

W1.35:9-1235

TM 9-1235

Document
Reserve

WAR DEPARTMENT

TECHNICAL MANUAL

✱

ORDNANCE MAINTENANCE

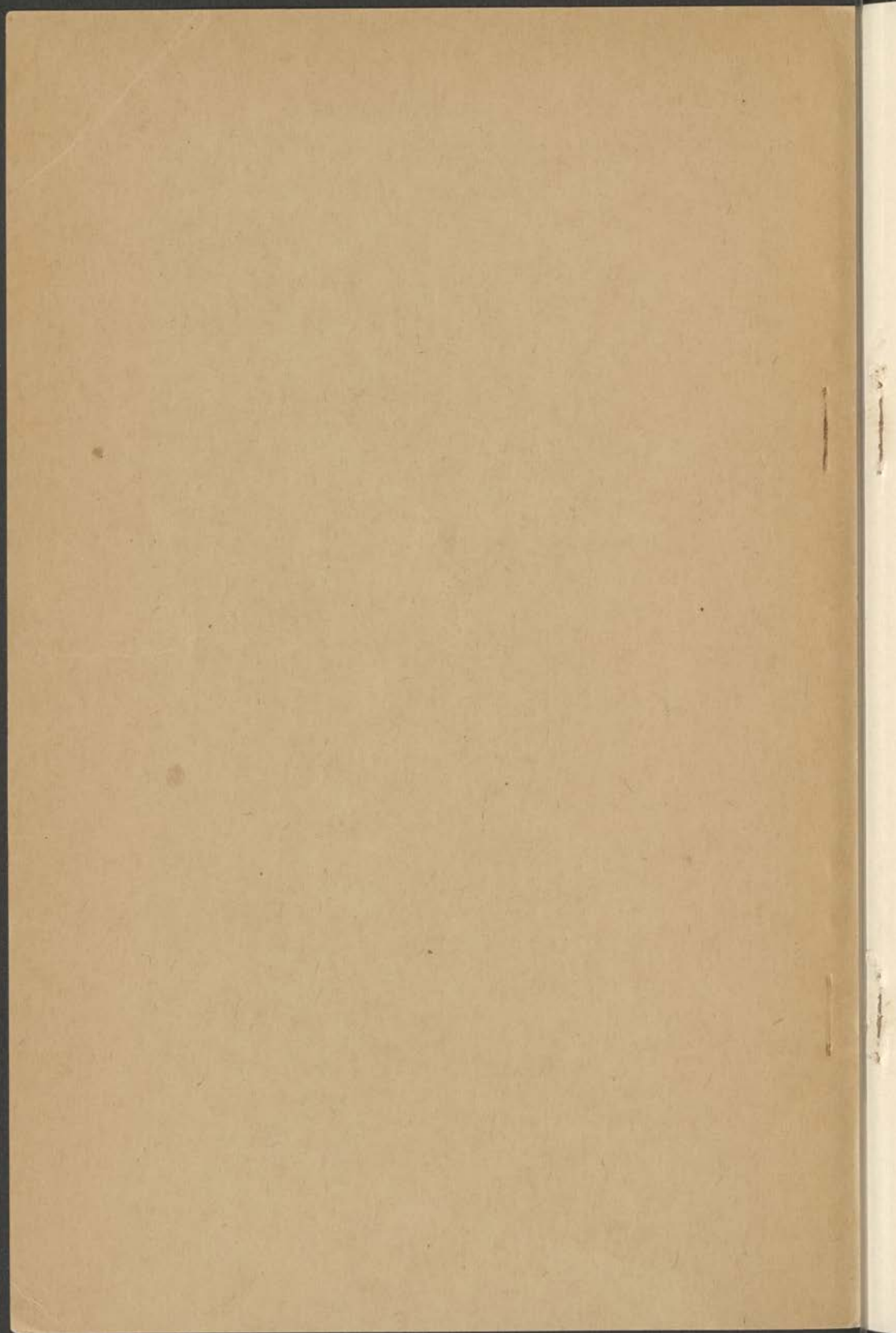
37-MM ANTIAIRCRAFT GUN

MATÉRIEL

July 6, 1942

NON-CIRCULATING

NTSU LIBRARY



TECHNICAL MANUAL }
No. 9-1235 }

WAR DEPARTMENT,
WASHINGTON, July 6, 1942.

ORDNANCE MAINTENANCE

37-MM ANTI-AIRCRAFT GUN MATÉRIEL

	Paragraphs
SECTION I. General-----	1-4
II. Inspection-----	5-25
III. Maintenance and repair-----	26-51
	Page
APPENDIX-----	98
INDEX-----	99

SECTION I

GENERAL

	Paragraph
Scope-----	1
Characteristics-----	2
Carriage data-----	3
Gun data-----	4

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

b. In addition to a description of the 37-mm antiaircraft matériel, this manual contains technical information required for the identification, use, and care of the matériel.

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

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

2. **Characteristics.**—The 37-mm antiaircraft gun is a full automatic weapon. The gun is mounted on a four-wheeled trailer carriage capable of being towed 50 mph on good roads. By means of counterpoise cylinders the chassis is lowered to the ground for firing and raised to the wheels for traveling. Antitank firing as well as antiaircraft firing is possible.

* This pamphlet supersedes TM 9-1235, November 27, 1940.

3. Carriage data.

Item	M3	M3E1	M3A1
Guns-----	One 37-mm AA automatic gun M1A2.	One 37-mm AA automatic gun M1A2 and two .50 cal. Browning machine guns M2, water-cooled, flexible.	One 37-mm AA automatic gun M1A2.
Carriage chassis	4-wheeled towed vehicle type.	Same as M3-----	Same as M3.
Brakes-----	Disk and lever type electric brakes on 4 wheels. Hand brakes on rear wheels.	Same as M3 carriage.	Same as M3.
Leveling mechanism.	Tilts through a range of 10°. Operated by two handwheels.	Same as M3 carriage.	Tilts through a range of 10°. Operated by 2 ratchet wrenches secured to the leveling mechanism.
Elevating mechanism.	Two speed ratios available for 0-85° limit elevation. Hand operated only. One turn of handwheel elevates 3.75° in slow ratio and 11.25° in fast ratio.		One speed ratio. Hand and power operated. Mechanical stops at -5° and 90°. Automatic stop switch for power operation at 0 and 85°. One turn of handwheel elevates 4.67°.
Traversing mechanism.	Two speed ratios available for 360° traverse. Hand operated only. One turn of hand wheel traverses 3.75° in slow ratio and 11.25° in fast ratio.		One speed ratio. Hand and power operated for 360° traverse. One turn of handwheel traverses 6°.
Equilibrator-----	Equilibrator connected to cradle by means of a rod.	Same as M3-----	Equilibrator connected to cradle by means of a rod and a chain.

Item	M3	M3E1	M3A1
Firing mechanism.	Cam and lever arrangement operated by a foot pedal.	Same as M3 carriage for the 37-mm gun. Separate pedal for cal. .50 machine guns.	Lever and cable arrangement operated by two foot pedals. Adjustment provided for semiautomatic or automatic firing.
Outrigger assembly.	Pivots about a bracket centrally located on each side of the chassis. Stands upright for traveling.	Removed from bracket and carried alongside the chassis for traveling.	Same as M3 or M3E1 carriage.
Cradle-----	Open frame construction.	Open frame construction. Contains brackets for attachment of two cal. .50 machine guns.	Frame construction with top, bottom, and front removable covers.
On-carriage fire-control equipment.	Sighting system M2 and telescopes M7.	Sighting system M2 and telescopes M7.	Remote control system M1 and direct fire sights.
Weight, complete, pounds.	5,300-----	5,600-----	6,100.
Rate of fire, rounds per minute.	120-----	120 for 37-mm gun; 650 for cal. .50 machine gun.	120.
Over-all length (traveling position) inches.	241-----	241-----	241.
Over-all width (traveling position) inches.	69.5-----	69.5-----	69.5.
Tread, inches-----	58-----	58-----	58.
Wheelbase, inches.	120-----	120-----	120.
Height (traveling position), inches.	80.5-----	80.5-----	72.
Height of trunnions above ground, inches.	33-----	33-----	54.5.

Item	M3	M3E1	M3A1
Road clearance, inches.	11	11	11.
Tire size	5.50-18	5.50-18	5.50-18.
Tire inflation, pounds per square inch.	38	38	38.

4. Gun data.—a. Gun, 37-mm, M1A2.

Weight of gun, complete	pounds	365
Length of gun, complete	inches	104
Weight of tube	pounds	119
Length of tube	inches	78
Length of bore	calibers	53.53
Life of tube	rounds	2,000
Muzzle velocity	feet per second	2,600
Rate of fire	rounds per minute	120
Type of breechblock		Vertical sliding
Recoil mechanism		Hydrospring
Length of recoil	inches	10%
Recoil fluid		Oil, recoil, light
Recoil fluid capacity	pints	3½
Maximum vertical range (HE shell)	yards	6,200
Maximum horizontal range (HE shell)	do	8,875
Vertical range, self destroying (HE shell)	do	3,960
Horizontal range, self destroying (HE shell)	do	4,070
Weight of high explosive projectile	pounds	1.34
Weight of armor-piercing projectile	do	1.9
Maximum number of rounds permitted to be fired before cooling	rounds	80-100
Weight of 1 round (HE shell M54)	pounds	2.62
Weight of 1 round (AP shot M59)	do	3.12

b. Gun, machine, caliber .50, Browning, M2, water-cooled, flexible.

Weight of gun with water, 36-inch barrel	pounds	110.00
Weight of gun with water, 45-inch barrel	do	121.50
Weight of gun without water, 36-inch barrel	do	94.00
Weight of gun without water, 45-inch barrel	do	100.50
Weight of barrel assembly, 36-inch barrel	do	14.50
Weight of barrel assembly, 45-inch barrel	do	17.08

Over-all length of gun, 36-inch barrel	inches	57.00
Over-all length of gun, 45-inch barrel	do	65.93
Number of grooves in barrel		8
Rate of automatic fire	shots per minute	500-650
Chest, ammunition, caliber .50, M2, empty	pounds	29
Chest, ammunition, caliber .50, M2, loaded	do	89
200 links, caliber .50	do	8
200 cartridges, caliber .50, M1	do	52

SECTION II

INSPECTION

	Paragraph
General	5
Gun as a unit	6
Gun tube	7
Lock frame and driving springs	8
Tube extension assembly	9
Feed box mechanism	10
Recuperator mechanism	11
Back plate buffer	12
Trunnion block	13
Firing mechanism	14
Chassis	15
Buffer mechanism	16
Counterpoise cylinders	17
Elevating and traversing mechanism	18
Foot-firing mechanism	19
Leveling mechanism	20
Brakes	21
Equilibrator	22
Cradles	23
Outriggers	24
Wheel alinement	25

5. General.—*a. Purpose.*—Inspection is for the purpose of determining the condition of the matériel, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning. Unusual conditions of the gun and carriage noted at inspection will be recorded in the Artillery Gun Book, O. O. Form No. 5825.

b. Scope.—The instructions with reference to inspection of the gun and recuperator mechanism are additional to those enumerated in TM 9-235.

c. References.—For additional instructions regarding inspection, see OFSB 4-1, Maintenance of Matériel in the Hands of Troops, and the first page of the Artillery Gun Book.

d. Tools for inspection.—An 0.010 armature gage is provided for checking brake drum clearance. Its use is detailed in paragraph 45b(1).

6. Gun as a unit.—The intricate and interrelated mechanisms of the gun call for a high degree of cleanliness of all parts. No accumulations of grease, dirt, or grit should be present and the parts should have neither burs, scratches, dents, nor any imperfections which might change dimensions or in any way interfere with their smooth operation. Ascertain that all sliding, moving, and pivoting parts operate smoothly and freely and that the various springs function properly. Cotter pins must be spread so that no projecting ends will interfere with the mechanism. Check the mounting of the gun in the cradle. There should be no looseness. Examine the gun for loose or missing parts.

7. Gun tube.—*a. Life.*—Note the condition of the bore for rust, corrosion, worn lands and grooves, and for erosion at the origin of rifling. Examine the firing chamber for scored surfaces. The estimated average accuracy life in full service rounds of the 37-mm gun M1A2 is approximately 2,000 rounds. The gun in service should be star gaged after firing approximately 200 rounds, 1,800 rounds, and after each 200 additional rounds during the remainder of its service. Also, it should be star gaged at any time an inspector may deem it necessary on account of doubtful conditions, or when the bore shows signs of unusual wear or other irregularities. In this gun the greatest distance from the muzzle at which star gage measurements may be made is 68.25 inches. Decoppering of the bore of the cannon before star gaging is prohibited.

b. Impressions.—For pastilles, or other defects of the bore of the gun which require plaster of paris or gutta-percha impressions for measurement purposes, plaster of paris should be used if practicable, as it gives a harder surface than gutta-percha and a more accurate measurement is obtained.

c. Mounting.—Inspect the mounting of the tube for proper action of the tube lock. There should be no looseness between the tube threads and the tube extension socket. Check the portion of the gun tube that recoils into the trunnion block bushing for signs of wear or abrasion and also for proper lubrication. A coating of grease, graphite, hard, will be applied at this point on assembly.

8. Lock frame and driving springs.—Ascertain that the driving springs operate smoothly and with sufficient force to load a cartridge into the firing chamber. Examine the operating cams in which the operating lever rides. Examine the mounting of these

cams and the two switches that guide the operating lever. These parts should all be free from rough spots and the operating lever should slide smoothly in its guides.

9. Tube extension assembly.—Remove the recuperator piston rod nut, remove the driving spring assembly, and move the tube extension back and forth by pushing the tube back and forth in the trunnion block. The tube extension should move back easily with no rubbing or scratching action. Note the action of the carrier cam on the carrier, the ejector in the ejector cam, and the feed lever operating stud on the feed lever. Remove the tube extension and examine the various components assembled to it for their proper actions.

Caution.—Do not have gun elevated while the piston rod nut is being unscrewed and the tube extension removed.

10. Feed box mechanism.—Examine the various links, pawls, and mechanisms in the feed box assembly for burs or scratches that will prevent their smooth action. The feed slide return lever should easily force all parts back to their original position. The action of the feed pawl assembly, cartridge feeder holding pawl, and cartridge feeder stop pawl is such that the cartridge feeder is moved to the right one clip at a time.

11. Recuperator mechanism.—*a. Recuperator action at high elevation.*—The recuperator mechanism should be capable of returning the tube to battery with no shock. If the gun remains more than $\frac{1}{8}$ inch out of battery, the round will not be fired. Fire several rounds when the gun is elevated to its highest degree. There should be no interruption in the operation when the gun is fired in this setting.

b. Leakage.—Examine the back cap of the recuperator cylinder for leakage of oil. Note all other oil leaks.

c. Expansion tube.—Remove the expansion tube and examine the inside. This tube should be clean, dry, and free from oil.

12. Back plate buffer.—The entire shock of the recoiling lock frame should be taken up by the buffer springs. The buffer plunger should not be forced back far enough to strike the rear wall of the buffer cylinder.

13. Trunnion block.—Examine the trunnion block (fig. 1) and feed box for loose rivets, malformed plates, or other signs of weakened construction.

14. Firing mechanism.—The gun may fail to fire even though the trigger is pulled back by the foot-firing mechanism and the ammunition is in good condition. In this case note whether the

tube, tube extension, lock frame, and breechblock are in battery or not. If they are in battery position, then check the functioning of the firing mechanism of the gun. Examine the trigger, trigger bar, trigger levers, trigger trip, sear, firing hammer and firing pin. These parts should work smoothly with no binding, and should be free from dents and burs. Smooth down such imperfections with crocus cloth or a fine file and then note their action.

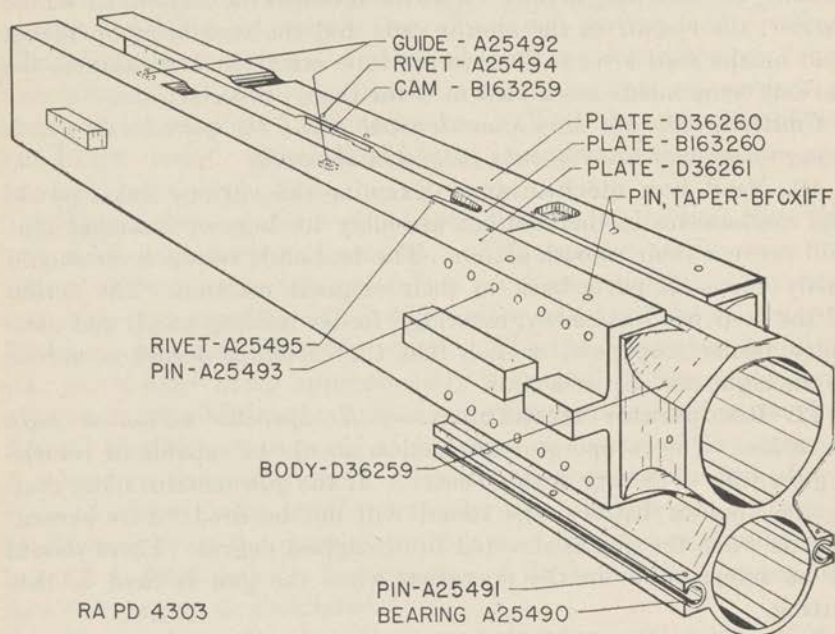


FIGURE 1.—Trunnion block.

15. Chassis.—Examine the chassis for the following:

Bent, broken, or cracked plates.

Broken welds.

Points of attachment of the buffer mechanism.

Points of attachment of the counterpoise cylinders.

Points of attachment of the axles and axle arms.

Operation of the gun support.

16. Buffer mechanism.—*a.* Operate the buffer mechanism from traveling to firing position and back again. There should be no undue binding of the motion.

b. Note the points on the axle arms where the buffer rod bears against the axle arm. The amount of wear on each of the two front

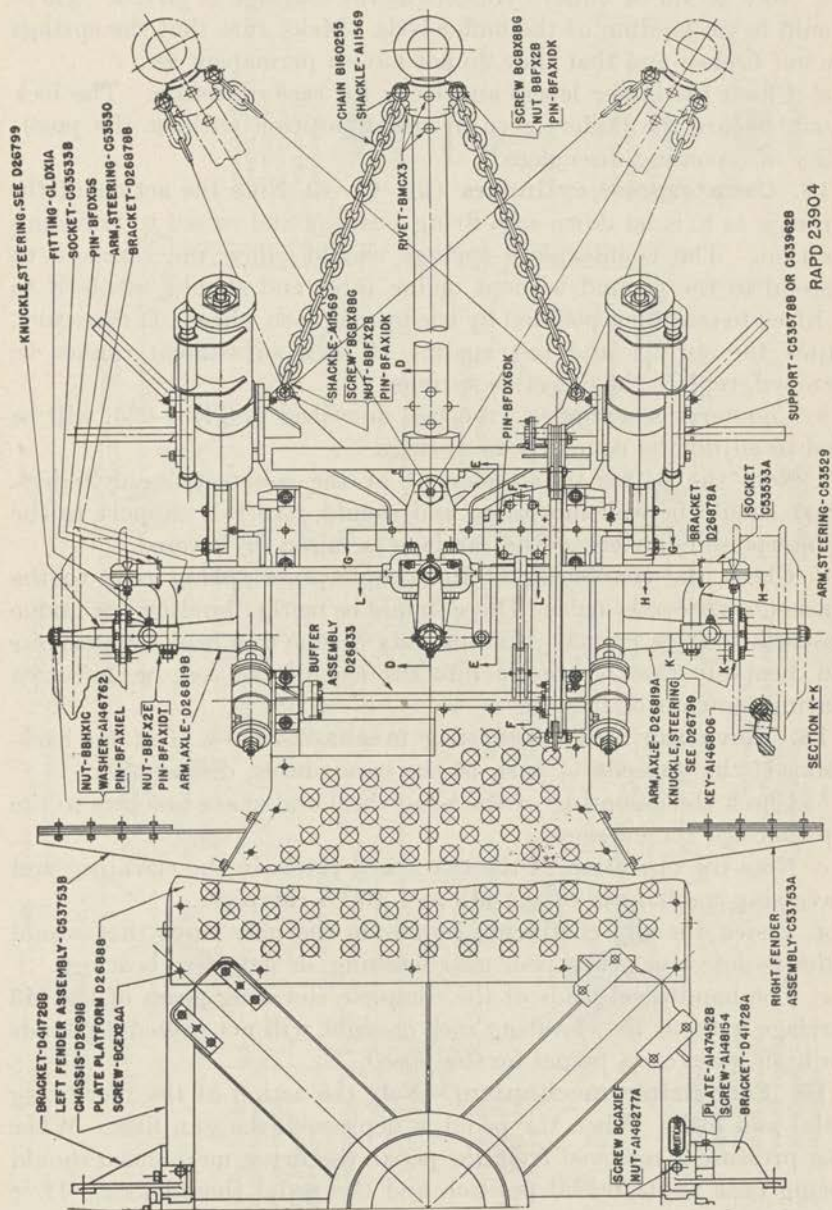


FIGURE 2.—Chassis assembly (pertains to fig. 3).

axle arms should be about the same, as should the wear on each of the two rear axle arms. Check the axle arms against FSMWO A29-W4.

c. Note action of buffer cylinders as the carriage is jarred. There should be no binding of the buffer rods. Make sure that the springs are not broken and that they do not have a permanent set.

d. Check the buffer levers and locks for ease of action. The lock should secure the buffer lever in either position without the possibility of becoming disengaged.

17. Counterpoise cylinders (fig. 6).—*a.* Note the action of the carriage as it is let down into firing position and raised to traveling position. The counterpoise springs should allow the carriage to descend to the ground without undue force and should enable it to be lifted to traveling position by one man at each wheel. If necessary, adjust the springs and test again. If such adjustment cannot be obtained, replace the defective springs.

b. Counterpoise cylinder wrenches, described in TM 9-235, will be used to adjust the counterpoise springs.

c. Note the points of attachment of the counterpoise cylinders. These should be well lubricated and should give full support to the counterpoise cylinders as the carriage is raised or lowered.

d. Check the connection of the counterpoise spring rods to the brackets on the axle arms. There should be neither binding nor undue looseness at these points. Binding may be due to a bent counterpoise rod, bent pin that is pressed into the end of the rod, or defective bearings on ends of the pin.

18. Elevating and traversing mechanism.—*a.* Test for backlash. If this exceeds $\frac{1}{4}$ turn of the handwheels, disassemble.

b. Check the mounting of the handwheel and shaft brackets to the top carriage for looseness.

c. Note the operation of the two speed ratios in the elevating and traversing mechanism of the M3 and M3E1 carriages.

d. Listen for any chattering sounds in the gear cases that would indicate defective gears, poor gear meshing, or defective bearings.

e. The handwheel loads of the complete elevating gears of the M3 carriage without the elevating rack or sight will not exceed 3 pounds for high speed or $\frac{1}{2}$ pound for low speed.

19. Foot-firing mechanism.—Note the action of the foot-firing pedal and lock. When the pedal is depressed, the gun fires. When foot pressure is removed from the pedal, the firing mechanism should spring back to its initial position and the pedal should lock. If it does not do this, check the entire mechanism for binding or weak or broken springs.

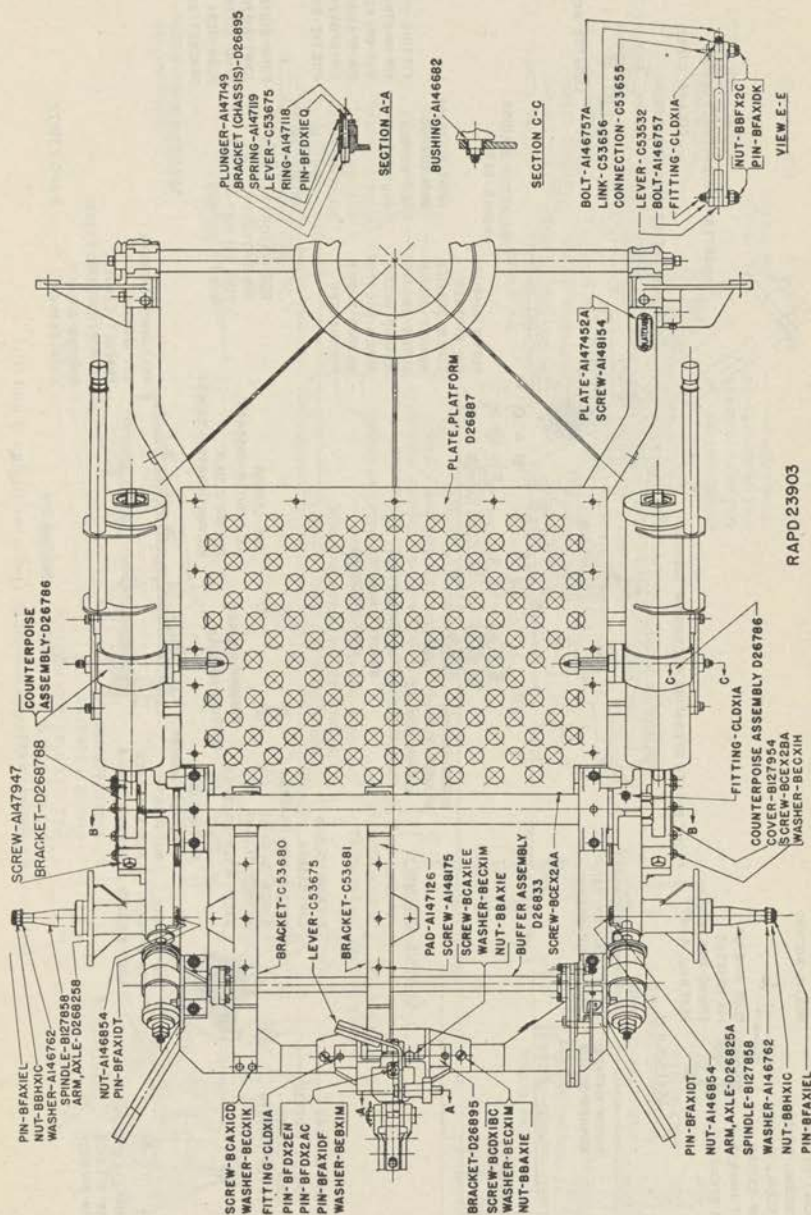


FIGURE 3.—Chassis assembly (pertains to fig. 2).

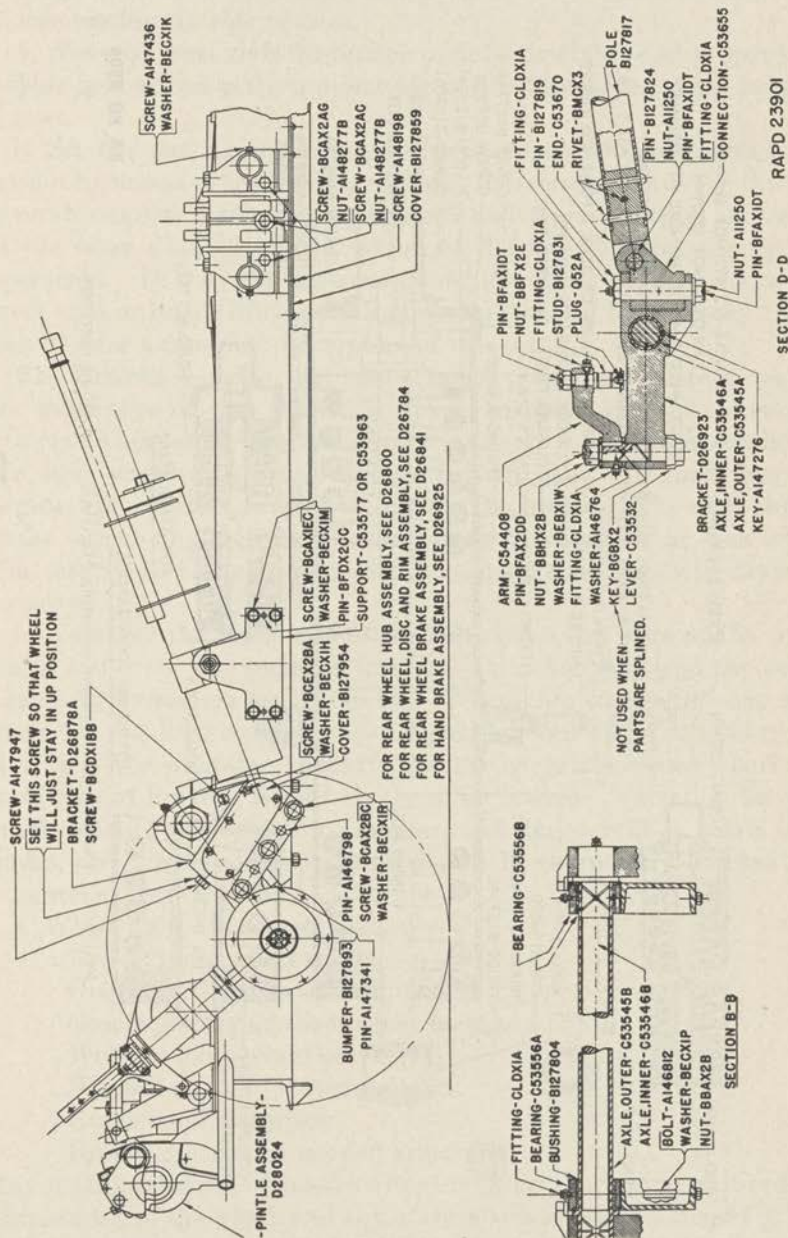
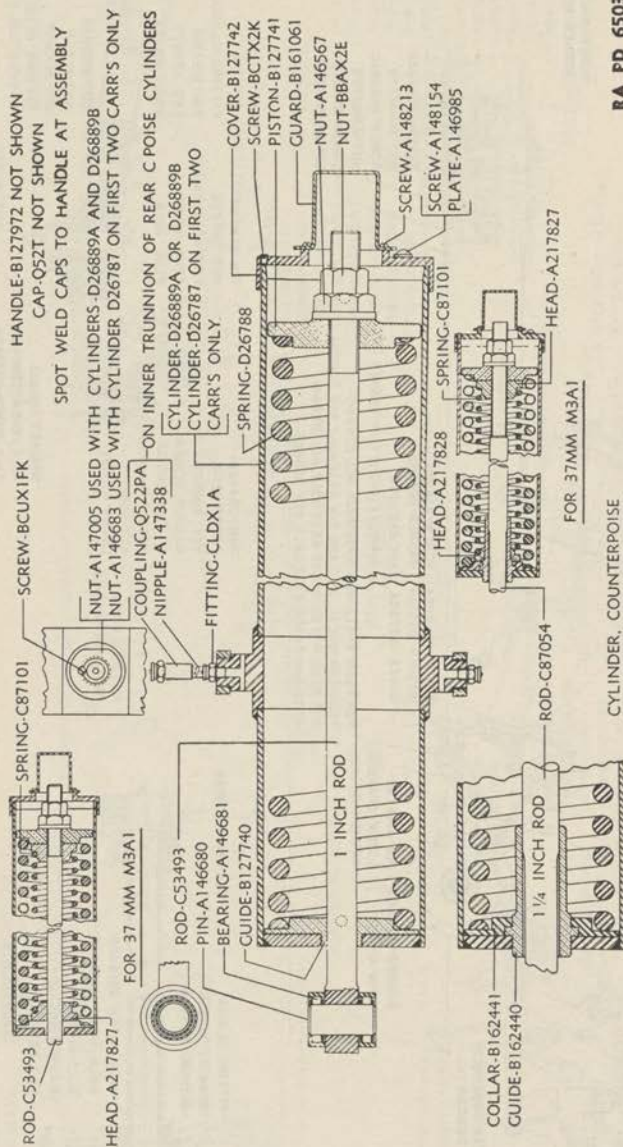


FIGURE 5.—Chassis assembly (pertains to figs. 2 and 3).



RA PD 6503

FIGURE 6.—Counterpoise cylinder assembly M3, M3E1, and M3A1 carriages.

20. Leveling mechanism.—*a.* Operate both leveling screws through their entire range to note their action. There should be no undue binding in this motion.

b. Note the level vials for broken or defective tubes and proper level bubble indications as the top carriage is tilted by means of the leveling screws.

c. Set the carriage in firing position on a smooth hard surface and level it by means of the leveling screws. Traverse the carriage through several complete revolutions and elevate and depress the gun and cradle at the same time. Note the action of the level bubbles during this operation. If they do not remain on the scale, adjustment of the level vials or repair of the leveling mechanism will be necessary. (See par. 41*d* for a complete description of this test.)

21. Brakes.—*a.* Wiring, connections, plugs, and battery require the same type of care that this type of material gets on automotive vehicles in order to provide electric current for brake operation at the four wheels. A truck storage battery that will turn over the engine has sufficient current to operate the brakes. The disk electric brake circuit in good condition will draw $2\frac{1}{2}$ amperes at each wheel. The lever type electric brake circuit in good condition will draw 2.2 amperes.

b. To check the brake circuit disconnect the live wire at the wheel brake and place the ammeter in series with that wire and the brake. Leave the other brakes in circuit. When this connection has been made, set the load control at No. 4 position and apply the controller full on. The ammeter should indicate the values stated above for each type of brake. Repeat on the other brakes. Variation between brakes should not exceed 0.1 ampere. If the current is below these limits, the wires and connections should be thoroughly checked and repaired as required.

c. Wheel units are subject to—

Brake lining wearing out.

Grease getting in and on lining.

Grease getting on the magnet facing.

Worn or loose wheel bearings.

Warped and out of round drums.

Brake band distortion.

Broken springs or warped armature.

Any malfunctioning of brakes after checking the wiring will require disassembly of the wheel, and any of the above conditions should be corrected or new parts installed. A glazed magnet facing due to grease can be roughened by coarse emery cloth.

d. Insert the feeler gage in the inspection hole and between brake lining and drum (fig. 39). Clearance should be 0.010 inch.

22. Equilibrator.—*a.* Elevate and lower the cradle and gun several times. Note the force required on the handwheels and the motion of the cradle. The cradle should rotate smoothly in its bearings and the handwheel forces should not become excessively great.

b. The two nuts screwed to the end of the piston rod can be adjusted to vary the compression of the equilibrator spring or springs. As the nuts are turned further on to the rod, it will be easier to elevate the cradle and harder to depress it. Equilibrator cylinder wrenches, described in TM 9-235, are used to make the adjustments on the equilibrator cylinder.

c. If adjustment of the equilibrator cannot properly balance the gun and cradle, the spring or springs will have to be replaced.

23. Cradles.—*a.* Remove the gun from the cradle and examine the gun slides of the cradle. These slideways should be straight and smooth, showing no signs of wear or rubbing action caused by a loose fitting of the gun in the cradle.

b. Inspect the elevating rack for the condition of the teeth.

c. Elevate and depress the cradle and examine the action and assembly of the trunnion bearings. There should be no indications of binding or looseness.

d. Examine the cradle for broken or bent parts and for broken welds.

24. Outriggers.—Examine the outriggers for the following:

Bent or broken plates.

Broken welds.

Operation about the hinge pin.

Operation of turnbuckle in firing and traveling positions.

25. Wheel alinement.—*a. Checking angles.*—Check the angles in both front wheels in the following order:

(1) King pin inclination.

(2) Camber.

(3) Caster.

(4) Toe-in and toe-out.

b. Preparations for checking alinement.—Before checking the alinement of the front wheels, perform the following operations:

(1) Inflate all tires to recommended pressure.

(2) Check wheel and tire run-out (wobble) and eccentricity.

(3) Check brakes for dragging.

(4) Check wheels for proper balance.

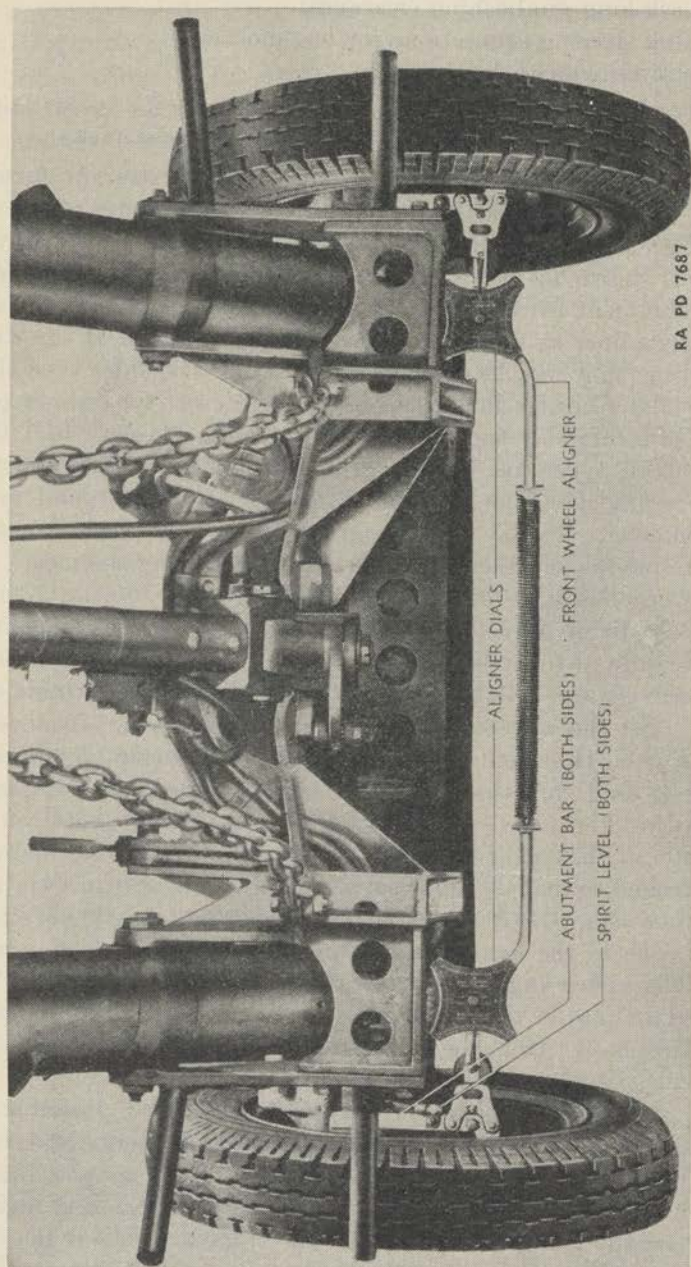
- (5) Check front wheel bearing adjustment.
- (6) Check king pin bushing clearance.
- (7) Check steering connections for lost motion.
- (8) Place vehicles on level floor.

NOTE.—The instruments used in checking wheel alinement are similar in principle to, though not identical with, those illustrated in this paragraph.

c. Checking alinement.—Set the front wheels in straight forward position, with the drawbar in a direct line with the center of the carriage. Place the wheel aliner between the front wheels in a vertical position as shown in figure 7. Check with a spirit level and make sure the abutment bars are both perfectly level. Care must be taken to force the aliner as far as possible into the curvature of the wheel. Dial readings may now be taken at each wheel. The older type aliner will give dial readings in inches only. The newer type aliner gives readings in inches and degrees, showing the pitch of each wheel. The dials on both types are graduated to accommodate various wheel diameter sizes. Use the dials which most nearly correspond to the wheel diameter. If the pitch is greater than 2° , check for worn bushings, spindles or other worn parts in the steering assembly. Replacing worn bushings or spindles is the only way to correct faulty camber. A direct adjustment cannot be made because camber is a built-in feature of the axle.

d. Checking caster.—Jack up the front axle so that the wheels clear the floor. Set the wheels in straight-forward position. Remove the hub caps from the front wheels and place the caster gage against the wheel, being sure that the gage is level according to the spirit level. Adjust the gage so that its left spring plunger seats into the lathe center at the end of the wheel spindle (fig. 8). Swing the wheel spindle around so that the right spring plunger will seat into the same lathe center (fig. 9). To do this the right plunger will have to be adjusted, due to the caster angle, thus causing the scale pointer to indicate the caster angle in degrees. The fact that the front wheels are jacked up must be taken into consideration when reading the caster angle. Deduct $\frac{3}{4}^{\circ}$ from the reading on the gage to obtain the actual caster angle. Replace bent parts if caster is incorrect.

e. Checking front wheel toe-in.—(1) Place the wheel aliner between the front wheels in a horizontal position as shown in figure 10, leveling both ends with spirit levels. Press the aliner as far as possible into the curvature of the wheels. Turn the wheels until one dial registers zero. Press the front wheels apart at the front to take out the slack, keeping the pointer on one dial at zero. The other dial will then register the combined toe-in of the two front wheels in inches.



RA PD 7687

FIGURE 7.—Front wheel camber.

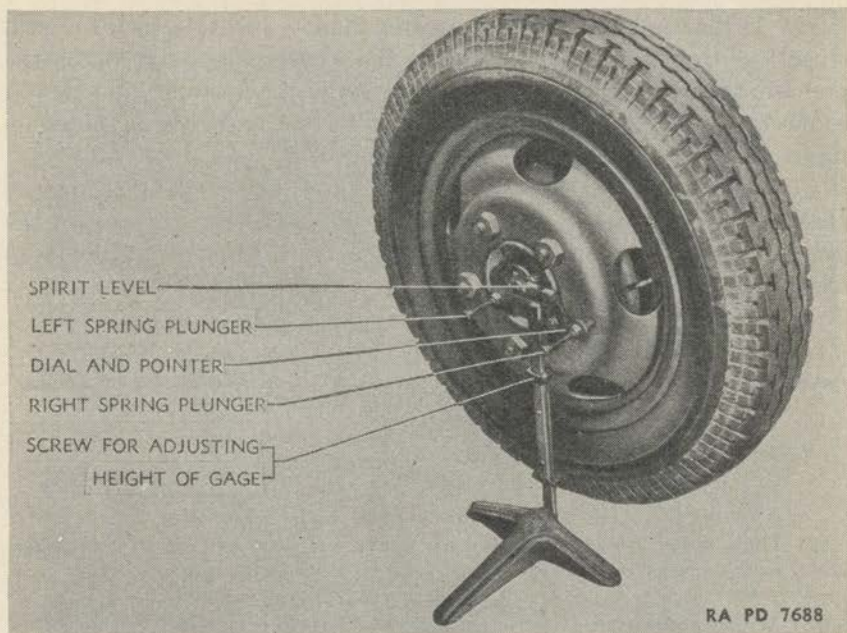


FIGURE 8.—Caster gage w/left spring plunger in wheel spindle lathe center.

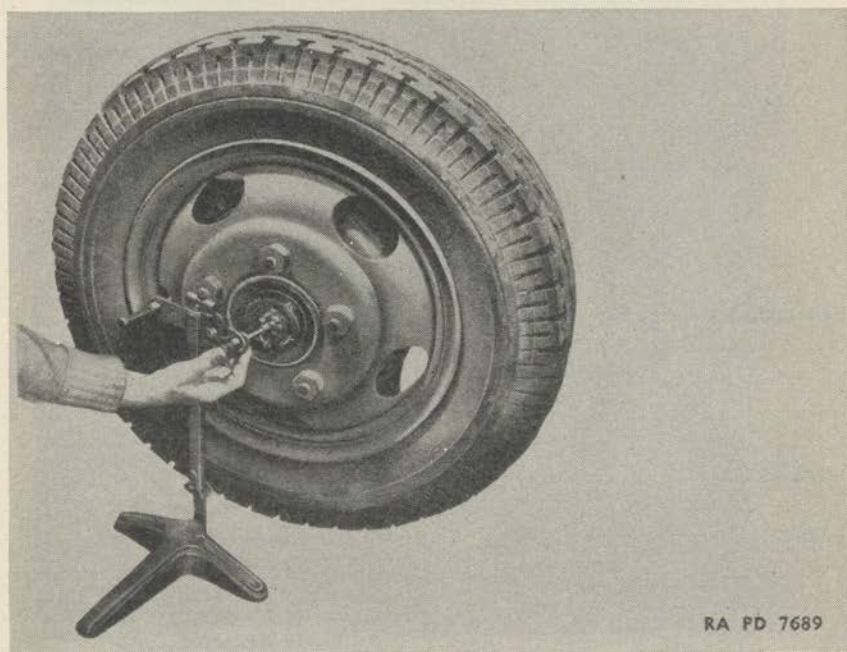


FIGURE 9.—Caster gage w/right spring plunger in wheel spindle lathe center for gage reading.

(2) If the combined toe-in is greater than $\frac{1}{4}$ inch ($\frac{1}{8}$ inch for each wheel) as shown on figure 11, press the wheels apart and watch the pointer; this will show the amount of play in the bushings and tie rod connections. Do likewise if a combined toe-out registers, as shown on figure 12.

f. Wheel alinement malfunctions.—All alinement angles are so closely related that any change of one will automatically change the others. The following list represents the more common difficulties in wheel alinement.

<i>Malfunction</i>	<i>Possible cause</i>
(1) Shimmy (generally exists at speeds below 30 mph).	(1) (a) Tire pressure incorrect. (b) Tires of unequal size or weight. (c) Wheel bearings loose. (d) Steering mechanism loose. (e) Too much caster. (f) King pins and bushings worn. (g) Tie-rod ends loose.
(2) High speed wheel tramp (generally exists at speeds above 35 m.p.h.).	(2) (a) Tire and wheel assemblies out of balance. (b) Buffer assemblies ineffective.
(3) Wander or weave.	(3) (a) Tire pressure incorrect. (b) Tires of unequal size. (c) Bent spindle. (d) Wheel bearings loose. (e) King pins and bushings worn. (f) King pins bent. (g) King pins tight. (h) Steering assembly tight or loose. (i) Too little caster. (j) Too much or too little camber. (k) Too much or too little toe-in. (l) Tie-rod ends tight or loose. (m) Front axle bent. (n) Front axle shifted.
(4) Hard steering.	(4) (a) Tire pressure low. (b) Wheel spindle bent. (c) King pin assembly poor fit. (d) Steering assembly tight. (e) Tie-rod ends tight. (f) Caster excessive.
(5) Uneven tire wear.	(5) (a) Tire pressure low. (b) Excessive camber. (c) Wheels out of balance. (d) Tires overloaded. (e) Eccentric wheels or rims. (f) Caster incorrect. (g) Toe-in incorrect.

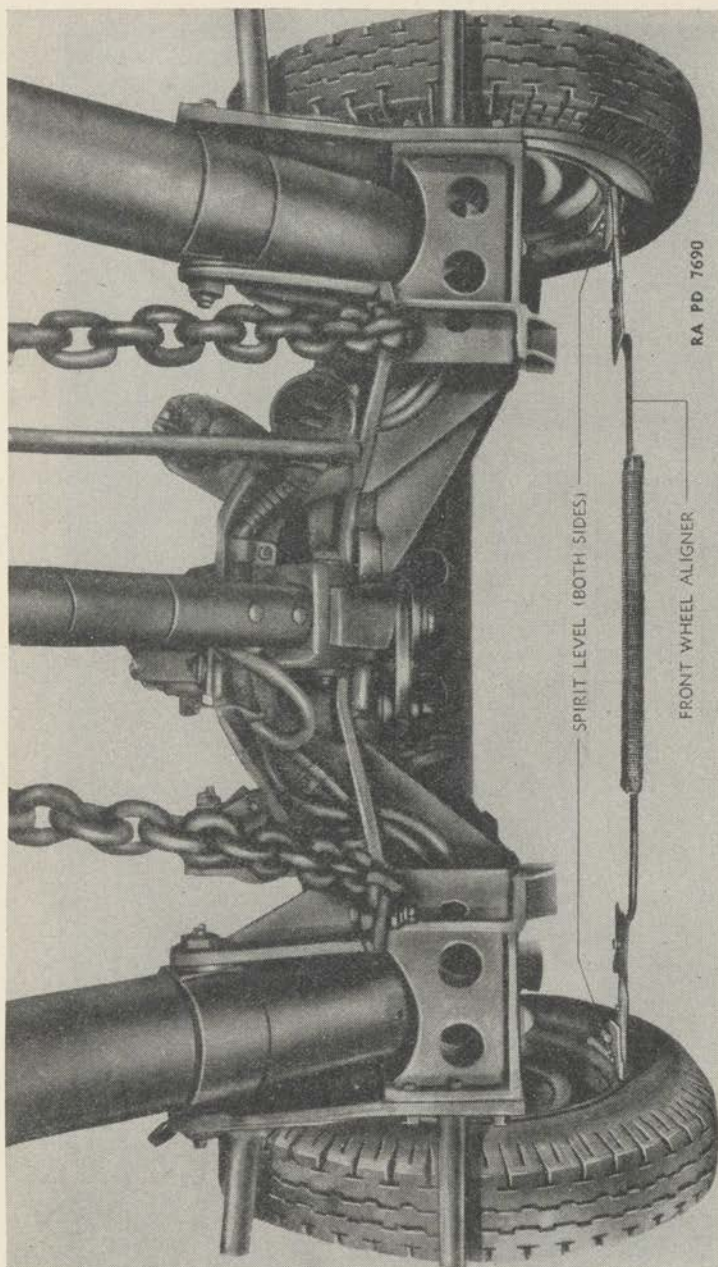


FIGURE 10.—Front wheel toe-in.

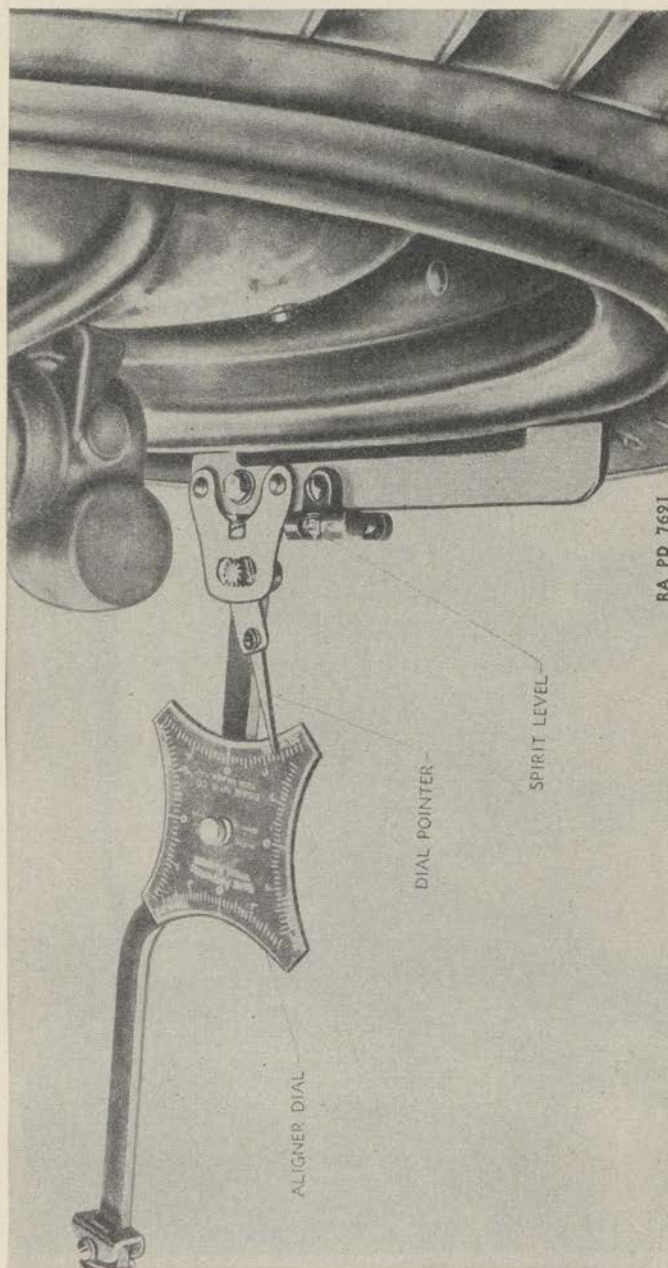
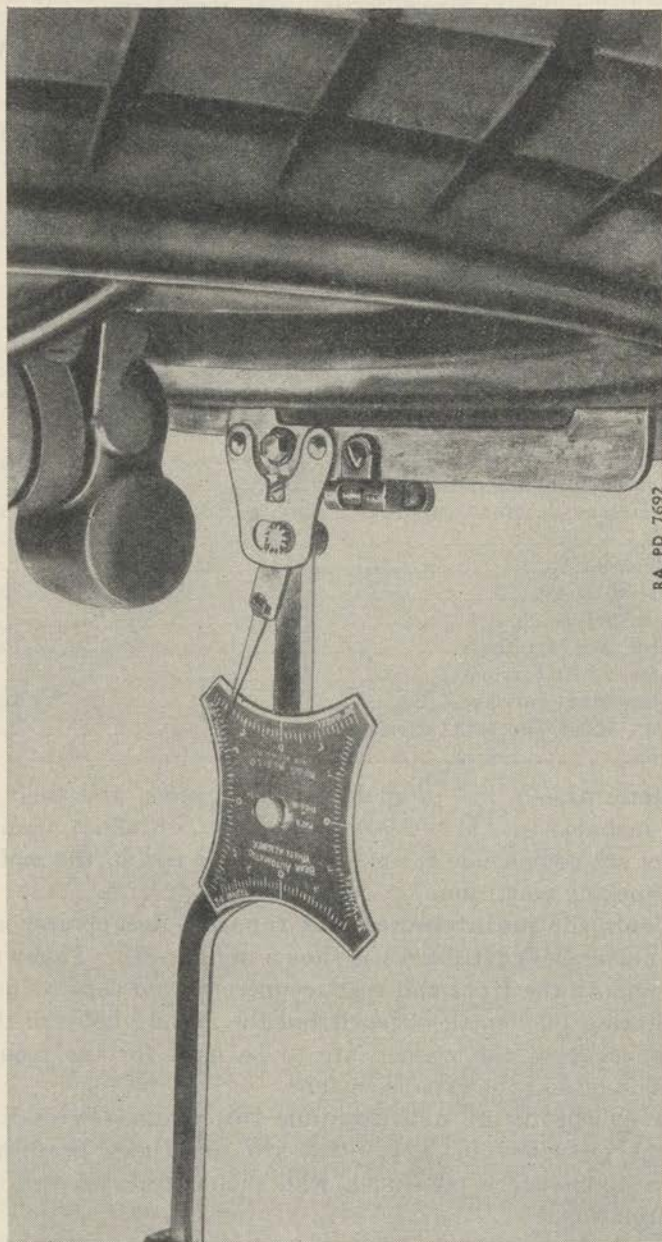


Figure 11.—Scale reading showing 1 3/8 inches exaggerated toe-in.



RA PD 7692

FIGURE 12.—Scale reading showing $1\frac{3}{4}$ inches exaggerated toe-out.

SECTION III

MAINTENANCE AND REPAIR

	Paragraph
General.....	26
Tools for maintenance and repair.....	27
Overlapping of maintenance functions.....	28
Recuperator mechanism.....	29
Driving spring assembly.....	30
Chassis.....	31
Buffer mechanism.....	32
Outtrigger assembly.....	33
Electrical circuit.....	34
Traversing mechanism, M3 and M3E1 carriages.....	35
Traversing mechanism, M3A1 carriage.....	36
Elevating mechanism, M3 and M3E1 carriage.....	37
Elevating mechanism, M3A1 carriage.....	38
Foot-firing mechanism, M3 carriage.....	39
Foot-firing mechanism, M3A1 carriage.....	40
Leveling mechanism, M3 and M3E1 carriages.....	41
Leveling mechanism, M3A1 carriage.....	42
Wheels.....	43
Wheel alinement.....	44
Lever type of brakes.....	45
Disk type of brakes.....	46
Equilibrator, M3 carriage.....	47
Equilibrator, M3E1 carriage.....	48
Equilibrator, M3A1 carriage.....	49
Cradles, M3, M3E1, and M3A1 carriages.....	50
Lubrication.....	51

26. General.—A list of malfunctions, causes, and their corrections is included in TM 9-235. In addition, ordnance maintenance personnel are responsible for maintaining the rest of the matériel in proper working condition.

27. Tools for maintenance and repair.—Recuperator and piston rod nut wrench (B163290) is shown in figure 13. This wrench is used to remove the front and rear recuperator end caps by means of the projecting pins on the wrench and the mating holes in the caps. The open ends of the wrench are to be used for the recuperator piston rod nut and the expansion tube.

28. Overlapping of maintenance functions.—Second echelon operations described in TM 9-235 are sometimes performed by ordnance maintenance personnel, who should refer to this manual for information.

29. Recuperator mechanism.—*a. Adjustment.*—(1) One of the reasons why the tube, tube extension, and lock frame do not come

into battery is a weak or broken recuperator spring. If the recoiling parts are more than $\frac{1}{8}$ inch out of battery, the gun will not function. Before attempting to replace or adjust the recuperator springs, the rest of the gun mechanism should be checked carefully to see that no other malfunction is present.

(2) If necessary to adjust the recuperator mechanism, the following procedure should be carried out: remove the recuperator front end cap (B163280, fig. 14) and packing with the wrench (B163290) supplied for this purpose and catch the recoil oil in a clean dry con-

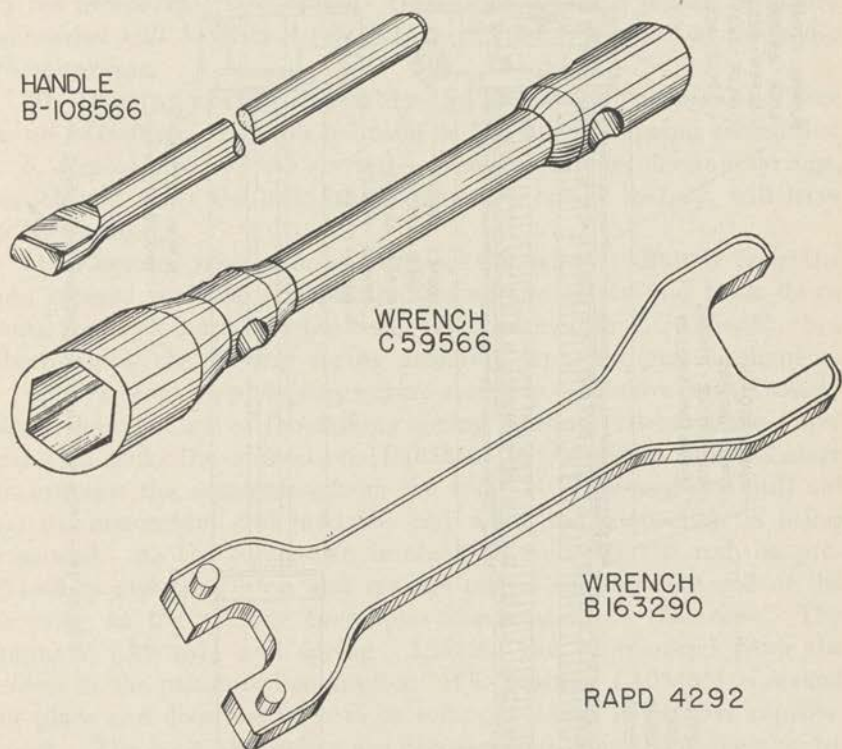
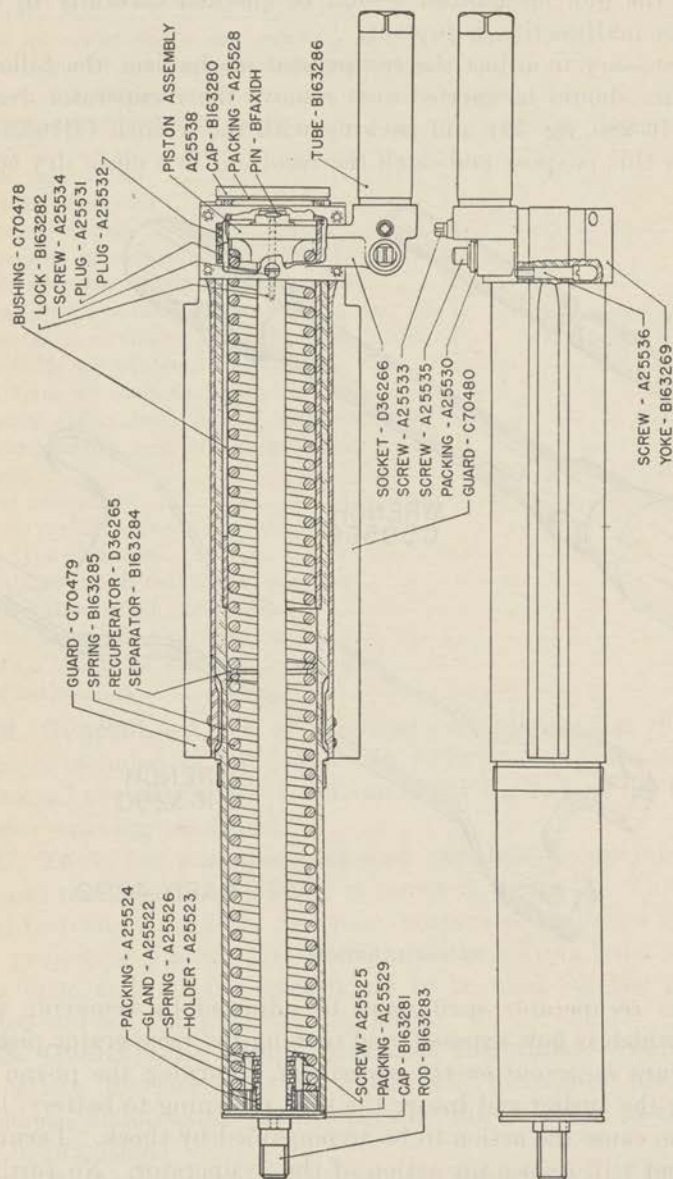


FIGURE 13.—Tools.

tainer. The recuperator spring can be adjusted by removing the cotter pin, which is now exposed, and turning the recuperator piston about *one turn in or out on the piston rod*. Turning the piston in will tighten the spring and insure the tube returning to battery, but this will also cause the action to be accompanied by shock. Turning the piston out will reduce the action of the recuperator. No further adjustment of the piston is permissible and the cotter pin should be replaced at the end of the adjustment. Replace the cap and packing

and refill the recuperator with a fresh supply of oil, recoil, light. The action of the recuperator can then be tested by firing the weapon and noting the recoiling and counterrecoiling action.



RA PD 4305

FIGURE 14.—Cross section of recuperator assembly.

(3) TM 9-850 describes the proper methods of handling and using recoil oils.

b. Replacement of the recuperator springs.—Replacement of the recuperator springs will be necessary if they are broken or if adjustment will not cause the mechanism to function properly.

Caution.—*The operation of changing recuperator springs will not be given at this time since no spring compressor is available for issue. It is extremely dangerous to disassemble the recuperator mechanism without a suitable spring compressor and a perfect working knowledge of the recuperator mechanism. Until such a tool is issued, ordnance personnel will have to devise their own tool or method of replacing these springs.*

30. Driving spring assembly (fig. 15).—*a. Adjustment.*—There is no adjustment that can be made on the driving spring assemblies.

b. Replacement of the springs.—Weak or broken driving springs, which will cause the lock frame to remain out of battery, will have to be replaced.

(1) *Removal from gun.*—Disengage the safety (A25462) from the pin secured to hook (B163252). Swing the safety and hook down until the hook snaps into position. Pull back on knob (A25455), thus disengaging the driving spring assembly from the gun mechanism.

(2) *Disassembly of driving spring assembly.*—Remove cap (A25454) from the front end of the driving spring housing. Remove the cotter pin that locks the connection (B163251) to the piston rod and start to unscrew the connection from the rod. It is necessary to pull out on the connection and hold the rod while the connection is being removed. As the connection is about to come off the rod, be prepared to ease the piston and springs out of the opposite end of the housing as *the springs have some compression at this time*. The plunger (A25461) and spring (A25466) can be removed from the recess in the piston rod connection. The bushing (A25460) is staked in place and does not have to be removed unless it requires replacement. The hook and safety are disassembled from the connection by removing the cotter pin and pin (A25456) used to secure these parts in place. The mechanism used for coupling the driving spring tube to the tube extension can be disassembled in the following manner: remove pin (A25459) and unscrew knob (A25455); remove the plunger (A25458) and spring (A25467) from the front end of the housing.

(3) *Assembly of driving spring assembly.*—Follow the reverse order of disassembly. Before replacing cap (A25454), flush the inner parts with oil, engine, SAE 10 (below 32° F.) or SAE 30 (above 32° F.) and allow to drain. Then replace the cap.

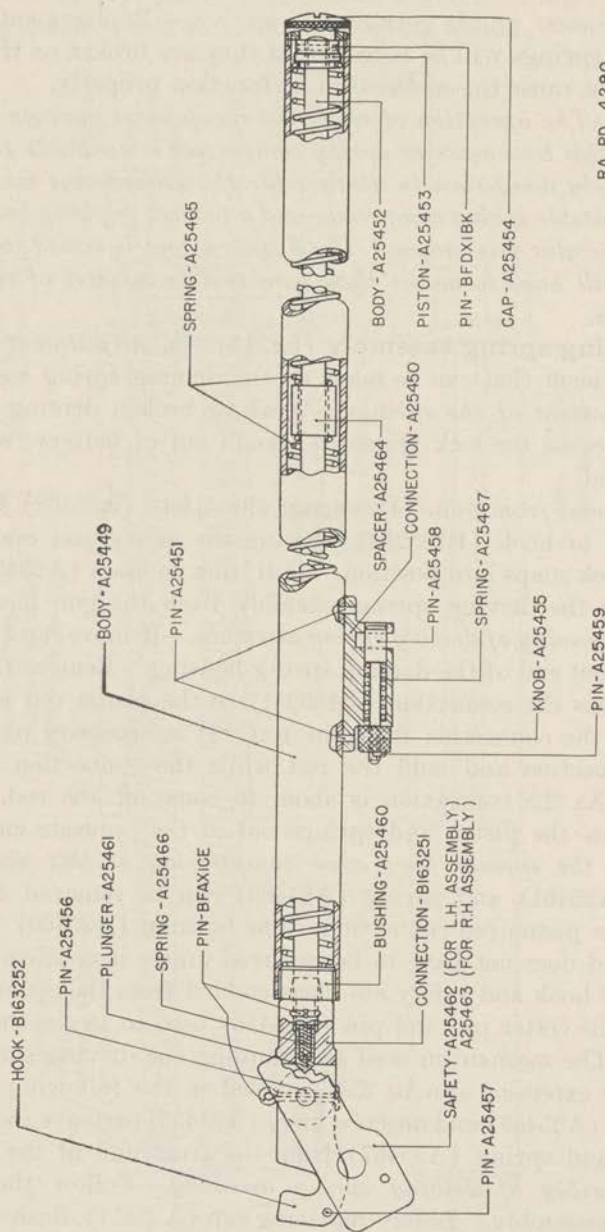
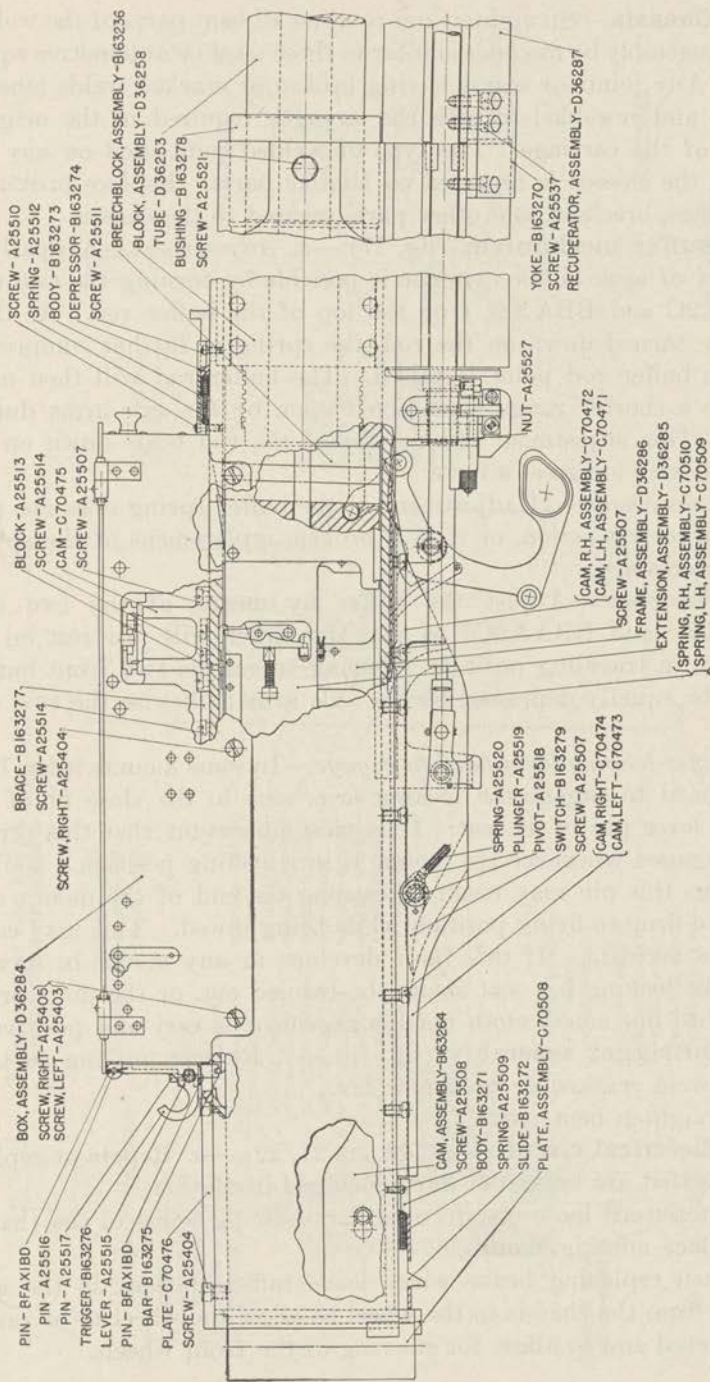


Figure 15.—Driving spring assembly.

RA PD 4290



RA PD 23900

FIGURE 16.—Breech mechanism assembly.

31. Chassis.—Straighten and re-align all bent parts of the welded chassis assembly by methods similar to those used on automotive equipment. Any joints or seams having broken or cracked welds must be cleaned and rewelded to give the strength required in the original design of the carriage. The type of welded joint used on any one part of the chassis is repeated on similar parts. Replace broken or bent rivets, brackets, and other parts secured to the chassis.

32. Buffer mechanism (fig. 17).—*a. Adjustment.*—A small adjustment of each buffer cylinder is possible by turning the two nuts (BBCX2C and BBAX2C) on the top of the buffer rod. As these nuts are turned down on the rod, the spring is further compressed and the buffer rod point is raised. The buffer rod will then move through a shorter range when acted upon by the axle arms during travel. This adjustment can be used if the rod bears down on the axle arm with too great a force.

b. Replacement.—If adjustment of the buffer spring does not produce the correct action, or if it is broken, replacement of the spring will be necessary.

c. Adjustment.—Adjust the buffer by means of the two nuts (BBCX2C and BBAX2C) so that the buffer will just rest on the axle arm in traveling position. During travel the two front buffers should be equally depressed by the axle arms; likewise the two rear buffers.

d. Buffer locking lever hard to engage.—In some mounts it has been found hard to engage the locking lever due to the close fit of the locking lever pin in its seat. It is most important that this pin be fully engaged whenever the mount is in traveling position. Failure to engage this pin may result in causing the end of the mount concerned to drop to firing position while being towed. This may cause a serious accident. If this fault develops in any mount in service, either the locking pin seat should be reamed out, or the pin worked down with fine emery cloth until engagement is easy and positive.

33. Outrigger assembly (fig. 18).—*a.* Replace missing parts.

b. Reweld cracked or broken welds.

c. Straighten bent parts.

34. Electrical circuit (figs. 19, 20, 21, 22).—*a.* Repair or replace all wires that are broken or have damaged insulation.

b. Tighten all loose clamps used for securing wires to the chassis and replace missing clamps.

c. When replacing brake wires, leave sufficient slack in the wire leading from the chassis to the wheel to allow the wheel to be raised and lowered and to allow for steering of the front wheels.

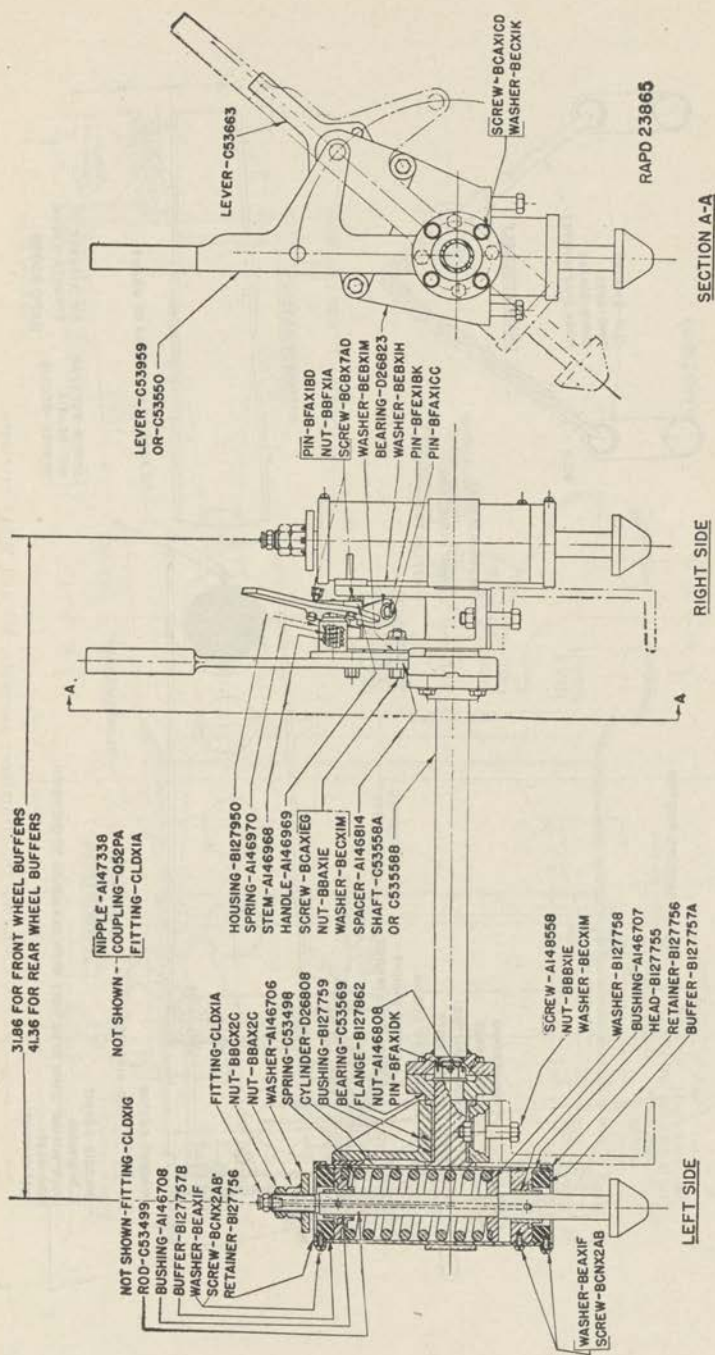


FIGURE 17.—Buffer assembly.

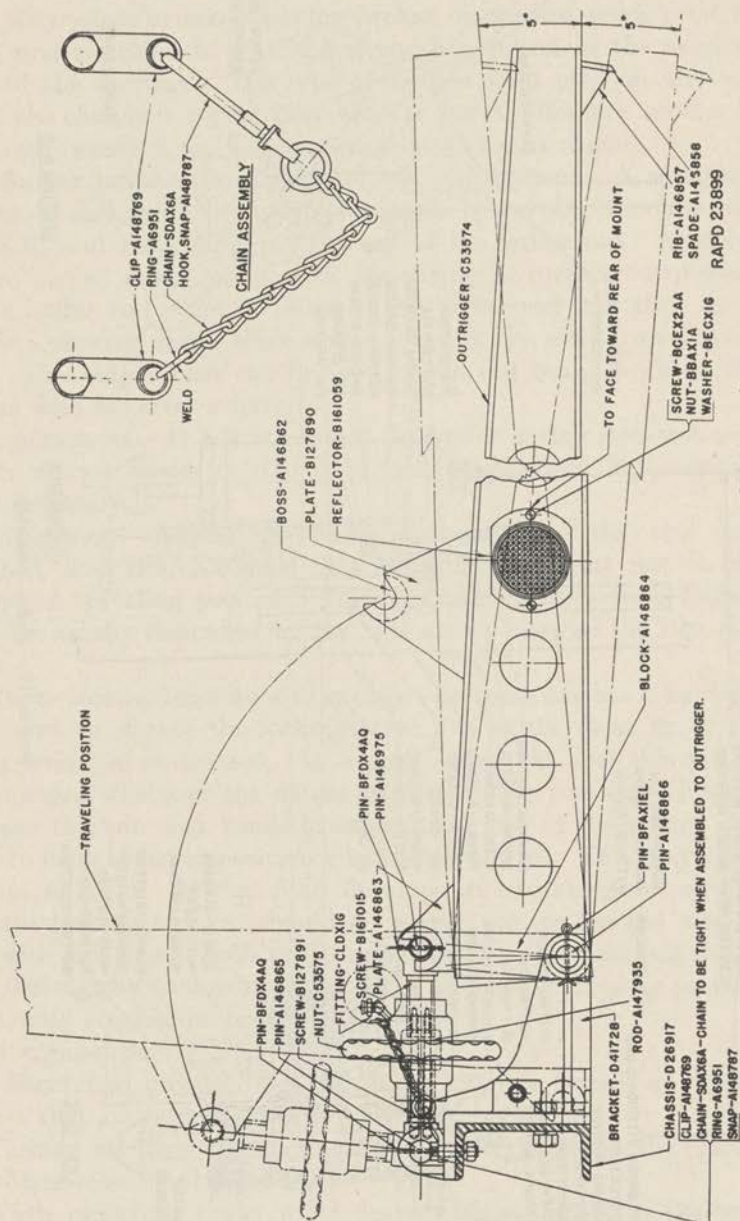
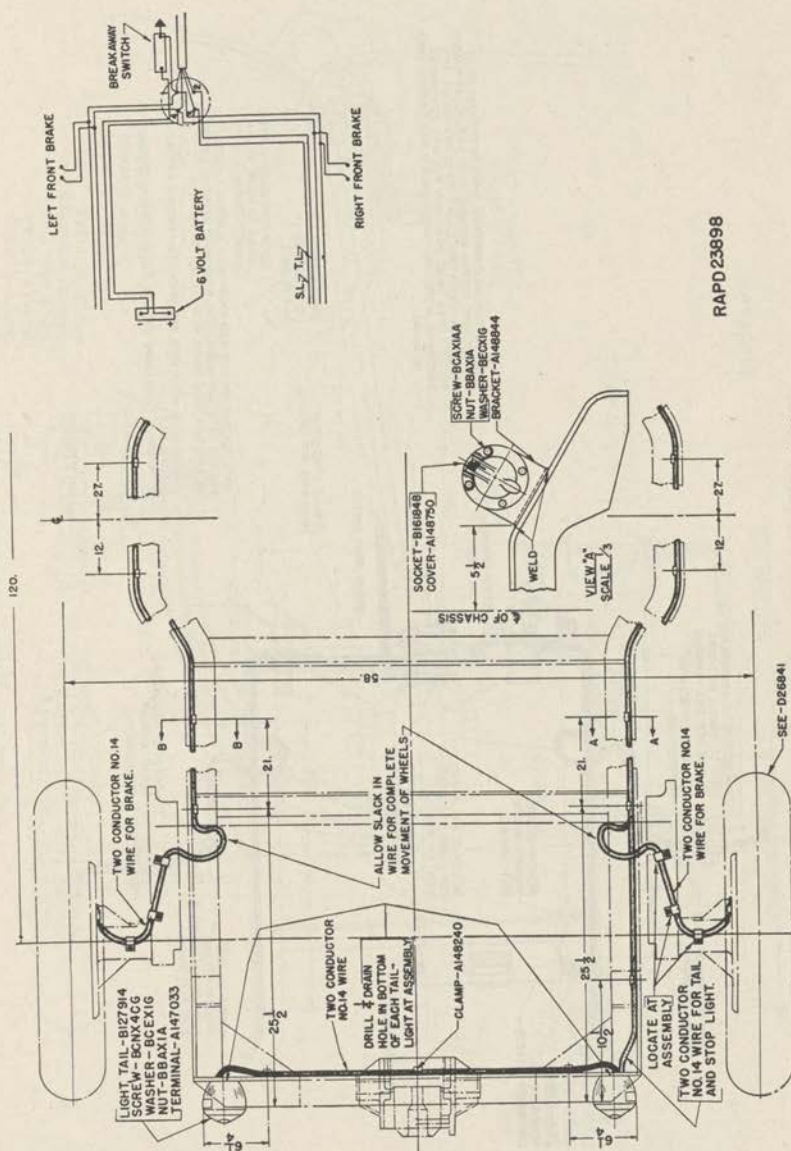


FIGURE 18.—Outrigger assembly, M3 and M3A1 cartridges.



RAPD23898

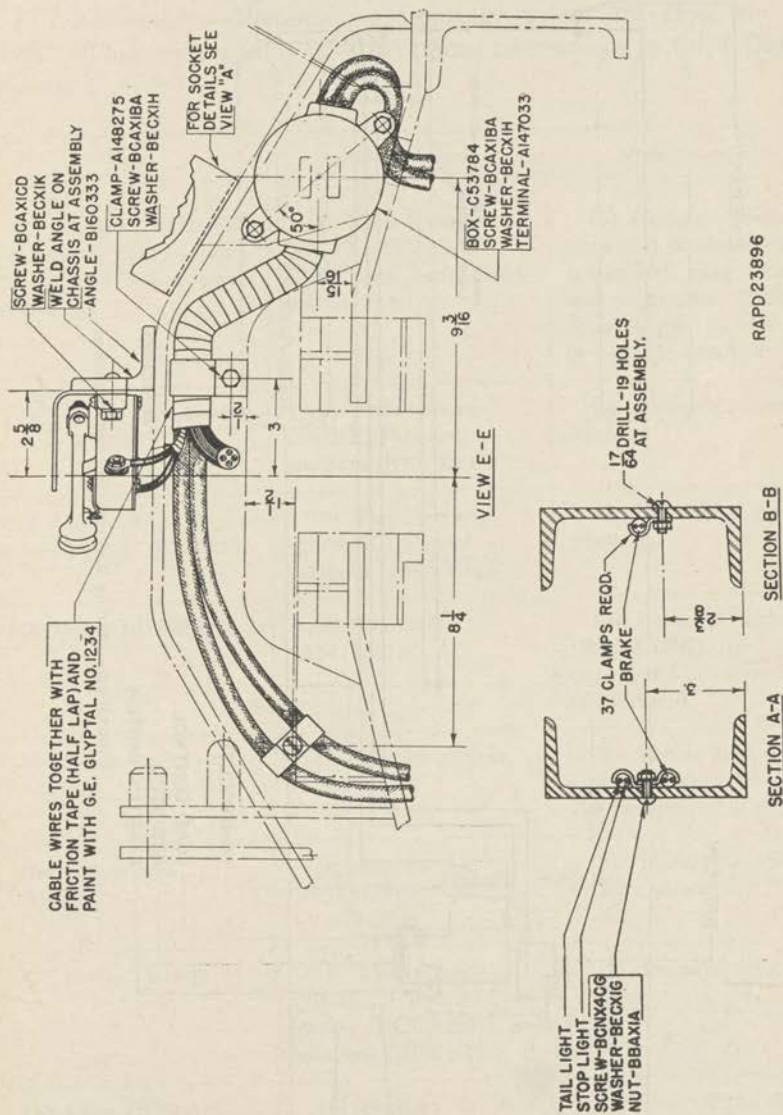
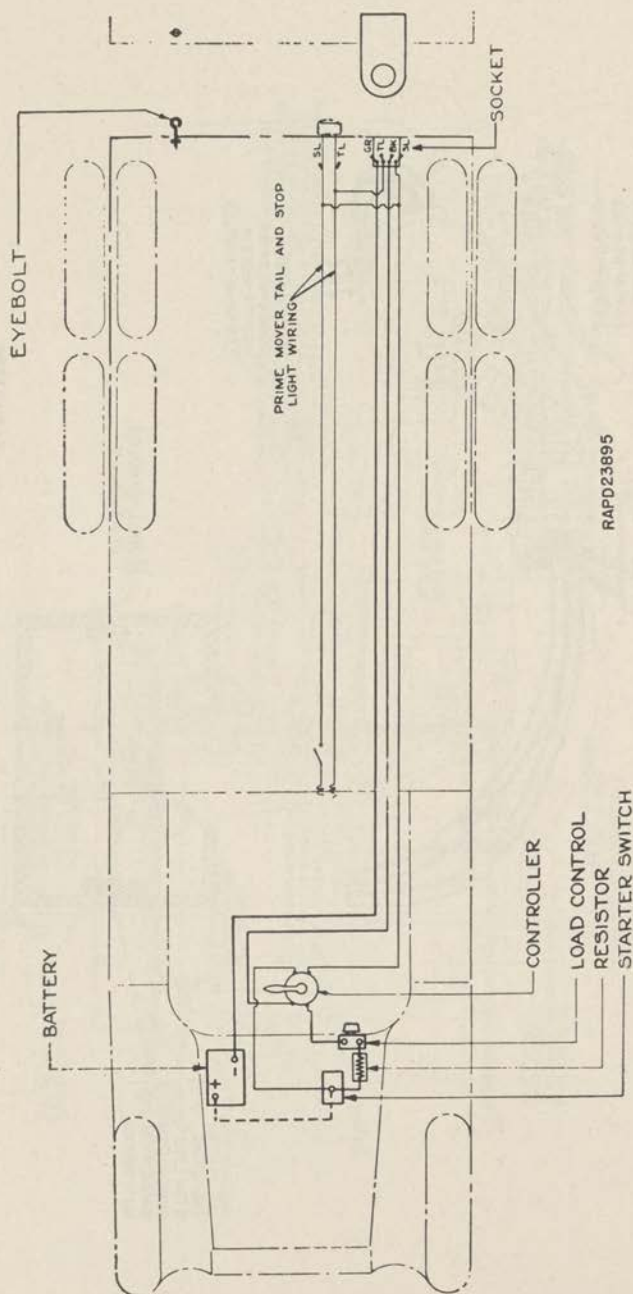


FIGURE 21.—Wiring arrangement and diagram.



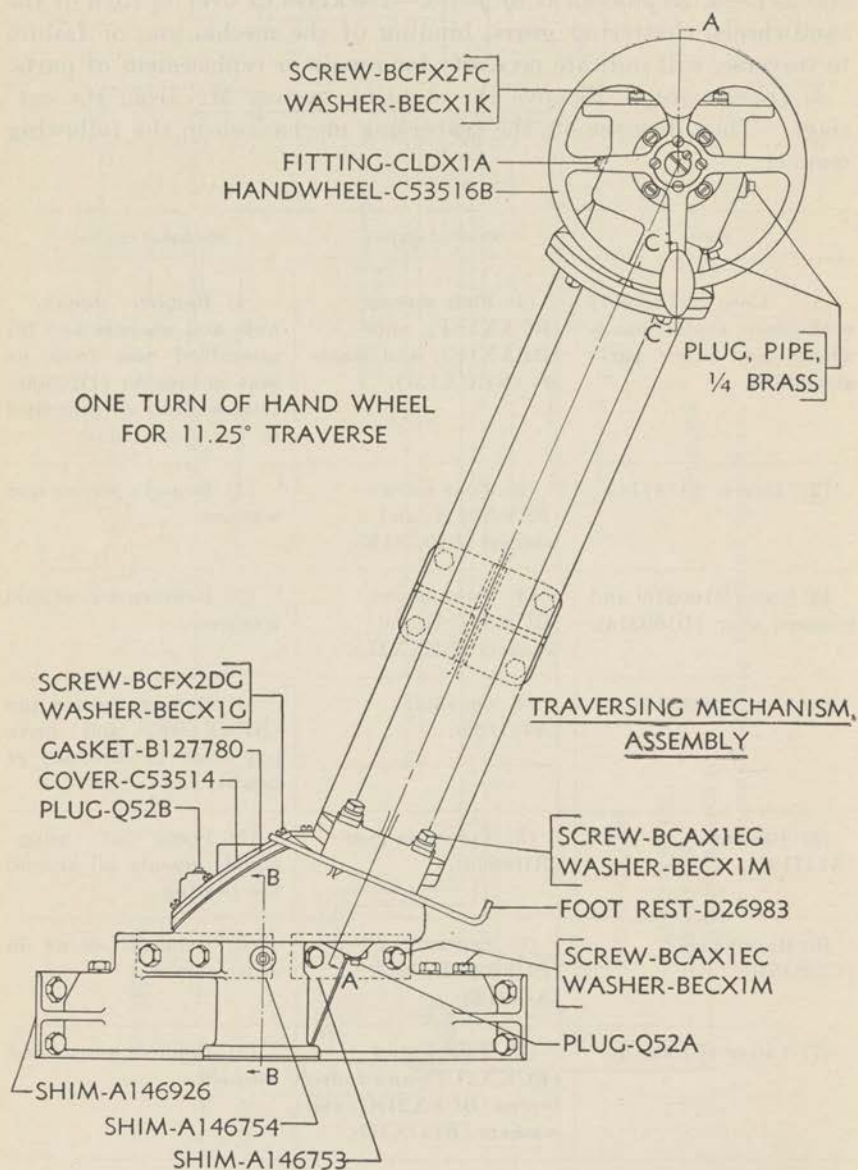
RAPD23895

FIGURE 22.—Wiring diagram for prime mover.

35. Traversing mechanism, M3 and M3E1 carriages (figs. 23 and 24).—*a. Replacement of parts.*—Backlash of over $\frac{1}{4}$ turn of the handwheels, chattering gears, binding of the mechanism, or failure to traverse, will indicate necessity for repair or replacement of parts.

b. Disassembly.—Remove the sighting system M2 from the carriage. Then disassemble the traversing mechanism in the following manner:

Part	Means of support	Method of removal
(1) Case (D26901) with gears, shafts, handwheels and other parts assembled.	(1) Four screws (BCAX1EF), nuts (BBAX1E), and washers (BECX1M).	(1) Remove screws, nuts and washers and lift assembled case from its seat on bracket (D26900). Disassemble as described in the steps below.
(2) Cover (A147144).	(2) Four screws (BCFX2FG) and washers (BECX1K).	(2) Remove screws and washers.
(3) Case (B160316) and inclosed gear (B160314).	(3) Four screws (BCAX1CA) and washers (BEAX1L).	(3) Remove screws and washers.
(4) Gear (B160314).	(4) On shaft (A147136).	(4) Remove cotter pin (BFAX1BE) and drive out shaft in direction of headed end.
(5) Bearings (A147135).	(5) Forced in gear (B160314).	(5) Force out, using equal pressure all around the bearing.
(6) Handwheel (C53515B).	(6) Screws (BCFX2BB) and (A147133).	(6) Remove screws in order named.
(7) Cover (B160315).	(7) Two screws (BCKX2CF) and four screws (BCFX2DG) and washers (BECX1G).	(7) Remove screws and washers.
(8) Gear (B160310).	(8) Splined to shaft (B160312).	(8) Pull off the shaft.
(9) Nut (BBRX1AF) and washer (BEFX1AF).	(9) Screwed to shaft (B160308).	(9) Unscrew.



RA PD 6522

FIGURE 23.—Traversing mechanism, M3 and M3E1 carriages (sections shown in fig. 24).

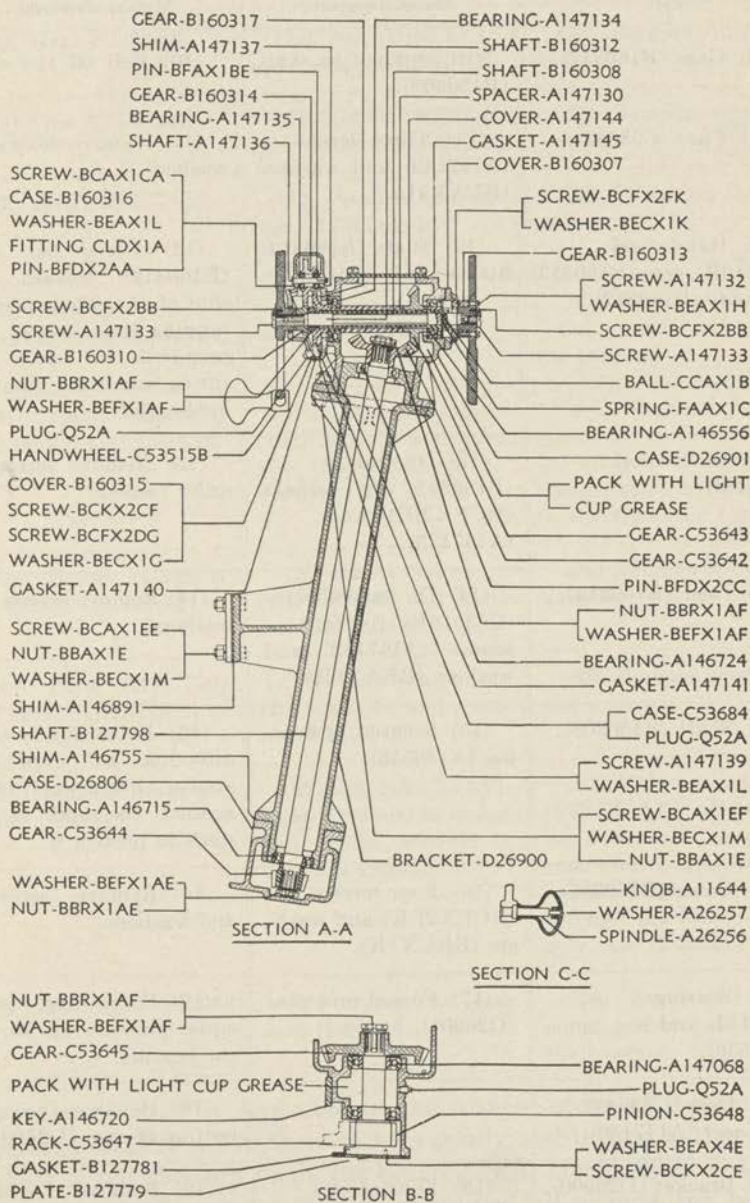


FIGURE 24.—Traversing mechanism sections, M3 and M3E1 carriages (sections pertain to fig. 23).

Part	Means of support	Method of removal
(10) Gear (B160317).	(10) Splined to shaft (B160308).	(10) Pull off the shaft.
(11) Case (C53684).	(11) Three screws (A147139) and washers (BEAX1L).	(11) Remove screws and washers.
(12) Handwheel (C53516B), gear (B160313) and shaft (B160312).	(12) Shaft (B160312) fits in shaft (B160308).	(12) Drive out shaft (B160312) toward the side of the handwheel by tapping opposite end. Be prepared to catch the spring and balls mounted in the shaft.
(13) Handwheel (C53516B).	(13) On shaft (B160312) by screws (BCFX2BB) and (A147133).	(13) Remove screws in order named.
(14) Gear (B160313).	(14) On handwheel (C53516B) by four screws (A147132) and washers (BEAX1H).	(14) Remove screws and washers.
(15) Shaft (B160308).	(15) Secured in bearing (A146556).	(15) Drive out in same direction as step (12) above. Use a wood block against the end of the shaft to protect it.
(16) Cover (B160307).	(16) Four screws (BCFX2FK) and washers (BECX1K).	(16) Remove screws and washers.
(17) Bearings (A147134) and (A146556).	(17) Forced into case (D26901).	(17) Force out, using equal pressure all around the bearing.
(18) Gear (C53643) and spacer (A147130).	-----	(18) Remove through bottom of case (D26901).
(19) Bracket (D26900).	(19) Four screws (BCAX1EE), nuts (BBAX1E), and washers (BECX1M), and four screws (BCAX1EG) and washers (BECX1M).	(19) Remove screws, nuts, and washer and lift the bracket out of its socket in the carriage. Shaft (B127798), its gears, and nuts should lift out with the bracket.

Part	Means of support	Method of removal
(20) Gear (C53642).	(20) Nut (BBRX1AF) and washer (BEFX1AF).	(20) Remove nut and washer.
(21) Gear (C53644).	(21) Nut (BBRX1AE) and washer (BEFX1AE).	(21) Remove nut and washer.
(22) Shaft (B127798).	(22) Secured by bearings (A146715) and (A146724).	(22) Drive out through either end.
(23) Bearings (A146715) and (A146724).	(23) Forced into bracket (D26900).	(23) Force out, using equal pressure all around the bearing.
(24) Case (D26806) with pinion and gears assembled.	(24) Eleven screws (BCFX1EC) and four nuts (BBAX1E) and 11 washers (BECX1M).	(24) Remove screws, nuts and washers and lift assembly from mount and disassemble as described in the following steps.
(25) Cover (C53514) and gasket (B127780).	(25) Seven screws (BCFX2DG) and washers (BECX1G).	(25) Remove screws and washers.
(26) Plate (B127779) and gasket (B127781).	(26) Five screws (BCKX2CE) and washers (BEAX4E).	(26) Remove screws and washers.
(27) Gear (C53645) and pinion (C53648).	(27) Nut (BBRX1AF). Gear is splined to pinion and pinion secured in bearings (A147068).	(27) Unscrew nut (BBRX1AF). Drive pinion down and out of gear and remove gear through upper hole and pinion through the lower hole of gear case (D26806).
(28) Bearings (A147068)	(28) Forced in gear case (D26806).	(28) Force out, using equal pressure all around the bearing.

c. Assembly.—(1) Assemble in the reverse order of disassembly. Bearings must be set in their sockets evenly and in line so that when a shaft is put through them, the bearings will not be displaced. An even amount of pressure should be applied all around the bearing when assembling to a shaft or casing.

(2) Lubricate as specified in paragraph 51.

36. Traversing mechanism, M3A1 carriage (figs. 25 and 26).—*a. Replacement of parts.*—Backlash of over $\frac{1}{4}$ turn of the hand-wheels, chattering gears, binding of the mechanism, or failure to traverse, will indicate necessity for repair or replacement of parts.

b. Disassembly.—The azimuth indicator must be removed and the hydraulic drive gear disconnected from the mechanism. Disassembly will be carried out in the following manner:

Part	Means of support	Method of removal
(1) Crank (C87039).	(1) Secured to sleeve (B162129) by plunger (A148996).	(1) Pull out plunger and lift crank from sleeve.
(2) Sleeve (B162129) with gear (A149004).	(2) Secured to gear (B162130) by screws (BCGX1.1BC) and (A149006).	(2) Remove screws in order given and pull off gear. Be prepared to catch balls and spring in gear and shaft.
(3) Gear (B162130).	(3) Splined to shaft (C54535).	(3) Pull from shaft.
(4) Cover (B162143).	(4) Four screws (BCAX1CA) and washers (BECX1K).	(4) Remove screws and washers.
(5) Shaft (C54535).	(5) Secured in ball bearings (CABX3AG) and (CABX1AG) forced in housing (D42229).	(5) Drive from housing.
(6) Bearings (CABX3AG) and (CABX1AG) and spacer (A149007).	(6) Forced on shaft (C54535) and locked with nut (BBRX1AG) and washer (BEFX1AG).	(6) Remove nut and washer and force bearings from shaft using equal pressure all around bearings.
(7) Housing (D42229) and inclosed shaft (C54580), gear (C54566) and bearings (CABX1AG).	(7) Six screws (BCAX1EC) and washers (BECX1M).	(7) Remove screws and washers.
(8) Gear (C54566).	(8) Splined to shaft (C54580) and locked with nut (BBRX1AF) and washer (BEFX1AF).	(8) Remove nut and washer and force gear from shaft.

Part	Means of support	Method of removal
(9) Shaft (C54580) with coupling (B162131).	(9) Secured in bearings (CABX1AG).	(9) Drive out in direction of coupling.
(10) Coupling (B162131) (outer half).	(10) Splined to shaft (C54580) and locked with cotter pin (BFAX1DK).	(10) Remove cotter pin and force from shaft.
(11) Bearings (CABX1AG).	(11) Forced into housing (D42229).	(11) Force from housing using equal pressure all around bearings.
(12) Housing (C54541) with inclosed pinion (C54549).	(12) Four screws (BCAX1EC) and washers (BECX1M).	(12) Remove screws and washers.
(13) Cover (B162144).	(13) Four screws (BCAX1AA) and washers (BECX1G).	(13) Remove screws and washers.
(14) Pinion (C54549).	(14) Secured in bearings (CAAX1AM) and (CABX1AG) and locked with nut (BBRX1AG) and washer (BEFX1AG).	(14) Remove nut and washer and drive pinion out of bearings.
(15) Bearings (CAAX1AM) and (CABX1AG).	(15) Forced into housing (C54541).	(15) Force out using equal pressure all around bearings.
(16) Housing (D42230) with inclosed shaft (C54576), gear (C54565) and gear (B162147).	(16) Six screws (BCAX1ED) and washers (BECX1M).	(16) Remove screws and washers.
(17) Coupling (B162131, inner half).	(17) Splined to shaft (C54576) and locked with cotter pin (BFAX1DK).	(17) Remove cotter pin and force from shaft.
(18) Gear (B162147).	(18) Splined to shaft (C54576) and locked with nut (BBRX1AF) and washer (BEFX1AF).	(18) Remove nut and washer and force gear from shaft.

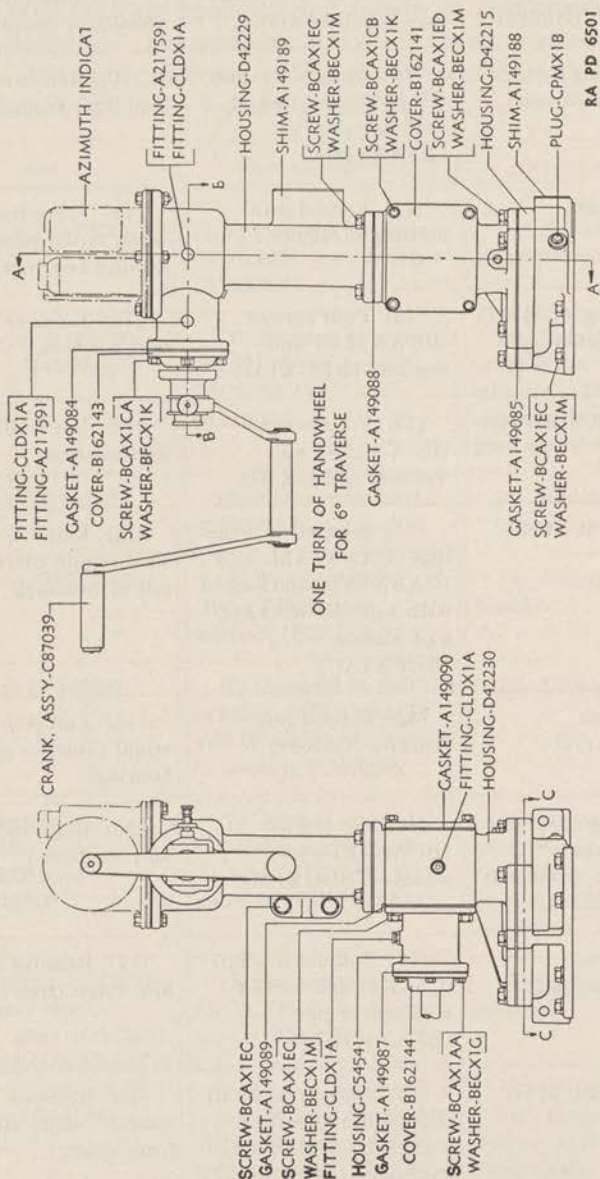
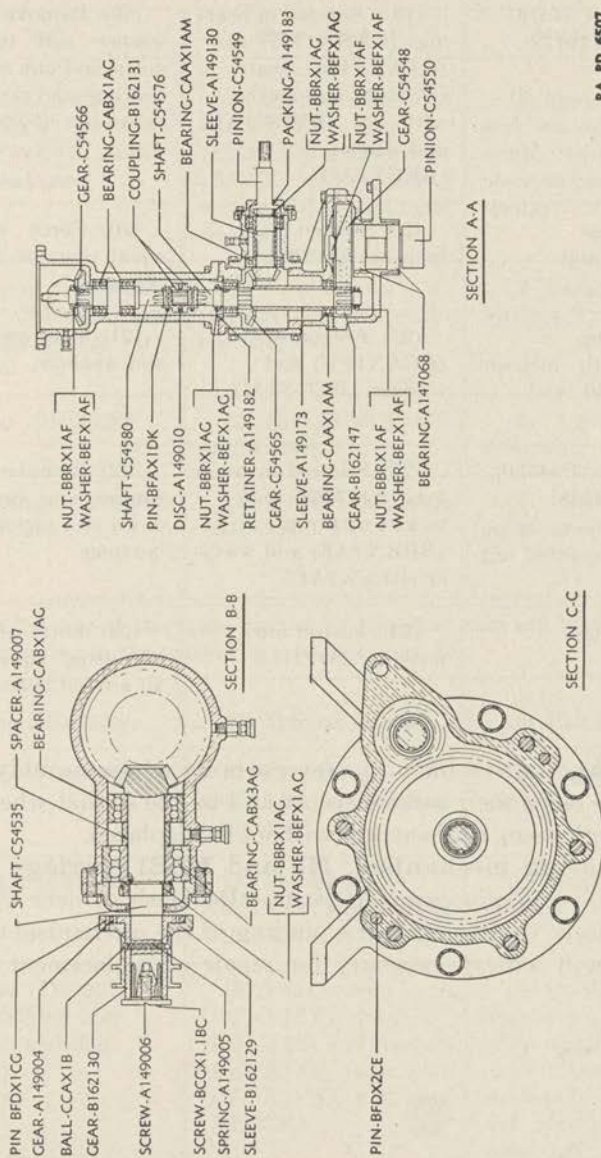


Figure 25.—Traversing mechanism assembly, M3A1 carriage (sections shown in fig. 26).



RA PD 6507

FIGURE 26.—Traversing mechanism sections, M3A1 carriage (sections pertain to fig. 25).

Part	Means of support	Method of removal
(19) Shaft (C54576) and sleeve (A149173).	(19) Secured in bearings (CABX1AG) and (CAAX1AM), gear (C54565) and locked with nut (BBRX1AG) and washer (BEFX1AG).	(19) Remove nut and washer and force shaft down and out of gear and bearings and pick gear and sleeve out of housing.
(20) Bearings (CABX1AG) and (CAAX1AM).	(20) Forced into housing (D42230).	(20) Force out using equal pressure all around bearings.
(21) Housing (D42215) with inclosed pinion (C54550) and gear (C54548).	(21) Six screws (BCAX1EC) and washers (BECX1M).	(21) Remove screws and washers.
(22) Pinion (C54550) and gear (C54548).	(22) Secured in bearings (A147068) and locked with nut (BBRX1AF) and washer (BEFX1AF).	(22) Remove nut and washer and drive pinion down and out of gear and bearings.
(23) Bearings (A147068).	(23) Forced into housing (D42215).	(23) Force out of housing using equal pressure all around bearings.

c. Assembly.—Assemble in the reverse order of disassembly. Bearings must be set in their sockets evenly and in line so that when a shaft is put through them, the bearings will not be displaced.

37. Elevating mechanism, M3 and M3E1 carriage (figs. 27, 28, and 29).—*a. Replacement of parts.*—Backlash of over $\frac{1}{4}$ turn of the handwheels, chattering gears, binding of the mechanism or failure to elevate, will indicate necessity for repair or replacement of parts.

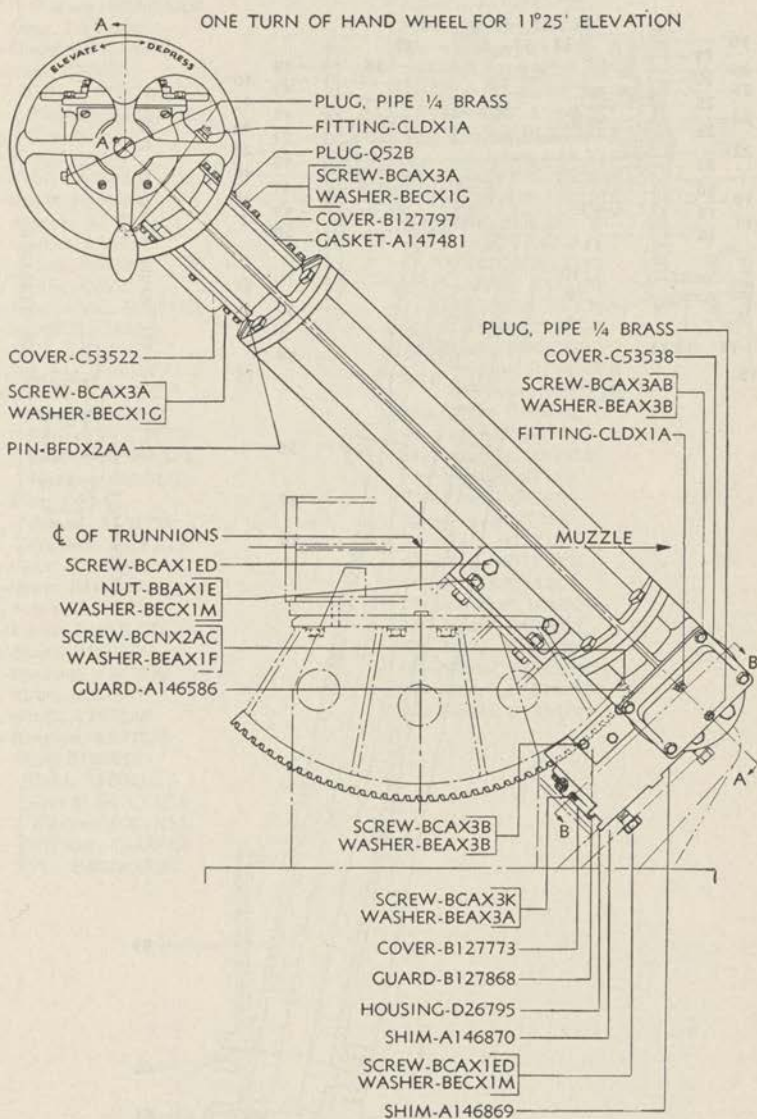
b. Disassembly.—Remove the gun and cradle from the carriage and disassemble in the following manner:

Part	Means of support	Method of removal
(1) Case (C53684), case (D26907), brackets (D26908) and (C53639), and inclosed parts.	(1) Four screws (BCAX1ED), nuts (BBAX1E) and washers (BECX1M) and four screws (BCAX1EC) and washers.	(1) Remove screws, nuts and washers and lift assembly to a convenient place to permits its disassembly.
(2) Cover (B160237) with gear (B160220) and bearings (A146723) and (A146725).	(2) Four screws (BCAX1CA) and washers (BECX1K).	(2) Remove screws and washers.
(3) Gear (B160220)----	(3) Nut (BBRX1AF) and washer.	(3) Unscrew nut and drive out.
(4) Bearings (A146723) and (A146725).	(4) Forced in cover (B160237).	(4) Force out using equal pressure all around the bearing.

(5) The balance of the upper portion of this gear case will be disassembled in the same manner as the traversing gear case (par. 35).

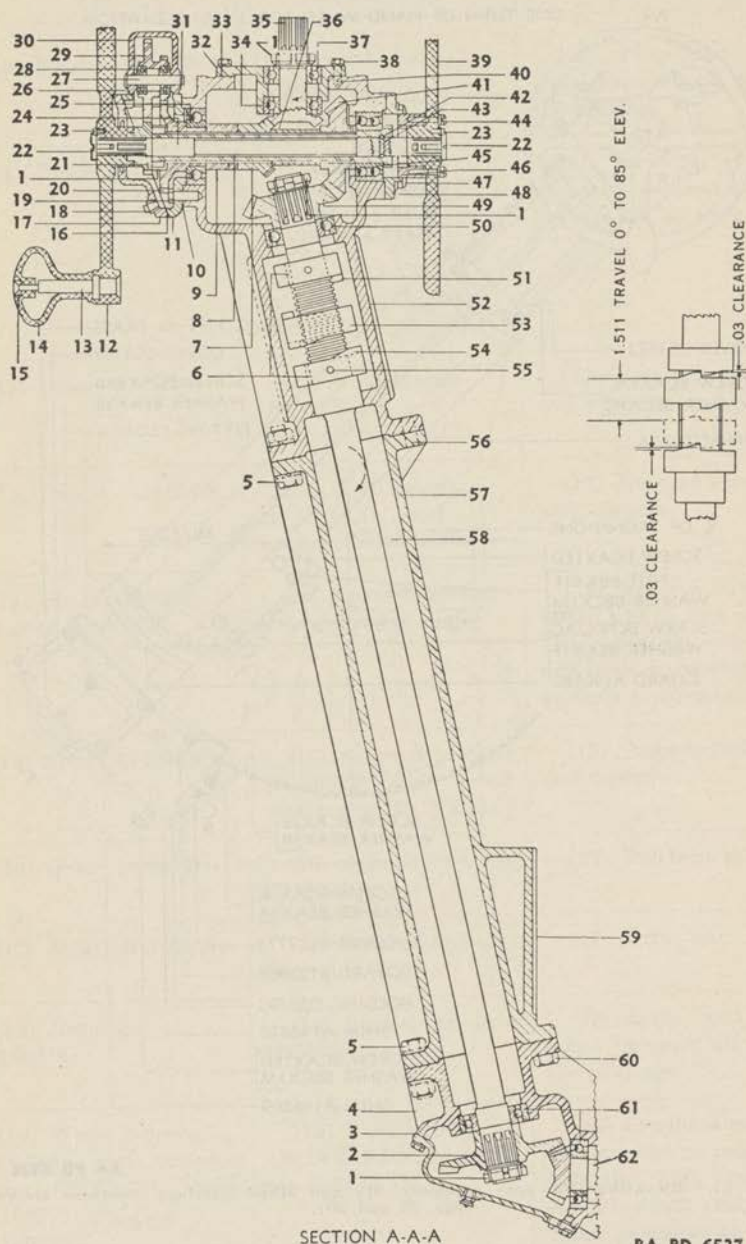
(6) Gear (B160235)	(6) Splined to shaft.	(6) Pull from the shaft.
(7) Cover (B127797).	(7) Six screws (BCAX3A) and washers (BECX1G).	(7) Remove screws and washers.
(8) Cover (C53522).	(8) Six screws (BCAX3A) and washers (BECX1G).	(8) Remove screws and washers.
(9) Case (D26907), stops (B127795) and (B127796), and dog (B127794).	(9) Four screws (BCAX1EF), nuts (BBAX1E) and washers (BECX1M), taper pins (BFCX1FK), and keys (A20239).	(9) Drive out taper pins from stops; spin the dog to its maximum height; remove screws, nuts and washers from case; raise case high enough to force stops off keys; remove upper key and spin dog off threaded portion of shaft and lift case free of shaft, picking off stops and dog.

Part	Means of support	Method of removal
(10) Bearing (A146724).	(10) Forced in case (D26907).	(10) Force out using equal pressure all around the bearing.
(11) Bracket (D26908).	(11) One screw (BCAX1ED), four nuts (BBAX1E) and washer (BECX1M) and three screws (BCAX1EF), nuts (BBAX1E) and washers (BECX1M).	(11) Remove screws, nuts and washers and lift bracket off, up over shaft.
(12) Cover (C53538).	(12) Four screws (BCAX3AB) and washers (BEAX3B).	(12) Remove screws and washers.
(13) Guard (A146586).	(13) Two screws (BCNX2AC) and washers (BEAX1F).	(13) Remove screws and washers.
(14) Shaft (C53646) and gear (B160233).	(14) Nut (BBRX1AF) on lower end of shaft.	(14) Remove nut (BBRX1AF) and washer. Drive shaft up, out of gear and bearing, catching gear as shaft is driven out.
(15) Stud (A146713).	(15) Screwed in shaft (B160232) and locked with screw (BCFX2AC).	(15) Remove lock screw and unscrew.
(16) Gear (B160231).	(16) Splined to shaft (B160232).	(16) Pull from the shaft.
(17) Shaft (B160232).	(17) Secured in bearings (A146715).	(17) Drive out.
(18) Bearings (A146715).	(18) Forced in case (C53639).	(18) Force out using equal pressure all around the bearings.
(19) Worm housing (D26795) and inclosed worm (B127646), shaft (B160223) and gear (B160230).	(19) Four screws (BCAX1ED) and washers (BECX1M).	(19) Cradle must either be removed or raised sufficiently high to have elevating rack clear worm. Remove screws and washers.



RA PD 6526

FIGURE 27.—Elevating gear case assembly, M3 and M3E1 carriage (sections shown in figs. 28 and 29).

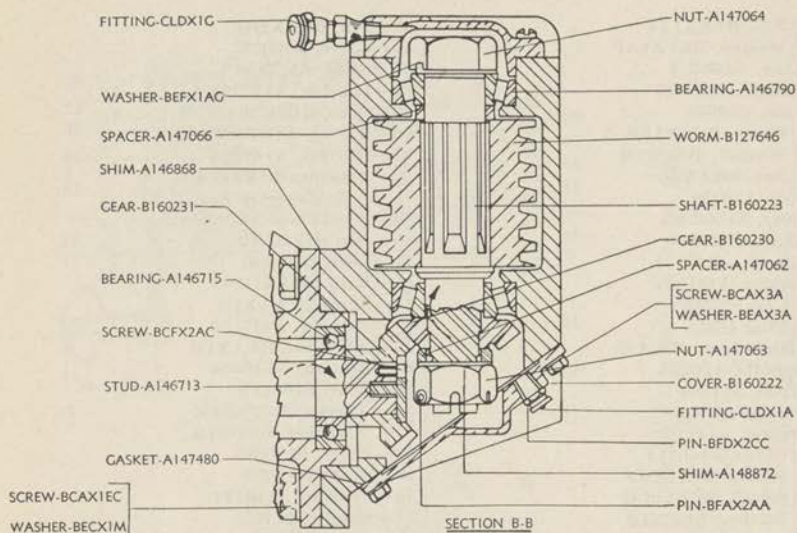


SECTION A-A-A

RA PD 6527

FIGURE 28.—Elevating gear case section, M3 and M3E1 carriages (sections pertain to fig. 27).

1—Nut, BBRX1AF	31—Pin, BFXAX1BE
1—Washer, BEFX1AF	32—Cover, B160237
2—Gear, B160233	33—Shim, B127846
3—Gasket, B127897	34—Bearing, A146725
4—Case, C53639	35—Gear, B160220
5—{ Screw, BCAX1EF	36—Spacer, A146726
5—Washer, BECX1M	37—Bearing, A146723
5—Nut, BBAX1E	38—{ Screw, BCAX1CA
6—Key, A20239	38—Washer, BECX1K
7—Gear, B160236	39—Handwheel, C53515A
8—Shaft, B160309	40—Pin, BFDX2BB
9—Spacer, A147131	41—Gear, B160234
10—Gasket, A147141	42—Ball, CCAX1B
11—{ Case, C53684	43—Spring, FAAX1C
11—Plug, Q52A	44—{ Screw, A147132
12—Handwheel, C53515A	44—Washer, BEAX1H
13—Spindle, A26256	45—Bearing, A146556
14—Knob, A11644	46—Gear, B160313
15—Washer, A26257	47—{ Screw, BCFX2FK
16—Gasket, A147140	47—Washer, BECX1K
17—{ Cover, B160315	48—Cover, B160307
17—Screw, BCKX2CF	49—Gear, B160235
17—Screw, BCFX2DG	50—Bearing, A146724
17—Washer, BECX1G	51—Stop, B127795
18—Plug, Q52A	52—Case, D26907
19—{ Screw, A147139	53—Dog, B127794
19—Washer, BEAX1L	54—Stop, B127796
20—Gear, B160317	55—Pin, BFCX1FK
21—Gear, B160310	56—Pin, BFDX2CC
22—Screw, A147133	57—Bracket, D26908
23—Screw, BCFX2BB	58—Shaft, C53646
24—Shaft, B160311	59—Shim, A146867
25—Bearing, A147134	60—Screw, BCAX1ED
26—Shim, A147137	61—Bearing, A146715
27—Shaft, A147136	62—Shaft, B160232
28—Bearing, A147135	
29—Gear, B160314	
30—{ Case, B160316	
30—Screw, BCAX1CA	
30—Washer, BEAX1L	
30—Fitting, CLDX1A	
30—Pin, BFDX2AA	



RA PD 7598

FIGURE 29.—Elevating gear case section, M3 and M3E1 carriages (sections pertain to fig. 27).

Part	Means of support	Method of removal
(20) Cover (B160222).	(20) Four screws (BCAX3A) and washers (BEAX3A).	(20) Remove screws and washers.
(21) Cover (B127773).	(21) Six screws (BCAX3K) and washers (BEAX3A).	(21) Remove screws and washers.
(22) Nut (A147064).	(22) Screwed on shaft (B160223) and locked with washer (BEFX1AG).	(22) Straighten prong of lock washer, unscrew nut and remove lock washer.
(23) Shaft (B160223) with gear (B160230).	(23) Splined to worm (B127646) and secured in bearing (A146790).	(23) Drive out in direction of gear and pick worm and spacer out of housing.
(24) Gear (B160230) and bearing (A146790).	(24) Nut (A147063) and cotter pin, and splined and forced to shaft (B160223).	(24) Remove cotter pin and nut. Pull gear from shaft.
(25) Outer cones of bearings (A146790).	(25) Forced in housing (D26795).	(25) Force out, using equal pressure all around cone.

c. Assembly.—(1) Assemble in the reverse order of disassembly. Bearings must be set in their sockets evenly and in line so that when a shaft is put through them, the bearings will not be displaced.

(2) Stops (B127795) and (B127796) and dog (B127794) must be placed in position on the shaft (C53646) at the same time that the assembled gear case (D26907) is put into position. Secure the stops to the shaft by means of the taper pins and keys in one of the keyways of each stop. Rotate the dog to its lowest position on the shaft. Assemble cover (C53522) to the case so that the stud of the dog will fit into the socket in the cover. Replace the cradle temporarily on the carriage at 0° elevation. Operate the elevating mechanism to check the operation of the dog and stops with relation to the movement of the cradle. Adjustment is possible by removing cover (C53522) and turning the dog on the shaft or by using a different keyway in one or both of the stops. It may be found necessary to cut new holes in the shaft for the taper pins that pass through the stops. Before replacing the cradle, set the dog in its lowest position and then put the cradle on the carriage at 0° elevation. The dog can then rise through its maximum range when the cradle is elevated to 85°. When the stop mechanism is properly adjusted, the covers should be replaced and the cradle secured at the trunnions.

(3) Lubricate as specified in paragraph 51.

38. Elevating mechanism M3A1 carriage (figs. 30 and 31.)—

a. Replacement of parts.—Backlash of over $\frac{1}{4}$ turn of the handwheels, chattering gears, binding of the mechanism, or failure to traverse, indicate that repair or replacement of parts is necessary.

b. Disassembly.—Disconnect the hydraulic drive gear from the mechanism and remove the gun and cradle. Disassembly will be carried out in the following manner:

Part	Means of support	Method of removal
(1) Crank assembly (C87039).	(1) Secured to sleeve (B162129) by plunger (A148996).	(1) Pull out plunger and lift crank from sleeve.
(2) Housing (D42233) with inclosed parts.	(2) Four screws (BCAX1EC) and washers (BECX1M).	(2) Remove screws and washers.
(3) Sleeve (B162129) with gear (A149004).	(3) Secured to gear (B162130) by screws (BCGX1.1BC) and (A149006).	(3) Remove screws in order given and pull from gear. Be prepared to catch balls and spring.

Part	Means of support	Method of removal
(4) Gear (B162130).	(4) Splined to shaft (B162213).	(4) Pull from shaft.
(5) Cover (B162143).	(5) Four screws (BCAX1CB) and washers (BECX1K).	(5) Remove screws and washers.
(6) Cover (B162220).	(6) Eight screws (BCCX1AS) and washers (BEAX1H).	(6) Remove screws and washers.
(7) Gear (C54563) and spacer (A149153).	(7) Splined to shaft (B162212) and locked with nut (BBRX1AF) and washer (BEFX1AF).	(7) Remove nut and washer and force gear and spacer from shaft.
(8) Shaft (B162212) and pinion (C54545).	(8) Secured in bearings (CABX1AG) and (CAAX1AM) and locked with nut (BBRX1AF) and washer (BEFX1AF).	(8) Remove nut and washer and drive shaft out of gear and bearings.
(9) Shaft (B162213) and gear (C54546).	(9) Secured in bearings (CABX1AG) and (CABX3AG) and locked with nuts (BBRX1AF) and (BBRX1AG) washers (BEFX1AF) and (BEFX1AG).	(9) Remove nuts and washers and drive shaft out of gear and bearings. Drive toward bearing (CABX3AG).
(10) Bearings (CABX1AG), (CABX3AG), and (CAAX1AM).	(10) Forced into housing (D42233).	(10) Force out of housing using equal pressure all around bearings.
(11) Housing (D42232) with inclosed parts.	(11) Six screws (BCAX1DC) and washers (BECX1L).	(11) Remove screws and washers.
(12) Housing (C54542) with inclosed gear (B162146) and shaft (B162210).	(12) Four screws (BCAX1DC) and washers (BECX1L).	(12) Remove screws and washers.
(13) Cover (B162218).	(13) Eight screws (BCCX1AS) and washers (BEAX1H).	(13) Remove screws and washers.

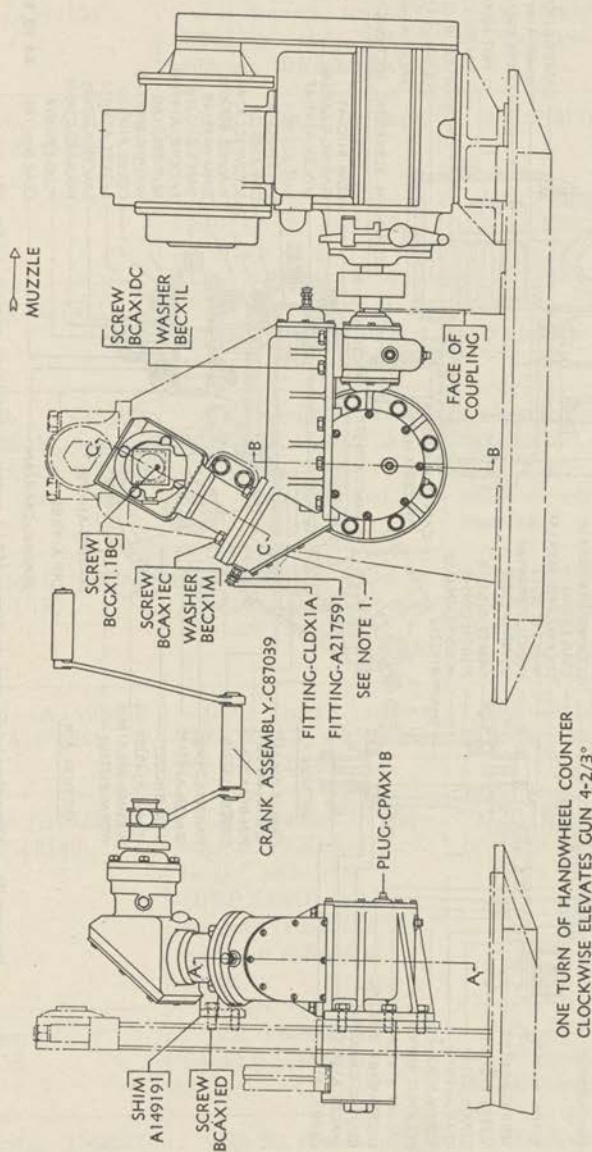


FIGURE 30.—Elevating mechanism assembly, M3A1 carriage (sections shown in fig. 31).

RA PD 6822

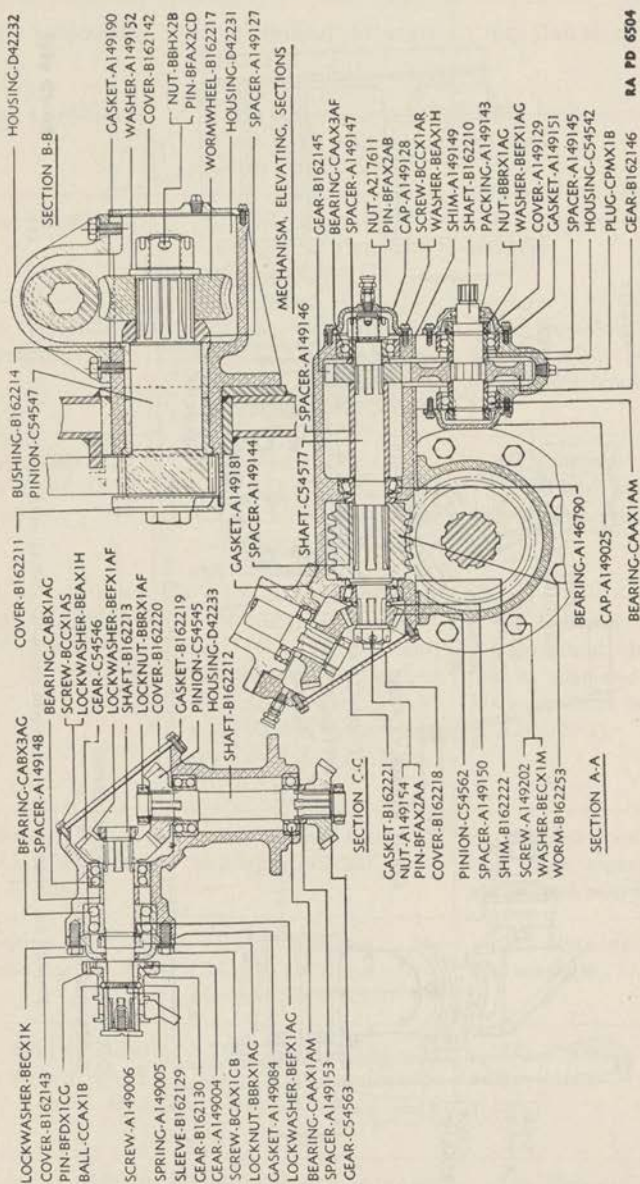


Figure 31.—Elevating gear case sections, M3A1 carriage (sections pertain to fig. 30).

Part	Means of support	Method of removal
(14) Nut (A149154).	(14) Screwed to shaft (C54577) and locked with pin (BFAX2AA).	(14) Remove cotter pin and unscrew.
(15) Pinion (C54562) and spacer (A149150).	(15) Splined to shaft (C54577).	(15) Pull from shaft.
(16) Cap (A149128).	(16) Four screws (BCCX1AR) and washers (BEAX1H).	(16) Remove screws and washers.
(17) Nut (A217611).	(17) Screwed to shaft (C54577) and locked with pin (BFAX2AB).	(17) Remove cotter pin and unscrew.
(18) Shaft (C54577), worm (B162253), spacers (A149144), (A149146), and A149147 and gear (B162145).	(18) Secured in bearings (A146790) and (CAAX3AF) and gear and worm splined to shaft.	(18) Drive shaft to the left out of bearings, worm and gear, and remove parts through openings of housing.
(19) Bearings (A146790) and (CAAX3AF).	(19) Forced into housing (D42232) and on shaft (C54577).	(19) Force bearings out of housing and off shaft, using equal pressure all around bearing.
(20) Cap (A149025) and cover (A149129).	(20) Eight screws (BCCX1AS) and washers (BEAX1H).	(20) Remove screws and washers.
(21) Shaft (B162210) and gear (B162146).	(21) Secured in bearings (CAAX1AM), locked with nuts (BBRX1AG) and washers (BEFX1AG) and gear splined to shaft.	(21) Drive shaft out of bearings and gear.
(22) Bearings (CAAX1AM).	(22) Forced into housing (C54542).	(22) Force out of housing using equal pressure all around bearings.
(23) Housing (D42231) with inclosed wormwheel (B162217) and pinion (C54547).	(23) Six screws (A149202) and washers (BECX1M).	(23) Remove screws and washers.

Part	Means of support	Method of removal
(24) Cover (B162211).	(24) Screwed into housing (D42231).	(24) Unscrew.
(25) Cover (B162142).	(25) Seven screws (BCCX1AS) and washers (BEAX1H).	(25) Remove screws and washers.
(26) Wormwheel (B162217) and spacer (A149127).	(26) Splined to pinion (C54547) and locked with nut (BBHX2B), washer (A149152) and pin (BFAX2CD).	(26) Remove cotter pin, nut, and washer and drive pinion out of worm, spacer, and housing.

c. Assembly.—Assemble in the reverse order of disassembly. Bearings must be set in their sockets evenly and in line so that when the shafts are put through them, the bearings will not be displaced.

39. Foot-firing mechanism, M3 carriage (fig. 32).—*a. Foot-firing mechanism does not have sufficient travel to fire the gun.*—This is usually caused by a bent trigger bar. If it is necessary to change the gun, replacing it with a gun other than the one issued in the mount, it will be necessary to adjust the motion of the foot-firing mechanism to the trigger of the new gun. This adjustment can be made by backing off on nut (BBFX1E) on the vertical shaft of the foot-firing mechanism. After the linkage has been adjusted so the gun will fire, the foot-firing pedal must be checked to see that the pedal lock does not lock the pedal in firing position. If this should occur, it will be necessary to build up with welding metal the link of the foot-firing mechanism which bears against the trigger bar until a proper adjustment is possible.

b. Foot-firing pedal lock sticks and is hard to disengage.—The clearance between the latch pin and its socket is rather close in a new mount. If not well lubricated, the pin may bind and be very hard to disengage. In extreme cases, or if the rod has been permitted to rust while the mount was in transit, it may be necessary to work the rod down with fine emery cloth. Clean and lubricate with oil, SAE 10.

c. Excessive play in the foot-firing pedal.—It may be possible to depress the firing pedal (C53755) so that the plunger (A147311) catches under its seat behind pedal (C53756). This, in effect, locks the firing mechanism in the open position so that the gun will continue to fire until the ammunition is exhausted. The pedal (C53756) has been modified on matériel under production so that the protrusion

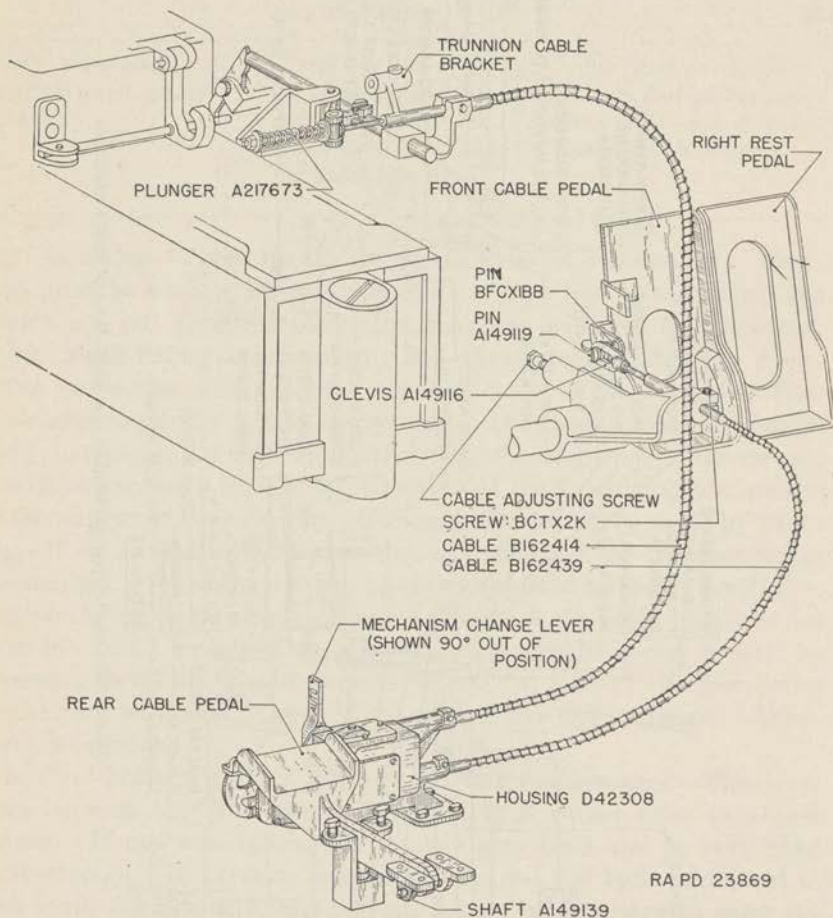


FIGURE 33.—Foot-firing mechanism, M3A1 carriage.

beneath the hole in which the plunger fits has been increased in length from 1 inch to $1\frac{1}{2}$ inches. This dimension is from the center of the hole to the outer edge of the protrusion. If a new pedal with these dimensions cannot be obtained, the old one can be modified by building up the additional half inch required on the protrusion by means of welding.

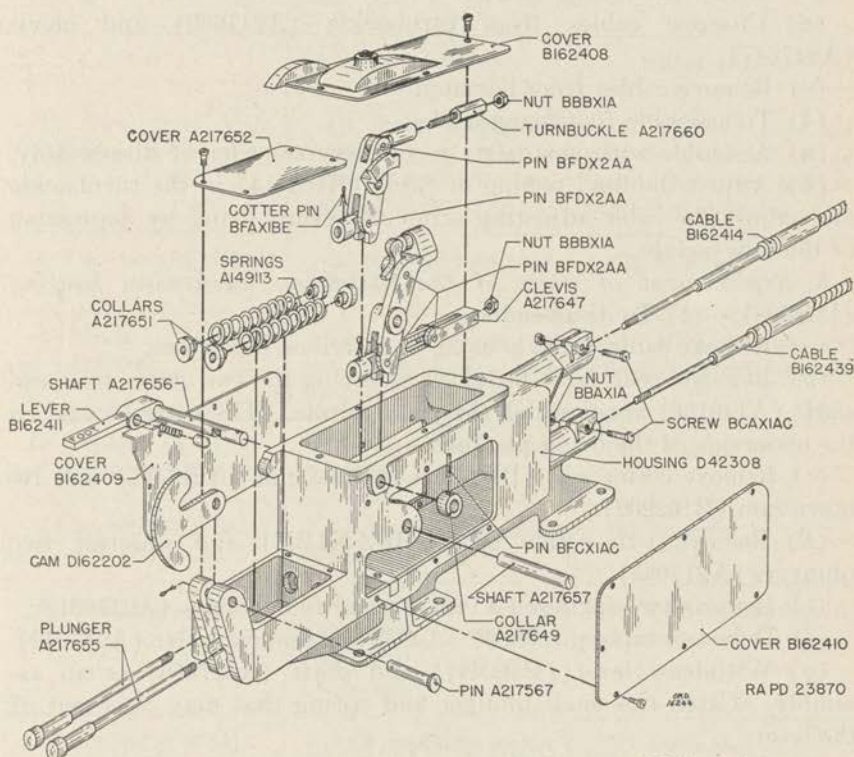


FIGURE 34.—Disassembly of foot-firing mechanism housing, M3A1 carriage.

40. Foot-firing mechanism, M3A1 carriage (figs. 33 and 34).—

a. *Replacement of foot cables.*—(1) To detach front end of cable (B162439)—

- (a) Loosen setscrew (BCTX2K).
- (b) Remove taper pin (BFCX1BB).
- (c) Remove pin (A149119).
- (d) Unscrew clevis (A149116) and nut from cable.
- (e) Withdraw cable from bracket.

(2) To detach upper end of cable (B162414)—

- (a) Remove clamping nut and screw on trunnion cable bracket.

- (b) Unscrew table from plunger (A217673).
- (3) To remove cables from foot-firing mechanism housing (D42308)—
 - (a) Remove foot-firing mechanism housing covers (A217652), (B162408), (B162409), and (B162410).
 - (b) Remove cap screws (BCAX1AC) and nuts (BBAX1A).
 - (c) Loosen nuts (BBBX1A).
 - (d) Unscrew cables from turnbuckle (A217660) and clevis (A217647).
 - (e) Remove cables from housing.
- (4) To assemble foot-firing cables—
 - (a) Assemble with new parts in the reverse order of disassembly.
 - (b) Adjust the final setting of cable (B162414) in the turnbuckle and adjust the cable adjusting screw to permit firing by depression of the foot pedals.
- b. Replacement of units of the foot-firing mechanism housing (D42308).—*(1) To disassemble—
 - (a) Remove cables from housing as described in *a* above.
 - (b) Remove rear cable pedal by removing the two cotter pins and shaft (A149139) about which the pedal pivots. These are located on the underside of the firing platform.
 - (c) Remove cotter pin (BFAX1CD) and pin (A217567) and remove cam (B162202).
 - (d) Remove two cotter pins (BFAX1BE) and unscrew two plungers (A217655).
 - (e) Remove two springs (A149113) and four collars (A217651).
 - (f) Drive out taper pin (BFCX1AC) and remove collar (A217649).
 - (g) Withdraw lever (B162411) and shaft (A217656) as an assembly. Catch the small plunger and spring that may come out of the lever.
 - (h) Remove shaft (A217657).
 - (i) Remove the remaining assemblies from the housing.
 - (j) Drive out pins (BFDX2AA) to disassemble the remaining parts.
- (2) To assemble—
 - (a) Assemble with new parts in the reverse order of disassembly.
 - (b) Adjust as described in *a*(4) above.
 - (c) Adjust the motion of the rear cable pedal by means of the adjusting screw on the underside of the firing platform below the pedal.

41. **Leveling mechanism, M3 and M3E1 carriages** (figs. 35, 36, and 37).—*a. Replacement of parts.*—If given proper care, the level-

ing mechanism should remain in good working condition for the life of the carriage. However, severe shock or maltreatment of the mechanism may cause excessive wear, corrosion, or rusting of the bearing surfaces. Backlash or binding indicate that repair or replacement of parts is necessary.

b. Disassembly.—Remove the 360° drive mechanism and the top carriage and proceed as follows:

Part	Means of support	Method of removal
(1) Two level vials (C8283).	(1) Studs (A146909), (A146910), and (A146911), nuts (BBAX1E) and washers (BECX1M).	(1) Remove nuts and washers securing vial assembly to studs and remove vial assembly.
(2) Two studs (A146911).	(2) Screwed into yoke (D26781).	(2) Unscrew.
(3) Studs (A146910) and (A146909).	(3) Locked in yoke by nut (BBAX1E) and washers (BECX1M).	(3) Remove nuts and washers and pull out studs.
(4) Nipple (A146655) and fitting (CLDX1B).	(4) Screwed into socket (D26782).	(4) Unscrew.
(5) Nipple (A146655) and vent (A146992).	(5) Screwed into socket (D26782).	(5) Unscrew.
(6) Rack (C53647).	(6) Twelve screws (A146669), washers (BECX1P), and nuts (A146668).	(6) Remove screws, nuts and washers.
(7) Bearing (C8751).	(7) Forced onto socket (D26782).	(7) Force out.
(8) Handwheels (C53634).	(8) Forced on screw (C53490) and pin (CFCX1CF).	(8) Remove pin and force from screw.
(9) Cover (B127738).	(9) Five screws (BCFX2FM) and washer (BECX1K).	(9) Remove screws and washers.
(10) Cap (A146660).	(10) Threaded into swivel (B127735) and locked with screw (A147984).	(10) Remove lock screw and unscrew cap.

Part	Means of support	Method of removal
(11) Screws (C53490) and bearings (A146663).	(11) Forced into place.	(11) Unscrew and force bearing out with screw.
(12) Bearings (A146663).	(12) Forced and locked to screws (C53490) with nut (BBRX1AG) and washer (BEFX1AG).	(12) Remove nut and washer and force bearing from screw using equal pressure all around the bearing.
(13) Support (C53488) with bearing (A146664) and cover (A146665).	(13) Four screws (BCAX1ED) and washers (BECX1M) forced on swivel (B127735).	(13) Remove screws and washers and pull from swivel.
(14) Covers (A146665).	(14) Four screws (BFCX2DG) and washers (BECX1G).	(14) Remove screws and washers.
(15) Swivel (B127735) and cover (C53640).	(15) Secured in bearing (A146664) and twelve screws (BCKX3EE).	(15) Remove screws from cover and drive swivel out of bearing.
(16) Bracket (C53497) and inclosed housing (C53496) and nut (B127746).	(16) Four screws (BCAX2AC) and washers (BECX1P).	(16) Remove screws and washers.
(17) Nut (B127746).	(17) Secured in bearings (A146688), nuts (BBRX1AF), and washers (BEFX1AF).	(17) Remove nuts and washers and drive out of housing.
(18) Housing (C53496).	(18) Secured in bearings (A146686), and (A146687), cover (A146685), nut (BBFX3B), and pin (BFAX2AC).	(18) Remove pin, nut, washer, and cover and drive out.
(19) Bearing (A146686).	(19) Secured in housing (C53496) or bracket (C53497).	(19) Pull from housing or drive out of bracket.
(20) Bearings (A146688).	(20) Secured in bracket (C53497) or on nut (B127746).	(20) Pull from nut or drive out of bracket.

Part	Means of support	Method of removal
(21) Bearings (A146664).	(21) One secured in support (C53488) and one in yoke (D26781).	(21) Force out using equal pressure all around bearings.
(22) Cover (C53495).	(22) Twelve screws (BCKX2AC).	(22) Remove screws.
(23) Cover (B127745).	(23) Six screws (BCKX2AC).	(23) Remove screws.
(24) Cup, oil (CLFX2H).	(24) Screwed into case (D26783).	(24) Unscrew.
(25) Case (D26783).	(25) Four bolts (A147056), nuts (BBAX2B), and washers (BECX1P).	(25) Remove screws, nuts, and washers.
(26) Nut (C53492).	(26) Five screws (BCKX2AC) through shield and secured on bearing (A146637).	(26) Remove screws and drive nut from bearing.
(27) Bearing (A146637) and shield (B127743).	(27) Secured on stud (B127744) in yoke (D26781) and locked with nut (BBRX1AK) and washer (BEFX1AK).	(27) Remove nut and washer and pull from stud.
(28) Clamp (D41724).	(28) Locked in socket (D26782) with nut (A147344), screw (BCCX1BB), and key (BGX2).	(28) Remove screw, nut, and pull clamp down out of socket. Remove the key.
(29) Socket (D26782) and yoke (D26781) shrunk together.	(29) Rests on bearing (C53487).	(29) Lift off.
(30) Bearing (C53487).	(30) Eight screws (BCAX2AC) and washers (BECX1P).	(30) Remove screws and washers.

c. Assembly.—When assembling the leveling mechanism and top carriage to the chassis, it will be necessary to observe the following general procedures:

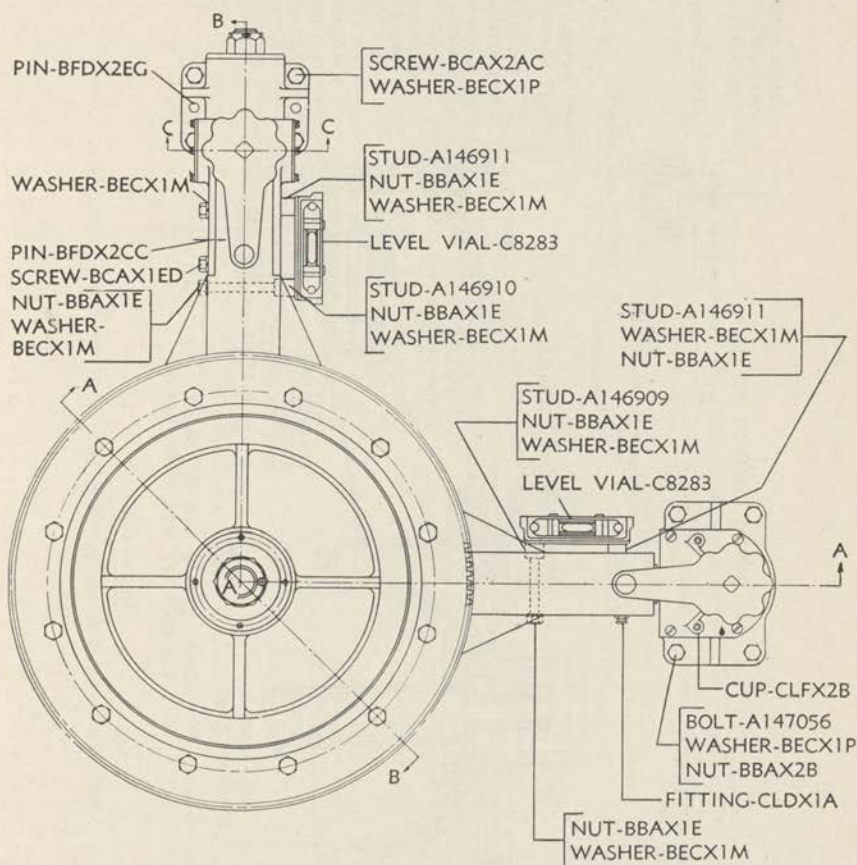
- (1) The chassis should be maintained level during the assembly.
- (2) Socket (D26782) and yoke (D26781) should be placed on bearing (C53487) so they will be level. This can be determined by placing two levels at right angles to each other on the socket.
- (3) Assemble screws (C53490) to the mechanism so that as much of the threads are above the nuts as below the nuts.
- (4) Clean and lubricate bearing (C53487), socket (D26782), and rack (C53647) before assembly.
- (5) After assembly, adjust the level vial bubbles as described below.
- (6) Lubricate as specified in paragraph 51.

d. Inspection and adjustment of level vials.—Inspection for proper adjustment of the level vials, as described below, will be performed at the time of inspection of the carriage, and after adjustment or repair of the leveling mechanism.

- (1) Set the gun in firing position on smooth, hard, level ground.
- (2) Traverse the top carriage until the gun tube is over one of the leveling jacks.
- (3) Level the top carriage by means of both leveling screws.
- (4) Insert a clinometer in the muzzle of the gun and elevate or depress the gun until the clinometer bubble is centered.
- (5) Traverse the gun until it points in the opposite direction and check the reading of the clinometer.
- (6) If the clinometer is not level, adjust the elevation of the gun by means of the elevating handwheel so as to bring the clinometer bubble half way back to the center point. Then adjust the leveling screw behind the gun until the clinometer bubble is centered.
- (7) Traverse the gun back to its original position and note the position of the clinometer bubble.
- (8) If it is not centered, adjust the elevation of the gun by means of the elevating handwheel so as to bring the clinometer bubble half way back to the center point. Adjust the leveling screw below the gun tube until the clinometer bubble is centered. Traverse the top carriage so that the gun points in the opposite direction and note the position of the clinometer bubble. Repeat as in (6) and (7) above if the bubble is not centered.
- (9) The adjustment is concluded when the clinometer bubble remains level while the gun is over the leveling jack and also opposite the leveling jack. The bubble of this leveling jack should then be adjusted to center the bubble. This can be done by removing the top of the level vial container and raising or lowering one end of the vial by means of the nuts and stud supporting it.
- (10) Repeat this procedure for the second leveling jack.

(11) When both leveling jack bubbles have been adjusted in this manner, the clinometer in the muzzle of the gun should remain centered as the gun carriage is traversed through 360°.

(12) If the level vial bubbles do not deviate more than one division from the center, the gun is considered level.



RA PD 6518

FIGURE 35.—Leveling mechanism assembly (sections shown in figs. 36 and 37).

42. Leveling mechanism, M3A1 carriage.—The leveling mechanism of the M3A1 carriage is similar in operation, design, and construction to that of the M3 and M3E1 carriages. The handwheels operating the leveling mechanism are somewhat different on the M3A1 carriage. These consist of a ratchet wrench (A217826) shown on figures 36 and 37. These ratchet wrenches can be disassembled by removing the screw and washer located above the pivoting points of the ratchet wrenches. Other changes in the design of the leveling

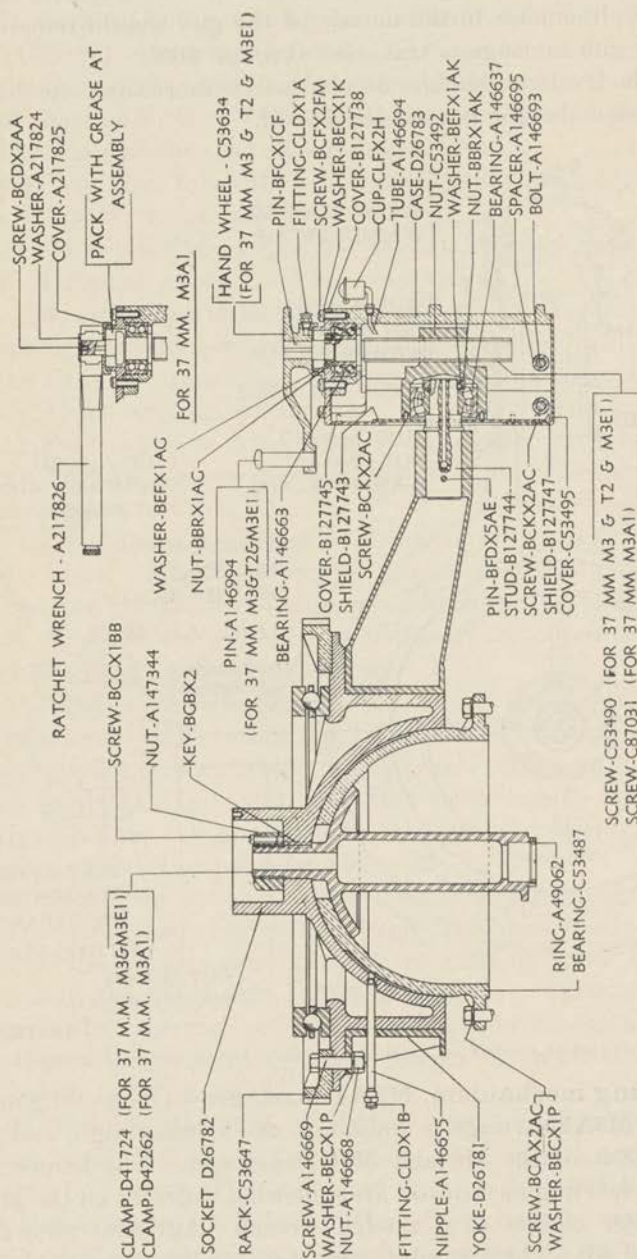
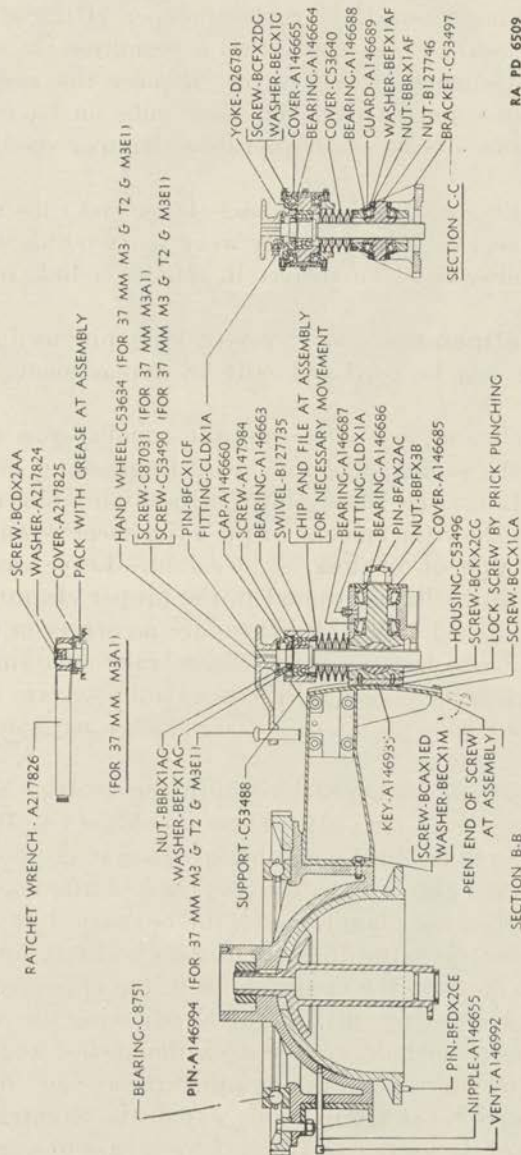


FIGURE 3K.—Leveling mechanism section (section pertains to fig. 35).



RA PD 6509

FIGURE 37.—Leveling mechanism section (section pertains to fig. 35).

mechanism for the M3A1 carriage are small and will not affect the disassembly as outlined in paragraph 41.

43. Wheels.—*a. Front wheels rub on carriage on sharp turns.*—On the first carriages issued, the rubber bumper (B129893) under the arm which carries the wheel was so thin it permitted the wheel to rub on the carriage during a sharp turn. Replace the rubber bumper with the present standard one. If wheel rubs on later model carriages, installation of the standard rubber bumper should eliminate the difficulty.

b. Tie rod rubs rims on sharp turns.—If tie rod rubs rims on any mounts now in service, it is caused by wear or stretching of the safety chains on the drawbar. To correct it, remove a link from each of these chains.

44. Wheel alinement.—*a. Incorrect king pin inclination, camber, and caster can be corrected only by replacement of the bent parts.*

b. To correct toe-in, first make sure the spindle arms are straight. If they check the same, adjust toe-in by lengthening or shortening the tie rods. Leave the wheel aliner in position while making corrections; it will show the amount of the adjustment required.

45. Lever type of brakes.—*a. General.*—Lever electric brakes are shipped with the lining ground to the proper clearances and the adjustments tightened. Provided there are no errors in the accurate location of the brake backing plate on the brake mounting flange, no adjustments will be necessary at the time the brakes are installed.

b. Adjustments on new linings.—The adjustments, however, should be checked as follows:

(1) An inspection hole is provided in the brake drum for inserting a 0.010-inch feeler gage (fig. 39). There should be a 0.010-inch clearance between the brake lining and brake drum at the point adjacent to the eccentric and also midway between the eccentric and anchor. If this condition does not obtain, loosen the eccentric lock nut slightly and turn the eccentric in the direction of the wheel rotation when moving forward to decrease the clearance, or in the opposite direction to increase the clearance (fig. 40). If, after adjusting the eccentric, the clearance at the point half way between the anchor and eccentric is not 0.010-inch, it will be necessary to adjust the anchor (fig. 41). The anchor is adjusted in exactly the same way as the eccentric. Through the adjustment of the anchor and eccentric it is easy to secure the 0.010-inch clearance which is required.

(2) With the preceding two adjustments securely locked, turn the adjusting wheel (figs. 42 and 43) until there is a slight drag when the

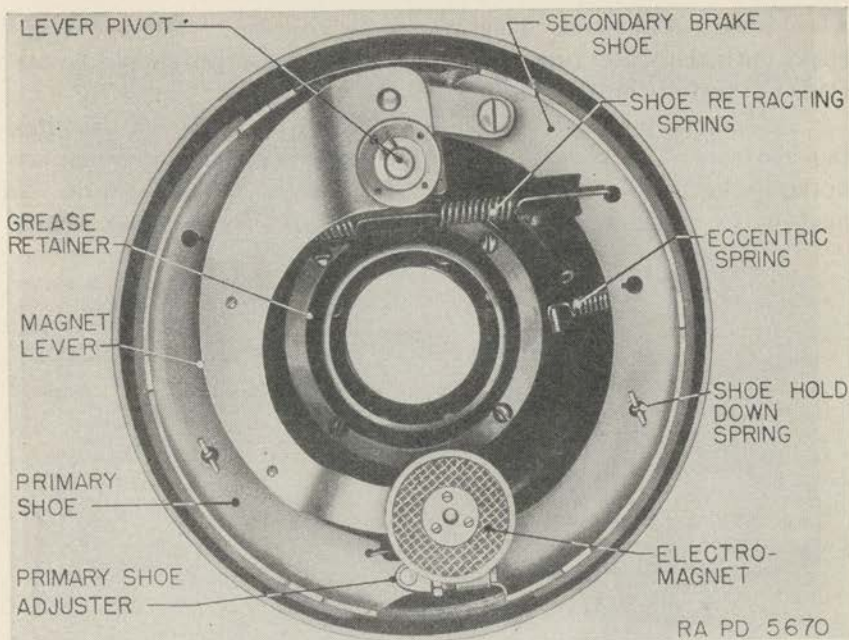


FIGURE 38.—Lever type electric brake.

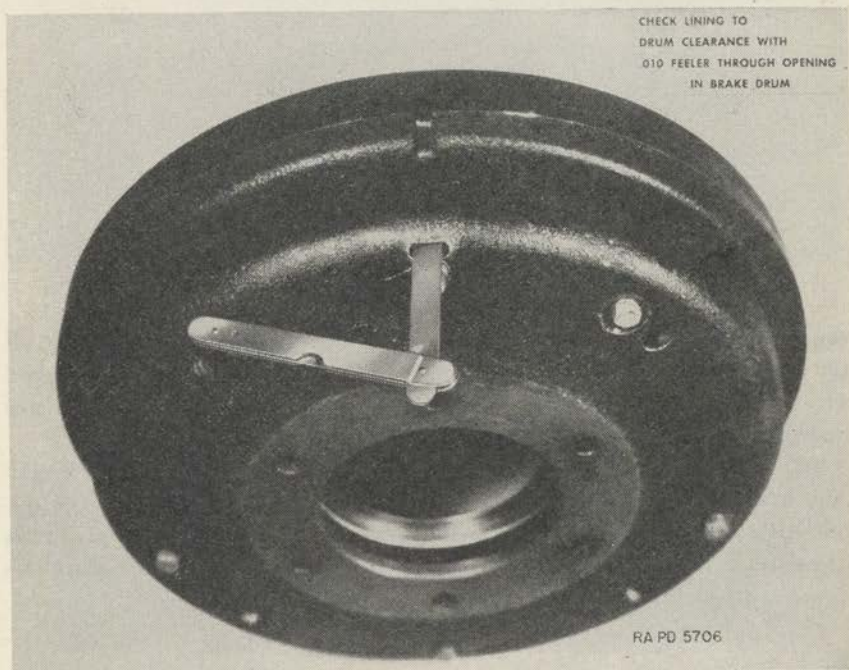


FIGURE 39.—Checking lining clearance, lever type electric brake.

wheel is turned by hand. Then release the adjusting wheel one or two clicks until the wheel turns freely. These adjustments should be carried out carefully on all wheels.

c. Adjustments during service.—The original adjustment, described in *b* above, is required only when new brakes are installed or when new brake lining is put on. Thereafter adjustments for lining wear are made only by adjusting the eccentric to 0.010-inch clearance, or turning

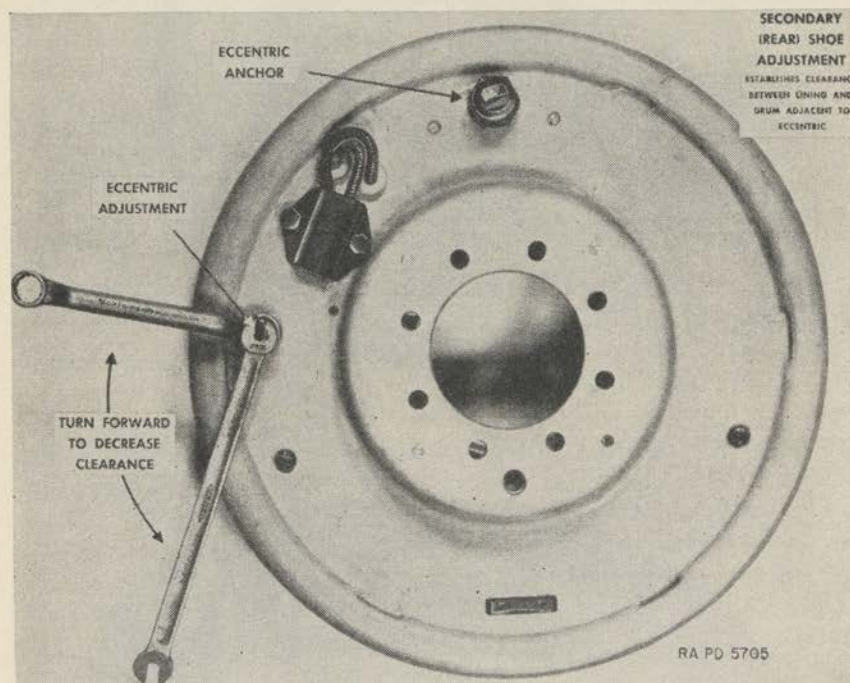


FIGURE 40.—Secondary shoe adjustment, lever type electric brake.

the adjusting wheel until a slight drag is felt and then backing off until the wheel is free. The anchor adjustment should not be disturbed after the brakes are in service except when new brake linings are installed. *This is extremely important.*

46. Disk type of brakes.—*a. Armature spacing* (fig. 44).—(1) The armatures should be depressed approximately $\frac{5}{32}$ inch against the magnet when the drum is mounted in running position. This measurement can be determined by a special armature gage before the drum is placed on the axle.

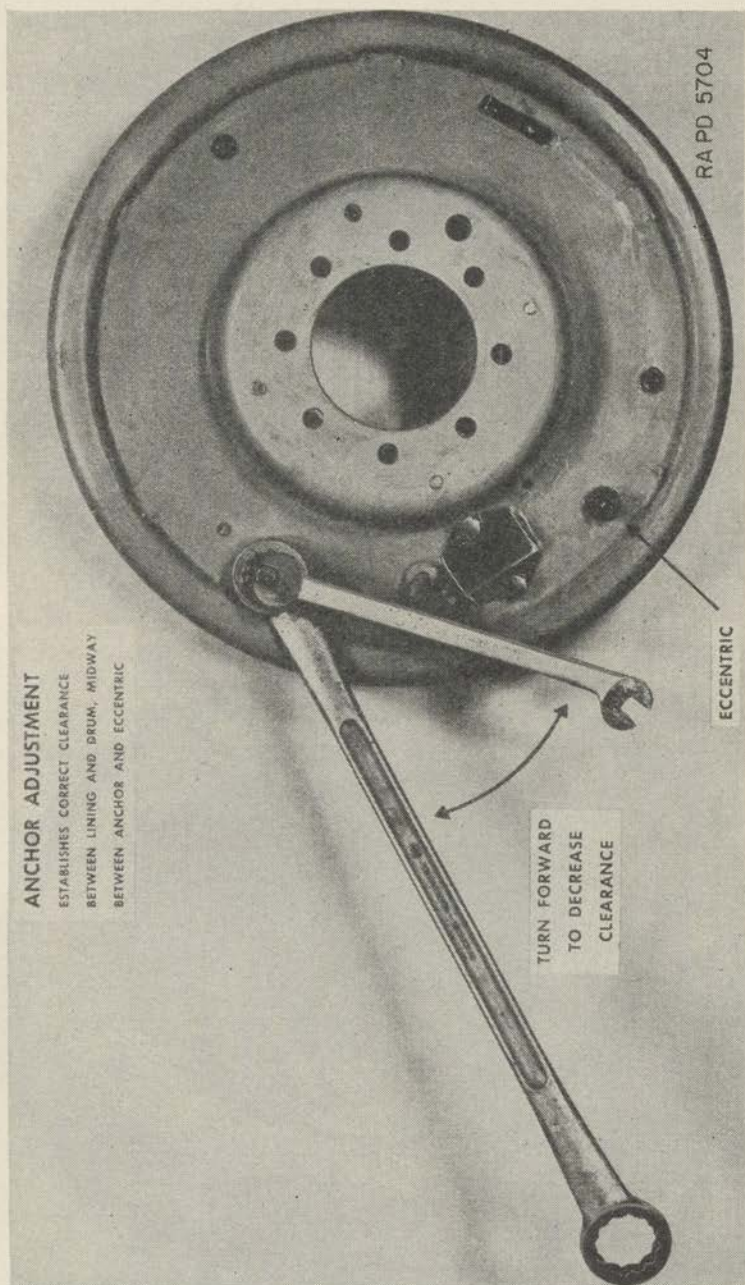


Figure 41.—Anchor adjustment, lever type electric brake.

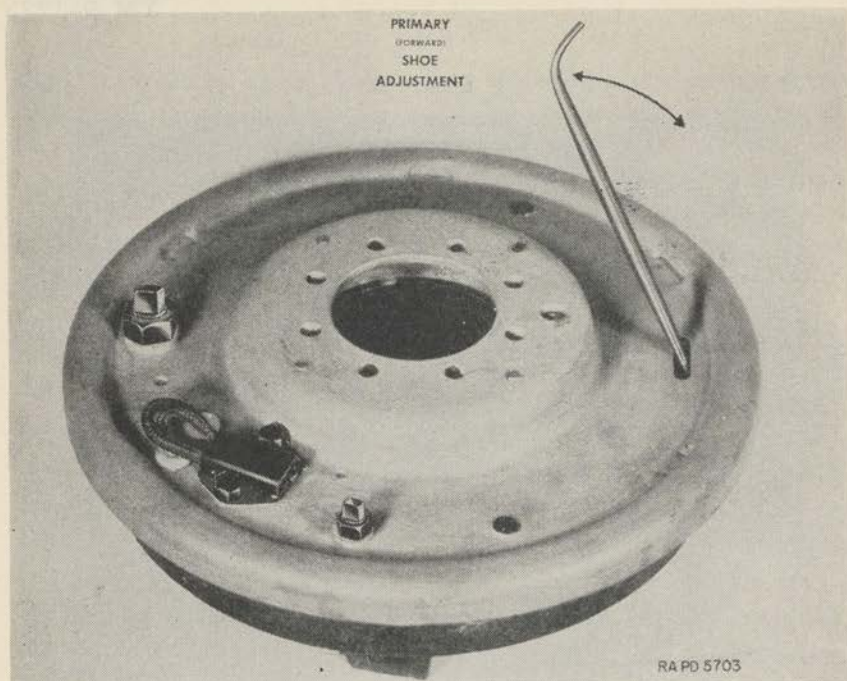


FIGURE 42.—Primary shoe adjustment, lever type electric brake.

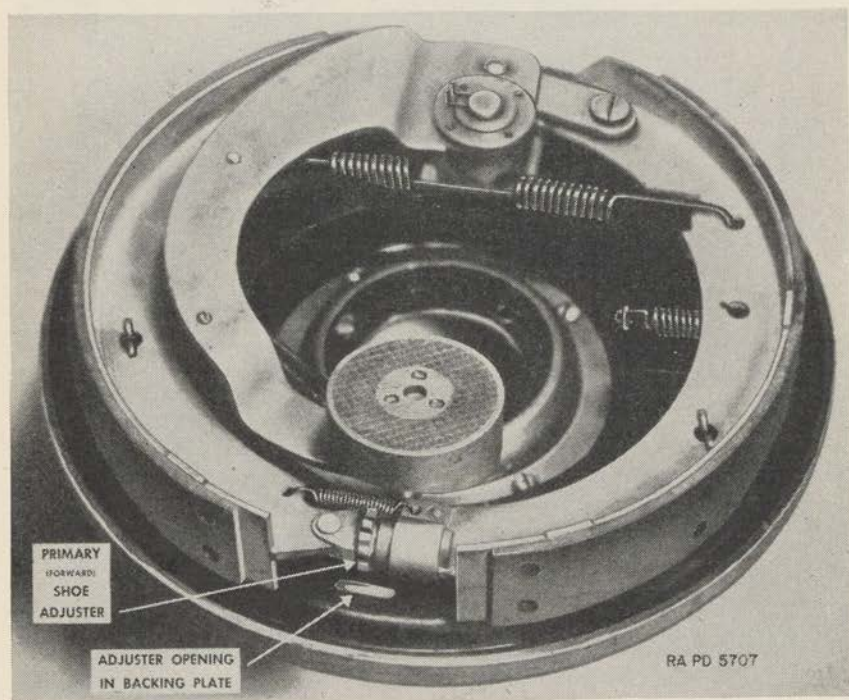


FIGURE 43.—Adjuster opening in back plate, lever type electric brake.

(2) Remove the disk and rim wheel from the wheel spindle. Remove the spindle inner taper roller bearing from the wheel spindle and place it in its correct position in the hub.

(3) Place the short end of the gage against the magnet face (fig. 44).

(4) Slide adjustable rod against the bearing seat at A.

(5) Tighten gage thumbscrew.

(6) Slide collar against the spacer gage frame.

(7) Tighten collar thumbscrew.

(8) Loosen gage thumbscrew.

(9) At three places on the armature circumference, wedge the armature away from the brake drum to its full travel.

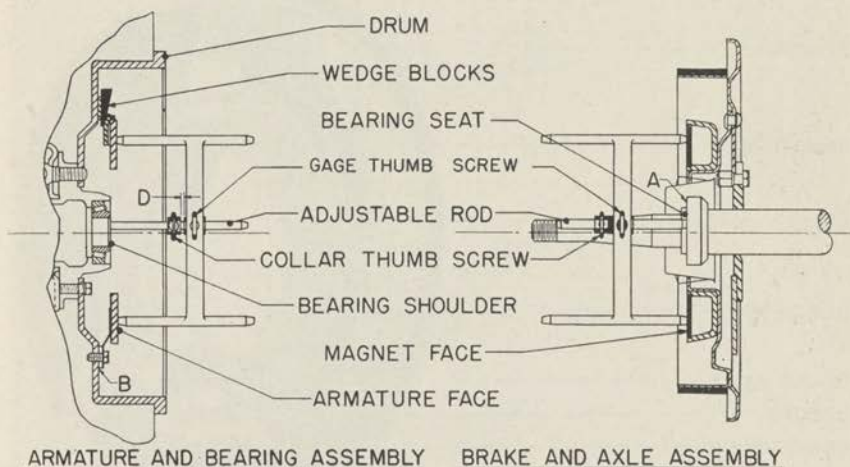


FIGURE 44.—Armature gage for disk type electric brake.

(10) Place the long legs of the gage against the face of the armature.

(11) Slide the adjustable rod against the bearing shoulder.

(12) Tighten the gage thumbscrew.

The distance D from collar to gage is the armature depression after assembly. If this is greater than $\frac{5}{32}$ inch, shim bearing out at bearing seat A. If it is under $\frac{1}{8}$ inch, then shim out the armature at B.

(13) If instructions have been carefully followed, armatures will be depressed approximately $\frac{1}{8}$ inch against the magnet when the drum is mounted in running position.

Caution.—When the spindle has a grease retainer that slips on the spindle back of the bearing, be sure the retainer is in place before checking the armature depression.

b. Assembly of brake.—(1) In assembling do not allow grease, however slight the amount, to touch any part of the brake. Grease will cause grabbing, locking, or loss of power.

(2) When the drum is placed in running position, the wheel nut must be pulled up snug to prevent loose bearings. The brake loses power if the armature is not kept firmly in contact with the magnet. When new brakes are installed the vehicle should be given a small amount (about 5 miles) of road travel, using the brakes frequently until they work satisfactorily. After the brakes are wet, several applications while traveling are required to dry out the linings and

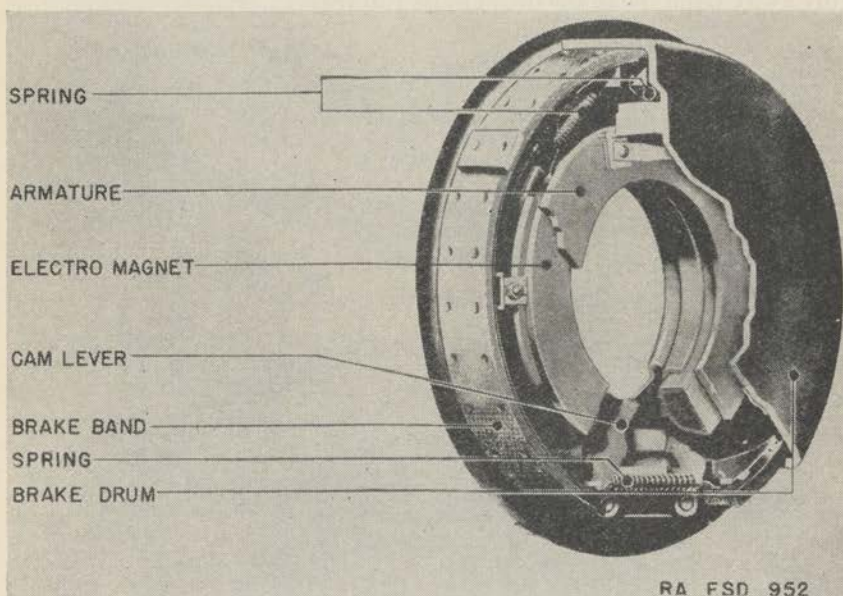
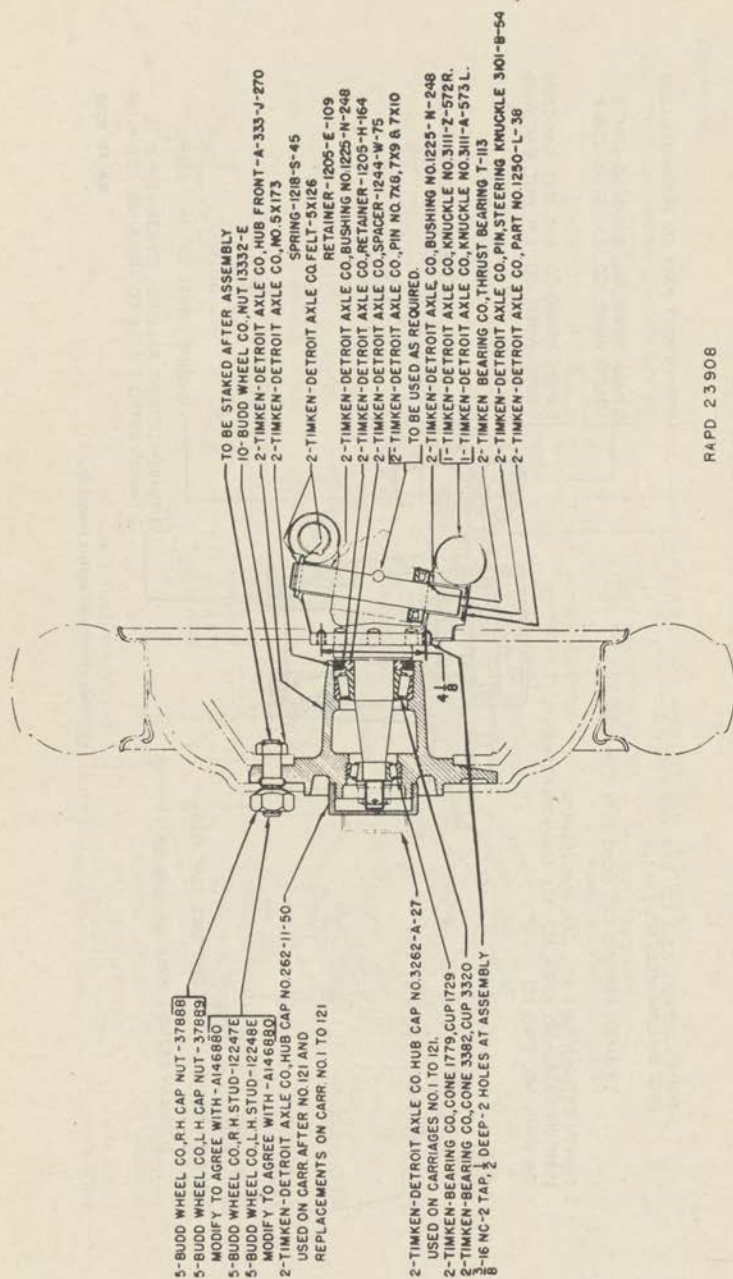


FIGURE 45.—Disk type electric brakes.

facing. Figure 22 shows a wiring diagram for the prime mover for proper operation of the brakes.

c. Glazed magnet facing.—This condition is caused by weak electric current in the brake circuit, light brake applications or grease or oil on the magnet facing. A magnet having a glazed or polished surface does not have sufficient friction to operate the brakes satisfactorily. To remedy cases of this kind, place the magnet in a lathe and turn about .005 inch to .008 inch off the magnet facing. The glazed surface may also be removed with a medium grade of emery cloth. *Do not remove metal from pole faces of magnet.* A new armature may be used with an old magnet but a new magnet must not be used with an old armature.



RAPD 23908

FIGURE 46.—Front wheel hub assembly.

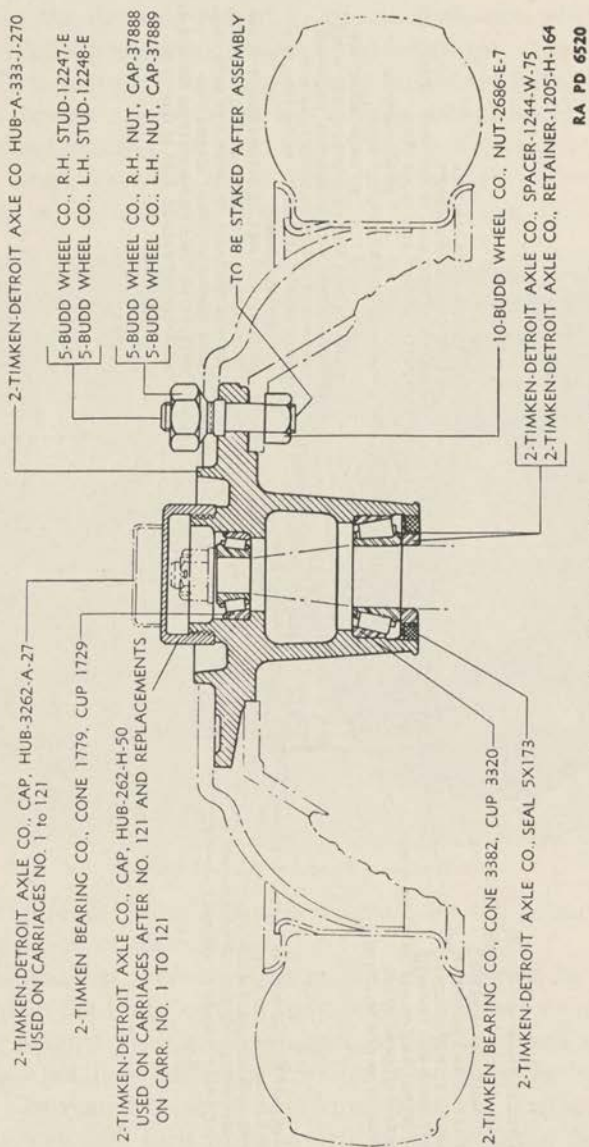


FIGURE 47.—Rear wheel hub assembly.

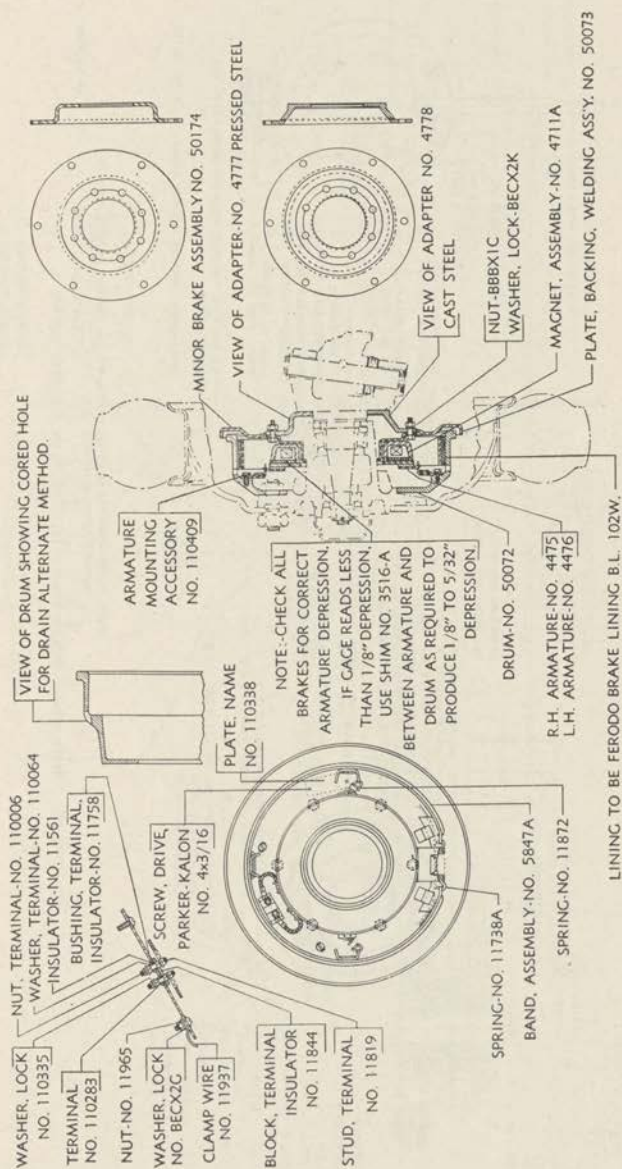
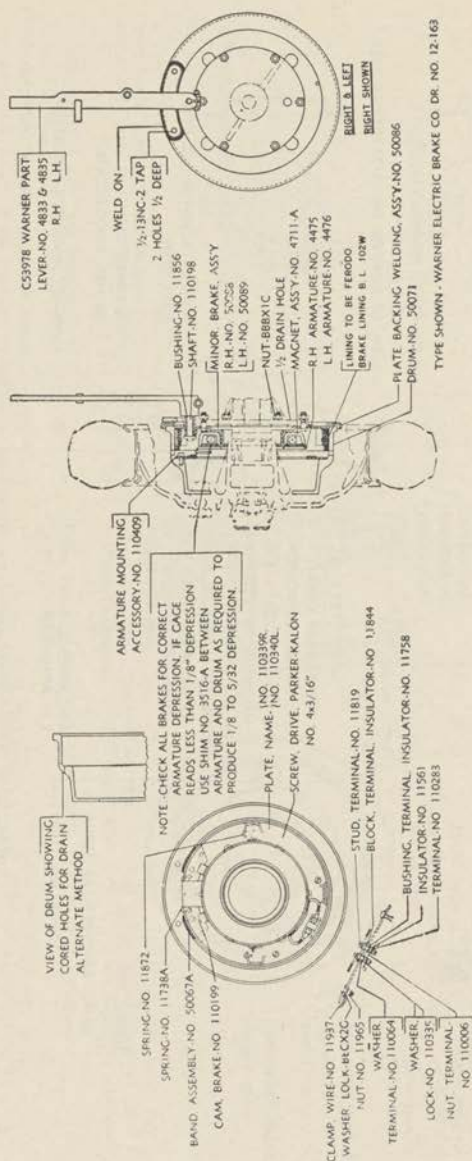


Figure 48.—Front wheel brake assembly, disk type electric brake.

RA PD 6521



NOTE: UNLESS OTHERWISE NOTED ALL PIECE MARKS AND ASSEMBLY NUMBERS REFER TO
 WARNER ELECTRIC BRAKE MFG. CO.

SA PD 6528

FIGURE 49.—Rear wheel brake assembly, disk type electric brake.

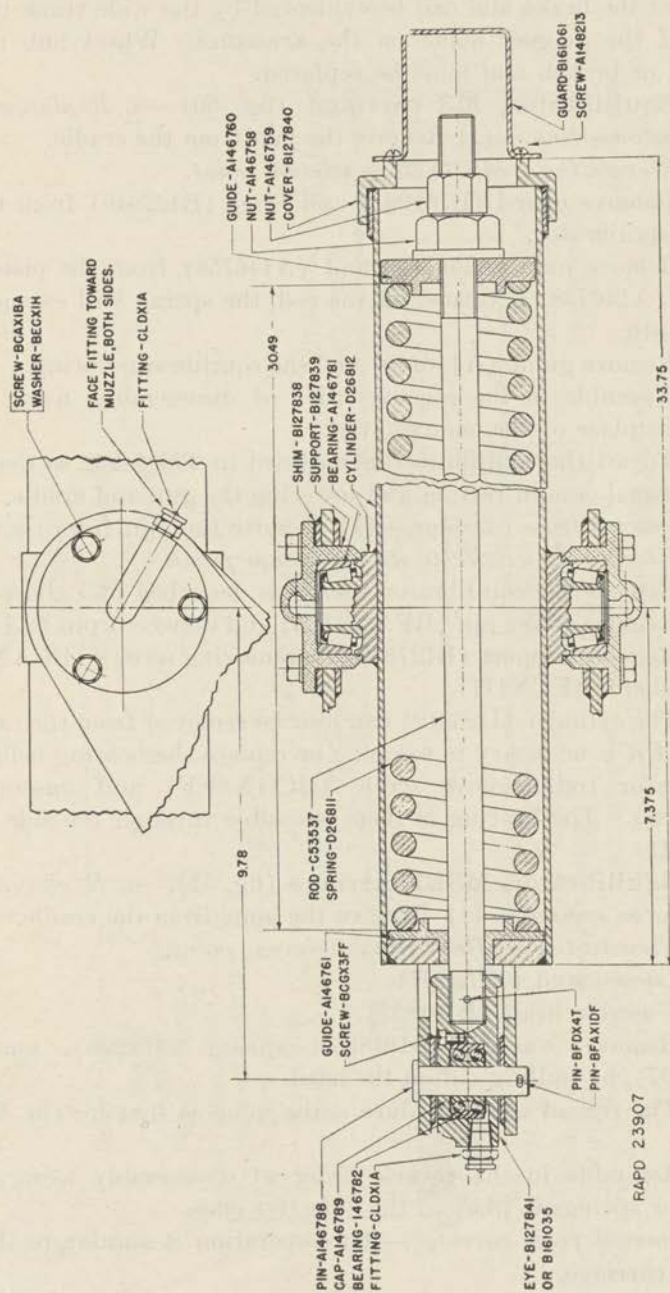


FIGURE 50.—Equilibrator assembly, M3 carriage.

d. Loose parts.—Worn bearings or loose wheels will cause erratic action of the brake and can be evidenced by the wide track the pole faces of the magnet make on the armature. Wheel hub may be cracked or broken and must be replaced.

47. Equilibrator, M3 carriage (fig. 50).—*a. Replacement of equilibrator spring.*—(1) Remove the gun from the cradle.

(2) *Elevate the cradle to its maximum point.*

(3) Remove guard (B161061) and cover (B127840) from the end of the equilibrator.

(4) Remove nuts (A146759) and (A146758) from the piston rod. As nut (A146758) is turned off the rod, the spring will extend to its free length.

(5) Remove guide (A146760) and the equilibrator spring.

(6) Assemble in the reverse order of disassembly, using a new spring in place of the one removed.

(7) Adjust the equilibrator as outlined in TM 9-235 so that there will be equal ease in raising and lowering the gun and cradle.

b. Removal from carriage.—(1) Remove the gun from the cradle.

(2) *Elevate the cradle to its maximum point.*

(3) Remove the equilibrator spring as described in *a* above.

(4) Remove cotter pin (BFAX1DF) and drive out pin (A146788).

(5) Remove support (B127839) by removing screws (BCAX1BA) and washer (BECX1H).

(6) The cylinder (D26812) can now be removed from the carriage.

(7) If it is necessary to examine or replace the bearing behind the equilibrator rod, remove screw (BCGX3FF) and unscrew cap (A146789). The bearing is then accessible through the side of eye (B127841).

48. Equilibrator, M3E1 carriage (fig. 51).—*a. Replacement of equilibrator springs.*—(1) Remove the guns from the cradle.

(2) *Elevate the cradle to its maximum point.*

(3) Loosen stud (A152297).

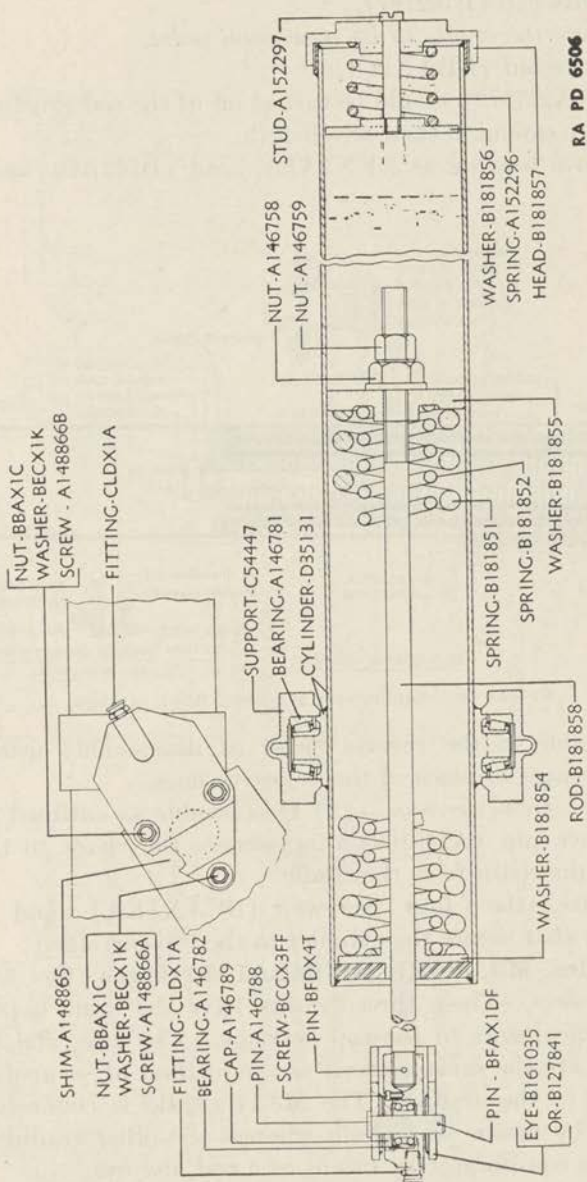
(4) Unscrew head (B181857).

(5) Remove washer (B181856), spring (152296), and stud (A152297), by pulling out on the head.

(6) The rest of the procedure is the same as that for the M3 carriage.

(7) Assemble in the reverse order of disassembly using a new spring or springs in place of the defective ones.

b. Removal from carriage.—This operation is similar to that for the M3 carriage.



RA PD 6506

FIGURE 51.—Equilibrator assembly, M3E1 carriage.

49. Equilibrator, M3A1 carriage (fig. 52).—a. Replacement of equilibrator springs.—(1) Remove the gun from the cradle.

(2) Remove cap (B162197).

(3) Elevate the cradle to its maximum point.

(4) Remove nut (BBAX2C).

(5) Nut (A217570) should be turned off of the rod slowly, allowing the springs to extend to their free length.

(6) Remove bearing (CAFX1AE), head (B162196), and the two springs.

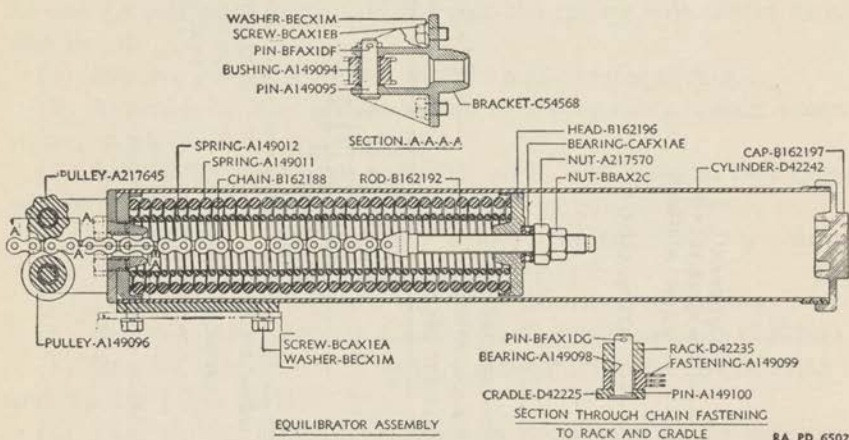


FIGURE 52.—Equilibrator assembly, M3A1 carriage.

(7) Assemble in the reverse order of disassembly using a new spring or springs in place of the defective ones.

b. Removal from carriage.—(1) Disassemble as outlined above.

(2) Remove pin (A149100) that secures the chain to the cradle and remove the chain from the cradle.

(3) Remove the four screws (BCAX1EA) and washers (BECX1M) that secure the cylinder to the top carriage.

50. Cradles, M3, M3E1, and M3A1 carriages (figs. 53, 54, and 55).—a. General.—These three cradles have the same bearings and trunnion attachments to the top carriage. The keys and slideways for the gun are the same, as well as the method of securing the elevating rack to the cradles. The M3A1 cradle is connected to the equilibrator by means of a chain whereas the other cradles are connected to the equilibrator by means of a rod and eye.

b. Disassembly.—(1) Remove the gun from the cradle.

(2) Disconnect the equilibrator as described in the preceding paragraphs.

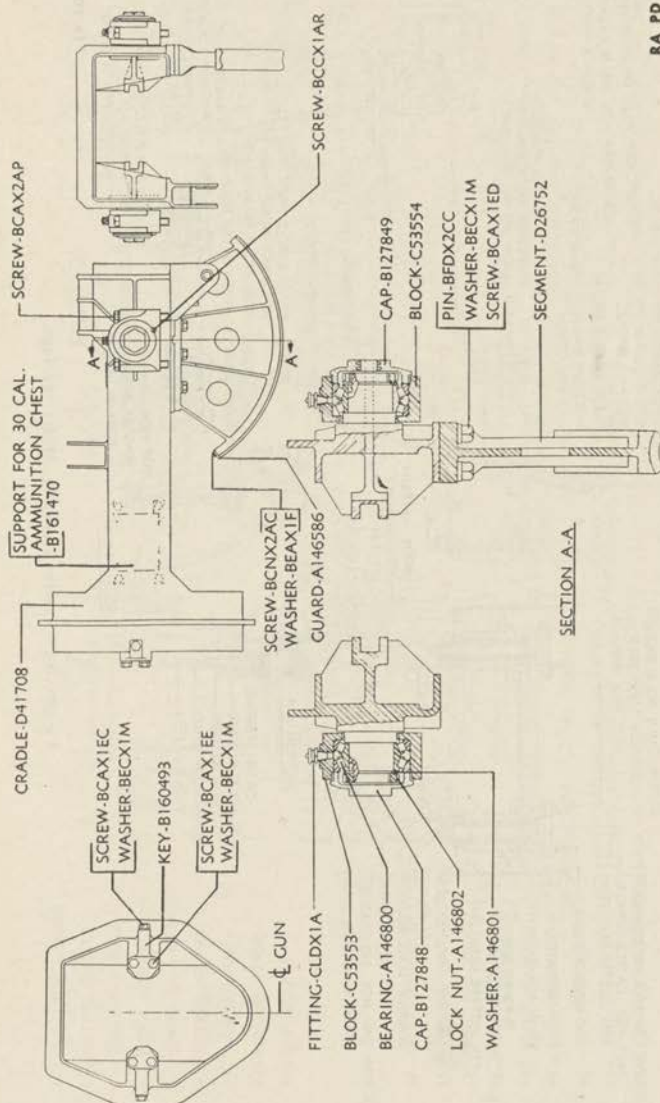


FIGURE 53.—Cradle assembly, M3 carriage.

RA PD 6525

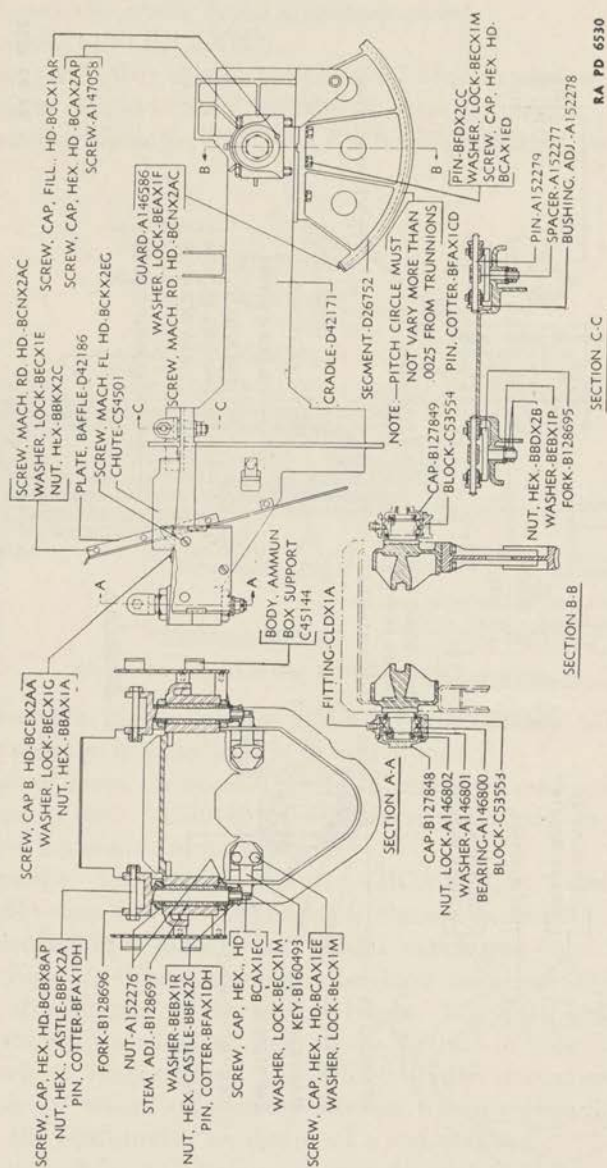


Figure 54.—Cradle assembly, M3E1 carriage.

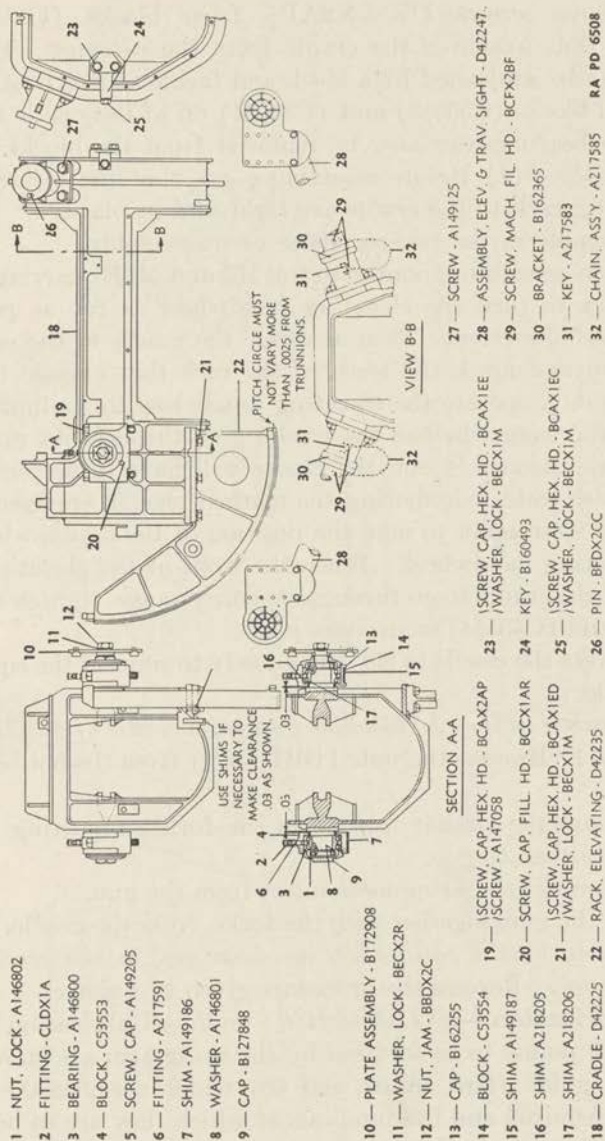


FIGURE 55.—Cradle assembly, M3A1 carriage.

(3) Remove lock screws (BCCX1AR) and then unscrew the caps from each trunnion.

(4) Unscrew lock nuts (A146802).

(5) Remove screws (BCAX2AP) from blocks (C53554) and (C53553), thus loosening the cradle from the carriage. The cradle will have to be supported by a block and tackle at this time.

(6) Pull blocks (C53553) and (C53554) off of the cradle trunnions.

(7) The bearings can now be removed from the blocks.

c. Assembly.—(1) Before assembling, see that the screws holding the elevating rack to the cradle are tight and in place.

(2) Assemble in the reverse order of disassembly.

(3) When assembling cradles to the M3 and M3E1 carriages, it will be necessary to turn the elevating handwheel as far as possible in the "depress" direction. Then assemble the cradle to the carriage at 0° elevation and mark the teeth of the rack that engage the worm. After assembly, operate the elevating handwheel to its limits in each direction and note whether the cradle goes through its range of 0° to 85° in elevation. If not, the cradle will have to be removed and replaced with teeth neighboring the marked ones in engagement with the worm. Test again to note the position of the cradle with respect to the elevating handwheel. When the stops of the elevating mechanism allow the cradle to go through its entire range, tighten the blocks (C53553) and (C53554) securely in place.

(4) Elevate the cradle to 85° when ready to connect the equilibrator to the cradle.

d. Removal of caliber .50 machine gun from cradle of M3E1 carriage (fig. 54).—(1) Remove the nuts (BBDX2B) from the bottom of fork (B128695).

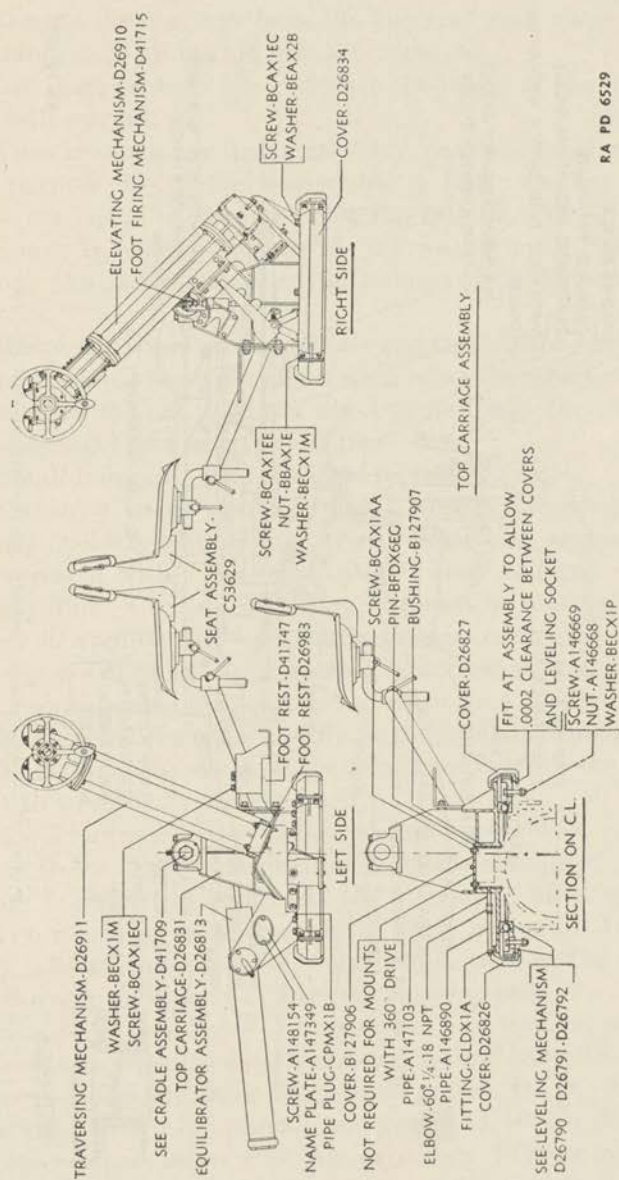
(2) Remove the similar nuts from the fork, supporting the front end of the caliber .50 gun.

(3) Disconnect the firing mechanism from the gun.

(4) Lift the gun, together with the forks, from the cradle.

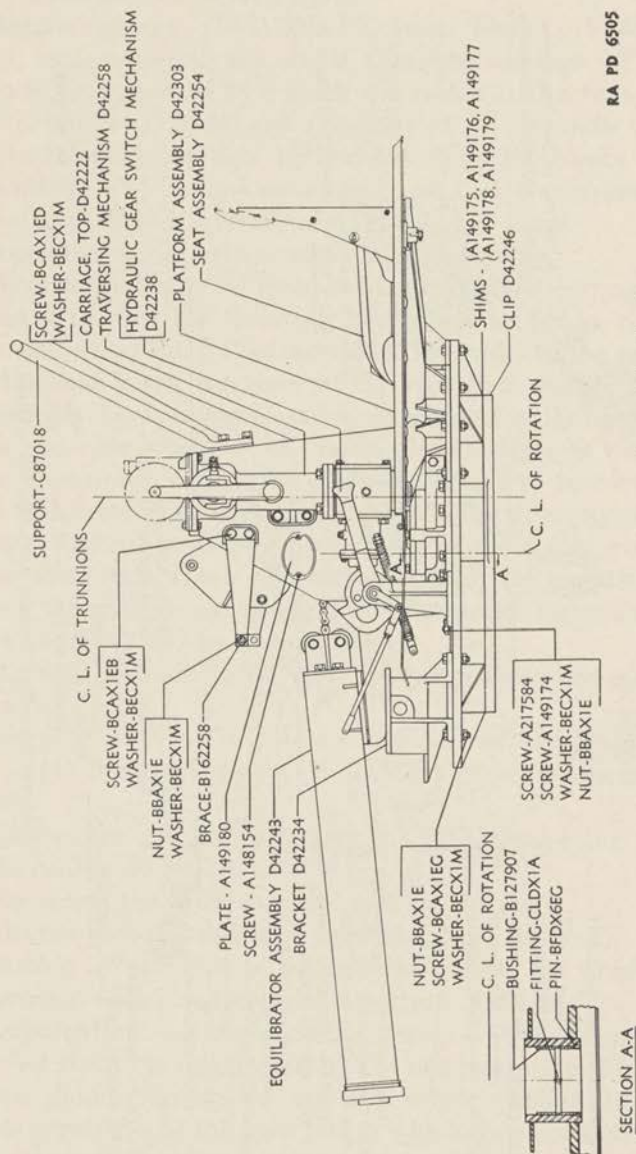
e. Assembly of the caliber .50 machine gun to the cradle of the M3E1 carriage.—Reverse the procedure given in *d* above.

51. Lubrication.—*a. Lubrication guide.*—Lubrication instructions for all points to be serviced by the using arm are shown in the lubrication guide (figs. 58, 59, and 60) which specifies the types of lubricants required and the intervals at which they are to be applied. Supplementary instructions appear in the notes. These guides are to be used for the M3, M3E1, and M3A1 carriages.



RA PD 6529

FIGURE 56.—Top carriage assembly, M3 carriage.



RA PD 6505

Figure 57.—Top carriage assembly, M3A1 carriage—left side view.

b. Lubrication service instructions.—(1) *Wheel bearings.*—To clean and pack wheel bearings properly, they must be removed from the hub. Follow the procedure below.

(a) Remove the bearings from the hub and wash them in solvent, dry-cleaning, until all the old grease is removed.

(b) Lay them aside to dry and wash the inside of the hub and the spindle with solvent.

(c) When bearings are thoroughly dry, pack the races with grease, general purpose, No. 2, and reassemble in hub. Do not apply any grease to the inside of the hub or on the spindle. The grease in the bearing races is sufficient to provide lubrication until the next service period. An excess may result in leakage of the lubricant into the brake drum.

(d) Mount the wheel on the spindle and tighten the nut on the end of the spindle until there is a slight drag when the wheel is rotated.

(e) Back off the nut until the wheel turns freely (one-half turn is usually sufficient) and insert cotter pin.

(f) Install hub cap. The cap must be free of grease.

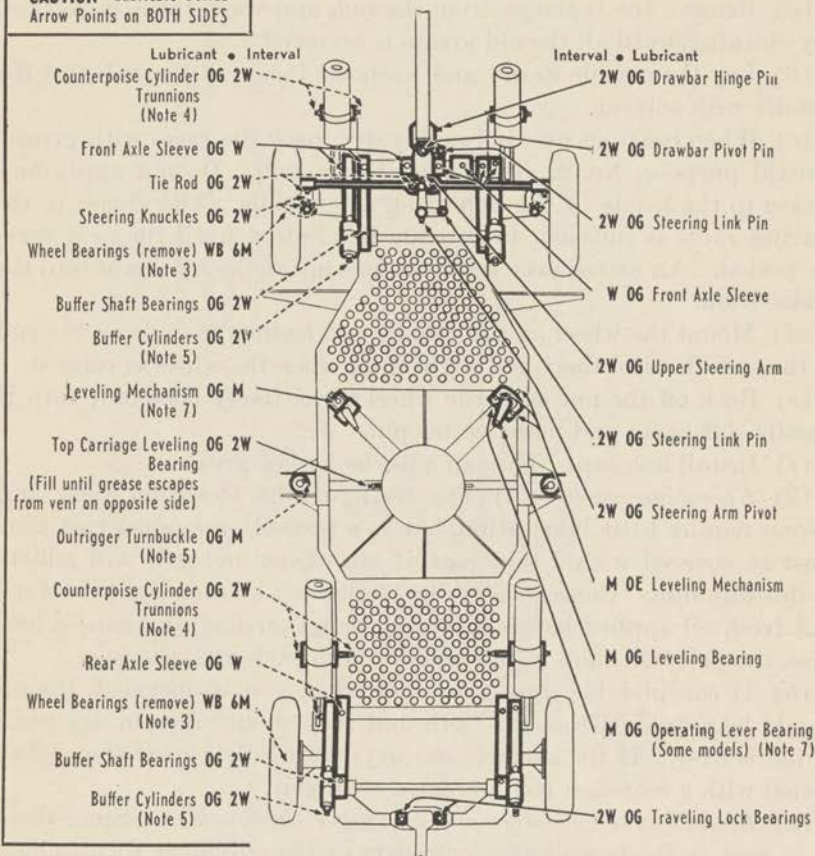
(2) *Elevating rack.*—(a) The teeth of the elevating rack and pinion require little lubrication, but as a protection against rust they must be covered with a thin coat of oil. Dust and grit will adhere to this oily film. Consequently the teeth must be thoroughly cleaned and fresh oil applied before elevating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

(b) If considerable dust is present when gun is operated, the oil should be removed from the teeth and they should remain dry until action is over. If the surfaces are dry, there is less wear than when coated with a lubricant contaminated with grit.

(3) *Bogie buffer cylinders and outrigger turnbuckles.*—Since there is no vent in the bogie buffer cylinders or the outrigger turnbuckles, overfilling is certain to occur. If the interior is filled with grease, there is no room for movement of the parts inclosed. Therefore, if the unit fails to function after lubrication, remove the fitting and operate the unit sufficiently to force out excess grease.

c. Points to be lubricated by ordnance maintenance personnel at time of ordnance inspection.—(1) *Traversing and lower hand elevating gear cases.*—Lubricate these units with grease, O. D., No. 0 where temperatures above +32° prevail, and grease, O. D., No. 00 where continued temperatures below +32° are expected. In most localities, this will necessitate a change of lubricant every 6 months. When changing from one grade to another it is essential that the old lubricant is completely removed from the housing and inclosed parts. This will

CAUTION—Lubricate Dotted
Arrow Points on BOTH SIDES



KEY

LUBRICANTS

OE—OIL, Engine
SAE 30 (above +32°)
SAE 10 (below +32°)

OG—GREASE, O.D.
No. 0 (above +32°)
No. 00 (below +32°)
WB—GREASE, General
Purpose No. 2

INTERVALS

W—WEEKLY
2W—2 WEEKS
M—MONTHLY
6M—6 MONTHS

RAPD23906

FIGURE 58.—Lubrication guide for chassis.

NOTES.—Additional lubrication and service instructions on individual units and parts.

COLD WEATHER.—For lubrication and service below -10° , refer to OFSB 6-5.

1. *Fittings*.—Clean before applying lubricant. **Caution**.—Lubricate after washing gun and carriage.

2. *Intervals*.—Those indicated are for normal service. For extreme conditions of speed, heat, water, mud, snow, rough roads, dust, etc., lubricate more frequently.

3. *Wheel bearings*.—Remove wheel, clean and repack bearings.

4. *Counterpoise cylinders*.—Remove cap on outer end of cylinder and coat the surface above piston with OG monthly.

5. *Buffer cylinders and outrigger turnbuckles*.—**Caution**.—Excessive grease in units will cause malfunction. If overfilled, remove grease fitting and operate parts to force out excessive grease.

6. *Oil can points*.—Lubricate buffer adjustment linkage, buffer rod, counterpoise cam bracket, outrigger hinge pins and hand levers with OE weekly.

7. *Points to be lubricated by ordnance maintenance personnel at time of ordnance inspection*.—Leveling mechanism worm (on left unit), ratchet type operating lever bearing (some models).

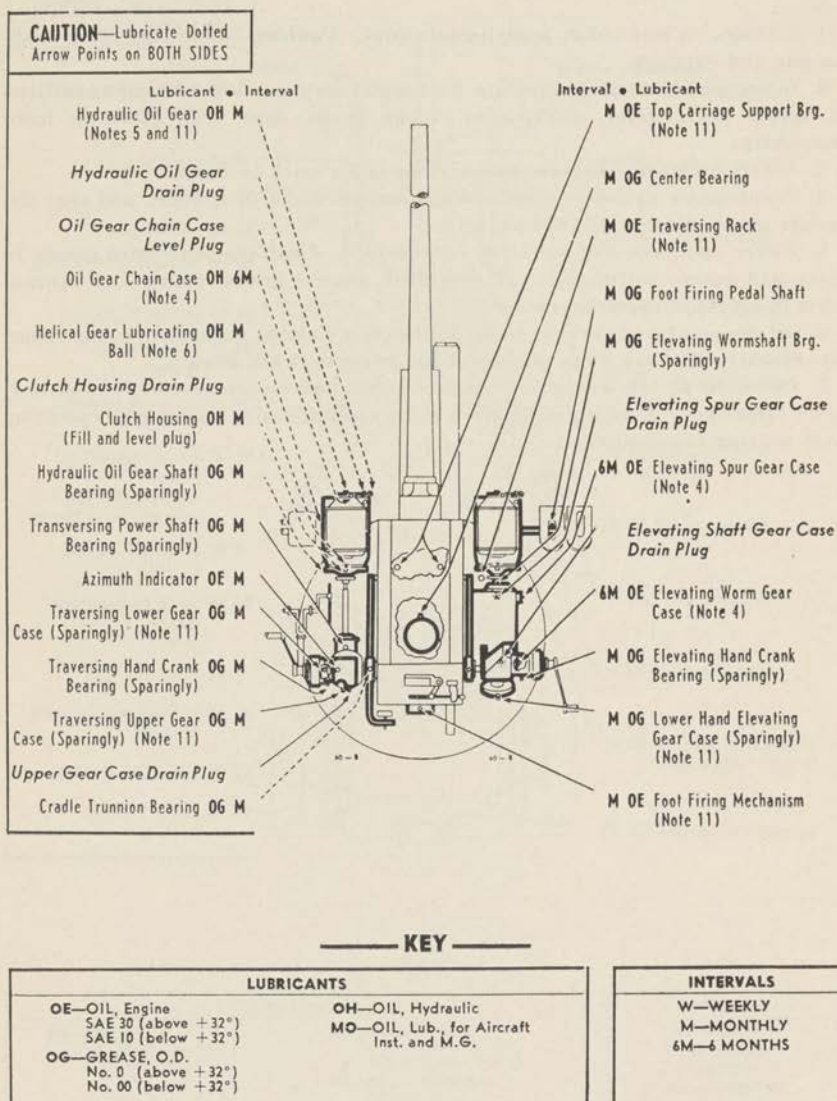


FIGURE 59.—Lubrication guide for top carriage, M3A1 carriage.

NOTES.—Additional lubrication and service instructions on individual units and parts.

COLD WEATHER.—For lubrication and service below -10° , refer to OFSB 6-5.

1. *Fittings*.—Clean before applying lubricant. **Caution**.—Lubricate trunnion bearings, foot-firing pedal shaft, and oil can points after washing gun and carriage.

2. *Recoil fluid*.—For instructions on type and quantity of recoil fluid, refer to War Department Recoil Fluid Guide No. 19 and OFSB 6-6.

3. *Intervals*.—Those indicated are for normal service. For extreme conditions of heat, water, dust, etc., lubricate more frequently.

4. *Oil gear chain case and elevating spur and worm gear cases*.—Check level monthly; add lubricant if necessary. Drain, flush and refill as indicated at points on guide. When necessary to drain, do so immediately after operation.

5. *Hydraulic oil gears*.—Remove cap from filter and fill through center hole, using gun provided, until oil, hydraulic, escapes from vent at side of filter.

6. *Helical gear lubricating ball*.—Remove cover, held on by six stud nuts, and fill recess around ball. **Caution**.—Do not allow moisture, dirt, or grit to enter open mechanism.

7. *Elevating rack*.—Clean and apply OE daily.

8. *Breech and firing mechanism*.—Clean and oil all moving parts and exposed metal surfaces with OE daily. Perform operation before and after firing. **Caution**.—To insure easy breech operation and to avoid misfiring in cold weather, clean with solvent, dry-cleaning, dry and lubricate with MO. To clean firing mechanism, remove and operate pin in solvent.

9. *Gun bore*.—Clean and coat with OE after firing. Inspect daily and oil if necessary.

10. *Oil can points*.—Lubricate crank handles, clevises and linkage with OE weekly.

11. *Points to be lubricated by ordnance maintenance personnel at time of ordnance inspection*.—Traversing and lower hand elevating gear cases, hydraulic oil gears, traversing rack and top carriage support bearings, foot-firing mechanism.

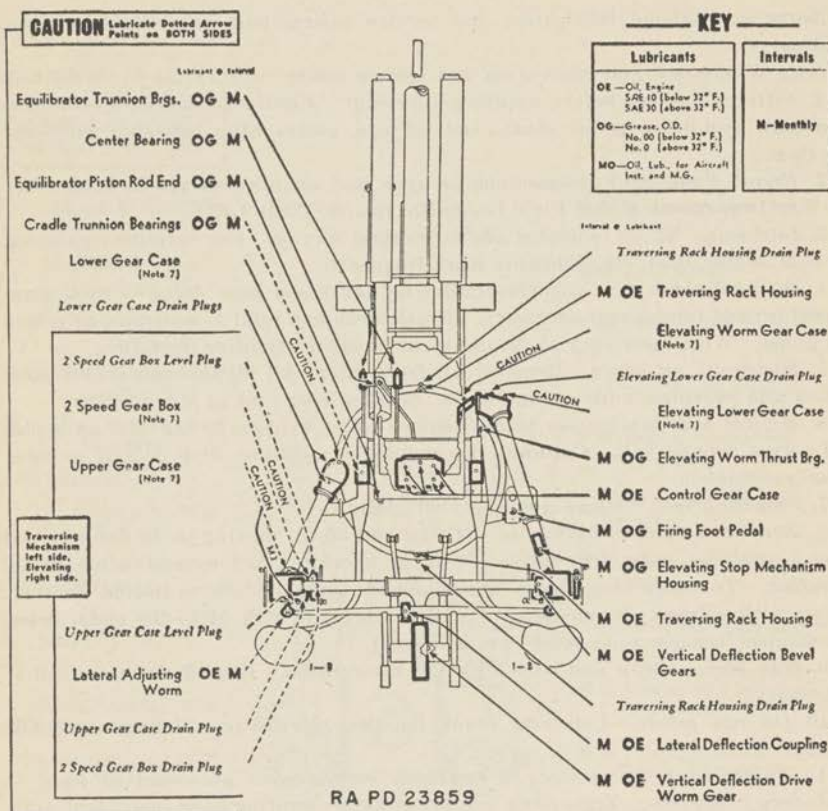


FIGURE 60.—Lubrication guide for top carriage, M3 carriage.

NOTES.—Additional lubrication and service instructions on individual units and parts.

1. *Intervals.*—Those indicated are for normal service. For extreme conditions of heat, water, dust, etc., lubricate more frequently.

2. *Fittings.*—Clean before applying lubricant. **Caution.**—Lubricate center bearing, trunnion bearings, and foot-firing pedal shaft after washing gun.

3. *Elevating rack.*—Clean and apply OE daily.

4. *Breech and firing mechanism.*—Clean and oil all moving parts and exposed metal surfaces with OE daily. To avoid misfiring below freezing, remove block. Dip block in solvent, dry-cleaning. Operate firing pin in solvent, lubricate with MO and replace mechanism.

5. *Gun bore.*—Clean and coat with OE after firing. Inspect daily and oil if necessary.

6. *Points requiring no lubrication.*—Sighting mechanism drive cables.

7. *Points to be lubricated by ordnance maintenance personnel at time of ordnance inspection.*—Traversing and elevating gear cases.

necessitate total or partial disassembly. New lubricant should be applied by removing the cover plate when possible. Apply grease through a fitting, and do not fill the housing to a point above the level testing plug.

(2) *Traversing rack and top carriage support bearings.*—Although the traversing rack and carriage ball bearings are inclosed, the lubricant becomes contaminated during use. To avoid damage, the parts must be disassembled and cleaned once yearly and repacked with grease, O. D., seasonal grade.

(3) *Hydraulic oil gears (M3A1).*—Due to expansion and contraction of oil, hydraulic, in these units, a breathing action is set up that tends to draw dirt and moisture into the mechanism. These impurities combine with products of oil oxidation and form sludge. Draining these units at intervals of 6 months and refilling them with fresh oil is essential and beneficial but, to prevent sludge deposits from becoming dangerously heavy, the mechanism will be disassembled and thoroughly cleaned once each year.

(4) *Helical gear lubricating ball.*—Remove plate on speed gear housing and refill chamber containing cork ball level full with oil, hydraulic.

(5) *Leveling worm and bearing (M3A1).*—Remove ratchet handle and bearing. Coat worm and pack bearing with grease, O. D. Replace mechanism.

(6) *Foot firing mechanism (M3A1).*—Coat internal parts with grease, O. D., seasonal grade.

d. Reports and records.—(1) *Reports.*—If lubrication instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, a report will be made to the ordnance officer responsible for the maintenance of the matériel.

(2) *Records.*—A complete record of lubrication servicing will be kept for the matériel.

APPENDIX

REFERENCES

1. Standard Nomenclature Lists.

- a. Cleaning and preserving.
 - Cleaning, preserving, and lubricating materials..... SNL K-1
 - Soldering, brazing, and welding compounds... SNL K-2
- b. Gun matériel.
 - Gun, automatic, 37-mm, M1A2 and carriage, automatic gun, 37-mm, M3 and M3A1..... SNL A-29
 - Gun, machine, cal. .50, Browning, M2, water-cooled, fixed and flexible..... SNL A-37
- c. Tools, special repair..... SNL A-35
- d. Current standard nomenclature lists are as tabulated here. An up-to-date list of SNL's is maintained as the Ordnance Publications for Supply Index (OPSI).

2. Explanatory publications.

- a. Cleaning, preserving, and lubricating materials... TM 9-850
- b. Fire control.
 - System, remote control, M1..... TM 9-1643
 - System, sighting, M2..... TM 9-1606
- c. Gun matériel.
 - Artillery gun book..... OO Form 5825
 - Service of the piece, 37-mm antiaircraft gun... FM 4-140
 - 37-mm antiaircraft gun matériel..... TM 9-235
- d. Maintenance of matériel in the hands of troops... OFSB 4-1
 - Maintenance and care of pneumatic tires and rubber treads..... TM 31-200

INDEX

	Paragraph	Page
Alinement, wheels.....	25, 44	16, 70
Antitank firing.....	2	1
Back plate buffer.....	12	7
Brakes:		
Disk type.....	46	72
Inspection.....	21	15
Lever type.....	45	70
Buffer, back plate.....	12	7
Buffer mechanism:		
Inspection.....	16	8
Maintenance and repair.....	32	30
Carriage data.....	3	2
Characteristics.....	2	1
Chassis:		
Inspection.....	15	8
Maintenance and repair.....	31	30
Counterpoise cylinders.....	17	10
Cradles:		
Inspection.....	23	16
Maintenance and repair.....	50	84
Data:		
Carriage.....	3	2
Gun.....	4	4
Disassembly, personnel authorized.....	1	1
Driving spring assembly:		
Inspection.....	8	6
Maintenance and repair.....	30	27
Electrical circuit.....	34	30
Elevating mechanism:		
Inspection.....	18	10
M3 and M3E1 carriage.....	37	46
M3A1 carriage.....	38	53
Equilibrator:		
Inspection.....	22	16
M3 carriage.....	47	82
M3A1 carriage.....	49	84
M3E1 carriage.....	48	82

INDEX

	Paragraph	Page
Feed box mechanism.....	10	7
Firing mechanism.....	14	7
Foot firing mechanism:		
Inspection.....	19	10
M3 carriage.....	39	58
M3A1 carriage.....	40	61
Gun—		
As a unit.....	6	6
Data.....	4	4
Tube.....	7	6
Inspection:		
Back plate buffer.....	12	7
Brakes.....	21	15
Buffer mechanism.....	16	8
Chassis.....	15	8
Cradles.....	23	16
Counterpoise cylinders.....	17	10
Driving springs.....	8	6
Elevating and traversing mechanism.....	18	10
Equilibrator.....	22	16
Feed box mechanism.....	10	7
Firing mechanism.....	14	7
Foot firing mechanism.....	19	10
Gun as a unit.....	6	6
Gun tube.....	7	6
Leveling mechanism.....	20	15
Lock frame.....	8	6
Outriggers.....	24	16
Purpose.....	5	5
Recuperator mechanism.....	11	7
References.....	5	5
Tools.....	5	5
Trunnion block.....	13	7
Tube extension assembly.....	9	7
Wheel alinement.....	25	16
Leveling mechanism:		
Inspection.....	20	15
M3 and M3E1 carriages.....	41	62
M3A1 carriage.....	42	67
Lever type brakes.....	45	70
Lock frame.....	8	6
Lubrication.....	51	88

Outrigger assembly :	Paragraph	Page
Inspection-----	24	16
Maintenance and repair-----	33	30
Personnel authorized to make repairs-----	2	1
Publications, explanatory-----	App.	98
Recuperator mechanism :		
Inspection-----	11	7
Maintenance and repair-----	29	24
References-----	App.	98
Second echelon operations-----	28	24
SNL's-----	App.	98
Tools :		
Inspection-----	5	5
Maintenance and repair-----	27	24
Traversing mechanism :		
Inspection-----	18	10
M3 and M3E1 carriages-----	35	37
M3A1 carriage-----	36	42
Trunnion block-----	13	7
Wheel alinement-----	25, 44	16, 70
Wrenches-----	27	24

[A. G. 062.11 (3-31-42).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

DISTRIBUTION:

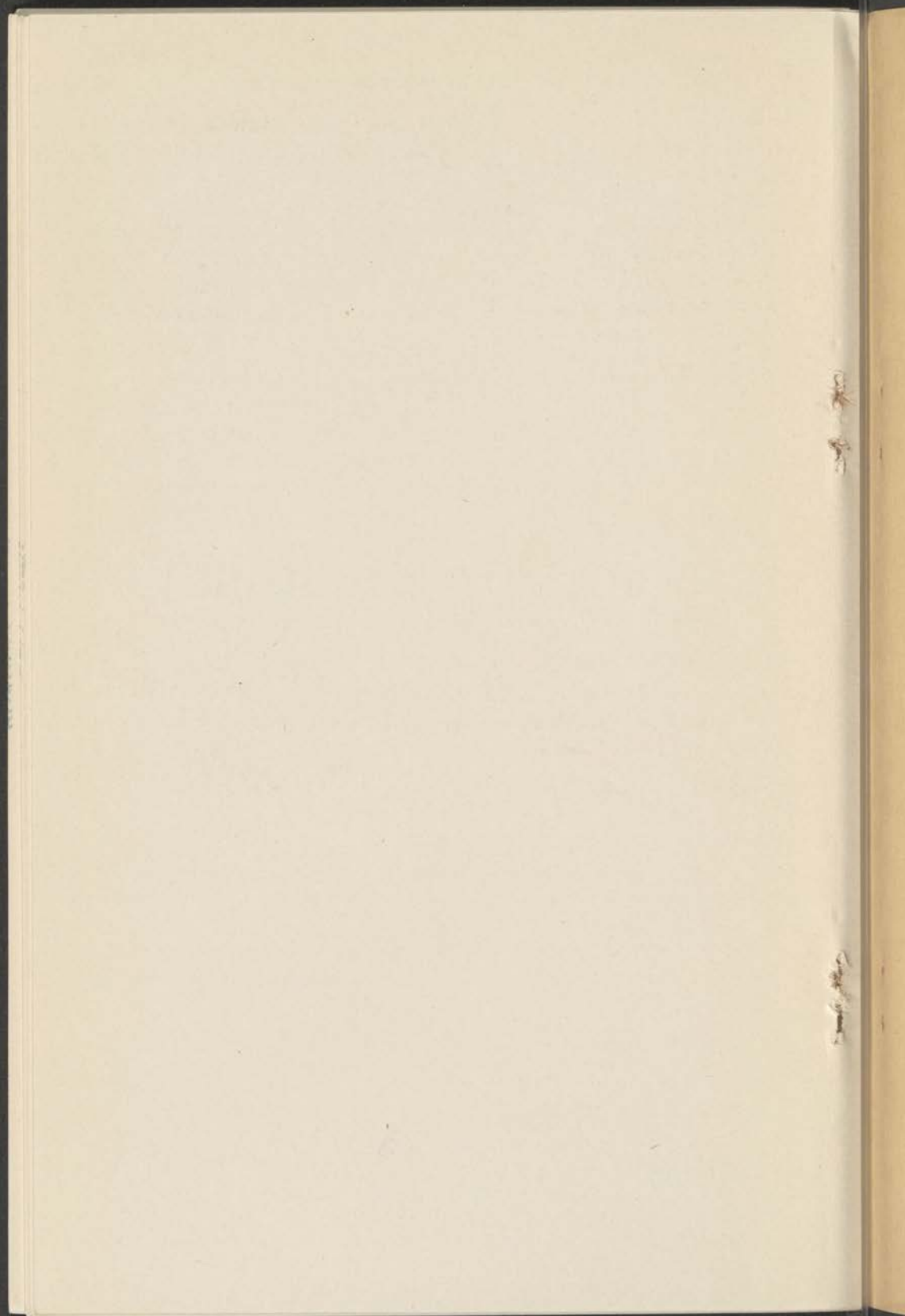
IBn 9 (1); IC 9 (3).

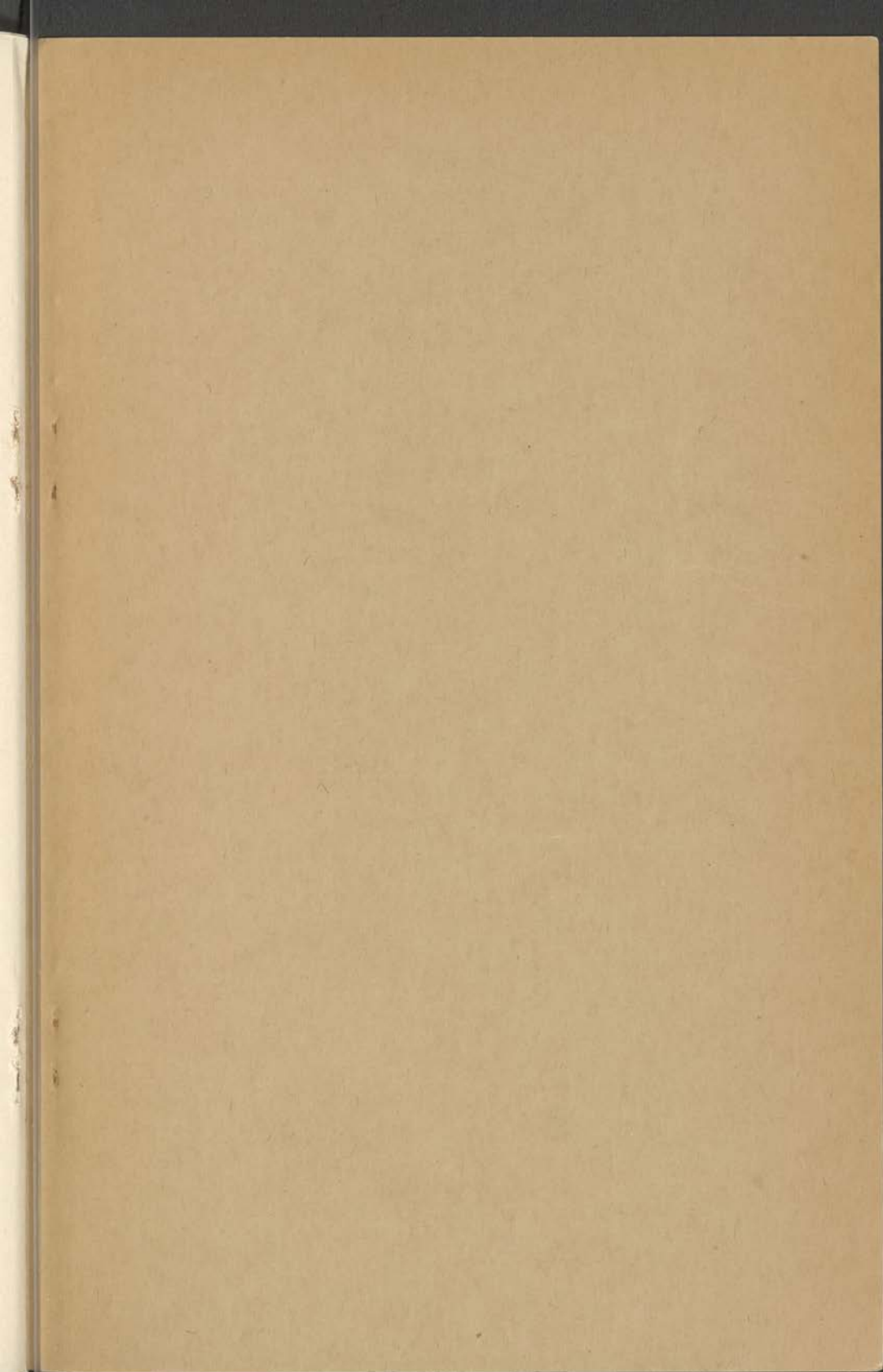
(For explanation of symbols see FM 21-6.)

The first part of the paper is devoted to a discussion of the general principles of the theory of the structure of the atom. It is shown that the structure of the atom is determined by the laws of quantum mechanics, and that the laws of quantum mechanics are determined by the laws of the special theory of relativity. The second part of the paper is devoted to a discussion of the application of the theory of the structure of the atom to the study of the properties of matter. It is shown that the theory of the structure of the atom can be used to study the properties of matter, and that the properties of matter can be used to study the theory of the structure of the atom.

100
100
100
100

100
100
100
100





TEXAS STATE COLLEGE
~~LIBRARY~~
NTSU LIBRARY
WITHDRAWN

UNT LIBRARIES, DENTON, TX 76203



1000961106

ks

APR 01 1956
APR 04 1956

(Form 14 - 5/73)

See
CV 1992 mod at p 982