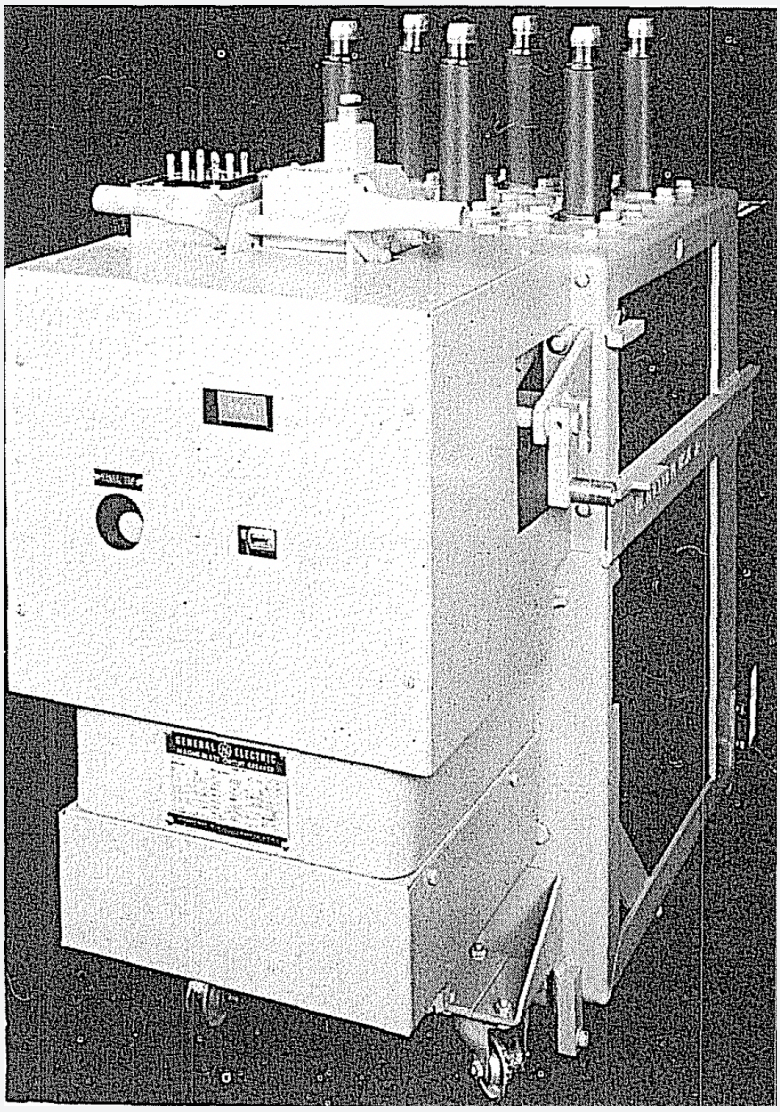
INSTRUCTIONS AND RENEWAL PARTS [GE LEGACY DOCUMENT]

Magne-Blast circuit breaker Type AM-4.16

GE legacy product documentation



Types

AM-4.16-150-3
AM-4.16-150A-3
AM-4.16-250-3
AM-4.16-250A-3
With MS-13 Mechanism

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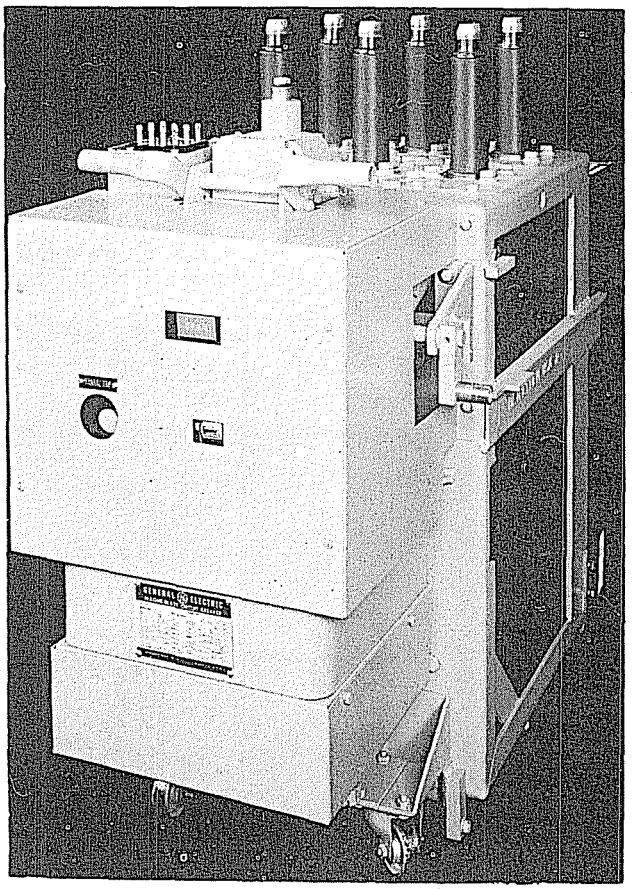


1. Secondary Coupler
2. Auxiliary Switch
3. Position Indicator
4. Opening Spring Unit
5. Operation Counter
6. Manual Trip
7. Control Device
8. Control Device Plunger Guide
9. Closing Solenoid
10. Plunger Interlock (Optional)

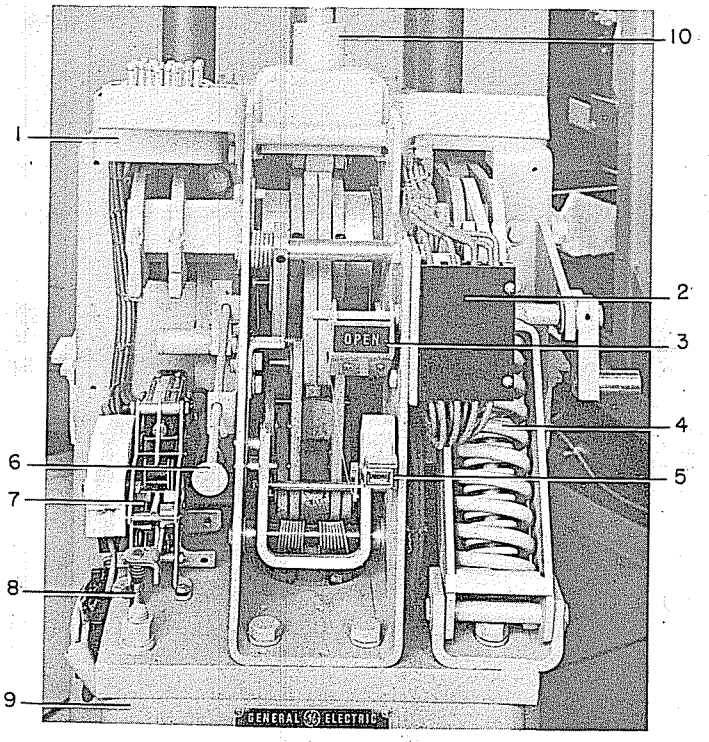
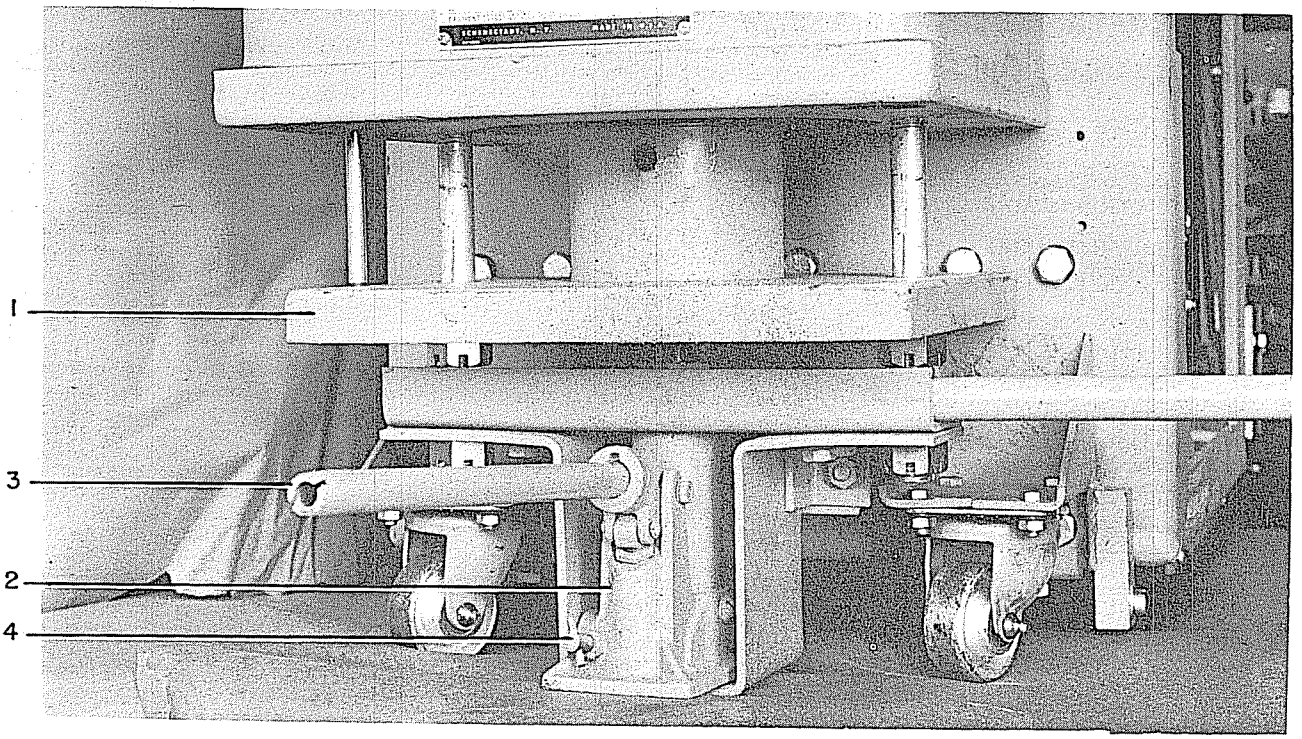


Fig. 1 MS-13 Operating Mechanism

Fig. 1 (8024599)



1. Closing Armature
2. Maintenance Operating Device
3. Handle
4. Release Valve

Fig. 2 Method of Mounting Maintenance Operating Device

Fig. 2 (8020882)

Cover (8022043)

MAGNE-BLAST CIRCUIT BREAKER

TYPE AM-4.16 WITH MS-13 MECHANISM

INTRODUCTION

The Magne-blast Circuit Breaker is the removable interrupting element for use in vertical-lift metal-clad switchgear, to provide reliable control and protection of power systems. Among the many advantages of metal-clad switchgear are added protection to equipment and personnel, compactness, simplified installation and reduced maintenance. In keeping with these features the Magne-blast breakers are designed for interchangeability and manueverability, together with reliability and low maintenance requirements.

The Magne-blast Circuit Breaker operates on the principle that an arc can be interrupted in air by sufficiently elongating and cooling it. This is accomplished by means of a strong magnetic field that lengthens the arc and forces it into intimate contact with cool dielectric material.

The AM-4.16 Magne-blast Breaker is available in a number of current and voltage ratings. Refer to the breaker nameplate for the complete rating information of any particular breaker. The short circuit conditions to be imposed on the breaker must not exceed its rating, nor should it be called upon to operate at voltages or currents greater than those given on the nameplate. Since this book is written to cover several ratings of breakers that are of the same general design, all instructions will be of a general character and all illustrations will be typical, unless otherwise specified.

PROPER INSTALLATION AND MAINTENANCE ARE NECESSARY TO INSURE CONTINUED SATISFACTORY OPERATION OF THE BREAKER. The following instructions will provide complete infomation for placing the magne-blast breaker in service and for maintaining satisfactory operation.

RECEIVING, HANDLING AND STORAGE

RECEIVING AND HANDLING

Each breaker is carefully inspected and packed by workmen experienced in the proper handling and packing of electrical equipment. Immediately upon receipt of the circuit breaker, 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 breaker so that no damage will occur from careless or rough handling, or from exposure to moisture or dirt. A nail puller should be used to open the crates, and care should be exercised to prevent tools from striking either the crate or any part of the breaker. Loose parts associated with the breaker are always included in the same crate. Check all parts against the packing list to be sure that no parts have been overlooked.

STORAGE

It is recommended that the breaker be put into service immediately in its permanent location. If this is not possible, the following precautions must be taken to insure the proper storage of the breaker:

1. The breaker should be carefully protected against condensation, preferably by storing it in a warm dry room, since water absorption has an adverse effect on the insulation parts. Circuit breakers for outdoor metal-clad switchgear should be stored in the equipment only when power is available and the heaters are in operation to prevent condensation.
2. The breaker 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. Machined parts of the operating mechanism, etc., should be coated with a heavy oil or grease to prevent rusting.

If the breaker 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 breaker be stored under unfavorable atmospheric conditions, steps should be taken to dry out the breaker before it is placed in service.

DESCRIPTION

The magne-blast breaker is composed of two major parts, the breaker element and the operating mechanism. The breaker element comprises three similar pole units, each pole unit consisting of main and arcing contacts, an interrupter, and an enclosing box barrier that segregates the interrupting units from each other to provide insulation between phases as well as from each phase to ground. The primary connections to the associated metal-clad equipment are made through the primary disconnect studs.

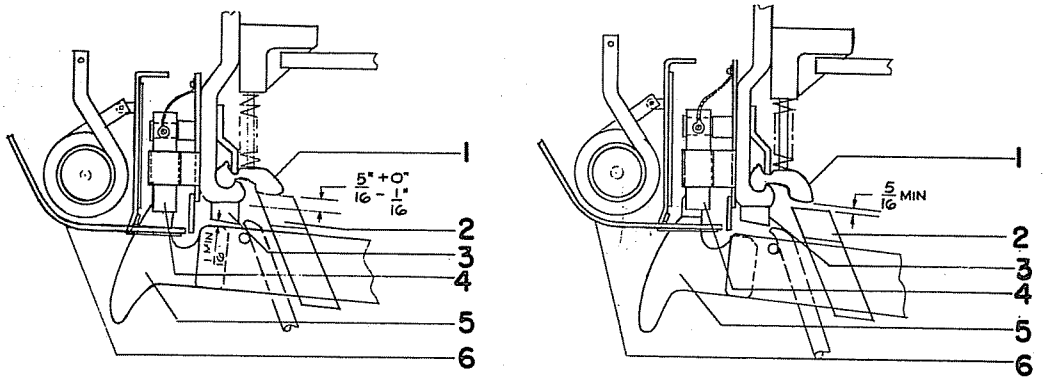
The MS-13 operating mechanism shown in Fig. 1 is of the solenoid type designed to give high speed closing and opening. The closing operation is controlled by the control device (7). The control device also permits trip free operation (tripping the breaker at any time during the closing operation), and prevents solenoid pumping (reclosing) after a trip free operation. For AC closing operation, rectifiers mounted elsewhere in the metal-clad unit are used to supply the direct current on which the closing coil operates. The breaker can be opened electrically, by remote control, or manually, by means of the manual trip device (6). All secondary connections from the breaker to the metal-clad unit are made through the coupler (1).

A positive interlock and interlock switch are provided between the breaker and metal-clad unit to prevent the raising or lowering of the breaker in the unit while in the closed position and to prevent a closing operation when the breaker is not in either the fully raised or lowered position. A plunger type interlock can also be provided to prevent the closing of two adjacent breakers at the same time or to operate an additional auxiliary switch mounted in the metal-clad unit.

The operating mechanism used on those breakers designed for MI-6 metal-clad

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.

equipment differs somewhat from those designed for M-26 equipment but its operation is principally the same. These breakers are identified by the "A" suffix in the breaker nomenclature thus: (AM4.16-150A-3). This mechanism is controlled by a relay scheme mounted in the metal-clad unit and a cut-off switch located on the breaker instead of the control device. Two seven terminal secondary couplers also replace the one sixteen terminal coupler. The positive interlock between the breaker and metal-clad unit is replaced with a trip interlock that trips the mechanism before raising or lowering of the breaker can be accomplished. A fork-type lever can be furnished to operate an auxiliary switch mounted in the metal-clad unit. For detailed explanation of the operation of the breaker and mechanism refer to the section OPERATION.



1. Stationary Primary Contacts
2. Movable Primary Contacts
3. Buffer Block
4. Stationary Arcing Contacts
5. Movable Arcing Contacts
6. Upper Arc Runner

Fig. 3 Contact Adjustments

Fig. 3 (2580688)

INSTALLATION

The following instructions explain the necessary steps to be taken before the breaker is placed in the metal-clad unit. This includes a complete check of all of the breaker adjustments, in addition to a thorough inspection. For final installation instructions refer to any issue of the Metal-clad Switchgear Instruction Book, GEH-1802. Reference should also be made to the connection diagram that is furnished with each unit.

DO NOT WORK ON EITHER THE BREAKER OR THE MECHANISM WHILE IN THE CLOSED POSITION UNLESS THE PROP AND TRIP LATCH HAVE BEEN SECURELY WIRED OR BLOCKED TO PREVENT ACCIDENTAL TRIPPING.

ADJUSTMENTS

Although the breaker has been completely adjusted and tested at the factory, it is possible that unusually rough handling during transportation may have caused some loosening or disturbance of parts of the apparatus. It is therefore advisable to review all adjustments before placing the breaker in service, making readjustments wherever necessary.

A maintenance operating device is provided for operation of the breaker during these adjustment checks. Mount the device as shown in Fig. 2, and turn the release valve (4) firmly to the right. To close the breaker, operate the handle (3) with a pumping motion. By turning the release valve (4) to the left, the closing armature will return to its normal position. Electrical operation must not be attempted until the breaker has been operated manually through its complete stroke several times and final installation inspection has been completed.

All adjustments should be checked not only during the initial installation of the breaker but also during periodic inspections and whenever it becomes necessary to repair or replace parts that have become worn or defective while in service. The following adjustments are listed in the order in which they are to be checked. First, however, remove the breaker from the metal-clad unit and remove the box barrier and the mechanism cover.

PRIMARY CONTACT WIPE

When the breaker is closed, as shown in Fig. 3, the stationary primary contacts (1) should rise 5/16" + 0-1/16". To obtain this adjustment, open the breaker and, referring to Fig. 4, loosen the check nut (4) and turn the adjusting nut (3). Screwing up on the adjusting nut will decrease the primary contact wipe, down will increase it. Tighten the check nut, close the breaker and recheck the wipe. With the primary contact wipe correctly adjusted, the clearance between the contact arm (7) and the buffer block should be 1/16" or greater (as shown in Fig. 3) when the breaker is fully closed.

ARCING CONTACT WIPE

Refer to Fig. 3. Close the breaker until the arcing contacts just touch. This can be determined with the use of a circuit continuity tester such as a light indication or bell set. In this position, the gap between the stationary primary contacts (1) and the movable primary contact (2) should be 5/16" or greater. This setting has been made in the factory and no adjustment is provided. A wipe of less than 5/16" is usually an indication that the arcing contacts need to be replaced. When making this check, also see that the movable arcing contact (5) passes through the slot in the upper arc runner (6) without touching.

PRIMARY CONTACT GAP

Refer to Fig. 4. With the breaker closed, press the manual trip button allowing the breaker to trip open normally. Do not force the contacts open wider by hand. The gap between the stationary primary contacts (5) and the movable primary contact (6) should be 3-13/16" + 1/8" - 3/16". To change this gap, loosen the check nut (25), Fig. 5, and turn the adjusting nut (26) on stud (9). Screwing the adjusting nut down will decrease the primary contact gap. Tighten the check nut and remeasure the contact gap (close and trip the breaker before checking the measurement).

TRIP LATCH WIPE

Refer to Fig. 5. The wipe of the trip latch (4) on the trip roller (6) should be from 3/16" to 1/4". This can be measured by putting a film of grease on the latch (4), closing the breaker part way, and tripping. The mechanism has the proper trip latch wipe when the latch rests against the stop pin (5). No adjustment is provided and a visual inspection is usually all that is required. If this setting is not correct, look for insufficient travel of the trip shaft (3).

WHEN WORKING ON THE MECHANISM IN THE CLOSED POSITION, KEEP FINGERS CLEAR OF THE LINKAGE, AS ACCIDENTAL TRIPPING CAN CAUSE SEVERE INJURY.

PROP CLEARANCE

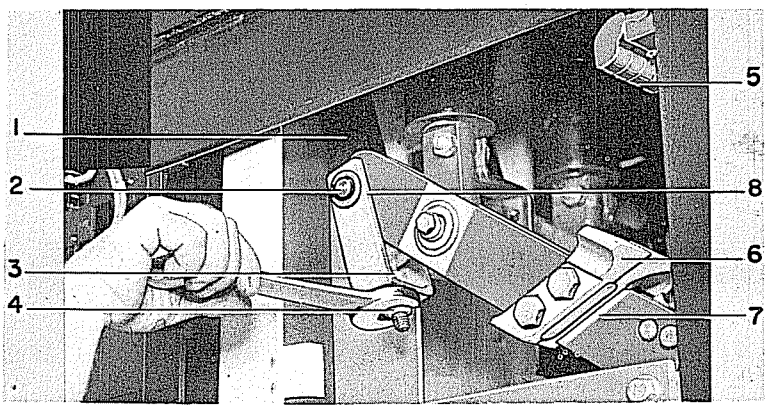
Refer to Fig. 5. With the breaker closed as far as possible with the maintenance device, the clearance between the closing pin (10) and the prop (15) should be 1/32" to 3/32". Measure the prop

clearance with a feeler gage to determine whether or not an adjustment should be made, and if so, exactly how much adjustment will be required. To make the adjustment, it will first be necessary to open the breaker and remove the maintenance operating device. Remove the stop nuts (22 and 24) being careful not to drop the armature (21). Lower the armature from the mechanism and remove the two set screws (19). Remove the closing plunger (17) from the armature and add or subtract the necessary thickness of shims (20) to give the required adjustment, then replace the closing plunger, screwing it down against the shims. Using a small drill, spot the closing plunger through the set screw hole. Replace the set screws. To remount the armature on the breaker, compress the piston ring (18). After reassembly, remount the maintenance closing device and check the adjustment.

CLOSING PLUNGER CLEARANCE

Refer to Fig. 5. With the breaker in the open position, the clearance between the closing plunger (17) and the closing roller (14) should be 1/16" to 3/16". To obtain this clearance, the nuts (22) on the two armature guide bolts (23) may be raised or lowered. Both nuts should be moved the same amount. After making an adjustment, close and open the breaker and recheck the plunger clearance. Repeat the adjustment if necessary.

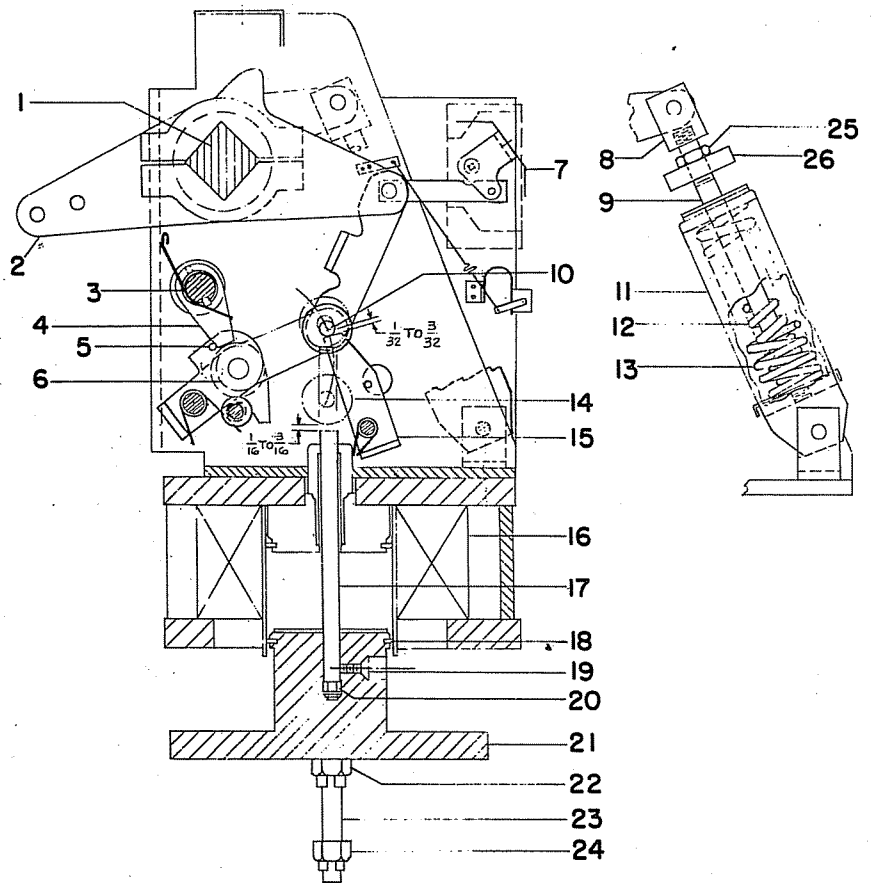
Fig. 4 (8018500)



1. Operating Rod
2. Operating Rod Pin
3. Adjusting Nut
4. Check Nut
5. Stationary Primary Contacts
6. Movable Primary Contacts
7. Contact Arm
8. Yoke

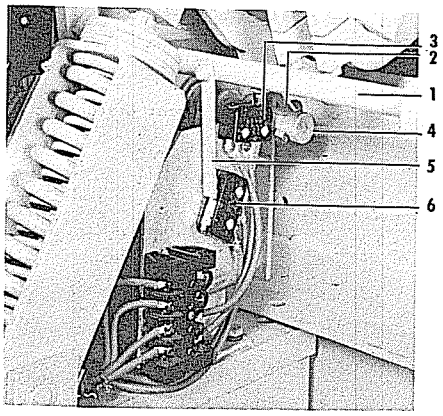
Fig. 4 Adjustable Coupling for Making Primary Contact Wipe Adjustment

Fig. 5 (2580688)



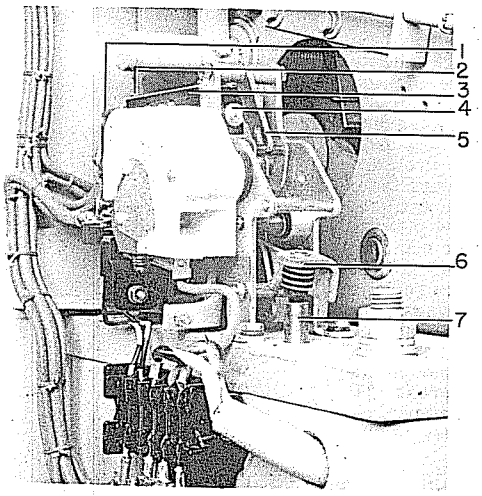
1. Main Oper. Shaft
2. Main Crank
3. Trip Shaft
4. Trip Latch
5. Trip Latch Stop
6. Trip Roller
7. Position Indicator
8. Clevis
9. Adjustable Stud
10. Closing Pin
11. Opening Spring Housing
12. Opening Spring, Inner
13. Opening Spring, Outer
14. Closing Roller
15. Prop
16. Closing Coil
17. Closing Plunger
18. Piston Ring
19. Set Screw
20. Shims
21. Closing Armature
22. Stop Nuts
23. Armature Guide Bolts
24. Stop Nuts
25. Check Nut
26. Adjusting Nut

Fig. 5 Cross Section of MS-13 Mechanism



1. Interlock Shaft
2. Latch Check Switch Arm
3. Latch Checking Switch
4. Trip Shaft
5. Interlock Switch Arm
6. Interlock Switch

Fig. 6 Interlock Switch and Latch Checking Switch



1. Back Auxiliary Switch
2. Mounting Screw
3. Top Auxiliary Switch
4. Plunger
5. Operating Arm
6. Trip Lever
7. Plunger Guide

Fig. 7 Control Device

Fig. 6 (8024689)

Fig. 7 (8024693)

Fig. 8 (8021970)

INTERLOCK SWITCH WIPE

Referring to Fig. 6, rotate the interlock shaft (1) manually clockwise to release the interlock switch arm (5). The point at which the contacts make can be determined with a circuit continuity tester such as a light indicator or bell set. To obtain adjustment on the interlock switch (6), bend the interlock switch arm (5). The roller and crank on the interlock switch (6) should have 1/32" to 1/16" overtravel after final adjustment.

CONTROL DEVICE ADJUSTMENT

Referring to Fig. 7, measure the overtravel of the two auxiliary switch plungers. Manually operate the control device by pressing the operating arm (5) the full extent of travel to the rear. With the device in this position further depress the plunger (4) on the top auxiliary switch (3). The gap between the plunger and operating arm should be 1/32" or greater. To increase the overtravel, loosen the screws (2) and move the switch toward the rear of the mounting plate. Tighten the screws and recheck the adjustment.

In a similar manner, check the overtravel on the back auxiliary switch (1).

BEFORE MANUALLY OPERATING THE CONTROL DEVICE, MAKE CERTAIN THAT ALL CONTROL POWER TO THE BREAKER HAS BEEN DISCONNECTED. MANUAL OPERATION OF THE CONTROL DEVICE WITH CONTROL POWER CONNECTED WILL ENERGIZE THE CLOSING COIL AND PRODUCE A CLOSING OPERATION.

CUT-OFF SWITCH ADJUSTMENTS (AM-4.16-150A-3, 250A-3)

Refer to Fig. 8. The operating arm (5) is set at the factory and will require no adjustment. With the breaker in the open position, depress the arm of the cut-off switch (1). There should be 1/32" to 1/16" clearance between the depressed roller of the switch and the striker (3). Washers (4) should be added or removed if necessary to correct adjustment.

AUXILIARY DEVICES

Latch Checking Switch Wipe

Referring to Fig. 6, rotate the trip shaft (4) manually clockwise to release the latch checking switch arm (2). The point at which the contacts make can be determined with a circuit continuity tester such as a light indicator or bell set. To obtain adjustment on the latch checking switch (3), bend the latch checking switch arm (2). The roller and crank on the latch checking switch (3) should have 1/32" to 1/16" overtravel after final adjustment.

Impact Trip, Current Trip, Capacitor Trip, and Undervoltage Trip Devices

Fig. 9 shows the necessary settings that are to be checked when these devices are furnished. The amount of wipe between the trip roller (16) and the trip latch (15) should be 3/32" to 5/32". This can be altered by changing the number of shims under the block against which the trip plate (14) stops.

In order to trip properly, the clearance between the trip bolt (11) and the trip plate (9) should be 1/32" to 1/16". This can be altered by releasing the check nut and screwing the trip bolt (11) in or out of the reset arm (8).

When an undervoltage device is furnished check the clearance between the trip hammer (19) and the trip plate (14), with the undervoltage coil energized. This clearance should be 1/32" to 1/16" and can be altered by removing the connecting pin at either end of the adjusting rod assembly (20), and turning the clevis at that end.

After checking all the mechanical adjustments as outlined above, operate the devices manually to make certain that they trip and reset properly.

Plunger Interlock (AM-4.16-150-3 and 250-3)

Refer to Fig. 9. With the breaker in the open position, the vertical distance "A" from the top of the interlock bolt (2) to the bottom of the elevating bar (13) should be 15-19/32" ± 1/16". To change this adjustment add or remove washers (3).

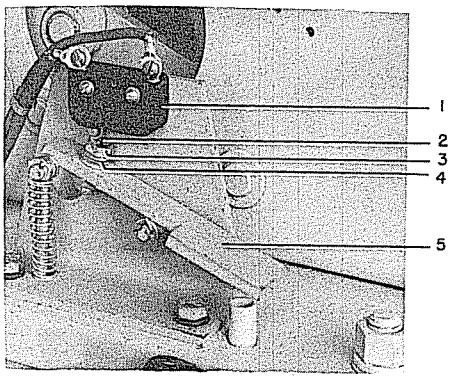
Auxiliary Switch Linkage (Furnished Special on AM-4.16-150A-3 and 250A-3)

Refer to Fig. 10. With the breaker in the open position, the distance from the center line of the front bushings (1) to the center of the slot in the fork lever (2) should be 12-9/32" as shown. To change this setting, loosen the locking bolts (3) and move the fork level in the proper direction. Tighten the lock bolts.

FINAL INSPECTION AND TEST

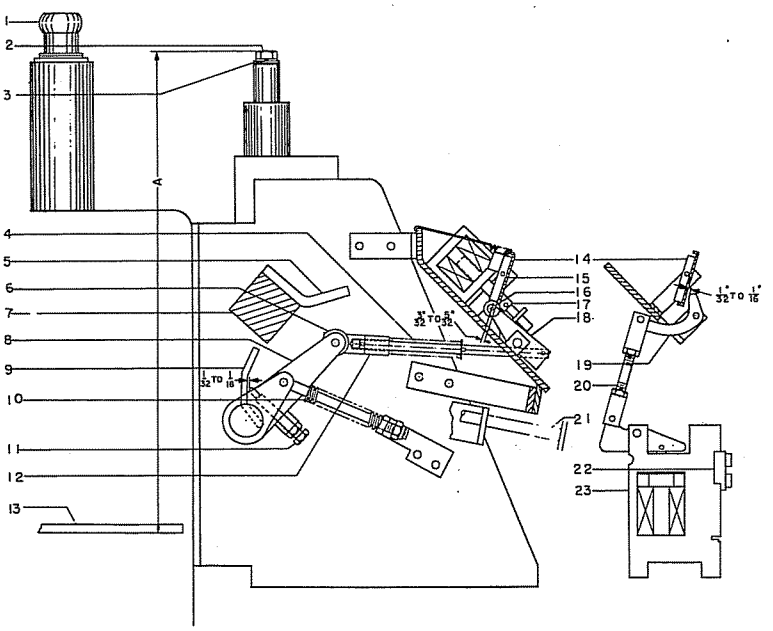
1. For ease in reviewing the adjustments, the following are recapitulated:

   a. Primary contact wipe: 5/16" + 0 - 1/16".



1. Cut-off Switch
2. Switch Roller
3. Adjusting Bolt
4. Washers
5. Lever Arm

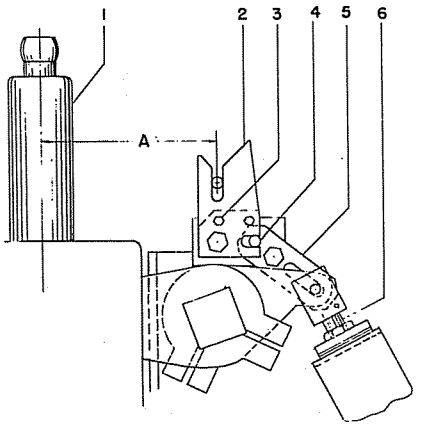
Fig. 8 Cut-off Switch Adjustments



1. Front Disconnect Stud
2. Plunger Interlock Bolt
3. Washers
4. Connecting Rod
5. Reset Plate
6. Reset Roller
7. Main Operating Shaft
8. Reset Arm
9. Trip Plate
10. Spring
11. Trip Bolt
12. Clevis
13. Elevating Bar
14. Impact Trip Plate
15. Trip Latch
16. Trip Roller
17. Trip Armature
18. Trip Lever
19. Undervoltage Trip Hammer
20. Adjusting Rod
21. Manual Trip Button
22. Trip Setting Plate
23. Undervoltage Device

Fig. 9 (T-6195074)

Fig. 9 Adjustments On Current Trip Device and Undervoltage Trip Device, Shown With The Breaker In The Closed Position



1. Front Bushing
2. Fork Lever
3. Locking Bolts
4. Pin
5. Link
6. Rod

Fig. 10 (M-6291393)

Fig. 10 Auxiliary Switch Linkage

b. Arcing contact wipe: 5/16" or greater (gap at primary contacts).

c. Primary contact gap: 3-13/16 + 1/8"- 3/16".

d. Trip latch wipe: 3/16" to 1/4" with trip latch resting against stop pin.

e. Prop clearance: 1/16" ± 1/32".

f. Closing plunger clearance: 1/16" to 3/16".

g. Interlock switch wipe: 1/16" min.

h. Control device switch overtravel: 1/32" min.

i. Cut-off switch overtravel: 1/32" max.

j. Latch checking switch wipe: 1/16" min.

k. Impact trip roller wipe: 1/8" ± 1/32".

l. Impact trip bolt clearance: 3/64" ± 1/64".

m. Undervoltage trip hammer clearance: 3/64" ± 1/64".

n. Plunger interlock (150-3 and 250-3): 15-19/32" ± 1/16".

o. Auxiliary switch linkage (150A-3 and 250A-3): 12-9/32".

2. Check all nuts, washers, bolts, cotter pins, and terminal connections for tightness.

3. Inspect all wiring to make sure that no damage has resulted during installation, and test for possible grounds or short circuits.

4. See that all bearing surfaces of the mechanism have been lubricated. Refer to the section on LUBRICATION.

5. Operate the breaker slowly with the maintenance closing device and note that there is no excessive binding or friction and that the breaker can be moved to the fully opened and fully closed positions.

6. See that any place where the surface of the paint has been damaged during installation is repainted immediately.

HI-POTENTIAL TEST

If the breaker had been stored for a long period of time, it is recommended that the insulation be checked before the breaker is placed in service. A standard 60 cycle high potential test at 14,000 volts RMS will normally indicate whether the breaker is satisfactory for service. With the breaker contacts in the fully opened position, apply the high potential to each terminal of the breaker individually for one minute with all other terminals and the breaker frame grounded. After high potential tests are made on organic insulating materials, these materials should be inspected for visible leakage current paths, and necessary action must be taken to replace insulation that may have been affected by moisture absorption. The high potential test is also recommended for breakers which have been removed from service and stored over an extended period of time under unfavorable atmospheric conditions.

AUXILIARY DEVICES

On breakers that are equipped with auxiliary devices such as a current trip, undervoltage trip or capacitor trip, the device should be checked for proper

electrical operation. The current trip device should trip the breaker at 3 amperes. The undervoltage trip device should trip the breaker when the control voltage drops below 30 to 60% of rated voltage, and it should pick up at 80% of the control voltage or less. An adjustment plate is provided on the front of the undervoltage trip device as an aid in obtaining the desired setting.

NOTE: When checking the pick-up value of the undervoltage device, apply a voltage equal to 80% of normal control voltage to the undervoltage device coil. The device should pick up at this value. Do not increase the voltage gradually on this coil as it will overheat the coil, producing a false reading, and may damage the coil if excessive overheating occurs.

The capacitor trip should be capable of tripping the breaker as late as 25 seconds after the control voltage is removed. If the auxiliary devices do not perform in accordance with these specifications, a careful examination should be made for defective parts.

CONTROL POWER CHECK

After the breaker has been closed and opened slowly several times with the maintenance closing device, and the mechanism adjustments checked as described above, the operating voltages should be checked at the closing coil and trip coil terminals. For electrical operation of the breaker, the control power may be either an alternating or direct current source. The operating ranges for the closing and tripping voltages are given on the breaker nameplate. Ordinarily, standard ranges apply which are as follows:

NOMINAL VOLTAGE	CLOSING RANGE	TRIPPING RANGE
125v d-c	90-130v d-c	70-140v d-c
250v d-c	180-260v d-c	140-280v d-c
230v a-c	190-250v a-c	190-250v a-c

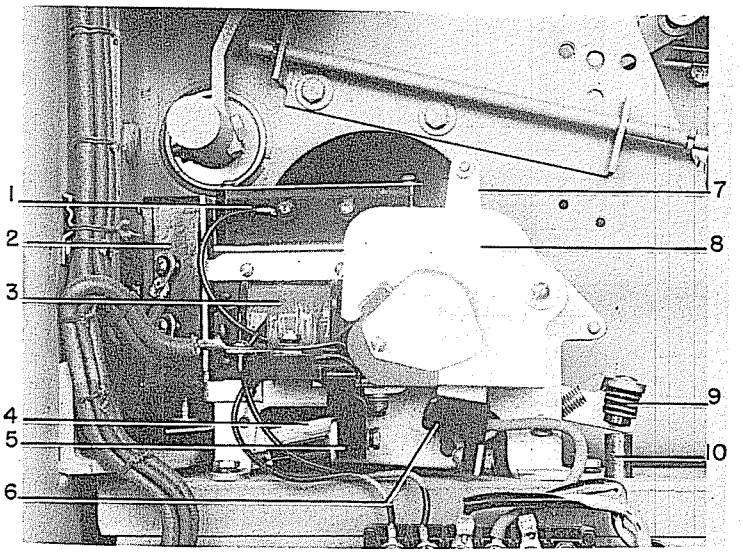
NOTE: When repetitive operation is required from a direct current source, the closed circuit voltage at the closing coil should not exceed 115v d-c and 230v d-c at the nominal voltages of 125v d-c and 250v d-c, respectively.

To check the d-c voltage at the closing coil terminals, proceed as follows:

1. Mechanism with a control device, Fig. 11. Close the breaker by manually operating the control device. Hold the contacts in the closed position and read the d-c voltage at the closing coil terminals. To de-energize the circuit, release the control device.
2. Mechanism with cut-off switch, Fig. 8. Close the breaker by manually operating the control relay located in the metal-clad unit. Hold the relay closed and read the d-c voltage at the closing coil terminals. Release the closing relay to de-energize the circuit.

If the closed circuit voltage at the terminals of the closing coil does not fall in the specified range, proceed as follows:

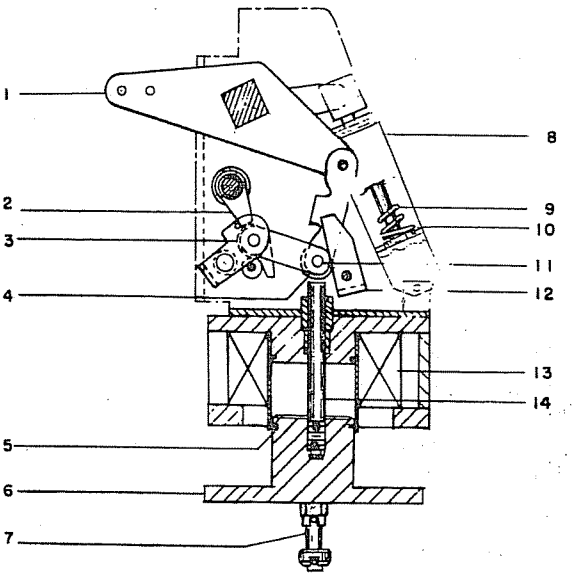
1. A-c control power source using copper oxide rectifiers. Decrease the series



1. Shunting and Anti-Pump Switch
2. Seal-in Switch
3. Operating Coil
4. Crank
5. Stationary Contact Assembly
6. Movable Contact Assembly
7. Arm
8. Arc Chute
9. Trip Lever
10. Plunger Guide

Fig. 11 Control Device

Fig. 11 (8024603)



1. Main Crank
2. Trip Latch
3. Trip Roller
4. Closing Roller
5. Piston Ring
6. Closing Armature
7. Armature Guide Bolts
8. Spring Retainer
9. Opening Spring, Inner
10. Opening Spring, Outer
11. Closing Pin
12. Prop
13. Closing Coil
14. Closing Plunger Rod

Fig. 12 Cross Section of MS-13 Operating Mechanism in the Open Position

Fig. 12 (374A293)

resistance to increase the d-c voltage, or increase the series resistance to decrease the d-c voltage. Recheck voltage at the closing coil.

2. D-c control power source. Check voltage at the source of power and line drop between the power source and breaker.

FOR A-C OPERATION

1. When copper-oxide rectifiers are used they are mounted in the metal-clad unit. A tapped 1-1/2 ohms resistor is provided in each rectifier circuit to control the d-c voltage. The resistor setting should be adjusted so that the closed circuit voltage at the breaker closing coil terminals is 110 to 120 volts d-c. Where repetitive operation is required, the voltage should be set at 105 to 115 volts d-c.

*A-c Volts (Closed Circuit)	Resistor Setting For Each Resistor	
	Summer	Winter
190-196	1/4	0
194-206	1/2	0
204-216	1/2	1/4
214-226	3/4	1/4
224-236	1	1/2
234-246	1-1/4	3/4
244-250	1-1/4	1

*A-c Volts as measured across the rectifier and a-c series resistor.

The preceding tabulation is included as a guide for adjusting the resistors for the particular combination of ambient temperature and a-c supply voltage. Summer settings are used where ambient temperatures are normally above freezing (32°F). It is necessary to use winter settings where the ambient temperature may drop to 20°F or less at any time. For a more detailed explanation of copper-oxide rectifiers for circuit breaker application, refer to instruction book GEI-11306.

flow.

RECTIFIER REFERENCE CHART

Closing Coil		Rectifier Resistor Setting		
Dwg. No.	Amps.	Germanium	Silicon	Resistor Taps
6375521G-6	58.0 to 62.0	1.50 Ω	1.25 Ω	
6375521G-2	95.0 to 115.0	1.0 Ω (ea. bridge)	0.75 Ω	
6375522G-2	180.0	.75 Ω (ea. bridge)	0.625 Ω	

2. When a germanium (color-black, -flanged base) - or a silicon (color-blue, hex base) - rectifier bridge assembly is used, it is mounted in the metal-clad unit. These rectifiers are of the button-type and are hermetically sealed units. They have been tested and the associated resistor properly set at the the factory. Unlike copper-oxide rectifiers the output of the germanium or silicon unit is affected very little by ambient temperature changes and it should not be necessary to disturb the factory setting.

DO NOT MAINTAIN VOLTAGE ON THE CLOSING COIL ANY LONGER THAN THE TIME REQUIRED TO CLOSE THE BREAKER. (20 Cycles max. at normal voltage.) Both the coils and the germanium and silicon rectifiers are designed for intermittent operation and may be damaged by prolonged current flow.

When two or more breakers, operating from the same control power source, are required to close simultaneously, the closed circuit voltage at the closing coil of each breaker must fall within the specified limits.

Electrical closing or opening is accomplished by merely energizing the closing or trip coil circuit. Control switches are provided for this purpose on the metal-clad unit. It is also possible to trip the breaker manually by pressing the manual trip button (6), Fig. 1.

When all the foregoing inspection details have been checked, the breaker may be safely placed in service. Before the breaker is finally raised into position in the metal-clad unit, rub a small amount of G. E. Contact Lubricant D50H28 on the silvered portion of the breaker studs to form a thin coating for contacting purposes.

NOTE: This breaker mechanism combination is designed only for electrical closing when in use. NEVER ATTEMPT MANUAL CLOSING WITH THE BREAKER IN SERVICE, for under such conditions, sufficient closing force and speed cannot be applied.

OPERATION

CLOSING OPERATION

The closing operation of the breaker is primarily controlled by the control device, Fig. 11, mounted on the operating mechanism. The closing sequence is initiated from a control switch mounted on the door of the metal-clad unit or at a remote operating station. Operation of the closing control switch energizes the pick-up coil of the control device. As the control device closes, seal-in contacts shunt the closing control switch to allow the opening of the closing control switch contacts without affecting the overall closing operation. This type of arrangement assures complete closing of the breaker with only momentary contact of the closing control switch.

Operation of the control device energizes the breaker closing coil by closing the main control device contacts (5 and 6), Fig. 11. Once the control device contacts are picked up, they are electrically held in the closed position until the breaker closing operation is completed. Energizing the breaker closing coil raises the armature (6), Fig. 12 which in turn lifts the closing roller (4) through plunger (14). This motion is transmitted through the mechanism linkage and rotates the main crank (1), closing the breaker contacts. As the armature reaches the end of its travel, the prop (12) rotates beneath the pin (11) latching the breaker in the closed position. During the closing operation, the opening springs (9 and 10) are compressed in readiness for an opening operation. Air trapped above the armature acts as a dashpot to absorb the energy of the mechanism as it approaches the end of its stroke.

When the solenoid armature is near the end of its stroke the control device plunger (5), Fig. 23, mechanically trips the main control device contacts, de-energizing the closing coil and allowing the armature to return by gravity to its original position. The control device plunger also mechanically trips the seal-in switch, de-energizing the control device coil if the closing control switch is not closed. If the closing control switch is held in the closed position throughout and after the breaker closing operation, the control device linkage will remain picked up and be unable to reset to prepare for another breaker closing operation. This arrangement insures that "pumping" of the breaker will not occur during a trip-free operation.

The operating sequence for those breakers designed for MI-6 metal-clad equipment is similar to that described above except that a relay mounted elsewhere in the metal-clad unit replaces the control device. Also, a cut-off switch (Fig. 8) is used to replace the mechanical trip arrangement of the control device. The cut-off switch energizes an auxiliary relay to de-energize the main relay.

The closing speed of the arcing contact at nominal voltage should be 5 to 9 feet per second for the 150 MVA breakers and 9 to 12 feet per second for the 250 MVA breakers with rated closed circuit voltage at the

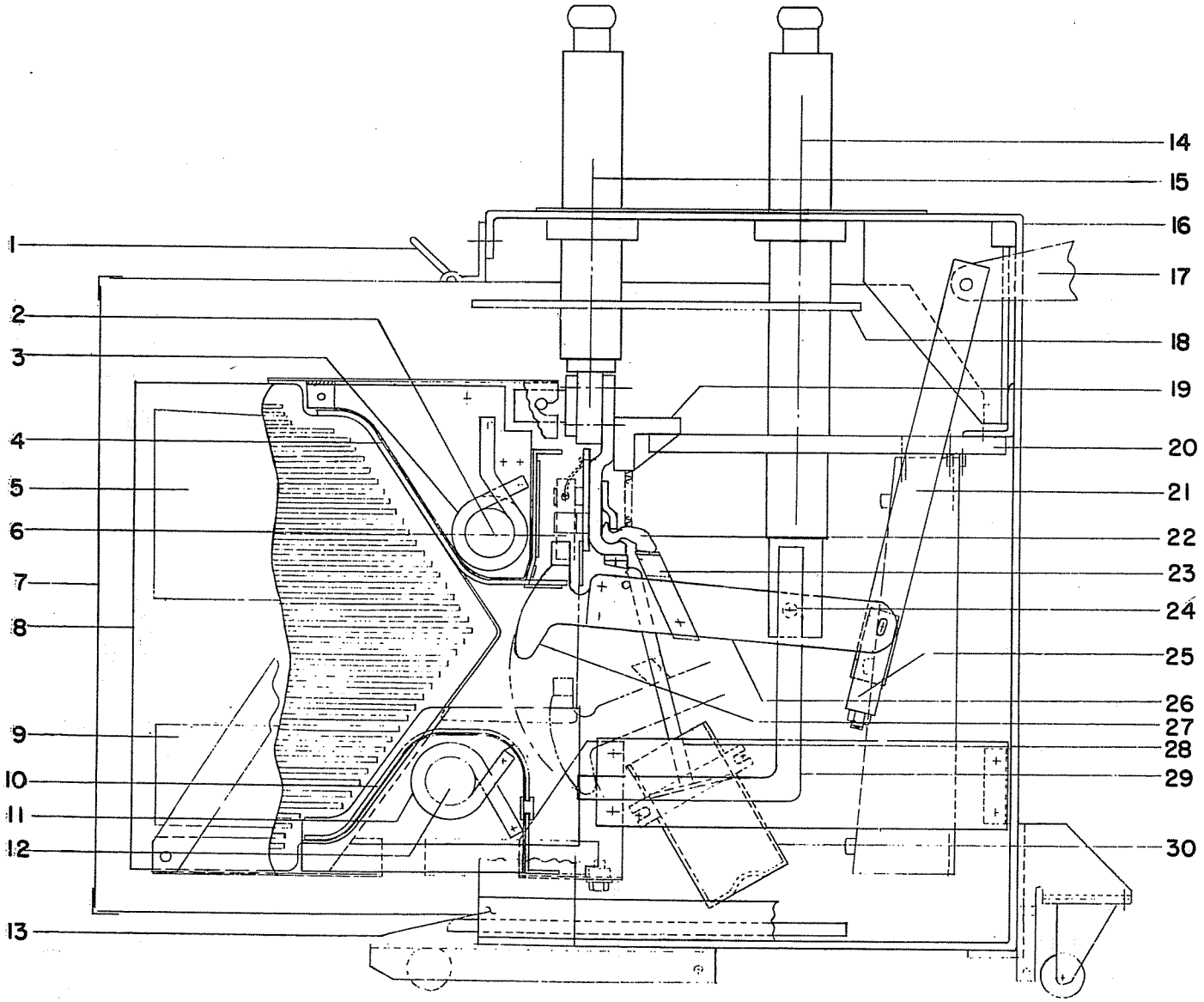


Fig. 13 (258C689)

1. Box Barrier Handle
2. Blow-out Core
3. Blow-out Coil
4. Arc Runner
5. Pole Piece
6. Stationary Arcing Contact
7. Box Barrier
8. Arc Chute
9. Pole Piece
10. Arc Runner
11. Blow-out Coil
12. Blow-out Core
13. Barrier
14. Front Bushings
15. Rear Bushings
16. Frame
17. Operating Crank
18. Upper Horizontal Barrier
19. Spring Retainer
20. Lower Horizontal Barrier
21. Operating Rod
22. Stationary Primary Contacts
23. Movable Primary Contacts
24. Cup Bearing
25. Yoke
26. Movable Contact Arm Assembly
27. Movable Arcing Contact
28. Booster Tube
29. Connection Bar
30. Booster Cylinder and Piston

Fig. 13 Cross Section Of Breaker Pole Unit

closing coil terminals. These speeds represent the average speed of the movable arcing contact from a point 1" before the tip is tangent to the lower surface of the upper arc runner to the tangent position.

OPENING OPERATION

An electrical opening operation is initiated by energizing the trip coil. This is accomplished either by actuating the opening control switch on the metal-clad unit or by a combination of relays and current devices used to detect a fault on the load side of the breaker. By energizing the trip coil, the trip plunger rotates the trip latch (2), Fig. 12, causing the operating mechanism linkage to collapse. The energy stored in the opening springs (9 and 10) is thus released, opening the breaker. During this operation, the trip coil circuit is de-energized, and upon completion of the opening operation, the operating mechanism is returned to its normal position, ready for closing.

As the breaker opens, the main contacts part first, shunting the current through the arcing contacts. An arc forms as the arcing contacts part. See Fig. 13. As the movable arcing contact (27) is withdrawn through the slot in the arc runner, the upper end of the arc is transferred to the upper arc runner (4). To assist the interruption at this point, a stream of air is emitted from the booster tube (28) and forces the arc onto the lower arc runner (10). Establishment of the arc on the runners automatically inserts the blowout coils into the circuit, introducing a magnetic field between the pole pieces which tends to draw the arc away from the arcing contacts. The 250 MVA interrupter contains one upper magnetic blowout coil and one lower blowout coil, each individually connected in series with its respective arc runner. The arc is forced outward along the diverging arc runners by the magnetic field.

At the same time, the arc is being forced into the arc chute (8) which is composed of a series of gradually interleaving insulating fins. These fins, which project alternately from the two opposite inner surfaces of the chute, elongate the arc into a gradually deepening serpentine path, so that the electrical resistance in the path of the arc is rapidly increased and the heat from the arc is absorbed. The increased resistance reduces both the magnitude and the phase angle of the current, and at an early current zero the arc path is so long and the gases produced by the arc so cooled that the arc cannot re-establish itself, and interruption occurs.

The 150 MVA interrupter is essentially the same as the 250 MVA interrupter except that it utilizes the magnetic elements in the upper runner only.

Manual tripping follows the same procedure except that instead of energizing the trip circuit, the manual trip (6), Fig. 1, is used.

The opening speed of the arcing contact should be 12 to 18 feet per second at rated control voltage. This speed represents the average speed over 3" from the point when the tip on the movable arcing contact is tangent to the lower surface of the upper runner.

TRIP FREE OPERATION

If the trip coil circuit is energized while the breaker is closing, the trip plunger will force the trip latch (2), Fig. 12, away from the trip roller (3) causing the mechanism linkage to collapse and the breaker to re-open. The closing armature (6) completes its closing stroke, but the closing coil is de-energized at the end of the stroke, and the armature is returned to its original position by gravity.

GENERAL MAINTENANCE

Dependable service and safer power equipment are contingent upon the unfailing performance of the power circuit breaker. To maintain such service, it is recommended that a definite inspection and maintenance schedule be set up and followed, as serious shutdowns can often be avoided by locating potential sources of trouble in an early stage. A periodic lubrication of parts subject to wear is also vitally important for the successful operation of the breaker.

BEFORE ANY MAINTENANCE WORK IS PERFORMED, MAKE CERTAIN THAT ALL CONTROL CIRCUITS ARE OPENED AND THAT THE BREAKER IS REMOVED FROM THE METAL-CLAD UNIT. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE IN THE CLOSED POSITION UNLESS THE PROP AND TRIP LATCH HAVE BEEN SECURELY WIRED OR BLOCKED TO PREVENT ACCIDENTAL TRIPPING.

PERIODIC INSPECTION

The frequency of periodic inspection should be determined by each operating company on the basis of the number of operations (including switching), the magnitude of currents interrupted, and any unusual operations which occur from time to time. Operating experience will soon establish a maintenance schedule which will give assurance of proper breaker condition. On installations where a combination of fault duty and repetitive operation is encountered, an inspection is recommended after any severe fault operation. The following instructions list the main points to be included in an inspection, and a number of general recommendations.

ARC CHUTES

It is not necessary to inspect the arc chutes unless there is evidence of damage or if the arc chutes are removed for any reason. When inspecting an arc chute, it should be disassembled and the following points noted:

1. Scale formed over the surface of the arc chute must not be removed, but loose particles collected in the chute should be blown out.
2. Cracks which have formed in the fins of the arc chute are to be expected in ceramic materials of this type when subjected to the severe heat of an arc. These fine cracks do not interfere with the operation of the device in any way and should be disregarded. Small broken corners on the exhaust end of the chute will not interfere with its performance and should be disregarded.
3. If the arc chute has suffered any mechanical injury due to dropping or accidental striking, resulting in the actual breaking off of fins, replacement of the chute will be necessary.

BREAKER CONTACTS

By removing the box barrier the movable and stationary primary contacts and the movable arcing contacts can be inspected. The stationary arcing contacts can be inspected only after removing the arc chute assembly, as explained under REPAIR AND REPLACEMENT. If the contacts are burned or pitted, they should be made smooth with a fine file.

After completing inspection of the contacts, check the contact adjustments as specified under INSTALLATION, ADJUSTMENTS.

MECHANISM

A careful inspection should be made to check for loose nuts or bolts and broken retaining rings. All cam, roller, and latch surfaces should be inspected for any evidence of damage or excessive wear. Lubricate the mechanism as outlined below, then, using the maintenance operating device, open and close the breaker several times to make certain that the mechanism operates freely throughout its entire stroke. Check the mechanism adjustments as specified under INSTALLATION, ADJUSTMENTS. Check all terminal connections.

BUSHINGS AND INSULATION

The surface of the Self-X bushings should be kept clean and unmarred to prevent moisture absorption. If the insulation surface should become damaged, it should be sanded and cleaned, and should be refinished with either clear varnish (GE-1170) or clear *Glyptal resin (GE-1202). Allow to dry smooth and hard.

All other insulation parts on the breaker should be kept clean and dry. Smoke or dust collected between inspection periods should be wiped off, and if dampness is apparent, heaters should be installed to insure dryness.

LUBRICATION

In order to maintain reliable operation it is important that all circuit breakers be properly lubricated at all times. During assembly at the factory, all bearing surfaces, machined surfaces, and all other parts of the breaker and mechanism subject to wear have been properly lubricated using the finest grade of lubricants available. However, even the finest oils and greases have a tendency to oxidize with age, as evidenced by hardening and darkening in color. Elimination of the hardened lubricant is essential for the proper operation of circuit breakers. Also frequent

operation of the breaker causes the lubricant to be forced out from between the bearing surfaces. A simple lubrication will often clear up minor disturbances which might be mistaken for more serious trouble.

A definite lubrication schedule should be set up taking into consideration the frequency of operation of the breaker and local conditions. Until such a schedule is worked out, the breaker should be lubricated at each periodic inspection and also whenever it is overhauled, in accordance with the lubrication chart, Fig. 14. It is also recommended that all circuit breakers be operated at regular intervals to insure the user that the equipment is operating freely.

The lubrication chart (Fig. 14) is divided into two methods of lubrication. The first method outlines the maintenance lubrication which should be performed at the time of periodic maintenance, and requires no disassembly. The second method outlines a lubrication procedure similar to that performed on the breaker at the factory, but should be used only in case of a general overhaul or disassembly for other reasons, or if the operation of the breaker becomes slower.

General Electric Lubricant D50H15 and D50H47 are available in 1/4# collapsible tubes. It is so packaged to insure cleanliness and to prevent oxidation.

Part	Lubrication at Maintenance Period	Alternative Lubrication (Requires Disassembly)
Ground surfaces such as cams, rollers, latches, etc.	Wipe clean and apply D50H15.	Wipe clean and apply D50H15.
Sleeve Bearings (Mechanism and Breaker Linkage)	Very light application of light machine oil SAE-20 or -30.	Remove pins and links and clean as per cleaning instructions. Apply D50H15 liberally.
Removable Seal and Open Type Ball, Roller and Needle Bearings	Light application of light machine oil SAE-20 or -30.	Clean as per cleaning instructions and repack with D50H15.
Silver Plated Contacts and Primary Disconnect Studs	Wipe clean and apply D50H47. **	Wipe clean and apply D50H47. **
Arcing Contacts	Do not lubricate.	Do not lubricate.
CONTACT ARM HINGE ASSEMBLY		
1. Cup Bearing	No lubrication required.	Wipe clean and apply D50H47** except on highly repetitive duty.
2. Loose rings between bushing and contact arm.	No lubrication required.	Replace rings showing evidence of excessive wear.
Booster Cylinders	No lubrication required.	No lubrication required.

** D50H47 supersedes D50H28.

Fig. 14 Lubrication Chart

METHOD OF CLEANING BEARINGS

Wherever cleaning is required, as indicated in the lubrication chart, the following procedures are recommended:

Sleeve Bearings

The pins should be removed and all old oxidized grease removed by immersion in clean petroleum solvent or similar cleaner. DO NOT USE CARBON-TETRACHLORIDE. Wipe the bearing clean. Apply a small amount of G. E. Lubricant D50H15 to the entire surface of the bearing and pin just before reassembling.

Removable Seal and Open Type Ball, Roller and Needle Bearings

The bearings should be first removed from the mechanism and disassembled by the removal of the seals or inner race in the case of needle bearings. They should then be placed in a container of clean petroleum solvent or similar cleaner. 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. Ordinarily, by agitating the bearings in the cleaning solution, and using a stiff brush to remove the solid particles, the bearings can be satisfactorily cleaned. Do not handle the bearings with bare hands as deposits from the skin onto the bearings are inducive to corrosion. If the bearings are touched, the contamination can be removed by washing in alcohol. After the bearings have been thoroughly cleaned, spin them in clean new light machine oil until the cleaner or solvent is entirely removed. Allow this oil to drain off and then repack them immediately with G. E. Lubricant D50H15 being sure all metal parts are greased. The removable seals should then be replaced.

NOTE: If it becomes necessary to clean the bearings in alcohol (shellac thinner) be sure the alcohol is perfectly clean, and do not allow the bearings to remain in the alcohol more than a few hours. If it is desirable to leave the bearings in the alcohol for a longer time, an inhibited alcohol such as is used for anti-freeze should be used. Even then the bearings should be removed from the alcohol within twenty-four hours. Esso Anti-Freeze and Du Pont Zerone are satisfactory for this purpose. Precautions against the toxic effects of the alcohol must be exercised by wearing rubber gloves and by using the alcohol in a well ventilated room; excessive exposure to the fumes is sometimes unpleasant to personnel. Washing the bearings in light oil and draining should follow immediately then apply the lubricant.

RECOMMENDED MAINTENANCE FOR MAGNE-BLAST BREAKERS APPLIED TO REPETITIVE SWITCHING DUTY

Magne-blast breakers applied to repetitive operation such as switching arc furnaces, capacitors and motors should be serviced and maintained according to the following schedule:

A. Every 2000 Operations, or Every Six Months - Whichever Comes First

1. Remove the box barriers and operating mechanism covers.

2. Wipe all insulating parts, with a clean dry cloth, including the bushings, clean of smoke deposit and dust, also the inside of the box barriers.

3. Primary Contacts - Inspect the condition of the stationary contact fingers and movable contact blocks. Badly pitted or burned contacts should be replaced. (Note: Burned primary contacts indicate the probable need for arcing contact replacement). If the contact surfaces are only roughened or galled, they should be smoothed with crocus cloth or draw filed. After contact dressing the contacts should be greased lightly with D50H47.

4. Arcing Contacts - When the arcing contact wipe is less than the minimum specified under "Adjustments", the contacts should be replaced. The contacts should be inspected for uneven wear and/or damage using a mirror to inspect the stationary contacts. Normally it will not be necessary to remove the arc chutes for this 2000 operation servicing unless inadequate wipe or contact conditions indicate a need for replacement. When the arc chutes are removed, the contact braids, coil protectors, and other parts subject to arcing should be checked for possible cleaning or replacement. Do not grease the arcing contacts under any circumstances.

5. Check the breaker and mechanism adjustments as summarized under "Final Inspection & Test". The necessary readjustments should be made as described under "Adjustments".

6. The breaker and operating mechanism should be carefully inspected for loose nuts, bolts, retaining rings, etc., all cam, latch and roller surfaces should be inspected for damage or excessive wear. The buffer blocks and their retainers on the bottom of the stationary contact support should be inspected for possible need of replacement.

7. The main contacts of the control device should be inspected for wear and possible replacement.

8. Lubricate the breaker operating mechanism in accordance with the table under paragraph heading "LUBRICATION".

9. Inspect all wiring for tightness of connections and possible damage to insulation.

10. After the breaker has been serviced, it should be closed and opened slowly with the maintenance closing device to be sure there is no binding or friction and that the breaker contacts can move to the fully opened and fully closed positions. Its electrical operation should then be checked using either the test cabinet or the test couplers.

B. After Every 10,000 Operations

1. In addition to the servicing done each 2,000 operations, the arc chutes should be removed from the breaker and disassembled to permit a detailed inspection of insulation, blowout coils and arc runners.

2. All areas in the throat area of the arc chute assembly which are contaminated by arc products should be thoroughly cleaned by using sandpaper. This cleaning should be performed any time the arc chute is removed. The arc chute fins should not be cleaned. Whenever the arc chute is removed, loose dust and dirt should be blown out before replacing arc chutes.

3. The blow-out coils should be carefully examined and if the insulation has been cracked, shrunk or eroded from arc action and heat so that the turns of the coils are not fully insulated from each other the coils should be replaced. All connections should be checked for tightness.

4. The arc runners should be inspected and replaced when any part of their area has been reduced to 25% of the original metal thickness as a result of arc erosion.

5. Check the stationary arcing contacts to assure that the arcing contacts are in good condition and that their connections are tight.

6. Insulating material that is carbonized and cannot be satisfactorily cleaned should be replaced.

7. Any parts damaged or severely burned and/or eroded from arc action should be replaced.
NOTE: Fine cracks may develop in the fins of the arc chute sides. This is to be expected with ceramic materials when subjected to the high heat of an arc and may be disregarded unless they are long and present a possibility of fin sections breaking completely off. Small broken corners on the exhaust end of the arc chute will not interfere with its performance and can also be disregarded.

C. Every 20,000 Operations or Approximately Every Five Years - Whichever Comes First

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

2. The trip roller and trip shaft bearings in the operating mechanism should be disassembled, cleaned and repacked with G. E. Lubricant D50H15 as described under "Lubrication".

3. The cup bearing at the hinge point of the contact blade should be disasembled, inspected, cleaned and re-lubricated with G. E. contact lubricant D50H47. Contact rings at the hinge point between the contact blade and bushing may be lubricated for prolonged life. The contact rings should be inspected for wear and replaced when reduced in thickness to less than 1/32".

4. The stationary primary contact fingers should be disassembled and the silver-plated pivot area of the contact and contact support cleaned and lubricated with G. E. lubricant D50H47.

5. The breaker and operating mechanism should be serviced as described for every 2,000 operations and properly adjusted before being put back into service.

TROUBLE SHOOTING

Failure of a breaker to operate properly will generally fall within three general classes: Failure to trip, failure to close or latch closed, and overheating. The following is a brief outline showing particular types of distress that might be encountered, together with suggestions for remedying the trouble:

FAILURE TO TRIP

1. Mechanism binding or sticking caused by lack of lubrication.
REMEDY: Lubricate complete mechanism.

2. Mechanism binding or sticking caused by being out of adjustment.
REMEDY: Check all mechanism adjustments, latches, stops, auxiliary devices, etc., in accordance with INSTALLATION, ADJUSTMENTS. Examine latch and roller surfaces for corrosion.

3. Damaged trip coil.
REMEDY: Replace damaged coil.

4. Blown fuse in trip circuit.
REMEDY: Replace blown fuse after determining cause of failure.

5. Faulty connections in trip circuit.
REMEDY: Repair broken or loose wires and see that all binding screws are tight.

6. Damaged or dirty contacts in trip circuit.
REMEDY: Recondition or replace contacts.

FAILURE TO CLOSE OR LATCH CLOSED

1. Mechanism binding or sticking caused by lack of lubrication.
REMEDY: Lubricate complete mechanism.

2. Mechanism binding or sticking caused by being out of adjustment.
REMEDY: Check all mechanism adjustments, latches, stops, auxiliary devices, etc., in accordance with INSTALLATION, ADJUSTMENTS. Examine latch and roller surfaces for corrosion.

3. Control device sticking or not operating properly.
REMEDY: Check and adjust control device, or replace.

4. Damaged or dirty contacts in control circuit, including control device.
REMEDY: Recondition or replace contacts.

5. Damaged control device coil.
REMEDY: Replace damaged coil.

6. Damaged closing coil.
REMEDY: Replace damaged coil.

7. Defective cut-off switch, latch-checking switch, or interlock switch.
REMEDY: Replace defective switch.

8. Blown fuse in closing circuit.
REMEDY: Replace blown fuse after determining cause of failure.

9. Faulty connections in closing circuit.
REMEDY: Repair broken or loose wires and see that all binding screws are tight.

10. Insufficient control voltage caused by excessive drop in leads.
REMEDY: Install larger wires and improve electrical contact at connections.

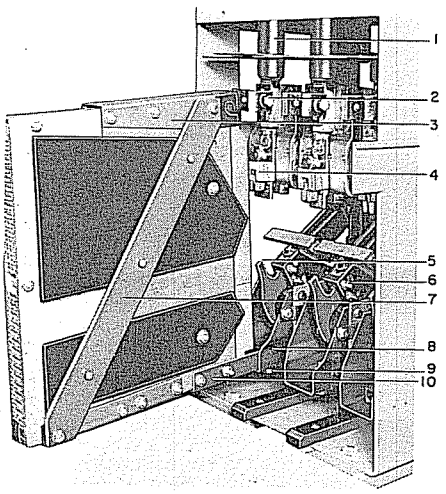
11. Insufficient control voltage caused by poor regulation (a-c control).
REMEDY: Install larger control transformer. Check rectifier to be sure it is delivering adequate d-c supply.

OVERHEATING

1. Poor condition of contacts due to lack of attention after severe duty or too frequent operation.
REMEDY: Recondition or replace burned and pitted contacts. (Contacts should be reconditioned very carefully and only when absolutely necessary).

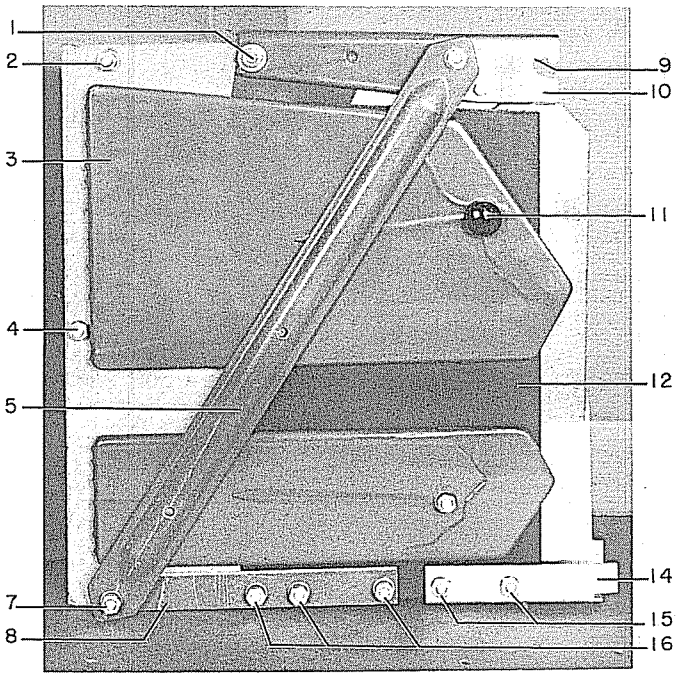
2. Contacts not properly aligned or adjusted.
REMEDY: Check all adjustments in accordance with INSTALLATION, ADJUSTMENTS.

3. Breaker kept closed or open for too long a period.
REMEDY: Operate breaker more often to wipe contacts clean. Replace contacts if necessary.



1. Rear Bushing
2. Supporting Bolt
3. Upper Mounting Support
4. Stationary Arcing Contact Assembly
5. Movable Arcing Contact
6. Assembly Bolts
7. Brace for Arc Chute
8. Arc Chute Mounting Bracket
9. Lower Supporting Bolt
10. Lower Mounting Support

Fig. 15 Arc Chute Partially Removed Showing Accessibility of Arcing Contacts



1. Assembly Bolts and Bushing
2. Assembly Bolts
3. Upper Pole Piece
4. Assembly Bolt
5. Side Brace
7. Assembly Bolt
8. Lower Brace
9. Mounting Slot
10. Upper Mounting Support
11. Assembly Bolt
12. Side Shield
14. Lower Mounting Support
15. Assembly Bolts
16. Assembly Bolts

Fig. 16 Arc Chute Assembly Complete (150 mva, 250 mva)

Fig. 15 (8019971)

Fig. 16 (8025742)

4. Overloading.
   REMEDY: Replace breaker with one of adequate rating for present or future load, or re-arrange circuits so as to remove excess load.

5. Primary connections of inadequate capacity.
   REMEDY: Increase size or number of conductors or remove excess current.

6. Loose connections or terminal connections.
   REMEDY: Tighten.

7. Ambient temperature too high.
   REMEDY: Relocate in a cooler place, or arrange some means of cooling.

REPAIR AND REPLACEMENT

The following information covers in detail the proper method of removing various parts of the breaker in order to make any necessary repairs. This section includes only those repairs that can be made at the installation on parts of the breaker that are most subject to damage or wear. IMPORTANT: UPON COMPLETION OF ANY REPAIR WORK, ALL BREAKER AND MECHANISM ADJUSTMENTS MUST BE CHECKED. Refer to the section on INSTALLATION, paying particular attention to ADJUSTMENTS and FINAL INSPECTION.

ARC CHUTE (To inspect or replace blow-out coils)

To remove an arc chute, first open the breaker and remove the box barrier (7), Fig. 13. Loosen the two upper supporting bolts (2), Fig. 15, and the one lower supporting bolt (9) using a 3/4" wrench. By raising the complete arc chute assembly about 3/8" and sliding it toward the rear of the breaker it can be removed as shown in Fig. 15.

To disassemble the arc chute after it has been removed from the breaker, proceed as follows:

1. Remove the assembly bolts (7, 9, 11 and 13), Fig. 16.

2. Remove the side brace and pole piece assembly (5), Fig. 16.

3. To remove the upper mounting support (10), Fig. 16, remove the assembly bolts (1) and connection screw (2), Fig. 18.

4. Remove the assembly bolts (16), Fig. 16 to remove the lower brace (8).

5. Remove the lower mounting support (14), Fig. 16, by removing the assembly bolts (15) and the connection nut (9), Fig. 18.

6. At this point the fiber side shields (6), Fig. 18, the upper arc runner assembly (4) and lower arc runner assembly (7) can be removed.

7. Further disassembly of both the upper and lower arc runner assemblies can be done by removing the various screws and 1/4" assembly bolts (not illustrated) as shown in Fig. 17.

8. The arc chute sides (6), Fig. 17, can be separated by removal of assembly bolts (2 and 4), Fig. 16.

Reassemble the arc chute in the reverse order. The following items should be noted during reassembly:

1. Equally space the fins of the arc chute sides before bolting together.

2. Check to insure that electrical connections to the blowout coils are tight.

3. When reassembling the arc runner assemblies, check that the spacers (1 and 13), Fig. 17, are correctly installed.

4. Before bolting the upper mounting support in place, make certain that the upper arc runner assembly is tight against the arc chute side so that the gap between the upper insulation (7), Fig. 17, and the arc chute side (6) is a minimum.

5. Make certain that the electrical connections (2 and 9), Fig. 18, are tight.

To reassemble the arc chute to the breaker, proceed as follows:

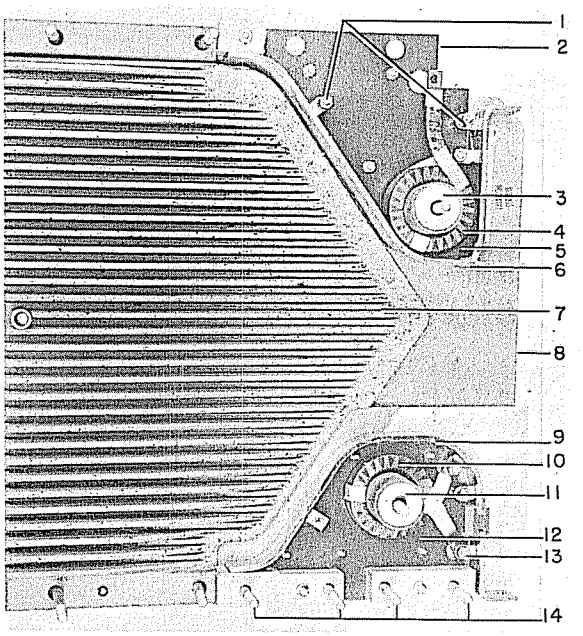
1. Rest the lower mounting support (10) on the arc chute mounting bracket (8) as shown in Fig. 15.

2. Slide the arc chute forward and lift it slightly to engage the supporting bolts (2), Fig. 15, in the slots of the upper mounting support (3).

3. Tighten the supporting bolts (2 and 9), Fig. 15. These bolts serve as both the electrical and mechanical connections between the bushing and the arc runners.

4. Check that the movable arcing contact (5), Fig. 3, passes through the slot in the upper arc runner (6) without touching.

Fig. 17 (8024600)



1. Upper Arc Runner Spacers
2. Upper Arc Runner Assembly
3. Blowout Core
4. Blowout Coil
5. Insulation
6. Upper Arc Runner
7. Arc Chute Side
8. Upper Insulation
9. Lower Arc Runner
10. Blowout Coil
11. Blowout Core
12. Lower Arc Runner Assembly
13. Lower Coil Connection
14. Lower Arc Runner Spacers

Fig. 17 Arc Chute Assembly with Side Removed

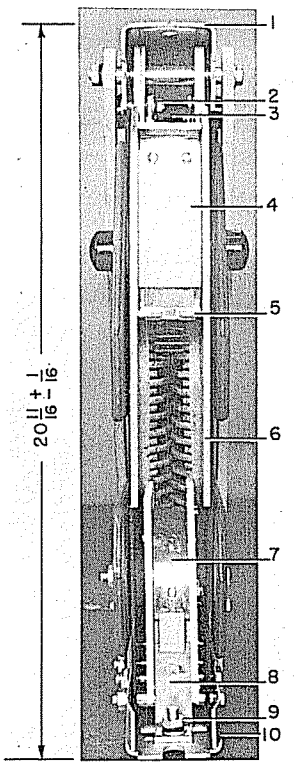
TRIP SHAFT BALL BEARINGS

1. Remove mechanism cover.
2. Remove mounting bolts for control device, Fig. 1, Part 7, letting control device hang free. Do not remove wiring.
3. Remove the trip coil frame mounting bolts, Fig. 24, Part 2, letting frame hang free. Also, remove trip coil leads from terminal boards, Fig. 24, Part 4.
4. Remove the trip coil and plunger bracket from trip shaft using snap ring pliers on ring holding trip coil plunger assembly.
5. Remove switch bar, Fig. 23, Part 5, from latch shaft and snap ring and washers near bearing.
6. Remove stop bar, Fig. 32, View A, Part 282, for manual trip rod. Also, remove snap rings and washers next to bearing on left side.
7. Using a brass rod approximately 15" long and 3/8" diameter, drive each bearing out, taking the right one out first using the opening in the left side of the mechanism frame and the left one out from the opening made from the removal of the right hand bearing.

NOTE: When removing the left hand bearing, brass rod as mentioned above may have to be bent in order to clear latch.

8. To reassemble, reverse the above procedure except to drive bearings back in the mechanism frame, a pipe should be used so as not to damage bearing surface.
NOTE: If latch is to be replaced, the first seven steps as listed above should be followed. Also remove the set screw holding the latch on shaft then place block between latch and frame to stop movement, and drive shaft out of latch. When replacing, make sure spring is in proper place and one half turn has been made to wind spring. Also, make sure latch is in place on stop bar roller before bearings and shaft are reassembled.

Fig. 18 (8024605)



1. Upper Mounting Support
2. Connection Bolt
3. Upper Blowout Coil
4. Upper Arc Runner Assembly
5. Upper Arc Runner
6. Side Shield
7. Lower Arc Runner Assembly
8. Lower Coil Connection
9. Connection Nut
10. Lower Mounting Support

Fig. 18 Front View Arc Chute Assembly

TRIP LATCH ROLLER BEARING

1. Remove mechanism cover.
2. Remove mounting bolts on control device, Fig. 1, Part 7, leaving control device hang free. Do not remove wiring.
3. Place block between manual trip rod Fig. 1, Part 6, and stop bar on trip shaft. This holds trip shaft in trip position and allows trip linkage to be free.
4. Working through hole on left hand side of mechanism, remove snap ring and washer from trip roller pin, Part 289, Fig. 32, View C, using snap ring pliers.
5. Slide trip roller pin, Part 289, Fig. 32, just enough to the right to allow room to hook snap ring pliers on ring on other end of pin. Compress pliers to free snap ring and pry the pin to the left with screwdriver to complete the removal of snap ring.
6. Trip roller bearing can now be removed for lubrication (see section on LUBRICATION). Particular attention should be paid to the location of washers and spacers.
7. To reassemble, reverse the above procedures.

CONTACTS

Open the breaker and remove the box barrier and arc chutes as previously described. To remove the contacts, proceed as follows:

A. Stationary Arcing Contacts (10) Fig. 19
1. Disconnect the contact braids from contact fingers by removing two bolts (8), Fig. 19.
2. Grasp the lower end of the contact fingers with pliers and pull contact assembly downward to remove from stud assembly.
3. To disassemble braids from stud assembly, remove one bolt (5).
4. To disassemble stud assembly from contact support, remove two bolts (6).
5. Reassemble in the reverse order.

B. Stationary Primary Contacts (9), Fig. 20
1. Compress the contact spring (6).
2. Remove spring and spring guide (1).
3. Raise the contact finger to clear the primary contact stop plate (8) and lift the finger out of contact support (7).

To replace the Stationary Primary Contacts:

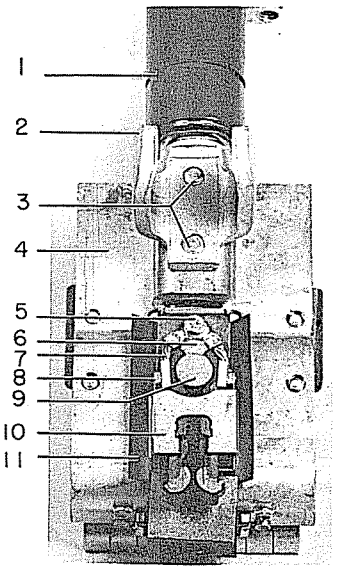
1. Apply a thin coating of D50H28 grease on the hinged end of the finger (9) then place it on contact support (7) so that it is retained by stop plate (8).
2. Open spring compressor (3) and assemble spring guide, spring and spring compression (Fig. 20A).
3. Turn handle (2) in clockwise direction to compress contact spring (Fig. 20B). Hold spring firmly in yoke on spring compressor to prevent the spring from slipping out of the compressor.
4. Place washer (not shown) on guide on top of spring, place top of guide into hole in spring retainer (4) and the round end of spring guide in cut out in primary finger (Fig. 20C).
5. Hold spring assembly firmly in place and remove spring compressor.

C. Movable Arcing Contact (7), Fig. 21.
1. Remove the assembly bolts (8).
2. Reassemble in reverse order.

D. Movable Primary Contacts (5), Fig. 21.
(1200 Amp. Breaker)
1. Remove the nuts from assembly bolts (6).
2. Remove the primary contacts and spacers (not illustrated).
3. Reassemble in reverse order.
(2000 Amp. Breaker)
1. Remove the nuts from assembly bolts (6).
2. Remove the connection bar (9).
3. Remove the cup bearing (3).
4. Spread the contact arms (4) and remove the primary contacts (5).
5. Reassemble in the reverse order.

E. Contact Blade Assembly (4,5;7), Fig. 21
1. Remove the connection bar (9).
2. Remove the cup bearing (3) and the pin (2) Fig. 4.
3. When reassembling, first insert the piston assembly (10), Fig. 21, into the booster cylinder and reassemble the cup bearing (3).
4. Replace pin (2), Fig. 4, and connection bar (9), Fig. 21.

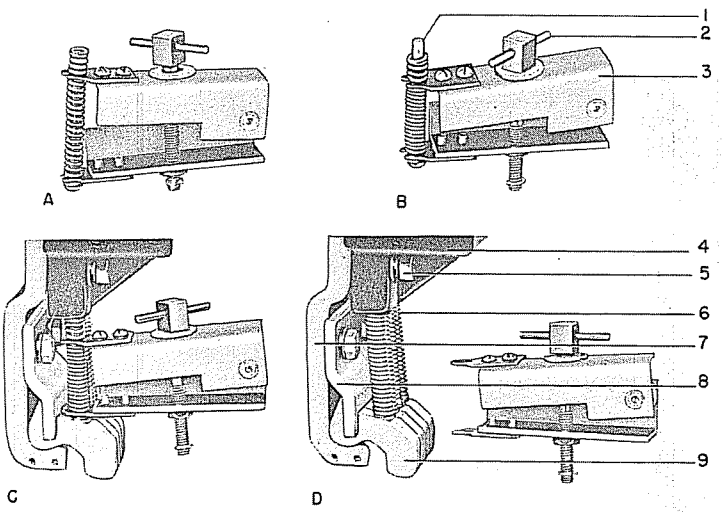
F. After disassembly and reassembly of any contacts, check all contact adjustments as described under INSTALLATION, ADJUSTMENTS.



1. Rear Bushing
2. Guide and Support for Arc Chute
3. Bolts for Contact Support
4. Contact Support
5. Bolt for Flexible Braid
6. Mounting Bolt
7. Flexible Braid
8. Connection Bolt
9. Stud for Mounting Arcing Fingers
10. Stationary Arcing Contact Assembly
11. Spring Baffle

Fig. 19 Rear Bushing Assembly

Fig. 19 (8025170)

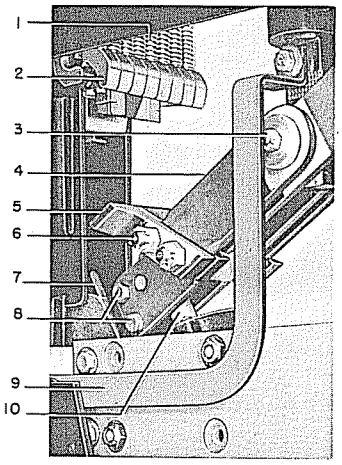


1. Spring Guide
2. Handle for Spring Compressor
3. Spring Compressor
4. Spring Retainer
5. Assembly Bolt for Spring Retainer
6. Spring
7. Contact Support
8. Stop Plate
9. Stationary Primary Contact Fingers

Fig. 20 Method of Installing Primary Contact Springs Using a Spring Compressor

Fig. 20 (8017149)

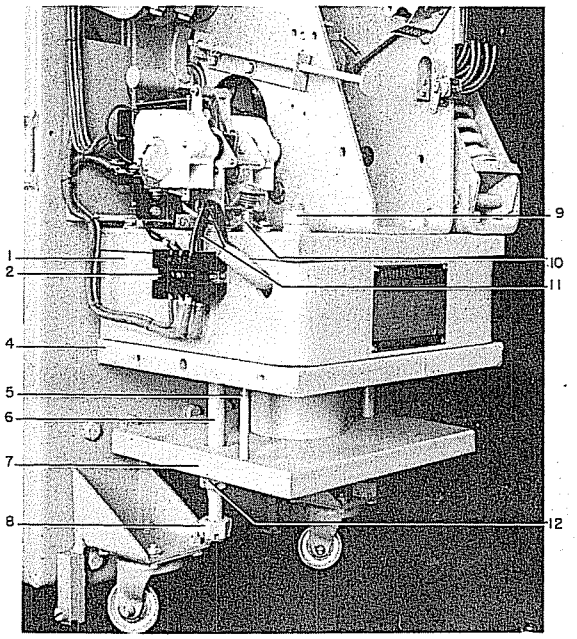
Fig. 21 (8012188)



1. Contact Springs
2. Stationary Primary Contacts
3. Cup Bearing
4. Contact Arm
5. Movable Primary Contacts
6. Assembly Bolts
7. Movable Arcing Contact
8. Assembly Bolts
9. Connection Bar
10. Piston Assembly

Fig. 21 Removal of Contacts

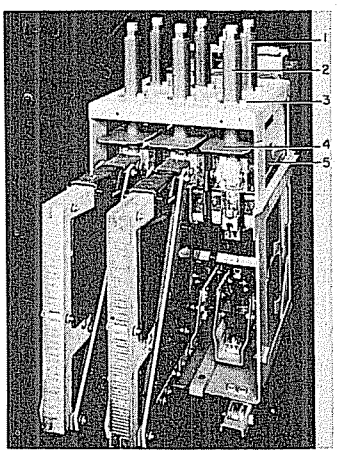
Fig. 22 (8022047)



1. Solenoid Pot
2. Terminal Board
4. Bottom Plate
5. Control Device Trip Plunger Rod
6. Guide Studs
7. Closing Armature
8. Stop Nuts
9. Front Stud Nuts
10. Plunger Guide
11. Closing Coil Leads
12. Stop Nuts

Fig. 23 Closing Solenoid Assembly

Fig. 23 (8022045)



1. Front Bushing
2. Rear Bushing
3. Mounting Bolts
4. Upper Horizontal Barrier
5. Lower Horizontal Barrier

Fig. 22 Rear View of Breaker with One Arc Chute Removed

BUSHINGS

IMPORTANT: DO NOT REMOVE ALL SIX BUSHINGS AT ONCE. The bushings have been carefully aligned with the breaker frame, during assembly at the factory, and it is important that this alignment be maintained to facilitate installation of the breaker in the metal-clad unit. It is therefore recommended that the bushings be removed and reassembled one at a time. Also, before removing any one bushing, measure the distance from that particular bushing to adjacent bushings in both directions, so that it may be re-installed in the same location.

It is also possible to remove and reassemble three bushings at one time. If this is preferred, alignment of the bushings may be accomplished by placing the breaker in a de-energized spare metal-clad unit before tightening the bushing mounting bolts. This must be done before the arc chutes are re-installed

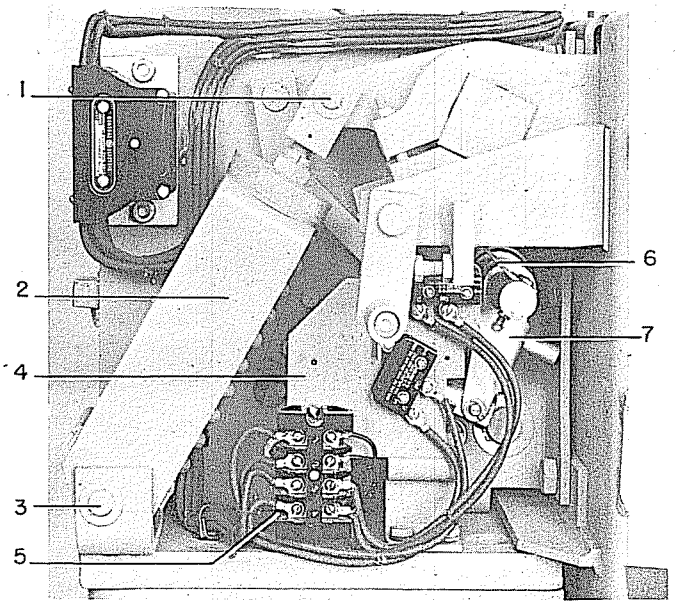
To replace the bushing, proceed as follows:

Rear Bushing

1. Open the breaker and remove the box barrier and arc chutes as already described.
2. Remove the upper and lower horizontal barriers (4 and 5), Fig. 22.
3. Remove the four bolts (3) at the mounting flange of the rear bushing being removed and lower the bushing assembly.
4. Referring to Fig. 20, disassemble the primary contact springs (6) as previously described.
5. Disassemble the spring retainer (4) by removing mounting bolts (5).
6. Referring to Fig. 19, disassemble the contact support (4) and arc chute mounting bracket (2) by removing two bolts (3).
7. Reassemble in the reverse order. The arc chute mounting bracket (2) is not symmetrical and must be assembled correctly to orient the arc chute properly on the breaker. The longest projection of the bracket should be toward the lower end of the bushing.

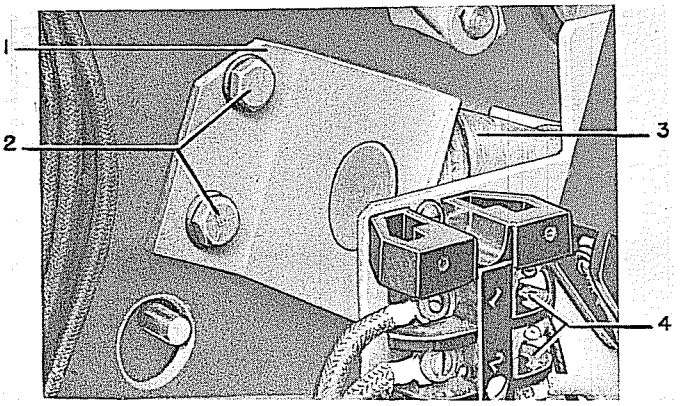
Front Bushing

1. Open the breaker and remove the box barrier and arc chutes as already described.
2. Remove the upper and lower horizontal barriers (4 and 5), Fig. 22.
3. Remove the connection bar (9), Fig. 21, and cup bearing (3).
4. Remove the four bolts at the mounting flange of the front bushing being removed, and lower the bushing.
5. When reassembling, first mount the bushing and assemble the cup bearing (3) and contact arm (4), Fig. 21. The contact surfaces at the hinge point of the contact blade and cup bearing should have a thin coating of D50H47 grease.
6. Check all contact adjustments as outlined under INSTALLATION, ADJUSTMENTS.



1. Pivot Pin
2. Opening Spring Unit
3. Pivot Pin
4. Trip Coil Mounting Plate
5. Terminal Board
6. Switch Bar
7. Trip Coil Plunger Bracket

Fig. 24 Opening Spring Assembly



1. Trip Coil Support
2. Mounting Bolts
3. Trip Coil
4. Trip Coil Leads

Fig. 25 Potential Trip Coil

Fig. 24 (8020728)

Fig. 25 (8019962)

CLOSING COIL

The closing coil is contained within the solenoid pot (1), Fig. 23. To remove the closing coil, proceed as follows:

1. Open the breaker.
2. Remove the two closing coil leads (11). Remove the terminal board (2) from the solenoid pot and let it hang by the wires. Also, remove the wire from band (3).
3. Remove the stop nuts (8 and 12) on guide studs (6), lower the armature plate (7) and control device trip plunger (5). Note: For ease in removing the closing coil and bottom plate (step 5) the armature and plunger assembly can be removed from the mechanism by removing the four bolts on the under side of the armature plate.
4. Loosen the four nuts under the bottom plate (4) approximately 1/2". Support the bottom plate with a rope sling or hoist and remove the two rear nuts.
5. Remove the nuts (9) at the top of the front studs. This permits the bottom plate, closing coil, solenoid pot (1) and control device plunger guide (10) to be removed.
6. To reassemble, first place the closing coil and spacers on the bottom plate (4). Raise into position, inserting the control device plunger guide (10) and compressing the piston ring on the upper pole piece.
7. Tilt the bottom plate downward and replace the solenoid pot (1) and two front studs and nuts (9).
8. Tighten the four nuts under the bottom plate taking special precaution to center the closing coil around the pole piece. If the closing coil is not firmly held in place, add spacers above the closing coil.
9. Replace the control device trip plunger rod (5) and armature (7).
10. Recheck the mechanism adjustments as explained under INSTALLATION, ADJUSTMENTS.

TRIP COIL

To replace the potential trip coil (3), Fig. 25, proceed as follows:

1. Open the breaker and remove the opening spring unit (2), Fig. 24, by removing the pivot pins (1 and 3).
2. Disconnect the two trip coil lead wires (4), Fig. 25.
3. Remove the two mounting bolts (2) and the trip coil support (1).
4. Remove the trip coil (3).
5. After reassembling (in the reverse order) check the primary contact gap adjustment as explained under INSTALLATION, ADJUSTMENTS.

INTERLOCK SWITCH

To remove the interlock switch (3) Fig. 6, remove the two mounting screws (4) and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under INSTALLATION, ADJUSTMENTS.

LATCH CHECKING SWITCH

To remove the latch checking switch (6), Fig. 6, (when furnished), remove the two mounting screws (8) and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under INSTALLATION, ADJUSTMENTS.

CUT-OFF SWITCH

To remove the cut-off switch (1), Fig. 8, remove the two mounting bolts and disconnect the lead wires. When reassembling, check the cut-off switch adjustment as explained under INSTALLATION, ADJUSTMENTS.

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.

Note: The listed terms "right" and "left" apply when facing the solenoid mechanism end of the breaker.

ORDERING INSTRUCTIONS

1. ALWAYS SPECIFY THE COMPLETE NAMEPLATE DATA OF BOTH THE BREAKER 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, REFER TO THE NEAREST OFFICE OF THE GENERAL ELECTRIC COMPANY.

ILLUSTRATION REFERENCE

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

In the tabulation below are listed the parts of those breakers which are usually recommended for stock for normal maintenance. Other parts are listed on the following pages.

FIG. NO.	REF. NO.	RATING IN MVA	RATING IN AMPS.	CAT. NO. FOR TYPE AM 4.16 (MVA)-3	NO. PER BREAKER	DESCRIPTION
26	1	ALL	ALL	263B293 P-2	3	Booster Cylinder
26	7	ALL	ALL	281B708 G-4	3	Operating Rod
26	117	ALL	ALL	414A116 P-2	3	Insulation Plate
26	118	ALL	ALL	414A117 P-1	6	Upper Runner Insulation Bottom
26	126	250, 250A	ALL	383A932 P-1	6	Lower Shield
26	130	ALL	ALL	258C616 P-9	6	Upper Runner Insulation
26	131	250, 250A	ALL	421711 P-1	12	Insulating Cup
26	*	250, 250A	ALL	407193 P-1	12	Washer
26	132	150, 150A	ALL	258C616 P-13	6	Lower Barrier
26	132	250, 250A	ALL	258C616 P-6	6	Lower Barrier
28	155	ALL	ALL	236C791 G-1	3	Flexible Conn. (Right)
28	155A	ALL	ALL	236C791 G-4	3	Flexible Conn. (Left)
28	156	ALL	ALL	236C790 G-9	3	Sta. Arcing Contact Assembly
28	158	ALL	ALL	414A116 P-4	3	Insulating Plate
28	159	ALL	ALL	6445087 P-2	3	Buffer
28	160	150A	600	414A180	12	Primary Contact Finger Spring
28	160	150, 150A	1200	414A180	12	Primary Contact Finger Spring
28	160	250, 250A	1200	6509787 P-1	24	Primary Contact Finger Spring
28	160	ALL	2000	6509787 P-1	24	Primary Contact Finger Spring
28	165	150A	600	236C791 P-8	12	Primary Contact Finger
28	165	150, 150A	1200	236C791 P-8	12	Primary Contact Finger
28	165	250, 250A	1200	236C791 P-8	24	Primary Contact Finger
28	165	ALL	2000	236C791 P-8	24	Primary Contact Finger
28	168	150A	600	6557243 P-1	6	Clamp for Buffer
28	168	150, 150A	1200	6557243 P-1	6	Clamp for Buffer
28	168	250, 250A	1200	6557243 P-2	6	Clamp for Buffer
28	168	ALL	2000	6557243 P-2	6	Clamp for Buffer
29	211	ALL	ALL	802B742 G-3	3	Movable Arcing Contact
29	212	150A	600	6591644 P-7	3	Movable Primary Contact
29	212	150, 150A	1200	6591644 P-7	3	Movable Primary Contact
29	212	250, 250A	1200	6591644 P-7	6	Movable Primary Contact
29	212	ALL	2000	6591644 P-7	6	Movable Primary Contact
29	213	150A	600	6591644 P-8	3	Movable Primary Contact
29	213	150, 150A	1200	6591644 P-8	3	Movable Primary Contact
29	213	250, 250A	1200	6591644 P-8	6	Movable Primary Contact
29	213	ALL	2000	6591644 P-8	6	Movable Primary Contact
30	261	250, 250A	ALL	6375521 G-2	1	Closing coil (125v d-c)
30	261	150, 150A	ALL	6375521 G-6	1	Closing coil (125v d-c)
30	261	250, 250A	ALL	6375521 G-1	1	Closing coil (250v d-c)
30	261	150, 150A	ALL	6375521 G-5	1	Closing coil (250v d-c)
32	370	ALL	ALL	6174582 G-1	1	Potential trip coil (125v d-c)
32	370	ALL	ALL	6174582 G-2	1	Potential trip coil (250v d-c)
32	370	ALL	ALL	6174582 G-14	1	Potential trip coil (230v a-c)
32	370	ALL	ALL	6275070 G-1	1	Potential trip coil (24v d-c)
32	370	ALL	ALL	6275070 G-2	1	Potential trip coil (48v d-c)
36	663	ALL	ALL	6275017 G-19	1	UVD Coil (125v d-c)
36	663	ALL	ALL	6275017 G-20	1	UVD Coil (250v d-c)
36	663	ALL	ALL	6275017 G-33	1	UVD Coil (230v a-c)
37	738	ALL	ALL	6174599 G-2	3	Current trip coil (3 Amp. a-c)
37	738	ALL	ALL	6174599 G-6	1	Capacitor trip coil (230v a-c)
38	753	ALL	ALL	6275017 G-19	1	Control device coil (125v d-c)
38	753	ALL	ALL	6275017 G-20	1	Control device coil (250v d-c)
38	753	ALL	ALL	6275017 G-33	1	Control device coil (230v a-c) (continuous)
38	753	ALL	ALL	6275017 G-34	1	Control device coil (230v a-c) (intermittent)

* Not shown

Fig. 26A (8025741)

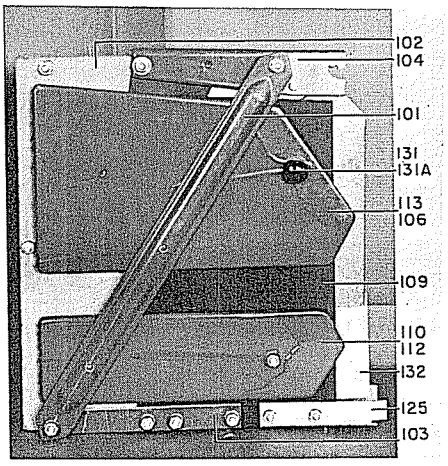


Fig. 26A Complete Assembly (250 mva)

Fig. 26B (8024600)

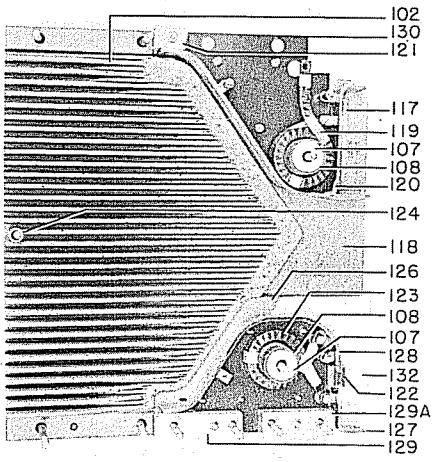


Fig. 26B Side Cover Removed

Fig. 26C (8020726)

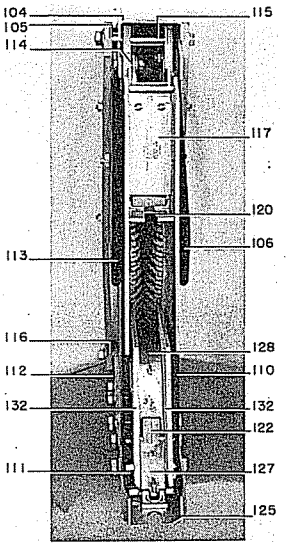


Fig. 26C Front View

Fig. 26 Arc Chute (Ref. No. 100)

PARTS REFERENCED IN FIGS. 26A, 26B & 26C

REF.	MVA	AMPS	CAT. NO. FOR AM-4.16-(MVA)-3	REQ.	DESCRIPTION
100	150, 150A	A11	215D469 G-1	3	Arc chute asm., complete
100	250, 250A	A11	215D469 G-2	3	Arc chute asm., complete
101	A11	A11	456A381 P-1	6	Brace
102	A11	A11	264B100 G-3	3	Arc chute sides
103	A11	A11	258C616 P-4	6	Lower support
104	150, 150A	A11	215D469 G-8	3	Upper support
104	250, 250A	A11	215D469 G-9	3	Upper support
105	A11	A11	6176109 P-78	6	Spacer
106	A11	A11	258C615 G-2	3	Upper pole piece (right)
107	A11	A11	258C615 P-29	6	Core
108	A11	A11	258C616 P-18	6	Core insulating tube
109	A11	A11	258C616 P-2	6	Shield
110	250, 250A	A11	258C615 G-6	3	Lower pole piece (right)
111	A11	A11	421A208 P-93	24	Spacer
112	250, 250A	A11	258C615 G-3	3	Lower pole piece (left)
113	A11	A11	258C615 G-1	3	Upper pole piece (left)
114	A11	A11	258C615 P-11	3	Connection
115	A11	A11	421A209 P-82	6	Spacer
116	A11	A11	432249 P-1	6	Spacer
117	A11	A11	414A116 P-2	3	Insulation plates
118	A11	A11	414A117 P-1	6	Upper runner insulation bottom
119	A11	A11	366A743 G-1	3	Coil (upper)
120	A11	A11	688C512 G-1	3	Runner (upper)
121	A11	A11	258C616 P-5	3	Spacer
122	A11	A11	258C616 P-11	3	Spacer
123	250, 250A	A11	366A744 G-1	3	Coil (lower)
124	A11	A11	421A208 P-434	3	Spacer
125	A11	A11	258C615 P-15	3	Support
126	A11	A11	383A932 P-1	6	Lower shield
127	A11	A11	258C615 G-5	3	Connection assembly
128	A11	A11	258C615 G-4	3	Runner (lower)
129	A11	A11	258C616 P-22	3	Spacer
129A	A11	A11	258C616 P-21	3	Spacer
130	A11	A11	258C616 P-9	6	Upper insulation
131	A11	A11	421711 P-1	6	Insulating cups
131A	A11	A11	407193 P-1	6	Washer (for insulating cup)
132	250, 250A	A11	258C616 P-6	6	Lower barrier
132	150, 150A	A11	258C616 P-13	6	Lower barrier

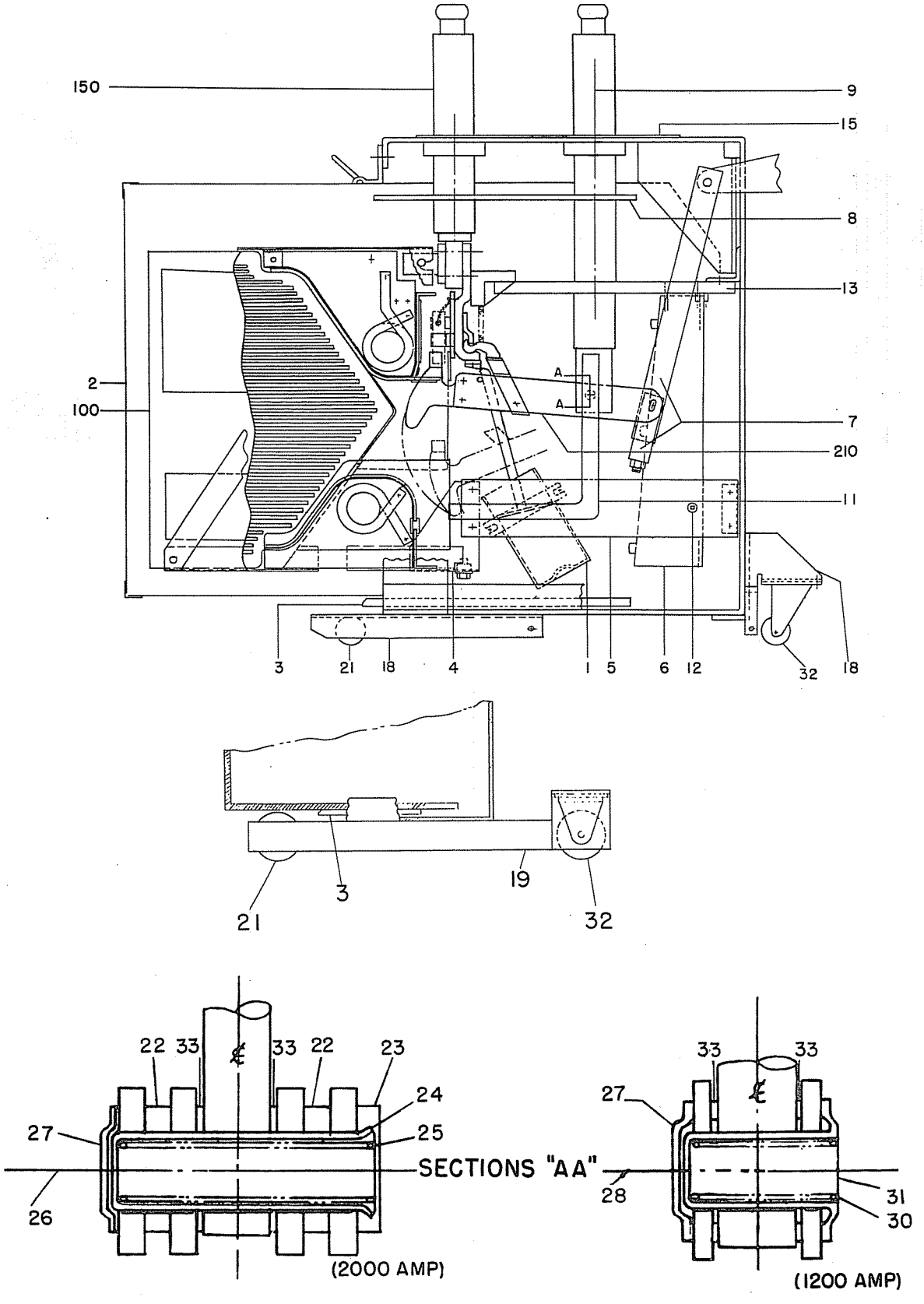


Fig. 27 (258C689)

Fig. 27 (281B771)

Fig. 27 (236C792)

Fig. 27 Cross-section Type AM-4.16-3

PARTS REFERENCED IN FIG. 27

REF.	MVA	AMPS	CAT. NO. FOR AM 4.16-(MVA)-3	NO. REQ.	DESCRIPTION
1	All	All	263B293 P-2	3	Booster cylinder
2	150, 150A	All	619C440 G-5	1	Box barrier assembly
2a	250, 250A	All	619C440 G-6	1	Box barrier assembly
3	All	All	258C614 P-13	1	Box barrier guide (right)
3	All	All	258C614 P-36	1	Box barrier guide (left)
4	All	All	258C619 G-3	3	Arc chute clamp
5	All	All	258C614 P-4 & P-16	3 of ea.	Arc chute support
6	All	All	802B723 G-4	1	Vertical barrier front
7	All	All	281B708 G-2	3	Operating Rod
8	All	600/1200	258C614 P-6	6	Horizontal barrier, upper
8	All	2000	258C614 P-7	6	Horizontal barrier, upper
9	150A	600	265C188 G-1	3	Bushing (long)
9	150, 150A	1200	269C842 G-1	3	Bushing (long)
9	250, 250A	1200	269C842 G-1	3	Bushing (long)
9	All	2000	265C188 G-3	3	Bushing (long)
11	All	All	258C619 P-8	3	Connection bar
12	All	All	258C614 P-5	3	Block
13	All	600/1200	258C614 G-3	3	Horizontal barriers (lower)
13	All	2000	258C614 G-2	3	Horizontal barriers (lower)
15	All	600/1200	258C614 P-20	4	Top Plate
15	All	2000	6592511 P-1	1	Top Plate
18	All	All	258C683 G-1	1	Wheel assembly complete
19	△	△	236C767 G-7	1	Wheel assembly complete
21	All	All	6597296 P-6		Wheel & spreader bushing
22	All	2000	6442246 P-1	6	Spacer
23	All	2000	6441630 P-1	3	Washer
24	All	2000	6442257 P-1	3	Bearing
25	All	2000	369A407 P-1	3	Spring
26	All	2000	6442258 P-1	3	Stud
27	All	All	6441617 P-1	3	Washer
28	All	600/1200	414A106 P-4	3	Screw
30	All	600/1200	421A239 P-1		Spring
31	All	600/1200	6442371 P-1	3	Bearing
	150A,250A	All	258C672 G-1	1	Mechanism cover (interchangeable)
	150, 250	All	281B726 G-1	1	Mechanism cover (standard)
32	All	All	6597296 P-5	2	Front wheel and caster
33	All	All	236C792 P-2	6	Loose rings

△ Those breaker model list numbers with 'W' suffix.

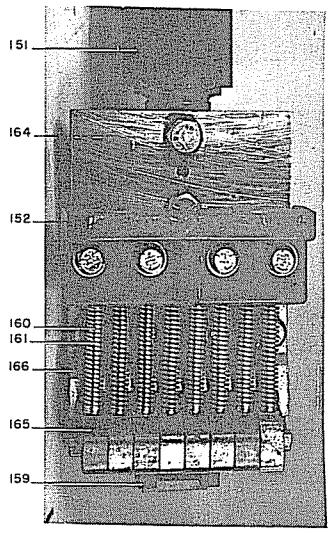


Fig. 28A Front View

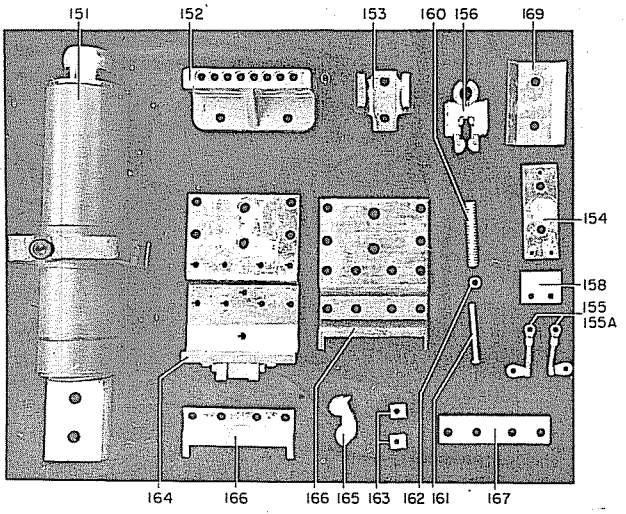


Fig. 28B Component Parts

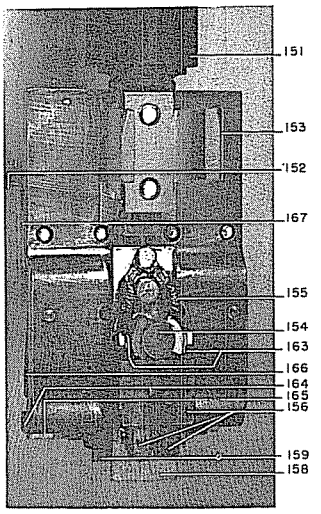


Fig. 28C Back View

Fig. 28 Rear Bushing Assembly (Ref. No. 150)

Fig. 28A (8020428)

Fig. 28B (8022946)

Fig. 28C (8020430)

PARTS REFERENCED IN FIGS. 28A, 28B & 28C

REF. NO.	MVA	AMPS	CAT. NO. FOR AM-4.16-(MVA)-3	NO. PER BREAKER	DESCRIPTION
150	150A	600	236C790 G-1	3	Rear Bushing, Assembly
150	150, 150A	1200	236C790 G-2	3	Rear Bushing, Assembly
150	250,250A	1200	236C790 G-3	3	Rear Bushing, Assembly
150	All	2000	236C790 G-4	3	Rear Bushing, Assembly
151	150A	600	265C187 G-1	3	Rear Bushing (Short)
151	All	1200	269C841 G-1	3	Rear Bushing (Short)
151	All	2000	265C187 G-3	3	Rear Bushing (Short)
152	150A	600	6592330 P-2	3	Spring Retainer
152	150, 150A	1200	6592330 P-2	3	Spring Retainer
152	250, 250A	1200	6592331 P-2	3	Spring Retainer
152	All	2000	6592331 P-2	3	Spring Retainer
153	150A	600	236C791 P-9	3	Support
153	All	1200	236C791 P-9	3	Support
153	All	2000	236C791 P-19	3	Support
154	All	All	236C791 G-3	3	Arcing Contact Support
155	All	All	236C791 G-1	3	Flexible Connection
155A	All	All	236C791 G-4	3	Flexible Connection
156	All	All	236C790 G-9	3	Arcing Contact Assembly
158	All	All	414A116 P-4	3	Insulating Plate
159	All	All	6445087 P-2	3	Buffer
160	150A	600	414A180	12	Spring
160	150, 150A	1200	414A180	12	Spring
160	250, 250A	1200	6509787	24	Spring
160	All	2000	6509787	24	Spring
161	150A	600	236C790 P-22	12	Spring Guide
161	150, 150A	1200	236C790 P-22	12	Spring Guide
161	250, 250A	1200	236C790 P-22	24	Spring Guide
161	All	2000	236C790 P-22	24	Spring Guide
162	150A	600	Nar. Wash. 1/4-20	12	Washer for Spring Guide
162	150, 150A	1200	Nar. Wash. 1/4-20	12	Washer for Spring Guide
162	250, 250A	1200	Nar. Wash. 1/4-20	24	Washer for Spring Guide
162	All	2000	Nar. Wash. 1/4-20	24	Washer for Spring Guide
163	All	All	175V557 P-1	3	Lock Plate
164	150A	600	258C666 P-1	3	Contact Support
164	150, 150A	1200	258C666 P-1	3	Contact Support
164	250, 250A	1200	258C666 P-3	3	Contact Support
164	All	2000	258C666 P-2	3	Contact Support
165	150A	600	236C791 P-8	12	Contact Finger
165	150, 150A	1200	236C791 P-8	12	Contact Finger
165	250, 250A	1200	236C791 P-8	24	Contact Finger
165	All	2000	236C791 P-8	24	Contact Finger
166	150A	600	258C666 P-5	3	Primary Contact Finger Retainer
166	150, 150A	1200	258C666 P-5	3	Primary Contact Finger Retainer
166	250, 250A	1200	236C791 P-20	3	Primary Contact Finger Retainer
166	All	2000	236C791 P-3	3	Primary Contact Finger Retainer
166	All	2000	236C791 P-4	3	Primary Contact Finger Retainer
167	250, 250A	1200	258C666 P-4	3	Spacer
168	150A	600	6557243 P-1	6	Buffer Clamp
168	150, 150A	1200	6557243 P-1	6	Buffer Clamp
168	250, 250A	1200	6557243 P-2	6	Buffer Clamp
168	All	All	6557243 P-1	6	Buffer Clamp
169	All	All	265C151 P-25	3	Spring Baffle

Figs. 29A, 29B, 29C (8020383)

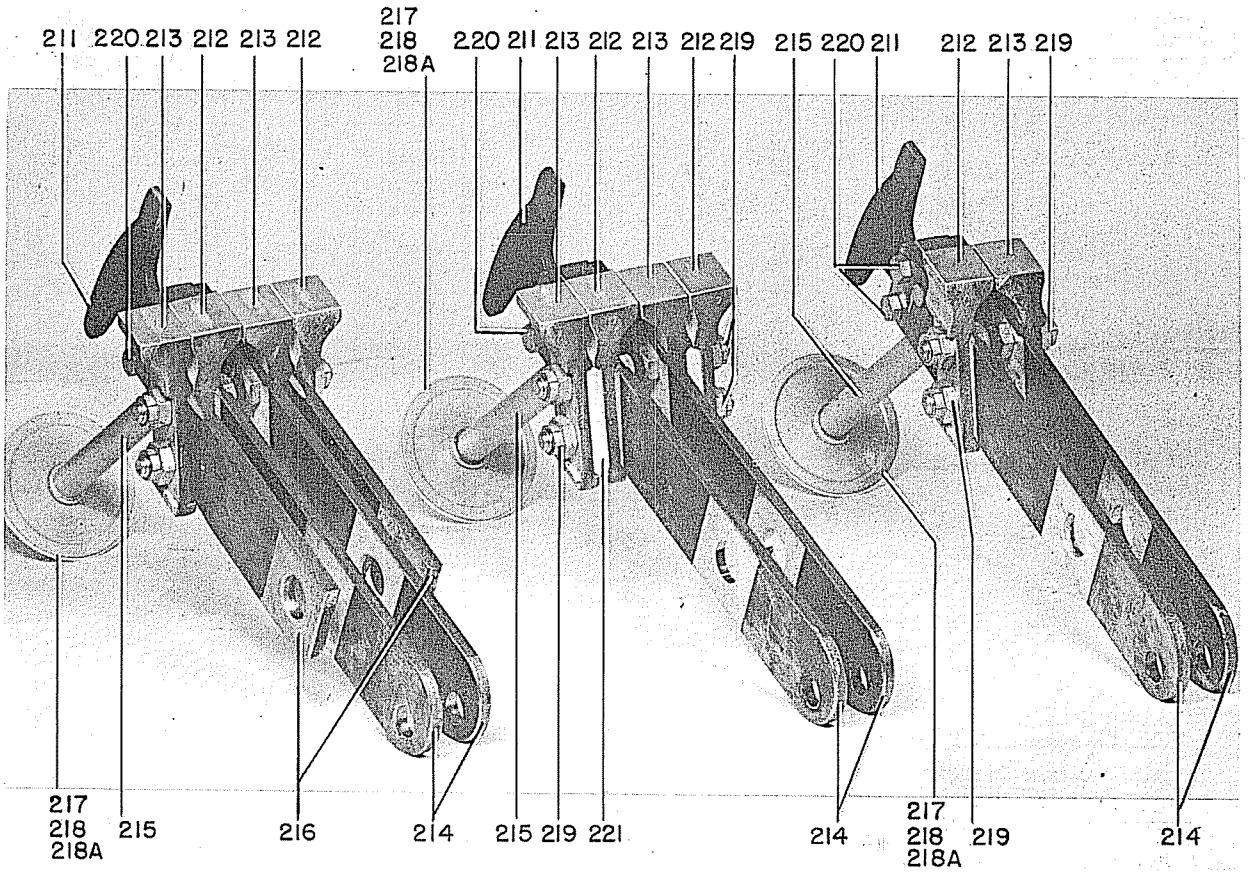


Fig. 29A For 2000 Amp. Breakers, All Ratings

Fig. 29B For 1200 Amp., 250 mva Rating

Fig. 29C For 600 and 1200 Amp., 150 mva Rating

Fig. 29 Movable Contact Arm Assembly

PARTS REFERENCED IN FIGS. 29A, 29B & 29C

REF. NO.	MVA	AMPS.	CAT. NO. FOR AM-4.16 (MVA)-3	NO. PER BREAKER	DESCRIPTION
210	150A	600	236C792 G-5	3	Movable Contact Arm Assembly
210	150, 150A	1200	236C792 G-5	3	Movable Contact Arm Assembly
210	250, 250A	1200	236C792 G-7	3	Movable Contact Arm Assembly
210	ALL	2000	236C792 G-6	3	Movable Contact Arm Assembly
211	ALL	ALL	802B742 G-3	3	Movable Arcing Contact
212	150A	600	6591644 P-7	3	Movable Primary Contact
212	150, 150A	1200	6591644 P-7	3	Movable Primary Contact
212	250, 250A	1200	6591644 P-7	6	Movable Primary Contact
212	ALL	2000	6591644 P-7	6	Movable Primary Contact
213	150A	600	6591644 P-8	3	Movable Primary Contact
213	150, 150A	1200	6591644 P-8	3	Movable Primary Contact
213	250, 250A	1200	6591644 P-8	6	Movable Primary Contact
213	ALL	2000	6591644 P-8	6	Movable Primary Contact
214	ALL	ALL	258C666 P-7	6	Contact Arm
215	ALL	ALL	236C792 G-8	3	Tube & Piston Assembly
216	ALL	2000	258C666 P-6	6	Contact Arm
217	ALL	ALL	421A248 P-1	3	Piston Ring
218	ALL	ALL	456A874 P-3	3	Piston Ring Expander
218A	150A	600	456A874 P-2	3	Piston Ring Equalizer
218A	150,150A	1200	456A874 P-2	3	Piston Ring Equalizer
218A	250,250A	1200	456A874 P-2	6	Piston Ring Equalizer
218A	ALL	2000	456A874 P-2	6	Piston Ring Equalizer
219	ALL	ALL	414A146 P-4	12	Flex Nut
220	ALL	ALL	414A146 P-3	6	Flex Nut
221	250, 250A	1200	258C619 P-2	6	Spacer

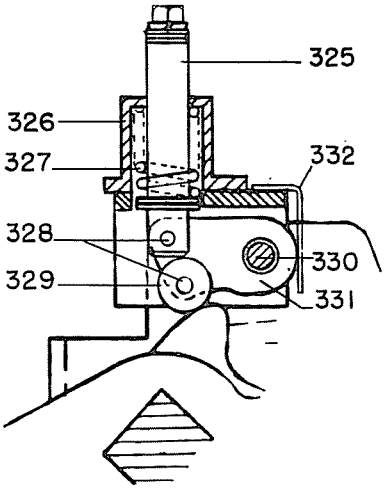


Fig. 30A Early Design

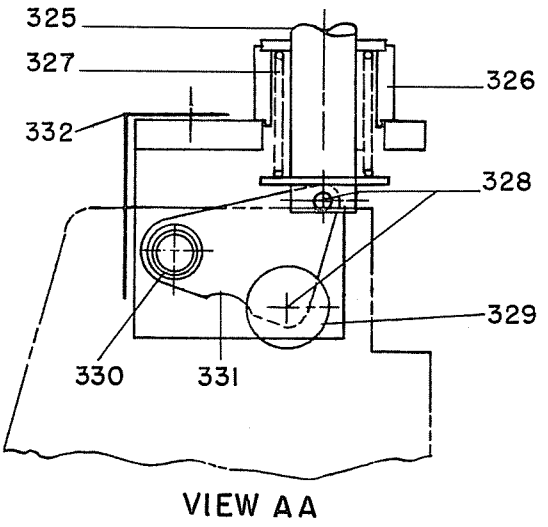


Fig. 30B Present Design

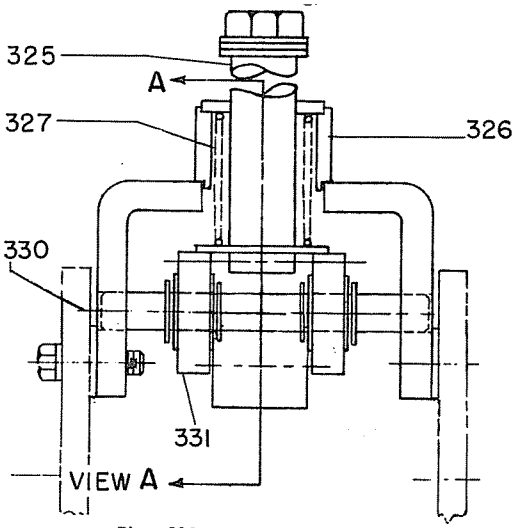


Fig. 30C Present Design

Fig. 30 Interlock Plunger

PARTS REFERENCED IN FIGS. 30A, 30B & 30C FOR ALL RATINGS

REF. NO.	CATALOG NO. FOR TYPE		NO. PER MECHANISM	DESCRIPTION
	AM-4.16-(MVA)-3 △	AM-4.16-(MVA)-3 ø		
324	236C769 G-1	236C787 G-1	1	Plunger interlock complete
325	6442255 P-1	236C787 P-12	1	Plunger for interlock
326	236C769 G-2	236C787 G-2	1	Bracket for interlock
327	6509728	6509728	1	Spring for interlock
328	6477427 AA P-9	383A926 AD P-1	2	Pin
329	6443714	236C787 P-14	1	Roller
330	6477427 CA-PT-2	236C787 P-5	1	Pin
331	6597228 P-1	236C787 P-16	2	Crank
332	236C769 P-9	236C787 P-6	1	Front guard

△ This plunger interlock frame is wider than the mechanism frame.

ø This plunger interlock frame is narrower than the mechanism frame.

Fig. 30A (236C731)

Figs. 30B & 30C (236C787)

Fig. 31A (8025739)

Fig. 31B (8024599)

Fig. 31C (8025740)

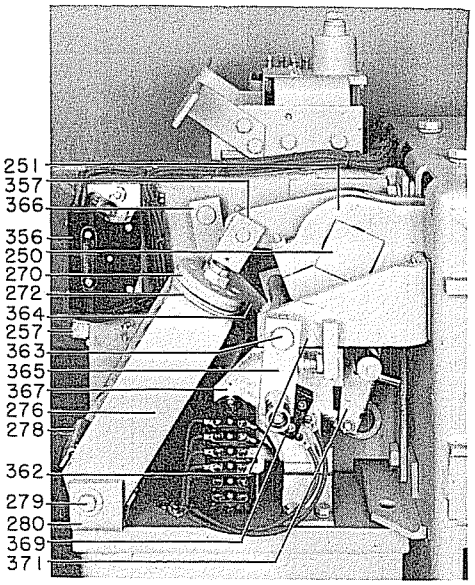


Fig. 31A Right Side View

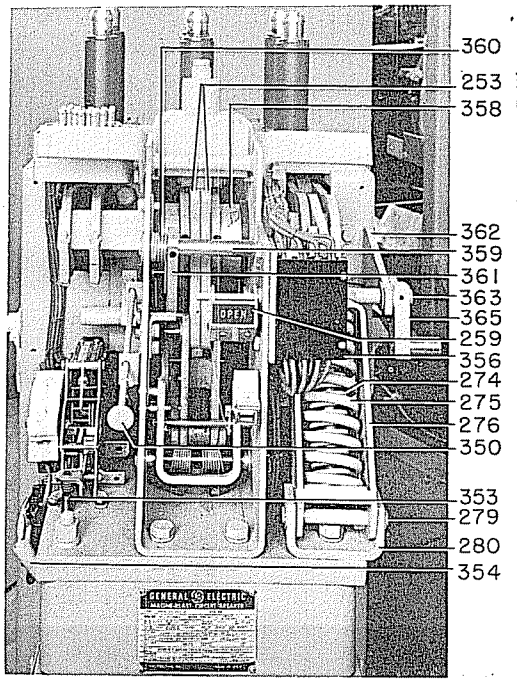


Fig. 31B Front View

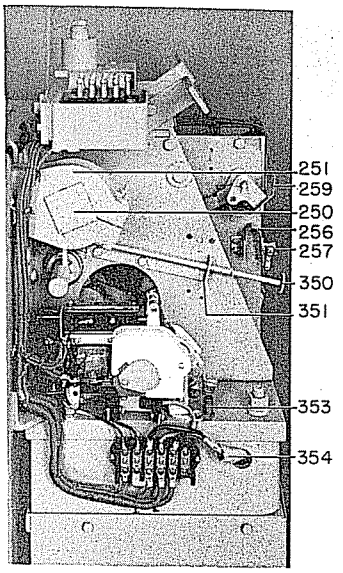


Fig. 31C Left Side View

Fig. 31 MS-13 Mechanism for Type AM-4-16 Breaker

PARTS REFERENCED IN FIGS. 31A, 31B & 31C FOR ALL RATINGS

REF. NO.	CAT. NO. TYPE AM-4.16-(MVA)-3	NO. PER MECHANISM	DESCRIPTION
350	258C604 G-3	1	Manual trip rod
351	258C604 P-2	1	Manual trip rod support
* 352	236C795 P-40	1	Rod for control device
353	174V394 P-1	1	Tube
354	6445059	1	Insulating tube
356	415A489 G-1	1	Auxiliary switch
357	258C609 P-4	1	Crank
358	456A876 P-4	2	Spacer
359	236C788 P-6	1	Interlock prop shaft
360	414A190	1	Spring
361	236C788 P-3	1	Interlock prop
362	258C601 G-3	1	Bearing bracket
363	258C601 P-14	1	Shaft
364	236C788 P-8	2	Link
365	236C788 P-7	1	Crank
366	258C601 P-16	1	Crank
367	236C788 P-30	1	Bracket
* 368	456A866 P-1	1	Latch checking switch
369	456A866 P-1	1	Interlock switch
* 370	6174582 G-1	1	Potential trip coil (125v d-c)
* 370	6174582 G-2	1	Potential trip coil (250v d-c)
* 370	6174582 G-14	1	Potential trip coil (230v a-c)
* 370	6275070 G-1	1	Potential trip coil (24v d-c)
* 370	6275070 G-2	1	Potential trip coil (48v d-c)
371	215D470 G-5	1	Potential trip linkage

* Not shown

PARTS REFERENCED IN FIGS. 32A, 32B & 32C FOR ALL RATINGS

REF. NO.	CAT. NO. FOR AM-4.16-(MVA)-3	NO. PER MECHANISM	DESCRIPTION
250	6443518 P-2	1	Shaft
251	258C608 P-6	6	Crank
252	258C608 P-7	1	Latch
253	215D470 G-54	2	Crank
254	215D470 G-55	1	Link
255	6551742	1	Spring
256	258C604 P-8	1	Spring clip
257	6192382 AB P-1	1	Veeder counter
258	215D470 G-51	1	Link
259	281B711 G-1	1	Indicator assembly
260	258C609 P-1	1	Prop
261	6375521 G-2	1	Closing coil (125v d-c) 250 mva
261	6375521 G-6	1	Closing coil (125v d-c) 150 mva
261	6375521 G-1	1	Closing coil (250v d-c) 250 mva
261	6375521 G-5	1	Closing coil (250v d-c) 150 mva
262	236C796 P-6	1	Plunger (AM-4.16-150/250)
263	6591632 P-1	1	Piston Ring (AM-4.16-150 & 250)
263A	6591632 P-1	1	Piston Ring (AM-4.16-250)
263A	6591632 P-2	1	Piston Ring (AM-4.16-150)
264	236C795 P-4	1	Pole piece (AM-4.16-250)
264	236C795 P-45	1	Pole piece (AM-4.16-150)
264A	236C796 P-14	1	Guide for pole piece (AM-4.16-150)
264A	236C796 P-12	1	Guide for pole piece (AM-4.16-250)
265	414A109 P-4	1	Washer
266	236C796 G-2	1	Arm plate
267	236C796 P-8	2	Stud
268	383A926 AE P-1	1	Pin
269	258C630 P-7	1	Clevis
270	258C630 G-3	1	Plate
271	258C630 P-8	1	Rod
272	414A109 P-8	1	Buffer
273	258C630 G-1	1	Complete spring assembly
274	369A411	1	Inner spring
275	369A468	1	Outer spring
276	258C630 P-3	1	Spring retainer
277	258C630 P-5	1	Retaining plate
278	258C630 P-4	1	Spring base
279	383A926 AF P-20	1	Pin
280	258C630 P-9	1	Bracket
281	258C611 P-1	1	Latch shaft
282	258C611 P-11	1	Stop bar
283	414A111 P-1	2	Trip shaft bearing
284	421A256 P-1	1	Spring
286	215D470 G-53	1	Roller
287	215D470 G-52	2	Link
288	258C611 P-3	1	Prop pin
289	414A111 P-1	1	Trip roller pin
290	421A256 P-1	1	Trip roller bearing
291	215D470 P-18	2	Spacer
292	6509799	2	Spring
293	414A110 P-3	1	Pin
294	6477097	1	Prop spring
295	258C609 P-8	1	Pin
296	104A2474 P-1	1	Pin
299	421A201 P-1	2	Spacer
301	258C608 P-3	1	Latch guide
302	258C611 P-5	1	Pin
303	258C609 P-9	1	Pin
304	421A209 P-101	2	Spacer
305	258C609 P-6	1	Roller
306	383A926 AE P-39	1	Pin
307	421A208 P-143	2	Spacer
308	619C478 P-20	1	Pin for center pole
308	619C478 P-19	2	Pin for end pole

Fig. 32A (258C688)

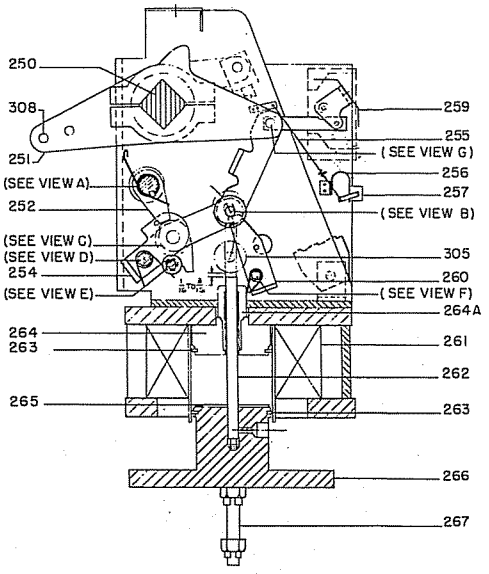


Fig. 32A Cross-section

Fig. 32B (258C688)

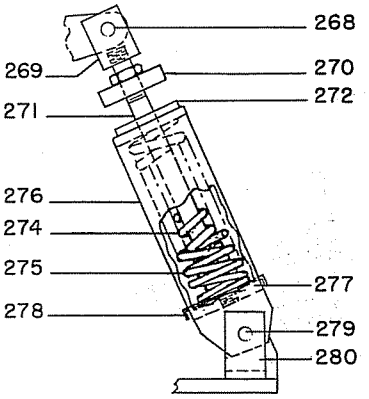
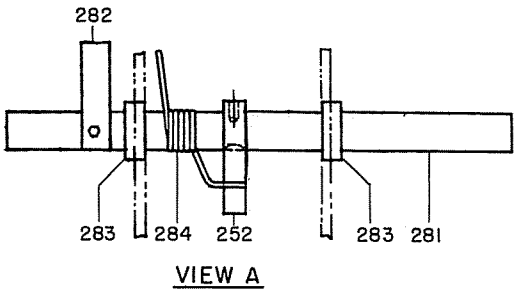
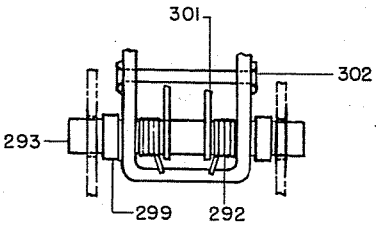


Fig. 32B Complete Spring Assembly (Ref. No. 273)

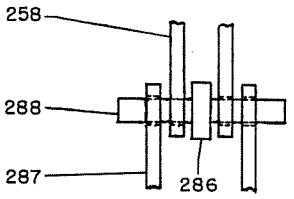
Fig. 32C (215D470)



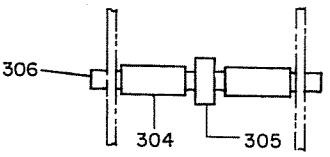
VIEW A



VIEW D



VIEW B



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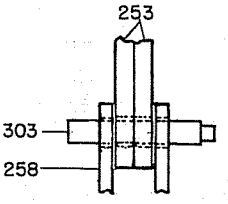
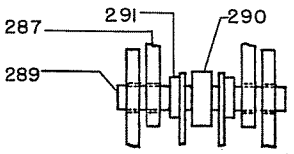
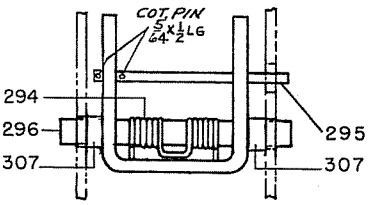


VIEW G



VIEW C



VIEW F

Fig. 32C Detailed Views

Fig. 32 MS-13 Mechanism for AM-4.16-3

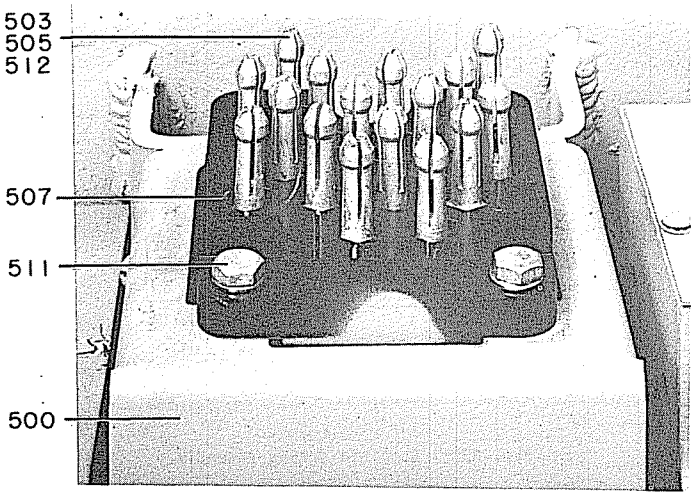


Fig. 33 (8026035)

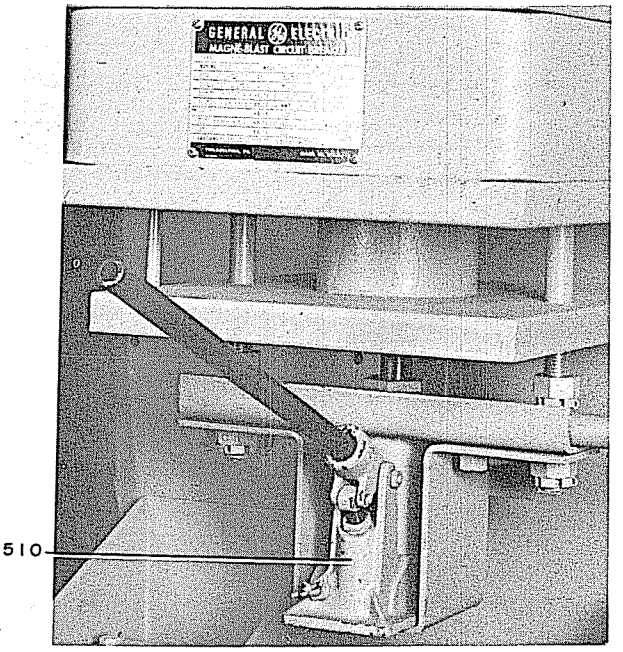


Fig. 34 (8022396)

Fig. 33 Secondary Disconnecting Device (Ref. 500)

Fig. 34 Maintenance Closing Device (Ref. 510)

PARTS REFERENCED IN FIGS. 33 & 34 FOR ALL RATINGS

REF. NO.	CAT. NO. FOR TYPE AM-4.16-(MVA)-3	NO. PER MECHANISM	DESCRIPTION
*500	802B795 G-3	1	Secondary disconnect device, complete: 16 point
500	264B173 G-2	2	Secondary disconnect device, complete: 7 point
503	6319964 P-2	16	Plug
505	848768 P-1	16	Lock washer for plug
507	6505244 P-1	1	Socket
510	258C669 G-1	1	Maintenance closing device
511	3663094 P-38	3	Spacer
512	366A234 P-1	2	Contact nut
512	366A234 P-2	14	Contact nut

* Additional drilling in field - 121A5912.

Fig. 35 (8020216)

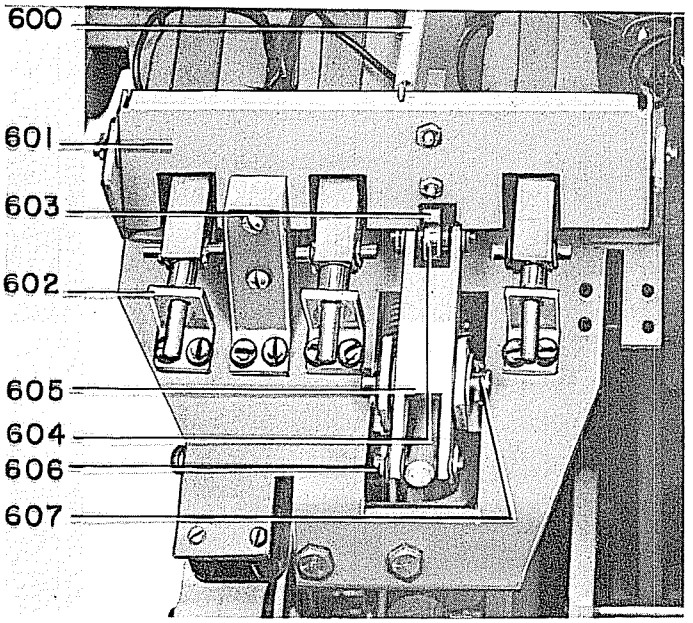


Fig. 35 Partial View of MS-13 Mechanism with Current Trip

Fig. 36 (8016105)

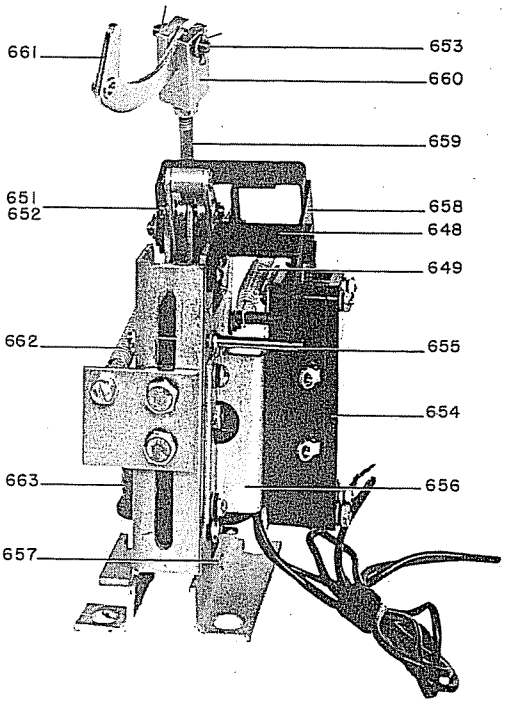


Fig. 36 Undervoltage Device (Ref. 647)

PARTS REFERENCED IN FIGS. 35 & 36 FOR ALL RATINGS

REF. NO.	CAT. NO. FOR TYPE AM-4.16-(MVA)-3	NO. PER MECHANISM	DESCRIPTION
600	6551725	1	Spring
601	366A611 G-1	1	Trip pan
602	6558748 P-1	1	Bracket
603	6558756 P-1	1	Trip latch
604	6477418 AA P-10	1	Ball bearing
605	366A600 P-1	1	Trip arm
606	6076401 P-307	1	Pin
607	6477427 AA P-8	1	Pin
647	9915617 AA	1	Undervoltage device complete
648	175V574	1	Stop for d-c only
649	369A443	1	Spring for d-c only
650	6551726	1	Spring for a-c only
651	175V578	1	Pin for d-c only
652	6076401 P-309	1	Pin for a-c only
653	6076401 P-305	2	Pin
654	295B227 G-2	1	Switch
655	175V576	1	Pin
656	374A246 P-1	1	Bracket
657	175V562 P-1	1	Shim for d-c only
658	384A330 G-1	1	Link arm assembly for d-c only
659	6477414 AC P-20	1	Stud
660	6558711 P-1	2	Coupling
661	6558723 G-1	1	Trip arm
662	6509798	2	Spring
663	6275017 G-19	1	Coil (125v d-c)
663	6275017 G-33	1	Coil (230v a-c)
663	6275017 G-20	1	Coil (250v d-c)
*664	684C642 G-1	1	Terminal board (6 point)

* Not shown

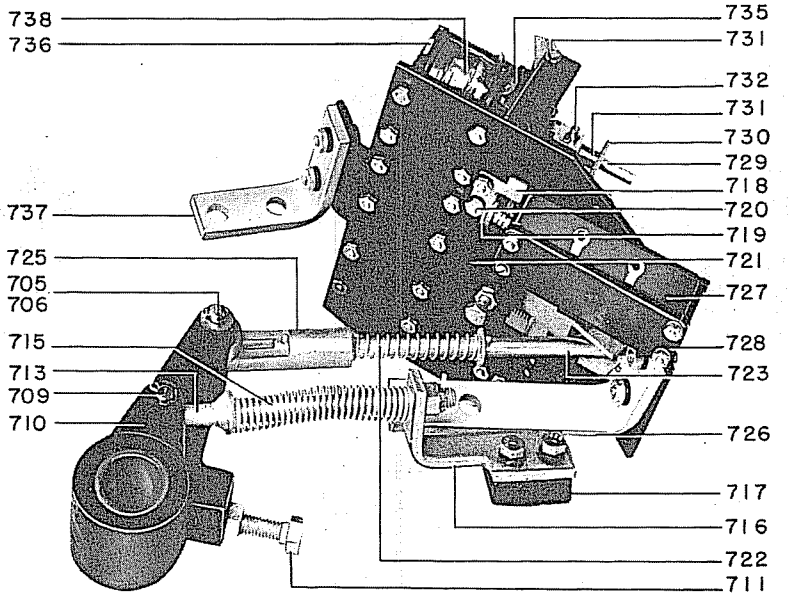


Fig. 37 (8016104)

Fig. 37 Impact Trip Device (Ref. No. 702)

PARTS REFERENCED IN FIG. 37 FOR ALL RATINGS

REF. NO.	CAT. NO. FOR TYPE AM-4.16-(MVA)-3	NO. PER MECHANISM	DESCRIPTION
702	6594553 AA	1	Impact trip device complete
703	6591817 P-1	1	Lever
704	6591388 P-19	1	Locking plate
705	6076403 P-315	1	Pin
706	6477425 BA P-3	1	Roller
709	6076403 P-311	1	Pin
710	6592554 G-1	1	Crank
711	6557106 P-1	1	Adjusting screw
713	6558791 G-1	1	Eyebolt asm.
715	6509706	1	Spring
716	6443516	1	Bracket
717	6557105 P-1	1	Spacer
718	6558746 P-1	1	Bracket
719	6558747 P-1	1	Trip arm
720	6076401 P-315	1	Pin
721	6477401 AA P-3	2	Spacer
722	6509794	1	Spring
723	174V378	1	Rod
725	174V373	1	Coupling
726	6443666	1	Bracket
727	295B227 G-3	1	Switch
728	6592505 AA	1	Frame assembly
729	6558752 G-1	1	Core assembly
730	6558751 P-1	1	Angle
731	6049320	3	Felt washer
732	6557068 P-9	1	Pin
734	6076401 P-385	1	Pin
735	2236575	2	Guide
736	4905058 G-4	1	Coil frame
737	6443667	1	Bracket
738	6174599 G-2	3	Coil for current trip 3 Amp. a-c
738	6174599 G-6	1	Coil for capacitor trip 230v a-c
* 739	456A334 P-1	1	Rubber guard

* Not shown

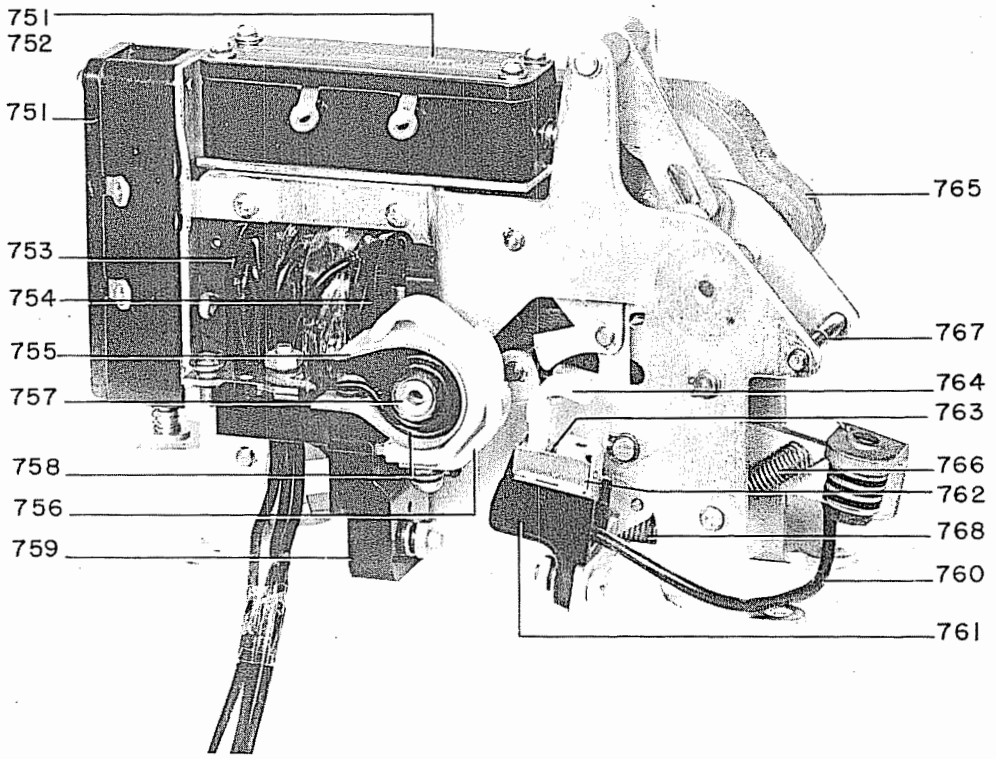


Fig. 38 (801I083)

Fig. 38 Control Device (Ref. No. 750)

PARTS REFERENCED IN FIG. 38 FOR ALL RATINGS

REF. NO.	CAT. NO. FOR TYPE AM-4.16-(MVA)-3	NO. PER MECHANISM	DESCRIPTION
750	403A225 G-1	1	Control device, 125 volt, d-c
750	403A224 G-4	1	Control device, 230 volt, a-c (continuous)
750	6375988 G-6	1	Control device, 250 volt, d-c
750	403A224 G-3	1	Control device, 230 volt, a-c
751	227B227 G-2	1	Auxiliary switch, top or back
752	295B227 G-1	1	Auxiliary switch, top, 230 volt, a-c only
753	6275017 G-19	1	Coil, 125 volt, d-c
753	6275017 G-33	1	Coil, 230 volt, a-c (continuous)
753	6275017 G-20	1	Coil, 250 volt, d-c
753	6275017 G-34	1	Coil, 230 volt, a-c (intermittent)
754	6591455 P-1	2	Support for contact tip
755	6442392 P-1	2	Insulation
756	6591411 G-1	2	Support for stationary contact
757	6591450 P-1	2	Core
758	6412255 P-1	2	Blowout coil
759	6412251 P-1	2	Support for coil
760	6591440 G-1	1	Connector
761	6592161 P-1	2	Support for movable contact
762	6592162 P-1	2	Shield
763	6477041 P-1	2	Spring
764	6591412 G-1	2	Movable contact
765	6591404 G-1	2	Arc chute assembly
766	6272844	1	Spring
767	365A458	1	Spring (a-c intermittent and d-c)
767	6370699	1	Spring (a-c continuous)
768	6477063	1	Spring
*769	456A812 G-1	1	Hardware for mounting control device

*Not shown

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