing the piece.

c. If PREPARE FOR ACTION has not been ordered before the piece is established in the firing position, the command is habitually given by the chief of section as soon as the vehicle is halted in position. If this is not desired, the caution "Do not prepare for action" must be given.

d. In drill and combat, higher-numbered cannoneers if present take posts as prescribed by the chief of section. For their protection all personnel should be trained to crouch

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behind the protection of the armored sides of the vehicle whenever it can be done without loss of efficiency in performance of duties.

e. In order to exercise the cannoneers in all the duties connected with the service of the piece and to lend variety to the drill, the posts of individual cannoneers should be changed frequently. The cannoneers being at their posts, the command is: 1. CHANGE POSTS, 2. MARCH. In each squad No. 1 quickly takes the post of No. 2, No. 2 of No. 3 and so on. No. 6 taking the post of No. 1. The gunner and higher-numbered cannoneers change only when specifically directed; the command is: 1. GUNNER AND CANNONEERS CHANGE POSTS, 2. MARCH. In each squad, the gunner quickly takes the post of No. 1, No. 1 of No. 2, and so on. The highest numbered cannoneer takes the post of the gunner.

■ 13. MARCH ORDER.—*a.* The howitzer being at PREPARED FOR ACTION, to resume the order for marching the command is: MARCH ORDER. Duties of individuals are as follows:

(1) *Chief of section.*—(*a*) Supervises work of the cannoneers.

(*b*) Inspects matériel; makes sure that the piece is not loaded and that the traveling lock is locked in the traveling position; and, when the operations have been completed, reports to the executive, "Sir, No. (so and so) in order," or reports any defects which the section cannot remedy without delay.

(*c*) On signal from executive, commands driver to start motor.

(2) *Gunner.*—(*a*) Operates traversing and elevating handwheels to assist No. 2 in locking the cradle traveling lock.

(*b*) Sets rotating head and deflection at zero and closes covers on the telescope mount leveling bubble..

(*c*) Removes panoramic telescope from mount and returns it to its case, closing case cover.

(*d*) Replaces breech end of howitzer cover, assisted by No. 1.

(*e*) Takes his post.

(3) *No. 1.*—(*a*) Inspects chamber to see that piece is unloaded and closes breech.

(*b*) Replaces zone VII range drum if necessary; sets site to 300, range to 3,000, and closes bubble covers.

(*c*) Assists gunner in replacing breech end of howitzer cover.

(*d*) Takes his post.

(4) *No. 2.*—(*a*) Assisted by No. 3, replaces traveling lock brace in reverse order of PREPARE FOR ACTION.

(*b*) Turns traveling lock handle to the locked position.

(*c*) Secures aiming posts in the traveling position.

(*d*) Takes his post.

(5) *No. 3.*—(*a*) Assists No. 2 in replacing traveling lock brace.

(*b*) Secures rammer staff in the traveling position.

(*c*) Replaces hand fuze setter.

(*d*) Prepares ammunition and tools in vehicle for movement.

(*e*) Takes his post.

(6) *No. 4.*—(*a*) Assisted by Nos. 5 and 6, returns unused ammunition to trailer and couples trailer to ammunition carrier.

(*b*) Assisted by No. 5, replaces muzzle end of howitzer cover.

(*c*) Takes his post.

(7) *Nos. 5 and 6.*—(*a*) Assist in returning unused ammunition to trailer and in coupling trailer to ammunition carrier.

(*b*) No. 5 assists No. 4 in replacing muzzle end of howitzer cover.

(*c*) Take their posts.

(8) *Howitzer driver.*—Starts motor on chief of section's command.

(9) *Ammunition carrier driver.*—Moves vehicle to facilitate coupling the ammunition trailer.

b. To resume fire in another position.—(1) If firing is to be resumed shortly in another position to which the piece must be ready to fire, the command MARCH ORDER is not given. In this case, at the command for displacement, only such of the operations incident to march order are performed as are necessary for the movement of the piece and for the care and security of the equipment.

(2) If the command MARCH ORDER is given while the piece is so disposed, the operations pertaining to march order are completed.

SECTION VI

DUTIES IN FIRING

■ 14. GENERAL.—*a.* In general the duties of all members of the section in firing are as follows:

(1) *Chief of section.*—Supervises and is responsible for the actions of all members of the section. He sees that all commands are executed rapidly and accurately and that all safety precautions are observed.

(2) *Gunner.*—Sets the announced deflection, lays for direction, and refers the piece.

(3) *No. 1.*—Sets the announced site and range (elevation), opens and closes the breech, lays the piece for range, and fires the piece. (In the howitzer motor carriage M–7, No. 1 also mans the caliber .50 machine gun.)

(4) *No. 2.*—Loads the piece.

(5) *No. 3.*—Operates fuze setter and cuts fuze (time) or makes proper setting of the fuze (SQ or delay) and is assisted by No. 4, to prepare the charge when a reduced charge is used. He passes rounds to No. 2. He opens and closes the breech and fires the piece in direct laying when the elbow sight is used.

(6) *No. 4.*—Receives ammunition from No. 5 or from prepared stack, passes it on to No. 3. Assists No. 3 in preparing ammunition. In time fire, he holds the round while No. 3 cuts the fuze. (In the howitzer motor carriage T–19, No. 3 also mans the caliber .50 machine gun.)

(7) *Nos. 5 and 6.*—Remove ammunition from containers, assist in preparing the rounds and pass them to No. 4. They remove empty cases from rear of vehicle.

(8) *Drivers.*—Move and place vehicles on the orders of the chief of section. When the piece is fired, the driver of the piece sets his foot brake. The driver of the ammunition carrier mans the caliber .30 machine gun when carrier is used in perimeter defense.

b. The rapidity of action peculiar to armored field ar-

tillery will normally prevent the selection of the charge most suited to range and terrain. Consequently armored field artillery will habitually fire its ammunition with all seven increments. This full charge (all seven increments) is the *normal charge.*

■ 15. CHIEF OF SECTION.—*a. Enumeration of duties.*—(1) To lay for elevation assisted by No. 1 when the gunner's quadrant is used.

(2) To measure the elevation (range).

(3) To measure the minimum quadrant elevation and measure the minimum range.

(4) To indicate to the gunner the aiming point, referring point, or target.

(5) To follow fire commands.

(6) To indicate when the piece is ready to fire.

(7) To give the command FIRE except when firing on moving targets with direct laying.

(8) To report errors and other unusual incidents of fire to the executive.

(9) To conduct prearranged firing schedules.

(10) To record basic data.

(11) To observe and check frequently the functioning of the matériel.

(12) To assign duties when firing with reduced personnel.

(13) To conduct the fire of his piece on a moving target when so ordered by the executive.

(14) To place the machine guns on ground mounts when so ordered by the executive:

(15) To give the command to start motor when necessary to move vehicle for large shifts.

(16) To keep constantly on the alert for air or ground attack when the howitzer is traveling.

b. Detailed description of certain duties.—(1) *To lay for elevation when gunner's quadrant is used.*—(*a*) The command QUADRANT (SO MUCH) indicates that the gunner's quadrant is to be used.

(*b*) To set an elevation on the gunner's quadrant, for example, 361.8 mils, the chief of section sets the upper edge of the head of the index arm opposite the 360 mark of the

graduated arc on the quadrant frame; he then slides the slide level along the index arm until the index of the slide level is opposite the 1.8 mark on the scale on the index arm. In setting the slide, the chief of section must be careful to use the scale on the index arm which is on the same side of the quadrant as the graduated arc he used in setting the index arm at 360 mils. After he has set the slide, he tightens the clamp just enough to hold the slide in place.

(*c*) The announced elevation having been set on the gunner's quadrant, the piece loaded, and the breechblock closed, the chief of section places the quadrant on the quadrant seat, with the words "line of fire" at the bottom and the arrow pointing toward the muzzle. The chief of section must be sure to use the arrow which appears on the same side of the quadrant as the scale which he is using. He stands squarely opposite the side of the quadrant and holds it firmly on the quadrant seat, parallel to the axis of the bore. It is important that he take the same position and hold the quadrant in the same manner for each subsequent setting, so that in each case he will view the quadrant bubble from the same angle.

(*d*) No. 1 operates the elevating handwheel until the quadrant bubble is centered, making sure that the last movement is in the direction in which it is most difficult to turn the handwheel. The chief of section warns No. 1 when the bubble is approaching the center, in order that the final centering may be performed accurately.

(2) *To measure elevation (range).*—The piece having been laid, at the command MEASURE THE ELEVATION (RANGE), the chief of section causes No. 1 to set site 300 and, with the elevating knob, to level the range quadrant elevating bubble. The chief of section then reads the elevation (range) set on the elevation scale (range drum) and announces the elevation (range) thus set; for example, "Elevation (range) No. (so and so), (so much)."

(3) *To measure minimum quadrant elevation or minimum elevation (range).*—(*a*) *Quadrant elevation.*—The command is: MEASURE THE MINIMUM QUADRANT ELEVATION. The chief of section, sighting along the lowest element of the bore, causes No. 1 to operate the elevating mechanism until

the line of sight just clears the crest. He then measures the quadrant elevation and, after reading the angle on the quadrant, reports it to the executive thus: "Minimum quadrant elevation No. (so and so), (so much)."

(*b*) *Elevation.*—The command is: MEASURE THE MINIMUM ELEVATION, SITE (SO MUCH). The chief of section causes No. 1 to set the site announced. Then, sighting along the lowest element of the bore, he causes No. 1 to operate the elevating handwheel until the line of sight just clears the crest. No. 1 then levels the bubble of the range quadrant by turning the elevating knob. The chief of section reads the elevation setting and reports it to the executive thus: "Minimum elevation No. (so and so), (so much), site (so much)."

(*c*) *Range.*—The command is: MEASURE THE MINIMUM RANGE, CHARGE (SO AND SO), SITE (SO MUCH). The chief of section causes No. 1 to install the range drum for the announced charge, and to set the site announced. Then sighting along the lowest element of the bore, he causes No. 1 to operate the elevating handwheel until the line of sight just clears the crest. No. 1 then levels the bubble of the range quadrant by turning the elevating knob. The chief of section reads the range setting and reports it to the executive thus: "Minimum range, No. (so and so), (so much), charge (so and so), site (so much)."

(*d*) When the executive announces the minimum quadrant elevation or the minimum elevation (range), charge, and site, the chief of section records it in a notebook and causes the gunner to chalk it in the prescribed place on the vehicle.

(4) *To indicate to gunner the aiming point, referring point, or target.*—Whenever an aiming point, a referring point, or target has been designated by the executive, the chief of section will make sure that he has properly identified the point in question. He will then indicate it to the gunner. If there is any possibility of misunderstanding, the chief of section will turn the panoramic telescope until the horizontal and vertical hairs are on the point designated.

(5) *To follow fire commands.*—The chief of section will follow the fire commands mentally. He will not repeat the commands, but will be prepared to give any element of the last command to any cannoneer who has failed to hear it.

(6) *To indicate when piece is ready to fire.*—When the executive can see arm signals of the chief of section, the chief of section will extend his right arm vertically as a signal that the piece is ready to fire. He gives the signal as soon as the gunner calls "Ready." When arm signals cannot be seen, the chief of section reports orally to the executive, "No. (so and so) ready."

(7) *To give command to fire.*—When No. 1 can see arm signals made by the chief of section, the chief of section will give the command to fire by dropping his right arm sharply to his side. When his arm signals cannot be seen, he orally commands: NO. (SO AND SO) FIRE. The chief of section will not give the signal or command to fire until all the cannoneers are in their proper places.

(8) *To report errors and other unusual incidents of fire to executive.*—If for any reason the piece cannot be fired, the chief of section will promptly report that fact to the executive, and the reason therefor; for example, "No. (so and so) out, misfire." Whenever it is discovered that the piece has been fired with an error in laying, the chief of section will report that fact at once; for example, "No. (so and so) fired with incorrect deflection." Whenever the gunner reports that the aiming posts are out of alinement with the panoramic telescope, the chief of section will report that fact and request instructions. Likewise, he promptly reports other unusual incidents that affect the service of the piece. (See FM 6–75.)

(9) *To conduct prearranged fire schedules.*—Whenever the execution of prearranged fire schedules is ordered, the chief of section will conduct the fire of his section in strict conformity to the schedule prescribed.

(10) *To record basic data.*—The chief of section will record in a notebook data of a semipermanent nature. These include such data as minimum elevations; base deflections, including aiming points used; prearranged fires when prepared schedules are not furnished; safety limits in elevation and deflection; number of rounds fired, with the hour and date; and calibration corrections when appropriate.

(11) *To observe and check functioning of matériel.*—The chief of section closely observes the functioning of all parts of the matériel during firing. Before the piece is fired, he

verifies the fact that the recoil mechanism contains the proper amount of oil; thereafter he carefully observes the functioning of the recoil system. He promptly reports to the executive any evidence of trouble.

(12) *To assign duties when firing with reduced personnel.*—Whenever the personnel of the section serving the piece is temporarily reduced in numbers below that indicated herein, the chief of section will make redistribution of duties as will best facilitate the service of the piece.

(13) *During direct laying on a moving target, to conduct fire of his piece when so ordered by executive.*—(*a*) *To announce initial lead.*—The chief of section observes the target, estimates its lateral speed and, based thereon, the lead in tank lengths depending upon range and speed of target, and announces the lead to the gunner; for example, "Lead right (left) (so many) tank lengths." The number of leads in tank lengths depends upon the estimated speed and estimated range of the target.

(*b*) *Initial range or elevation.*—The chief of section estimates the initial range to the target and announces the range or the corresponding elevation. The announced range is used by the gunner when he lays for range (par. 16*b*(9)) and by No. 1 when he lays for range using the elbow telescope (par. 17*b*(2)(*b*)). When elevation is announced it is the algebraic sum of the range elevation and angle of site. For rapid determination of the elevation he should be furnished with a tabulated card for charge VII, showing the elevation setting for plus and minus angles of site and ranges for which such fire may be used. He is trained to determine the range and measure the site to various points in the sector from which enemy combat vehicles may be expected to appear. These are recorded and should be memorized by him. They are used in determining the initial elevation announced.

(*c*) *To announce initial range (elevation) and lead.*—The command is: TARGET (SO AND SO), RANGE (ELEVATION) (SO MUCH), (SO MANY) LEADS.

(*d*) *To announce change in range (elevation) and lead.*—The chief of section observes the fire of his piece, and when the gunner or No. 1 is not tracking the target effectively, he announces a range change or a new lead. The announced

change in range or elevation is given in yards. The command is: UP (DOWN) (SO MUCH). The announced change in lead is given as a new lead in the number of target lengths. The command is: (SO MANY) LEADS.

■ 16. GUNNER.—*a. Enumeration of duties.*—(1) (*a*) To center the bubbles on the telescope mount.

(*b*) To set or change the deflection.

(*c*) To apply deflection difference.

(*d*) To lay for direction.

(*e*) To call "Ready."

(*f*) To refer the piece.

(*g*) To record base deflection.

(*h*) To measure deflection.

(*i*) To take and maintain an announced lead during direct laying on a moving target.

(*j*) When directed, to lay for both direction and range during the direct laying on a moving target.

(*k*) To give command to fire during direct laying on a moving target.

(2) For indirect laying or direct laying on a stationary target the gunner performs the duties prescribed in (1) (*a*), (*b*), (*c*), (*d*), and (*e*) above.

(3) For direct laying on a moving target, the gunner performs the duties prescribed in (1) (*a*), (*i*), and (*k*) and, when directed, (*j*) above.

(4) When directed the gunner performs the duties prescribed in (1) (*f*), (*g*), and (*h*) above.

b. Detailed description of certain duties.—(1) *To set or change deflection.*—(*a*) *To set deflection.*—At the command, for example, DEFLECTION 1,885, the gunner first sets the zero of the azimuth micrometer opposite the fixed index, if it is not already so set. He then pushes the throwout lever with his left hand and with his right hand turns the rotating head until the hundreds' graduation (18 in this case) is opposite the azimuth scale index. He then releases the throwout lever and, grasping the deflection knob with his left hand with the thumb on top, turns the knob to the left until the micrometer index is opposite the graduation 85 of the counterclockwise graduations on the azimuth micrometer.

The line of sight will then make a horizontal angle of 1,885 mils with the axis of the bore. He then turns the azimuth micrometer until its zero graduation is opposite the micrometer index. Any movement of the azimuth micrometer does not change a deflection previously set.

(*b*) *To change deflection.*—The gunner should be trained always to grasp the deflection knob with his left thumb on top, then the command for changing the deflection will indicate the direction in which he should move his thumb in turning the knob. He also should be taught that turning the knob to the right decreases the deflection set on the telescope and results in moving the muzzle to the right when the piece is laid with the new deflection. Similarly, turning the knob to the left increases the deflection and results in moving the muzzle to the left when the piece is laid. The deflection having been set at 1,885 mils, if a subsequent command is, for example, RIGHT 65, the gunner turns the azimuth-worm knob by moving his thumb to the right until the micrometer index has moved from zero to 65 on the clockwise graduations of the azimuth micrometer. As turning the deflection knob to the right decreases the deflection, the resulting deflection will be 1,820 mils. The azimuth micrometer is then reset with its zero opposite the micrometer index. If the command is LEFT (SO MUCH), the deflection setting is changed in a similar manner, except that the gunner moves his thumb to the left and follows the counter-clockwise graduations of the azimuth micrometer.

(2) *To apply deflection difference.*—(*a*) The command is: ON NO. (SO AND SO) OPEN (CLOSE) (SO MUCH). The gunner of the piece indicated in the command does not change the deflection set on his telescope. Each of the other gunners changes his sight setting by the number of mils specified in the command if his piece is next in line to the piece indicated; by twice this number of mils if his piece is second in line from the piece indicated; by three times this number of mils if his piece is third in line from the piece indicated, and so on.

(*b*) If the command is, for example, ON NO. 1 OPEN 5, the gunner on No. 1 makes no change; the gunner on No. 2 turns the deflection knob by moving his thumb to the left,

away from the piece indicated in the command, and sets off 5 mils once; the gunner on No. 3 turns the deflection knob in a similar manner, except that he sets off 5 mils twice, a total of 10 mils; the gunner on No. 4 also turns his deflection knob in a similar manner, except that he sets off 5 mils three times, a total of 15 mils; No. 5 sets 20 mils, No. 6 sets 25 mils. It is recommended that gunners be taught to use the panoramic telescope as an adding machine, instead of totaling the shifts.

(*c*) If the command is, for example, ON NO. 3 CLOSE 10, the gunner on No. 1 turns the deflection knob by moving his thumb to the left, toward the piece indicated in the command, and sets off 10 mils twice, or a total of 20 mils; the gunner on No. 2 turns his deflection knob in a similar manner, except that he sets off 10 mils once; the gunner on No. 3 makes no change; the gunner on No. 4 turns his deflection knob by moving his thumb to the right and sets off 10 mils once; the gunner on No. 5 sets 10 mils off twice or 20 mils; the gunner on No. 6 sets off 30 mils.

(*d*) It should be noted that in making the deflection changes involved in applying the deflection difference, each gunner turns the deflection knob by moving his thumb away from the piece indicated if the command is OPEN, and toward the piece indicated if the command is CLOSE; also that the muzzles of the pieces will be moved in similar directions when the pieces are laid after the deflection differences have been set.

(*e*) When a deflection change and deflection difference are announced at the same time, for example, "Right 30, on No. 1 close 5," both of which affect the gunner's piece he should set off the deflection change first and then apply the deflection difference.

(*f*) In the methods described above, it is implied that the gunner resets the azimuth micrometer with its zero opposite the micrometer index each time the azimuth worm knob has been turned. By so doing, each change in the deflection setting is made by starting with the micrometer index at zero. This facilitates setting off the tens and units on the azimuth-micrometer scales. It is important that the gunner verify the setting of the azimuth micrometer before

turning to the deflection knob to make sure that its zero coincides with the micrometer index.

(3) *To lay for direction.*—(*a*) *Indirect laying.*—The deflection having been set, the gunner brings the vertical hair of the panoramic telescope on the aiming point by traversing the piece. If the amount of movement necessary is greater than can be obtained by traversing, the vehicle must be shifted. To shift the vehicle, the gunner commands or signals: MUZZLE RIGHT (LEFT). The driver moves his vehicle forward and to the right and then reverses and backs either straight to the rear or to the left, depending upon how great an angular change is desired. The gunner then completes the laying by bringing the vertical hair of the panoramic telescope on the aiming point.

(*b*) *Direct laying on stationary target.*—The deflection having been set, the gunner traverses the piece by means of the traversing handwheel until the vertical hair of the panoramic telescope is on his part of the target. If the amount of movement necessary to lay on the target is greater than can be obtained by traversing, the vehicle must be shifted as in (*a*) above.

(*c*) *Direct laying on moving target.*—See (8) and (9) below.

(*d*) *Procedure to insure accuracy.*—To take up lost motion, the final movement of the traversing handwheel should be such as to cause the vertical hair of the panoramic telescope to approach the aiming point from the left. The gunner should habitually lay with the vertical hair of the panoramic telescope on exactly the same portion of the aiming point or target and make certain the cross level bubble is centered for each round.

(4) *To call "Ready."*—The piece having been laid for direction, and No. 1 having called "Set," the gunner verifies the laying, moves his head clear of the panoramic telescope, and calls "Ready," to indicate that the piece is ready to be fired.

(5) *To refer piece.*—The piece having been laid for direction, to refer the piece, the command is: 1. AIMING POINT (SO AND SO), 2. REFER. Without disturbing the laying of the piece, the gunner brings the vertical hair of the panoramic telescope on the new aiming point (referring point). He then

reads and announces the deflection thus set and records the deflection and the referring point upon a convenient part of the vehicle. Two referring points usually are used, one for day and another for night. A referring point should be at least 50 yards from the panoramic telescope, preferably to the rear. Frequently it will be necessary to use the aiming posts as referring points, particularly for night use.

(6) *To record base deflection.*—At the command RECORD BASE DEFLECTION, the gunner records the deflection set on his panoramic telescope in the prescribed place on the vehicle.

(7) *To measure deflection.*—The command is: 1. AIMING POINT (SO AND SO), 2. MEASURE THE DEFLECTION. The piece having been established in direction, the gunner turns the panoramic telescope until the vertical hair is on the aiming point. He then reads and announces the deflection.

(8) *For direct laying on moving target, to take and maintain announced lead.*—The command is: TARGET (SO AND SO), RANGE (SO MUCH), (SO MANY) LEADS. The gunner sets his azimuth scale at zero and tracks the target with the traversing handwheel, keeping the vertical hair of the panoramic telescope ahead of the target by the announced lead, measured in the reticle scale of the panoramic telescope. When time does not permit the chief of section to announce the lead, it is determined by the gunner.

(9) *To lay for both direction and range on moving target.*—When required by the situation, the gunner will lay for both direction and range on a moving target. The scales of the rotating head of the panoramic telescope and the azimuth scale will be set at zero. The arrows indicating the position of the telescope mount which brings the line of sighting parallel to the axis of the bore are brought into coincidence. The gunner then tracks the target with the traversing and elevating handwheels, keeping the vertical hair of the panoramic telescope ahead of the target by the announced lead measured in the reticle scale of the panoramic telescope and placing the range line in the reticle corresponding to the announced range on the visible center of the target, giving the command FIRE when he has laid on the target. Where time does not permit the chief of section to announce the range and lead, the gunner determines them.

■ 17. No. 1.—*a. Enumeration of duties.*—(1) (*a*) To set angle of site.

(*b*) To set range.

(*c*) To set elevation.

(*d*) To lay for elevation (range).

(*e*) To open and close breech.

(*f*) To call "Set."

(*g*) To fire the piece.

(*h*) To use rammer.

(*i*) To man caliber .50 machine gun (on 105-mm howitzer motor carriage M–7).

(2) For indirect laying or direct laying on a stationary target, No. 1 performs the duties prescribed in (1) above.

(3) For direct laying on a moving target, No. 1 performs the duties prescribed in (1) above, except that when the gunner lays for both direction and range, he performs the duties prescribed in (1) (*e*), (*f*), (*g*), and (*h*).

b. Detailed description of certain duties.—(1) *To set angle of site.*—No. 1 is first taught to read angles of site on the angle of site scale and then to set angles of site. To set an angle of site, No. 1 grasps the angle of site knob in his left hand and turns it until the announced reading is shown. The angle of site is indicated by a scale graduated in hundreds of mils from zero to 6 and a micrometer scale graduated in mils, 300 is horizontal. No. 1 first sets the index in the proper section of the scale in hundreds of mils and then sets the units on the micrometer scale. The last motion in setting the angle of site should be in the direction of increasing site.

(2) *To set range.*—(*a*) No. 1 is first taught to read ranges on the range drum and then to set ranges. To set the range, No. 1 installs the range drum corresponding to the announced change, grasps the range drum knob in his right hand and turns it until the announced range is opposite the index, making sure that the last movement is in the direction of increasing range.

(*b*) *Using elbow telescope.*—In direct laying, when so directed, he sets the range (with the correct angle of site automatically applied) by using the appropriate range line in the reticle of the elbow telescope. No. 1, using the elevat-

ing handwheel, keeps the range line corresponding to the announced range on the base of the target.

(3) *To set elevation.*—(*a*) *Indirect laying.*—No. 1 is first taught to read elevations on the elevation scale and then to set elevations. To set an elevation, No. 1 sets the angle of site at 300 (or at an announced site) and sets the announced elevation on the elevation scale. The elevation is indicated by a scale graduated in hundreds of mils from minus 100 to plus 1,200 and a micrometer scale graduated from zero to 100 mils. No. 1 grasps the elevation knob in his left hand and turns it until the announced elevation is shown, making sure that his last movement is in the direction of increasing elevation.

(*b*) *Direct laying on moving targets.*—At the command TARGET (SO AND SO), ELEVATION (SO MUCH), (SO MANY) LEADS, No. 1 sets the angle of site at 300 and the announced elevation on the elevation scale ((*a*) above) and then lays for elevation ((4) below). Announced changes in elevation are given in yards, for example, "Down, 50." No. 1 having been trained to know the effect in range resulting from turning the elevating handwheel, follows the announced range changes by this method, without further reference to the initial elevation setting.

(4) *To lay for elevation.*—No. 1 grasps the cross-level worm knob in his right hand and levels the cross-level bubble. No. 1, having performed the duties described in (1), (2) or (3) above, grasps the elevating handwheel in his left hand and elevates or depresses the piece until the bubble is level, making sure that his last movement is in the direction in which it is most difficult to turn the handwheel.

(5) *To open and close breech.*—(*a*) *To open.*—No. 1 grasps the breech operating level handle in his left hand, pushes down on the handle to release the catch and draws it toward him and to the rear, opening the breech.

(*b*) *To close.*—No. 1 grasps the operating handle with his left hand, pushes the handle forward and away from him until the breech is closed and the latch is engaged.

(c) *To fire on moving targets.*

1. In fire on moving targets when the gunner lays for both direction and range, No. 3's duties are as prescribed in (*a*) and (*b*) above.
2. When No. 1 lays for range, No. 3 will open and close the breech and fire the piece.

(6) *To call "Set."*—No. 1, calls "Set" when the piece has been laid, the breech closed, and the piece laid for elevation.

(7) *To fire piece.*—In indirect laying, at the chief of section's command, NO. (SO AND SO) FIRE, or for direct laying on a moving target when the gunner is laying for direction and range, at the gunner's command FIRE, No. 1 grasps the handle of the lanyard with his left hand and pulls it away from the piece as far as possible. Under no circumstances will No. 1 grasp the lanyard until the gunner calls "Ready." In case of misfire, the instructions contained in paragraph 34 will be followed.

(8) *To use rammer.*—The rammer bore brush will be handled by No. 1 only. The rammer and rammer staff are used to extract unfired rounds or cartridge cases which cannot be ejected by the extractor. To extract a cartridge case which cannot be ejected by the extractor, No. 1 removes the rammer (bore brush) from the rammer staff, inserts the rammer staff in the bore and lightly taps the bottom of the inside of the case until it is lossened and can be pushed out of the chamber. No. 2, standing at the breech, receives the cartridge case in both hands. To extract an unfired round, the procedure described in paragraph 33 will be followed.

(9) *To operate caliber .50 machine gun (on the 105-mm howitzer motor carriage M–7).*—The caliber .50 machine gun will be operated by No. 1 when directed by the executive or chief of section. When the vehicle is traveling, No. 1 will remain on the alert facing to the rear prepared to operate the caliber .50 machine gun instantly.

■ 18. No. 2.—*a. Enumeration of duties.*—(1) To load piece.

(2) To call out number of rounds in volley fires.

(3) To inspect chamber and bore frequently to ascertain if there is any residue from the charge.

b. Detailed description of certain duties.—(1) *To load piece.*—No. 2 receives the round from No. 3, and grasps it with his right hand at the base of the cartridge case and his left hand in front of the rotating band. He then faces the breech and inserts the round in the breech and pushes it home with his right hand. He must use care, especially at higher elevation, to avoid injuring his hand. When necessary to insert his hand into the breech recess to push a round home, he should first close his fist. No. 2 will be particularly careful to avoid striking the fuze against any portion of the matériel. To prevent premature bursts caused by fuzes in projectiles being struck by the piece in recoil, a round to be loaded will be held well out of the path of the recoil of the howitzer until the latter is again in the battery. (See AR 750–10.)

(2) *To call out number of round.*—To insure that the correct number of rounds are fired in volley fire, No. 2 calls out the range and the number of the round as he loads the piece; and, as he loads the last round, adds "Last round." For example, when two rounds are to be fired at 2,800, he calls out "2,800 one; 2,800 two, last round." He should not speak louder than necessary to insure his being heard by the members of his own gun squad.

(3) *To inspect chamber and bore frequently to ascertain if there is any residue from the charge.*—No. 2 will inspect the chamber and bore frequently, particularly when firing in the lower zones and at low elevations, to make certain that no residue from the charge which might cause jamming of the round in loading remains in the chamber or bore.

■ 19. No. 3.—*a. Enumeration of duties.*—(1) To make prescribed setting of impact fuzes.

(2) To set fuze setter.

(3) To set time fuzes.

(4) To pass round to No. 2.

(5) To open and close breech and fire piece in direct laying, when these duties are not performed by No. 1.

(6) To prepare charges, assisted by No. 4, when Nos. 5 and 6 are absent.

(7) To set out aiming posts assisted by No. 4.

b. Detailed description of certain duties.—(1) *To make prescribed setting of impact fuzes.*—(*a*) The fire commands for opening fire will contain a designation of the setting desired when the prescribed fuze can be given more than one setting.

(*b*) If the command is FUZE QUICK, before the round is passed to No. 2 for loading, No. 3 will verify the setting, and reset to "quick" any fuzes which may be set "delay," using a screw driver or similar implement to turn the slotted head of the sleeve to the proper position.

(*c*) If the command is FUZE QUICK, No. 3 will verify the setting and reset to "quick" any fuzes which have been set "delay."

(*d*) After firing is completed, No. 3 will reset to "quick" any fuzes which have been set "delay."

(2) *To set fuze setter.*—The duties of No. 3 in setting the fuzes are as prescribed by the battery executive.

(3) *To set time fuzes.*—The duties of No. 3 in setting time fuzes are as prescribed by the battery executive.

(4) *To pass round to No. 2.*—No. 3, with his left hand under the cartridge case, his right hand under the projectile, taking care that the projectile and cartridge case do not separate, passes the round to No. 2 in such a manner that No. 2 is able to grasp the base of the cartridge case in his right hand.

(5) *To open and close breech and fire piece in direct laying when these duties are not performed by No. 1.*—No. 3 will take position in rear of No. 1 and will open and close the breech and fire the piece.

(6) *To prepare charges, assisted by No. 4, when Nos. 5 and 6 are absent.*—(*a*) When firing other than charge VII with Nos. 5 and 6 absent, No. 3 dismounts and assists No. 4 in preparing the proper charge. No. 3 will then pass the prepared rounds to No. 2.

(*b*) When all the rounds in the howitzer trailer ar eexpended, Nos. 3 and 4 prepare the rounds with the proper charge inside the vehicle (M–7 on rear deck).

(7) *To set out aiming posts assisted by No. 4.*—When directed by the chief of section, No. 3 sets out one aiming post

under guidance of the gunner. No. 4 sets out the other aiming post.

■ 20. No. 4.—*a. Enumeration of duties.*—(1) To pass round to No. 3.

(2) To prepare charges.

(3) To set out aiming posts.

(4) To man caliber .50 machine gun (on the 105-mm howitzer motor carriage T–19).

b. Detailed description of certain duties.—(1) *To pass round to No. 3.*—No. 4, with his left hand under the cartridge case and his right hand under the projectile, taking care that the projectile and cartridge case do not separate, passes the round to No. 3.

(2) *To prepare charges.*—(*a*) The fire command will designate the charge. When a charge other than charge VII is designated, No. 4, assisted by Nos. 5 and 6 if present, otherwise No. 3, removes the projectile from the cartridge case, withdraws the increments from the cartridge case, and removes those numbered higher than the charge designated. He then replaces the remaining increments in the cartridge case in their original numerical order and reassembles the projectile to the cartridge case. To disassemble the round, No. 6 grasps the cartridge case near the neck and holds it in a vertical position; No. 5 grasps the body of the projectile and, with a twisting motion, lifts the projectile clear of the cartridge case. After No. 4 has prepared the charge, No. 5, assisted by No. 6, reassembles the projectile to the cartridge case. Care must be used to prevent damage to the lip of the cartridge case.

(*b*) When using ammunition from the ammunition rack of the vehicle, No. 4 mounts and assists No. 3 in preparing the round on the rear deck.

(3) *To set out aiming posts.*—When directed by the chief of section, No. 4 sets out one aiming post under guidance of the gunner. No. 3 sets out the other aiming post.

(4) *To operate caliber .50 machine gun (on 105-mm howitzer motor cariage T–19).*—The caliber .50 machine gun will be operated by No. 4 when directed by the executive or chief of section. When the vehicle is traveling, No. 4 will remain on

the alert facing to the rear prepared to operate the caliber .50 machine gun instantly.

■ 21. No. 5.—*a. Enumeration of duties.*—(1) To assist in preparing charges.

(2) To command ammunition carrier when it is traveling.

(3) To keep constantly on alert for air or ground attack from the front and flank when in command of the ammunition carrier.

b. Detailed description of certain duties.—To assist in preparing charges.—Assisted by No. 6, No. 5 removes rounds from their containers and arranges them so that they are within easy reach. He inspects each round to see that it is free from sand and dirt and that the rotating band is not burred. Any foreign matter should be removed by wiping with waste. Projectiles with burred rotating bands should be placed aside until burs can be removed with a file.

■ 22. No. 6.—*a. Enumeration of duties.*—(1) To man the machine gun in the ammunition carrier when traveling.

(2) To assist in preparing charges.

b. Detailed description of certain duties.—(1) When the ammunition carrier is traveling, No. 6 remains on the alert facing the rear of the half-track prepared to operate the caliber .30 machine gun instantly.

(2) To assist in preparing charges as indicated in paragraph 21*b*(1).

■ 23. HOWITZER DRIVER (IN THE 105-MM HOWITZER CARRIAGE T–19).—*a.* To release hand brake, take vehicle out of gear, and apply foot brake prior to firing of round and announce "Brake" after No. 1 calls "Set."

b. To cut motor off during firing.

■ 24. AMMUNITION CARRIER DRIVER.—*a.* To place carrier as directed by chief of section for perimeter defense.

b. To man the caliber .30 machine gun in perimeter defense.

SECTION VII

ADDITIONAL INFORMATION ON THE SERVICE OF THE PIECE

■ 25. ACCURACY IN LAYING.—Sighting and laying instruments, fuze setters, and elevating and traversing mechanisms will be so manipulated as to minimize the effects of lost motion. This requires that last motions in setting instruments and in laying be always in the directions prescribed. The gunner and any other cannoneers who have duties in connection with laying the piece will invariably be required to verify the laying after the breech has been closed.

■ 26. FIRE AT WILL.—The piece being uncovered and prepared for action, in case of sudden attack, when the target appears at a range of less than 600 yards, the executive may command: 1. TARGET (SO-AND-SO), 2. FIRE AT WILL. If a method of close defense has been prearranged, the command is: FIRE AT WILL. The chief of section repeats the command adding the target designation (when necessary), the range or elevation, and the lead.

a. The methods of fire used in direct laying on moving targets are:

(1) The gunner lays for direction, No. 1 lays for elevation (algebraic sum of range elevation and site), No. 3 opens and closes the breech and fires the piece.

(2) The gunner lays for direction, No. 1 lays for range, No. 3 opens and closes the breech and fires the piece.

(3) The gunner lays for both direction and range, No. 1 opens and closes the breech and fires the piece.

b. Firing is commenced at the gunner's command FIRE. The piece is loaded and fired as rapidly as possible until the command CEASE FIRING, or until the enemy disappears from view or actually reaches the piece.

■ 27. AIMING POSTS.—When a suitable natural aiming post is not visible, the piece, after it has been laid initially for direction, is referred to the aiming posts as described in paragraph 16*b*(5). Two aiming posts are used for each piece. Each post is equipped with a light for use in firing

at night. One post is set up in a convenient location at least 100 yards from the piece, and to the left flank whenever possible. The other post is set up at the midpoint between the first post and the piece, and is lined in by the gunner so that the vertical hair of his panoramic telescope and the two aiming posts are all in line. Any lateral displacement of the piece during firing can then be detected easily and corrected as indicated in paragraph 28. For night use, the lights should be adjusted so that the far one will appear several feet higher than the near one; thus the two lights will clearly establish a vertical line on which the vertical hair of the panoramic telescope can be laid.

28. DISPLACEMENT CORRECTION.—*a.* When a gunner sees that his aiming posts are out of line, he notifies the chief of section (who notifies the executive) and uses the far post for laying until the piece can be moved or a correction is authorized by the executive. The correction is made by the gunner, who—

(1) Lays on the far post.
(2) Refers to the near post.
(3) Lays on the far post with the new reading.
(4) Reports the new deflection.
(5) Realines the posts (as soon as practicable) by having the near post moved.

b. It is advisable to use this method of correcting displacement when making the final correction necessary to bring the panoramic telescope in alinement with the aiming posts, rather than attempting to make this final correction by continued movement of the vehicle.

29. REPORTING ERRORS.—All members of the howitzer section are trained to report to the chief of section errors in setting or laying discovered after the command FIRE has been given. The chief of section will immediately report errors to the executive, as prescribed in paragraph 15*b*(8).

30. CEASE FIRING.—The command CEASE FIRING normally is given to the howitzer squad by the chief of section, but in emergencies anyone present may give the command. At this command, regardless of its source, firing will cease immedi-

ately. If the piece is loaded, the chief of section will report that fact to the executive. Firing is resumed at the executive's announcement of the range or elevation.

■ 31. SUSPEND FIRING.—The command SUSPEND FIRING is given only when the battery is firing on a prearranged schedule and a temporary halt in the firing is desired. At this command, firing is stopped, but settings continue to be altered in conformity with the schedule. If the piece is loaded, the chief of section will report that fact to the executive. Firing will be resumed at the executive's command RESUME FIRING.

■ 32. CHANGE IN DATA DURING FIRING.—The announcement to the gun squad of any new element of firing data serves as a signal to stop all firing previously ordered but not yet executed. If the piece is not loaded when a new element of firing data is announced, the new data will be set off and firing resumed at the announcement of the range or elevation. If the piece is loaded and the new data require a change in the fuze setting, the chief of section will suspend firing and report to the executive that the piece is loaded. The piece will be unloaded (par. 33) or firing will be resumed only on orders of the executive. (If no change in the fuze setting is required, the new data are set off and the firing is resumed.)

■ 33. TO UNLOAD PIECE.—*a.* When the command UNLOAD is given, No. 1 opens the breech slowly, No. 2, standing at the breech, receives the ejected round or cartridge case.

b. Should the extractor fail to eject the complete round, the assembled staff and rammer (or staff and unloading device, if available) is used. An officer sees that the recess in the head of the rammer or device is free from obstructions and is designed to clear the type of fuze being used. Under direct supervision of an officer, No. 1 inserts the rammer or device in the bore until the head incloses the fuze and comes in contact with the projectile. He pushes and if necessary taps the rammer staff lightly until the round is dislodged from its seat. He then pushes it out of the breech; No. 2 receives it.

c. If the extractor has ejected the cartridge case but not the projectile, No. 1 fills the chamber with waste and closes the breechblock. He dislodges the projectile as prescribed in *b* above. No. 2 then opens the breech, removes the waste, and receives the projectile as No. 1 pushes it to the rear.

d. When practicable, the procedure prescribed in TM 9–1900 should be followed.

■ 34. MISFIRES.—In the event of a misfire, at least three attempts to fire the primer will be made. After at least 2 minutes have elapsed since the last attempt to fire the primer, the executive will command: UNLOAD. The procedure is the same as in paragraph 33*a*. If the extractor ejects the round, the round will be disposed of as prescribed in TM 9–1900. If the extractor ejects only the cartridge case (which will happen most frequently), the case will be immediately thrown clear of all personnel to prevent injury in case of a hangfire. Another cartridge case with the proper charge will be inserted in the breech, care being taken not to damage the case. Authority to fire the round will be obtained from the officer conducting fire.

■ 35. AMMUNITION.—Ammunition, especially the rotating bands and cartridge cases, must be protected from damage. It is sorted and stored by lots. It is kept in containers as long as practicable. Whether in or out of containers, it is protected from dirt and ground moisture by being placed on paulins or raised off the ground. It is protected from sun and rain by a paulin or other shelter placed above it. The powder temperature is kept uniform for any one lot; to permit free circulation of air, wood or brush is placed between layers of unboxed rounds. If time permits, trenches for ammunition will be dug to minimize the effects of a direct hit. The ammunition is stacked, with each stack containing not more than 75 rounds and being not more than four layers high. Stacks are at least 10 yards apart.

SECTION VIII

CARE AND MAINTENANCE OF MATÉRIEL

■ 36. GENERAL.—*a.* This section covers such operations in the care and maintenance of matériel as may be performed by a battery in the field.

b. Complete instructions for battery maintenance, including disassemblies, are found in the Technical Manuals and Standard Nomenclature Lists referred to in paragraph 2, especially TM 9–325 and SNL C–21. Operations not covered in those publications are performed by ordnance personnel.

c. In general, the battery is charged with preventive maintenance; that is, with routine cleaning, lubricating, and preserving. Also, certain classes of repairs, adjustments, and replacement of parts may be made under the direction of an officer or the chief mechanic. Parts which may be drawn by a battery for replacement purposes are indicated in SNL C–21 by the symbol %, and unless specifically prohibited, such parts may be installed by the battery mechanic. For routine care and maintenance, specific duties are assigned to individuals or gun squads, and a strict accountability for the proper performance of such duties is enforced.

d. The following operations may be performed within the battery:

(1) Draining and replenishing the recoil liquid.

(2) Dismounting the howitzer from the sleigh.

(3) Dismounting the sleigh from the cradle.

(4) Removal, disassembly, and replacement of parts of the breech, operating, and firing mechanisms.

(5) Removal of the equilibrator for cleaning and lubricating.

(6) Replacement of minor parts or assemblies indicated by the symbol % in Standard Nomenclature List C–21.

■ 37. INSPECTION.—Regulations do not require that periodic inspections of ordnance matériel be made by field artillery troops. However, the battery executive should make a daily general inspection and, following the monthly lubrication period, he should make a detailed inspection of the matériel. The purpose of the daily inspection is to insure that the

battery is properly performing its preventive maintenance functions. For this purpose, a general inspection of the weapon for appearance and a spot check of one or two parts of the weapon for mechanical functioning are deemed sufficient. The parts selected for spot check should be varied from day to day in order to insure a check of all parts of the weapon. At the monthly inspection all personnel of the firing battery should be present. The executive should make a thorough mechanical inspection of all weapons and an inspection of ordnance tools, spare parts, and equipment for condition and for completeness of the sets. The artillery mechanic should accompany the executive at the mechanical inspection of the weapons. All necessary repairs or adjustments which may be performed by the mechanic should be accomplished; all other necessary repairs or adjustments should be reported to ordnance personnel. In addition to the two inspections referred to above, there should be frequent inspections by battery and battalion commanders, at which times the complete battery allowances should be displayed and inspected. These command inspections insure, in general, only that the appearance and completeness of equipment are maintained at the prescribed standard. General instructions concerning the inspection of this matériel are found in section VI, TM 9–325.

■ 38. CLEANING.—*a.* Dirt and grit accumulated in traveling or from the blast of the piece in firing settle on the bearing surfaces, and in combination with the lubricant form a cutting compound. Primer fouling attracts moisture and hastens the formation of rust. During lulls in firing and immediately after firing, the piece must be thoroughly cleaned. At other times it should be cleaned at intervals not exceeding 2 weeks, depending upon the use and condition. Dirt on nonbearing surfaces can usually be removed by water; lubricated or other greasy parts must be cleaned with dry-cleaning solvent applied with a rag. The procedure in cleaning the bore and breech mechanism is described in paragraphs 42 and 43. The following cleaning materials are issued by the Ordnance Department for use in the field.

(1) *Soda ash (dehydrated sal soda).*—Used for cleaning the bore, breech mechanism, and firing mechanism after firing.

(2) *Dry-cleaning solvent.*—For removing grease. It is preferred to kerosene because it does not leave a corrosive film, and to gasoline because it is less inflammable.

(3) *Crocus cloth.*—This is the coarsest abrasive permitted for cleaning rust and stains from bearing surfaces.

(4) *Emery cloth.*—Used for cleaning unfinished or non-bearing steel surfaces only. Issued in five degrees of coarseness, of which 00 is the finest.

(5) *Burlap, jute.*—Issued for cleaning the bore.

(6) *Cotton waste, clean rags, and sponges.*—For general cleaning purposes.

b. A division of duties for members of the gun squad in routine cleaning and maintenance is as follows:

(1) *Gunner.*—Panoramic telescope, telescope mount, and gunner's quadrant.

(2) *No. 1.*—Range quadrant and firing mechanism.

(3) *No. 2.*—Breech mechanism and firing lock.

(4) *No. 3.*—Fuze setter.

(5) *Nos. 4, 5, and 6.*—Bore, elevating and traversing mechanisms, and recoil slides.

■ 39. LUBRICATION.—*a.* To facilitate identification, all oil-holes and grease fittings should be marked with bright red enamel.

b. Lubrication instructions for the gun are covered in figure 10.

c. The following lubricants are issued by the Ordnance Department for use on this matériel:

(1) *Engine (crankcase) oil, SAE 10* (Navy contract symbol 1042).—A pure petroleum oil used for general purpose lubrication when the temperature is below 32° F. When Navy contract oil is unobtainable, use premium or regular brand of first quality SAE 10 motor oil sold by reputable companies.

(2) *Engine (crankcase) oil, SAE 30* (Navy contract symbol 1065 or 3065).—An oil used for general lubricating purposes as in (1) above, but when the temperature is above 32° F.

(3) *Grease, O. D. No. 0 and No. 00.*—An automotive type of mineral grease. No. 0 is used in the grease fittings of the howitzer when the temperature is above 32° F. No. 00 is used when the temperature is below 32° F. At least every 6 months all old grease is removed; the gear boxes and housing are cleaned with dry-cleaning solvent, wiped dry, and packed with new grease.

■ 40. PROTECTION AGAINST CHEMICALS.—*a.* Whenever chemical attacks are anticipated, all bright parts should be covered with oil. After a gas attack, the oil is wiped off and fresh oil applied. If mustard or other persistent gas is used, absorbent objects may be deeply contaminated, and even hard surfaces may be dangerous for from 6 to 8 days, if the chemical is not neutralized. Bleaching powder or chloride of lime and a noncorrosive decontaminating agent (a solution of either a light tan or white powdery material in acetylene tetrachloride) are standard. The noncorrosive agent will be used for the decontamination of weapons when corrosion or other serious damage might result from the use of chloride of lime.

b. The noncorrosive decontaminating agent is sprayed on with the hand-operated decontaminating apparatus. The contaminated surfaces should be given a number of light applications of the spray at intervals of 15 to 30 minutes until the required amount of solution has been applied (see FM 21X40). After all the solution has evaporated from the treated surfaces, the matériel should be scrubbed, preferably with soapy water, rinsed with clear water, and thoroughly dried. When appropriate, metal surfaces should then be oiled or greased to prevent corrosion.

c. Chloride of lime, if used, may be sprinkled on the matériel, painted on as a whitewash, or sprayed on with the hand-operated decontaminating apparatus. The application should not be left on for more than an hour at most, after which the lime is washed off and the matériel rinsed thoroughly with water.

d. All cleaning rags and sticks used in decontamination must be destroyed or otherwise disposed of to prevent danger from subsequent handling. If destroyed by burning, care

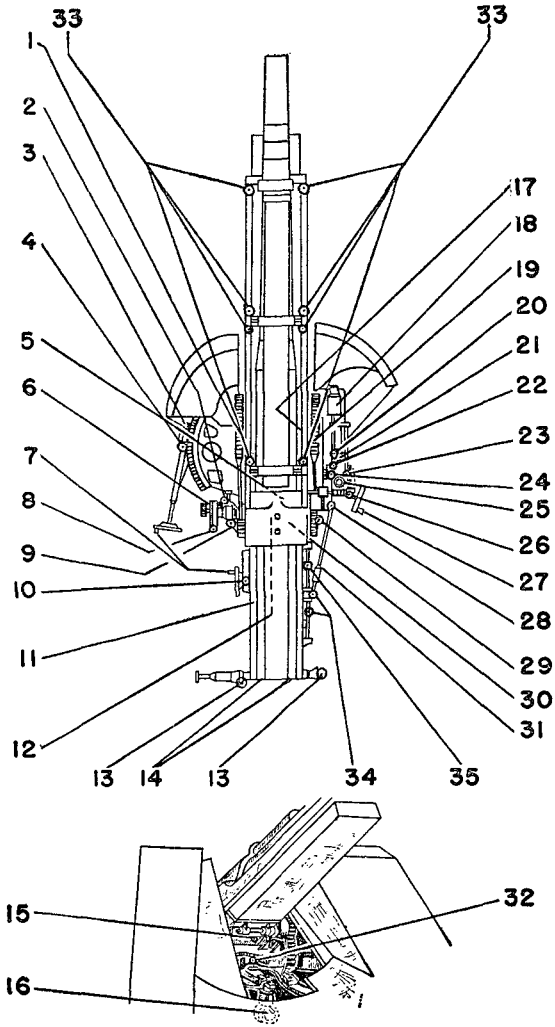


FIGURE 10.—Lubrication chart.

1 ELEVATING ARC AND PINION, LEFT — D OE
2 TELESCOPE MOUNT M21 — O OE
3 TRAVERSING WORM AND RACK — D OE
4 TRAVERSING HAND-WHEEL SHAFT BEARINGS — M OG
5 PINTLE BEARING LOWER — W OG
6 TELESCOPE MOUNT M21 — D OE
7 HANDWHEEL HANDLE — D OE
8 TELESCOPE MOUNT M21 — O OE
9 TRUNNION, LEFT — M OG
10 LEFT ELEVATING HAND-WHEEL SHAFT BEARING — M OG
11 EXPOSED PORTION CRADLE SLIDES — D OE
12 EQUILIBRATOR FULCRUM HAND-PACK — M OG
13 TRAVELING LOCK SHAFT PIECE (BALL) — D OE
14 EQUILIBRATOR SPRING ROD BEARINGS HAND-PACK — M OG
15 ELEVATING PINION SHAFT — M OG
16 PINTLE BEARING TOP — W OG
17 RECOIL INDICATOR — D OE
18 ELEVATING GEAR HOUSING 1 FITTING — M OG
19 ELEVATION ARC AND PINION, RIGHT — D OE
20 RANGE QUADRANT, M4 — O OE
21 RANGE QUADRANT, M4, 2 FITTINGS — O OE
22 RANGE QUADRANT, M4 — D OE
23 RANGE QUADRANT, M4 — D OE
24 RANGE QUADRANT, M4 — O OE
25 ELBOW TELESCOPE MOUNT 1 OIL CUP — D OE
26 RIGHT ELEVATING GEARSHAFT BEARINGS — M OG
27 ELEVATING HANDWHEEL HANDLE — D OE
28 RIGHT ELEVATING GEAR-SHAFT BEARINGS 2 FITTINGS — M OG
29 TRUNNION, RIGHT, 1 FITTING — M OG
30 BREECH AND FIRING MECHANISMS — D OE
31 FLEXIBLE JOINTS ELEVATING MECHANISM — D OE
32 AXLE SUPPORT PIVOT PIN — M MG
33 CRADLE RECOIL SLIDES AND GROOVES 4 FITTINGS — D OE
34 ELEVATING GEAR SHAFT BEARING, 2 FITTINGS — M OG
35 LANYARD SHAFT HOUSING, 1-OILCUP — D OE

TEMPERATE CONDITION

OE	OIL ENGINE, S.A.E. 10, FOR BELOW 32° F. OIL ENGINE, S.A.E. 30, FOR ABOVE 32° F.
OG	GREASE, O. D., NO 0
	ARTIC CONDITION
OE	OIL; LUBRICATING FOR AIRCRAFT INSTRUMENTS AND MACHINE GUNS
OG	GREASE, O. D., NO 00
	TROPIC CONDITION
OE	OIL ENGINE S.A.E. 30
OG	GREASE, O. D., NO 1

KEY
D—DAILY
W—WEEKLY
M—MONTHLY
—OILER
—PRESSURE L. GUN
—HAND

FOLLOW INSTRUCTIONS PRESCRIBED IN TM 9-325

FIGURE 10.—Lubrication chart—Continued.

must be taken to prevent contamination by dangerous vapors produced. If possible, the articles should be buried. In all cleaning operations, the gas mask and special gasproof gloves must be worn.

■ 41. RECOIL MECHANISM.—*a. General.*—Battery maintenance of the recoil mechanism is limited to exterior cleaning and lubricating, draining and filling with recoil oil, removing the recoil cylinder rear head, and disconnecting the piston rod from the cradle. Whenever the barrel is removed, the recoil cylinder rear head should be removed in order to clean the rear interior of the recoil cylinder and to inspect for excess oil leakage. At this time the rear head should be thoroughly cleaned and the relief valve should be lubricated and checked for correct functioning. Only the heavy low-pour-point recoil oil as issued by the Ordnance Department may be used in the recoil mechanism. A full reserve of oil for the recoil system amounts to approximately 1½ fills of the screw filler. In using the screw filler, care must be exercised to prevent crossing the threads or breaking off the end of the filler. The screw handle must be turned with both hands. The amount of oil reserve in the system is shown by the position of the oil index with reference to the front fact of the recuperator cylinder front head, as follows:

(1) *No reserve.*—The indicator is well into the recess. The piece must not be fired in this condition.

(2) *Full reserve.*—The end of the indicator is even with the front face of the recuperator cylinder front head. The oil index does not of itself show when there is an excess of oil reserve, as the addition of excess oil does not move the index out beyond the front face of the recuperator cylinder front head. The piece must not be fired with an excess reserve (see *b* below).

b. Operations prior to firing.—(1) Before firing, the reserve oil should be extracted until an insufficient reserve is indicated; then a full reserve should be established by inserting oil until the index is flush with the front face of the recuperator cylinder front head.

(2) The rear end of the recoil cylinder, the filling and drain plug hole, and the oil index recess should be examined

for oil leakage. The presence of a few drops of oil at any of these places is to be expected, but if there is an undue leakage the piece must not be fired, and the condition should be reported to ordnance personnel.

c. Operations during firing.—During firing, the recoil mechanism should be maintained at full reserve and the slides kept clean and properly lubricated. The chief of section should constantly verify the complete return of the piece to battery. Firing may be continued as long as the piece returns to battery sufficiently for the firing mechanism to actuate the trigger shaft. The chief of section should observe constantly the behavior of the recoil mechanism in firing, and take such action in the case of malfunctioning as is indicated below:

Malfunction	*Cause*	*Correction*
(1) Oil index projects less than the required distance.	(1) (*a*) Loss of reserve oil. (*b*) Loss of gas pressure either through the recuperator cylinder rear head or past the floating piston.	(1) (*a*) Drain remainder of the oil reserve and refill to normal. (*b*) Gas escaping by the floating piston is indicated by an emulsified condition of the reserve oil drained off. If in reestablishing the oil reserve, the oil index does not move out and the oil screw filler works easily, the gas pressure has been lost. Substantiate this by an attempt to drain the mechanism. Oil will not spurt out unless some pressure is present. Report the malfunctioning to ordnance personnel for repair.
(2) Oil index remains stationary when the reserve is pumped in against evident pressure.	(2) The packing is too tight, or the index is broken, or the index is locked by some foreign substance.	(2) Withdraw all reserve oil, then insert approximately one and one-half fills of the oil screw filler. Tap the oil index lightly as oil is being added. If it still fails to function, report the malfunctioning to ordnance personnel for repair. (*In an emergency,* drain all reserve oil and insert one and one-half fills of the screw filler; the piece then may be fired until the howitzer returns to battery with a shock when reserve oil should be extracted, or the howitzer fails

Malfunction	*Cause*	*Correction*
		to return to battery when additional oil should be inserted.)
(3) Failure of howitzer to return to battery.	(3) (*a*) Insufficient oil reserve.	(3) (*a*) Withdraw the reserve oil and establish a new full reserve.
	(*b*) Dirt or obstruction on the slides.	(*b*) Clean and lubricate the slides.
	(*c*) Relief valve in recoil cylinder rear head not functioning.	(*c*) Remove recoil cylinder rear head and clean. If malfunction continues, report the malfunctioning to ordnance personnel for repair.
	(*d*) Low nitrogen pressure, excessive internal friction; damaged slides, piston rod or piston.	(*d*) Report malfunction to ordnance personnel for repair.
(4) Return of howitzer to battery with a shock.	(4) Too much oil reserve.	(4) Withdraw reserve oil until index is halfway in and, when mechanism has cooled, refill to a full reserve.

■ 42. BARREL ASSEMBLY AND SLIDES.—*a. Care of bore.*—Whenever the rate of firing permits, the bore should be swabbed with clean water and a sponge; such swabbing should be done at least once every hour during firing. During or just prior to firing, it is unnecessary and undesirable to lubricate the bore. Drying subsequent to swabbing should be insisted upon. As soon as possible after firing, the bore is washed with a solution of ½ pound of soda ash (or 1 pound of sal soda) per gallon of hot water. Cleaning of the bore is accomplished by means of a swab of burlap around the metal end of the rammer staff, or by means of the bore cleaning brush. No attempt should be made to remove copper fouling. When all powder fouling has been removed, the bore is swabbed with clear water. Finally, it is dried with clean burlap or cloths and then coated with engine oil, either SAE 10 or SAE 30 depending upon the temperature. The cleaning process may have to be repeated on successive days if there is evidence of sweating. If the piece is not to be kept in constant service, the bore should be slushed with rust-preventive compound instead of oil. The chief purposes of swabbing the bore during the firing period are to flush out the primer salts and residue and to lower the temperature of the barrel. The purpose of cleaning after firing is to remove all traces of the residue

and primer salts that cause corrosion. A clean bore is indicated by a uniform grey appearance; no attempts should be made to obtain a bright, polished appearance since such attempts result in damage to the bore.

b. Care of slides.—The bronze slides should be examined by retracting the howitzer until the rear of the breech is opposite the rear of the cradle. Burs or rough spots are removed with a fine file. The slides are cleaned with dry-cleaning solvent, wiped dry, and coated with a light film of engine oil. After the gun is secured in battery, engine oil is applied to the slides through the eight oil fittings. Periodically, or at least every 2 weeks when in constant service, the howitzer and sleigh should be removed from the cradle in order to permit cleaning the entire length of the slides and the interior of the cradle.

c. To retract howitzer.—The howitzer is retracted on its slides as follows:

(1) Place howitzer at approximately zero elevation.

(2) Remove cotter pin and piston rod outer nut.

(3) Push howitzer and sleigh to the rear, being careful that the howitzer and sleigh are not pushed so far to the rear that the breech ring bearing strips lose contact with the rear of the cradle.

d. To remove howitzer and sleigh.—To prevent damaging the recoil mechanism, first the howitzer is removed and then the sleigh is removed. The procedure is as follows:

(1) Provide at least three heavy timbers and two rope slings to support the howitzer in a horizontal position when it is being removed.

(2) Remove the breechblock.

(3) Place howitzer at approximately zero elevation.

(4) Remove locking screw in the recoil mechanism bracket locking ring (barrel locking ring) and remove the ring.

(5) Start howitzer to the rear by striking muzzle with one of the lifting timbers or by means of a pinch bar inserted between the front of the breech ring and rear edge of the cradle trunnion bracket.

(6) Push howitzer about 12 inches to the rear.

(7) Using timbers and a rope sling, support breech and muzzle ends of the howitzer to avoid cramping, and carry

howitzer to the rear. The third timber and a rope sling are used to support the middle of the howitzer as soon as the front end passes within the sleigh. Place howitzer on the rear deck supported by wooden blocks or a suitable rest so as to prevent damage to the finished surfaces and the bronze bearing strips in the bottom face of the breech ring.

(8) Remove cotter pin and piston rod outer nut.

(9) Four cannoneers working in pairs on opposite sides of the carriage push the sleigh to the rear until it is free from the cradle, then lift it off and place it on wooden blocks.

e. To replace howitzer and sleigh.—The howitzer and sleigh are replaced by reversing the procedure of *c* or *d* above. The piston rod outer nut should be fully tightened and then backed off to the nearest castellation in order to permit side play without noticeable end play; it must not be drawn so tight that the inner nut is tight against the cradle. The chief of section must verify that the piston rod outer nut and its cotter pin are in place before traveling and before firing.

■ 43. BREECH AND FIRING MECHANISMS.—*a. General.*—Since the breech and firing mechanisms consist entirely of unpainted and unprotected steel surfaces, the mechanisms are subject to corrosion caused by powder fouling, rain, dirt, and mud. It is of particular importance that the moving elements be kept well cleaned and lubricated. This can be accomplished in only one way; that is, by a complete disassembly of all moving parts. The solution of water and soda ash (or sal soda) is used to remove the larger portion of the fouling. After the parts are rinsed with clear water and dried, any gummy residue remaining on them is removed with dry-cleaning solvent. The mechanism is lubricated while disassembled. It is important that the mechanism is thoroughly cleaned and dried before being lubricated, that the proper lubricant is selected, and that it is used in quantities sufficient only to reduce friction. In case of doubt as to the viscosity of oil to be used, especially when the piece is to be fired, the lighter weight of oil should be selected. Constant checking is necessary to insure that cracked parts are replaced, and that burred parts are replaced or burs removed. Hence,

whenever the mechanism is disassembled, each part should be carefully inspected.

b. Disassembly of breech mechanism and firing lock.—To disassemble the breech mechanism—

(1) Raise detent handle and remove trigger shaft.

(2) Open breech to the point where the assembling line on the top of operating lever is parallel with the side of the breech ring and lift out operating-lever pivot.

(3) Slide breechblock to the right, removing operating lever as soon as the crosshead clears the breech ring.

(4) Push breechblock to the left to clear the extractor and remove extractor from the breech ring.

(5) Remove breechblock by pushing through to the right.

(6) Lay breechblock on its lower face and remove detent spring retaining screw, spring, detent, and handle.

(7) Rotate firing case 60° in either direction and pull it out of the breechblock.

(8) Pry trigger fork out of the firing case with a screw driver, first through the trigger shaft hole, then from the outside of the case.

(9) Insert trigger shaft to engage yoke ends of the sear. Press front end of sear out of engagement with firing pin holder, insert a screw driver through the bottom hole and in rear of the firing-pin holder, and pry assembled sleeve and holder forward until they can be grasped and pulled from the case.

(10) Remove trigger shaft and shake out sear and sear spring.

(11) Hold front end of firing-pin holder in one hand and place the lower rear end of the sleeve against the edge of a bench or some convenient part of the vehicle. Push the firing-pin holder down to unhook it from the sleeve. Allow holder to recede out of the sleeve, freeing the spring.

(12) Remove cotter pin from the firing-pin holder, unscrew firing-pin bushing, and remove firing pin from the bushing.

(13) Unscrew cross-head screw and remove cross head.

c. Assembly of breech and firing mechanisms.—The breech and firing mechanisms are assembled in the reversed order of the disassembly described in *b* above. However, the following aids and precautions should be observed:

(1) The ends of the cotter pin in the firing-pin holder must be spread so that they will not rub the firing case.

(2) The sear spring may be readily inserted into its seat by introducing the point of a screw driver between two coils to hold the spring.

(3) The sear should be pressed down when the firing-pin holder is inserted in the case. This is easily done by inserting a screw driver through the front top hole of the firing case.

(4) The part of the trigger fork marked "muzzle face" must be toward the front of the case when assembling.

(5) The trigger shaft may be inserted when the lines on the firing case and the breechblock marked "top" coincide.

d. Causes and corrections of malfunctioning.—The causes and corrections of malfunctioning of the breech and firing mechansims are given in the following table:

Malfunction	*Cause*	*Correction*
(1) Fails to fire; no percussion on primer.	(1) (*a*) Broken firing spring; broken or deformed firing pin. (*b*) Breechblock not fully closed. (*c*) Howitzer out of battery.	(1) (*a*) Disassemble firing lock and replace broken or deformed part. (*b*) Close breechblock. (*c*) Check recoil mechanism for proper reserve and howitzer slides for dirt or obstructions. If cause is not found, report malfunctioning to ordnance personnel for repair.
(2) Fails to fire until primer is struck several times.	(2) (*a*) Firing mechanism parts not working freely. (*b*) Weak firing spring.	(2) (*a*) Disassemble firing lock and examine for burs and roughened surfaces. Remove burs, and smooth roughened surface with crocus cloth or an oilstone. Wash parts with dry-cleaning solvent, dry, and lubricate before reassembly. (*b*) Replace.
(3) Fails to fire when proper percussion on primer is obtained (misfire).	(3) Defective primer.	(3) Make three attempts to fire the primer, then wait 2 minutes before opening breech and removing round. (See par. 26.)
(4) Fails to extract empty case.	(4) Broken extractor.	(4) Gently ram out the case. Examine edge of chamber for deformations or burs which might cause difficult extraction. Replace extractor.

■ 44. EQUILIBRATOR.—*a. General.*—To clean and lubricate the equilibrator spring rod bearing and fulcrum bearing, the equilibrator assembly should be dismounted from the carriage once a month. After the equilibrator is removed, the bearings are washed in dry cleaning solvent, dried, and hand packed with grease, O. D. No. 0. Disassembly of the equilibrator is prohibited. There are no means provided for adjusting the equilibrator.

b. To remove.—The equilibrator is removed as follows:

(1) Depress piece to approximately zero elevation, insert a 3- by 3- by 12-inch wooden block between the front spring seat and equilibrator fulcrum, and elevate piece to remove load from the springs.

(2) Remove cotter pins, and force out headless pins from the equilibrator fulcrum. Depress piece, lowering front end of equilibrator to the floor of the carriage.

(3) Drive out straight pin from traveling lock (ball) piece on the right side of the cradle.

(4) Unscrew ball piece.

(5) Gently push traveling lock shaft to the left, holding equilibrator to prevent its falling, and remove equilibrator assembly.

c. To mount.—Reverse procedure in *b* above, noting that the dust shields on either side of the equilibrator fulcrum bearing are in place.

■ 45. ELEVATING MECHANISM AND CRADLE TRUNNION BEARINGS.—Disassembly, cleaning, and inspection of the elevating mechanism and cradle trunnion bearings, and packing of the elevating mechanism gear housings will be done at the regular ordnance inspections.

■ 46. SIGHTING AND FIRE-CONTROL EQUIPMENT.—*a. General.*—Special care is required to insure the positive and accurate functioning of the sighting and fire-control mechanisms. Care must be exercised to prevent denting the soft metal surfaces or scratching the lenses. The steel surfaces should be kept covered with a light film of high grade lubricant to prevent corrosion. Dirt should be removed from optical surfaces by brushing lightly with a camel's-hair brush. Oil

or grease should be removed from glass by applying alcohol or, if alcohol is not available, by breathing on the glass and then wiping lightly with lens paper or a clean, soft cloth. Battery personnel are forbidden to disassemble any part of the gunner's quadrant, panoramic telescope, telescope mount, or range quadrant, but are permitted to perform certain adjustments. The procedure of *c* to *f* below may be used to insure accuracy of the sighting and laying mechanisms. In general, the sighting system is correct—

(1) In direction, if the deflection scales read zero when the line of sighting is in a plane parallel to the vertical plane passing through the axis of the bore.

(2) In elevation—

(*a*) If, with the elevation scales of the panoramic telescope set at zero and with the elevation indexes of the mount in coincidence, the line of sighting through the zero range line of the telescope is parallel to the axis of the bore.

(*b*) If the algebraic sum of the site and elevation setting indicates the same angle above the horizontal that is measured with an accurate gunner's quadrant on the tube.

(3) If there is no excessive lost motion between the sights and the tube.

b. Testing equipment.—Equipment used in testing sights consists of bore sights and a gunner's quadrant. Tools needed for adjustments are a screw driver and a teat-wrench. The target for bore sighting may be a terrain object more than 1,000 yards away, or a test target. When the test target is used, the displacement of the axis of sighting from the axis of the bore must be correctly shown. For this howitzer the displacement of the panoramic telescope is 15.23 inches to the left of and 10.61 inches above the axis of the bore and the displacement of the elbow telescope is 13.375 inches to the right of and 8.375 inches above the axis of the bore. Aiming posts with wooden blocks or markers attached make a suitable test target. Tests can be made without the bore sights by sighting through the firing lock recess in the breechblock or through a brass cartridge case with the primer removed, using improvised cross hairs at the muzzle.

c. Gunner's quadrant.—(1) *End-for-end test.*—(*a*) Set both graduated arc and index arm (sliding level) scales at zero, and tighten clamp screw.

(*b*) Place quadrant on leveling plates of the howitzer and center the bubble, using either elevating handwheel of the piece.

(*c*) Reverse quadrant on the leveling plates. The bubble should recenter itself. If it does not, change the settings until the bubble is centered and take the reading. In the case of a minus correction it will be necessary to set the graduated arc scale one notch below zero, and move the sliding level initially to the opposite end of the index arm. The correction (the setting to be used in getting a true horizontal) is one-half of the displacement measured, in the same sign. If the necessary correction exceeds 0.3 mil, the quadrant should be adjusted by ordnance personnel at the earliest opportunity.

(2) *Index arm test.*—Set a reading of any multiple of 10 on the quadrant and place sliding level at zero. Level bubble by means of either elevating handwheel of the piece. Move index arm one notch down, and slide level vial to the opposite end of the scale. The bubble should remain centered.

(3) *Comparison test.*—Successively place all the quadrants of the battery on the leveling plates of a piece which is laid at any selected elevation. Repeat the same process for several other elevations and list the reading of each quadrant at each elevation. Determine a mean correction for each quadrant and apply this as a correction constant. If any quadrant exceeds an error of 0.3 mil it should be adjusted by ordnance personnel at the earliest opportunity.

d. Rapid daily test.—The fire-control equipment mounted on the howitzer is rapidly checked for correct adjustment in the following manner:

(1) The chief of section sets the gunner's quadrant at zero, places it on the leveling plates, and No. 1 levels the piece.

(2) No. 1 sets the angle-of-site scales at 300 and centers the cross-level and angle-of-site bubbles. The elevation scales should read zero. (The range drum will not read exactly zero due to the allowance for jump.)

(3) The gunner centers the longitudinal and cross-level bubbles of the telescope mount. The elevation indexes should be in coincidence.

(4) Nos. 1 and 2 install the bore sights and, if necessary, set up the testing target. The gunner lays the piece by bore sighting on the testing target or distant terrain object.

(5) The gunner lays the center vertical cross hair and the zero horizontal cross hair of the panoramic telescope reticle on the proper portion of the test target. If the panoramic telescope is in adjustment, the azimuth and elevation scales and their respective micrometer scales will indicate zero deflection and elevation.

(6) No. 1 by observation restores the range lines in the reticle of the elbow to the horizontal with the erecting knob. The "N" (normal) cross hair of the reticle should be on the appropriate line of the test target.

(7) If the foregoing tests indicate that some portion of the mechanism is out of adjustment, it should be adjusted by following the procedure outlined in *c* above and *f* and *g* below, or a correction should be determined, written on some convenient location such as the shield, and used until there is an opportunity to adjust the faulty mechanism.

e. Verification and adjustment of telescope mount and panoramic telescope.—Periodically, and whenever the mechanism is found to be out of adjustment, a detailed test and adjustment should be made. For this purpose it is desirable to have the howitzer on an approximately level platform or the howitzer trunnions level. It is assumed that all lost motion has been eliminated and that cross-level bubbles are in adjustment. (For details see TM 9–325.) Tests and adjustments are performed in sequence as follows:

(1) *Elevation indexes of telescope mount.*—Lay the howitzer at zero elevation with the gunner's quadrant and center the cross-level and longitudinal-level bubbles. The elevation indexes should coincide; if they do not, loosen the two screws in the adjustable index and slide it into coincidence with the fixed index. Tighten the screws and recheck.

(2) *Deflection and range scales of panoramic telescope.*—Bore sight on the test target or a distant terrain object. Insure that the elevation indexes of the telescope mount are in

coincidence. Using the appropriate knobs of the telescope, place the center vertical cross hair and zero horizontal cross hair of the telescope reticle on the proper portion of the test target. If the azimuth and elevation scales and their respective micrometer scales do not indicate zero deflection and elevation, adjust in the following manner:

(*a*) *Deflection adjustment.*—Turn azimuth worm knob of telescope until center vertical cross hair is on the appropriate line of the test target. Loosen screw in center of azimuth micrometer index and, while holding the azimuth worm knob, slip index until it corresponds with deflection index. Tighten screw and recheck. This adjustment must not be made by moving the headless adjusting screws in the telescope socket. If necessary, the main azimuth scale should also be adjusted to zero.

(*b*) *Elevation adjustment.*—Turn the elevating knob of the telescope until the zero horizontal cross hair of the reticle corresponds with the appropriate mark of the testing target. Loosen screws in end of knob and, holding the knob, slip elevation micrometer until the zero graduation lines up with its index; then tighten screws and recheck the setting.

f. Verification and adjustment of range quadrant.—(1) Move range drum assembly indexes into coincidence. The elevation micrometer scale and the elevation scale should read zero. The range drum will indicate a reading slightly greater than zero if properly assembled.

(2) With the range drum properly assembled, if the elevation micrometer scale does not read zero, it is adjusted in the following manner:

(*a*) Loosen the three screws in micrometer knob.

(*b*) Without moving the knob, slide the zero of micrometer scale into coincidence with the index.

(*c*) Tighten and recheck.

(3) With the elevation micrometer scale in adjustment, if the elevation scale does not indicate zero, it is adjusted in the following manner:

(*a*) Loosen the two screws in index. Move index opposite the zero graduation.

(*b*) Move index into coincidence with the zero graduation.

(*c*) Tighten screws and recheck.

(4) With the elevation micrometer scale and the elevation scale in adjustment and set at zero, the trunnions and the axis of the bore are accurately leveled, the angle of site is set at 300, and the cross-level bubble is centered. If the longitudinal-level bubble is not centered, the range quadrant is adjusted in the following manner:

(*a*) Center longitudinal bubble by means of angle-of-site knob.

(*b*) While holding the angle-of-site knob, loosen clamping screw in center of knob and slip angle-of-site micrometer to indicate zero. Tighten clamping screw.

(*c*) If necessary, loosen the two screws which secure the angle-of-site scale and shift the scale so that the "3" graduation registers at the index line. Tighten the screws to secure the scale in this position.

(*d*) Recheck. Further adjustment, if required, is to be performed only by authorized ordnance personnel.

g. Verification and adjustment of elbow telescope and mount.—With the axis of the trunnions leveled, bore sight on the test target. By observation, correct the reticle to the horizontal by means of the erecting knob. If the "N" cross hair is not on its line of the test target, put it on in the following manner:

(1) Loosen worm clamping bolt.

(2) With a screw driver, move elevating adjusting worm to bring the "N" cross hair in coincidence with the proper line of the target.

(3) Tighten worm clamping bolt.

(4) Recheck.

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