

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

SUBSTATION, TRAILER MOUNTED, 500 KVA, AC,

4160-416Y/240V, 208Y/120V

3 PHASE 50/60 HERTZ

AVIONICS MODEL 950-2200A

FSN 6120-422-1047

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HEADQUARTERS, DEPARTMENT OF THE ARMY

MAY 1972

## **WARNING**

### **HIGH VOLTAGE**

The high voltage input and distribution of this mobile substation are dangerous to personnel coming in contact with any part of the electrical system when substation is energized or on the line. If contact occurs, a severe, possibly fatal shock may result. Substation must be grounded whenever connected to any power source. Be extremely careful when unit or surrounding area is wet.

When servicing any part of substation or making corrections, make sure all power has been disconnected from that part if not possible to have source power disconnected.

### **ELECTRICAL SHOCK**

In case of accident or electrical shock, shut down substation at once. If substation (cannot be shut down, free victim from live conductor. Avoid direct contact with victim. Use a dry board., dry rope or any nonconducting implement to free victim. If victim is unconscious, apply artificial respiration and get medical help.

### **BODILY INJURY**

Before energizing substation see that all loose bars, tools and parts are removed from the operation platform (trailer bed). Loose parts and tools could cause serious damage to equipment and bodily injury to personnel.

TECHNICAL MANUAL }  
 No. 5-6120-250-34 }

HEADQUARTERS  
 DEPARTMENT OF THE ARMY  
 WASHINGTON, D.C., 11 May 1972

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**CHAPTER 1**  
**INTRODUCTION**

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**Section I. GENERAL**

**1-1. Scope**

This manual contains instructions for direct and general support maintenance personnel responsible for maintenance of the mobile substation. It provides information on maintenance of equipment which is beyond the scope of tools, equipment, personnel, or supplies normally available to the operator and organizational levels.

**1-2. Forms and Records**

DA forms and records used for equipment maintenance will be only those prescribed in TM 38-750.

**1-3. Reporting of Errors**

Reports of errors, omissions and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028, (Recommended Changes to Publications), and forwarded to Commanding General, U. S. Army Mobility Equipment Command, ATTN: AMSME-MP, 4300 Goodfellow Boulevard, St. Louis, Missouri 63120.

**Section II. DESCRIPTION AND DATA**

**1-4. Description**

A general description of the Avionics Model 950- 2200A 500 KVA Mobile Substation and information pertaining to the identification plates are contained in the operator and organizational maintenance manual TM 5-6120-250-12. A more detailed description of specific components and assemblies is contained in the applicable sections of this manual.

**1-5. Tabulated Data**

*a. General.* This paragraph contains all maintenance data pertinent to direct and general support maintenance and repair procedures.

*b. Mobile Substation.*

Manufacturer.....Avionics Div. of Mechanical Technology Inc.  
Model.....950-2200A  
Rating .....500 KVA, AC, 4160-416Y/240V, 208Y/120V 3 Phase 50/60 Hertz  
Contract Number.....DAAK01-70-C-7955  
Type.....Trailer mounted, self contained

*c. Trailer.*  
*(1) Frame.*

Manufacturer.....Trailco Manufacturing and Sales Company  
Type.....Flat bed, tandem axle  
*(2) Air brake system.*

Manufacturer.....Bendix-Westinghouse  
Type.....Straight Air  
Brake Chamber .....Type 30  
Valve, Relay Emergency.....Type RE-6  
Operating Air Pressure.....85 PSI Minimum-Reservoir  
Slackadjusters.....Type PL-20 Straight Arm

*(3) Brakes.*

Manufacturer ..... North American Rockwell  
Type of Brake Mechanism .. 2 Shoe, Cam Actuated

*(4) Brake drums.*

Manufacturer .....Webb Wheel Div. of Amer. Steel and Pump Corp.  
Size ..... 16 1/2 inches by 7 inches

*(5) Wheels.*

Manufacturer .....Webb Wheel Div. of Amer. Steel and Pump Corp.  
Type ..... 20 inch, 3 Spoke

*(6) Rims.*

Manufacturer ..... Redco Corp.  
Size ..... 7:00 x 20  
Type ..... Demountable 2 Piece

*(7) Wheel spacer.*

Manufacturer ..... Goodyear  
Width..... 4 inch K Type Dual Channel

*(8) Tires.*

Size ..... 9:00 x 20  
Rating..... 10 Ply, Transport

*(9) Suspension.*

Manufacturer ..... Hutch  
Type ..... Side Mount, Tandem Axle  
Springs..... Eight Leaf

(10) Oil seals (wheel bearing).

Manufacturer.....Stemco

(11) Axles.

Manufacturer.....North Amer. Rockwell  
 Size .....4 inch x 6 inch Type RN  
 Wheel Bearing Lubrication..Oil

(12) Landing gear.

Manufacturer.....Homan  
 Model.....HH-500 Two Speed with  
 Wheels

**1-6. Torque Data.**

Table 1-1 lists the standard and specific nut and bolt torque data for Model 950-2200A mobile substation.

Table 1-1. Model 950-2200A Mobile Substation.

Standard bolt size	Ft-Lb. Torque
1/4.....	9
5/16.....	18
3/8.....	32
7/16.....	50
1/2.....	75
9/16.....	100
5/8.....	150
3/4.....	265
7/8.....	420
1.....	640

Bus bar connecting bolts:

Bolt size	Ft. Lb.
3/8-16	15-20
1/2-16	30-40
5/8-11	35-45

**CHAPTER 2**  
**DIRECT AND GENERAL SUPPORT**  
**MAINTENANCE INSTRUCTIONS**

**Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT**

**2-1. Special Tools and Equipment**

No special tools or equipment are required by direct and general support maintenance personnel for performing maintenance on the substation.

**2-2. Direct and General Support Maintenance Repair Parts**

Direct and general support maintenance repair parts are listed and illustrated in TM5-6120-250-34P.

**Section II. TROUBLESHOOTING**

**WARNING**

**Before inspection or any maintenance work is performed, all electrical power should be disconnected, both the source and load.**

**2-3. General**

This section provides information useful in diagnosing and correcting unsatisfactory operations or failure of the

mobile substation and its components. Malfunctions which may occur are listed in tables 2-1 through 2-4. Each malfunction stated is followed by a probable cause and recommended corrective action.

**2-4. Load Break Switch Troubleshooting**

Table 2-1 lists the load break switch troubleshooting malfunctions for direct and general support maintenance personnel.

**Table 2-1. Load Break Switch Troubleshooting**

Malfunction	Probable Cause	Corrective Action
1. Overheating.	<ul style="list-style-type: none"> <li>a. Contact not aligned.</li> <li>b. Contacts dirty, greasy, or coated with dark film.</li> <li>c. Contacts badly burned or pitted.</li> <li>d. Connection to switch terminals not tight.</li> </ul>	<ul style="list-style-type: none"> <li>a. Adjust (para 2-14).</li> <li>b. Clean contacts (para 2-14).</li> <li>c. Replace contacts and adjust movement (para 2-14).</li> <li>d. Tighten, but do not exceed elastic limit of bolts and nuts. (table 1-1).</li> </ul>
2. Operates Hard.	<ul style="list-style-type: none"> <li>a. Switch loose on mounting frame allowing it to twist.</li> <li>b. Switch movement loose.</li> <li>c. Mechanisms dry.</li> </ul>	<ul style="list-style-type: none"> <li>a. Tighten mounting bolts, but do not exceed elastic limit of bolts and nuts (table 1-1).</li> <li>b. (Check all nuts, washers, bolts, cotter pins for tightness. Check for binding or excessive friction. (para 2-14).</li> <li>c. Check and see that all bearings and other moving parts for need of lubrication or dry hardened old lubricants.</li> </ul>

**2-5. Transformer Troubleshooting**

Table 2-2 lists the transformer troubleshooting

malfunctions for direct and general support maintenance personnel.

**Table 2-2. Transformer Troubleshooting**

Malfunction	Probable Cause	Corrective Action
High liquid and/or wind temperature	<ul style="list-style-type: none"> <li>a. Low liquid level.</li> <li>b. Leak of liquid coolant.</li> <li>c. Rise in line load and / or ambient Temperature.</li> </ul>	<ul style="list-style-type: none"> <li>a. Check gages for damage, replace if damaged.</li> <li>b. Check pressure gage reading. (No change in pressure with a temp. rise indicates a leak.) Inspect transformer for leaks. Report leaks to depot maintenance.</li> <li>c. Report to systems engineer.</li> </ul>

**2-6. Circuit Breaker Troubleshooting**

Table 2-3 lists the circuit breakers troubleshooting malfunctions for direct and general support maintenance personnel.

**work is being done on a circuit breaker, make sure that it is in the open position and the closing springs are restrained by the safety pin.**

**WARNING**

**When inspecting, removing, installing or maintenance**

**Table 2-3. Circuit Breaker Troubleshooting**

Malfunction	Probable Cause	Corrective Action
1. Overheating.	<ul style="list-style-type: none"> <li>a. Contacts not aligned.</li> <li>b. Contacts badly burned or pitted.</li> </ul>	<ul style="list-style-type: none"> <li>a. Adjust. (para. 5-71).</li> <li>b. Replace and check adjustment, alignment mechanisms. (para. 5-11).</li> </ul>
2. AK-2 (Feeder) Breaker Fail to Trip.	<ul style="list-style-type: none"> <li>c. Current-carrying surfaces dirty.</li> <li>a. Travel of tripping device does not provide positive release of tripping latch.</li> <li>b. Worn or damaged trip unit parts.</li> <li>c. Binds in overcurrent trip device.</li> </ul>	<ul style="list-style-type: none"> <li>c. Clean all current-carrying surfaces.</li> <li>a. Readjust or replace tripping device. (para. 5-15, 5-16).</li> <li>b. Replace trip unit. (para. 5-16).</li> <li>c. Replace overcurrent trip device. (para 5-14).</li> </ul>
3. Failure to Close	<ul style="list-style-type: none"> <li>a. Binding in attachments preventing resetting of latch.</li> <li>b. Latch out of adjustment.</li> <li>c. Hardened or gummy lubricant.</li> <li>d. Latch return spring too weak or broken.</li> </ul>	<ul style="list-style-type: none"> <li>a. Check and readjust. (para 5-15).</li> <li>b. Readjust. (para 5-15)</li> <li>c. Clean bearing and latch surfaces.</li> <li>d. Replace spring.</li> </ul>
4. Burned Main Contacts.	<ul style="list-style-type: none"> <li>a. Improper contact sequence (Main contacts not sufficiently parted When arcing contacts part.</li> <li>b. Loss of contact wipe or pressure</li> </ul>	<ul style="list-style-type: none"> <li>a. Increase arcing contact wipe. Adjust contact sequence. (pars 5-7, 5.9).</li> <li>b. Replace stationary contact spring and dress up or replace contacts. (para 5-1 1.</li> </ul>
5. Unnecessary Tripping (that is tripping when tripping should not Occur.)	<ul style="list-style-type: none"> <li>a. Calibration setting too low. setting. (para 5-15).</li> <li>b. Worn latch (breaker easily jarred open)</li> </ul>	<ul style="list-style-type: none"> <li>a. Check tripping device for proper</li> <li>b. Replace with new part.</li> </ul>

**2-7. Semi-trailer Troubleshooting**

Table 2-4 lists the semi-trailer troubleshooting

malfunctions for direct and general support maintenance personnel.



**Table 2-4. Semi-trailer Troubleshooting**

Malfunction	Probable Cause	Corrective Action
1. Brakes will not hold.	a. Worn out brake lining.	a. Replace. (para 7-31).
2. Brake action slow.	b. Leaky relay emergency valve.	b. Replace, repair.
3. Brakes grab.	a. Defective brake air chamber.	a. Replace (para 7-7).
4. Trailer pulls hard.	b. Slack adjuster travel too long. (para 7-3).	b. Adjust check to see if within spec.
	Loose brake lining.	Inspect if still useable realign and adjust. (para 7-31).
	a. Undercarriage assy. loose.	a. Check mounting bolts of assy. to frame. Tighten, if loose to the torque spec.
	b. Brakes dragging.	b. See brakes drag malfunction.
	c. Wheels not aligned to trailer.	c. Check wheel alignment. (para 7-8).
	d. Bent or broken spring (for leaves). U bolt.	d. Replace. (para 7-9).

**Section III. GENERAL MAINTENANCE INSTRUCTIONS**

**2-8. General**

- a. This section provides general cleaning, inspection and repair instructions that are common to components used on the mobile substation.
- b. Special cleaning, inspection and repair instructions applicable to any individual component is covered with that component in the applicable sections of this manual.

**2-9. General Cleaning Instructions**

- a. *Prior to Removal or Disassembly of Major Components.*
  - (1) Clean the exterior of the trailer, metal enclosures and external mounted accessories of road grime, dirt, oil and grease, and other foreign matter.
  - (2) Clean the interior of high and low voltage section and their compartments thoroughly using a vacuum cleaner and clean rags.

**CAUTION**

**Do not use compressed air to blow out the compartments.**

- b. *Prior to Removal or Disassembly of Electrical Components.* Clean off excess oil and dirt. Wipe clean with lint free cloth dampened with cleaning solvent (Fed. Spec P-D-680).
- c. *Gaskets and Seals.*
  - (1) Clean all old gasket particles and weather seals from mating surfaces.
  - (2) Discard and replace all non-reusable type and damaged weather seals and gaskets.

**2-10. General Inspection Instructions**

- a. General. Perform an inspection of all parts as soon as possible after cleaning. Instructions for specific inspection procedures are included in the text at

the point in repair instructions where the inspection must be performed.

b. *Visual Inspection.*

(1) Visually inspect all external surfaces of all enclosures, trailer bed and frame, trailer running gear and accessories for badly dented, bent or weathered spots.

(2) Visually and by hand inspect all working parts such as doors, panels, lids (or tops for wear, damage or looseness.

c. *Electrical Parts.*

(1) Visually inspect all internal wiring for frayed or damaged insulation and poor connections to terminal lugs and terminals.

(2) Visually inspect all buses for cracks and discoloration.

**2-11. General Repair Instructions**

- a. *Thread Repair.* Use proper size tapping tool to repair tapped holes. Discard and replace all hardware that has defective threads.
- b. *Bearing Replacement.* Do not press on outer race of bearing when installing on shafts. Do not press on inner race of bearings when installing in a housing.
- c. *Electrical Parts.* Replace wire with frayed or damaged insulation. Replace cracked or broken terminal boards, lugs, terminals and clamp connectors. Record bus deficiency for replacement.
- d. *Trailer.* Straighten, clean and repaint accessories and weathered spots of trailer bed and frame. Record running gear deficiency to be repaired. Schedule them for replacement or repair.

**Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS**

**2-12. General**

This section contains instructions for removal and installation of major components of the mobile substation

to facilitate repair and overhaul instructions which are covered in subsequent sections of this manual.

## 2-13. Load Break Switch Removal

### **WARNING**

All power must be removed so that substation is completely de-energized before attempting to remove load break switch. Serious personnel injury and/ or damage to equipment may result.

#### a. Disconnect Load Break Switch.

(1) Clear trailer deck of all unnecessary equipment.

(2) Check and make sure all primary power has been removed to unit if switch is being replaced in a field installation.

(3) Loosen and remove the four hex head bolts and washers from the upper front hinged panel.

(4) Loosen and remove the three hex head bolts and washers from the lower front hinged panel.

(5) On the rear loosen and remove the six hex head bolts, lockwashers and plain washers securing each panel, upper and lower. Remove upper and lower panels.

(6) If switch is being removed in a field installation, disconnect the three primary conductors from the connection clamps in the rear compartment (fig. 2-1).

(7) Disconnect the three leads from each of the lightning arresters connected to the primary connection clamp of switch.

(8) Loosen and remove the bolts, nuts and washers securing the two horizontal insulating barriers around the primary connection bar.

(9) In front swing open the upper and lower hinged panels.

(10) Disconnect the three secondary conductors at the switch connections. Identify and tag each conductor for easier installation of switch.

(11) Across the bottom front of the switch is a narrow insulating barrier strip (fig. 2-2). Loosen and remove the two screws 12, one for each end) that fasten the barrier to the cabinet mounts.

#### b. To Remove Load Break Switch.

(1) The switch is mounted to the cabinet mounting rails by five vertical bolts, nuts and washers, three on the left side and two on the right. The right front bolt has a spacer also.

(2) Loosen and remove the five bolts, nuts and washers (the vertical ones mounting the switch frame to the cabinet rails).

(3) Lift and remove switch care must be taken not to hit and break the insulating barriers when removing switch and when setting it down after removal.

(4) Replace the two, barriers and their hardware are that were removed in preceding step a(8)

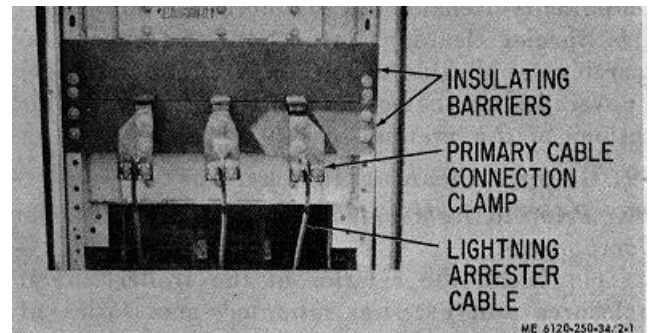


Figure 2-1. High voltage cabinet, rear upper and lower panels removed.

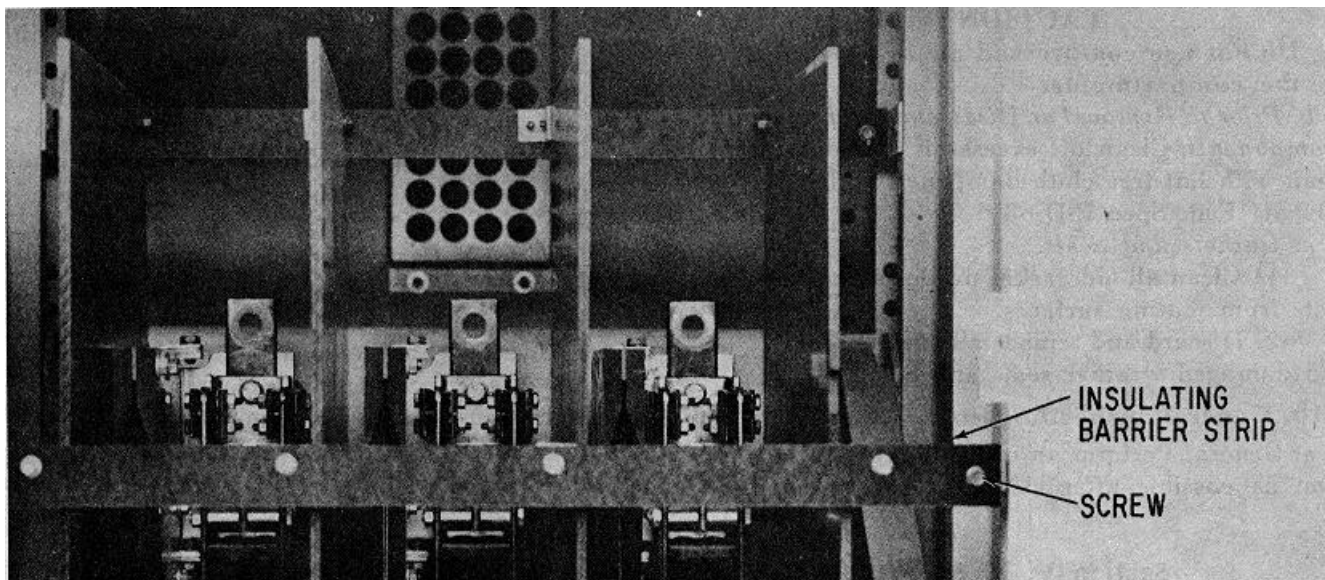


Figure 2-2. High voltage cabinet, upper front panel open.

## 2-14. Load Break Switch Installation

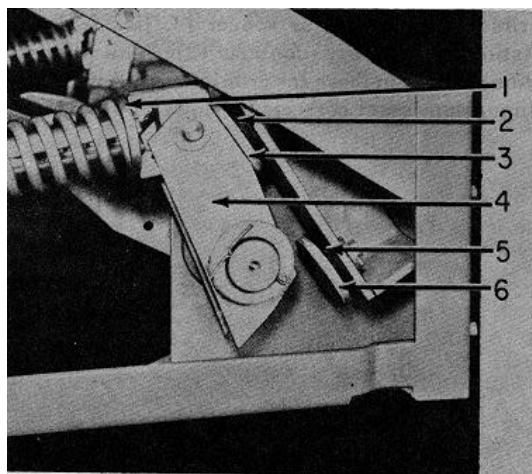
a. *General.* Prior to installation of switch, adjustments and alignment checks should be made to insure proper operation.

### CAUTION

**To check operation of load break switch it must be operated slowly with the power springs blocked. See TM 5-6120-250-12.**

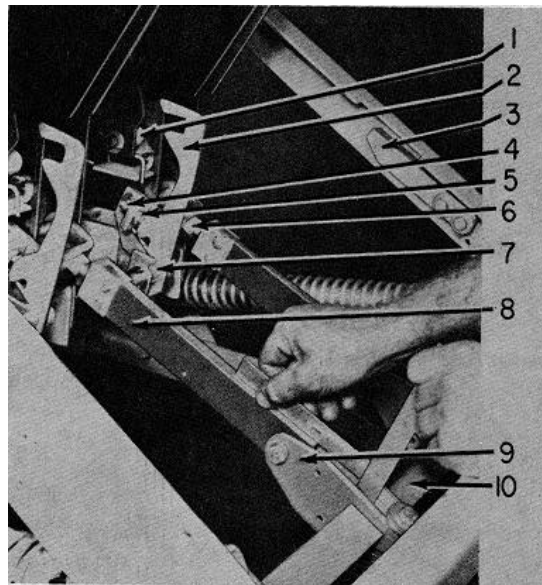
b. *Checks and Adjustments.*

(1) *Upper(closed) mechanism stop.* The upper buffer stops, (3, fig. 2-3 ) located on either side of the mechanism at the ends of the main crank shaft, must be adjusted to position the operating rod cranks when the switch is closed. Operate the switch to the fully closed position. The operating rod (8, fig. 2-4) must go over toggle approximately 1/1 inch at the crank connection, when the switch is closed. A simple means of measuring the correct toggle angle is to place a straight edge along the upper side of the operating rod. Extend it until it is over the square main shaft (10, fig. 2-4). The dimension from the straight edge to the closest corner of the square shaft should be 1/4 to 3/8 inch. If adjustment of the stop is necessary, remove the cotter pin holding the spring stop (3, fig. 2-4). Move washers and metal shims (from the front to the rear or the reverse) until the proper toggle angle is obtained. Adjust the stops at both ends of the main shaft the same amount to keep them balanced.



1. Collar
2. Buffer rubber
3. Upper buffer stop
4. Booster crank
5. Buffer rubber
6. Lower buffer stop

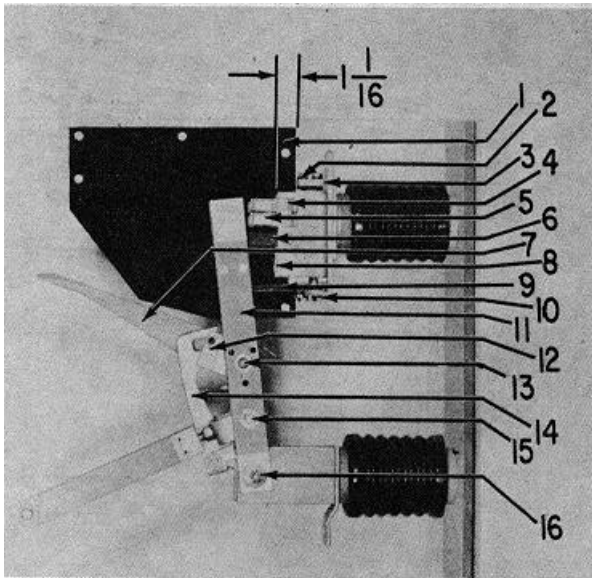
Figure 2-3. Buffer assembly, load break switch



1. Auxiliary blade spring
2. Auxiliary blade release hook
3. Spring stop
4. Cramming screw
5. Lock nut
6. Adjusting nut
7. Release hook spring
8. Operating rod
9. Operating rod crank
10. Main crank shaft

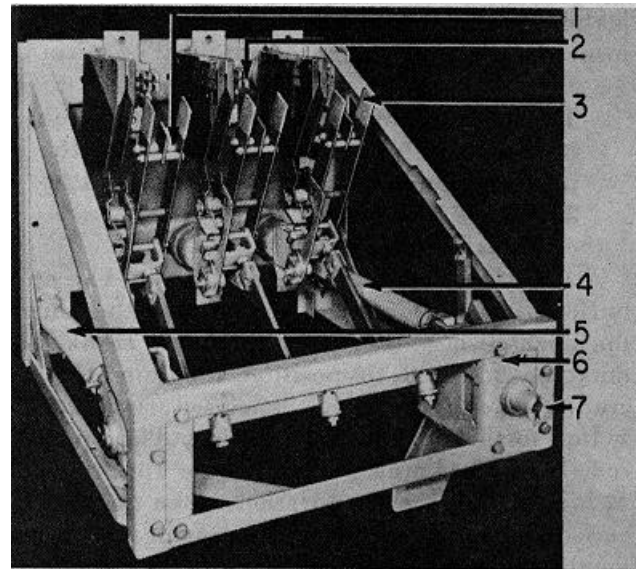
Figure 2-4. Switch blade adjustments.

(2) *Primary wipe.* The operating rod must fully close the switch primary blades to obtain the correct primary finger wipe. With the switch in the closed position, pull the top of the primary contact blades (1, fig. 2-5) to the front with your hands to remove connection clearances. There should be 1 / 64 to 1 / 32 inch clearance between the buffer stop (18) and the primary blade stop (1, fig. 2-6). There should also be 3 / 16 to 1 / 4 inch between the edge of the primary blade and the front of the primary contact support. Adjust the length of the rod by use of the adjusting nut (6, fig. 2-4) to obtain the 3 / 16 to 1 / 4 inch gap then adjust the buffer stop (8, fig. 2-5) by adding or removing shims to get the 1 / 64 to 1 / 32 inch clearance.



1. Buffer stop
2. Arc chute mounting bolts
3. Shims
4. Contact bolt
5. Primary contact fingers
6. Arcing contact fingers
7. Auxiliary blade
8. Buffer stop
9. Guide block
10. Arc chutes mounting bolts
11. Primary contact blade
12. Auxiliary blade release hook
13. Pivot pin for auxiliary blade
14. Auxiliary blade release hook
15. Operating rod clevis pin
16. Hinge pin

Figure 2-5. Unit pole closing.

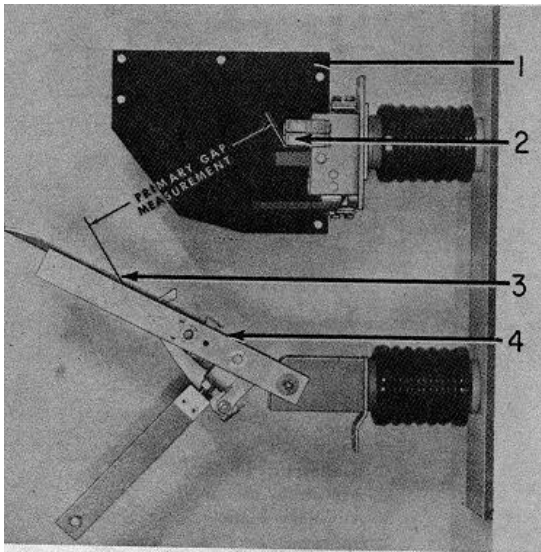


1. Primary blade buffer stop
2. Primary contact fingers
3. Primary contact blade
4. Primary spring
5. Booster spring
6. Operating mechanism
7. Operating hub

Figure 2-6. Switch partially open.

(3) *Primary gap.* The primary gap should be measured with the primary blades in the normal position. A measurement should be made from the primary blade stop or spacer (3, fig. 2-71 to the stationary primary contact 121. The dimension should be 1 inches plus or minus 3 / 8 inch. If this dimension is not correct, the lower buffer stop (6,

fig. 2-3) should be adjusted in a similar manner to the adjustment of the upper stop. Move shims and washers from the top to the bottom of the stop (or the reverse) as required. Adjust the stops at both ends of the main shaft the same amount to keep them balanced.

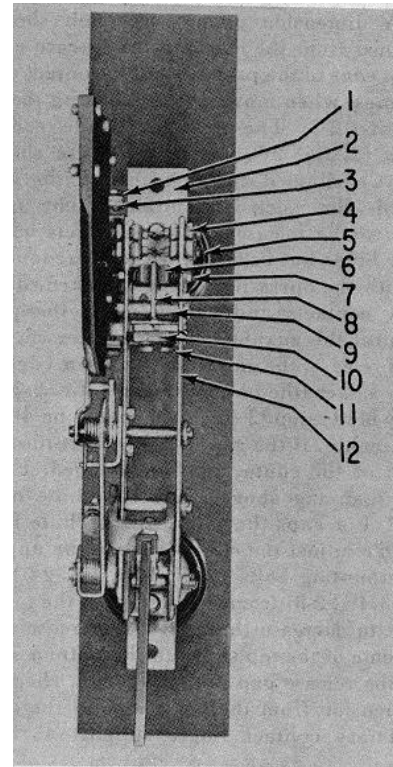


1. Arc chute
2. Stationary primary contact finger
3. Primary blade stop
4. Primary blade

Figure 2-7. Unit pole fully open.

(4) *Primary and arcing contact alignment.*

Close the primary blades 112, fig. 2-81 slowly using tile maintenance handle. Note the engagement of the primary contacts (4), arcing contact fingers 1 (and 8), and the guide block (10). The blades should center around the guide block without hearing heavily on either side. They should also be centered in the primary and arcing contact fingers. If the blades press hard against the sides of the guide block, loosen the two bolts (11) holding the block. Again check the contact alignment. If the contacts are properly aligned, reposition the guide block and tighten the bolt. If the contacts are not in alignment, loosen the bolts holding the top insulator and position the insulator to center the contacts. After securing the insulators, reposition the guide blocks and tighten the bolts. Be certain the insulator is moved only in a horizontal direction. Vertical displacement may cause misalignment of the auxiliary blade contacts.

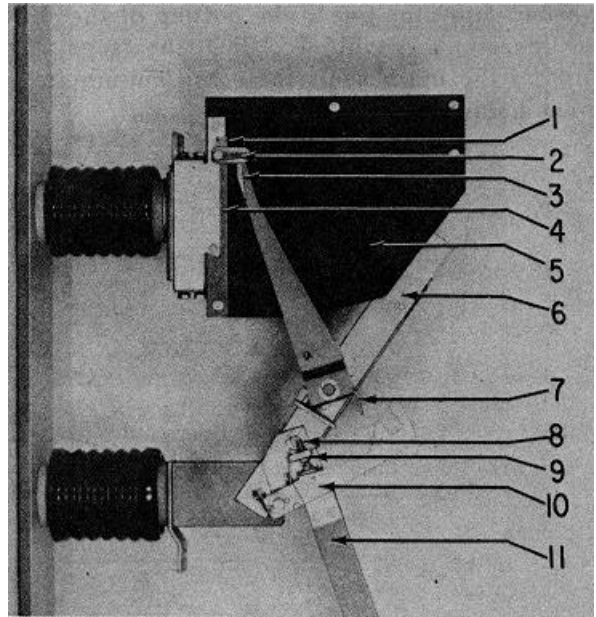


1. Arc chute mounting bolts
2. Upper terminal
3. Shims
4. Primary contacts
5. Contact bolts
6. Arcing contact fingers
7. Contact bolt
8. Movable arcing contact fingers
9. Tube spacer
10. Guide block
11. Buffer block bolts
12. Primary contact blades

Figure 2-8. Contact arrangement.

(5) *Arc chute alignment.* The arc chute must be positioned to allow entry of the auxiliary blade to latch, and finally to release the auxiliary blade at the proper time. Slowly close the contact arm and check the entry of the auxiliary blade (7, fig. 2-5) into the arc chute. The blade should enter smoothly and be in the center of the opening. If the blade scrapes heavily on the sides of the chute, loosen the

two arc chute mounting bolts ( 2 ) at the top and the chute so the blade will travel the full length without binding or heavy scraping, and tighten the bolts. A dimension of 1-1/16 inch should be maintained from the rear edge of the arc chute to the front edge of the primary finger contact support at all times, when moving or re-aligning the chute. See figure 2-5. The auxiliary blade arc chute contacts (2, fig. 2-91 inside the chute should be properly positioned to latch the auxiliary blade when this dimension is maintained. The auxiliary blade must be released by the contacts when the primary blade has been opened to a predetermined gap. With the operating springs blocked, open the primary contacts and slowly move the primary blade until the auxiliary blade is released. At the point of release, the gap from the lower edge of the primary finger (the bottom finger 2, fig. 2-7) to the primary blade stop 13, fig. 2-7) should be 4-7 / 8 to 5-3 / 8 inches. If the gap is not correct the vertical location of the chute must be changed. For gaps greater than the above range the chute must be lowered. For gaps that are less the chute must be raised. To adjust the chute, remove the upper and lower mounting bolts (2 and 10, fig. 2-5). Move shims (3, fig. 2-81 from the bottom to the top of the support to decrease the gap. To increase the gap move some of the top shims to the bottom support. When the release gap is properly set, check again the dimension from the back edge of the chute to the primary contact finger support as directed above.



1. Blade stop block
2. Arc chute contacts
3. Auxiliary blade
4. Spacer
5. Arc chute side
6. Primary contact blade
7. Auxiliary blade spring
8. Camming screw
9. Lock nut
10. Auxiliary blade release hook
11. Operating rod

*Figure 2-9. Unit pole opening.*

(6) *Auxiliary blade release.* The auxiliary blade release hook (14, fig. 2-5) should be adjusted to hold the blade out of the arc chute until a predetermined position in the closing operation. Close the switch slowly with the maintenance handle and note the position of the primary blades when the auxiliary blade is released by the hook (10, fig. 2-9). The hook should be adjusted by setting the camming screw (8) to release the auxiliary blade within the range of 1/2 inch before arcing contacts touch. After adjustment is made the lock nut (9) should be tightened.

(7) *Primary contact pressure.* The primary finger pressure has been adjusted at the factory to be 12 pounds per contact. This can be measured with a pull scale exerting a pressure against the contact surface. The contact pressure of each finger 15, fig. 2-5) should be measured individually. Increase or decrease the contact pressure by loosening or tightening the contact bolts (4).

(8) *Arcing finger contact pressure.* The arcing finger contact pressure should be 12 pounds. This pressure can again be measured with a spring scale against the contact surface. Loosen or tighten the contact bolts (7, fig. 2-8) as necessary.

(9) *Primary blade hinge pressure.* The correct hinge pressure is essential for proper operation of the switch. The hinge pressure is difficult to measure. A required torque to move the primary blades can be easily measured and substituted. The break away torque of the hinge (the torque required to start the blades moving) should be between 60 to 90 inch-pounds. This can be measured by pulling at the buffer stop or spacer (1, fig. 2-6) on the primary blade. Use a spring scale without the primary contacts, arcing contacts and auxiliary block contacts engaged. The scale reading should be 51/2 to 81/a pounds. If adjustment is necessary, remove cotter pin from either side of hinge pin (16, fig. 2- 5 1. Tighten or loosen the nut as required. Move the nut in increments of one sixth of a turn. This assures line-up for the cotter pin replacement in hole and slot in the nut.

*c. Mounting Load Break Switch.*

(1) Open upper and lower hinged front panels of high voltage section.

(2) Remove upper and lower rear panels.

(3) Remove horizontal barriers and hardware that fit around primary connectors of switch.

(4) Inspect switch mounting angles in cabinet for level from front to rear and from one side to the other. When mountings are level and square make sure they are tight.

**CAUTION**

**Switch must be mounted in the housing, supported at both front and rear. Care must be taken not to distort the frame by mounting on unflat or out of square surfaces as twisting will cause**

**misalignment of contacts. Do not** bump switch during installation or it may crack or break the insulating barriers.

(5) Lift and place switch in cabinet on the mounting angles.

(6) Line holes of switch base with holes of mounting angles.

(7) Insert up through the front hole in the left side mounting angle a bolt, lockwasher and a plain washer, and thread it hand tight into switch base.

(8) Insert a bolt with lockwasher and plain washer up through front hole in right side mounting angle, place the spacer on top of angle pushing bolt through it and into the tapped hole of switch base. Tighten hand tight.

(9) Insert two bolts and plain washers up through left mounting, one midway, other in rear. Then place lockwasher and nut on them, tighten hand tight.

(10) Install rear right side bolts same manner as Step (8).

(11) Check switch position for flatness and alignment, close upper front panel to make sure operating handle can be inserted and used to operate switch. If switch is not at proper height, raise mounting angle to next hole up in cabinet side or spacer may have to be used.

**CAUTION**

**If spacers are used in mounting switch, make sure switch is mounted flat and is not distorted. If it is twisted and distorted it will not operate because of misalignment.**

(12) When switch is mounted in correct position and flat, tighten all five mounting bolts. See table 1-1 for correct torque values.

(13) Fasten the ends of the narrow insulating barrier across the bottom front of switch to the mounting angles.

*d. Test.* A standard 60 cycle high potential test at 14,000 volts RMS will normally indicate whether the device is satisfactory for service.

**WARNING**

**Before applying a high-potential test make certain that the switch is disconnected from the source and load.**

(1) With the switch contacts in the fully opened position, apply the high potential to each terminal individually for one minute with all the other terminals and the frame grounded.

(2) After high potential tests are made all organic insulating material should be inspected for visible leakage current paths. Necessary action must be taken to replace insulation that may have been affected by moisture absorption.

e. *Connecting Load Break Switch.*

(1) Identify and connect the conductors to the transformer, to their respective poles on the switch. Connections on switch are at the bottom of each pole. Make sure connecting lugs are clean and tight when made.

(2) Replace the horizontally mounted insulator barriers that were removed in subparagraph c. above. These barriers are mounted around lone above and one below) the switch primary connecting bars.

(3) Connect the leads from the lightning arrester to the primary connectors of switch. A lead from each (of the three) lightning arresters goes up between the conductors clamps to the bolt above. See figure 2-1. Make sure connections are clean and tight.

(4) Check adjustment and alignment prior to placing switch in service. See b. above.

(5) When switch is declared serviceable, primary connections may be made.

(6) Replace and secure rear panels.

(7) Close and secure front panels.

**2-15. High Voltage Section Removal**

a. *Disconnect High Voltage Section from Transformer.*

(1) Clear trailer deck of all unnecessary equipment.

(2) Loosen the 18 bolts securing the front access cover of the transition area between transformer and high voltage section, remove cover. (fig. 2-10 and 2-11).

(3) Loosen and remove the three nuts connecting the load break switch to the transformer. Identify and mark each conductor for future hook lip.

(4) Replace and secure the front cover on the transition area.

(5) Loosen and remove the three bolts securing the lower front hinged panel, open panel.

(6) On the bottom left just behind heater is a terminal board. Loosen and remove the two wires coming out of the conduit connecting high voltage and low voltage sections.

(7) Close and secure the lower front panel.

(8) Loosen and remove the six bolts and washers securing the lower rear panel, remove panel.

(9) Loosen and disconnect the conduit in the lower left bottom connecting the high voltage and low voltage sections.

(10) Pull the two wires that were disconnected from the heater terminal board free so that they will not catch when moving high voltage section.

(11) Replace and secure lower rear panel.

(12) Loosen and remove the 12 (6 each side) bolts, nuts and washers in the flange of the weatherproof joint securing transition to transformer. Care must be taken not to damage gasket so that it may be reused.

(13) Loosen and remove the four bolts, nuts and washer in base fastening high voltage section to trailer bed.

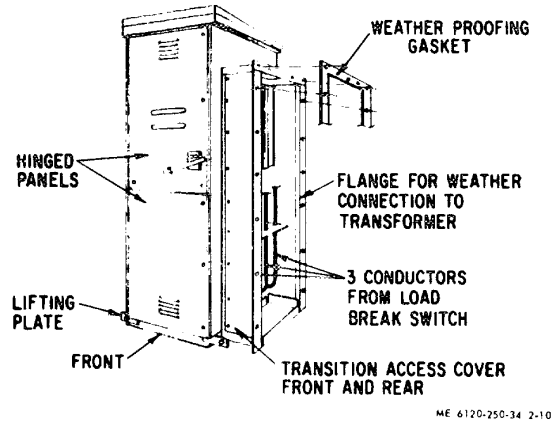


Figure 2-10. High voltage section.

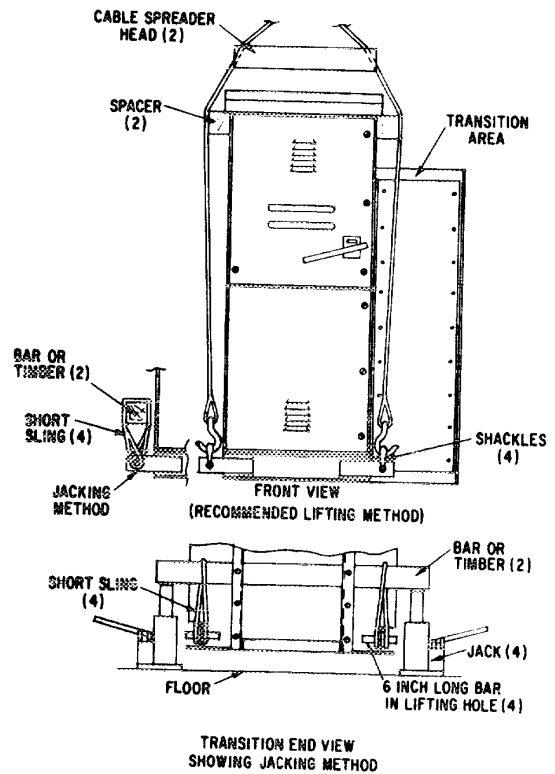


Figure 2-11. Lifting and jacking methods for high voltage section.

b. *Lifting High Voltage Section.*

(1) On the bottom at each corner are lifting plates with holes. Attach at each corner a shackle to



be used with hook and lifting cable using the lifting plate holes to lift or hoist cabinet. See figure 2-11.

#### **CAUTION**

**Use two wood spacers across each side of cabinet near top and spreader heads holding cables apart to obtain vertical pull on lift plates. Otherwise serious damage will result to the equipment.**

(2) Use shackles, cables, hooks and crane capable of lifting 1600 lbs. minimum.

(3) Carefully lift high voltage section up and away from transformer. Avoid hitting transformer insulator connections.

c. *Moving High Voltage Section Without Hoist (fig. 2-11).*

(1) Items needed:

(a) Four short slings with a loop on each end.

(b) Four short bars about six inches long with a diameter which will permit them to fit through holes in lifting plates on cabinet base.

(c) Four lifting jacks capable of lifting 1600 lbs.

(d) Two metal bars or timbers with a minimum length of 4 feet and capability of lifting or supporting 1600 lbs.

(e) Three construction roller bars 5 feet long with uniform diameters.

(2) Disconnect high voltage cabinet per paragraph 2-15 a.

(3) Remove transition area front and rear covers.

(4) Insert a six-inch long bar through each lifting plate hole. Each end should protrude an approximately equal distance from the plate. See figure 2-11 transition end view.

(5) Place the loop of one end of a short sling around one end of rod in lifting plate and other loop around other end of rod on opposite side of lifting plate. This should form a short lifting sling whose ends are around the six inch long rod, one each side of lifting plate.

(6) Repeat step 3 on all four corners.

(7) Place one bar or timber across each end of high voltage cabinet, inserted into sling loop of the front and rear corner. One bar will pass through the transition area where front and rear covers were removed .

(8) Place one lifting jack under bar or timber at each lifting plate corner.

(9) Using lifting jacks raise cabinet a sufficient height to clear rollers to be used. Raise cabinet as evenly as possible so as not to twist and distort it causing damage to equipment.

(10) Place construction rollers under the three channels of the cabinet base.

#### **CAUTION**

The rollers must be long enough to fit the

entire width of the three channels and placed so that the cabinet is not distorted. (Never use transition area to support weight.) Otherwise serious damage may result to equipment.

(11) Lower cabinet on to construction rollers.

(12) Cabinet may be shifted or moved using the rollers.

(13) Put bolts, nuts and washers in flange holes for safe keeping. Insert bolts with washers in the holes for the front and rear transition covers for safe keeping. Place front and rear covers aside so that they will not be damaged until reinstalled.

#### **2-16. High Voltage Section Installation**

a. *Lifting High Voltage Section.*

(1) Clear trailer deck of all unnecessary equipment, have area for high voltage section ready.

(2) Attach slings, lifting devices and lift cabinet per paragraph 2-15 b.

(3) With hoist move cabinet into position for lowering onto trailer. The transition side goes toward the transformer.

#### **CAUTION**

**Care must be taken not to hit the transformer insulator connections when lowering high voltage section on trailer.**

(4) Lower cabinet slowly and guide it to its position as close as lifting equipment will allow.

(5) When cabinet is on trailer deck, remove lifting equipment from cabinet and area.

b. *Connecting High Voltage Section to Transformer.*

(1) If cabinet must be moved more than a few inches the method described in paragraph 2-15 c may be used. The last inch may require hand winching.

(2) Install gasket on flange of the transition of high voltage cabinet as follows:

(a) Clean flange surface.

(b) Apply a thin coat of adhesive to both the flange and one side of gasket.

(c) Allow adhesive to dry until it is no longer tacky.

(d) Install gasket just outside the mounting bolt holes of flange. Allow the piece across the top to overlap the two side pieces. Press gasket against flange with enough pressure to make good contact.

(3) Move cabinet into position. The bolt holes in base must be aligned with holes in trailer deck. The bolt holes in flange must line up with holes in flange of transformer.

#### **NOTE**

**If trouble is experienced with aligning flange holes, it may be possible to line them lip by loosening transformer mounting bolts. Then when flange holes line lip, insert bolts and hand tighten nuts. Then line high voltage section base holes with trailer holes and insert high voltage section mounting bolts and nuts.**

(4) With all bolts inserted in flange and mounting base, tighten flange bolts and then mounting bolts to the torque of the bolt size in table. If transformer had been loosened be sure to retighten. See table 1-1 for correct torque values.

(5) Remove the lower rear panel of the high voltage section.

(6) Feed the two wires in the conduit from the low voltage section through the conduit mounting hole in high voltage section. This conduit connection is at the bottom left side looking in from rear. (fig. 2-12).

(7) Connect conduit to high voltage section.

(8) Replace and secure lower rear panel.

(9) Loosen and remove the three bolts securing the lower front hinged panel. Open panel.

(10) Connect the two wires (fig. 2-13) from the conduit to the heater terminal board terminals 1 and 2. The terminal board is located at the bottom left side right behind the heater. Make sure connections are tight.

(11) Loosen and remove the four bolts securing the upper front hinged panel. Open panel.

(12) Before connecting load break switch to transformer check adjustments and alignment to insure proper operation. See Checks and Adjustments paragraph 2-14. Leave switch in "open" position.

(13) Loosen and remove the eighteen bolts securing the transition front access cover, remove cover. (fig. 2-101).

(14) Identify each conductor to indicate their phase relationship with the rest of the system.

(15) Check and make sure each connector of transformer is clean and apply a coat of contact lubricant.

(16) Connect switch conductors to the transformer connector using cables clamps, tighten nut to approximately 20 ft-lbs.

(17) Completely cover each connection with I-200 tape.

(18) Completely cover each connection with "Duxseal" type NSG.

(19) Replace transition front cover and secure it.

(20) Close and secure upper and lower front panels.

(21) Check and make sure switch is in the "open" position and bar covering switch operating socket is in place and locked.

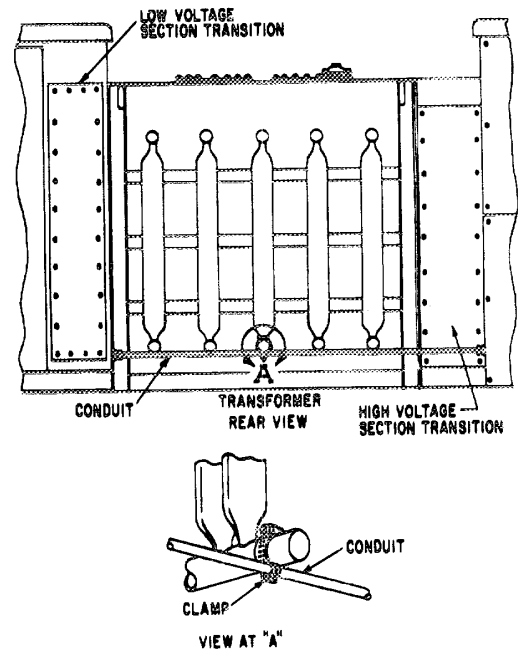


Figure 2-12. Rear view of transformer.

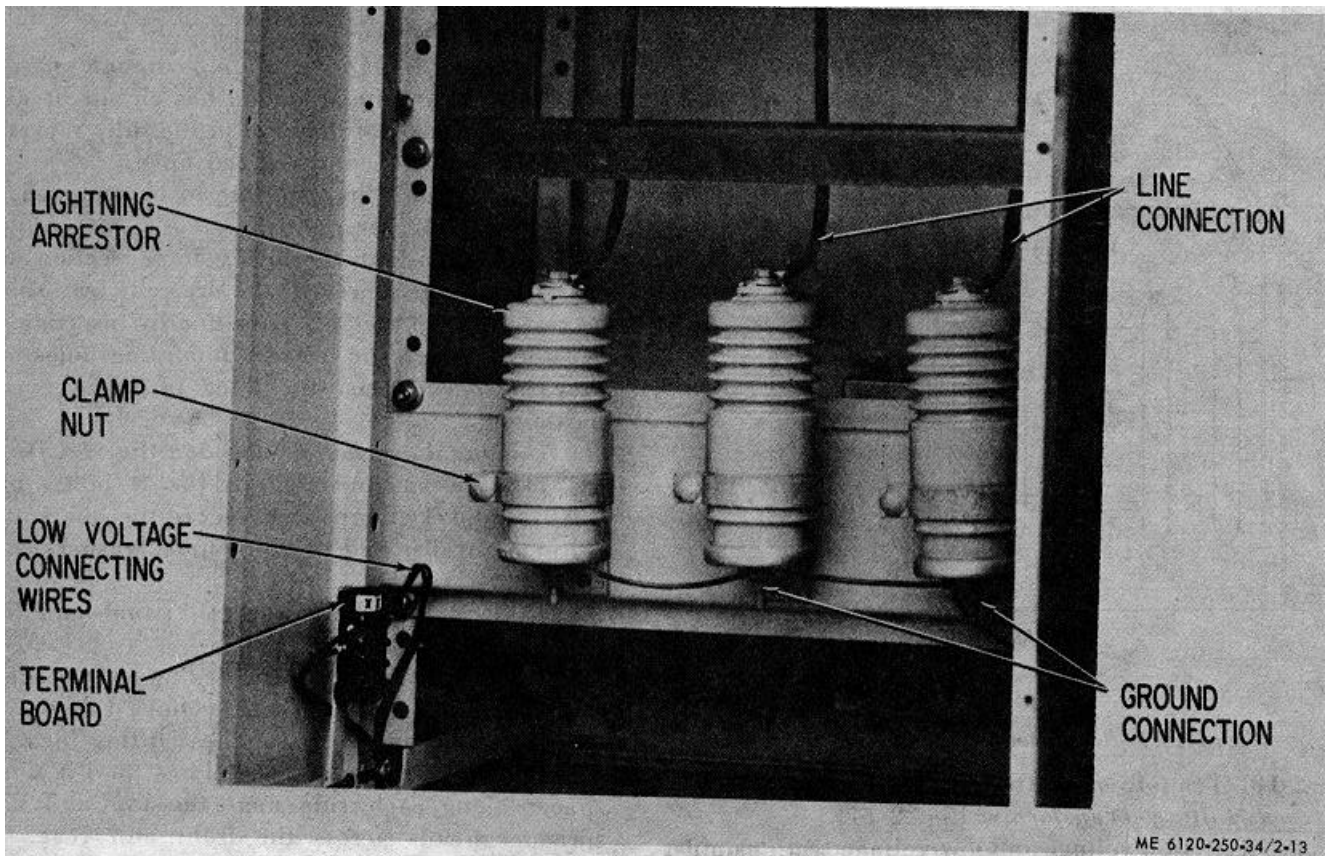


Figure 2-13. High voltage cabinet, front lower panel removed.

## 2-17. Transformer Removal

a. Disconnect Transformer from High Voltage Section. paragraph 2-15 a.

b. Disconnect Transformer from Low Voltage Section.

(1) Clear trailer deck of all unnecessary equipment.

(2) On the right rear of cabinet, loosen and remove the 24 bolts and washers securing the access cover on the transition area between transformer and low voltage cabinet. (fig. 2-12).

(3) Loosen and remove the bolts, nuts and washers connecting the bus connections of the three legs, neutral and ground from transformer to low voltage section.

(4) Loosen and remove the two wires on terminal board HX, terminals 1 and 2. These wires should be the ones going from TBHX out through the conduit to the high voltage section.

(5) Loosen and remove the conduit on the low voltage section transition area that goes along transformer bottom to the high voltage section.

(6) On the bottom rear of transformer unfasten the strap securing the conduit to the transformer. (fig. 2-12).

(7) Remove the conduit with wires. Care should be used in pulling wires through conduit mounting hole in transition side wall.

(8) Replace and secure the transition access cover with its 24 bolts and washers. Be careful of weather proof gasket.

(9) Loosen and remove the 13 bolts and washers in the transformer flange connecting the transformer to the low voltage transition.

### c. Lifting The Transformer.

(1) Loosen and remove the 8 bolts, nuts, and washers 14 each side) fastening the transformer to the trailer bed.

(2) Four lifting lugs at the top are provided for lifting the complete transformer. Lift the transformer by means of these lifting lugs, using cables long enough to obtain cable pull angles not over 30 degrees from vertical. (fig. 2-14).

(3) Use hooks, cable and hoist capable of lifting 6900 lbs.

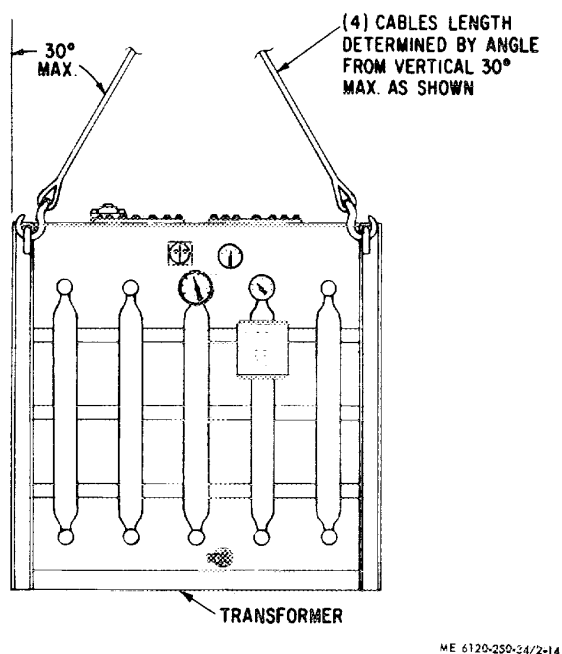


Figure 2-14. Recommended lifting of transformer.

## 2-18. Transformer Installation

### a. Lifting Transformer (fig. 2-14).

(1) High voltage and low voltage sections must be moved away front area where transformer is to be mounted. Normally this will have been done when transformer was removed. If not, see paragraph 2-19d for low voltage section and paragraph 2-13 c for high voltage section.

(2) Clear trailer deck of all unnecessary equipment.

(3) Attach slings and lift transformer per paragraph 2-17 c.

(4) With hoist move transformer and lower it into its position on trailer bed. The side with the gauges should face the operator's side. This puts the three insulator connections of transformer towards the front of the trailer and the four bus connections towards the rear of the trailer.

(5) When transformer is on trailer deck remove lifting slings and hoist away from transformer.

(6) Insert the 8 bolts with washers and tighten the nuts hand tight.

**b. Connect to High Voltage Section.** Move and connect high voltage section per paragraph 2-16.

**c. Connect to Low Voltage Section.** Move and connect low voltage section per paragraph 2-20.

## 2-19. Low Voltage Section Removal

### a. Disconnect Low Voltage Section from Transformer

(1) Clear deck of trailer of all unnecessary equipment.

(2) If desirable to remove cable reel drums, see TM 5-6120-250-12.

(3) Disconnect the low voltage section from the transformer per paragraph 2-17 b.

### b. Circuit Breakers or Compartment.

(1) If low voltage section has circuit breakers installed, check that they are in the fully racked to the "IN" position and tripped open.

(2) If circuit breakers are to be removed, see paragraph 2-21 for removal.

(3) When moving low voltage section with circuit breakers remove, the drawout tray should be restrained in the "IN" position by inserting two 3/8 bolts through the breaker mounting holes until the bottom against the floor of breaker compartment.

### c. Lifting Low Voltage Section (fig. 2-151)

(1) Loosen and remove the 8 bolts, nuts, washers and 4 clamps that secure the low voltage section to trailer bed 14 bolts, nuts, washers and 2 clamps per side).

(2) Inspect and make sure all panels and doors are closed and secured.

(3) Lifting lugs are provided on each corner of the base for lifting complete section. Lift the low voltage section by means of these lifting lugs. Use cables with hooks and / or clevises, and a timber spacer along each side near the top and cable spreader heads across the front and rear. The spacer and cable spreader heads keep the Cables from crushing or denting the top of cabinet besides providing a more vertical lift on the lifting lugs. The cable and lifting device must be capable of lifting

### d. Moving Low Voltage Section without Hoist.

(1) Items needed fig. 2-15).

(a) Four short slings with a loop on each end.

(b) Four short bars about six inches long, with a diameter which will permit them to fit through holes in lifting lug holes on cabinet base.

(c) Four lifting jacks capable of lifting 7700 lbs.

(d) Two metal bars or timbers approximately 5 feet long and capable of lifting or supporting 7700 lbs.

(e) Five construction roller bars 5 feet long and all the same diameter.

(2) Disconnect low voltage section per paragraph 2-17 b.

(3) Loosen and remove the 8 bolts, nuts, washers and 4 clamps that secure the low voltage section to trailer bed 14 bolts, nuts, washers and 2 (clamps per side).

(4) Insert a six-inch long bar through hole of each lifting lug. each end should protrude an approximately equal distance from lug.

(5) Place the loop of one end of a short sling around one end of rod in lifting lug, and the other end loop around the other end of rod on opposite

side of lifting lug. This should form a short lifting sling whose loops are around the six inch long rod, one each side of lifting lug. (fig. 2-15.)

(6) Repeat steps (4) and (5) on all four corners.

(7) Place a bar (or timber) across each end of low voltage cabinet. Insert ends in sling loops of front and rear corners.

(8) Place one lifting jack under bar or timber at each lifting lug.

**CAUTION**

**Inspect and make sure all panels and doors are closed and secured. If circuit breakers are in they should be in the full "IN" position and open.**

(9) Using lifting jacks raise cabinet a sufficient height to clear rollers to be used. Raise cabinet as evenly as possible so not to twist and distort it, causing damage to equipment.

(10) Place construction rollers under the three channels of the cabinet base.

**CAUTION**

**The rollers must be long enough to fit the entire width of the three bottom channels and placed so that the cabinet is not distorted. Otherwise serious damage may result to the equipment.**

(11) Lower cabinet onto construction rollers.

(12) Cabinet may be shifted or moved using the rollers.

**2-20. Low Voltage Section Installation**

a. *Lifting Low Voltage Section, (fig. 2-15).*

(1) Clear trailer deck of all unnecessary equipment, and have area for low voltage section clear.

(2) Attach slings, and lifting devices, and lift cabinet per paragraph 2-19c.

(3) With hoist move cabinet into position for lowering onto trailer. The transition side goes toward the transformer.

**CAUTION**

**Care must be taken not to hit the transformer bus connections when lowering low voltage section on trailer.**

(4) Lower cabinet slowly and guide it to its position as close as lifting equipment will allow.

(5) When cabinet is on trailer deck, remove lifting equipment from cabinet and area.

b. *Connecting Low Voltage Section to Transformer.*

(1) If cabinet must be moved more than a few inches, the method described in paragraph 2-19d may be used.

(2) Install gasket on flange of the transition of low voltage cabinet as follows:

(a) Clean flange surface.

(b) Apply a thin coat of adhesive to both the flange and one side of gasket.

(c) Allow adhesive to dry until it is no longer tacky.

(d) Install gasket just outside the mounting bolt holes of the flange. Allow the piece across the top to overlap the two side pieces. Press gasket against flange with enough pressure to make good contact.

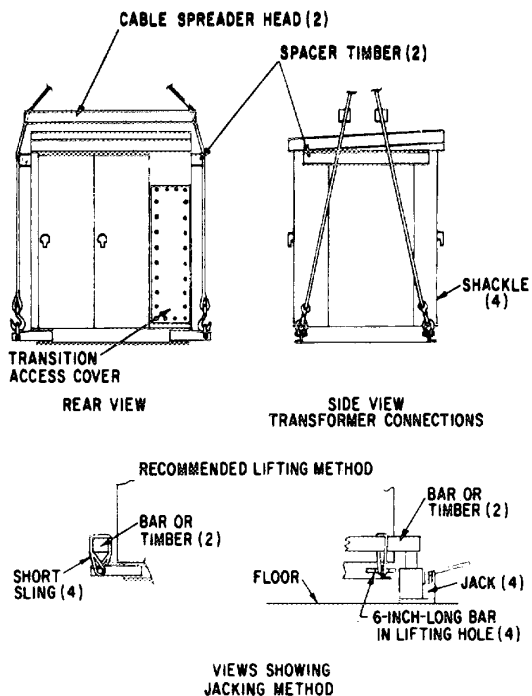
(3) Move cabinet into position. The bolt holes in base must be aligned with holes in trailer deck. The bolt holes in flange must line up with holes in flange of transformer.

**NOTE**

**If trouble is experienced with aligning flange holes, it may be possible to line them up by loosening transformer mounting bolts. Then when flange holes line up insert bolts and hand tighten nuts. Then line low voltage section base holes with trailer holes and insert low voltage section mounting bolts and nuts.**

(4) With all bolts inserted in flange and mounting base, tighten flange bolts and then mounting bolts to the torque of the bolt size in table 1-1. If transformer had been loosened be sure to retighten.

(5) On the right rear of cabinet loosen and remove the 24 bolts and washers securing the access cover on the transition area, between transformer and low voltage cabinet.



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Figure 2-15. Lifting and jacking methods for low voltage section.

(6) Bus connections, 3 phases, neutral and ground.

### CAUTION

**When making bolted bus connections clean the silver plated contacting surfaces with a clean cloth or solvent if required. Sandpaper or abrasives must not be used. Apply contact lubricant. Bolt the bus connection using a bolt, washer and lockwasher. Refer to table 1-1 for the proper torque values of bus bolts and nuts.**

(7) Insert the two wires in the conduit (from high voltage section) through the conduit connection on lower right end wall of transition.

(8) Connect conduit to transition wall and secure it to transformer (fig. 2-12).

(9) Connect the two wires from the conduit to the terminal board HX mounted on the lower left inside wall, connect to terminals 1 and 2.

(10) Replace transition rear access cover and secure with its 24 bolts and washers.

(11) Open both rear doors and check for alignment and that weatherproof seal has not been disturbed.

(12) Check that all bus connections are tight, fuses in place.

(13) Check both front doors as in paragraph (11) above.

(14) Check circuit breaker panels alignment and working.

(15) Check circuit breaker drawout mechanism for alignment and workability.

(16) Close and secure all panels and doors.

### WARNING

**Whenever circuit breakers are being installed, removed, inspected, or maintenance is being done, the breaker must be open and the closing springs restrained by the safety pin. Otherwise serious bodily injury and / or damage to the equipment may result. See paragraph 5-3 for safety pin insertion.**

## 2-21. Removal of Circuit Breaker

### a. Breaker Withdrawal.

(1) Push trip button, breaker should trip free and indicator read "OPEN". This also releases positive racking interlock.

### CAUTION

**Never open breaker compartment panel unless the breaker is open.**

(2) Open breaker compartment hinged panel.

(3) Lift the racking handle as far as it will go.

This re-engages the trip interlock to hold the breaker trip-free for the remainder of the withdrawal racking operation.

(4) Reset racking handle to its lowered position and lift it again. This operation must be performed five times to completely disengage the cams from their racking pins.

(5) After the fifth lifting stroke let handle drop to its normal position.

(6) Pull the breaker out of its compartment until it engages the test stop.

(7) Depress the test position stop handle (located directly beneath and in middle of breaker), and pull the breaker out as far as the drawout tray will travel.

### b. Lifting Circuit Breaker from Drawout Tray.

(1) Use a portable crane (hoist) and a web sling approximately 1 inch wide and 6 feet long with a loop on each end. Both sling and crane must be capable of lifting and supporting 400-500 lbs.

(2) Place sling under and across the two top frames of the breaker (fig. 2-16).

(3) Loosen and remove the two 3/8 inch hex head bolts in front, of the base angles of the breaker fastening breaker to drawout tray.

(4) Lift the breaker approximately 1 / 2 inch off the dowel pins in rear bottom of the drawout tray.

(5) Pull the breaker forward until its primary contacts clear the cabinet.

(6) Push the tray all the way back into the compartment.

(7) Close the breaker compartment panel.

(8) The breaker can now be moved to wherever the situation dictates.

## 2-22. Circuit Breaker Installation

a. Clear Trailer deck of all unnecessary objects and equipment from area where breaker is to be installed.

b. See paragraph 2-21 b for lifting circuit breaker.

c. Inserting circuit breaker.

(1) Make sure that breaker contacts are open.

(2) Raise or lower breaker to a position approximately six inches above its compartment drawout tray. (fig. 2-16).

(3) Pull drawout tray out under the breaker until the outer limit stop is reached.

### WARNING

**Make sure a bolt is in each of the front bottom mounting holes of the housing, the bolt heads provide the limit stop for drawout tray. If these are not in place, serious bodily injury or damage to equipment may result. See Figure 2-16.**

(4) Lower the breaker to a distance of about 1 / 2 inch above dowel pins on the tray. Push the breaker back into its compartment so that the rear bottom angle of the breaker is against the guides. The guides are on the tray directly back of the dowel pins.

(5) Slowly lower the breaker onto the tray guiding it so that the holes in the rear angle of the breaker fit over the two dowel pins on the tray. If the breaker is correctly positioned on the dowels, its rear and side bottom frame angles will all sit firmly on the tray.

(6) Insert two 3/8 inch hex head bolts through the holes in the front of the side angles of the breaker base. Thread them part way into the tapped holes in the tray. Do not tighten the bolts firmly. This will permit self-alignment of the primary disconnects during the subsequent racking operation.

(7) Remove lifting device and sling.

(8) Push the breaker into the compartment until the Lest position stop engages preventing further travel.

(9) Release the test position stop by depressing its lever and push the breaker back into the compartment. The racking pins on the compartment housing should butt against the outer surface of the racking cams of the breaker.

(10) Lift racking handle as high as it will go. This engages pawl to first notch on the cam.

(11) After pawl engages the first notch on the cam push handle down to its normal position. This causes the cam to rotate about the racking pin.

(12) Repeat steps (10) and (5) five times to rack the breaker into its final "Connected" position. Interlocks hold the breaker trip-free until it is racked into the fully "Connected" position.

#### NOTE

It is imperative that each stroke is performed with a positive motion and carried to its limiting position. Once a racking operation has been started it should be completed, as the breaker cannot be reversed until the racking operation is completed.

(13) The fifth stroke of the handle is only a partial stroke and does not result in any further movement of the breaker.

#### NOTE

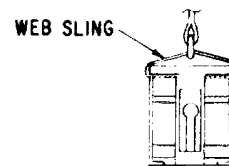
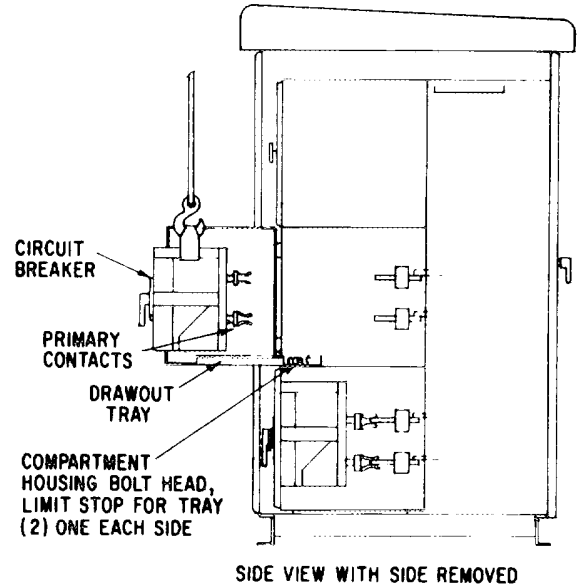
The fifth stroke serves three useful purposes: 1-It positions the cam so that it cannot rotate and allow the breaker to back out under short circuit stresses. 2- The partial stroke signals that the racking operation is complete. 3-It releases the trip interlock which was engaged by the racking pin during the previous four pumps of the racking handle.

(14) After completing the fifth racking stroke, lift the handle as high as it will go and allow it to drop to its normal position. This operation will reverse the pawl so that it is set for a racking out operation.

#### CAUTION

**Any stroke beyond this point will cause the breaker to be trip-free.**

(15) Tighten the 3/8 inch hex head bolts inserted in the front holes of the drawout tray. The breaker is now aligned and in the "Connected" position.



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Figure 2-16. Circuit breaker installation.

**CHAPTER 3**  
**REPAIR OF HIGH VOLTAGE SECTION**

---

**Section I. HIGH VOLTAGE CABINET**

**3-1. General**

The high voltage cabinet is a weatherproof housing with two hinged front panels (upper and lower), two removable rear panels (upper and lower), and a transition area. The cabinet houses the load break switch in upper front section, three lightning arrestors and a heater in lower front section. The rear panels allow access for connecting the primary conductors up and through the bottom to the connectors on rear of load break switch. The transition area provides a housing for the connections to the primary sides of the transformer from load break switch, with access panels front and rear. All panels are secured with hex head bolts. The front upper panel allows for a visual inspection through two non-reflecting windows, and operation of switch with panel closed. The switch operating handle socket is covered and has a lockable bar to prevent unauthorized switching.

**3-2. Enclosure Inspection and Repair**

- a. Inspect exterior and interior for dents, holes, scratches, bends, panel alignment, weather seals and other damages.
- b. Inspect interior for loose or missing hardware, broken or cracked cable supports or insulating barriers.
- c. Straighten dents and bends, fill holes, clean, prime and repaint bare metal, cement loose weather

seals or replace damaged one, tighten loose hardware or replace any that is missing. Replace broken or cracked insulating barriers and cable supports.

**3-3. Inspect and Replace Lightning Arresters**

- a. *Inspect.*

**CAUTION**

**Lightning arresters are live equipment. No work should be done or contact made with them while the line is energized. (Current flows through an arrester from line to ground. A potential gradient exists that is hazardous if handled while energized.)**

- (11) Inspect insulator for damage caused by external flashover. If cracked or burned, replace.
  - (12) Inspect for damage to apparatus protected by or near arrester.
- b. *Replace.* Refer to figure 2-13.

**CAUTION**

**Make sure lines are de-energized, and load breaker switch and main circuit breaker are open.**

- (1) Remove line connection at top of arrester.
- (2) Remove ground connection on bottom of arrester.
- (3) Loosen nut of clamp holding arrester, and remove arrester.
- (4) Replace or install in reverse order.

**Section II. LOAD BREAK SWITCH**

**3-4. Load Break Switch Inspection and Repair**

a. *Description.* The load break switch is a manually operated, triple pole disconnecting switch with an integral interrupter that has the capability of interrupting transformer magnetizing and load current within its rating. It has a manually charged, spring stored energy operating mechanism capable of closing the switch against maximum rated short circuited current. The operation of the switch is accomplished by manual rotation of the detachable operating handle through an arc of 180°. The switch has a positive closing and opening operation supplied from the stored energy of springs. The interrupting ability of the switch is accomplished by the use of an arc chute type interrupter and an

auxiliary blade. When the switch is opened the auxiliary blades contacts are the last to part and will initiate all arc in the chute. The hot arc releases gases from the last plastic chute in such volume that the arc is blown away from the rapidly moving auxiliary blade and cooled by contact with the larger area of the chute sides. After the arc has been extinguished, the blade will continue to open producing a sufficient air gap to isolate the terminals.

- (b) *Switch Inspection* Refer to TM 5-6120-250-12.
- 1 2.
- (c) *Switch Repair* Refer to Checks and Adjustment paragraph 2-14b.



## Section I. TESTING

## 4-1. Leak Test

Inspect the entire transformer for evidence of leaks and make the following pressure test. Introduce dry nitrogen through the vent valve (located on the rear tank wall) until the pressure in the transformer reaches 5 psi. Seal the tank at this pressure and make an examination for leaks over a period of 12 hours. Leaks above the liquid level can be located by applying a liquid soap solution to all gasket joints, pipe fittings, etc.

## 4-2. Tap Changer Test

The purpose of this test is to determine if the positions are correct and the steps progress in accordance with the transformer nameplate. Apply a low voltage to one winding (normally the high- voltage) and measure the voltage on the other winding for each tap changer position.

**WARNINGS**

**The turns ratio must be taken into consideration when making this test, as voltages endangering operating personnel may be present.**

## 4-3. Testing Insulating Oil for Moisture

## a. Handling Insulating Oil.

(1) When handling insulating oil, use only metal or oil-proof synthetic rubber hose for oil lines. The sulfur in natural rubber hose will dissolve in the oil and prove harmful to the copper in the windings.

(2) In the sampling and testing of insulating oil, strict attention should be given to cleaning and drying of sampling and testing receptacles. Samples should be taken when the oil is at least as warm as the surrounding air to avoid the possibility of moisture condensation. If the transformer is out of doors, the sample should be taken to guard against contamination by blowing dust, etc.

## b. Sampling from Transformer.

(1) Impurities which tend to affect the dielectric strength of the oil will generally be found at the bottom of the transformer, therefore the sampling valve is located on the main drain valve. See figure 4-1.

(2) Three types of containers are recommended for sampling purposes.

- (a) A one-quart small neck brown glass bottle.

- (b) A clear glass bottle in a lightproof carton.

- (c) A one-quart tin can that has had the solder seams thoroughly cleaned to remove all traces of soldering flux.

**CAUTION****Do not use rubber stoppers or rings**

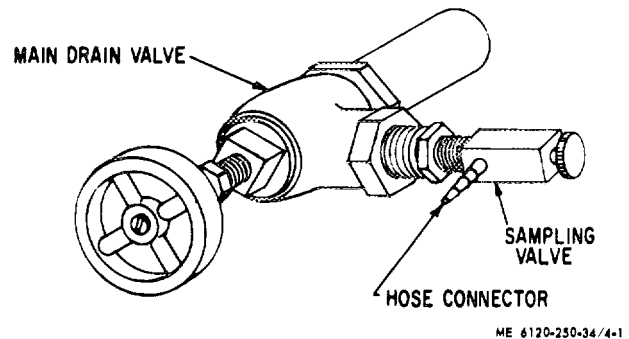
(3) To clean the bottles, rinse with nonleaded, oil free gasoline. Then wash with strong soapsuds, rinse thoroughly with distilled water, and dry in an oven at 1050C to 1100C for at least eight hours. After drying, the bottles must be tightly sealed with glass stoppers or with clean corks protected by clean metal foil. Store them in a dry, dust free cabinet or compartment.

(4) Carefully clean the sampling valve and allow enough insulating oil to run out so that any moisture or foreign matter which may have collected in valve and pipe is removed.

(5) Rinse the bottle carefully, at least three times, with small portions of liquid drawn from the sampling valve. Allow the sampling bottle to drain thoroughly between rinses.

(6) Draw a sample into the bottle, leaving sufficient air space to allow for possible expansion of the liquid. Reseal the transformer and carefully seal the bottle to prevent exposure to the atmosphere.

(7) When making repeated samplings, observe the transformer liquid level and add additional oil as required.



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Figure 4-1. Transformer main drain valve.

## c. Field Test for Moisture Content.

- (1) Obtain a sample of the insulating oil when

the transformer is at operating temperature, preferably above 40°C.

(2) Starting with the hot sample, rinse a clean dry test tube with the liquid. Fill half full and stir continuously with a centigrade thermometer while cooling to approximately 20°. Cool as much as possible in the ambient air and complete the cooling by momentarily dipping the test tube in an ice bath, removing and stirring and then redipping, etc.

(3) Observe the sample carefully and note the temperature at which initial cloudiness appears. Wipe the outside of the tube with a clean rag or paper towel to facilitate observation of the slight moisture cloud that may form. Compare to clean insulating oil at ambient temperature in a similar tube if necessary. Examination for the presence of a cloud should preferably be made against dark background and not directly into the sunlight.

(4) If cloudiness appears at 20° or above, high to excessive moisture content is indicated.

(a) Inspect the unit for free water on the bottom.

(b) If free water is present, remove water as indicated in paragraph 4-4.

(5) If cloudiness does not appear until the temperature is below 20°C, an acceptable moisture content range is indicated.

#### 4-4. Filtering Oil and Filling

a. If test results indicate that moisture or other contaminants are present they can usually be removed by passing the liquid through a filter system. Any free water in the transformer should be removed before the filter operation is started.

b. If it should become necessary to refill transformer, make sure all joints are tight and vent the tank to the atmosphere while filling. In order to prevent aeration, it is preferable to fill the transformer through the drain valve with a filter system. Fill to the level indicated on the transformer nameplate in accordance with the prevailing temperature. If tests on the insulating oil are satisfactory and no filter system is available fill the transformer through a cover opening. Strain the oil through two or more thickness of muslin or other closely woven cotton cloth which has been thoroughly washed and dried to remove the sizing. Use at least one set of cloths for each transformer.

c. A transformer contaminated with moisture will not only have moisture suspended in the insulating oil, but also in the windings and insulation. The most efficient temperature for filtering moisture from the transformer is between 20° and 40°, but at this temperature the transfer of moisture from the windings and insulation to the insulating oil is quite slow. In order to completely dry the transformer the filtering operation should be followed by a short-circuit heat run.

#### 4-5. Drying a Transformer

a. The first step in drying a transformer consists of removing any free water and the water in solution as previously explained in paragraph 4-4. The moisture remaining in the windings and insulating oil can then be driven off by heating the transformer. Exercise caution when heating the transformer to avoid damaging the insulation. The maximum winding temperature as determined by resistance measurements should not be allowed to exceed 950C.

#### **WARNING**

**Any drying method which involves heating an oil-filled transformer when it is exposed to the atmosphere creates a serious fire hazard. No smoking or open flames should be permitted near the transformer and suitable fire extinguishers of the carbon dioxide type must be on hand before beginning the dryout.**

b. Heating the transformer can be accomplished by shorting one winding and applying a suitable voltage on the other. Full-load current can be obtained by applying the impedance voltage of the transformer. Be sure to load the entire winding. If the transformer is at room temperature at the start of drying, 125 per cent load may be applied until the top liquid temperature reaches 650C. At this point, the current should be reduced in accordance with the following table:

<i>Max. Allowable Short-Circuit Amps. (in Percent of Full Load)</i>	<i>Max Top-Oil Temperature- (in Degrees Centigrade)</i>
100	75
85	80
50	85

Since the windings are at a higher temperature than the insulating liquid, the insulation may be damaged if these values are exceeded. Filtration during the heat run will not greatly hasten the drying process, because at these temperatures the filter press loses its ability to remove any appreciable amount of moisture.

c. The air space in the transformer must be thoroughly ventilated to remove the water vapor given off. This can be done by removing manhole covers, the pressure relief device, or the entire cover. If drying is done indoors, provide good ventilation to drive exhaust vapors from the room. If the cover is left in place, it should be thoroughly insulated to prevent condensation. The required temperature can be more readily obtained by blanketing the transformer with heavy paper, cloth, building felt, etc.

d. Take liquid samples every four hours and make tests of the dielectric strength. Samples should be

taken from both the top and bottom. To determine the drying progress, plot curves of load current, top liquid temperature, and dielectric strength versus time. A decrease in dielectric strength indicates that moisture is passing from the winding and insulation into the insulating oil. As the moisture is driven out of the oil, the dielectric strength will increase, indicating that the drying process is progressing satisfactorily.

e. Continue the drying until four consecutive samples test at least 26 K V and preferably 30 K V or higher and until a satisfactory "cloud test" is obtained as outlined in paragraph 4-3 "Field Test for Moisture Content".

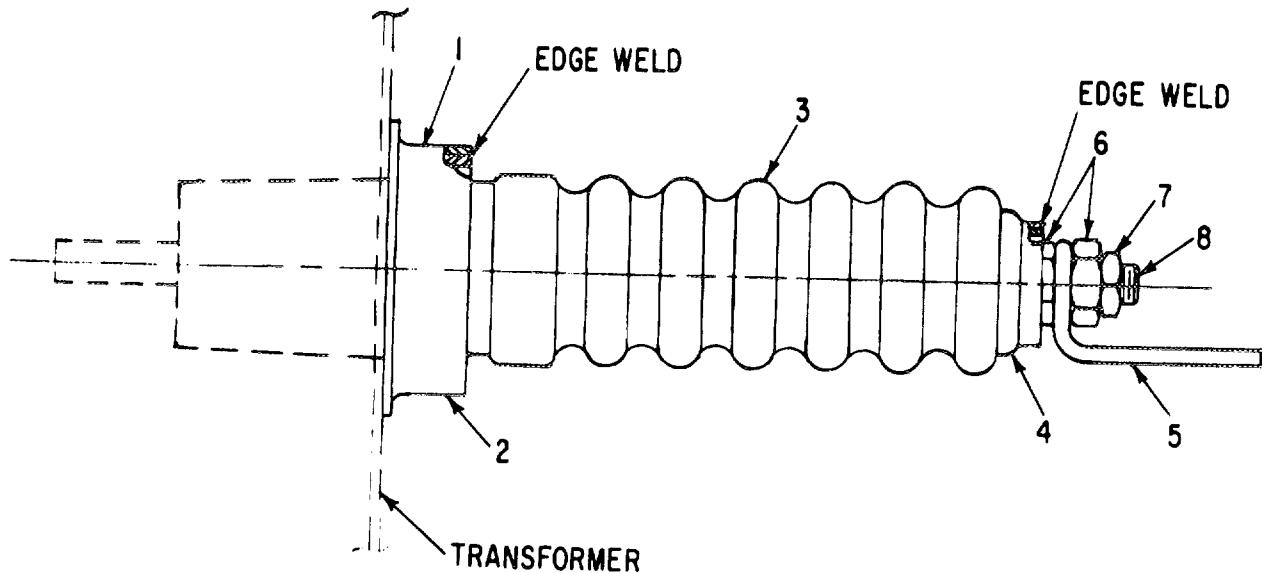
f. When the drying operation has been completed, the liquid removed for sampling must be replaced. To avoid the possibility of entrapping air bubbles in the windings, it is recommended that the oil be returned through the upper filter press connection.

## Section II. INSULATOR REPAIR

### 4-6 General

High and low-voltage winding leads are brought out through hermetically sealed RE-X glass ceramic bushings. A metal-to-glass seal is established in the bushing through the use of an oxide treatment of the cap flange (4, fig. 4-2) and mounting flange (2) prior to casting, plus a special glass ceramic material having a

thermal coefficient of expansion designed to match that of the metal. The cap flange is fusion-welded to a spinning brazed on the bushing stud. The mounting flange is fusion-welded to an adapter ring (1) which in turn is welded to the transformer tank wall, thus completing the bushing seal without the use of gaskets.



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1. Adapter ring
2. Mounting flange
3. Bushing shell, glass body
4. Cap flange
5. Conductor
6. Contact nut
7. Locknut
8. Bushing stud

Figure 4-2. Transformer RE-X bushing.

### 4-7. Removing Insulator Bushing.

a. Lower the insulating oil until the level is below the lowest insulator bushing.

### CAUTION

Before attempting to remove or replace a bushing, thoroughly flush out the air

**space inside the tank with dry nitrogen or carbon dioxide gas and maintain a small flow of gas during operation. If the bushing is to be reused, exercise care in the removal operation to avoid damaging the glass or the remaining portion of the adapter ring and stud spinning.**

b. Grind off the edge welds at both the mounting and cap flanges (2, and 4, fig. 4-2) using a rotary hand grinder or similar tool. Keep the depth of grinding to a minimum and as even as possible. With these two joints broken the bushing shell can then be withdrawn from the transformer, leaving its stud (8) in place, connected to the internal winding lead.

c. An alternate method of insulator removal when the bushing shell is being replaced by a new one is to cut away the mounting and cap flanges with a chisel. After removal of the shell, prize out the remainder of the old bushing flanges and smooth up the adapter ring and stud spinning for rewelding.

#### **4-8. Replacing Insulator Bushing**

a. The edge welds at the mounting and cap flanges are specifically designed for Tungsten Inert- Gas (TIG) welding. To successfully reweld these joints using this fusion method, it is important to keep the radial gap between mating parts as small as possible. The clearance should not be allowed to exceed 0.005 inches at any point. If a new bushing is being installed, its flanges may have to be ground down slightly to match the ground-off edges of the adapter ring and stud spinning.

b. Clean the joints of all oil, dirt, grease, paint, etc.

and wire brush the area where the fusion weld is to be made.

c. Loosen locknut 1(i, fig. 4-2) and remove it and contact nut (6). Remove conductor (5) and second contact nut (6). Grind off the edge welds at both the mounting and cap flanges (2 and 4) using a rotary hand grinder or similar tool. Keep the depth of grinding to a minimum and as even as possible. If the bushing is to be reused, exercise care in the removal operation to avoid damaging the glass body (3) or the remaining portion of the adapter ring (1) and the stud spinning. With these two joints broken the bushing shell can then be withdrawn from the transformer, leaving its stud (8) in place connected to the internal winding lead.

d. Slip the bushing shell (3) over the stud (8) and insert it through the mounting hole until the stud spacer is seated at the internal end of the bushing and the stud spinning is even with the cap flange.

e. Tack weld the assembly in four places and then use a screwdriver or similar tool to carefully expand the stud spinning to bring it in contact with the entire perimeter of the cap flange.

f. It is recommended that the fusion weld be completed in several segments with a cooling period allowed between each section. Welding should be done at 8 to 12 amps dc using straight polarity (electrode negative) and argon gas flow of about 200 cu. ft. / hr. Similar techniques should be used in making the mounting-flange-to-adapter-ring weld except for a slightly higher current of 32 to 40 amps.

g. When the welding has been completed, pressure test the joints as outlined under "Leak Test" paragraph 4-1.

h. Refill transformer per paragraph 4-4.

### **Section III. TAP CHANGER**

#### **4-9. General**

The tap changer is the wedge-type with tap leads from the transformer windings connected to a circular group of nickel-plated copper rods which are held together between two insulating heads. A wedge in the middle can be moved by a crankshaft to wedge between any two adjacent rods. A spring between the wedge and crankshaft maintains a high-pressure line contact between current carrying components. When the crankshaft is turned to move the wedge from one operating position to another, pressure is gradually reduced on the spring and the wedge is withdrawn from between rods. As shaped guide on the opposite side then pivots the wedge around to the next set of rods. As the crankshaft continues to turn, pressure is again

applied to the spring and the wedge is forced into position with a wiping action, insuring positive contact.

#### **4-10. Tap Changer Drive Mechanism Removal**

a. Changer must be on position "ONE" before removal in order to facilitate reassembly.

##### **CAUTION**

**Tap changer drive mechanisms are not interchangeable. When two or more are removed at the same time each one must be identified with the transformer from which it was removed for purposes of reassembly.**

b. Unbolt the flange and lift out as an assembly.

#### **4-11. Tap Changer Drive Mechanism Installation**

a. See that the tap changer and the drive mechanism are both on position "ONE". The tap changer is on position "ONE" when the wedge bridges tap lead A and B and the index marks on the drive shaft and support structure are in line with one another.

b. Place the drive shaft through the opening in the mounting flange and slide the coupling over the tap (changer shaft. The slotted end of the coupling shoulder

engage a pin in the tap changer shaft without difficulty if both mechanisms are in the proper position.

c. .Secure the flange with its bolts.

d. After installation check to see that the wedge seats itself properly in each position by observing the torque required to turn the drive mechanism in each direction. The mechanism will be at the center of a high torque region when the wedge is properly seated. If the device was correctly reassembled the position indicator should accurately show the various positions.

## CHAPTER 5

### REPAIR OF LOW VOLTAGE SECTION

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#### Section I. LOW VOLTAGE CABINET

##### 5-1. General

The low voltage cabinet is a weatherproof housing with two full height doors at front and rear and a transition area with a rear access panel. The cabinet (contains totally enclosed compartments for four circuit breakers and two instrument sections, with their hinged panels and controls accessible behind the front doors. The rear doors give access to the section housing the buses, bus supports and breaker connections. The cabinet has built in wire troughs for the 115 volts ac interconnections to the compartment lights, three heaters (two in low cottage in high voltage) and switch, convenience outlet, fuses and interconnecting terminal

boards. The transition area covers the direct connections from the transformer.

##### 5-2. Enclosure Inspection and Repair

a. Inspect exterior and interior for dents, holes, scratches, bends, panel and door alignment, weather seals and other damage.

b. Inspect interior for loose or missing hardware and door and panel latch mechanisms. and properly secure them.

c. Straighten dents and bends, align panels and doors. Fill holes, clean, prime, and repaint bare metal. Cement loose weather seals; replace if damaged. Tighten loose hardware; replace if missing.

#### Section II. SAFETY DEVICES

##### 5-3. Restraining of Contact Closing Springs

###### a. Insertion of Safety Pin.

(1) Operate the closing handle 122, fig. 5-11 three and one half complete cycles.

(2) At the end of the fourth counterclockwise stroke and before performing the fourth clockwise stroke, remove the safety pin (3) from its clip holder (12).

(3) Insert the safety pin (13) into the hole (41) near the top in the guide rod. This hole is just above the closing springs (5) that are around the guide rod (1)hl. The inserted pin thus prevents the closing springs from their energy and closing the breaker contacts.

(4) Complete the last clockwise or fourth stroke.

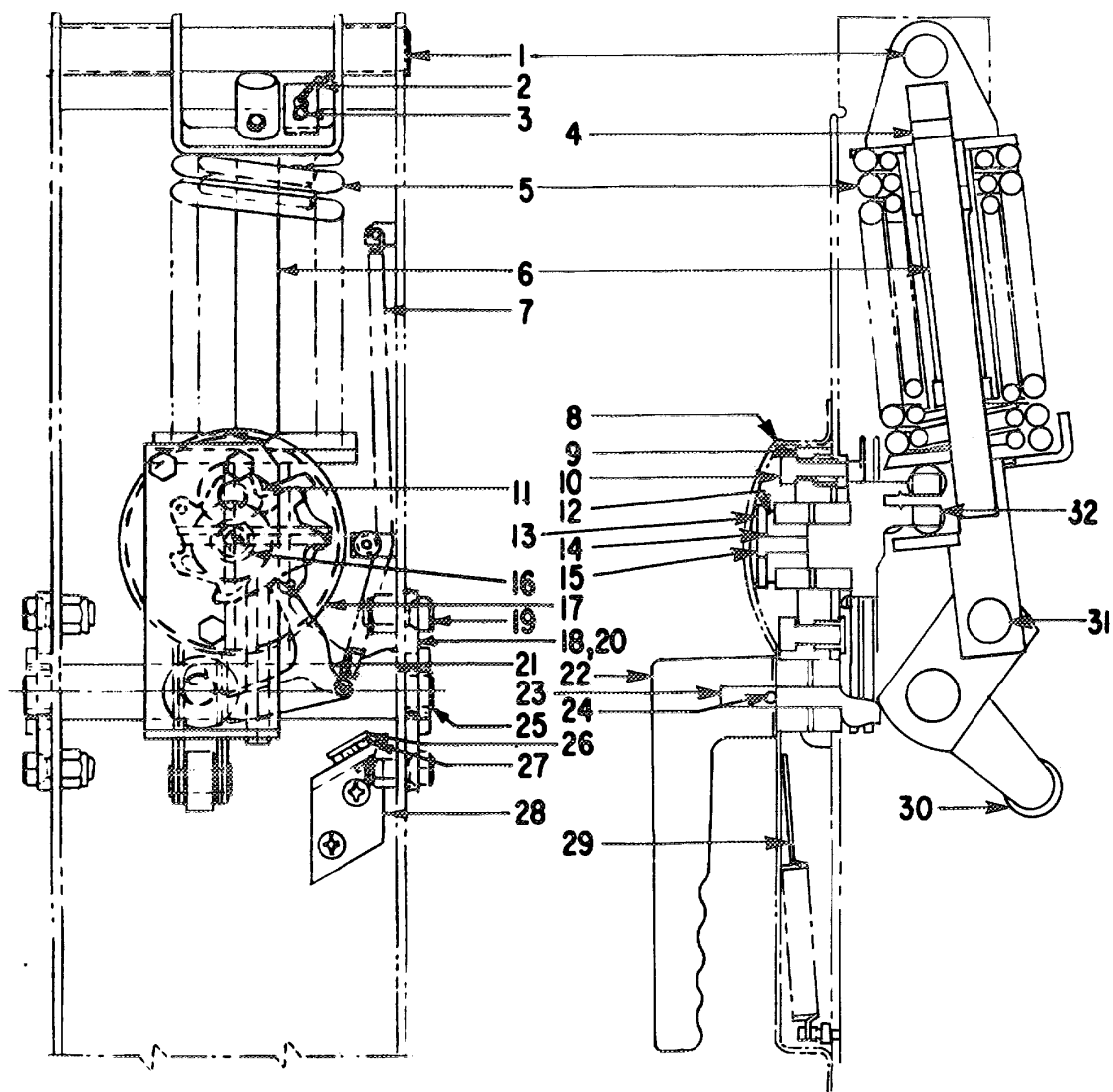
###### b. Removal of Safety Pin.

(1) Operate the closing handle (221) three and one half complete cycles.

(2) At the end of the fourth counterclockwise stroke and before performing the fourth clockwise stroke, remove the safety pin (31) from the hole (4) in the guide rod.

(3) Place pin in its clip holder (21).

(4) Complete the last clockwise or fourth stroke. The breaker will then close.



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- |                                      |  |
|--------------------------------------|--|
| 1. Upper spring pin                  | 17. Ratchet wheel                          |
| 2. Safety pin clip holder            | 18. Side plate shims                       |
| 3. Safety pin and chain              | 19. Side plate mounting bolts              |
| 4. Safety pin hole                   | 20. Bearing side plate                     |
| 5. Closing springs                   | 21. Ratchet pawls                          |
| 6. Guide rod                         | 22. Closing handle                         |
| 7. Pawl spring                       | 23. Closing handle shaft and pawl assembly |
| 8. Front escutcheon                  | 24. Roll pin                               |
| 9. Front Bearing plate               | 25. Main closing crank                     |
| 10. Bearing plate mounting bolts     | 26. Pawl buffer stop                       |
| 11. Output crank roller              | 27. Buffer stop shims                      |
| 12. Thrust bearing                   | 28. Buffer stop support                    |
| 13. Shims                            | 29. Handle return spring                   |
| 14. Groove pin                       | 30. Mechanism roller                       |
| 15. Nylok screw                      | 31. Lower spring pin                       |
| 16. Ratchet wheel shaft and assembly | 32. Output crank                           |

Figure 5-1. Stored-energy manual closing mechanism.

#### 5-4. Separation of Front and Rear Frames

a. To repair or replace contacts, operating mechanism, or the overcurrent devices, the front frames must be separated from the back frame.

b. To remove the circuit breaker from its compartment see paragraph 2-21.

c. To Separate the Front and Rear Frames.

(1) The breaker contacts must be open with the safety pin in place. See paragraph 5-3 a

(2) Remove the two opening springs ion lower part of the breakers from the outside pole units.

(3) Remove the clevis pin (16, fig. 5-2) from the center pole unit.

(4) Remove the six nuts from the back frame using a socket wrench with an extension. These include the two nuts at the top of the frame.

#### 5-5. General

There are four type AK drawout air circuit breakers: one main breaker (AK-3-50) and three feeder breakers (AK-2-50) each in its own metal compartment. They are connected mechanically and electrically to form a distribution load center. The drawout air circuit breakers are easily removable to provide maximum accessibility for maintenance. The type AK removable breaker elements consist of an interlock mechanism, the movable portion of the primary and secondary disconnecting devices, the breaker closing and tripping devices, and the required protective devices. The breaker is equipped with a positive mechanical interlock which prevents the breaker from being racked in or out of the connected position until after the breaker is tripped open. This interlock also holds the breaker trip free and prevents the breaker from being closed while it is being racked in or out of the connected position. The breaker fits on a drawout tray which is part of and rides within the breaker compartment. The drawout features of the breaker are primary and secondary disconnect devices, and on the rear vertical frame members of each side of the breaker are the racking cams (with the positive mechanical interlocks. These cams are joined by a rod across the back and are operated by the racking handle on the front right side of the breaker (fig. 5-11.). All circuit breaker removable elements of the same type and rating may be interchanged. The following paragraphs give circuit breaker details.

#### 5-6. Inspection

At regular inspection periods the breaker should be operated manually (stored energy mechanisms with the safety pin restraining the closing springs).

(5) Check along the trip shaft for a mechanical interference or connection between the overcurrent trip device and the trip paddles. Remove mechanical connection if present, or if interference exists, use extreme care when removing front and back frames to avoid mechanical breakage of trip devices.

d. To Reassemble Front and Back Frames. Reassemble in reverse order of preceding subparagraph 5-4c

#### CAUTION

**The breaker should be fastened to a suitable mounting base with the front frame supported by a sling or hook as the bolts are being installed.**

### Section III. CIRCUIT BREAKERS

Observe the contact alignment and make sure all parts of the mechanism move freely without binding or excessive friction. If the breaker remains open or closed for a period of six months or more, arrangements should be made to open and close it several times in succession. It is important not to permit pencil lines, paint, oil or other foreign material to remain on the insulating surfaces of the breaker. They may cause low resistance between points of different potential and result in eventual electrical breakdown. A complete contact inspection, including contact wipe and pressure, should be made at regular inspection periods and always after a known short circuit current has been interrupted to determine whether the contacts are worn or pitted, in which case they should be dressed or replaced.

#### CAUTION

**Never use cotton waste to wipe bearing surfaces. The cotton raveling may become entangled under the bearing surfaces and destroy the surface of the bearing.**

#### 5-7. Circuit Breaker Contacts

a. *Contact Sequence on the Horizontal Plane.* The difference in the making of the arcing contacts on the same pole must be no greater than 1/32 inch; the difference between arcing contacts on separate poles 1/16 inch. If it is desired to advance or retard the closing of the main contacts of a pole, loosen the bolts holding the adjusting plate 121, fig. 5-2) of that pole and slide plate to the left to advance contact closing, or to the right to retard contact closing. Make this adjustment on the outer poles, using the center pole as a reference. Upon retightening adjustment plate bolts, make sure the



locking tabs are turned up around bolt heads, locking the bolts securely in place.

**CAUTION**

**The following check must be done by operating the breaker slowly with the safety pin restraining the closing springs. See paragraph 5-3.**

b. Contact Sequence in the Vertical Plane. This should be such that when the arcing contacts are just touching, the intermediate contact gap should be at least 3/16 inch, the main contacts gap at least 1/4 inch. If the gap is under the required minimum, it is usually possible to form the arcing contacts and obtain the required dimensions. To form the arcing contacts, place a piece of conduit approximately two feet long, over the contact and form the contact either forward or backward. If the proper dimensions are still not obtained, the movable arcing contacts should be replaced.

**CAUTION**

**If it has been necessary to make any adjustments while obtaining proper contact sequence, the contact wipe and pressure must be checked, and adjusted if necessary.**

c. Contact Gap. When the breaker is open, the gap between the movable (29, fig. 5-2) and stationary contacts (31) should be between 2 5/8 and 2 3/4 inches. The gap may be adjusted by varying the number of buffer spacers (20) on the crossbar. The locking nuts on the buffer bolts should be locked in such a position that the buffer bolt may be rotated freely.

**5-8. Pole ITnit Assembly**

a. Each pole unit assembly consists of a set of arcing contacts, a set of main contacts, the actuating linkage and the mounting base.

i). The stationary arcing-contact assembly consists of a set of parallel finger contacts (31, fig. 5-29, pin 1301, and compression springs (7), which provide continuous contact pressure for the full travel of the contacts. Steel springs (28) shunt the pivot pin to prevent possible pitting at the pivot point when interrupting high currents.

c. The movable arcing-contacts assembly consists of parallel contact arms (29) carried on two movable pivot pins (24) and (11). The arcing contacts interleave the main contacts and pivot with them about the pin (11). This relative motion is obtained by linkages from the upper shoulder pin (251) to the breaker mechanism.

d. The stationary main contact assembly includes main and intermediate contacts. The intermediate contact surface extends beyond the main contacts and will, therefore, make before the main contacts and break after the main contacts.

e. The movable main contacts pivot around a stationary pin (12), which holds them to the lower block. Motion is obtained from a second pin (125), connected by an insulated link (18) to the breaker mechanism. In addition steel springs shunting the current from the contact directly to the lower contact block, steel springs 1131 force the contacts against the pins to prevent pitting at the pivot point. The movable main contact assembly also contains main and intermediate contacts.

f. In order to function properly, a definite amount of contact pressure and contact wipe must exist between the movable and stationary contacts. Table 5-1 gives the figures for contact pressure and contact wipe. Both wipe and pressure should be checked during the regular inspection period.

**Table 5-1. For AK-50 Breaker**

Main contact			Intermediate contacts				Arcing contacts		
No of contacts Per Pole	Pressure lb	Wipe (in) (in)	No of contacts Per Pole	Pressure lb.	Wipe (in)	No of Contacts Per Pole	Pressure (lb)	Wipe IN	
3	55 to 65	4/64 to 7/64	1	55 to 65		2	31 to 43	12/64 to 18/64	

The intermediate contact wipe should be at least 1/16 inch greater than the main contact wipe.

### 5-9. Measuring Contact Wipe and Pressure (fig.5-2).

#### a. Contact Wipe.

(1) Remove arc quenchers, see TM 5-6120-250-12.

(2) With the breaker open, measure the horizontal distance from the edge of the stationary contact to the stationary block behind it. ("B" dimension for arcing contacts; "C" dimension for main contacts).

(3) Close the breaker and repeat step (2). The difference between the readings in step (2) and (3) determines the wipe of the contacts.

#### **WARNING**

**Extreme care must be used not to trip the breaker.**

#### b. Contact Pressure.

(1) Remove arc quenchers, see TM 5-6120-250-12.

(2) Close the breaker and measure dimension "B" figure 5-2.

(3) Open the breaker. Place a push-type scale against the stationary arcing contacts (7) at a point measured in line with the break between the contact stop (9) and the contact pivot block. Push the c contact backward until dimension "B" recorded in step (2) is reached.

(4) Read the scale. If the pressure is not within the requirements listed in table 5-1 refer to paragraph 5-10.

### 5-10. Adjusting Contact Wipe and Pressure

a. *Adjusting Center Pole.* To obtain proper wipe and pressure, regulate dimension "A" in figure 5-2 to increased to increase wipe and decreased to decrease wipe.

(1) To change dimension "A" remove the clevis pin (16) and rotate the clevis as necessary.

(2) To prevent overstressing the clevis threads dimension "A" should not exceed 3/16 inch and space "A" should be filled with shims to 0.005 inch of being solid.

#### b. Adjusting Outside Poles.

(1) With the proper center pole wipe obtained, moving the cross-bar adjusting plate on the center pole to the right will simultaneously increase the wipe on both outside poles; moving the adjusting plate to the left will have the reverse effect.

(2) To increase the wipe on either outside pole individually, move the crossbar adjusting plate of that pole to the left; to decrease the wipe move the adjusting plate to the right.

#### **CAUTION**

**If the proper contact pressure does not exist when the contact wipe is within its limits, the stationary contact springs should be replaced.**

### 5-11. Replacement of Contacts

#### a. Stationary Arcing Contacts.

(1) Remove the plate by removing the two screws (32, fig. 5-2).

(2) Loosen screws holding spring (leaf contact) (28).

(3) Remove pin (30) freeing the stationary contacts (31) and springs (7).

(4) Install new springs and stationary arcing contacts in reverse order.

(5) Adjust contact wipe and pressure. See paragraph 5-10.

#### **CAUTION**

**The movable arcing contacts should be replaced when the stationary arcing contacts are replaced.**

#### b. Movable Arcing Contacts.

(1) Separate front frame from rear frame. See paragraph 5-4.

(2) Remove pins (11, 24, fig. 5-2) and withdraw the contacts (29).

(3) Reassemble in reverse order of steps (2) and (1).

#### c. Stationary, Intermediate Main Contacts.

(1) Remove stationary arcing contacts as described in preceding step a.

(2) Remove screws (2, fig. 5-2) and remove bracket which holds pin (4) in place.

(3) Remove main and intermediate contact stop (19) which holds the lower part of the stationary contact. Removal will be easier if the force on the contact springs (8) is neutralized. This can be accomplished by operating the breaker with operating handle (with safety pin restraining closing springs) slowly until the load on the contact stop is relieved.

(4) Loosen the hardware which fastens the upper stud (6) to the pole unit base until the contact spring load on pin (4) is relieved.

(5) Remove pin (4) and screws (2) and lift out contacts (27) and (3).

(6) Reassemble contacts in reverse order, being careful to replace the intermediate contact (27) in the proper position.

#### d. Movable Intermediate and Main Contacts.

(1) Remove the movable arcing contacts as described in preceding step b

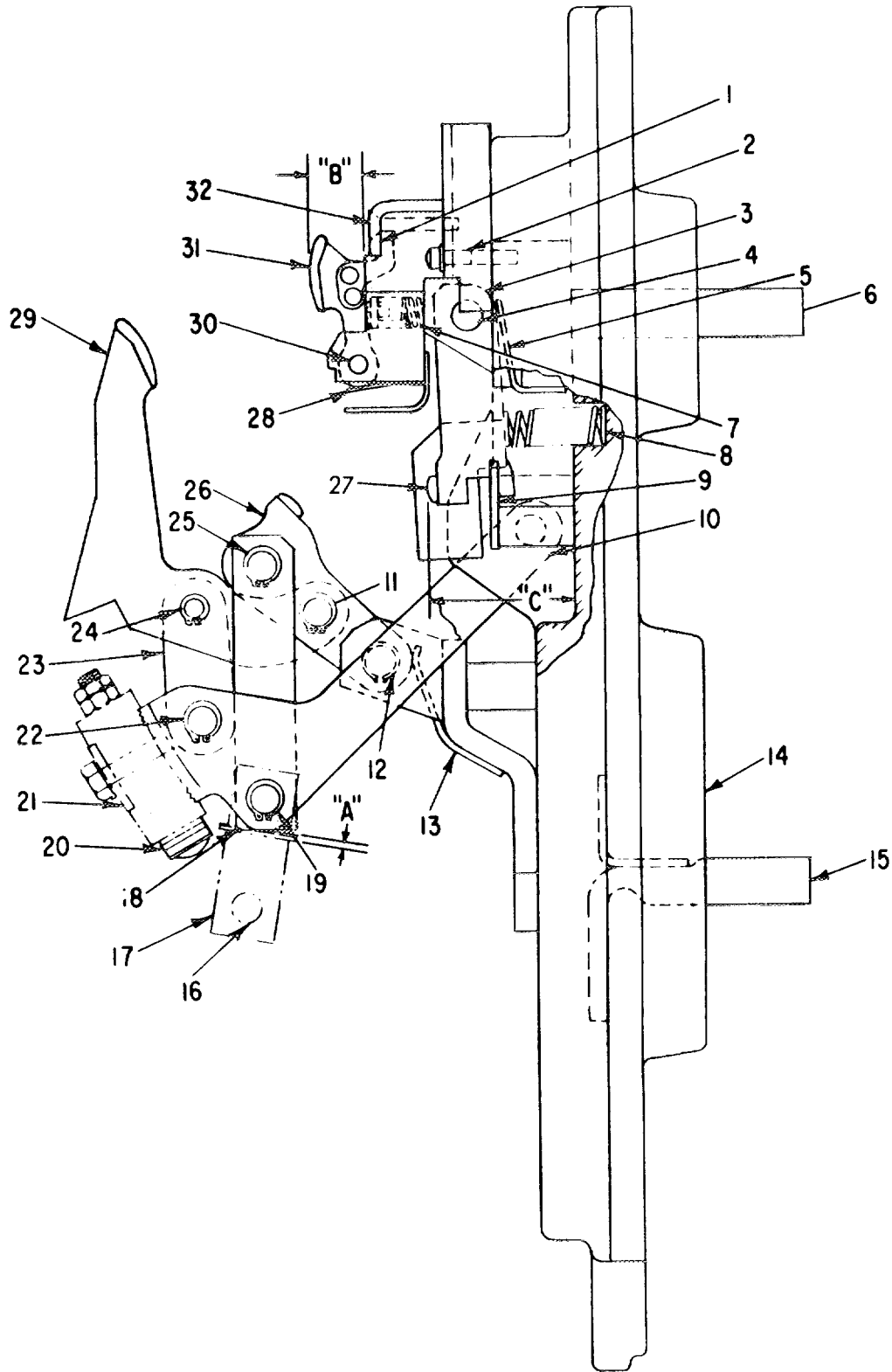
(2) Loosen spring (13, fig. 5-2).

(3) Remove braid if present by removing screw at bottom of contact.

(4) Slide link (18) to the side and off of pin (25).

(5) Slide pins (25) and (12) far enough to the side to allow the movable intermediate contacts to be replaced.

(6) Reassemble parts in reverse order. Check contact wipe and pressure following contact replacement.



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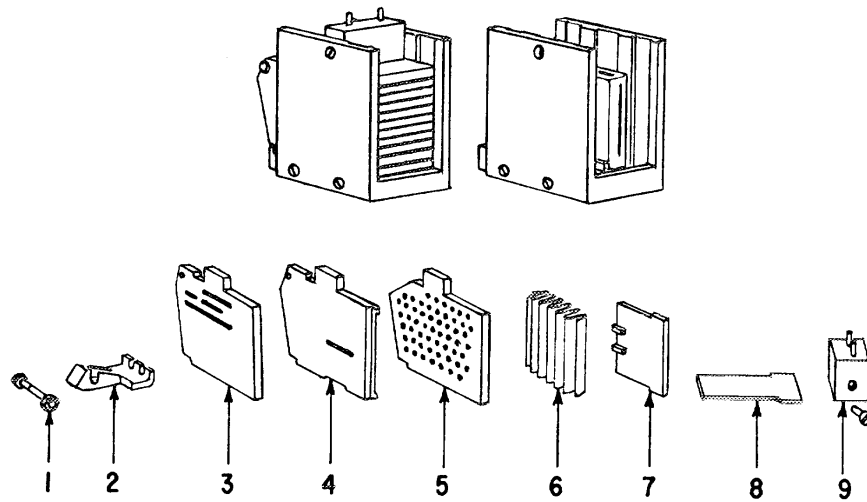
Figure 5-2. Pole Unit assembly--AK-50

KEY to figure 5-2

1. Stop
2. Screw
3. Stationary main contact
4. Pin (stationary main contact)
5. Leaf spring (stationary main contact)
6. Upper stud
7. Spring (stationary arcing contact)
8. Spring (stationary main contact)
9. Contact stop
10. Side link
11. Pin (main arcing contact)
12. Pin (main movable contact)
13. Spring (main movable contact)
14. Pole unit base
15. Lower stud
16. Clevis pin
17. Clevis
18. Link
19. Pin (side link)
20. Buffer spacer
21. Adjusting plate
22. Pin (insulating link)
23. Insulating link
24. Pin (arcing contact link)
25. Shouldered pin
26. Movable main contact
27. Stationary intermediate contact
28. Spring (leaf contact)
29. Movable arcing contact
30. Pin stationary arcing contact)
31. Stationary arcing contact
32. Screw

**5-12. Arc Quencher Disassembly**

- a. Remove arc quenchers.
- b. Remove screws holding spacer block (9, fig. 5- 3).
- c. Remove spacer block steel back plate (8) and compound support (7).
- d. Rock muffler (6) slightly and remove. The inner barriers (5) can now be removed for inspection.
- e. Remove nut and withdraw stud (1).
- f. Remove cap (2). The side barrier (3) and pocket barriers (4) should be free.
- g. Reassemble and replace the arc quencher in reverse order. Tighten the fastenings after replacement.



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- |                   |                     |
|-------------------|---------------------|
| 1. Stud           | 6. Muffler          |
| 2. Cap            | 7. Compound support |
| 3. Side barrier   | 8. Steel back plate |
| 4. Pocket barrier | 9. Spacer block     |
| 5. Inner barrier  |                     |

**Figure 5-3. Arc quencher disassembly**  
5-7

### 5-13. Breaker Disassembly , Assembly and Adjustment

#### NOTE

If it is necessary to replace any of the mechanism parts the following total procedure is used. This procedure may be halted at the step required to replace any particular part.

#### *a. Disassembly.*

- (1) Install the safety pin as described in paragraph 5-3.
- (2) Separate the front and rear frames as described in paragraph 5-4.
- (3) Remove the closing spring assembly by removing the upper and lower spring pin ( 1, 31, fig. 5-1).
- (4) Remove the right hand bearing side plate (20) and the side plate shims (18) if present, allowing the main closing crank (25) to be removed.
- (5) Remove the closing handle (22 ) by removing two set screws threaded in same hole.
- (6) Remove the front escutcheon by removing four screws holding it to the front frame center support.
- (7) Remove the handle return spring (29) by unhooking either end of the spring.
- (8) Disconnect the top end of each pawl Spring
- (9) Remove the roll pin (24) thus allowing the closing trundle shaft and pawl assembly (23) to be removed.
- (10) Remove the ratchet wheel (17) and its assembly (16) by removing Nylock screw (15) and thrust bearing (12). If Shims (13) are present they must also be removed
- (11) Remove front bearing plate (9) by removing three mounting bolts ( 10) accessible from the front of the breaker. The mechanism is now completely disassembled.

#### *b. Assembly*

- (1) To reassemble reverse the order described in subparagraph a.
- (2) It will be necessary to check the adjustments give in subparagraph c.

*c. Adjustments* When reassembling the mechanism the adjustments listed should be checked at the appropriate time during reassembly. The appropriate time for each adjustment follows:

- (1 ) It may be necessary to add shims /13, fig. 5-1)to reduce the end play of the ratchet wheel shaft (16) An end play of 0.010 to 0.020 of an inch is recommended
- (2) It may be necessary to add buffer stop shims (27) to the pawl buffer stop (26) to provide a clearance of 1/64 to 1 / 32 inch between the ratchet pawls (21 ) and the buffer stop. when the pawls ls are touching the ratchet wheel teeth extending a maximum distance from the center of

rotation of the ratchet wheel (17) This measurement should be made while operating the e closing handle during the four spring charging operations and before the closing springs are reassembled

(3) The ratchet pawls (21) should operate freely throughout the closing strokes. They should engage the ratchet wheel teeth near the end of each counter clockwise and clockwise stroke of the e closing handle with a definite c licking sound indicating a free non-binding operation. After the c licking Sound is detected, the c closing trundle should have a minimum over travel of 1/2 inch or .3 1/2 degrees measured at the end of each handle stroke.

(4) The groove pin (14) in the front of the ratchet wheel assembly (16) must be assembled in a manner that will allow Nylock screws (15) to be tightened securely A clearance of 1 / 64 to 1/ 32 inch should exist between the front of the groove pin and the rear surface of the Nylock screw head.

### 5-14. Overcurrent trip EC-1 Replacement AK 2-50

- a. Remove breaker from compartment
- b. Separate front and rear frames per paragraph
- c. Remove the bolts holding the c oil to the lower stud.
- d. Before installing a new device, check the travel of the trip arm with a rod and wire and push the armature solidly against the magnet. The trip arm should travel at least 5/ 32 inch.
- e. Replace new device in reverse order of steps a, b, c, and d.
- f. Adjust device as described in TM 5-6120-250-12.

### 5-15. Power Sensor Trop AK 3-50 5 Breaker

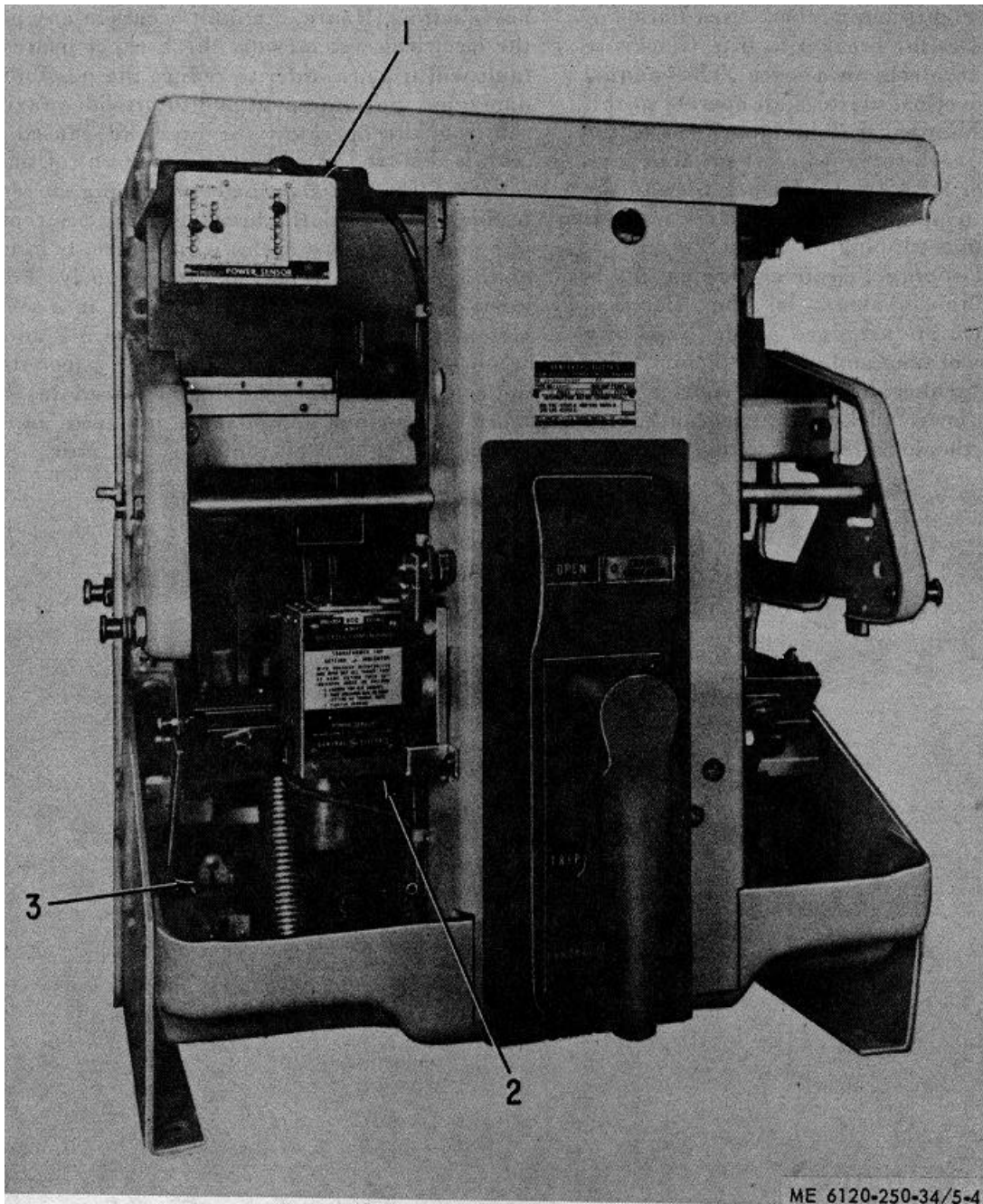
a. *General* The AK-.3 type power sensor trip functions with solid state components with the exception of the solenoid trip which is used to trip the breaker on a signal from the power sensor unit. The power sensor overcurrent trip device consists of four major components: 1-the magnetic coils around the breaker conductors 2-the power supply which provides both the tripping energy and the comparison basis for overcurrent detection, 3- the power sensor unit with the various pickup settings and time delay selection taps and 4-the trip solenoid which physically trips the breaker.

b. *Tripping.* The breaker is tripped open by the displacement of a mechanism latch. This allows a toggle linkage supporting the movable contacts in the closed position to collapse. This trip latch is fastened rigidly to a trip shaft which runs horizontally from left to right through the breaker. All the means provided for tripping the breaker operate through striker arms. These arms displace

the mechanism trip latch by moving against trip paddles fastened on the trip shaft. Looking at the breaker from the right, counterclockwise rotation of the trip shaft causes the breaker to trip. Clockwise rotation resets the mechanism latch. The manual trip button and overload devices all operate in this fashion to trip the breaker. The movement of the striker arms of each of these, when activated, should move from 1/32 to 1/16 inch beyond the point at which tripping occurs. This is what is meant by "positive tripping."

c. *Selective Tripping.* Selective tripping is obtained when the breakers in the electrical distribution system are arranged on the basis of a progressive series of time and current pickup. This will allow the breaker having the shorter time setting and the lower pickup to trip before the breaker having the longer time setting and the

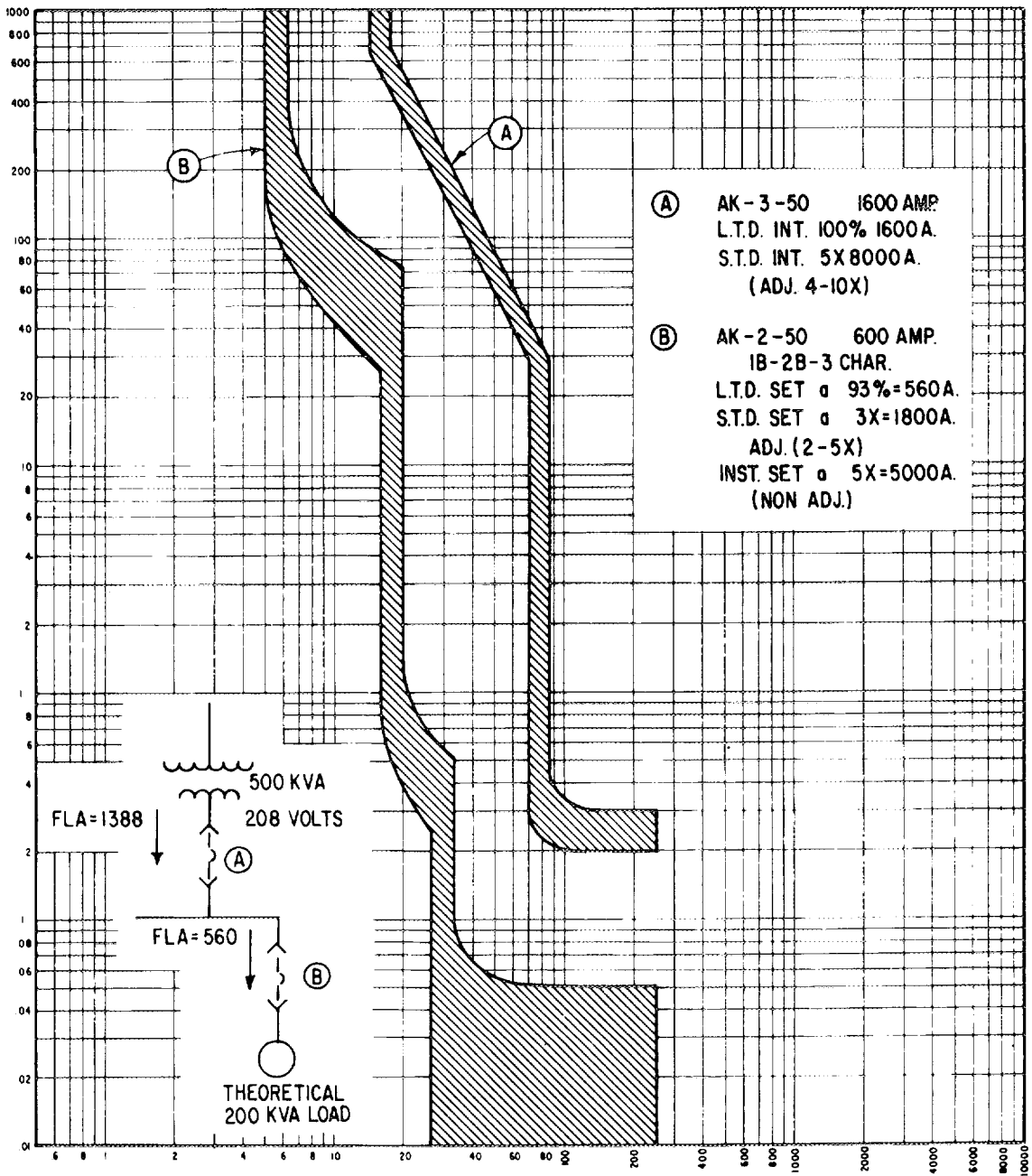
higher current pickup. provided the fault is on the part of the line protected by the breaker having the lower setting. Hence if a fault occurs in any part of the electrical system, only the breaker nearest the fault will trip. In order to reduce the possibility of damaging the equipment and to provide maximum safety to the operator, the overload caused by a fault is removed in a minimum amount of time by selective tripping. Overloads producing current up to five or ten times the breaker rating are removed in a matter of a few cycles less while currents in excess of this value are removed instantaneously. For the exact characteristics and setting each in a selective system see coordination charts figure 5-5 and 5-6. When malfunctioning of the power sensor trip is indicated the trouble should be traced to one or more of the four components involved and that component should be replaced as a unit.



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- 1. Power sensor unit
- 2. Power supply
- 3. Magnet trip device

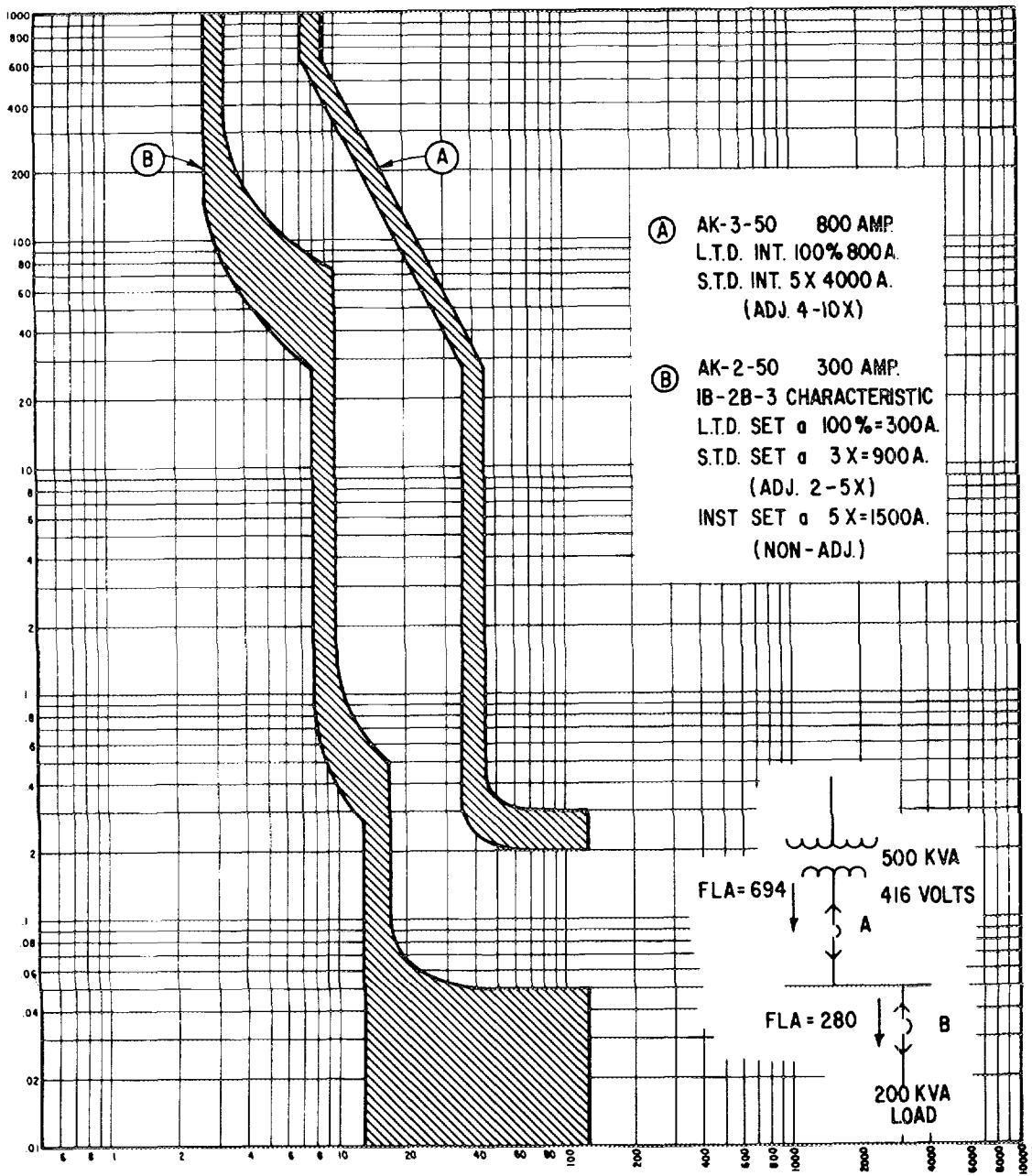
**Figure 5-4. AK-3-50 Circuit breaker.**



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Figure 5-5. Time-current characteristics for magnet overcurrent trip device (208 volts mode of operation).





ME 6120-250-34/5-6

Figure 5-6 Time-Current characteristics for magnet over current trip devices (416 volts mode of operation).

## 5-16 REPLACEMENT of Power sensor Components

### a. Power Sensor Unit.

(1) Loosen screw ( 1 fig.5-7 ) connecting unit to the front frame.

(2) Slide unit forward.

(3) Remove control plug alternately loosening the two retaining screws.

(4) Install new unit in reverse order of preceding steps (1) (2) and (3).

### b. Trip Solenoid.

(1) Remove opening springs (2, fig.5-8).

(2) raise cross bar to gain additional access room

(3) Remove two nuts holding device to bracket.

(4) Remove wiring cleats and connections to terminal board on Power Supply to free the trip solenoid for removal.

(5) Install new device in reverse order of steps(1) (2) (3) and (4).

(6) Check positive trip to obtain ap proximately 1 /32 inch overtravel after armature moved sufficiently to trip the breaker.

### c. Power Supply.

(1) Remove trip solenoid wire. from the terminal board on power supply.

(2) Remove three bolt. holding mounting bracket (6, fig.5-9) to mechanism frame.

(3) Remove wiring cleats

(4) Remove disconnect plug by alternately loosening two retaining screws.

(5) Remove power supply unit with control wiring.

(6) Install new device in reverse order of steps (1)

(2), (3) (4), and (5).

### d. Sensor Coils.

#### NOTE

To remove sensor coils the front and rear frames must he separated. The breaker must be removed from the drawing mechanism and put on a work bench.

(1) Remove breaker from compartment and drawout mechanism per paragraph 2-21.

(2) Disconnect plug (4 fig.5-10) between the power supply unit and the sensor coils. Remove tapped screw holding female plug to breaker mechanism frame.

(3) Separate front frame from rear frame per paragraph 5-4.

(4) Remove the four bolts connecting each coil assembly to the pole unit.

(5) Remove the Coil assemblies taking care to damage the interconnecting coil wire.

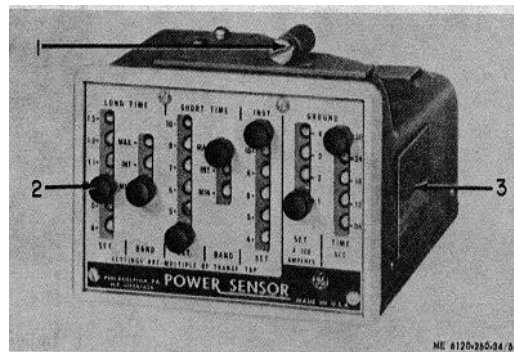
#### NOTE

No further breakdown of the coil assemblies should be made. Do not remove coin from around their iron core.

(6) Install new coil assemblies in reverse order of steps (2) (3) (4), and (5).

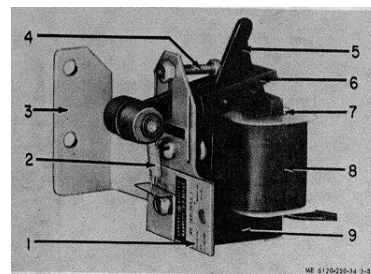
(7) Connect front and rear frame per paragraph 5-4 d.

(18) Reinstall circuit breaker per paragraph 2-22.



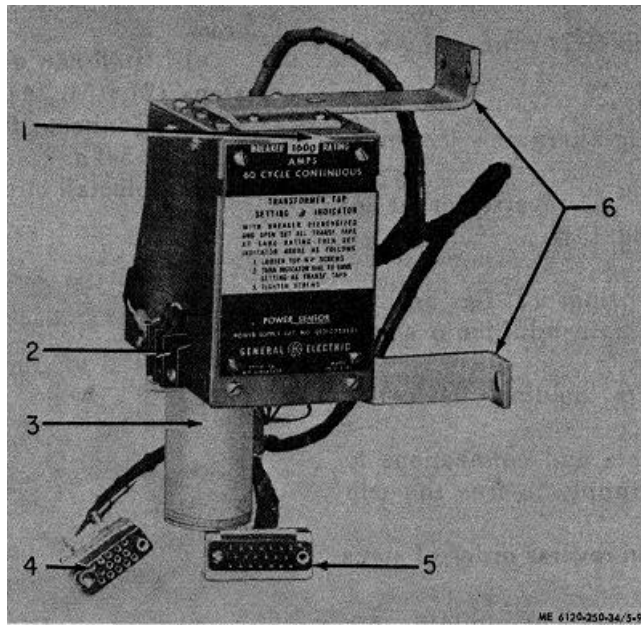
1. Mounting screw
2. Captive thumb screw
3. Name plate

**Figure 5-7. Power sensor unit.**



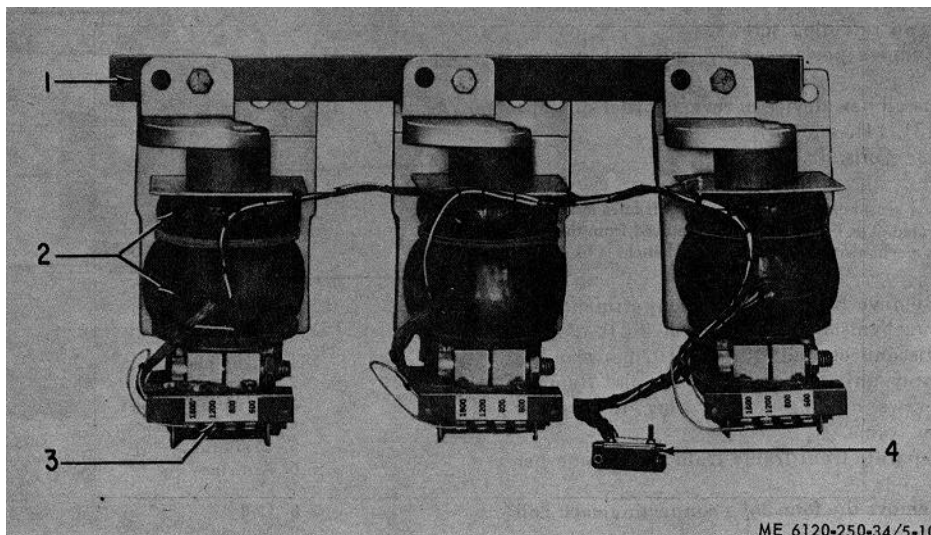
1. Name plate
2. Spring
3. Mounting bracket
4. Adjusting screw
5. Trip arm
6. Armature
7. Clamp
8. Coil
9. Magnet

**Figure 5-8. Magnet trip device**



1. Indicator
2. Terminal block
3. Capacitor
4. Female disconnect plug
5. Male disconnect plug
6. Mounting brackets

**Figure 5-9. Power supply.**



1. Carrying fixture
2. Power supply coil, current sensor coil
3. Transformer taps in amperes
4. Disconnect plug

**Figure 5-10. Magnetic coil assembly AK-3-50**

## 5-17. Disconnect

a. *General.* The disconnects are attached to the circuit breaker studs at the rear of the breaker. Each disconnect assembly consists of four pairs of opposed contact fingers. The contact fingers (fig.5-11) are secured to the breaker stud by two bolts which pass through the assembly and the stud of the enclosure. The disconnect fingers exert a set amount of force against the stationary stud through the action of the compression springs. Retainers and spacers hold the contact fingers in correct alignment for engagement with the stud. The amount of force which the fingers exert against the stud is

determined by the degree to which the springs are compressed by the bolt and nut which hold the assembly together.

b. *Disconnects Replacement.* If for any reason the disconnects must be replaced or removed, the position of the nuts on the bolts should be carefully noted and the number of turns of the nut must be counted. This is important because in reassembly the original amount of compression can be restored by replacing the nuts in their former position on the bolts. The primary disconnects should always be kept lubricated with a grease according to the current Lubrication Order.

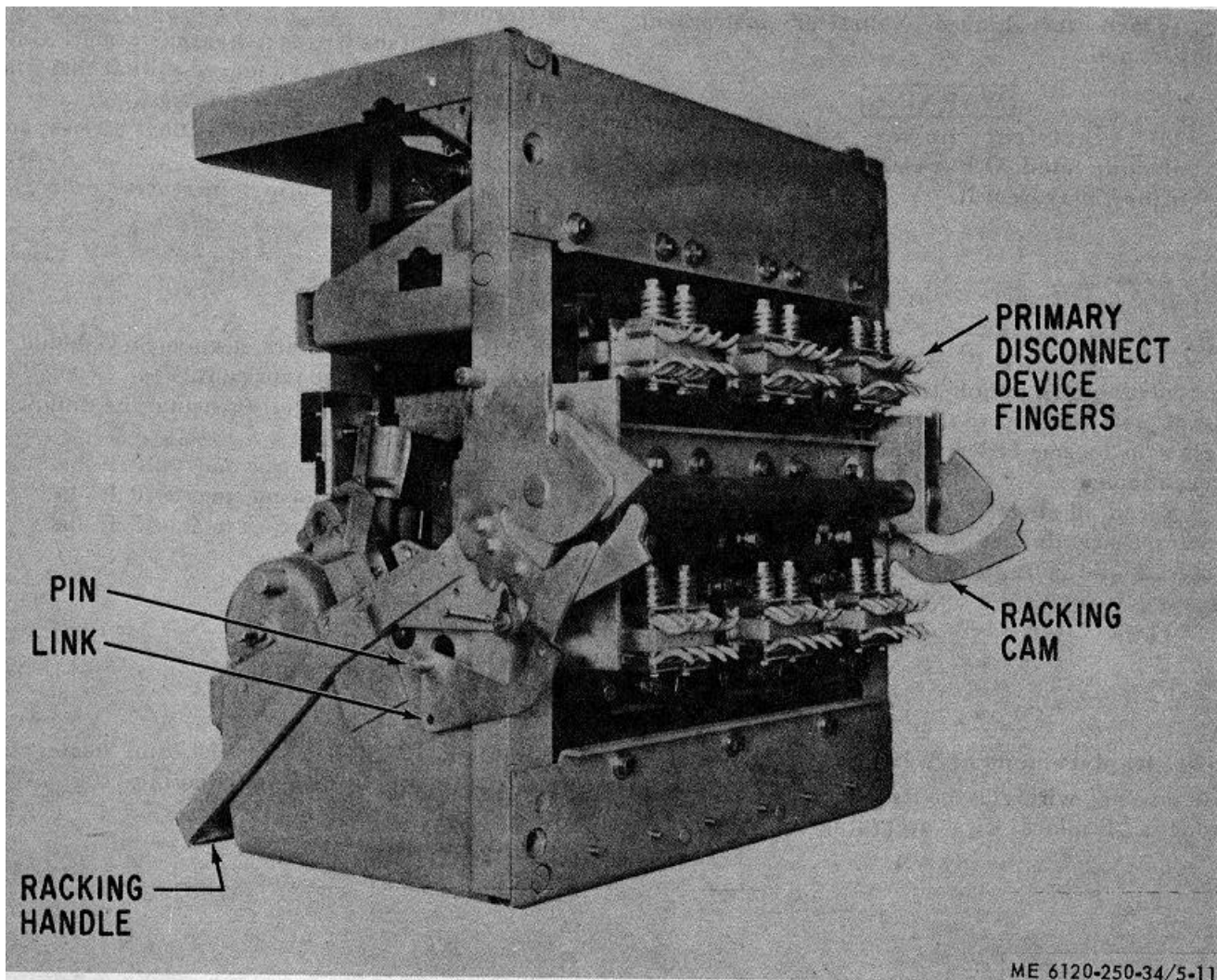


Figure 5-11. Circuit breaker. right rear oblique view.

## 5-18. Drawout Mechanism

a. *General* Drawout breakers are furnished with a drawout mechanism which facilitates the inserting and withdrawing of the breaker from its compartment. It provides a suitable means of forcing the breaker through the part of inserting and withdrawal operations when the stationary and movable halves of the disconnect engage

and disengage.

b. *Operation.* The drawout mechanism is equipped with a drawout trip interlock which prevents a racking operation from being performed when the breaker is closed. Inserting the breaker into the compartment causes the racking pins on

the compartment sides to engage the semicircular slot in the racking cam (fig 5-11). In this position the breaker is ready to be fully racked-in by operating the racking handle which causes the pin on the compartment side to engage the trip interlock link and pin assembly. Rotating the link and causing the pin to move upward against the adjusting screw on the interlock trip paddle. This trips the breaker and holds it trip-free during the entire racking operation. The fifth and final stroke of the racking handle releases

the trip interlock and allows the breaker to be closed, since the breaker is now fully racked in.

*c. Adjustments.* One adjustment on the trip interlock is required with the breaker mechanism in the reset position and the racking cam not engaging the racking pins of the compartment. There should be at least 1/8 inch clearance between the top edge of the trip interlock pin and the adjusting screw on the interlock trip.

## Section IV. TRANSFORMERS

### 5-19. POTENTIAL Transformer Replacement

a. Open the hinged voltmeter instrument compartment.

**WARNING**

All electrical power should be disconnected. Otherwise serious bodily injury may result.

*b.* Remove the protective screen around the transformers.

*c.* Disconnect the wires on the transformer. Make sure wires are identified and tagged so that they may be reconnected to proper terminals.

*d.* Loosen and remove mounting screws and transformer.

*e.* Install new transformer in reverse order.

## Section V. BUSSES

### 5-20. Replacement of Busses

To replace a bus, unbolt section to be replaced and install new section to be replaced. Install new section in reverse order after taking the following precautions:

a. Clean all silvered contacts with silver polish. Do not use sandpaper or any other type of abrasive material. Be sure all polish is removed after leaning.

*b.* After the contacts are cleaned they should be coated with a contact lubricant.

*c.* Bolt bus bars together using the following torque's for tightening:

3/ 8"-16 bolt torque to 15-20 ft.-lbs.

1/ 2"-13 bolt torque to 30-40 ft.-lbs.

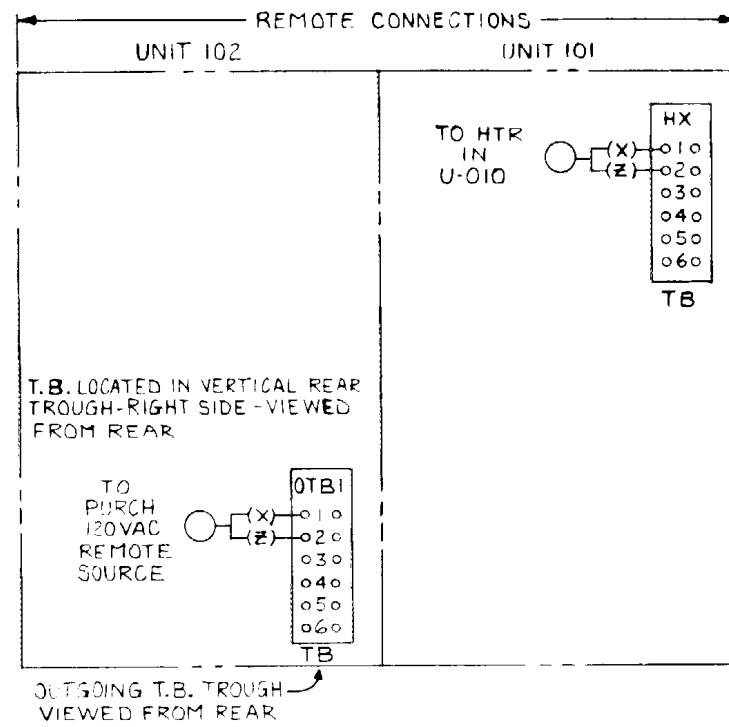
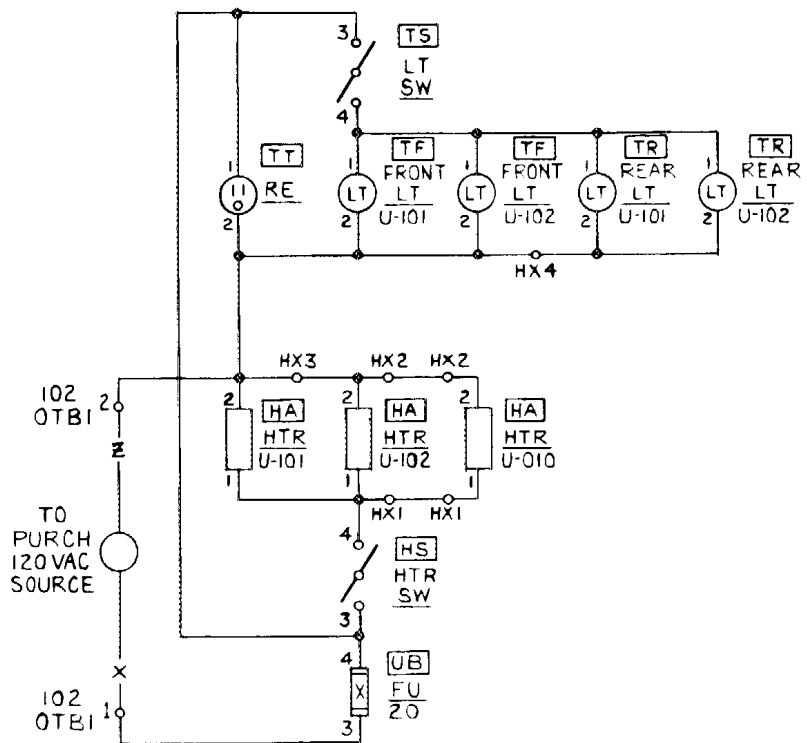
5/ 8"-11 bolt torque to 35-45 ft.-lbs.

## Section VI. WIRING

### 5-21. Replacement of Wiring

All internal wiring is contained in covered wire troughs. Replace wire according to connection

diagram in TM 5-6120-250-12, and heater and light circuit and connection diagram (fig.5-12).



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Figure 5-12. Heater and light circuit and connection diagram.

## CHAPTER 6

### REPAIR OF CABLE

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#### 6-1. General

When a cable fault occurs, one or a combination of the following conditions may be found to exist: (1) One or more of the conductors may be grounded, (2) there may be a short circuit between two or more conductors, (3) the cable may be open circuited. Faults in exposed cable, joints, connections or equipment can usually be found by visual inspection. Any source of dc potential connected to the cable terminal through a voltmeter or a volt dc meter resistance can be used to determine the type of fault. A portable testing set megger of appropriate voltage! should be used to test isolated sections of cable after the ends have been disconnected from feeders, buses or equipment.

#### 6-2. Test

*a. Grounded Conductor.* In checking for a grounded conductor, the test is made between each conductor and ground while the far end of the cable is open.

*b. Short Circuit.* In checking for a short circuit between conductors, the test is made between each of the possible combinations of conductors An ground or by testing each conductor with the o per conductors of the cable ground.

*c. Open Circuit.* The continuity of the conductors is determined by tying the conductors together temporarily at the far end and then testing between each conductor and ground. If the conductors are continuous, the voltmeter reads full voltage, the meter reads full voltage' or the meager reads zero.

## CHAPTER 7 REPAIR OF SEMI- TRAILER

### Section I. UNDER CARRIAGE ASSEMBLY

#### 7-1. General

The undercarriage is one complete unit that may be removed from the trailer bed for air shipment or a unit replacement. It contains all of the running gear wheels, brakes, brake air chamber, axle and springs.

#### 7-2. Brake Drum Repair

Generally there is no repair to a brake drum. Reboring of brake drums is not encouraged due to the reduced strength of refaced drums. Under circumstances where refaced drums and oversize linings are used, precautions regarding cam travel should be observed to prevent sticking cams or cam "roll over". This condition prevails when the linings become worn. The instructions relative to the use of oversize roller cam followers should be carefully followed.

#### 7-3. Brake Shoe Replacement

a. The brakes are a type of two shoe brake signed for use with power. The shoes are lubricated steel and are mounted on individual "anchor pins on an open spider. To replace brake shoes, perform the following steps:

b. Remove wheel as described in TM 5-6120-250-12.

c. Remove shoe return spring (1, fig. 7-1) and shoe return spring pin (2).

d. Remove lock ring (3), washer (4) and bushing (5) from anchor pin (6).

e. Tap out anchor pin (6) bushing (5) washer (4) and remove shoe assembly (7).

f. Unhook shoe web retainer spring (8) and remove roller cam follower (9).

g. Install new brake shoes in reverse order.

h. With the cam in the full release position, the lining should be circle ground 0.070 inches less than the drum diameter. If 80% of the lining has not cleared up, the cam should be adjusted and the linings ground until 80% To contact of the drum diameter is obtained. The 80% contact must be continuous and in the middle of the lining.

#### 7-4. Use of Oversize Linings

To compensate for material removed when refacing brake drums X (1 /16) oversize and XX (1/8" oversize) linings should be used. When oversize rigs are used the drums should also be machined in increments of 1/16 inch radius increased

1 / 16 inch ). To avoid sticking cam or cam roll over and obtain maximum lining wear, oversize roller cam followers should be installed when linings become approximately 50% worn. Roller cam followers are available in four sizes, each having been designed for a specific purpose, as follow.

a. Standard-1.250 Inches. Standard rollers are used when installing standard lining with standard drums, "X" lining with 1/ 16 inch oversize drums and "XX" lining with 1/8 oversize drums.

#### CAUTION

If the drums were previously refaced and oversize rollers installed, the oversize rollers must be removed and standard rollers installed.

b. 1/8 Inch Oversize-1.375 Inches. One-eighth oversize rollers are to be used with the installation of standard liners with worn or trued drums which are 1/32 inch oversize. One-eighth inch oversize rollers should be installed and the liners circle ground a few thousandths less than the drum diameter.

c. 1/4 Inch Oversize -1.500 Inches. Where "X" liners have been installed with 1/16 inch oversize drums and standard roller, these rollers should be removed and 1/4 inch oversize installed before the lining becomes worn to a point where the brake cam is no longer effective with the standard rollers.

d. 1/2 Inch Oversize-1.750 Inches. Where "XX" liners and 1/8 inch oversize drums have been used, the standard rollers should be removed when the liners become approximately 50% worn and 1/2 inch oversize rollers installed.

#### 7-5. Brake Disassembly

a. During an overhaul the following parts should be carefully checked and replaced as required.

(1) Inspect spiders for looseness or sheared rivets.

(2) Inspect anchor pins for wear or misalignment.

(3) Inspect brake shoes for wear at anchor pin holes.

(4) Inspect cam shafts and cam shaft bearings or bushings for wear.

(5) Replace shoe return springs at the time of overhaul or when lining is replaced.



(6) Inspect brake linings for grease saturation, wear and loose rivets or bolts.

(7) Inspect drums for cracks, scoring or other damages.

*b. Disassembly.*

(1) Perform steps (a) through (f) of paragraph 7-3.

(2) Remove inner cam end lock ring (10, fig.7-1), washer (11) from cam shaft.

(3) Release cam shaft lock ring (13) adjacent to spider.

(4) Pull cam shaft (14) out so that end clears the slack adjuster, inner cam shaft bushing support (15) and bushing assembly (16) being careful of bushing assembly seals (22)

(5) Slide the lock ring (13) and washers (17) to the end of cam shaft (14) and remove.

(6) Complete the cam shaft (14) removal.

(7) Remove bushings (19 and 20) from spider only if replacement is necessary. Check "O" rings (21),

(8) If inner cam end bushing assembly (16) is to be replaced, remove bolts, a screw (18) and lock washers (23) and flat washer (24) and remove bushing.

**7-6. Brake Assembly**

*a. Prior to Reassembly.* The following parts should be lightly coated with brake lubricant.

(1) Cam shaft bushings.

(2) Cam roller follower shafts and journals.

**CAUTION**

Excessive lubricant should be avoided as grease soaked lining cannot be salvaged

or cleaned

*b. Assembly.*

(1) Install new bushings (19 and 20, fig.7-1) in brake spider and "O" rings (21) if required.

(2) Install "O" ring (21) on cam end of shaft. Install cam shaft through spider bracket and bushings.

(3) Install cam shaft with one of the "O" rings (21) on spider bushing assembly. When end of cam shaft clears the bushing assembly, install second "O" ring (21), washer (17) and lock ring (13) on cam shaft. Proceed with shaft into and through the support bracket housing (20) and bushing assembly (16).

(4) Slide the lock ring (13) into position near spider next to washer (17) and secure in groove.

(5) Align the parts end "O" bushing seals (22) and carefully tighten the screws (18) around the bushing assembly (16).

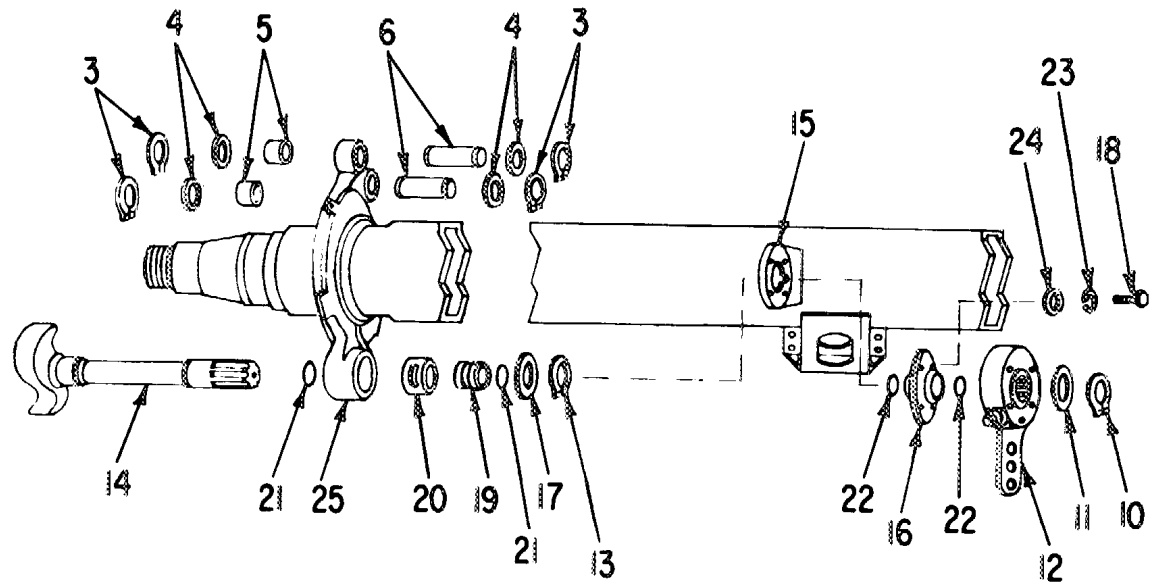
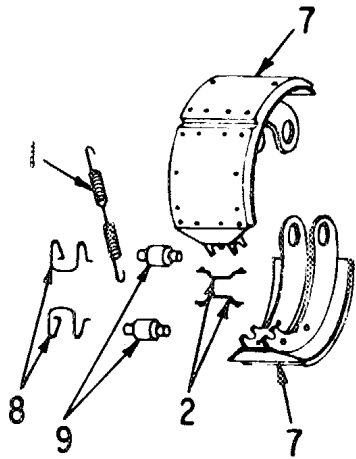
(6) Position "S" cam on cam shaft (14) at zero and install slack adjuster (12), washer (11) and lock ring (10).

(7) Attach roller cam followers (9) to brake shoe assembly (7) with retainer spring (8).

(8) Assemble brake shoe assembly (7) to spider (25) and tap anchor pin (6) in place.

(9) Secure anchor pin (6) with washers (4) and lock rings (3) on inner side then anchor pin bushing (5), washer (4) and lock ring (3) on outer end. It is recommended that all new lock rings be installed where used.

(10) Install brake shoe return spring (1)



ME 6120-250-34/7-1

- |                             |                                    |
|-----------------------------|------------------------------------|
| 1. Shoe return spring       | 14. Cam shaft                      |
| 2. Shoe return spring pin   | 15. Cam shaft bushing support      |
| 3. Anchor pin lock ring     | 16. Inner cam end bushing assembly |
| 4. Anchor pin washer        | 17. Washer                         |
| 5. Anchor pin bushing       | 18. Screws                         |
| 6. Anchor pin               | 19. Inner bushing                  |
| 7. Shoe assembly            | 20. Outer bushing                  |
| 8. Retainer spring          | 21. "O" ring                       |
| 9. Roller cam follower      | 22. Bushing assembly seal          |
| 10. Inner cam end lock ring | 23. Lockwasher                     |
| 11. Washer                  | 24. Flat Washer                    |
| 12. Slack adjuster          | 25. Spider                         |
| 13. Lock ring               |                                    |

Figure 7-1. Brake assembly

## 7-7. Brake Chambers

a. *Operation.* The air brake chamber converts the pressure of compressed air into mechanical force and motion. Air entering the unit forces the chamber diaphragm to flex and carry its push rod outward. When pressure is released, the rod and diaphragm resume their static position due to action of the unit return spring. When the air flexes the diaphragm carrying the push rod outward, this actuates the slack adjuster. The rotation of the slack adjuster rotates the cam shaft which is connected to the "S" cam acting on the cam followers of the brake shoes.

### b. *Maintenance Repair.*

(1) At brake adjustment check chamber for dents and leaks, hose or pipe connection for leaks and wear, and chamber linkages for binds and balanced alignment on left hand and right hand brakes.

(2) At brake reline remove the pressure plate for inspection which includes the diaphragm, hose or pipe connection and outrigger. Installation of a

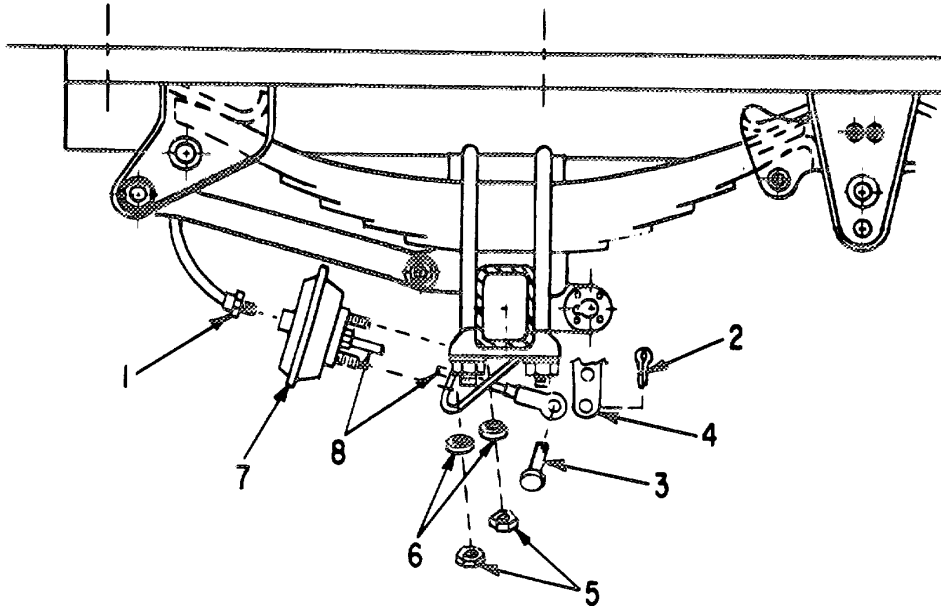
new diaphragm assures; trouble free operation during the life of the new lining.

(3) To remove air chamber remove air line (1, fig.7-2) Remove cotter pin (2) and clevis pin (3) from slack adjuster (4). Loosen and remove the two nuts (5) and washer(6) securing air chamber to axle bracket. Pull chamber (7) with push rod /8) up and off chamber axle bracket.

(4) To examine chamber diaphragm loosen and remove ring clamp which holds the mounting plate' diaphragm and pressure plate assembly.

(5) When assembling chamber, dust lip. of plate and diaphragm with talc powder. Before tightening clamp, align plate and diaphragm with moderate pressure, sufficient to allow the diaphragm to slip into a firm seat, without wrinkling or bulging against plates. Test assembly for air leaks with soap suds. and retighten clamps or bolts as required.

(6) Reinstall air chamber in reverse order of preceding step. (3).



ME 6120-250-34/7-2

- 1. Air line
- 2. Cotter pin
- 3. Clevis pin
- 4. Slack adjuster

- 5. Hex nut
- 6. Washer
- 7. Air brake chamber
- 8. Push rod

**Figure 7-2. Brake air chamber removal.**

## 7-8. Axle Replacement

### a. *Axle Removed*

(1) Raise trailer and support the body so that the

wheels heels are not supporting any weight.

(2) Disconnect air line connection (1, fig. 7-3) to the brake chambers (2) mounted on the axle to be removed.

(3) Remove the wheels, hub and brake drum from axle. See TM 5-6120-250-12.

(4) Remove brake assembly.(para.7-5).

(5) Remove slack adjusters (3) and brake chambers 121 from their brackets on the axle (para 7-7 b(3)).

(6) Place jacks or stands underneath axle to support it.

(7) Remove the 1 inch hex head bolts (4) washers (5) and lock nuts (6) fastening the torque arms(7) on left end and adjustable torque arm 181 on right end to the spring seat (9) of the axle.

#### **NOTE**

The torque arms on the right hand side of each axle are nonadjustable. The torque arms on the left hand side of - each axle are adjustable are length.

(8) Remove the two 7/8 hex lock nut (10) and washer (11) from each of the two "U" bolts (12)at each end of axle(14).

(9) Remove the "U" bolts top plate (13).

(10) Remove axle (14)

#### **b. Axle Installation.**

(11) Place new axle in position carefully aligning the spring seats (9, fig.7-3) with "U" bolts (12), top plate (13) and torque arms (7 and 8).

(2) With "U" bolt top plate (13) in position on top of spring (15), and "U" bolts (12) positioned, install the 7/8 washers (11) and 7/8 hex head lock nuts (10), do not tighten.

(3) Place end of torque arms (7 and 8) in place and

align it with its mounting hole in the spring seat (9) of the axle. Insert the 1 inch hex head bolt(4), then the washer (5) and lock nut (6).

(4) Tighten "U" bolt 7/8 hex nuts (10) and torque arm 1 inch bolt (4) and 1 inch lock nuts (6) snug.

(5) If the axle that was not replaced was correctly positioned with trailer bed and king pin, it may be used to correctly position the replacement axle. See following step (6).

(6) To check the position of the newly installed axle from the other, measure the distance from the center of the correctly mounted axle. This measurement should be 43 1/2 inches (E and D on fig. 7-7) and should be within 1/8 inch of each other, one side to the other side.

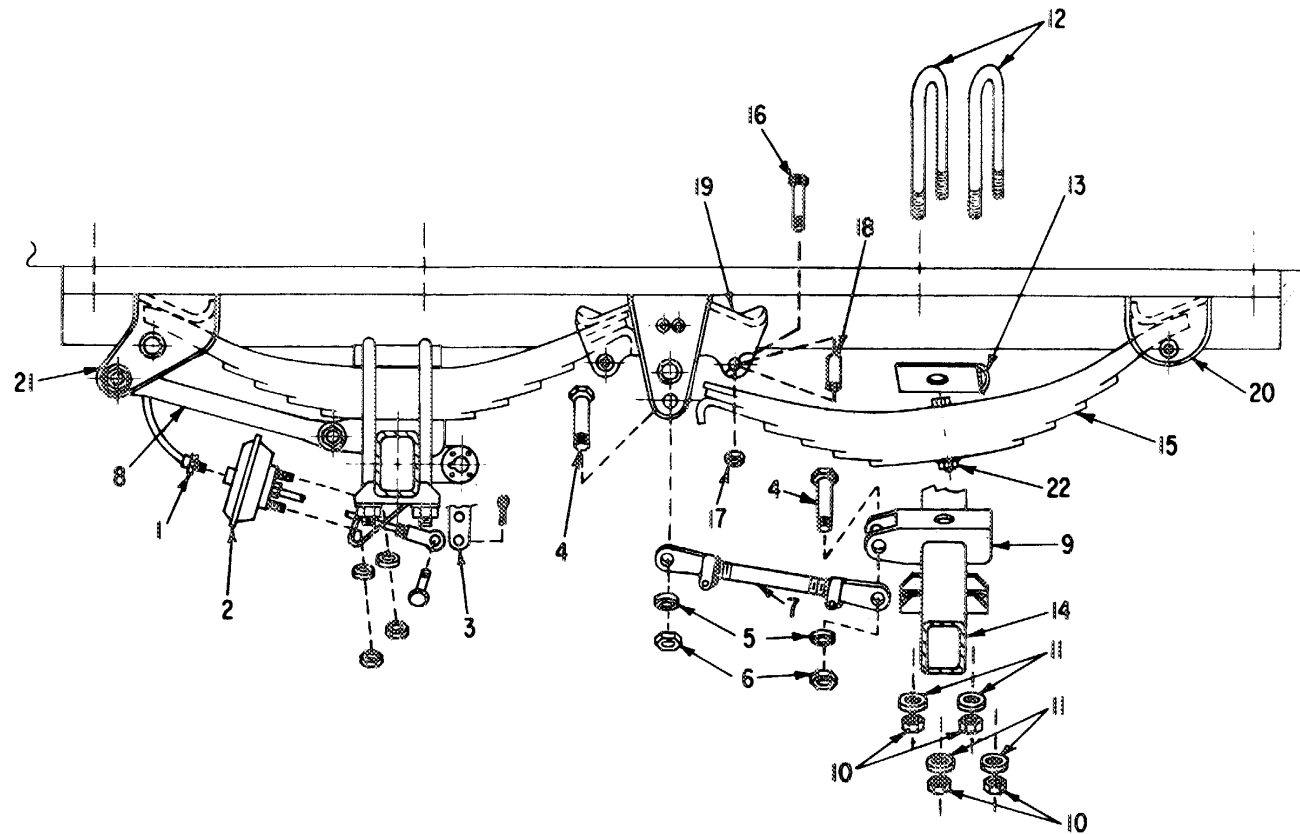
(7) When the newly installed axle is in position torque 1" bolts and lock nuts to :350-375 ft-lbs., and 7/8 bolts and locknuts to 225-250 ft.-lbs.

(8) Install the brake chambers and slack adjuster" on their mounting bracket on axle. See preceding paragraph 7-7b(6).

(9) Reassemble the brake assembly, see preceding paragraph 7-6.

(10) Install wheels on axle, see TM 5-6120-250-12.

(11) Lower trailer onto its wheels, run trailer back and forth. Check axle position and adjust if needed (fig.7-7).



ME 6120-250-34/7-3

- |                         |                          |                             |                        |
|-------------------------|--------------------------|-----------------------------|------------------------|
| 1. Air line connection  | 7. Torque arm            | 13. "U" bolt top plate      | 18. Sleeve spacer      |
| 2. Brake chamber        | 8. Adjustable torque arm | 14. Axle                    | 19. Equalizer hanger   |
| 3. Slack adjuster       | 9. Spring seat           | 15. Spring                  | 20. Rear end hanger    |
| 4. Hex head bolt 1 inch | 10. Lock nut 7/8 inch    | 16. Hex head bolt, 5/8 inch | 21. Front end hanger   |
| 5. Washer 1 inch        | 11. Washer 7/8 inch      | 17. Nut 5/8 inch            | 22. Spring center bolt |
| 6. Lock nut 1 inch      | 12. "U" bolt             |                             |                        |

**Figure 7-3. Wheel suspension assembly.**

## 7-9. Spring Replacement

### a. Spring Removal

(1) Raise and support trailer so that the wheels on the side where the spring is being replaced will be high enough for that axle to be dropped giving enough clearance to remove spring.

#### **WARNING**

If the whole trailer is not supported, the wheel on the opposite side must be blocked at, trailer cannot move.

(2) Remove wheels on the axle that is supported by the spring to be replaced. See TM 5-6120-250-12

(3) Remove the 1 inch hex head bolts (4, fig.7-3) washer (5) and lock nut (6) that fasten the torque arms (7 or 8) to the spring seat (9) of the axle (14).

(4) Place a jack underneath the axle to give it support

(5) At the bottom and both ends of the equalizer hanger (19) is a 5- inch hex head bolt (16) nut (17) and sleeve spacer (18). Loosen and remove those that are on the end where the spring is being removed.

(6) Loosen and remove the two 7/ 8 hex lock nuts (10 ) and washers (11) from the two "U" bolts (12) of the spring being replaced.

(7) Remove the "U" bolt (12) and "U" bolt top plate (13).

(8) Using the jack placed under axle in step 141, lower the end of the axle so that it will not be in the way.

#### **CAUTION**

When lowering the axle the spring is loose and will come down with it. Care must be taken so that it will not drop or slide causing bodily injury or damage to axle and brake chamber, adjuster and cam shafts of either axle assembly.

(9) When the end of the spring is down and free from the equalizer hanger (19), slide spring (15 ) away from, and out of end hanger(20 or 21).

#### **NOTE**

The end of the springs are not the same. The end that goes in the middle equalizer hanger has - sharp bend down in bottom leaf.

(10) Remove spring (15)

### b. Spring Installation (fig. 7-3).

(1) Install new spring in reverse order of Spring Removal a. Care must be taken to put the correct end of spring in the middle equalizer hanger (see step (9) of spring removal) and place hole of U bolt top plate (13) over spring center bolt (22).

(2) When spring and axle are reassembled the measurements in Axle Installation paragraph 7-8b (5) and (6) must be checked for correct axle alignment.

## Section II. LANDING GEAR

### 7-10 General

The landing gear is operated by a hand crank. The crank can be positioned for one of two speeds by pushing or pulling handle in or out. Rotation of the hand crank and crankshaft, rotates a jackscrew in each upper leg by the means of gears. As the jackscrew rotates it raises or lowers the inner mount that telescopes into the upper fixed part outside mount. The lower inner section of each has dual steel wheels mounted on the bottom. Each leg is identical except the right hand leg contains the gear housing and hand crank assembly. The hand crank can be pulled out (disengaged) so that it may swing underneath trailer, then placed in a hook retainer when not in use or in transit. The landing gear is removed from the trailer in three subassemblies. See TM 5-6120-250-12 if it is necessary to replace any of the landing gear parts. The following paragraphs give disassembly procedures. These procedures may be halted on any step required to replace any particular part.

### 7-11. Disassembly of Upper (Outside) and Lower (Inner)Leg

a. Remove leg as described in TM 5-6120-120-12.

b. To remove wheels on bottom inner leg.

(1) Loosen nut ( 1,fig.7-4) washer(2) and cap screw (3) and remove.

(2) Remove axle collar (4).

(3) Remove wheels (5) and axle (6) from axle housing.

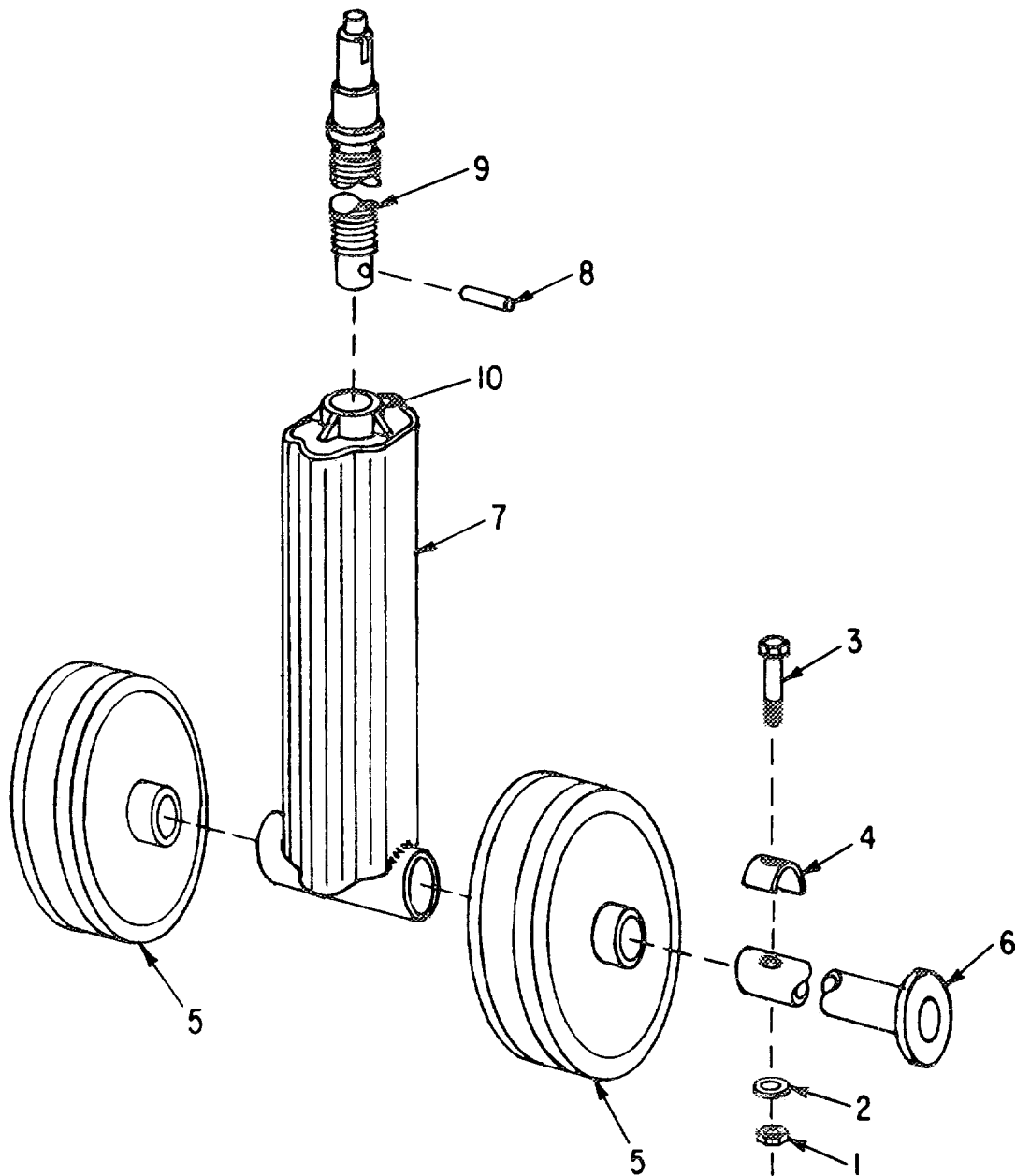
c. To separate upper and lower legs.

(1) Retract inner leg (7) up into upper leg. This is done by rotating crank handle on right leg. On left leg rotate crankshaft (fig.7-5).

(2) When inner leg (7) is fully retracted up, the groove pin(8) may be seen in the bosom of the jackscrew (9) by looking in axle housing.

(3) Remove groove pin (8) from jackscrew (9), Groove pin is 3/ 8 diameter by 2 inches long.

(4) Rotate jackscrew so that inner leg (7) goes out of upper leg. With groove pin (8) removed the inner legs elevating nut (10) will disengage from jackscrew. This separates upper and lower legs.



ME 6120-250-34/7-4

1. Hex nut, 3 / 8 - 24
2. Plain washer, 3 / 8 std.
3. Hex head cap screw, 3 / 8-24 x 1 inch
4. Axle collar
5. Wheel

6. Wheel axle
7. Inner leg
8. Groove-pin, 3 / 8 dia. x 2 inch
9. Jackscrew
10. Elevating nut, inner leg

**Figure 7-4. Landing gear outer and inner leg disassembly.**

**7-12. Crankshaft Disassembly (fig.7-50)**

- a. Loosen and remove 3 / 8-24 hex lock nut (1) and special hex head cap screw (2) and two washers (3)
- b. Remove crank (4) crank hook (5) from crankshaft housing (6).

- c. Loosen and remove three 3/8-24 hex nuts (7) and washers (8) securing crankshaft housing (6).
- d. Remove crankshaft housing (6).
- e. Loosen and remove six hex head screws (9) securing gear housing cover (10).
- f. Remove gear housing cover (10) with its two

shaft bushings (11) Crankshaft (12) and the two speed gear (13) may come out with cover. To remove shaft and gear, pull them out of the crankshaft housing (6) bushings.

*g.* To remove two-speed gear (3) from crankshaft (12), remove groove pin, 3/8 inch dia. x 1 5/16 lg. (14), then slide two speed gear off shaft.

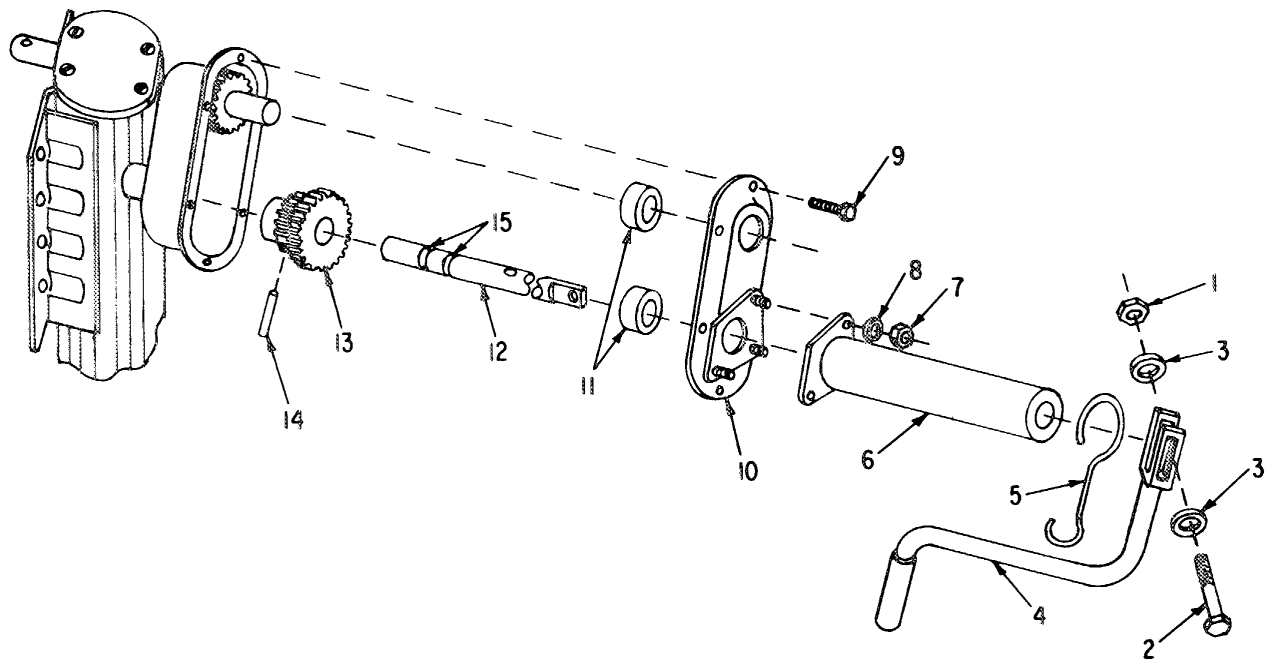
*h.* To install a two speed gear(13) on crankshaft

(12) insert shaft into hole of two speed gear with the smaller gear towards the inside of gear box or towards cover end. The inside end of shaft is the one that has the two detent grooves. Slide gear so that its groove pin hole aligns with hole in shaft. Insert groove pin (14) in hole of gear hub and shaft.

*i.* To remove shaft bushings (11) use a rod to gently tap until bushing is out of cover.

*j.* Install shaft bushing in cover in reverse order.





ME 6120-250-34/7-5

- |                           |   |
|---------------------------|---|
| 1. Hex lock nut 3/8-24    | 9. Screw  |
| 2. Hex cap screw special  | 10. Gear housing cover                            |
| 3. Plain washer, 3/8 std. | 11. Shaft bushing                                 |
| 4. Crank                  | 12. Crankshaft                                    |
| 5. Crank hook             | 13. Two-speed gear                                |
| 6. Crankshaft housing     | 14. Groove pin, 3/8 in. dia. x 1<br>5/16 in. log. |
| 7. Hex nut 3/8-24         | 15. Detent grooves                                |
| 8. Washer 3/8 std.        |   |

**Figure 7-5. Landing gear. crankshaft disassembly.**

### **7-13. (dross Shaft Disassembly**

- a. On right leg remove the handle and crankshaft assembly - (para 7-12)
- b. Loosen and remove four round head screws (1, fig. 7-6) securing top cover (2), and remove cover.
- c. Remove the two groove pins (3).
- d. On right leg remove the groove pin (8) from gear hub (7) and shaft (5).
- e. Slide shaft (5) or (6) out removing gear (4) on right leg gear (7) too, as it is withdrawn from shaft bushing in housing.
- f. Shaft bushing (9) is replaced the same way as crankshaft bushing in paragraph 7-12.
- g. On right let detent assembly(10) may be removed from inner plate. This is the spring-loaded detent that fits in the detent grooves (15,fig. 7-5) of the crankshaft (12) giving position for gear ratio.
- h. Reassemble cross shaft assembly in reverse order. Care must be taken that the gears (4, 11, fig.7-6) are properly meshed. On the right leg the two

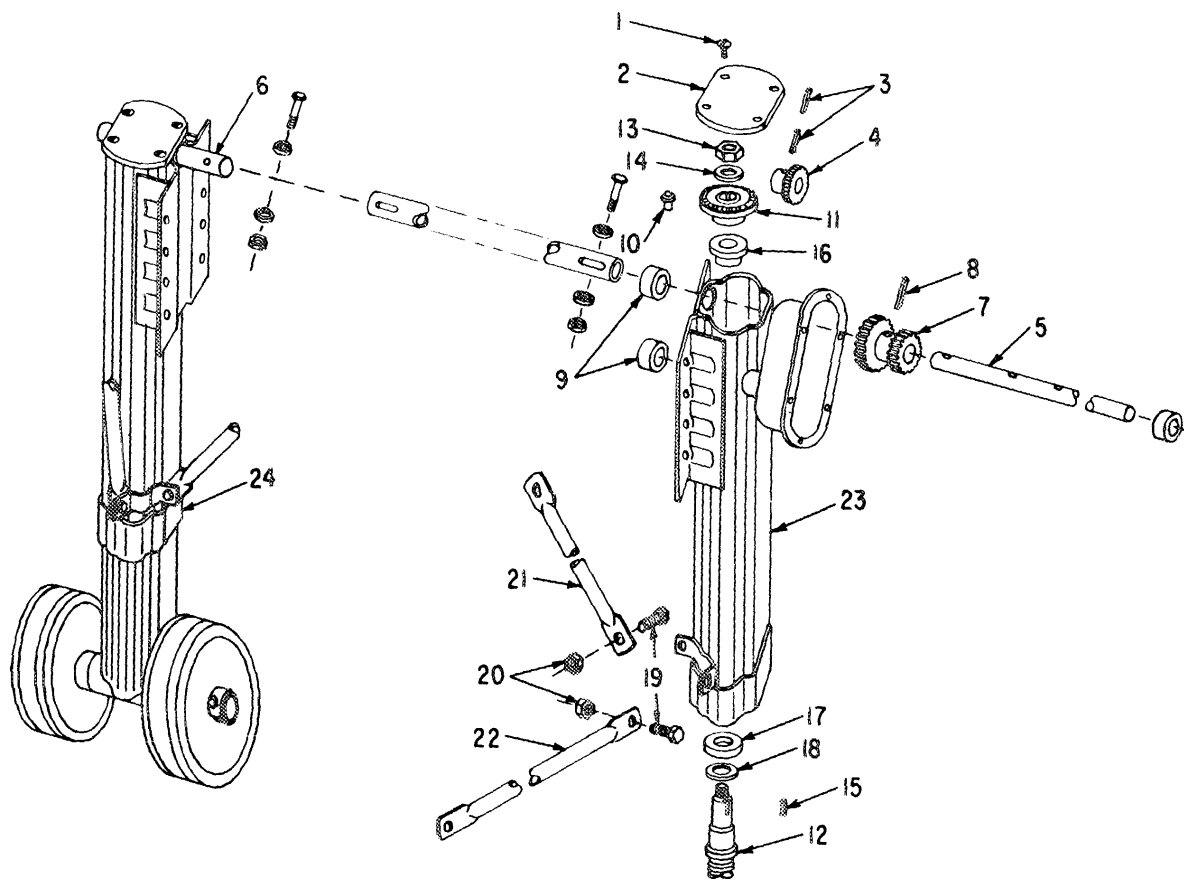
speed gear (7) must be installed with larger gear teeth towards the inside.

### **7-14. Removal of Jackscrew**

- a. Complete cross shaft d is assembly ( para 7-13)
- b. .Holding bottom of jackscrew (12, fig.7-6) to keep it from rotating, loosen and remove jam nut (13) washer (14) gear ( 11) with key (15) and jackscrew bushing.
- c. Slide jackscrew down and out of leg and remove thrust bearing (17) and bearing washer (18).
- d. Reassemble jackscrew in upper leg housing in reverse order.

### **7-15. Removal of Braces**

- a. Loosen and remove hex head bolt (19), and lock nut (20). These secure bottom of each brace (21) and (22) to bracket on housing.
- b. Install braces in reverse order.



ME 6120-250-34/7-6

**Figure 7-6. Landing gear, cross shaft and jack screw disassembly**

KEY to figure , -6:

1. Round head screw
2. Top cover
3. Groove-pin 5/ 16 dia. x 9/16 inch
4. Cross shaft gear
5. Cross shaft R. H. outside mount
6. Cross shaft L. H. outside mount
7. Two speed gear, cross shaft
8. Groove pin, 3/8 in. dia. x 1 1/ 2 in. lg.
9. Shalt bushing
10. Detent assembly
11. Jack screw gear

12. jackscrew
13. Lock jam nut. 3/4-16
14. Washer, 3/4 std.
15. jackscrew key
16. Jackscrew bushing
17. Thrust bearing
18. Bearing washer
19. Hex head bolt. 5/ 8-11
20. Locknut 5/ 8-11
21. Landing gear cross brace
22. Landing gear brace
23. Right hand leg upper housing
24. Left hand land gear assembly

### Section III. TRAILER FRAME AND BED REPAIRS

#### 7- 16. General

The trailer frame and bed is specially designed and built to support and transport the mobile substation. Due to its construction the following items and assemblies are considered repairable or replaceable; landing gear braces, trap door assemblies, mud flap assembly, rear bumper assembly king pin fifth wheel plate assembly, undercarriage frame assembly and trailer deck.

#### 7-17. Weldments

*a. Removal of Welded Members.* The method used to separate welded members is dictated by the situation and which member if not both, is being replaced. Care must be taken 80 as not to damage remaining members to be reused.

*b. Welding.* Weld all joints per Mil-Spec.1261.

*c. Painting.* Prime with metal primer per MILP858. Paint with two coats of Semi-Gloss Olive Drab X24087 (Federal Standard 595A) per MIL Std.-193.

#### 7-18. Landing Gear Braces Repair

*a. Replacement.* The braces are made from steel tubing. Therefore, if bent it is best to replace them rather than straighten.

*b. Installation.* Install new brace with new hex head bolts 5/8-11 NC x 11/4 and 5/ 8-11 hex lock nuts at each end of brace.

#### 7-19. King Pin Fifth Wheel Replacement

*a. General.* To replace a damaged king pin a new fifth wheel plate is needed. The wheel plate must be removed and a new king pin fifth wheel plate assembly installed.

*b. Fifth Wheel Plate Removal.* Cut weld securing fifth wheel plate to trailer per paragraph 7-17 a.

*c. King Pin Fifth Wheel Assembly.* Weld new king pin to new fifth wheel plate per paragraph 7-17 b. and figure 7-7.

#### CAUTION

**The location of the king pin is critical. Its position on trailer in relation to the front axle of wheels affects towing quality .**

*d. King Pin Fifth Wheel Assembly Installation.* Locate assembly on trailer as shown in figure 7-7. Clamp in position and check position dimensions for location, reposition if necessary, or weld in place if correct.

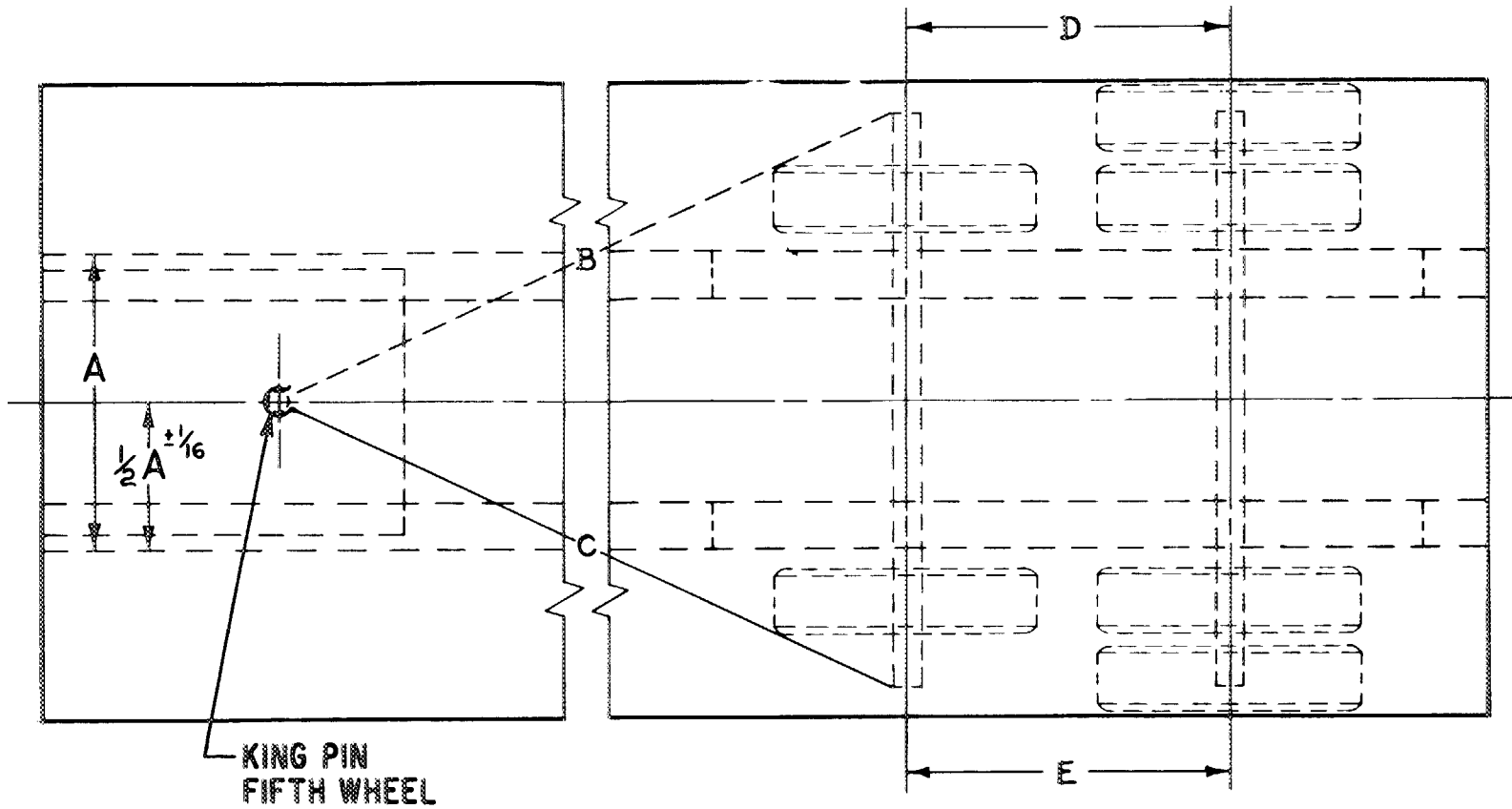
#### 7-20. Under carriage Assembly Frame

*a. General.* The undercarriage frame alignment is important because it supports the suspension and wheel assembly. The alignment affects the towing qualities of the trailer. Before straightening bent members all weld joints should be inspected for cracks or tears. If joints are damaged they should be cut. Bent parts should be straightened or replaced. Use procedures outlined in paragraph 717 a and 7-17 b

*b. Suspension Mounts.* When wheel suspension hangers are damaged they should be replaced. Use procedures in paragraph 7-17 a and 7-17 b for removal and welding.

#### 7-21. Trailer Deck Repair Replacement

The deck is made of two 1/4 inch thick steel plates. The front plate is 10 feet long by 95 3/8 inches wide' the rear plate is 20 feet long by 95 7/8 inches wide. If deck is damaged to the point of repair, sections can be replaced. By inspection of supporting members it can be determined at what point a damaged area may be cut out and replaced.



DIMENSIONS B AND C WITHIN  $\frac{1}{16}$  INCH OF EACH OTHER.

DIMENSIONS D AND E SHOULD BE  $43\frac{1}{2}$  INCHES AND WITHIN  $\frac{1}{8}$  INCH OF EACH OTHER.

ME 6120-250-34/7-7

Figure 7-7. Axle and kingpin location and alignment.

## APPENDIX A

### REFERENCES

**A-1 Fire Protection**  
TB 5-4200-200-10 0

**A-2 Lubrication**  
C9100-IL

**A-3 Maintenance**  
TM 38-750

TM 5-6120-250-12

TM 5-6120-250-20P

TM 5-6120-250-34P

**A-4 Destruction To Prevent Enemy Use**  
TM 750-244-3

Hand Portable Fire Extinguishers Approved for  
Army Users

Identification List for Fuels, Lubricants, Oil  
and Waxes

The Army Maintenance Management System

Operator and Organizational Maintenance Manual

Organizational Maintenance Repair Parts and  
Special Tools List

Direct Support, General Support Maintenance  
Repair Parts and Special Tools List

Procedures for Destruction of Equipment to  
Prevent Enemy Use

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