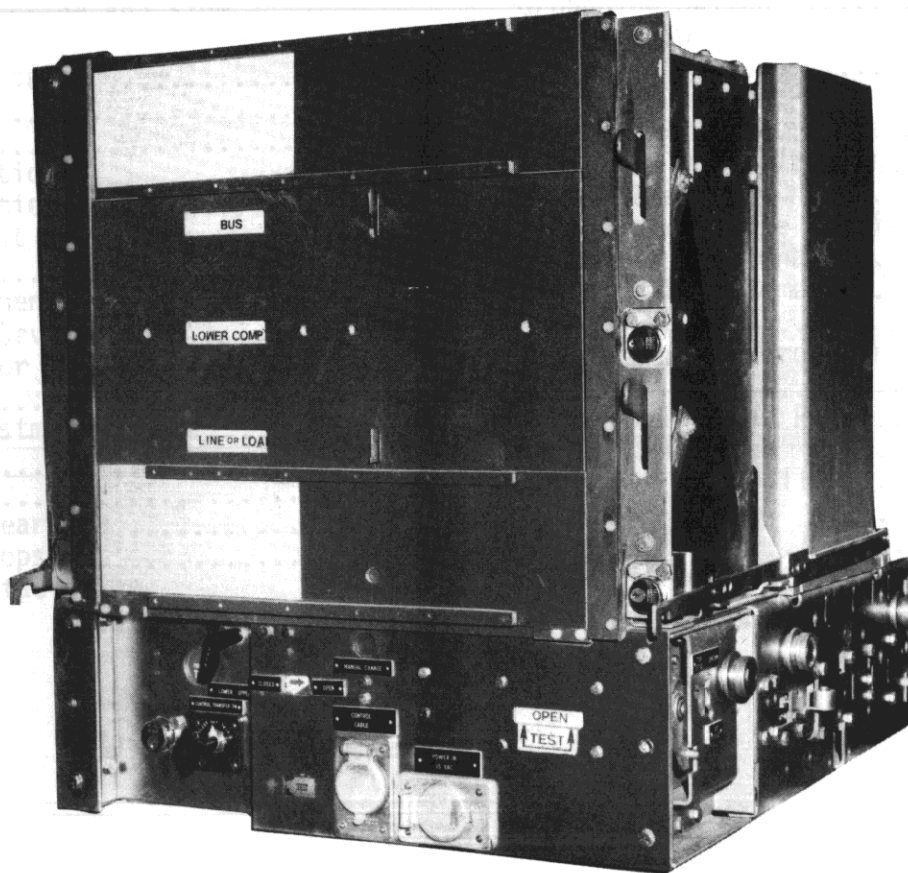




**INSTRUCTIONS AND  
RECOMMENDED PARTS FOR  
MAINTENANCE**

GEK-39684A  
Supersedes GEK-39684

POWER/VAC\* GROUND AND TEST DEVICE  
TYPE GMV-1000  
WITH ML-17 MECHANISM  
4.16KV-13.8KV-80KA MOMENTARY  
1200A-2000A-3000A



**GENERAL**  **ELECTRIC**



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POWER/VAC\* GROUND AND TEST DEVICE  
TYPE GMV-1000  
WITH ML-17 MECHANISM

INTRODUCTION

To the extent required the products described herein meet applicable ANSI, IEEE and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

\*\*This instruction manual covers all Power/Vac\* ground and test devices of the Type GMV-1000. Several minor variations of configuration are supplied under the general Type GMV-1000 to meet specific customer requirements. This instruction manual describes the most common configuration which utilizes control power supplied by the metal clad via the secondary disconnect. On some units the control power may be supplied by an external power source via a cable connected to the front panel of the device. Use the wiring diagram furnished with the device rather than the typical wiring diagram in this instruction which is given for reference only.

SAFETY

Each user has the responsibility to instruct all personnel associated with his equipment on all safety precautions which must be observed.

The following are recommendations to be considered in a user's safety program. These recommendations are not intended to supplant the user's responsibility for devising a complete safety program and shall not be considered as such. They are rather suggestions to cover the more important aspects of personal safety related to ground and test devices. General Electric neither condones nor assumes any responsibility for practices which deviate from these recommendations.

General

1. All personnel associated with installation, operation and maintenance of power circuit breakers and ground and test devices should be thoroughly instructed and supervised regarding power equipment in general, and also, the particular model of equipment with which they are working. Instruction books and service advices should be closely studied and followed.
2. Maintenance programs must be well planned and carried out consistent with both customer experience and manufacturer's recommendations, including service advices and instruction books. Good maintenance is essential to the ground and test device reliability and safety.

*These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.*

*To the extent required the products described herein meet applicable ANSI, IEEE and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.*

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\*\*Indicates revision.

3. For more detailed information on the ground and test device mechanism maintenance and service, consult instruction book GEK-39671, "POWER/VAC\* Vacuum Circuit Breaker with ML-17 Mechanism."

Local environment and ground and test device application must be considered in such programs, including such variables as ambient temperatures, extreme moisture, number of operations, and any unusual local conditions such as corrosive atmosphere or major insect problems.

#### Specific

1. DO NOT work on an energized device. If work has to be performed on the ground and test device, remove it from the metal clad.
2. DO NOT work on any part of the ground and test device with the power cord attached.
3. All spring-charged mechanisms related to a circuit breaker or a ground and test device must be serviced only by skilled and knowledgeable personnel capable of releasing each spring load in a controlled manner. Particular care must be exercised to keep personnel clear of mechanisms which are to be operated as their springs are released. Information on construction of such mechanisms is provided in this instruction book.
4. Operational tests and checks should be made on the ground and test device after maintenance, before it is returned to service, to ensure that it is capable of operating properly. The extent of such tests and checks should be consistent with the level of maintenance performed.

#### DESCRIPTION

The POWER/VAC\* ground and test device is an auxiliary device for use with POWER/VAC\* horizontal drawout metal-clad switchgear equipment, and is designed for use during both the initial installation and at normal maintenance periods. The primary function of the device is to solidly ground the equipment as well as permit various types of tests.

A single ground and test device with interchangeable primary contact fingers for 1200A/2000A, and 3000A will cover all the metal-clad equipment ratings and can be installed in the upper or lower compartment.. The ground and test device has no interrupting rating, but is designed to close and latch against short circuit currents equivalent to the maximum momentary rating of the equipment.

Various interlock arrangements are included within the device, where possible, to insure proper operation. Since this device has been designed to serve many purposes and cover many ratings, it is not practical to interlock every element. It is the responsibility of the user to properly set up the components for the particular requirements of the application.

The POWER/VAC\* ground and test device is composed of three major parts; the grounding switch, the selector switch and test receptacles, and the operating mechanism. The grounding switch, selector switch and test receptacles are composed of three similar pole units mounted on top of the unit frame that contains the operating mechanism.

The nameplate describes the control power requirements for the ground and test device. Be certain this is in agreement with the control voltage in the metal-clad equipment.

Proper installation and maintenance are necessary to insure continued satisfactory operation of the ground and test device. The following instructions will provide information for placing the device in service and for maintaining satisfactory operation.

## RECEIVING, HANDLING AND STORAGE

### RECEIVING

Each ground and test device is carefully inspected and packed for shipment. Immediately upon receipt of the device an examination should be made for any damage sustained in transit. If injury or rough handling is evident, a damage claim should be filed immediately with the transportation company, and the nearest General Electric Sales Office should be notified.

It is expected that due care will be exercised during the unpacking and installation of the device so that no damage will occur from careless or rough handling, or from exposure to moisture or dirt. Check all parts against the packing list to be sure that no parts have been overlooked.

### HANDLING

When lifting the ground and test device, use of the specially designed lift truck, \*\*Model GE-6, serial numbers 1280-725 and above, is recommended. It is necessary to use the truck when placing the ground and test device into or removing it from the metal-clad equipment. If it is necessary to lift the device with a hoist, use four 1/2 inch diameter hooks rated at least 500 pounds each. The hooks should be located only in the lower metal frame area. Use a spreader at least 12 inches wider than the device to prevent slings from contacting the insulating material parts.

A front swivel wheel and two rear wheels are provided for ease of movement on flat, level floors. When the device is unattended or when a lift truck is used, block both rear wheels in both directions to prevent any accidental movement.

### STORAGE

When the ground and test device is not in use it should be stored in a clean, dry room and the following precautions should be observed:

1. The ground and test device should be carefully protected against condensation, preferably by storing it in a warm, dry room of moderate temperature such as 40° - 100°F since water absorption has an adverse effect on the insulation parts. If it becomes necessary to store the device temporarily in outdoor metal-clad equipment, power should be available and the heaters in operation to prevent condensation.
2. The ground and test device should be stored in a clean location, free from corrosive gases or fumes; particular care should be taken to protect the equipment from moisture and cement dust, as this combination has a very corrosive effect on many parts.
3. Unplated surfaces of rollers, latches, etc. of the operating mechanism should be coated with D6B15A1 grease to prevent rusting.

If the device is stored for any length of time, it should be inspected periodically to see that rusting has not started and to insure good mechanical condition. Should the device be stored under unfavorable atmospheric conditions, it should be cleaned and dried out before being placed in service.

### INSTALLATION

#### SAFETY PRECAUTIONS

This ground and test device uses powerful springs for energy storage. Do not work on the grounding switch or mechanism unless both the closing springs and opening springs are either discharged or blocked and all electrical power is removed. These precautions are required to prevent accidental operation. Anyone working on the device should be familiar with the contents of this instruction book.



## SHIPPING POSITION

The ground and test device has been shipped in a closed position with the mechanism trip latch blocked by a bolt through the left side frame. A yellow tag identifies this bolt. Before operation or insertion into the metal-clad equipment, this bolt must be removed and the mechanism tripped open with the manual tripping button. The close spring is shipped discharged.

After removing packing material, locate and remove the trip latch blocking bolt indicated with a yellow tag on the left side frame of the mechanism. Turn the control transfer switch to TRIP and press in on the manual trip button (12, Fig. 1) to trip the mechanism open, keeping hands away from moving parts. Closing and opening springs are now in their discharged positions. Check this by first pressing the closing spring discharge roller (3, Fig. 2), then the manual trip button.

## MECHANICAL CHECKING AND SLOW CLOSING

1. Visually inspect the ground and test device for any signs of damage or loose hardware.
2. Move pin of manual charge cover on right side of mechanism to the right to uncover manual wind shaft. Manually charge the mechanism closing spring using a 5/8 inch hex socket-ratchet-type wrench for safety, and turn in the direction of the arrow as indicated on or near the end of the manual wind shaft. Several rotations with no apparent load are necessary until the winding mechanism engages the spring charging pawl. As the manual charging shaft is rotated the trip latch will reset first with a small "click". Continued rotation will fully charge the closing spring and a louder sound will be heard. Stop cranking when this occurs.
3. Insert the closing spring blocking pin (3, Fig. 4) by carefully removing it from its storage hole, rotating the interlock lever and reinserting it in the blocking hole. Press the closing spring discharge roller to partially discharge the closing spring against the blocking pin.
4. Pull the slow close pawl pin on the flywheel (1, Fig. 5) and resume ratchet wrench operation of the manual spring charging shaft. After several rotations at no apparent load, the winding mechanism will engage the slow close pawl and begin the closing operation of the mechanism.

Slowly operate the mechanism, checking for smooth operation with lack of sticking or sudden load increases. Be sure the close toggle (Fig. 6) goes over center against the frame. After the one-half flywheel rotation necessary for closing, the slow close pawl is automatically disengaged and the flywheel is held by a brake.

5. In the closed position, check and record the erosion indicator dimensions (Fig. 7). Check that the position indicator shows CLOSED. See section on GROUNDING CONTACT WIPE AND EROSION INDICATOR.
6. Check to see that the control transfer switch is in the TRIP position. Keep clear and push the manual trip push button to open the grounding contacts. Check that the position indicator shows OPEN and the operation counter advances one number.
7. Repeat (2) to put the closing spring in a latched position, then press the closing spring discharge roller to partially discharge the closing spring against the blocking pin.
8. Repeat (4), (6), (7) in sequence to slow close and trip the ground and test device several times to insure proper operation.
9. Repeat (2), then carefully remove the closing spring blocking pin from its blocking hole, rotate the interlock coupling, and reinsert the pin in its storage hole.
10. Close the grounding contacts by pressing the closing spring discharge roller, then check that the close toggle is over center onto the frame (Fig. 6). Open the grounding contacts by pressing the manual trip button. Closing and opening springs are now in their discharged positions.

#### ELECTRICAL CHECKING

Electrical checking consists of electrical ground and test operation, secondary wiring high-potential testing (if required), primary current path resistance (if required) and POWER/VAC\* ground switch high potential testing.

1. To check the electrical operation, apply the secondary coupler test plug from the test cabinet to the connection on the rear of the ground and test device. Also insert the four-prong remote cable plug into the proper receptacle on the front panel. The control transfer switch must be in the CLOSE position to close the grounding contacts and in the TRIP position to trip open. The selector switch must be in the TOP or BOTTOM position to complete the electrical circuits.
2. A secondary high potential test of 1500 RMS volts, 60 hertz to ground may be made, but, first disconnect both motor leads from the circuit to prevent possible winding insulation damage. Reconnect the motor leads after testing.
3. A resistance check of the primary circuit may be made with the grounding contacts closed. Use a low resistance measuring instrument which measures microhms. The 100 ampere reading should not exceed 100 microhms when connected from the primary bars on the device side of the disconnect fingers to the ground connection bar.

4. Before energizing the ground and test device in the POWER/VAC\* equipment, a high potential test of the POWER/VAC\* grounding switch should be made to verify the condition of the switch. See HIGH POTENTIAL TEST under MAINTENANCE for the proper procedure, precautions and appropriate voltages. Do not attempt ground switch high potential testing without first reading HIGH POTENTIAL TEST.
5. Leave the ground and test device contacts in the open position and the closing springs in the discharged condition after checks are complete and refer to metal-clad instruction book GEK-39672 before inserting the device into a metal-clad unit.

## OPERATION

### GENERAL

The POWER/VAC\* ground and test device uses sealed vacuum grounding switches to establish the ground circuit. The device has no interrupting capabilities but the mechanism will close and latch the vacuum grounding contacts against the full momentary rating of the POWER/VAC\* metal-clad equipment. Primary connections to the associated metal-clad switchgear are made by horizontal bars and disconnect fingers, electrically and mechanically connected to the vacuum grounding switches. The primary finger clusters are interchangeable 1200A/2000A or 3000A assemblies that can be installed on the three upper studs, three lower studs, or on all six studs as required by the application. Three molded insulated housings support the grounding switches, primary studs and disconnect fingers, and isolate the three primary circuits. The operating mechanism provides vertical motion at each pole location to move the lower contacts of the vacuum grounding switches from an open position to a spring-loaded closed position and then back to the open position on command of the control circuit.

Six test receptacles, three upper and three lower, are accessible from the front by opening sliding covers that will permit connecting test equipment for various types of tests. Each test receptacle stud is directly connected to a metal-clad primary disconnect stud when the device is in the connected position in the equipment.

The selector switch can be set to connect the upper or lower stud to ground through the vacuum grounding switch or to a neutral position where all six stud connections are available for phasing. With the selector switch in the neutral position all electrical power is removed from the mechanism. The selector switch can only be operated when the ground and test device is removed from the metal-clad switchgear.

The ML-17 mechanism is of the stored-energy type and uses a gear motor to charge a closing spring. During a closing operation, the energy stored in the closing spring is used to close the vacuum grounding contacts, charge the wipe springs which load the contacts, charge the opening springs, and overcome bearing and other friction forces. The energy then stored in the wipe and opening springs will open the contacts during an opening operation.

Closing and opening is controlled electrically by the remote control cable that is plugged into the connector on the front panel of the ground and test device and the control transfer switch that sets up the electrical circuits for proper operation.

Mechanical tripping can be accomplished by pressing the manual trip button when the control transfer switch is in the trip position.

Mechanical closing can be done only when the device is withdrawn from the metal-clad unit by manually charging the close springs then pressing the closing spring discharge roller (3, Fig. 2) on the right side of the mechanism frame.

Mechanical and electrical interlocks are provided for safe operation and are described in this section under INTERLOCKS.

#### CLOSING OPERATION

Electrical closing operations on the ground and test device require that the control transfer switch be positioned on CLOSE. This sets up the electrical circuits and mechanical interlocks for the remote cable operator to initiate a closing operation. The closing springs are always in a discharged position until the closing operation is called for.

Fig. 8 (rear view) shows the mechanism expanded schematically in an open, closing spring-charged condition. When the closing spring is discharged, the AA flywheel eccentric would be about 180 degrees from where it is shown with respect to center pivot CC. The transfer crank BB would be rotated counterclockwise, the slotted link (17) will be holding the close toggle (20, 21) against the frame through link (19), and the trip latch (18) will be held out of latch clockwise by the trip toggle roller. The position of the trip linkage will be as shown in Fig. 6d.

Refer to wiring diagram Fig. 9. When the remote cable operator completes the closing circuit the 57Y control relay will complete the motor circuit and the wind hub (11, Fig. 8) will rotate until it engages wind pawl (9). The flywheel will then rotate counterclockwise compressing the closing spring assembly (6), and rotating the transfer crank (BB) shaft clockwise by pushing on rod (13). As the line of action of the closing spring shifts over center on the flywheel and attempts to discharge, the close roller (3) is blocked by the close latch (4) and held momentarily. As the close roller approaches the close latch the gear motor limit switch (43) will be opened by the cam surface of the flywheel (2) on the limit switch operator (44) roller.

At the same time the 57 CHG switch will be closed and the closing solenoid will be energized and close latch (4) will be moved from its blocking position. Without the restraints of the close latch the over-center closing springs will rotate the flywheel assembly counterclockwise. This action, transmitted to the slotted link (17) by means of the pull rod (13), transfer crank system (14, 15, 16), pulls the close toggle (20, 21) through the center against link (19) which is tied to the frame. This action rotates the output crank (22) counterclockwise. The Pole 1 bell crank (23) on the same shaft as the output crank, also rotates counterclockwise, and by means of the horizontal connecting bar (28) rotates Pole 2 and 3 bell cranks. This rotation compresses the opening spring (29), closes the ground switch connected with each operating rod (25), and compresses the wipe spring (26) on each pole when the trunnion (24) continues moving after the operating rod (25) stops. Rotation of an arm (34) on the output shaft changes the auxiliary switch (37) position, and the position flag (38) indicates "CLOSED".

During the closing operation two pairs of auxiliary switch contacts, 1 and 3, open to de-energize the closing circuit and seal-in circuit. The closing springs remain in the uncharged position.

#### OPENING OPERATION

To trip open the grounding contacts of the ground and test device it is necessary to have the control transfer switch in the TRIP position. This sets up the electrical circuits and mechanical interlocks so that the remote cable operator can initiate an electrical opening operation or a manual opening operation can be made by pressing the manual trip button.

By either energizing the trip solenoid or depressing the manual trip button, the trip latch (18, Fig. 8) is rotated clockwise permitting the trip toggle (19, 20) to collapse and the vacuum grounding switch contacts to open under the force of the wipe springs (26) and opening spring (29). At the end of the opening stroke, a stop block ring (30) on the bottom of the trunnion (24) strikes set screws in the horizontal connecting bar (28) which limits the over-travel. At the same time an opening stop (50) is provided by a plate and buffer assembly. An opening dashpot (31) controls opening velocity and prevents excessive rebound of the interrupter contacts due to unabsorbed energy. Rotation of the output shaft from a closed to an open position operates the auxiliary switch (37) as described under CLOSING OPERATION and interrupts the trip coil circuit.

Since the vacuum grounding switches have no interrupting capacity the mechanism is mechanically and electrically non-trip-free during the closing operation.

#### CONTROL CIRCUIT

The POWER/VAC\* vacuum ground and test device uses the basic ML-17 operating mechanism from the POWER/VAC\* breaker to operate the grounding switch. The control circuits for electrical operation of the mechanism have been considerably modified to have the necessary interlocking and control performance.

Refer to Fig. 9. With the control transfer switch in the CLOSE position a closing operation is initiated by the close button on the remote cable operator. If the selector switch is in either the TOP or BOTTOM position the 57SSI selector switch interlock will be closed and the 57Y relay will be energized and two contacts will close, one to complete the motor circuit, the other to seal in the relay circuit to assure completing the closing cycle. At the end of the spring-charging cycle the motor switch 57 SM/LS will open and remove the motor power. At the same time the 57 CHG switch will close and complete the 57X closing solenoid circuit. The closing solenoid will remove the spring blocking latch and the closing spring will discharge. The closing spring energy will close the grounding contacts through the mechanism linkage. While the breaker is closing the 57 auxiliary switch, contacts 1 and 3 will open in the closing circuit, contacts 2 and 4 will close in the trip circuit and the circuits are in order for a tripping operation. The closing springs will remain discharged. Before the grounding contacts can be opened the 43 control transfer switch must be moved to the TRIP position. To complete the trip circuit the remote cable operator trip button must be pushed. This will energize the trip solenoid 57TC that will remove the trip latch holding the grounding contacts in a closed position and allow the contacts to be opened by the opening and wipe springs. During the opening operation the 57 auxiliary switch contacts 2 and 4 will open the trip solenoid circuit and contacts 1 and 3 in the closing circuit will close, setting up the circuits for the next closing operation.

## INTERLOCKS

\*\*Each Power/Vac\* ground and test device is furnished with a number of interlocks, some that work automatically and others that must be set.

DO NOT REMOVE OR ATTEMPT TO DEFEAT ANY OF THE INTERLOCKS.

The interlocks are so arranged to prevent, as much as possible, errors of setup or operation. They are for the protection of the operating personnel and a thorough understanding of their functions and performance will simplify the setup and operation of the ground and test device.

1. The function of the closing spring discharge interlock is to prevent racking into the metal clad a breaker that has the closing spring charged. This is accomplished by the manual closing roller on the right-hand side of the mechanism, Fig. 2, which contacts the racking mechanism and discharges the closing spring unless the ground and test device is in the DISCONNECT/TEST position or the CONNECT position in the metal clad. This interlock also opens the 57 CL/MS switch in the motor charging circuit and removes the spring blocking latch to prevent charging the closing springs when the device is between the DISCONNECT/TEST or CONNECT position in the metal clad.
2. The function of the negative trip interlock (4, Fig. 3) is to remove the trip latch from the trip latch roller thereby preventing a closing operation. The negative interlock is in operation while the device is moving between the DISCONNECT/TEST and the CONNECT position.

3. The positive interlock, (3, Fig. 3), operates to prevent the racking of a ground and test device that is closed. A linkage connected to the horizontal connecting bar extends a detent bar out from the side of the mechanism frame when the grounding contacts are in the closed position. If the device is in the CONNECT or DISCONNECT/TEST position in the metal clad the detent bar locks into the racking mechanism to prevent access to the hex section of the jack screw.
4. The closing spring gag interlock (1, Fig. 3) is provided on the ground and test device to prevent a device that has a gagged closing spring from entering the metal-clad unit. This is accomplished by projecting a lever out of the left side of the mechanism when the closing spring is gagged.
5. The control transfer switch (10, Fig. 1) will set up the electrical circuits for the close and trip operations allowing the remote cable operator to complete the circuits. In the CLOSE position the trip circuits are open and the trip shaft is mechanically blocked so that only a closing operation is possible. In the TRIP position the closing circuits are open and the trip shaft block is removed allowing the grounding contacts to be electrically or mechanically tripped open.
6. The selector switch will determine whether the top or bottom primary studs of the ground and test device will be grounded when the grounding contacts are closed. The switch handle (5, Fig. 2) can only be inserted into the right side of the device when it is removed from the metal-clad unit and must be removed before the device enters the metal clad. The switch handle must be rotated fully to one of three positions (TOP, OPEN, BOTTOM) before the handle can be removed.

When the switch is in position to ground the bottom studs, interfering blocks will not allow the disconnect bars to be bolted to the top primary studs. At the same time the top receptacle shutter will be mechanically locked in place and only the bottom receptacle shutter can be opened. When the disconnect bars are in place on the bottom studs the switch will be interlocked so that it cannot be put into the position for grounding the top stud. When it is required to have all six primary disconnect bars in place for phasing, the selector switch must be in the OPEN or neutral position. When the six bars are bolted in place the selector switch cannot be moved from the OPEN position. With the selector switch in the OPEN position an interlock switch 57SSI in the closing circuit will be open removing all electrical power from the closing circuits and both sliding shutters for the receptacles can be opened.

7. The grounding contacts of the ground and test device can be locked in a closed position by the key interlock on the control transfer switch. When the key is removed from the lock, electrical power is removed from the tripping circuits and the trip shaft is mechanically blocked locking the grounding contacts in a closed position. The device cannot be moved from the connected position or the disconnected position with the grounding contacts closed.

8. The top and bottom receptacle shutters are alternately locked closed by the action of the selector switch. When the switch is positioned to ground the top stud the bottom receptacle shutter will be mechanically locked closed. When the selector switch position is moved to ground the bottom stud the top receptacle shutter will be mechanically locked closed. In addition, each receptacle shutter is provided with a key interlock that can lock the cover closed.
9. When the compartment position switch is set in the UPPER position, interlocks will set up an interference so that the device cannot be inserted into the lower compartment. Likewise with the compartment selector switch set to the LOWER position the device cannot enter the upper compartment.

#### OPERATING SEQUENCE

**\*\*Before inserting the ground and test device into the metal-clad unit it must be properly set up for the particular application. The following sequence should be followed and checked before applying the device. An identical list for Setting Up is located on the upper receptacle shutter, and for Operation on the lower receptacle shutter. Because of the many interlocking features on the ground and test each step of the setting up and operation must be followed in the proper order to assure successful operation of the device.**

#### Setting Up Device

1. Set compartment position lever to proper position, UPPER compartment or LOWER compartment. Indicators should read BUS and LOAD OR LINE in proper location. Mechanical interference will be set up so that the interference plate in the metal clad will assure the device can only be put into the indicated compartment location, UPPER or LOWER.
2. Insert handle and move selector switch to TOP, OPEN or BOTTOM position depending on which stud is to be tested or grounded.
  - a) Both receptacle shutters must be in the closed position before the selector switch handle can be inserted.
  - b) All primary disconnects should be removed before moving selector switch.
  - c) The handle is keyed so that it can be inserted in only one position and must be rotated fully to the other positions before it can be removed.
  - d) When the switch is in the TOP position the lower receptacle shutter will be mechanically locked and an interference will not allow the bottom primary disconnects to be bolted in place.
  - e) When the switch is in the BOTTOM position the upper receptacle shutter will be mechanically locked and an interference will not allow the upper primary disconnects to be bolted in place.



- f) When the switch is in the open position, the upper and lower receptacle shutters are both free and primary disconnects can be assembled on all studs.
- g) The selector switch handle must be removed before the device can be inserted into the metal clad.

- \*\*3. For grounding, select three primary disconnects of the proper rating (1200A/2000A or 3000A) and bolt onto the primary stud location previously set up by the selector switch. The opposite stud location will be interlocked and will not accept the primary disconnects.

DO NOT MOVE THE SELECTOR SWITCH AFTER THE PRIMARY DISCONNECTS ARE BOLTED TO THE STUDS.

For phasing, or other applications where six primary disconnects are required, the selector switch must be in the OPEN position. When the six primary disconnects are assembled the selector switch will be locked in the OPEN position and electrical or mechanical operation of the closing switch is not possible.

- 4. The control transfer switch must be in the TRIP position before the device can be inserted into the metal clad unit.
- \*\*5. An electrically operated remote racking operator is available for moving the ground and test from the disconnect to the connect position. The operator adds another degree of safety to the operation of the ground and test by allowing racking from a remote position of 30 feet.

#### Operation for Testing or Grounding

After proper setup and insertion into the metal clad, the following operations can be performed.

1. Return control transfer switch to OFF.
2. Open appropriate receptacle shutter and insert suitable test plugs to insure that compartment is de-energized.
3. Remove test plugs and close shutter. Shutter can be key locked if required.
4. Turn control transfer switch to CLOSE.
5. Insert remote control cable into receptacle on front panel of ground and test device.
6. Move a safe distance away and close grounding switch.
7. Return transfer switch to OFF.
8. The grounding contacts can be key locked closed, if required, by the mechanism keylock. This lock will also lock the device in the connected position in the metal clad unit.
9. To open grounding contacts, move the control transfer switch to TRIP.
10. Insert remote control cable into receptacle on front panel of ground and test device and open grounding contacts or operate PUSH TO TRIP button manually.
11. For phasing, the selector switch must be set to OPEN and both receptacle shutters will then be free and can be opened. Phasing can then be done with the proper test plugs.

## MECHANICAL ADJUSTMENTS

## GENERAL

The initial mechanism adjustments should be set up with the grounding switches disconnected. After this has been completed the settings should be rechecked with the ground switches connected.

The mechanical adjustment to the mechanism and ground switches must be made in the sequence given below. If any readjustment is required, the sequence of adjustments must be repeated from the beginning.

## PULL ROD

Refer to Fig. 8. The pull rod (13) is a turnbuckle, with a right-hand thread at the crank and a left-hand thread at the flywheel connection. Gag the closing spring and slow close the mechanism as described in MECHANICAL CHECKING AND SLOW CLOSING. As the flywheel and pull rod turn, the slotted links will pull the closing toggle pin over center so that the rollers on the end of the pin are resting on the mechanism frame. In this position, the slotted link should be free to move slightly from side to side.

CAUTION: If the rollers are not against the frame, the toggle links must be tapped firmly downward so that they rest against the frame. Loosen the two bolts holding the brake to the pull rod, then loosen the nuts on each end of the pull rod and adjust the rod length until the slotted link bottoms against the toggle pin. Increase the rod length by backing off about 1/4 turn so that the slotted links can move slightly from side to side.

In this position the slotted links (17) should have slight clearance to the pin in the close toggle (20, 21) (capable of being moved axially along the pin by finger pressure). Tighten the pull rod lock nuts and brake bolts to 20-25 foot-pounds of torque.

If there is no clearance between close toggle and pin the pin may be bent by continued slow closing. The pin must be replaced if this occurs.

## TRIP LATCH CLEARANCE

Refer to Fig. 6a, with the close spring still gagged, wind manual charging shaft until flywheel roller is against closing prop. Stop manual charging at once, determine the trip latch clearance by depressing the trip roller (8) against the latch face from its spring-reset position. If no apparent motion exists, depress the manual trip push button slowly and see if the trip roller rotates.

The acceptable range of initial latch clearance is 0.005 to 0.020 inch. The trip roller must not rotate when the latch is moved by the manual push button. The clearance may be estimated by pressing the roller down against the latch.

To adjust the latch clearance, loosen the locking nut (3/4 hex) under the mechanism adjacent to the horizontal connecting bar (28, Fig. 8) and then unscrew the opening stop bolt (3/4 hex) to decrease latch clearance while pushing the manual trip push button in and out until the trip roller just starts to turn. Now, screw in on the stop bolt until the roller no longer turns plus an additional 1/4 turn. Torque the lock nut to 55 foot-pounds while holding the stop bolt. This sets latch clearance at a minimum and any mechanism wear will tend to increase the clearance. When 0.060 inch is reached readjustment will be required.

#### OVERTRAVEL STOPS

With the grounding contacts in the open position refer to Fig. 10. The horizontal connecting bar has stop bolts (8) threaded into the bar to provide a stop for each pole to prevent over stroking the POWER/VAC\* grounding switches. Turn each of the six stop bolts (8) in toward the wipe spring assembly stop ring (14) until the bolt touches the stop ring. Back off 1/4 turn and tighten locking nut (11) to 20-25 foot-pounds.

#### GROUNDING CONTACT WIPE ADJUSTMENT

Contact wipe is the additional compression of a preloaded spring, used to apply force to the vacuum grounding switch contacts and to provide opening kick-off force.

An indicator is provided on the wipe spring assembly with graduations given in fractions of an inch on which the wipe is indicated directly. See Fig. 7. However, to improve the accuracy of wipe measurements and settings it is recommended that the contact wipe gage tool which is furnished with the POWER/VAC\* metal clad be used.

The gage consists of an assembly which can be slid into position on the orange erosion disk as shown in Fig. 12. The vernier screw should be positioned over the top edge of the wipe indicator. With the grounding contacts open, slide the gage over the erosion disk. Turn the vernier screw until it contacts the top edge of the wipe indicator. Remove the indicator without disturbing the screw and measure the length of the screw which is protruding from the gage as accurately as possible with a micrometer or vernier caliper. Record the readings for each pole. Close the breaker and repeat the readings. The difference between the two readings is the contact wipe.

The wipe dimension should be set between 0.155 and 0.180 inch. Do not readjust unless the dimension is less than 0.125 or greater than 0.187 inch.

To adjust primary contact wipe, close the grounding switches and block the trip shaft against the frame to prevent accidental opening. Use a 1/4-20 bolt in trip latch blocking hole (2, Fig. 3).

1. Loosen but do not remove the screws (3/16 hex key) holding the operating rod interrupter clamp (3), Fig. 10.
2. Check that the clamp is loose. A light prying at the clamp half junction may be required to loosen the wedging action of the clamp.
3. Hold the hexagon projection at the bottom of the operating rod insulator (1-1/8 inch wrench) and loosen the adjacent locknut (15/16 inch wrench) (13, Fig. 10). Adjust by rotating the operating rod insulator. The thread is 5/8-11 and each 1/4 turn will give about 0.023 inch change in primary wipe. Screw the operating rod insulator toward the interrupter to increase wipe.
4. After setting the contact wipes on each phase, torque the operating rod locknut to 40-50 foot-pounds while preventing the operating rod insulator from turning. Tighten the clamp screws (3) to 10 foot-pounds. Remove the trip shaft block and trip the grounding contacts open. This procedure prevents accidental twisting of the operating rod of the grounding switches by loading the contacts with the wipe springs and forcing relative rotation to occur at the clamp interface.

After adjustment, remeasure the wipes to check the adjustment. If the wipe settings are within the required limits, there is an adequate contact closing relationship between the poles.

#### GROUNDING CONTACT GAPS AND EROSION INDICATION

Refer to Items 9 and 10, Fig. 10. Measure the distance from the lower edge of the skirt on the operating rod insulator on each pole to the adjacent frame in both the open and closed positions of the breaker. The difference in open and closed readings is the primary contact gap. The gap at the grounding contacts is nominally 0.750 inch.

The erosion indicator (12 and 15, Fig. 10) should be set when the grounding contacts are new and should not be readjusted during the life of the contacts. The indicator finger (12) is fixed to the mechanism frame and the indicator disk (15) will move with the operating rod insulator. With the grounding contacts in the closed position the indicator disk will move upward from alignment with the reference point due to contact erosion. Contact erosion will increase the contact gap which will be brought back to normal when the contact wipe is adjusted. When the erosion reaches 0.125 inch the POWER/VAC\* grounding switches should be replaced.

## CONTROL COIL PLUNGER TRAVEL

**Trip Coil:** With the grounding switches in the open position and the closing springs in the charged position, make certain that the trip linkage and trip shaft move freely over the full plunger travel.

**Close Coil:** With the closing spring discharged operate the plunger in the same manner as described above for the trip coil. Make certain that the plunger moves freely over its full stroke in the coil.

## CONTROL SWITCHES

There are two switch locations on the right-hand side of the operating mechanism and one on the selector switch mechanism. The single switch on the right-hand side (CL/MS) is toward the front of the mechanism and monitors the closing latch position. To the rear of this switch are two switches mounted together, the SM/LS switch that operates the closing control relay, and the 57 CHG switch that energizes the closing solenoid and initiates the closing operation.

The selector switch operates an interlock switch (SSI) in the motor circuit that removes motor power when the switch is in the OPEN position. Fig. 13 shows the SM/LS switches but the adjustment on the other two is similar. The switches should be adjusted in their operated positions so that there is 0.015 to 0.032 inch clearance between the operator (6) and support (7). Screws (5) can be loosened to make this adjustment.

## SUMMARY OF MECHANICAL ADJUSTMENTS

1. Pull Rod - Minimum clearance of slotted links to close toggle pin (links must be free).
2. Trip latch clearance - 0.005 - 0.020 inch. Readjust if more than 0.060.
3. Overtravel stops - 1/4 turn from touching.
4. Primary Contact Gap - nominal of 0.750 inch.
5. Primary Contact Wipe - 0.155 to 0.180 inch. Readjust when reduced to 0.125 inch.
6. Control Coil Plunger Travel - Free action.
7. Control Switches - 0.015 to 0.032 inch.

## ELECTRICAL CHECKS

### CONTROL POWER

\*\*The control power for the ground and test device is supplied by either the metal-clad secondary coupler or by an external power cord which connects to the front of the unit. Check the ground and test device nameplate to assure that it agrees with the control power source from either the external source or from the metal-clad secondary coupler.

### TIMING

A check on the timing of the device grounding contacts can sometimes reveal problems that are otherwise difficult to detect.

Timing may be checked by monitoring control circuit voltage and using no more than six volts DC and one ampere through the vacuum interrupter contact to indicate the closed or open position. Typical time ranges are as follows:

Trip coil voltage to contact part: 35-50 milliseconds

Close coil voltage to contact close: 60-90 milliseconds

## MAINTENANCE

## GENERAL

To obtain maximum reliability the ground and test device should be inspected and maintained on a regular schedule depending on such service factors as number of operations and storage conditions. Generally the limit of mechanical operations is similar to the POWER/VAC\* circuit breakers, 10,000 operations, before any replacement of parts should be necessary. This requirement is based on the device being serviced, or maintained, at least every 2,000 operations or once a year depending on service and storage conditions. Extreme conditions of dust, moisture, corrosive gases, etc. can indicate that inspection and maintenance will be required more frequently. The following instructions give the items that should be included in an inspection and general recommendations on the maintenance of ground and test devices.

BEFORE ANY MAINTENANCE WORK IS PERFORMED, MAKE CERTAIN THAT ALL CONTROL CIRCUITS ARE DE-ENERGIZED AND THAT THE BREAKER IS REMOVED FROM THE METAL-CLAD UNIT. DO NOT WORK ON THE DEVICE OR MECHANISM WHILE IN THE CLOSED POSITION WITHOUT TAKING PRECAUTIONS TO PREVENT ACCIDENTAL TRIPPING BY REPLACING THE LONG BOLT USED FOR SHIPPING TO BLOCK THE TRIP SHAFT AND SECURE THE GROUNDING CONTACTS IN THE CLOSED POSITION. DO NOT WORK ON THE BREAKER WHILE THE CLOSING SPRINGS ARE CHARGED UNLESS THEY ARE SECURED IN THAT POSITION BY THE CLOSE-SPRING-BLOCKING PIN.

## GROUNDING SWITCH

The grounding switches used in this device have contacts sealed in a vacuum chamber and will remain clean and require no maintenance at any time. Any small amounts of metallic vapors eroded from the contact surfaces during high current closings will remain in the chamber and will be deposited on metal shields thus insuring a high dielectric value of the vacuum and the walls of the glass container.

Three checks are required on each pole unit.

**Contact Erosion:** With the grounding contacts in the closed position check erosion per PRIMARY CONTACT GAP AND EROSION INDICATION. When erosion reaches 0.125 inch the ground switch should be replaced.

**Transfer Finger Wear:** Examine the ground switch moving contact rod projecting below the transfer fingers when the contacts are in the open position. Wipe off the lubrication in order to see the metal surface condition. The finger locations should present a burnished silver contact appearance without copper showing at more than one location. If copper is visible at more than one location per pole or the silver plating is torn, the ground switch should be replaced. If the contact surface is good, lubricate with D6B151A grease.

High Potential Test: The high potential test is performed to test the vacuum integrity of the ground switch. It is a go/no-go test which will confirm whether a \*\*sufficient vacuum level is present for safe operation. The voltage should be increased gradually to 36 kV rms 60 hertz, or 50 kV DC, and maintained for 60 seconds. If a DC high potential test is to be performed, the test equipment recommended by the Product Department should be used. If another DC tester is used the hipot value should be 50 kV.

When performing a high potential test, care and precautions must be taken or serious injury may result.

CAUTION: Although the procedure for hipotting a vacuum grounding switch is similar to that used for any other electrical device, there are two areas that require the exercise of extra caution.

1. During any hipotting operation the main shield inside the grounding switch can acquire an electrical charge that usually will be retained even after the hipot voltage is removed. This shield is attached to the midband ring of the insulating envelope and a grounding stick should always be used to discharge the ring as well as the other metal parts of the assembly before touching the switch, connections, or device studs. A long thin extension will be required on the grounding stick in order to reach the ring through the top of the insulating support.
2. High voltage applied across open gaps in a vacuum can produce x-radiation that may constitute a health hazard on prolonged exposure at close range unless the source is adequately shielded. The patented internal shield of the GE vacuum switch contributes to x-radiation control by providing a measure of radiation shielding.

When the contacts are open in normal service on a maximum rated 15 kV system, the x-radiation at one meter is well below the level of concern, and the metal-clad equipment enclosure provides additional shielding.

CAUTION: AS WITH ANY OPEN CONTACTS IN A VACUUM, HAZARDOUS X-RADIATION CAN BE PRODUCED IF THE VOLTAGE ACROSS THE CONTACTS EXCEEDS A CERTAIN LEVEL, WITH A CERTAIN CONTACT GAP: THEREFORE, DO NOT CONDUCT HIPOT TESTS ON THE VACUUM SWITCH AT VOLTAGES HIGHER THAN THE RECOMMENDED LEVEL OF 36 KV (RMS) 60 HERTZ OR 50 KV DC DURING THE HIPOT TEST, PERSONNEL SHOULD STAND AWAY FROM THE SWITCH AT LEAST TWO METERS (SIX FEET, SIX INCHES).

#### SELECTOR SWITCH

Occasional inspection and lubrication of the selector switch contact surfaces will be necessary. To gain access to the selector switch compartment the top and front insulation covers must be removed. This can be accomplished by removing the top cover first, then the front cover.



The selector switch handle should move the contact blades into full engagement and lock over-center at each extreme of travel and the detent in the center location should position the blades so that the primary finger bar interlocks (1, Fig. 11) work freely. Add D50H47 lubrication to the upper and lower contact blocks before securing the top and front covers in place.

### MECHANISM

Check all items on the check list under SUMMARY OF MECHANICAL ADJUSTMENTS readjusting or tightening as required. Lubricate as recommended under LUBRICATION.

### PRIMARY INSULATION PARTS

Using dry non-linting cloth or industrial-type wipers, clean accessible insulation surfaces on the grounding switch supports, operating rod insulators, and front receptacle box. In service locations where contamination is heavy or external flash-overs have occurred during switch high-potential testing, remove the switch and upper primary assemblies per the procedure in REPAIR AND REPLACEMENT and clean the inside surface of the interrupter supports and the outer insulation surface of the POWER/VAC\* grounding switch. Be sure to discharge the switch midband ring before removing the switch. Removal and reassembly of the switches will normally not require readjustment due to the design of the switch operating rod insulator connection.

### LUBRICATION

Proper lubrication is important for maintaining reliable ground and test device performance. The ML-17 mechanism uses bearings having a synthetic lining in some locations. These bearings do not require lubrication to maintain low friction, but lubrication does not harm them and oiling lightly is recommended. Sleeve bearings are used in some linkage locations and needle or roller bearings are used for low friction on the flywheel, trip shaft, and close shaft.

Bearings are lubricated during factory assembly with grease and oil, but all lubricants have a tendency to deteriorate by oxidation or contamination with age. Providing a fresh lubricant supply at periodic intervals is essential to proper device operation, especially where frequent operation may have forced lubricant out of the bearing surfaces. On all sleeve, needle, and roller bearings, apply a few drops of light machine oil such as Mobil #1 at each bearing. Apply a few drops on the closing spring guide rod where it enters its sleeve inside the spring.

Electrical primary contact surfaces also require periodic lubrication to inhibit oxidation and minimize friction. At each inspection and maintenance interval, do the following:

1. Metal contact surfaces such as the movable contact rod of the interrupter should be lubricated with D6B15A1. This grease is available commercially as Mobil 28.
2. Silvered primary contact surfaces: Wipe clean and apply a light coat of D50H47 on primary disconnect fingers. General Electric lubricant D50H47 is available packaged in four-ounce collapsible tubes.

#### METHOD OF CLEANING BEARINGS

##### SLEEVE BEARINGS

The non-metallic sleeve bearings used utilize Teflon surfaces and do not require disassembly unless worn. If worn they should be pressed out and replaced. After a number of operations the surface will acquire a thin black film. Do not remove this film unless the surface of the bearing has been damaged.

Bronze sleeve bearings are not pressed into location so may move from side to side.

##### ROLLER AND NEEDLE BEARINGS.

The trip latch roller bearing and close latch roller bearing are pressed into the frame or parts. In order to check the bearings and relubricate them, the shafts must first be removed and the inner race disassembled. Clean the parts with petroleum solvent and a stiff brush. Apply a light coating of machine oil until the cleaner or solvent is entirely removed. Allow this oil to drain off and then repack the bearing with GE lubricant D6B15A1 being sure all metal parts are greased.

Flywheel and output crank bearings should not be removed from frame for lubrication purposes. A major disassembly is required. A few drops of Mobil #1 oil should be applied when required.

When cleaning the bearings DO NOT USE CARBON TETRACHLORIDE. If the grease in the bearings has become badly oxidized, it may be necessary to use alcohol (type used for thinning shellac) to remove it. Precautions against the toxic effects of the alcohol must be exercised by wearing rubber gloves and by using alcohol in a well-ventilated room. Excessive exposure to the fumes is sometimes unpleasant to personnel. Bearings cleaned with alcohol should be washed with a light machine oil immediately after using the alcohol. After the machine oil has drained off the bearing apply GE lubricant D6B15A1.

## RECOMMENDED MAINTENANCE

A ground and test device that is used nominally throughout the year and is stored in a dry clean room should be serviced and maintained at each 2,000 mechanism operation or every year, whichever comes first.

1. Make a visual inspection of the device and remove dust and contaminants from the grounding switches and insulation.
2. A high potential test should be applied to the vacuum switches as outlined under MAINTENANCE - GROUNDING SWITCHES.
3. Check the grounding switch erosion indicator as described.
4. Check the grounding switch and mechanism adjustments as summarized under MECHANICAL ADJUSTMENTS. The necessary readjustments should be made as described under MECHANICAL ADJUSTMENTS.
5. The grounding switches and operating mechanism should be carefully inspected for loose nuts, bolts, damaged parts, etc. All cam, latch and roller surfaces should be inspected for damage or excessive wear.
6. Lubricate the breaker operating mechanism in accordance with instructions under LUBRICATION.
7. Inspect all wiring for tightness of connections and possible damage to insulation.
8. After the ground and test device has been serviced, it should be slowly closed and opened as described in INSTALLATION, to be sure there is no binding or friction and that the movable contact of the grounding switch can move to the fully opened and fully closed positions. Its electrical operation should then be checked using the remote cable operator.

When service operations on the ground and test device have reached 10,000 operations or at five year intervals, the following maintenance should be performed.

1. At this time the device should be given a general overhaul and all excessively worn parts in both the mechanism and on the grounding switches replaced. Such wear will usually be indicated when the device cannot be adjusted to instruction book tolerances. This overhaul and inspection is more detailed and will require disassembly of mechanism and grounding switch operating parts.

2. All roller and needle bearings in the operating mechanism should be disassembled, cleaned, and repacked with GE lubricant D6B15A1 as described under LUBRICATION.
3. The grounding switches and operating mechanism should also be serviced as described for 2,000 operation intervals and properly adjusted before being put back into service.

## REPAIR AND REPLACEMENT

### GENERAL

The following information covers in detail the proper method of removing various parts of the ground and test device in order to make any necessary repairs. This section includes only those repairs that can be made at the installation on parts of the device that are most subject to damage or wear.

**IMPORTANT:** UPON COMPLETION OF ANY KIND OF REPAIR WORK, ALL GROUNDING SWITCH AND MECHANISM ADJUSTMENTS MUST BE CHECKED.

Refer to the sections on MECHANICAL AND ELECTRICAL ADJUSTMENTS.

### REPLACEMENT OF GROUNDING SWITCH

To replace a grounding switch the front and top insulation covers (8, 9, Fig. 2) must be removed and the operating rod to grounding switch clamp (2, Fig. 10) must be disconnected.

To remove the switch from the insulated support the connection braids (1, Fig. 14) to the bottom stud must be removed, then remove the top four bolts (1, 5, Fig. 15) and lift the channel assembly straight up. The channel, top copper bar and switch will be removed as a group. To remove the grounding switch from the stud assembly loosen bolts (3, Fig. 15) in the center of the stud and pry the connection loose by inserting a large screwdriver into the slot of the bar and twisting gently.

The lower guide and bearing support (3, Fig. 16) can be removed from the switch by removing the three nuts (5). Reassemble the guide on the new switch positioning it in the same manner with respect to the pinch-off tube as the original assembly.

When installing the new grounding switch into the stud assembly be certain the shoulder on the switch rod is seated tightly against the bottom of the channel, then tighten the two holding bolts. The grounding switch assembly can now be reinstalled into the insulated support and the four holding bolts replaced. The primary stud dimension from the center of the adjacent pole stud at the rear where the primary disconnect finger stud connects and at the front selector switch contact should be  $10.00 \pm 0.030$  inches.

After alignment, tighten the four mounting bolts to 25 inch-pounds of torque. Operate the selector switch to assure proper contact of the blades and the contact blocks. Do not forget to reconnect the braid assemblies to the lower stud.

When the assembly is complete reconnect the operating clamp after slow closing the mechanism as described in MECHANICAL CHECKING and adjust contact wipe per PRIMARY CONTACT WIPE ADJUSTMENT.

## MECHANISM

For most mechanism adjustments, lubrication and electrical checks, access through the top or bottom of the mechanism frame is sufficient. To replace some specific parts, however, it will be necessary to disassemble some items to gain working room. To replace some of the electrical control components located at the front of the mechanism frame or parts of the switch closing linkage it will be necessary to remove one or more ground switch support.

Remove the front and top insulation covers (8, 9, Fig. 2) and the operating rod to grounding switch clamp (2, Fig. 10). Remove the pins (5, Fig. 17) to disconnect the interlock arms. Remove four mounting bolts and lift the grounding switch assembly up and to the rear. DO NOT REMOVE ALL THREE GROUNDING SWITCH POLE ASSEMBLIES FROM THE FRAME AT THE SAME TIME. AT LEAST ONE POLE MUST REMAIN FOR DIMENSIONAL REFERENCE FOR REALIGNMENT OF PRIMARY STUDS.

When reassembling the grounding switch pole unit the rear ends of the primary studs and the front contacts for the selector switch must be aligned to the adjacent pole on  $10.00 \pm 0.030$  inch centers. After tightening the mounting bolts operate the selector switch to assure proper contact. Do not forget to reconnect the interlock arms to the selector switch mechanism.

## WIND SHAFT SHEAR PIN AND MOTOR

A flywheel wind shaft shear pin is provided to minimize the chance of gear motor damage if a jammed flywheel should occur. After locating and correcting the jamming condition, the gear motor can be removed from the frame by removing the four mounting bolts securing the mounting bracket. Remove all pieces of the old pin, align the spline coupling and shaft holes, install a new pin, and remount the gear motor.

## CONTROL SWITCHES

Control switches may be removed from their mounting brackets by disconnecting the wires and removing the two mounting screws. Use a small screwdriver to remove and replace the switch on the bracket checking that the correct type, normally open or normally closed, is used. Reinstall wire and adjust per MECHANICAL ADJUSTMENTS - CONTROL SWITCHES.

## TRIP OR CLOSE COILS

To replace trip or close coils, cut wires close to the coil, loosen the coil bracket bolt closest to the plunger and remove the other bracket bolt. Pivot the bracket and remove the coil. Drive out the pole piece and install in the new coil. Slide the new coil over the plunger and into the bracket on the plunger end. Pivot the other bracket into position, locate so the plunger does not bind and torque the bolts to 20-25 foot-pounds. Butt connect the wiring, check adjustment and electrical and mechanical operation.

## SELECTOR SWITCH

The selector switch contact blades (3, Fig. 17) can be replaced by removing the entire switch assembly. Remove the front insulation cover (8, Fig. 2) and two of the slide brackets (8, Fig. 17) for the receptacle indicator and push the indicator to one side. Remove the two mounting bolts (4, Fig. 17) for the blades to be replaced. Remove the four channel mounting bolts and pull the entire assembly forward. Remove the X retaining washer (9) at one end of the operating rod shaft and partially remove rod until the contact blades are free.

When the new parts have been assembled replace the channel support and locate to give good alignment on the contacts of the other two contact blades. The new blade assembly can then be adjusted individually by loosening the hinge block bolts (4, Fig. 17) and adjusting to give proper contact on the upper and lower contact blocks. Reassemble the receptacle indicator brackets and move the compartment position lever at the rear of the frame to assure proper operation. Replace front insulation cover and check alignment of the BUS and LINE or LOAD indicators.

## RENEWAL PARTS

It is recommended that sufficient renewal parts be carried in stock to enable the prompt replacement of any worn, broken, or damaged parts. A stock of such parts minimizes service interruptions caused by breakdowns, and saves time and expense. When continuous operation is a primary consideration, more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

Renewal parts which are furnished may not be identical to the original parts, since improvements are made from time to time. The parts which are furnished, however, will be interchangeable.

## ORDERING INSTRUCTIONS

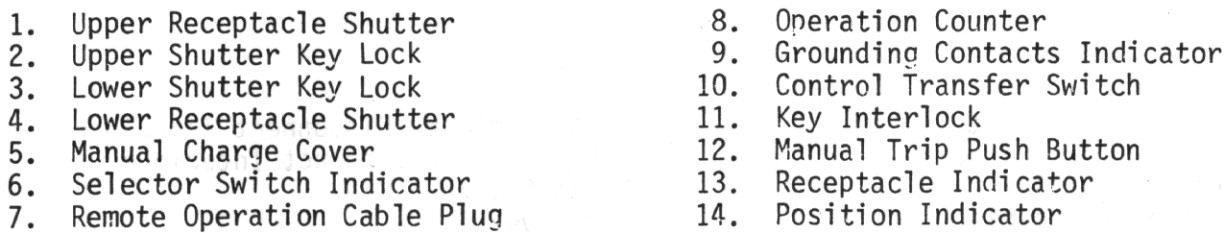
1. Always specify the complete nameplate data of both the device and the mechanism.
2. Specify the quantity, catalog number (if listed), reference number (if listed), and description of each part ordered, and this bulletin number.
3. Standard hardware, such as screws, bolts, nuts, washers, etc. is not listed in this bulletin. Such items should be purchased locally.
4. For prices or information on parts not listed in the renewal parts list, refer to the nearest office of the General Electric Company.

## RECOMMENDED RENEWAL PARTS

DESCRIPTION	NO. REQ.	CATALOG NO.
Grounding Switches	3	0282A2751G057
Primary Disconnect Finger Assemblies	1200A/2000A 3000A 6 6	0282A2834G001 0282A2537G001
Operating Rod Insulators	3	0209B3401G001
Spring Charging Motor	48 VDC 125 VDC & 115 VAC 60 Hz 250 VDC & 230 VAC 60 Hz 1 1 1	0282A2034P003 0282A2034P001 0282A2034P002
Relay	48 VDC 125 VDC 250 VDC 115 VAC 60 Hz 230 VAC 60 Hz 1 1 1 1 1	0282A2008P001 0282A2008P002 0282A2008G001 0282A2008P003 0282A2008P004
Potential Trip Coil	48 VDC 125 VDC 250 VDC 115 VAC 60 Hz 230 VAC 60 Hz 1 1 1 1 1	0282A2009P007 0282A2009P008 0282A2009P009 0282A2009P004 0282A2009P005
Closing Coil	48 VDC 125 VDC 250 VDC 115 VAC 60 Hz 230 VAC 60 Hz 1 1 1 1 1	0282A2009P001 0282A2009P002 0282A2009P003 0282A2009P004 0282A2009P005
Control Switch - Normally Open	2	0282A2097P003
Normally Closed	1	0282A2097P002
Interlock Switch - Normally Open	1	0282A2005P002
Auxiliary Switch	1	0209B3410P001
Control Transfer Switch	1	0209B3923G001

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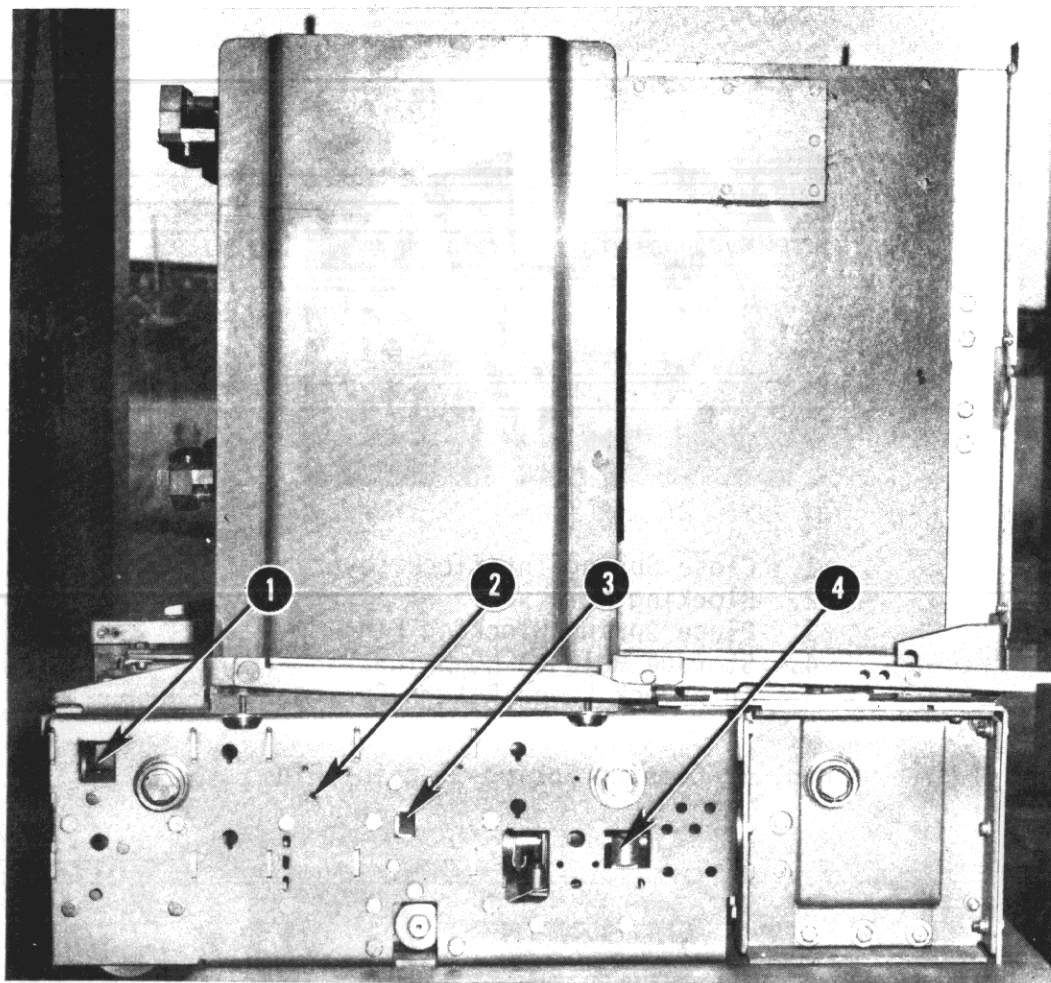


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- |                               |  |
|-------------------------------|--|
| 1. Primary Disconnect Bolt    | 6. Bottom Primary Disconnect Interlock |
| 2. Primary Disconnect Fingers | 7. Top Primary Disconnect Interlock    |
| 3. Manual Closing Roller      | 8. Front Cover                         |
| 4. Selector Switch Interlock  | 9. Top Cover                           |
| 5. Selector Switch Handle     |  |

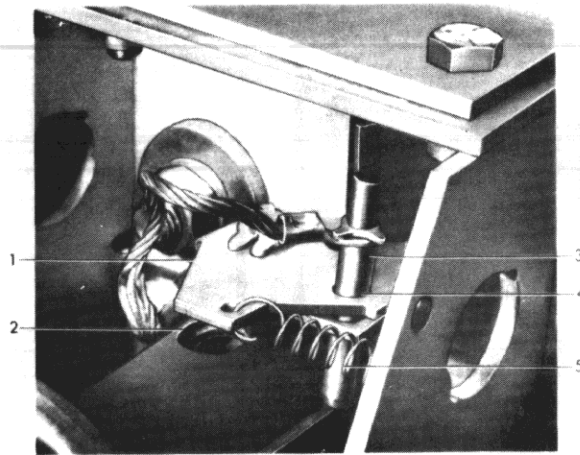
Fig. 2 Right Side View of Ground and Test Device

Fig.3 (8919093C)



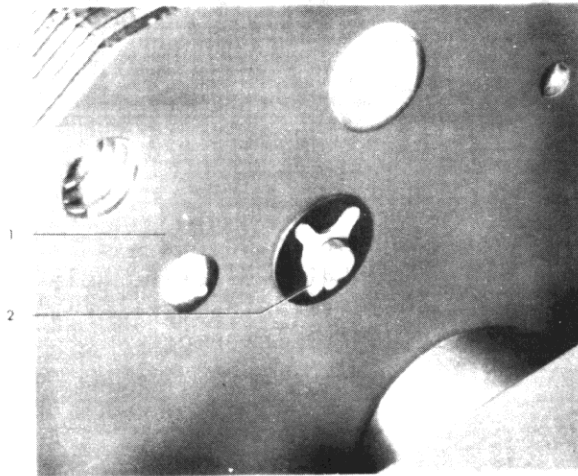
1. Gag Pin Interlock
2. Trip Latch Blocking Hole
3. Positive Interlock
4. Negative Interlock

Fig. 3 Left Side Frame of Ground and Test Device



1. Close Spring Interlock Lever
2. Blocking Hole
3. Close Spring Blocking Pin
4. Storage Hole
5. Interlock Lever Return Spring

Fig. 4 Closing Spring Blocking Pin

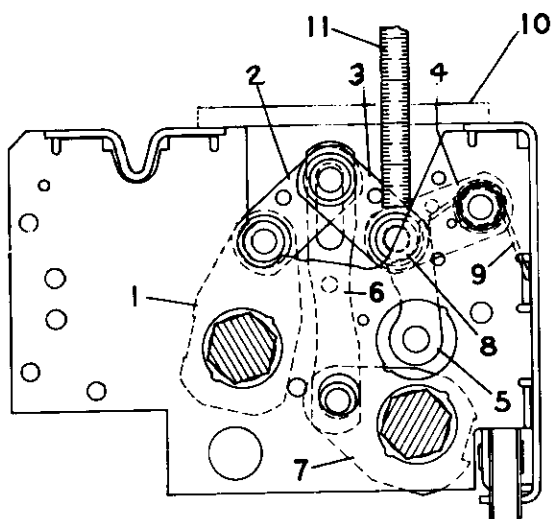


1. Flywheel
2. Slow Close Pin

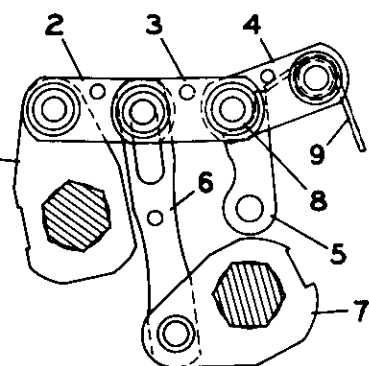
Fig. 5 Slow Close Pin on Flywheel

Fig.4 (8918438Q)

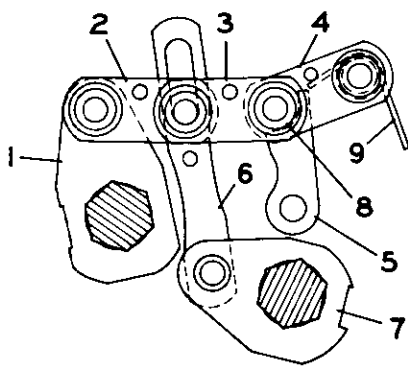
Fig.5 (8918438P)



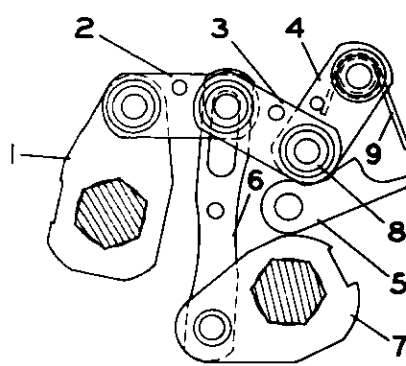
(a) Breaker Open-Close Spring Charged



(b) Breaker Closed-Close Spring Discharged



(c) Breaker Closed-Close Spring Charged



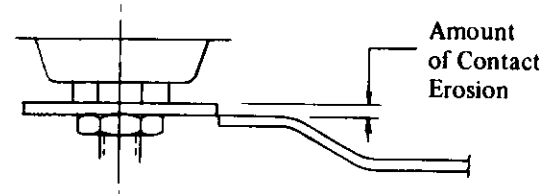
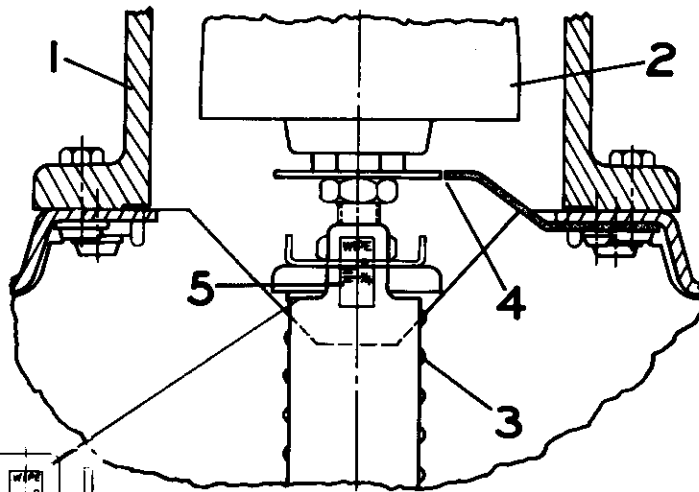
(d) Breaker Open-Close Spring Discharged

Input Crank  
 Link-Output Crank to Close Toggle  
 Link-Close Toggle to Trip Toggle  
 Link Trip Toggle to Frame  
 Trip Latch  
 Coupled Link

7. Transfer Crank  
 8. Trip Roller  
 9. Linkage Return Spring  
 10. Straight Edge  
 11. Measuring Scale for Trip Latch Clearance

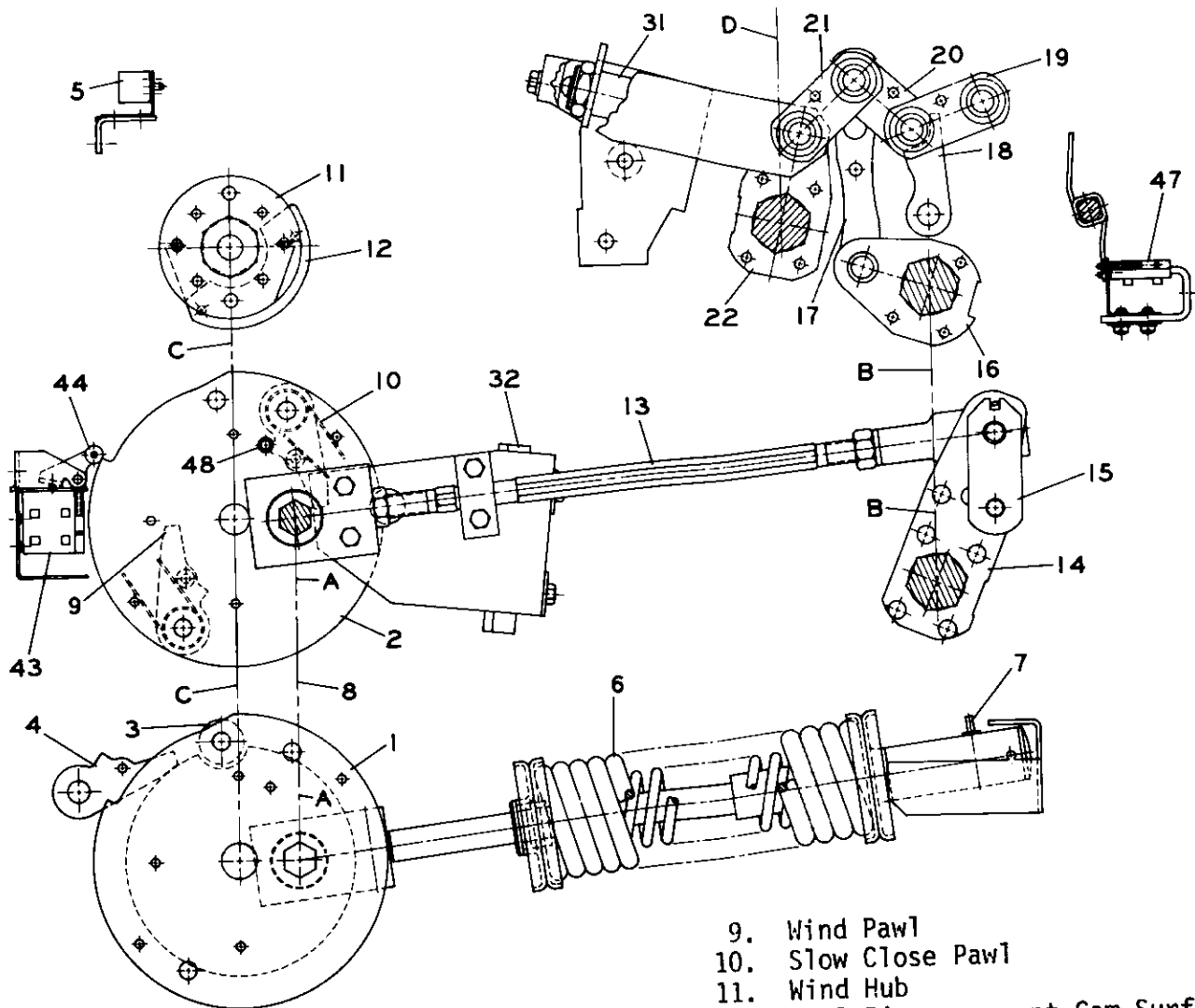
Fig. 6 Toggle Linkage Positions of ML 17 Mechanism  
 View From Rear

NOTES



1. Interrupter Support
2. Operating Rod Insulator
3. Wipe Spring
4. Erosion Indicator
5. Wipe Indicator

Fig. 7 Erosion and Wipe Indicator



AA Eccentric shaft connecting flywheel halves  
 BB Hex shaft connecting transfer cranks  
 CC Flywheel rotation axis  
 DD Hex shaft connecting output cranks

1. Rear Flywheel Section
2. Front Flywheel Section
3. Close Roller
4. Close Latch
5. Close Latch Checking Switch
6. Closing Spring Assembly
7. Gag Pin in Closing Spring Assembly
8. Hex Shaft with Connection Blocks on Flywheel

9. Wind Pawl
10. Slow Close Pawl
11. Wind Hub
12. Pawl Disengagement Cam Surface on Frame
13. Pull Rod
14. Adjustable Throw Transfer Crank
15. Adjustment Link and Indicator
16. Short Transfer Crank
17. Slotted Link
18. Trip Latch
19. Link - Trip Toggle to Frame
20. Link from Close Toggle to Trip Toggle
21. Link from Output Crank to Close Toggle
22. Output Crank
23. Pole 1 Bell Cranks
24. Wipe Spring Trunnion Block
25. Interrupter Operating Rod Connection
26. Wipe Spring

Fig. 8 Exploded Schematic - Rear View of ML-17 Mechanism



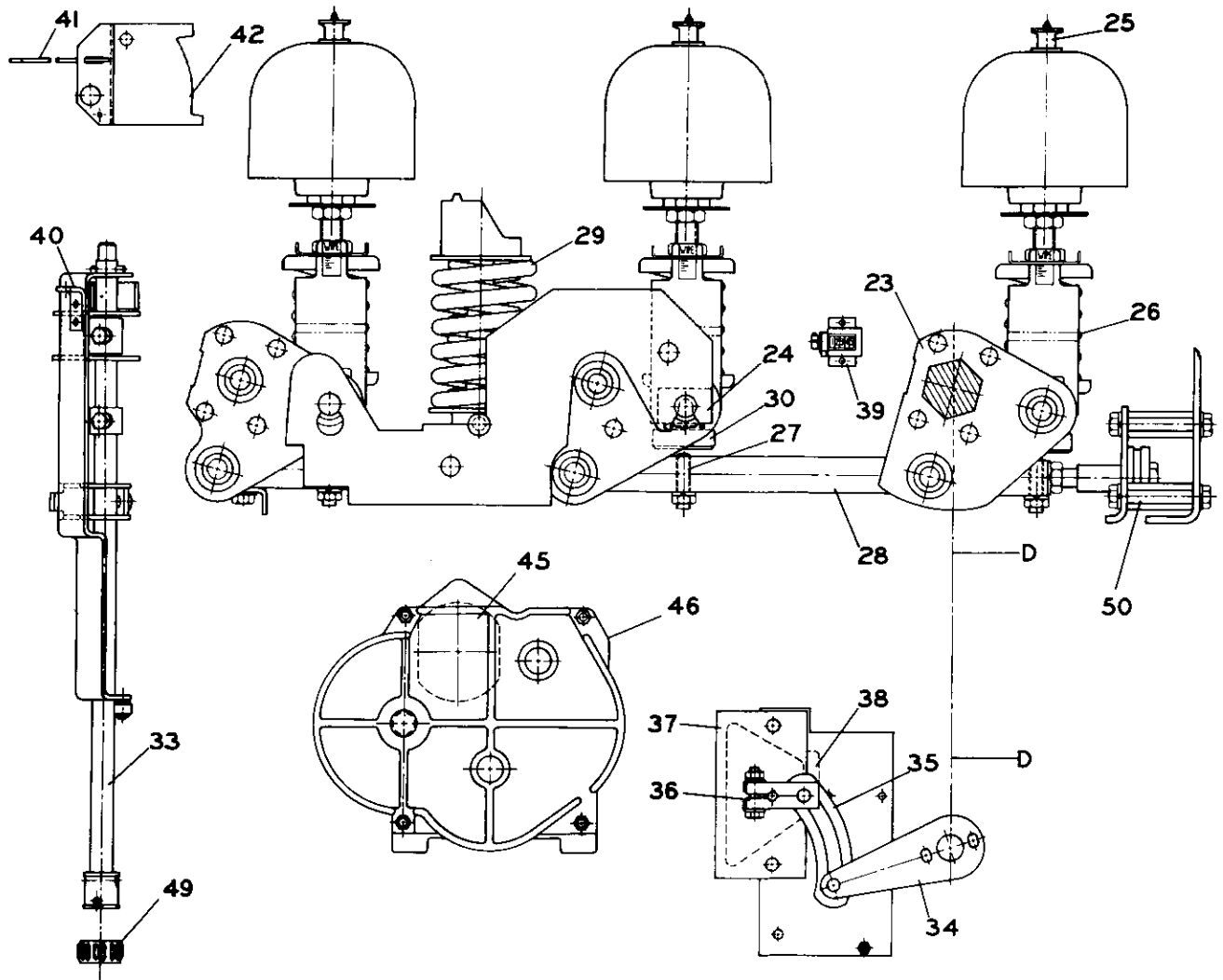
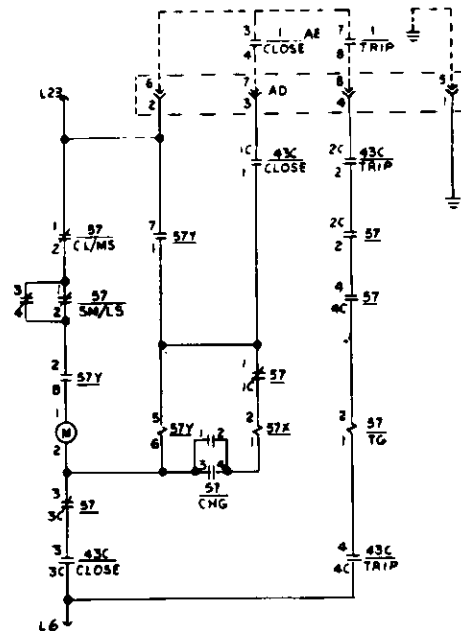
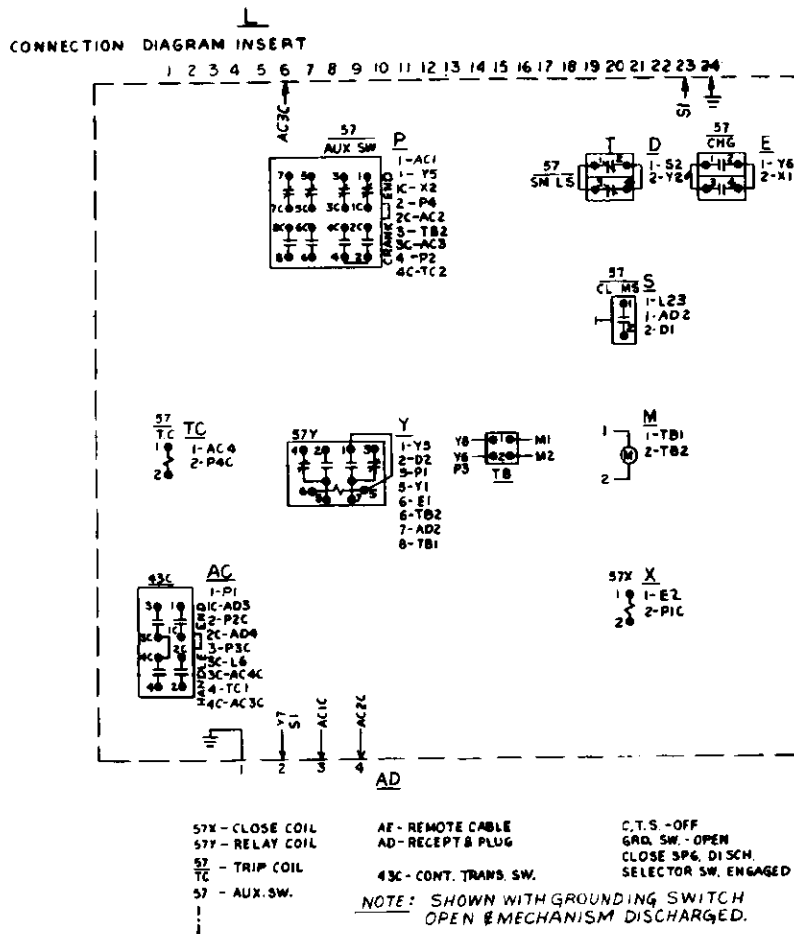


Fig.8 (0144D1406 Sh. 2)

- |   |  |
|---|--|
| 27. Overtravel Stop Adjustment - on Each Pole | 39. Operation Counter                      |
| 28. Horizontal Connecting Bar                 | 40. Spring Charge Indicator Arm            |
| 29. Opening Spring Assembly                   | 41. Rod                                    |
| 30. Opening Stop Ring                         | 42. Spring Charge-Discharge Indicator Flag |
| 31. Dashpot                                   | 43. Gear Motor Limit Switch                |
| 32. Brake                                     | 44. Gear Motor Limit Switch Operator       |
| 33. Closing Latch Shaft                       | 45. Reduction Gear Housing                 |
| 34. Auxiliary Switch Drive Arm                | 46. Gear Motor                             |
| 35. Idler Link                                | 47. Trip Latch Checking Switch             |
| 36. Switch Drive Arm                          | 48. Enabling Pin                           |
| 37. Auxiliary Switch - SB-12 - Four Stage     | 49. Retaining Ring                         |
| 38. Position Indicator Flag - on Switch Shaft | 50. Opening Stop                           |

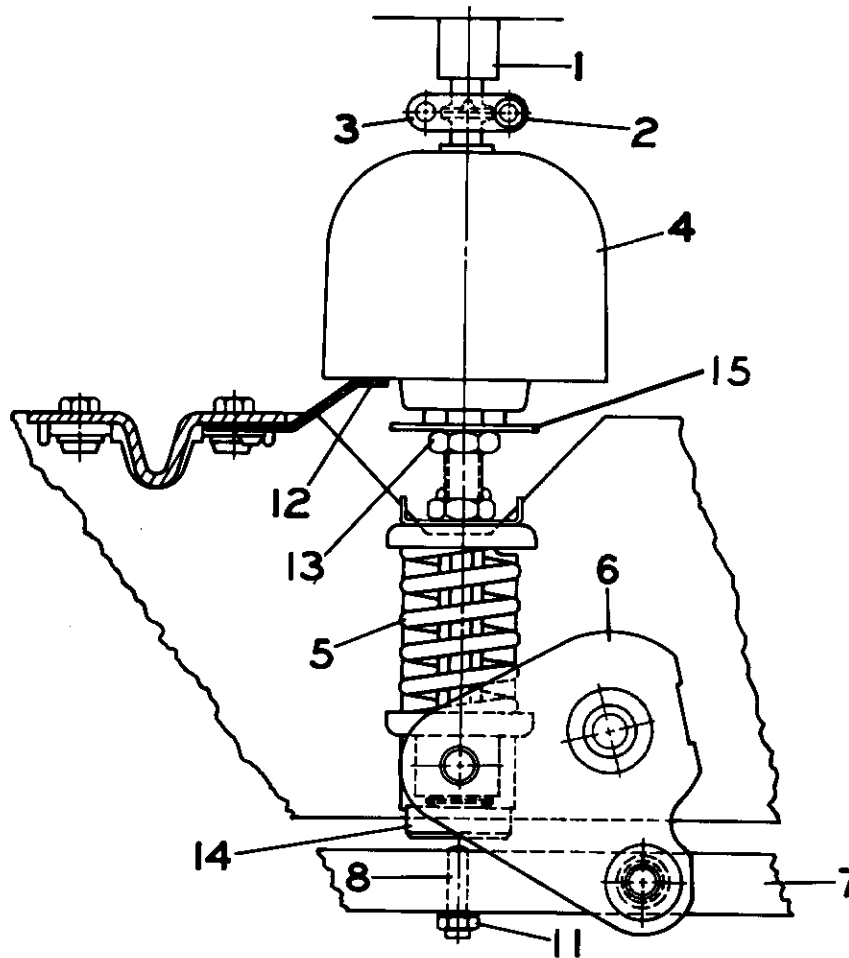
Fig. 8 Exploded Schematic - Rear View of ML-17 Mechanism



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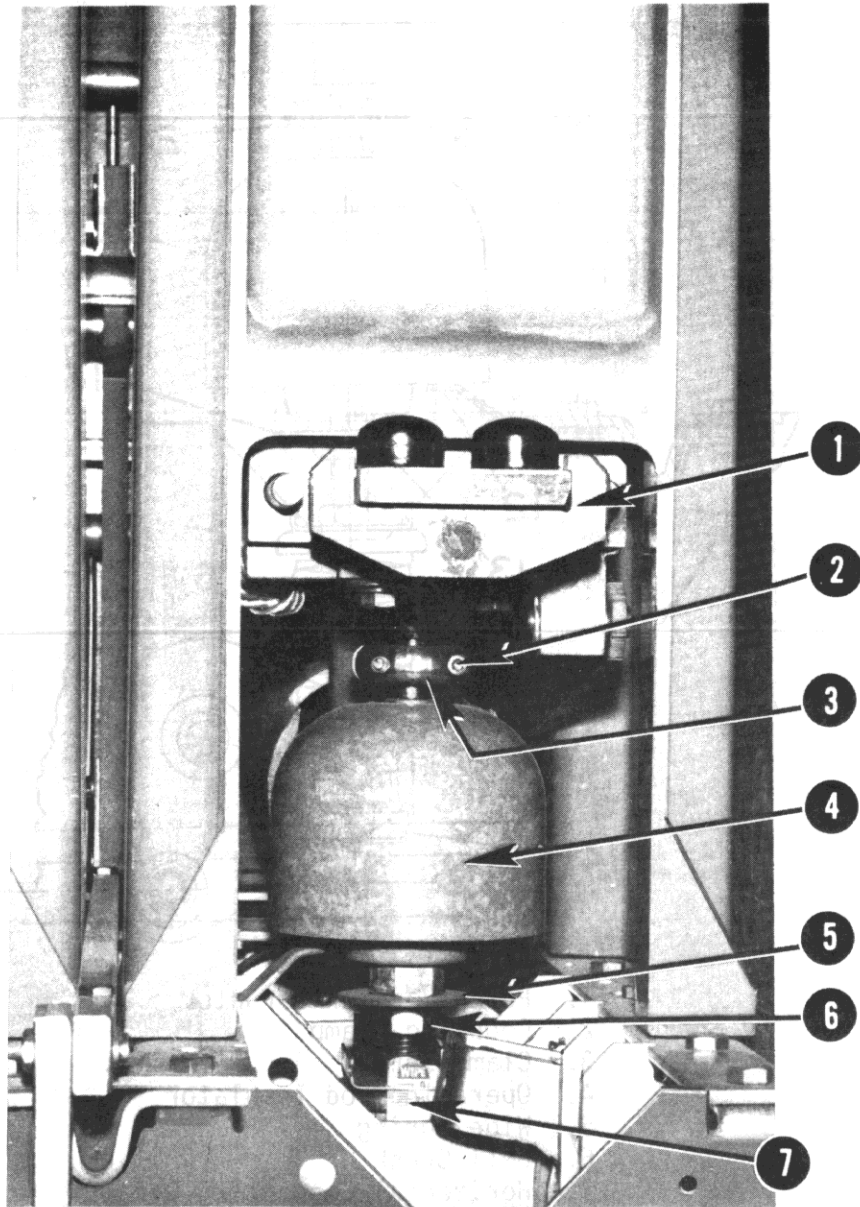
Fig. 9 Typical Wiring Diagram for Type GMV-1000  
Check the wiring diagram supplied with the actual device for its wiring.

\*\*Indicates revision



1. Power/Vac\* Interrupter
2. Coupling Clamp
3. Clamp Screws
4. Operating Rod Insulator
5. Wipe Spring
6. Bell Crank
7. Horizontal Connecting Bar
8. Overtravel Stop Bolt
9. Not Used
10. Not Used
11. Locknut
12. Indicator Finger
13. Locknut
14. Stop Ring
15. Indicator Disk

Fig. 10 Primary Contact Gap and Erosion Indication



1. Connection Bar Interlock
2. Clamp Screws
3. Coupling Clamp
4. Operating Rod Insulator
5. Indicator Disk
6. Locknut
7. Wipe Indicator

Fig. 11 Rear View of Pole Unit

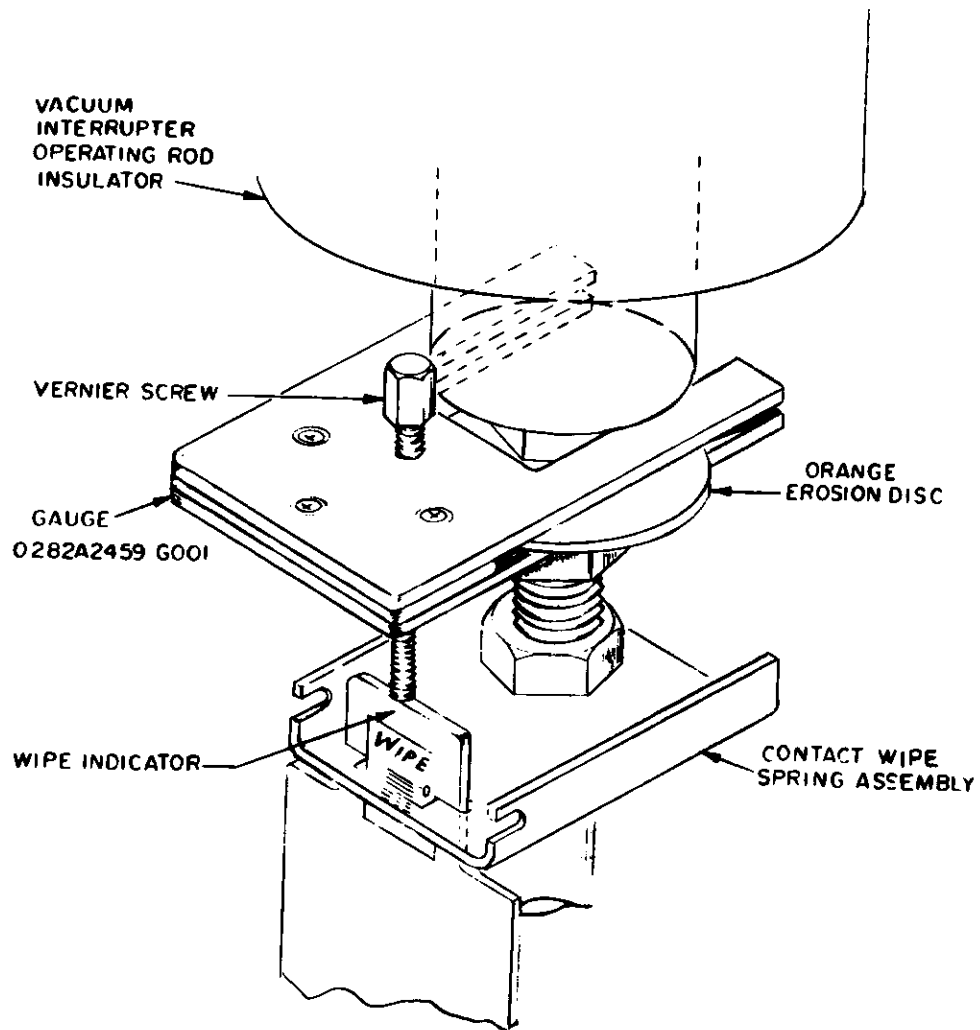
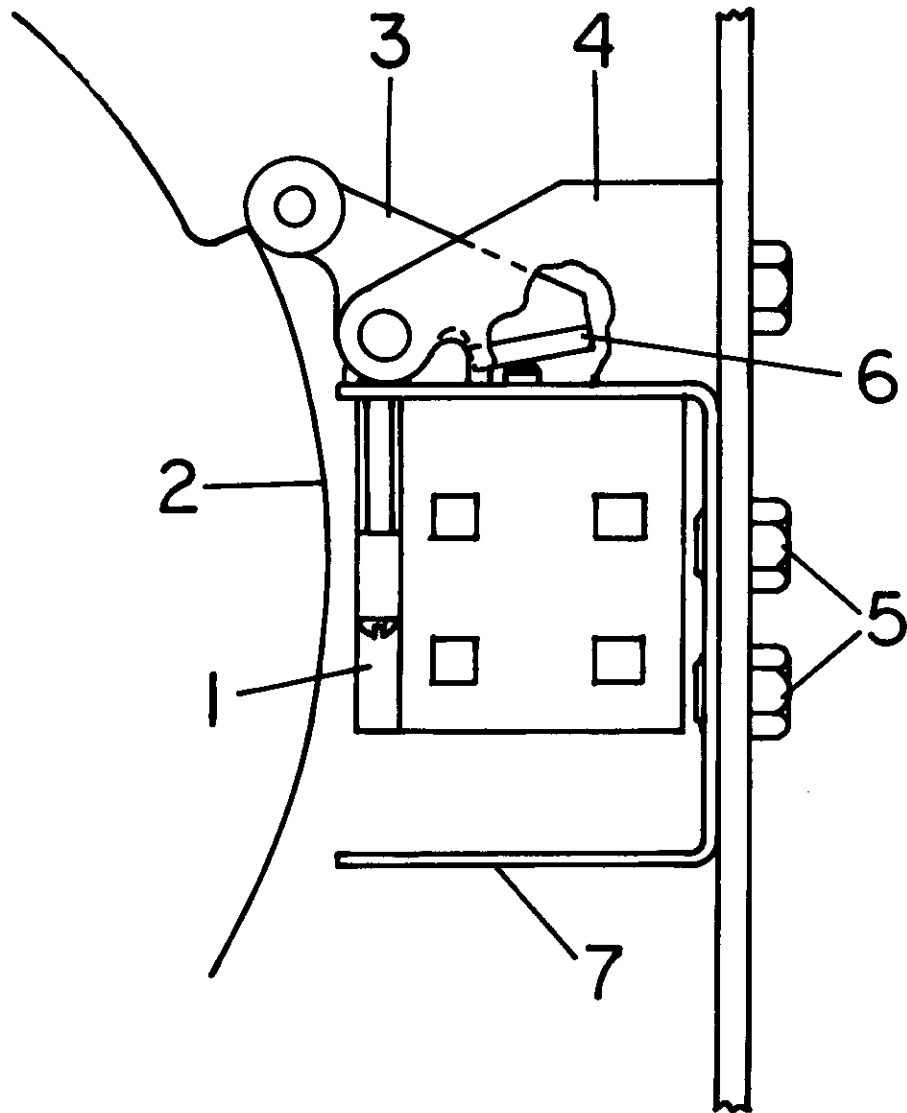


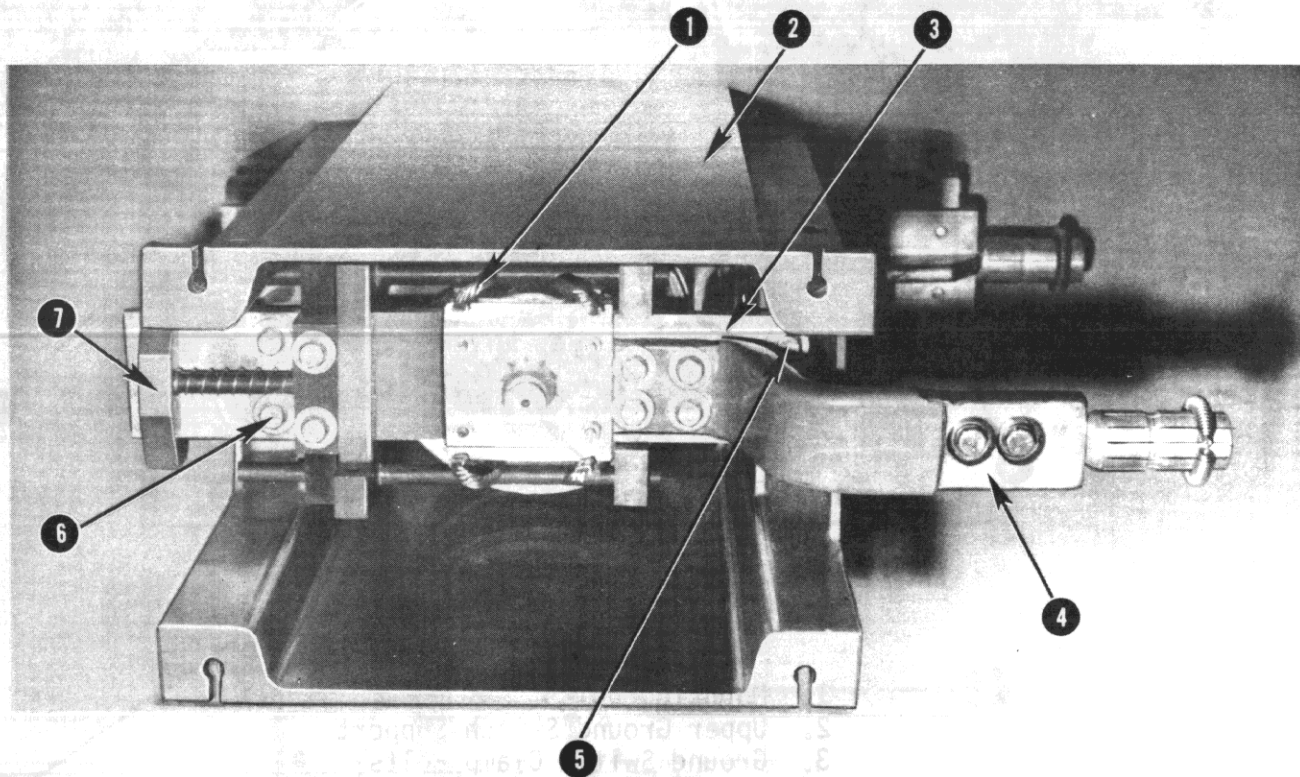
Fig. 12 Wipe Gage



- 1. Switch
- 2. Flywheel
- 3. Operating Arm
- 4. Support Bracket
- 5. Switch Adjusting Screws
- 6. Operator
- 7. Support

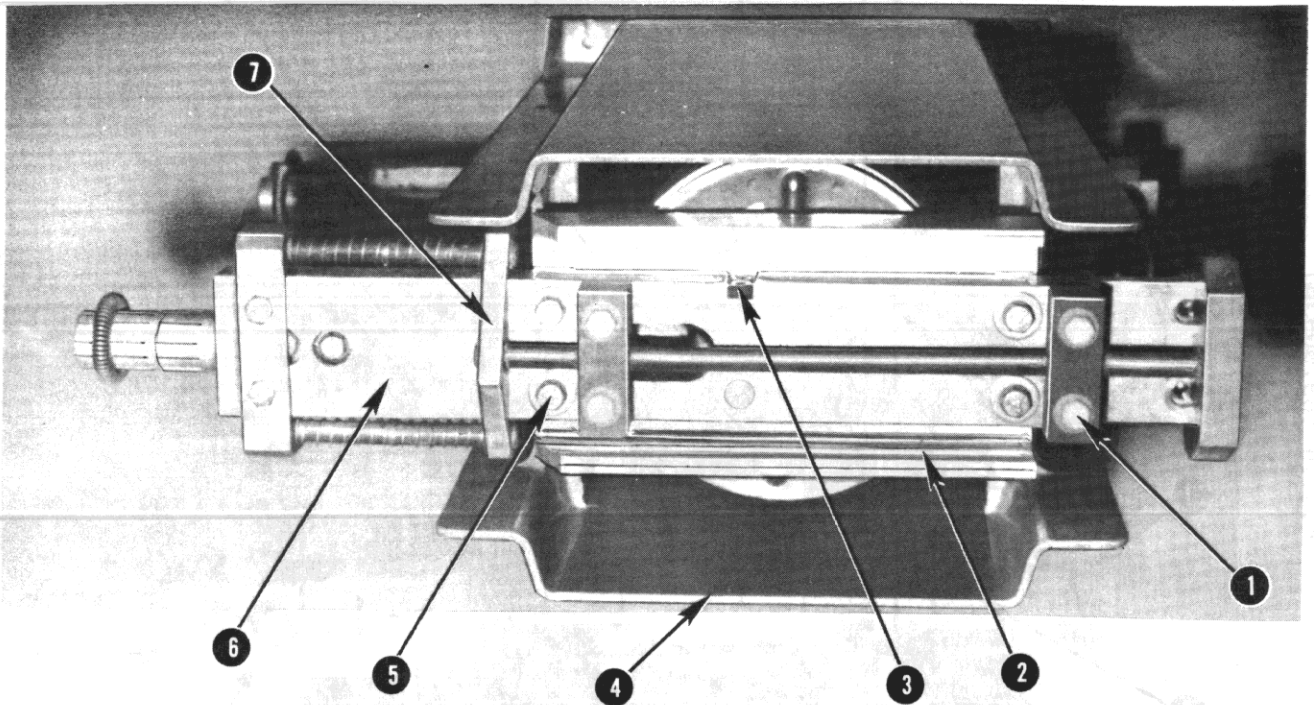
Fig. 13 Closing Spring Monitoring Switch

Fig. 14 (8919093H)



1. Connection Braids
2. Insulation Support
3. Lower Stud
4. Lower Receptacle Bar
5. Lower Stud Bolts
6. Lower Stud Bolts
7. Bottom Primary Disconnect Interlock

Fig. 14 Bottom View Grounding Switch

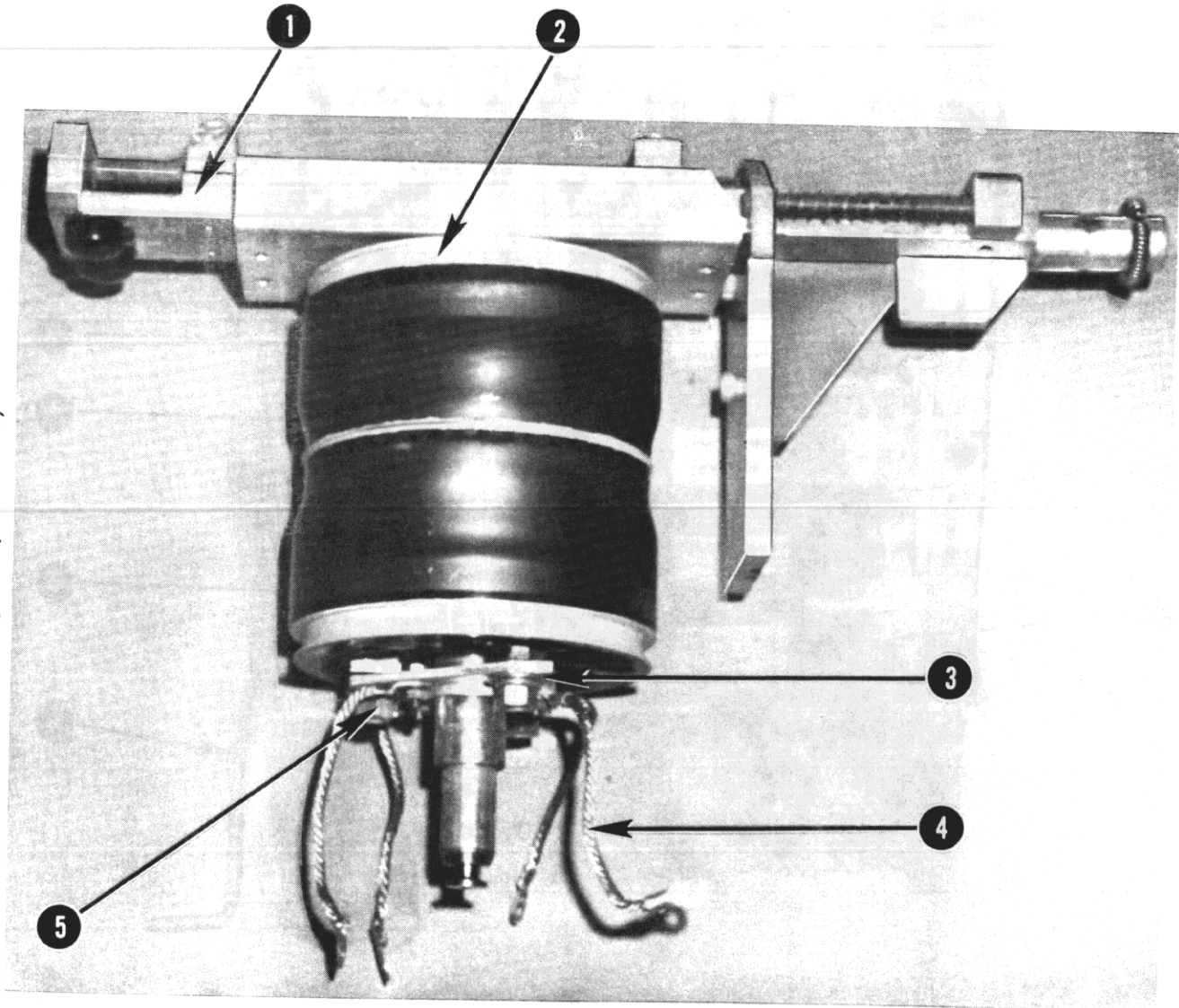


1. Mounting Bolts
2. Upper Ground Switch Support
3. Ground Switch Clamp Bolts
4. Insulation Support
5. Mounting Bolts
6. Upper Stud
7. Interlock

Fig. 15 Top View Grounding Switch



Fig.16 (8919093J)



1. Upper Stud
2. Grounding Switch
3. Guide and Bearing Support
4. Connection Braid
5. Mounting Nuts

Fig. 16 Ground Switch Assembly

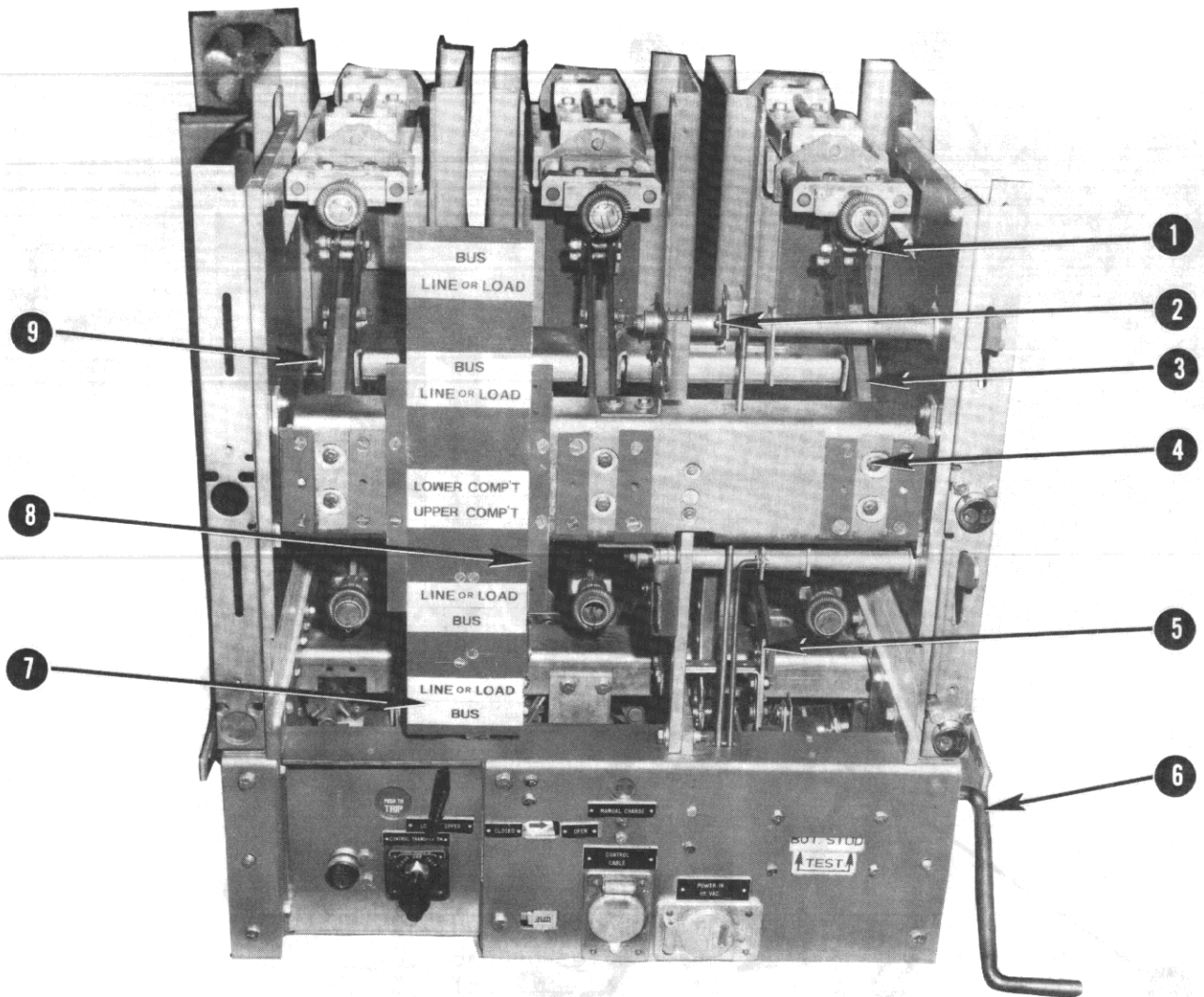


Fig. 17 (8919093F)

1. Selector Blade Contact Bolts
2. Interlock Retainer
3. Selector Blade
4. Hinge Mounting Bolts
5. Interlock Arm Pin
6. Selector Switch Handle
7. Receptacle Indicator
8. Slide Bracket
9. Retaining Ring

Fig. 17 Selector Switch