.E. - MAGNE-BLAST BREAKERS AND SWITCHGEAR (Volume 1 of 3)

TAB #	CAT SECTION	DESCRIPTION	CONTENTS
1	GEI-77070B	Instruction Book	AM-4.16-75, 75A, 75H-1
	GEI-77070A	Instruction Book and Renewal Parts	with MS-9 Mechanism
	GEI-77070	Instruction Book and Renewal Parts	
2	GEH-2000A	Instruction Book and Renewal Parts	AM-2.4/4.16-100/150-3
			AM-2.4/4.16-100/150A-3
			AM-2.4/4.16-150/250-3
			AM-2.4/4.16-150/250A-3
			With MS-13 Mechanisms
	GEH-1804D	Instruction Book and Renewal Parts	Same but -1 & -2 Breakers
	GEH-2000F	Instruction Book and Renewal Parts	AM-4.16-150-3
			AM-4.16-150A-3
			AM-4.16-250-3
			AM4.16-250A-3
			With MS-13 Mechanisms
3	GEH-2054C	Instruction Book and Renewal Parts	AM-4.16-150A-4 & 4S
	GEH-2054A		AM-4.16-250A-4 & 4S
			AM-4.16-150H-4 & 4ML
			AM-4.16-150H-4S & 4SML
			AM-4.16-250H-4 & 4ML
			AM-4.16-250H-4S & 4SML
			With ML-11 & MS-13 Operating Mechanism:
4	GEI-88761E	Instruction Book and Renewal Parts	AM-4.16-250-6C
			AM-4.16-250-6H
			AM-4.16-250-7C
			AM-4.16-250-7H
5	GEK-41902C	Instruction Book and Renewal Parts	AM-4.16-250-9 1200 & 2000A
			with ML-13 Mechanism

6	GEI-88762A	Instruction Book and Renewal Parts	AM-4.16-350-1C AM-4.16-350-1H
7	GEK-7320F	Instruction Book and Renewal Parts	AM-4.16-350-2C AM-4.16-350-2H
8	GEI-88771D GEI-88771A	Instruction Book	AMH-4.76-250-OD AMH-4.76-250-1D
9	GEI-23903C	Instruction Book	AM-5-50-4 AM-5-50-5 With MS-9 & MS-9-1 Mechanisms
10	GEI-13532D GEI-23961G	Instruction Book	AM-5-100 AM-5-150
	GEF-3486B	Renewal Parts	AM-5-150
11	GEI-50143F GEI-50143A	Instructions & Renewal Parts Instructions & Renewal Parts	.11, 11A, 11B. 11C, 11D Stored Energy Me ML11, 11A, 11B Stored Energy Mech
12	GEF-4379A	Renewal Parts	ML-13 Mechanism

NOTE: SIL/SAL Information is in Vol. 3 of 3 @ the back (last tab)

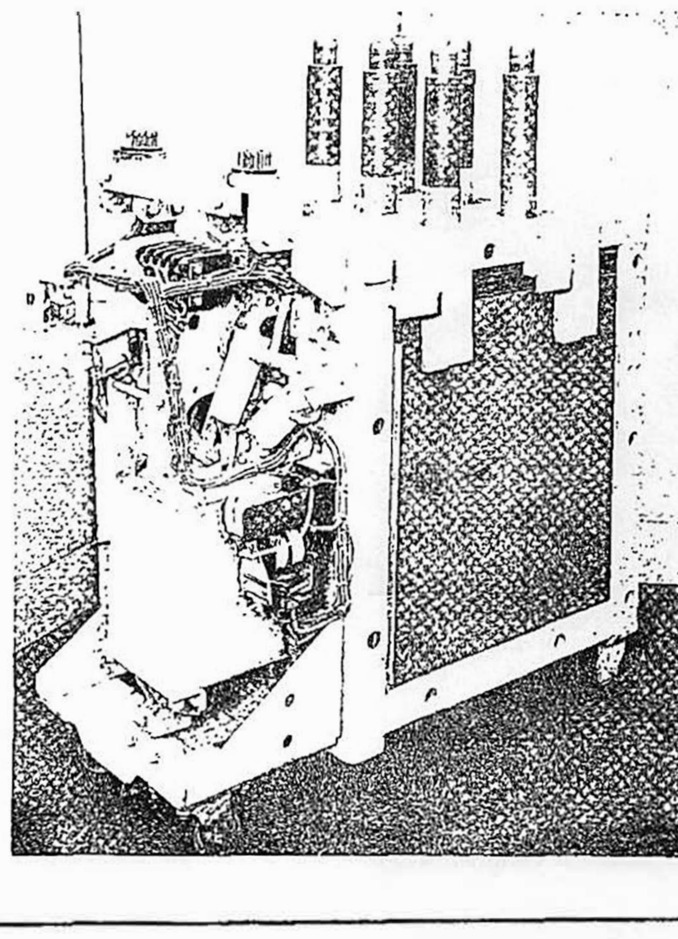
INSTRUCTIONS

GEI-77070 B

SUPERSEDES GEI-77070A

MAGNE - BLAST CIRCUIT BREAKERS

Types
AM 4.16-75-1
AM 4.16-75A-1
AM 4.16-75H-1
with
MS-9 Mechanism



CONTENTS

GENERAL ELECTRIC

MAGNE-BLAST CIRCUIT BREAKER
TYPES AM 4.16-75-1 AND AM 4.16-75A-1
WITH MS-9 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.

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.

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 information for placing the magne-blast breaker in service and for maintaining satisfactory operation.

RECEIVING, HANDLING AND STORAGE

Cover (8028976)

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.

INSTALLATION

Remove box barrier and make a visual inspection to ascertain that the breaker is in satisfactory condition. Check all bearing surfaces of the mechanism for lubrication. Refer to the section on LUBRICATION (page 11).

Operate breaker manually using the maintenance closing device provided with the breaker. During the closing operation, check to insure that the mechanism and breaker does not stick or bind during the entire stroke, that it latches securely in the closed position, and that it trips freely when the manual trip plunger is operated. The breaker should not be operated electrically until it has been operated manually to insure this freedom of action.

The following adjustments should be checked at this point.

a. Primary contact wipe (page 5).

b. Primary contact gap (page 5).

c. Prop clearance (page 5).

Attach test coupler to circuit breaker and operate electrically several times. The control voltage should be checked at the breaker as indicated under CONTROL POWER CHECK (page 10).

Remove test coupler and replace box barrier.

If breaker has been stored for a long period of time, it is recommended that the insulation be checked with the standard 60 cycle high potential test --- see INSULATION TEST (page 11).

Lubricate the silver portion of the primary disconnect studs by rubbing a small amount of contact lubricant D50H47 to form a thin coating on the ball contact.

Refer to instruction book GEH-1802 for final instructions before inserting the breaker into the metal-clad unit.

DESCRIPTION OF OPERATION

The magne-blast breaker is composed of two major parts, the breaker element Fig. 9 and the operating mechanism Figs. 7 and 8. 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-9 operating mechanism shown in Fig. 7 is of the solenoid type designed to give high speed closing and opening. The closing operation is controlled by the control relay. The control relay scheme 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 a-c 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. All secondary connections from the breaker to the metal-clad unit are made through the coupler.

A positive interlock and interlock switch is 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.

OPENING OPERATION

REFER TO FIGS. 8 & 9

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, causing the operating mechanism linkage to collapse. The energy stored in the opening spring 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. As the movable arcing contact is withdrawn through the slot in the arc runner, the upper end of the arc is transferred to the upper arc runner. To assist the interruption at this point, a stream of air is emitted from the booster tube and forces the arc onto the lower arc runner. Establishment of the arc on the runners automatically inserts the blowout coil into the circuit, introducing a magnetic field between the pole pieces which tends to draw the arc away from the arcing contacts. At the same time, the arc is being forced into the arc chute 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.

Manual tripping follows the same procedure except that instead of energizing the trip circuit, the manual trip button is used.

CLOSING OPERATION

REFER TO FIGS. 8 & 9

The closing operation of the breaker is primarily controlled by the control device, Figs. 5 and 6 mounted on the breaker frame. 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 coils of the control relay. As the control relay 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 relay energizes the breaker closing coil by closing the main control relay contacts. Once the control relay 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 which in turn lifts the closing roller by action of the solenoid plunger rod. This motion is transmitted through the mechanism linkage and rotates the main crank closing the breaker contacts. As the armature reaches the end of its travel, the prop rotates beneath the pin latching the breaker in the closed position. During the closing operation, the opening spring is compressed in readiness for an opening operation. Air trapped above the armature acts as a dash pot to absorb the energy of the mechanism as it approaches the end of its stroke.

TRIP FREE OPERATION

REFER TO FIG. 8

If the trip coil circuit is energized while the breaker is closing, the trip plunger will force the trip latch away from the trip roller causing the mechanism linkage to trip free and the breaker to re-open. The closing armature 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.

ADJUSTMENTS

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.

A maintenance operating handle is provided for operation of the breaker during these adjustment checks. Electrical operation must not be attempted until the breaker has been operated manually through its complete stroke several times and final inspection has been completed.

All adjustments should be checked during periodic inspections and whenever it becomes necessary to repair or replace parts that have become worn or defective while in service.

PRIMARY CONTACTS

REFER TO FIGS. 1 AND 9

The primary contacts, Fig. 1, can be adjusted by means of the operating rod adjusting screw. To adjust, remove the pin fastening the adjusting screw to the mechanism crank and push the contact blade far enough closed so the adjusting screw can be turned. To increase the primary contact travel, turn the adjusting screw in the direction to lengthen the rod, and to decrease the primary contact travel, turn the screw to shorten the rod (1/2 turn gives approximately 1/32" change in contact travel). Reconnect the operating rod to the crank, and close the breaker manually to check the adjustment.

After the above adjustment has been made, the travel of the contact surface of the primary contact should be measured on a manual closing operation. The primary contact wipe should be 1/8" + 1/16" -0.

ARCING CONTACT WIPE

Refer to Fig. 1. 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 and the movable primary contact should be 7/32" to 9/32". To adjust, the following procedure should be followed:

(a) Loosen the lock nut on the arcing contact stop bolt.

(b) With Allen wrench, turn the stop bolt until the arcing contacts just touch when the gap at the primary contact is 7/32" to 9/32".

(c) Lock the stop bolt in position with the locknut, and close the breaker manually to check the adjustment.

ARCING CONTACT CLEARANCE

REFER TO FIG. 1

The movable arcing contact should be centered between the arcing plates located on the arc runner. This is accomplished by moving the arc chute sideways to the correct position. The mounting support has an oversize hole to permit adjustment.

CONTACT GAP

REFER TO FIG. 6

With the breaker tripped from the closed position, the minimum distance from the primary contact fingers to the surface of the primary contact on the movable contact blade should be 4-1/16" to 4-1/4". To adjust for these conditions, turn the stop nut (21), Fig. 8, to increase or decrease the contact gap. After making the adjustment, close and trip the breaker manually and measure the gap once more.

NOTE: A change in this adjustment may require a change in the adjustment of the plunger rod (17), Fig. 8, in the mechanism as described later.

LATCH WIPE

REFER TO FIG. 2

The wipe of the latch on the trip roller should be from 1/8" to 1/4". This can be determined easily by putting a film of grease on the latch, closing the breaker part way, and tripping. To adjust, add or remove washers under the head of the stop bolt located near the top of the latch on the trip coil frame.

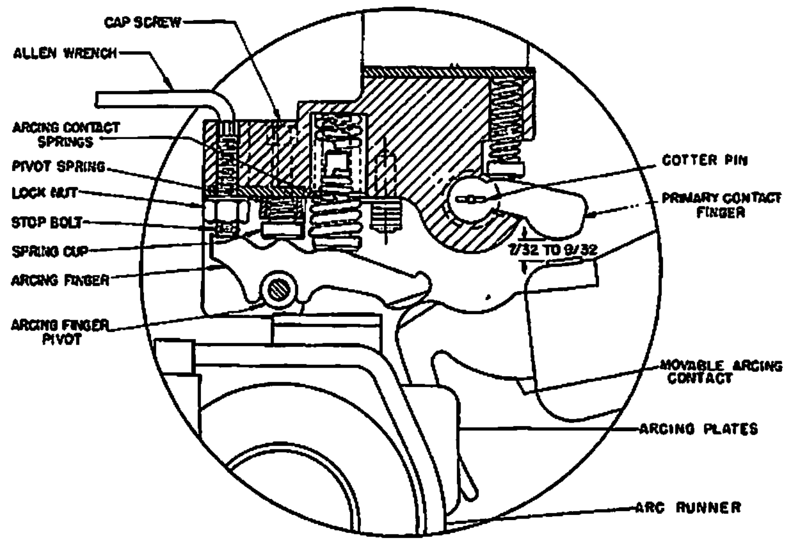


Fig. 1 Contact Assembly

PROP CLEARANCE

REFER TO FIG. 2

With the breaker closed as far as possible with the manual handle, the clearance of the pin through the closing roller over the prop should be 1/32" to 3/32" with a maximum variance of 1/32" between sides. This can be adjusted by dropping the closing armature (18), Fig. 8, and closing plunger rod (17), Fig. 8, and screwing the rod into or out of the armature. To do this turn the breaker on its back as shown in Fig. 15 and disassemble the wheel base and solenoid pot assembly as described in replacement of a closing coil on page 15.

NOTE: Two set screws are used to lock the plunger rod in position in the armature. If the rod adjustment is changed the rod must be spotted in the correct position and the set screws replaced.

LATCH CLEARANCE

REFER TO FIG. 3

The clearance between the trip latch and roller with the breaker open should be approximately 1/32" to 1/16". This can be adjusted by means of the stop bolt (12), Fig. 7, in the front of the mechanism frame near the bottom. The lock nut should be fastened securely if any adjustment has been made.

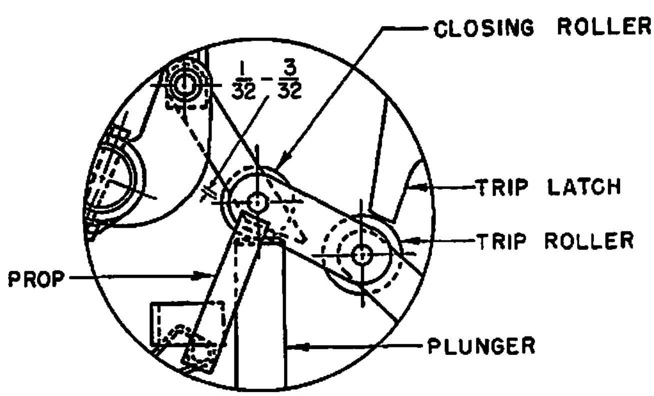


Fig. 2 Mechanism Linkage Closed Position

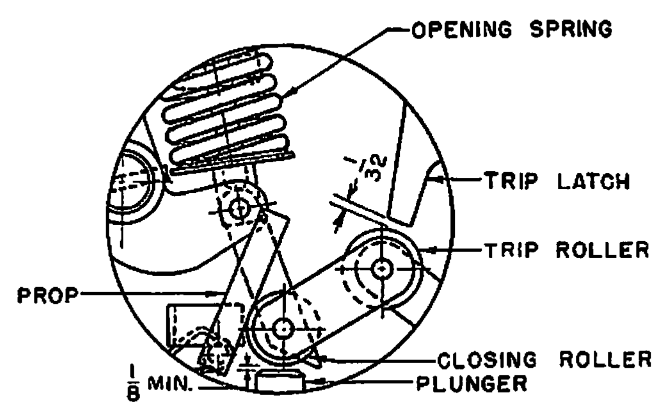


Fig. 3 Mechanism Linkage Open Position

PLUNGER CLEARANCE

REFER TO FIGS. 3 AND 8

With the breaker in the open position there should be at least 1/8" clearance between the plunger and closing roller. To increase this clearance, the brackets (22), Fig. 8 should be lowered by placing a shim between the bracket and the bottom plate of the solenoid housing.

INTERLOCK SWITCH WIPE

REFER TO FIG. 4

Rotate the interlock shaft manually counter clockwise. The point at which the contacts break can be determined with a circuit continuity tester such as a light indicator or bell set. To adjust interlock switch (1), Fig. 4 move switch bracket (6). The roller and crank on the interlock switch should have 1/32" to 1/16" overtravel after final adjustment.

CUT-OFF SWITCH ADJUSTMENT

REFER TO FIGS. 5 AND 5A

Using a manual closing handle, close the breaker as far as possible. (So that the prop pin is over the prop and not resting on the prop). At this point the "S" shaped striker rod should be resting against the striker rod guide bracket (3), Fig. 5 as shown in Fig. 5A.

Adjust cut-off switch striker rod (2), Fig. 5 so that it is against the switch roller (7), Fig. 5 and so that the switch roller has an additional overtravel of 1/32".

CONTROL RELAY ADJUSTMENT

REFER TO FIGS. 5 AND 6

TYPE HJA RELAY

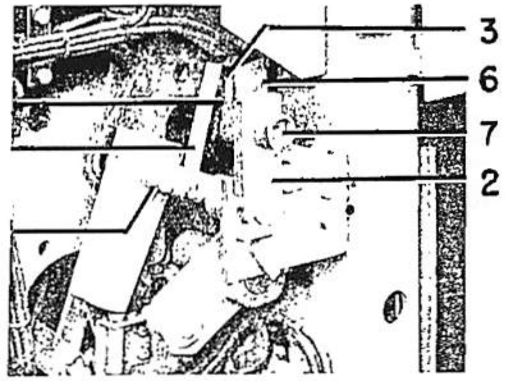
The relays have been adjusted at the factory to pick up at 61 per cent of rating for d-c relays and 80 per cent for a-c relays. The settings of the various contact gaps and wipes should not be disturbed.

If it is necessary to readjust the relays the following points should be observed. The wipe of the main contacts should be 1/8" measured at the top edge of the pole piece while that of the auxiliary should be 1/8" when measured at the rear edge of the armature stops.

If the setting of the control spring must be changed for any reason, care must be taken during the readjustment to see that the control spring is not weakened to the point of permitting the minimum of wipe to exist at the normally closed auxiliary interlock contacts.

The relay contains a permanent magnet which has numbers stamped on one end only. The magnet is oriented properly in the relay when it is positioned so that the numbers are located on the left hand side. (Facing relay.)

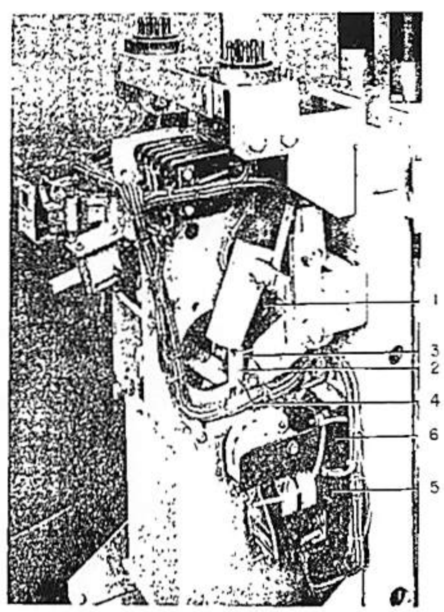
On d-c operated relays, a visible check should be made to see that the arc being interrupted by the relay is directed through the arc chute and not back over the relay



1. Positive Interlock Switch
2. Interlock Arm
3. Switch Roller
4. Switch Actuator Cam
5. Interlock Shaft
6. Switch Mounting Bracket
7. Interlock Indexing Roller

Fig. 4 (8028976)

Fig. 4 Positive Interlock Switch



1. Cut-off Switch
2. Cut-off Switch Striker Rod
3. Striker Rod Guide Bracket
4. Striker Rod Adjustment Nut
5. Control Relay (HJA Relay)
6. Control Relay Mounting Plate

Fig. 5 (8028974)

Fig. 5 Side View of Control Relay and Cut-off Switch Assembly

INSPECTION AND TEST

For ease in reviewing the adjustments the following are recapitulated:

a. Primary contact wipe: 1/8" + 1/16" - 0.

b. Arcing contact wipe: 7/32" to 9/32".

c. Primary contact gap: 4-1/8" to 4-1/4".

d. Trip latch wipe: 1/8" to 1/4".

e. Prop clearance: 1/32" to 3/32" with a maximum variance of 1/32".

f. Trip latch clearance: 1/32" to 1/16"

g. Solenoid plunger clearance: 1/8" or greater.

h. Impact trip wipe: 1/32" to 1/16".

j. Impact cam latch clearance: 1/16".

k. Interlock switch: 1/32" to 1/16" overtravel.

l. Cut-off switch overtravel: 1/32" to 1/16".

m. Plunger interlock: 5-1/8" + 1/16" - 0.

Check all nuts, bolts, screws, and cotter pins to make certain that they are properly tightened.

Inspect all wiring. Check all terminals, screws, and connections and test the circuits for possible short circuits or grounds.

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

Operate the breaker slowly with the maintenance closing handle 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.

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

Check the operating voltage for both the closing coil and trip coil to determine if, with line drop, it is within the limits specified on the nameplate. In the case of a rectifier operated mechanism, the d-c voltage across the coil terminals with full closing coil current flowing should be 105-110 volts. (For applications of repetitive operations, the d-c voltage across the closing coil should not exceed 110 volts.) Refer to section on CONTROL POWER CHECK.

AUXILIARY DEVICES

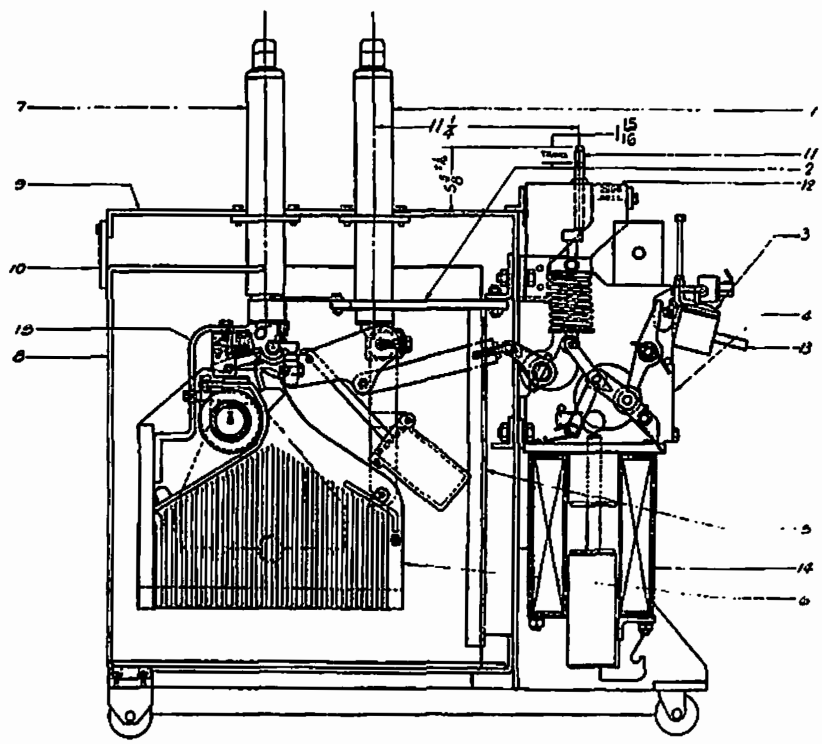
On breakers that are equipped with auxiliary devices such as current trip, undervoltage trip or capacitor trip, the device should be checked for proper electrical operation. The current trip device should trip the breaker at 3 amperes. The undervoltage device should trip the breaker when the control voltage drops below 40 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.

OPENING AND CLOSING SPEED

The closing speed of the arcing contact should be 12 to 16 feet per second with rated closed circuit voltage at the 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 transfer lugs to the tangent position.

Fig. 9 (862C735)



1. Front Bushing
2. Horizontal Barrier
3. Trip Coil
4. Operating Mechanism
5. Front Vertical Barrier
6. Arc Chute Assembly
7. Rear Bushing
8. Box Barrier
9. Breaker Frame
10. Box Barrier Locking Plate
11. Plunger Interlock
12. Secondary Coupler
13. Manual Trip Button
14. Closing Coil
15. Arc Chute Mounting Support

Fig. 9 Side View AM-4.16-75-1 Breaker with MS-9 Mechanism

Fig. 5A (698C503)

Fig. 6 (8028975)

Fig. 6 "AA" (6496372)

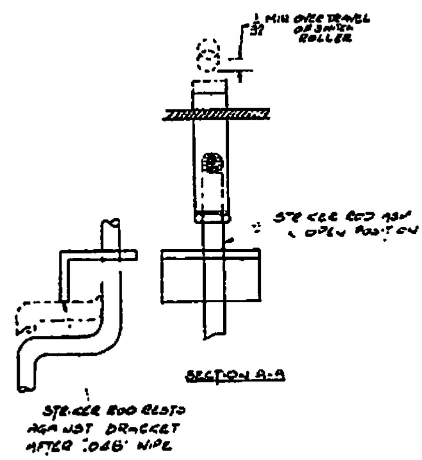


Fig. 5A

coil. If the arc is not being directed through the arc chute the following checks should be made:

1. Check the polarity of the control power.

2. Check the control device to see if the magnet is assembled properly. (As described previously.)

3. Check to see that the closing coil leads have been assembled properly. (Refer to the section on repair and replacement of closing coil).

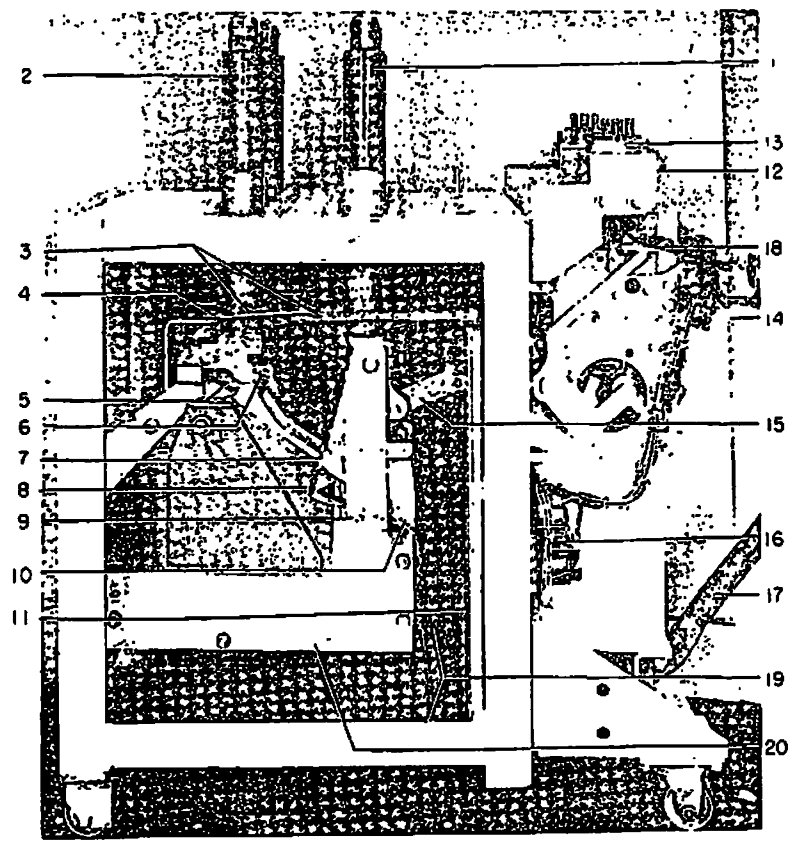
TYPE HMA RELAY

The relays are properly adjusted at the factory for operation when mounted on a vertical surface. Relays for d-c service are adjusted to pick up at 60 per cent of their rating when cold and 80 per cent when hot. Relays for a-c service are adjusted to pick up to 80 per cent of their rating.

Normally it should not be necessary to make any further changes in these adjustments. If, however, the correct pickup is not realized, adjustments can be made by changing the tension of the armature restraining spring. This is accomplished by bending the projecting spring holder on the armature stop. The spring tension should not be so low that the back wipe is sacrificed.

AUXILIARY SWITCH

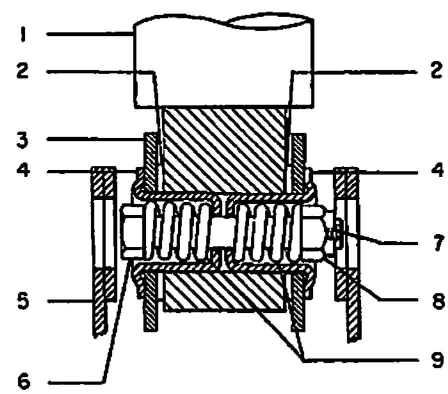
The auxiliary switch (7) is mounted on the right side of the operating mechanism Fig. 7. The shaft of the position indicator operates the auxiliary switch shaft which opens and closes the "a" and "b" contacts. (The "a" contacts are open when the breaker is open and the "b" contacts are open when the breaker is closed.)



1. Front Bushing
2. Rear Bushing
3. Horizontal Barriers
4. Arc Chute Support Bolt
5. Stationary Arcing Contact
6. Stationary Primary Contact
7. Movable Primary Contact
8. Movable Arcing Contact
9. Arc Chute Support Bracket
10. Booster Cylinder
11. Front Vertical Barrier
12. Breaker Handle
13. Secondary Couplers
14. Manual Trip Button
15. Connecting Rod
16. Control Device (HMA Relay)
17. Removable Manual Operating Handle
18. Operating Mechanism
19. Insulating Base
20. Arc Chute Assembly

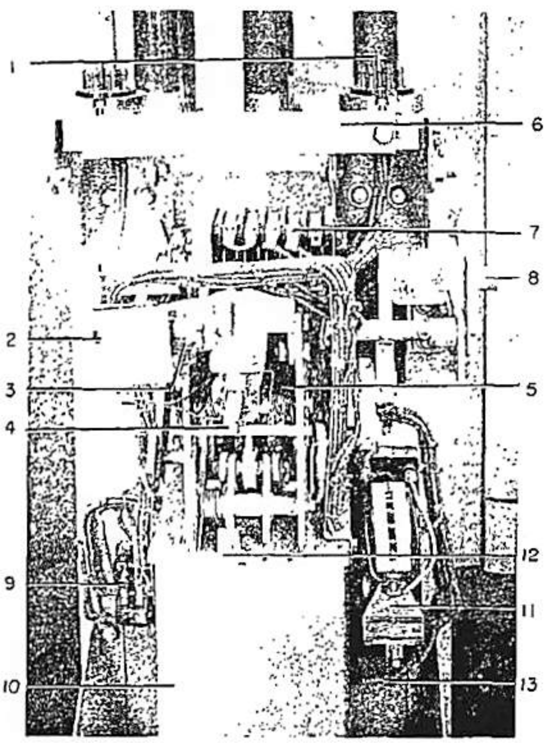
Fig. 6 Partial Side View of Breaker

1. Front Bushing
2. Washer
3. Contact Arm
4. Bearing
5. Support Asm.
6. Screw
7. Cotter Pin
8. Nut
9. Spring



CONTACT BLADE HINGE

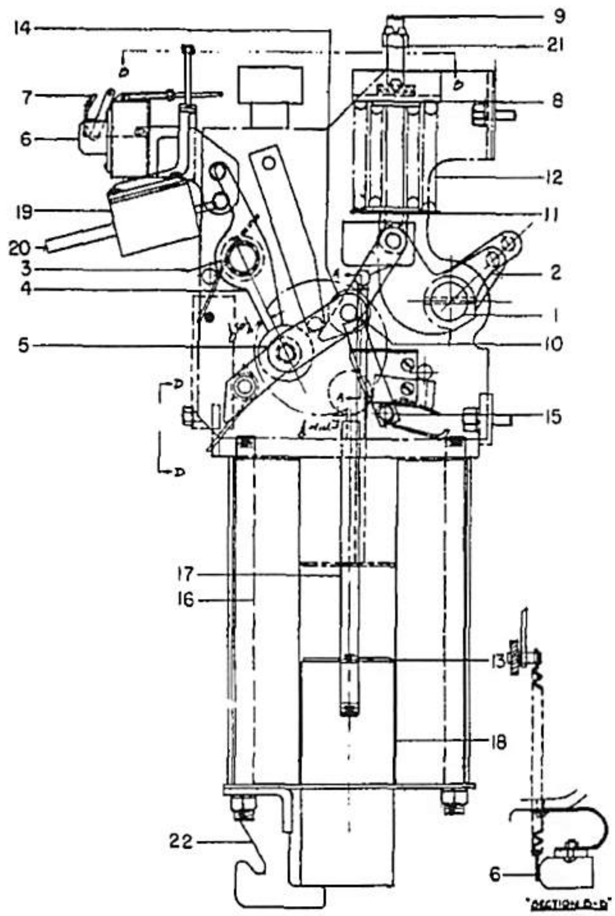
Fig. 6 Sec. "AA"



1. Secondary Coupler
2. Position Indicator
3. Operation Counter
4. Manual Trip
5. Opening Spring Unit
6. Breaker Handle
7. Auxiliary Switch
8. Positive Interlock Arm
9. Control Relay
10. Closing Solenoid
11. Control Relay (HJA)
12. Stop Bolt
13. Closing Coil Leads

Fig. 7 MS-9 Operating Mechanism

Fig. 7 (8028977)



1. Main Operating Shaft
2. Main Crank
3. Trip Latch Shaft
4. Trip Latch
5. Trip Roller
6. Operations Counter
7. Position Indicator
8. Upper Spring Support
9. Adjustable Spring Stud
10. Prop Rest Pin
11. Lower Spring Support
12. Opening Spring
13. Impact Shim
14. Closing Roller
15. Prop
16. Closing Coil
17. Closing Plunger Rod
18. Closing Armature
19. Trip Coil
20. Manual Trip Button
21. Mechanism Stop Nut
22. Bracket

Fig. 8 Type MS-9 Solenoid Operating Mechanism

Fig. 8 (688C503)

AUXILIARY DEVICES

LATCH CHECKING SWITCH WIPE

REFER TO FIG. 11

The latch checking switch is used to insure that the mechanism latch has been reset after a tripping operation. The latch checking switching contacts are connected in the control circuits in the metal-clad unit to prevent the closing coil from being energized until the latch is reset. The contacts in the switch should "make" at the end of the reset stroke of the tripping latch. The point at which the switch contacts "make" may be adjusted by adding or removing shims.

PLUNGER INTERLOCK

Refer to Fig. 9. With the breaker in the closed position, the vertical distance from the top of the interlock bolt to the top of the breaker frame should be 5-5/8" + 1/16" -0. To change this adjustment add or remove washers.

IMPACT CURRENT TRIP, CAPACITOR TRIP AND UNDERVOLTAGE TRIP DEVICES

REFER TO FIG. 12

When these devices are furnished with the breaker, the wipe of the impact current trip latch should be 1/32" to 1/16". This can be adjusted by the use of the small adjusting screw located behind and near the right end of the current trip mounting bracket. Also, the adjusting screw (14) should be set 1/16" below the pin (12). This is to prevent the cam latch (3) from going over center.

The opening speed of the arcing contact should be 12 to 16 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 transfer lug.

CONTROL POWER CHECK

After the breaker has been closed and opened slowly several times with the maintenance operating handle 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: Where 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:

Close the breaker by manually operating the control relay, Fig. 5 and 6. 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.

If the closed circuit voltage at the terminals of the closing coil does not fall within the specified range on d-c operated breakers, check the voltage at the source of power and the line drop between the power source and the breaker.

For a-c operation a germanium (color-black, flanged base) or a silicon (color-blue, hex base) rectifier bridge assembly mounted elsewhere in the metal-clad unit is used. These rectifiers are of the button-type and are hermetically sealed units. They have been tested and the resistor has been set to 2 ohms at the factory. Unlike rectifiers of previous design 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 maximum at nominal voltage). Both the coils and rectifiers are designed for intermittent operation and will 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 (Fig. 9).

When all the foregoing inspection details have been checked, the breaker may be 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 D50H47 on the silvered portion of the breaker studs to form a thin coating for contact 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.

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 DE-ENERGIZED 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

At this time a thorough inspection should be made of all parts of the breaker and mechanism.

BREAKER CONTACTS

REFER TO FIG. 6

After removing box barrier, the contacts on the two outside phases can readily be inspected. The contacts on the center phase can be seen with the aid of a mirror and flashlight. If the contacts are in good condition, there is no need of removing the arc chute. If, however, the surface of the contacts needs smoothing up with a fine file or sandpaper, the arc chutes can be removed as described under REPLACEMENT OF PARTS.

ARC CHUTE

REFER TO FIG. 14

If the arc chutes are removed for contact maintenance, and are for any reason disassembled for inspection, the following points should be noted:

1. Scale formed over the surface of the chute must not be removed but loose particles collected in the muffler 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 cracks do not interfere with the operation of the device in any way and should be disregarded. If the chute has had any mechanical injury due to dropping or accidental striking which has resulted in actual breaking off of fins, replacement of the arc chute is necessary.

INSULATION PARTS

The 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.

BUSHINGS

REFER TO FIG. 6

The surface of the bushings should be smooth and unscratched. If the insulation surface should become damaged, it should be well cleaned, and then refinished.

MECHANISM

REFER TO FIGS. 7 AND 8

Careful inspection should be made to check for loose nuts or bolts and broken cotter pins. The latch surface should be inspected for wear and the surface of the rollers should be inspected for chipping or other evidences of damage. Lubrication should be done in accordance with the instructions under LUBRICATION.

INSULATION TEST

When insulation has been repaired or replaced or when the breaker has been stored under adverse conditions, 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 test 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.

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. 10. 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 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 lubricants 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.	
CONTACT ARM HINGE ASSEMBLY		
1. Cup Bearing	No lubrication required.	Wipe clean and apply D50H47.
2. Loose rings between bushing and contact arm.	No lubrication required.	Wipe clean and apply D50H47.
Booster Cylinders	No lubrication required.	No lubrication required.

Fig. 10 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 the 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.

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 relay sticking or not operating properly.
REMEDY: Check and adjust control relay or replace.

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

5. Damaged control relay 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.

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.

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 connectors.
REMEDY: Tighten.

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

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.

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 and the breaker should be operated several times. After operation, the contacts should be wiped dry with a clean rag. Sufficient grease will remain on the contacts for proper lubrication.

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 condition indicate a need for replacement. Do not grease the arcing contacts under any circumstances.

5. Check the breaker and mechanism adjustments as summarized under INSPECTION AND 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 on the bottom of the stationary contact support should be inspected for possible damage and replacement.

7. The main contacts of the control relay 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 tighteness of connections and possible damage to insulation.

10. After the breaker has been serviced, it should be operated 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 coil and arc runners.

2. The throat area of the arc chute 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.

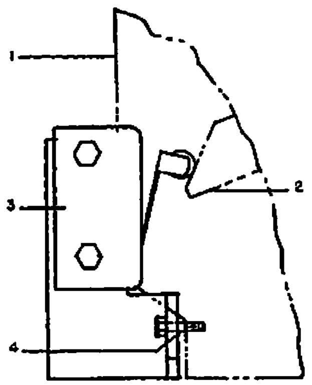
3. The blow-out coil should be carefully examined and if the insulation has been cracked, shrunk or eroded from arc action and heat so that the turns of the coils are not fully insulated from each other the coils should be replaced. All connections should be checked for tightness.

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 not broken 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



1. Mechanism Frame
2. Linkage
3. Latch Checking Switch
4. Shims

Fig. 11 Latch Checking Switch

Fig. 11 (688C508)

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 disassembled, inspected, cleaned and re-lubricated with G-E contact lubricant D50H47. It is not necessary to grease the self-lubricating contact ring at the hinge point between the contact blade and bushing. The contact ring 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.

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 breakers 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 ADJUSTMENTS, INSPECTION AND TEST.

Before maintenance or replacement of contacts, the arc chutes must be removed.

ARC CHUTE REMOVAL

REFER TO FIG. 13

To remove the arc chutes, first loosen the arc chute support bolt (2), Fig. 13, and remove the arc runner connecting bolt (1), Fig. 13. The arc chute is then free to be pulled away from the breaker.

PRIMARY CONTACTS

REFER TO FIG. 1

The primary contacts are designed to carry the normal load current with a minimum amount of heating and are provided with an inlaid block of silver to minimize the effects of wear. The stationary primary contacts consist of 4 fingers for the 1200 ampere breaker and are mounted along with the associated springs on the support casting carried by the rear bushing. The fingers may be replaced after removing the cotter pin through the pivot end.

REFER TO FIG. 6

The movable primary contact (7), Fig. 6 is carried on the blade hinged at the front bushing. The arc chute must be removed (see section ARC CHUTE REMOVAL) and the following steps should be followed for replacement of the contact blade:-

(a) Remove the bolt fastening the arc chute supporting the bracket to the lower end of the front bushing, and remove the bracket.

(b) Disconnect the puffer tube and operating rod from the contact blade.

(c) At the blade hinge, remove the bolt, springs, spacers (only on 600 amp. breaker) and thimbles, see Fig. 6.

(d) Slip the contact blade off the end of the bushing and withdraw.

1. Current Trip Unit
2. Trip Shaft
3. Cam Latch
4. Breaker Trip Latch
5. Latch Bracket
6. Guide
7. Spring
8. Crank
9. Spacer Block
10. Lock Nut
11. Adjustable Rod
12. Pin
13. Locknut
14. Adjusting Screw

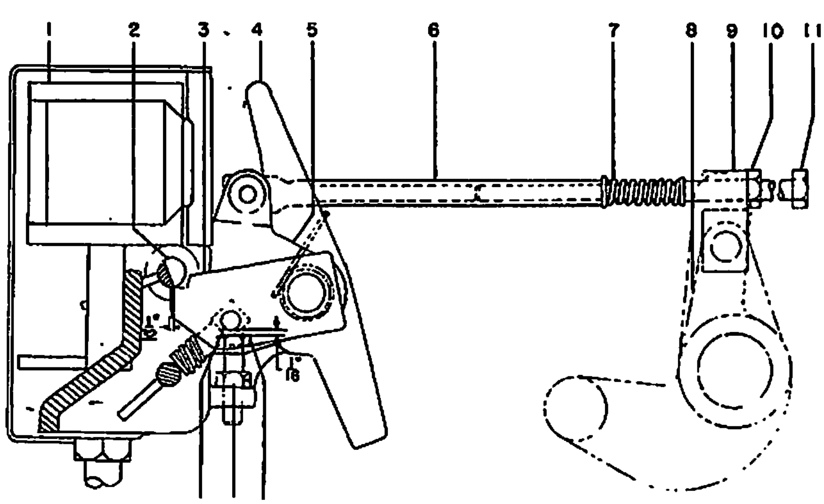
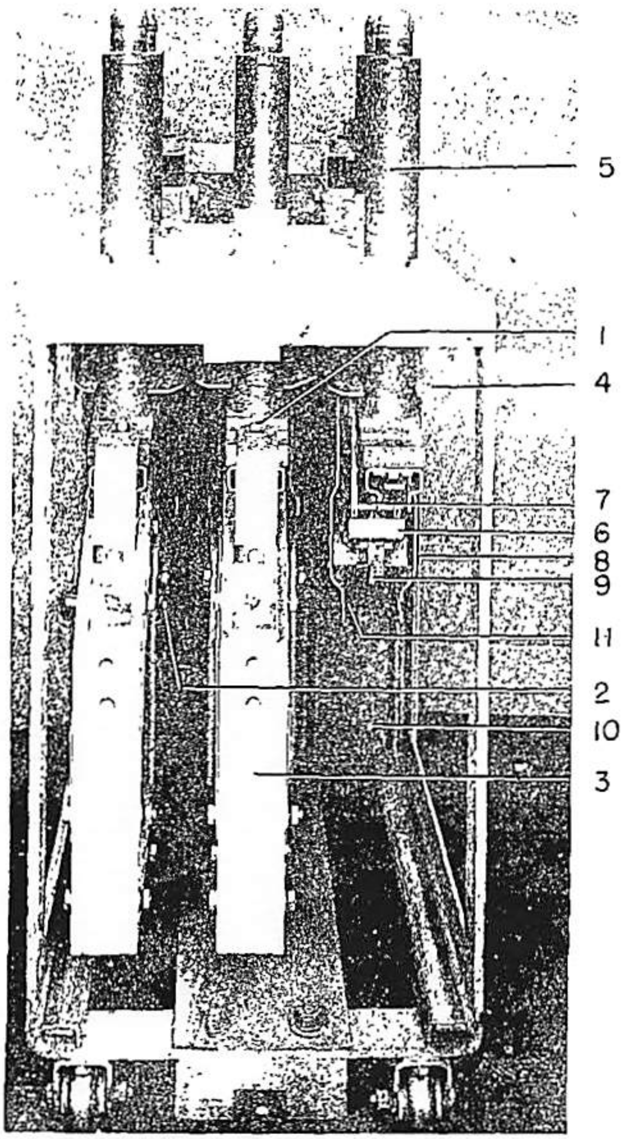


Fig. 12 (264B180)

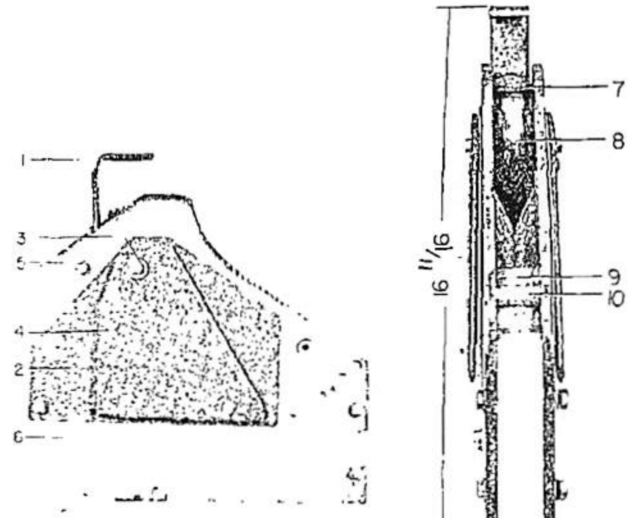
Fig. 12 Current Trip Assembly MS-9 Solenoid Mechanism



1. Arc Chute Connection Bolts
2. Arc Chute Supporting Bolts
3. Arc Chute Assembly
4. Upper Horizontal Barrier
5. Rear Bushing Assembly
6. Movable Primary Contact
7. Tube and Piston Assembly
8. Arc Chute Support Bracket
9. Movable Arcing Contact
10. Front Vertical Barrier
11. Booster Cylinder

Fig. 13 Rear View of Breaker With Box Barrier and Two Arc Chutes Removed

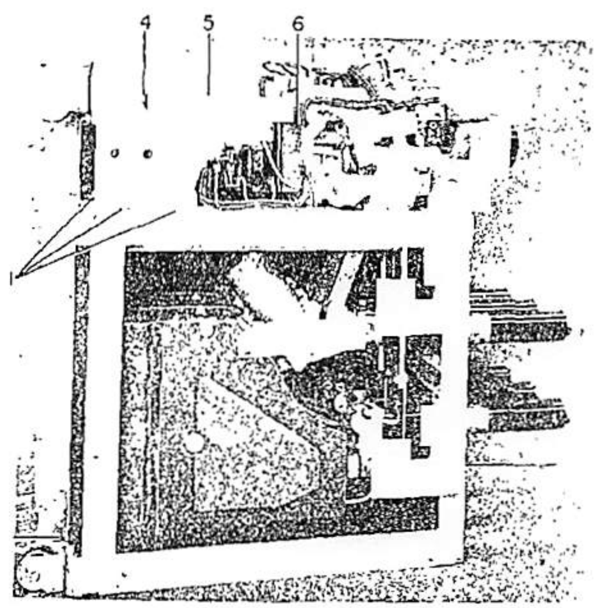
Fig. 13 (8028978)



1. Hanger Support
2. Shield
3. Pole Piece Mounting Bolt
4. Pole Piece
5. Bolt
6. Arc Chute Side
7. Insulation Block
8. Upper Runner
9. Lower Runner
10. Arc Chute Mounting Lug

Fig. 14 Side and End View of Arc Chute

Fig. 14 (8028844 & 8028845)



1. Wheel Base Bolts
4. Solenoid Pot Assembly Nuts
5. Solenoid Pot Assembly Cover
6. Control Relay

Fig. 15 AM-4.16-75-1 Magne-blast Breaker Resting on Frame Back

Fig. 15 (8025213)

Reassemble the replacement parts making certain that all cotter pins are replaced. If a new hinge bolt has been used, or if it seems desirable for any other reason, the pressure at the hinge joint should be checked by measuring with a spring balance the force required to swing the contact arm. For both the 600 and 1200 ampere breakers, this force should be between 40 and 60 pound-inches.

ARCING CONTACTS

REFER TO FIG. 1 AND 3

The stationary arcing contact (see Fig. 1) is carried by the bracket fastened to the lower side of the rear bushing. To remove, take out the two Allen head cap screws from the top (not shown). To replace, the following steps should be followed:

(a) Remove lock nut and stop bolt.

(b) Place arcing finger on pivot pin.

(c) Place fibre spring cup on top of the arcing finger.

(d) Place pivot spring guide block in position on the underside of the top of the bracket.

(e) Insert spring through the top of the bracket, spring block and into the spring cup.

(f) Place the assembly on the underside of the bushing, and engage the cap screws one turn in the spring guide block.

(g) Insert the arcing contact springs and guide.

(h) Tighten the cap screws, and reassemble the stop bolt and lock nut.

The contacts should be adjusted as described previously under ADJUSTMENTS.

CLOSING COIL

REFER TO FIG. 15

To replace the closing coil turn the breaker over on its back. Remove the wheel base by removing eight bolts (1) holding it to the frame. Disconnect closing coil leads (13) Fig. 7. Remove four nuts (4) holding the solenoid pot assembly together. Slide cover (5), closing coil (16) Fig. 8, and armature and plunger assembly (17) and (18), Fig. 8 out. To assemble, reverse the above procedure.

When making the final connection of the closing coil wires be careful on d-c operated breakers to connect the bottom coil lead (designated with a wire tap, lettered "B") to the HJA relay terminal #3 and connect the top coil lead (designated with a wire tap, lettered "T") to the HJA relay terminal #1. (NOTE: The letters "T" and "B" designate top and bottom in relation to the physical position of the closing coil as it is assembled in the mechanism on the breaker.) A final check should be made to see if the connection is made accurately. After the breaker adjustments have been made, and the breaker manually operated a few times, operate it electrically and observe the direction of the arc on the control relay (5) Fig. 5. If it is directed through the arc chute the connection is made correctly. If the arc is directed toward the relay coil, a careful check for other trouble should be made by going over the check list as described under HJA CONTROL RELAY ADJUSTMENT.

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 NEARES OFFICE OF THE GENERAL ELECTRIC COMPANY.

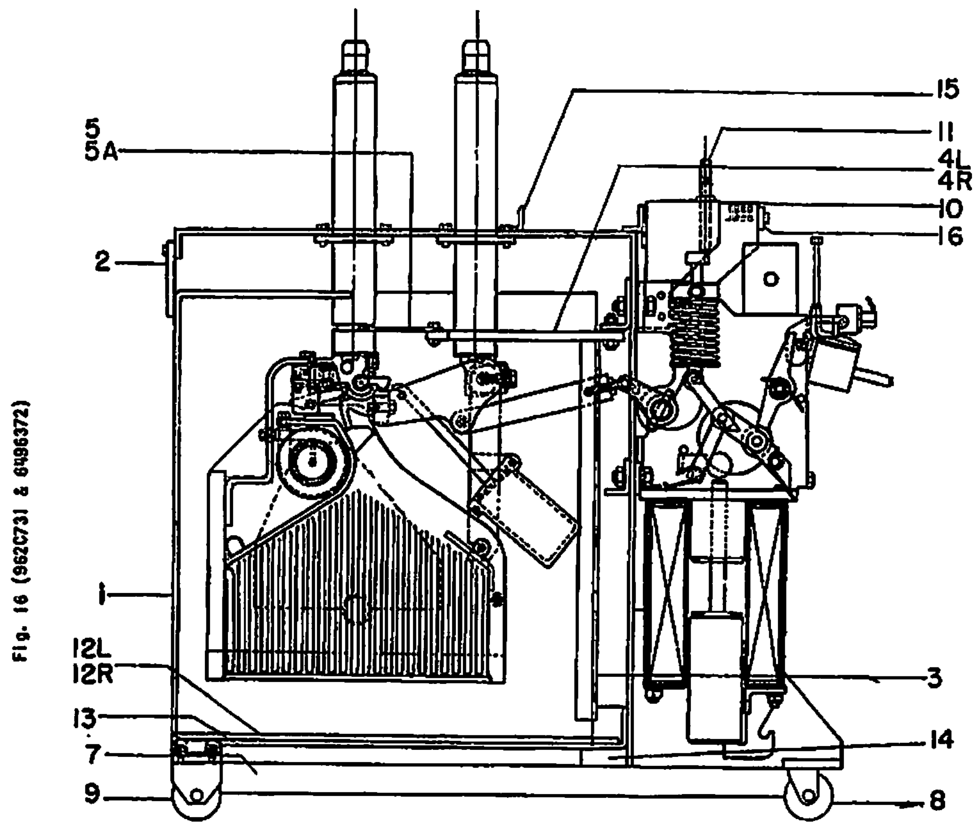
ILLUSTRATION REFERENCE

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

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

PARTS FOR ALL RATINGS

REF. NO.	CAT. NO. FOR AM-4.16-75-1	NO. PER BREAKER	DESCRIPTION
27	0958C0649 G-0002	3	Movable Arcing Contact
28	0958C0638 G-0010	3	Movable Contact Arm
34	281B793 P-1	3	Booster Cylinder
45	236C770 G-5	3	Operating Rod and Eye Bolt
52	269C864 P-15	12	Primary Contact Finger
53	6301381 P-1	12	Spring for Primary Contact
54	6242891 P-1	15	Spring Guide
56	269C828 G-2	3	Buffer
57	6301242 G-1	3	Arcing Contact
58	369A460	3	Spring, Outside
59	6301364 P-1	3	Spring, Inside
60	269C828 P-1	3	Guide Pin
62	6370615 P-1	3	Spring for Arc Contact
76	0958C0637 P-0014	3	Insulation Block
146	6306734 G-2	1	Closing Coil (125v d-c)
146	6306734 G-3	1	Closing Coil (250v d-c)
146	6306734 G-2	1	Closing Coil (230v a-c)
147	6174599 G-4	1	Potential Trip Coil (125v d-c)
147	6174599 G-15	1	Potential Trip Coil (250v d-c)
147	6275084 G-22	1	Potential Trip Coil (230v a-c)
147	6174599 G-11	1	Potential Trip Coil (24v d-c)
147	6174599 G-3	1	Potential Trip Coil (48v d-c)
147	6174599 G-6	1	Capacitor Trip Coil
176	6275017 G-12	1	Undervoltage Device Coil (230v a-c)
200B	6174599 G-2	3	Current Trip Coil (3 Amp. a-c)



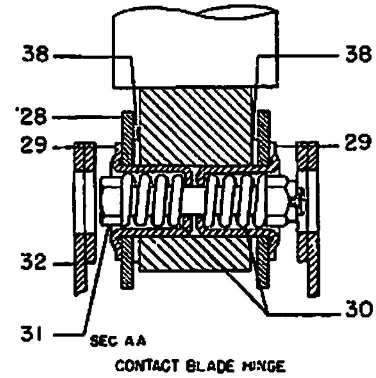


Fig. 16 Cross Section Type AM-4.16-75-1

PARTS REFERENCED IN FIG. 16

REF. NO.	AMPS	CAT. NO. FOR AM-4.16-75-1	NO. PER BREAKER	DESCRIPTION
1	ALL	269C862 G2	1	Box Barrier
2	ALL	269C846 P12	1	Box Barrier Clamp
3	ALL	236C770 G6	1	Vertical Barrier
4L	ALL	236C771 P10	3	Horizontal Barrier (Left)
4R	ALL	236C771 P8	3	Horizontal Barrier (Right)
5	ALL	236C771 P6	1	Horizontal Barrier (Center Ø)
5A	ALL	236C771 P7	2	Horizontal Barrier (Outer Ø)
7	ALL	269C830 G1	1	Wheel Base Assembly
8	ALL	6597296 P5	2	Front Wheel & Caster
9	ALL	6597296 P6	2	Rear Wheel
10	ALL	264B173 G4	2	Secondary Coupler Plug
11	ALL	269C861 G3	1	Plunger Interlock Assembly
12L	ALL M/C	236C771 P15	1	Box Barrier Guide (Left)
12L	ALL Δ	236C771 P17	1	Box Barrier Guide (Left)
12R	ALL M/C	236C771 P16	1	Box Barrier Guide (Right)
12R	ALL Δ	236C771 P18	1	Box Barrier Guide (Right)
12	ALL	236C771 P14	1	Barrier
14	ALL	6176109 P21	1	Spacer
15	ALL	414A126 P1	2	Lifting Angle
16	ALL	269C828 P15	1	Handle

Δ Mine type

Fig. 17A (8023751)

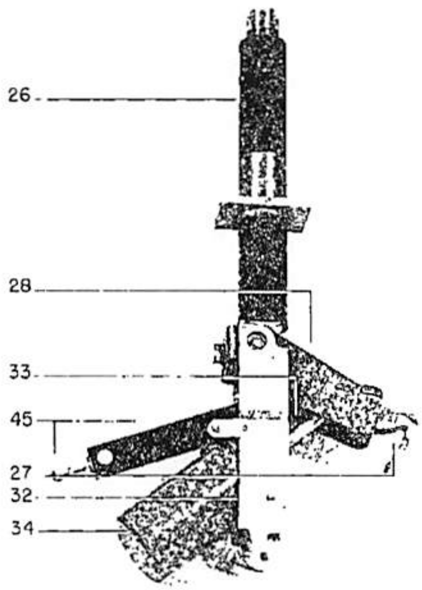


Fig. 17A Complete Assembly

Fig. 17B (8023750 & 962C732)

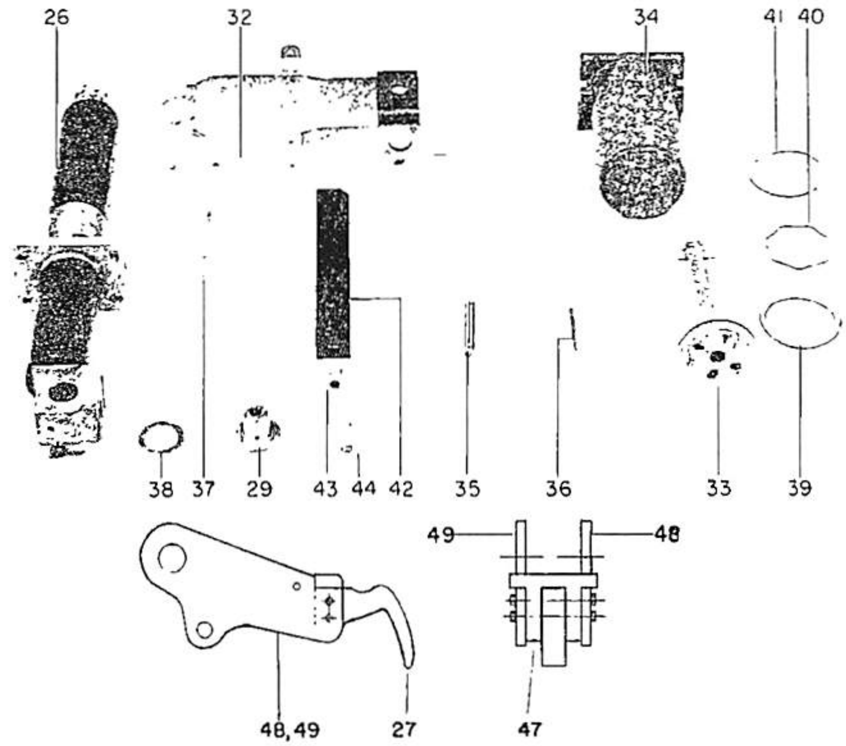


Fig. 17B Component Parts

Fig. 17 Front Bushing Assembly (Ref. No. 25)

PARTS REFERENCED IN FIGS. 16, 17A AND 17B

REF. NO.	AMPS	CAT. NO. FOR AM-4.16-75-1	NO. PER BREAKER	DESCRIPTION
25	600 M/C	0958C0638 G0001	3	Front Bushing Complete
25	1200 M/C	0958C0638 G 0002	3	Front Bushing Complete
25	600 Δ	0958C0638 G0003	3	Front Bushing Complete
26	600 M/C	0962C0728 G0001	3	Front Bushing
26	1200 M/C	0114C5468 G0001	3	Front Bushing
26	600 Δ	0898B0292 P0001	3	Front Bushing
27	ALL	0958C0649 G0002	3	Movable Arcing Contact
28 *	ALL	0958C0638 G0010	3	Movable Contact Arm Assembly
29	ALL	006243035 P0001	6	Cup Bearing
30	ALL	006172976 P0001	6	Hinge Spring
31	ALL	0269C0828 P0008	3	Hinge Bolt
32	ALL	0269C0864 G0008	3	Support Assembly
33	ALL	0269C0864 G0002	3	Piston Assembly
34	ALL	0281B0793 P0001	3	Booster Cylinder
35	ALL	0269C0827 P0016	3	Pin
36	ALL	006076401 P0025	3	Pin
37	ALL	006076401 P0049	3	Pin
38	ALL	0104A2495 P0004	6	Washer
39	ALL	0421A0248 P0002	3	Piston Ring
40	ALL	0383A0999 P0002	3	Piston Ring Expander
41	ALL	0456A0874 P0001	3	Piston Ring Equalizer
42	ALL	0236C0770 P0017	3	Rod
43	ALL	0236C0770 P0018	3	Nut
44	ALL	0236C0770 P0020	3	Eye Bolt
45	ALL	0236C0770 G0005	3	Operating Rod and Eye Bolt
47	ALL	0958C0649 P0002	3	Contact
48	ALL	0958C0649 G0003	3	Blade Assembly (Right)
49	ALL	0958C0649 G0004	3	Blade Assembly (Left)

Δ Mine type
* Includes Reference Nos. 27 & 47

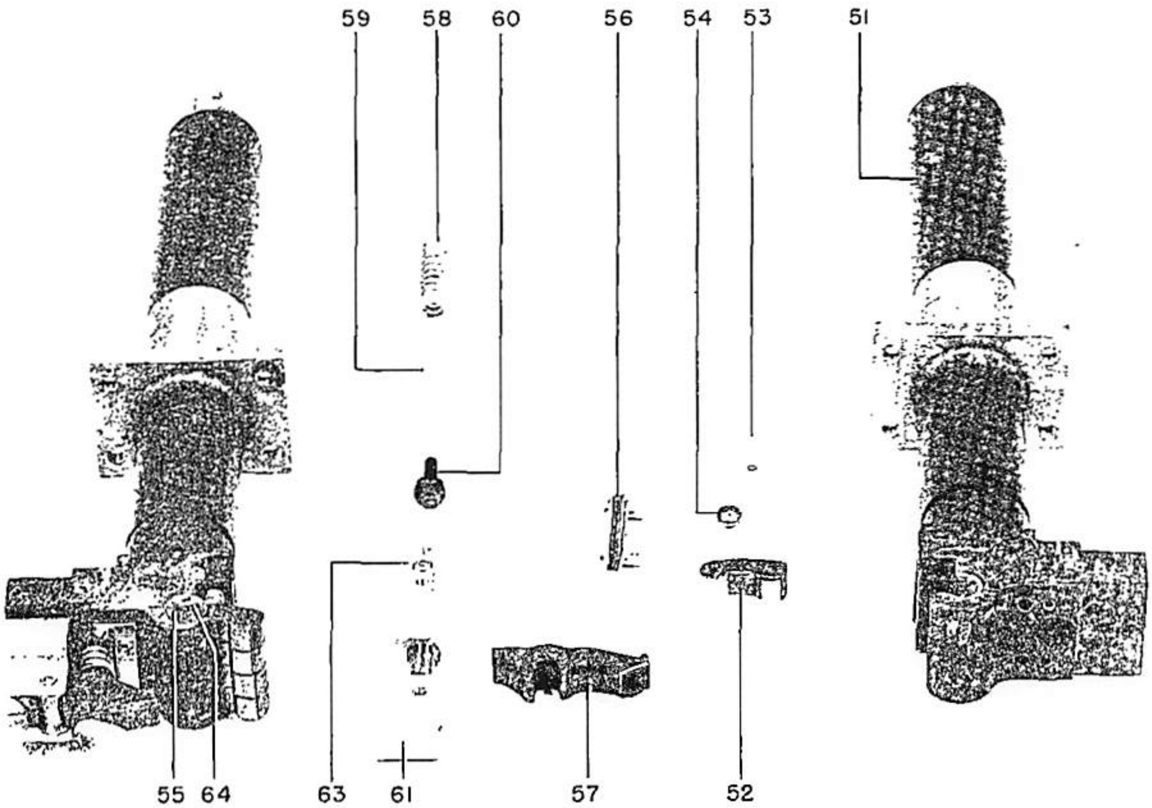


Fig. 18A Complete Assembly

Fig. 18B Component Parts

Figs. 18A & 18B (8023749)

Fig. 18 Rear Assembly (Ref. No. 50)

PARTS REFERENCED IN FIG. 18

REF. NO.	AMPS	CAT. NO. FOR AM-4.16-75-1	NO. PER BREAKER	DESCRIPTION
50	600	0958C0638 G0012	3	Rear Bushing Assembly Complete
50	1200	0958C0638 G0013	3	Rear Bushing Assembly Complete
50	600 △	0958C0638 G0014	3	Rear Bushing Assembly Complete
51	600	0962C0728 G0002	3	Rear Bushing
51	1200	0114C5488 G0002	3	Rear Bushing
51	600 △	0898B0292 P0002	3	Rear Bushing
52	ALL	0269C0864 P0015	12	Primary Contact
53	ALL	006301381 P0001	12	Spring for Primary Contact
54	ALL	006242891 P0001	15	Spring Guide
55	ALL	0269C0828 P0007	6	Washer
56	ALL	0269C0828 G0002	3	Buffer
57	ALL	006301242 G0001	3	Arcing Contact
58	ALL	0369A0460	3	Spring, Outside
59	ALL	006301364 P0001	3	Spring, Inside
60	ALL	0269C0828 P0001	3	Guide Pin
61	ALL	0269C0828 G0001	3	Contact Support
62	ALL	006370615 P0001	3	Spring for Arcing Contact
63	ALL	0269C0828 P0014	3	Spring Guide for Arcing Contact
64	ALL	0269C0828 P0006	3	Cotter Pin

△ Mine Type

Fig. 19A (8028844)

Fig. 19B (8028847)

Fig. 19C (8028846)

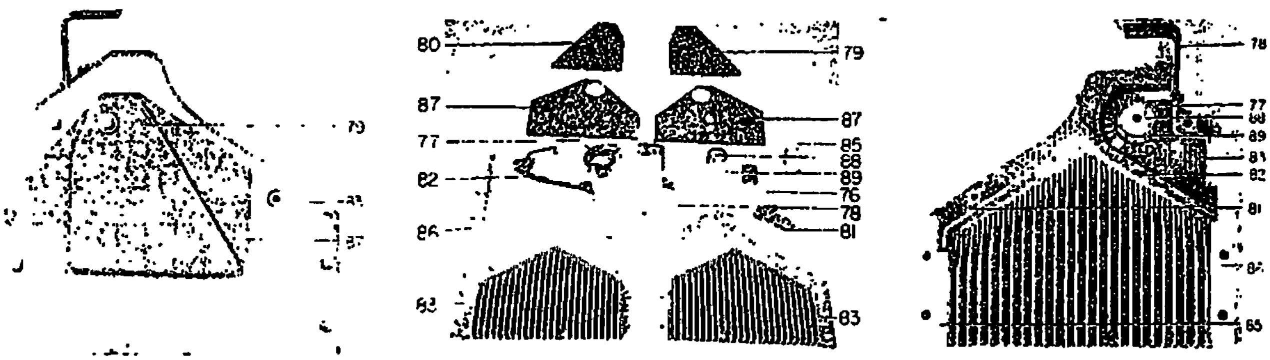


Fig. 19A Complete Assembly

Fig. 19B Component Parts

Fig. 19C Cut-away View

Fig. 19 Arc Chute (Ref. No. 75)

PARTS REFERENCED IN FIG. 19

REF. NO.	CAT. NO. FOR AM-4.16-75-1	NO. PER BREAKER	DESCRIPTION
75	0834D0366 G0001	3	Arc Chute Assembly Complete
76	0958C0637 P0014	3	Insulation Block
77	0269C0854 G0001	3	Coil
78	0958C0637 G0001	3	Coil Support
79	0958C0637 G0004	3	Pole Piece
80	0958C0637 G0005	3	Pole Piece
81	0958C0637 G0002	3	Arc Runner
82	0958C0637 G0003	3	Arc Runner
83	* 0958C0636 P0001	3	Arc Chute Side
83	* 0958C0636 P0002	3	Arc Chute Side
85	0958C0637 P0012	3	Spacer
86	0958C0637 P0013	3	Spacer
87	0958C0637 P0009	6	Shield
88	0958C0637 P0010	3	Core
89	0958C0637 P0011	3	Insulating Tube

* Shipped in Pairs Only.

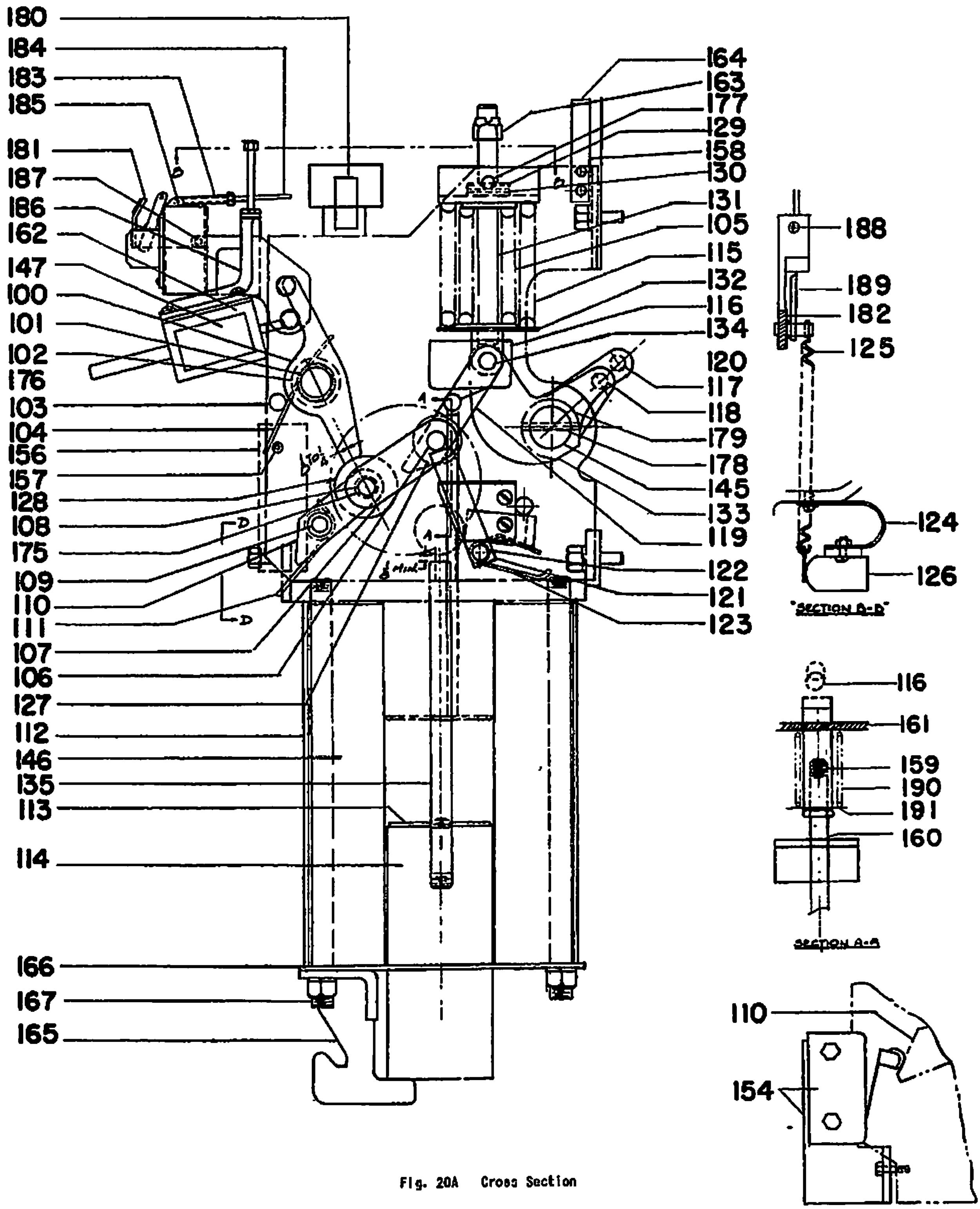


Fig. 20A Cross Section

VIEW "D-D"

Fig. 20 MS-9 Mechanism for AM 4.16-75-1 (Con't.)

Fig. 20A (962C729)

Fig. 20B (9620732)

Fig. 20C (6438456)

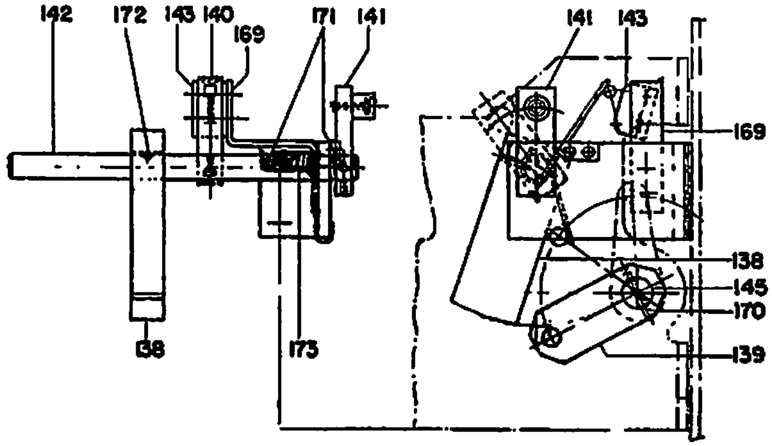


Fig. 20B Positive Interlock Linkage

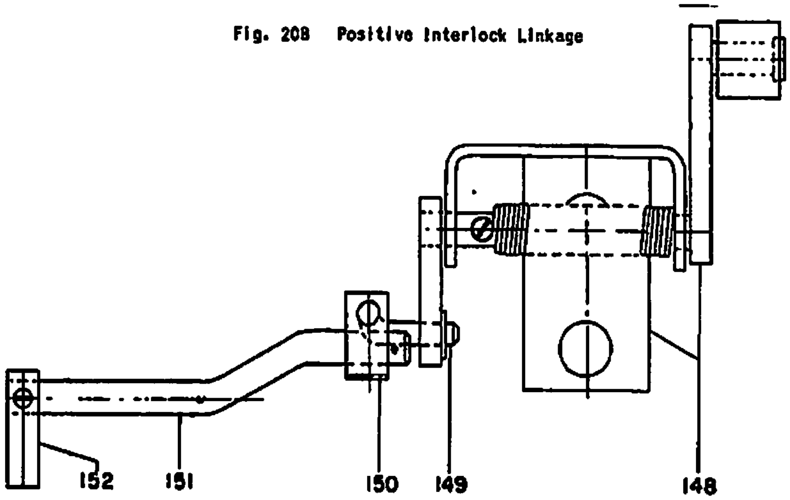


Fig. 20C Trip Mechanism (Ref. No. 153)

Fig. 20 MS-9 Mechanism for AM 4.16-75-1

PARTS REFERENCED IN FIGS. 20A, 20B AND 20C

REF. NO.	MVA	CAT. NO. FOR AM-4.16-75-1	NO. PER MECHANISM	DESCRIPTION
100	ALL	269C858 G-4	1	Latch
101	ALL	6077971 P-7	1	Pin
102	ALL	414A112 P-34	1	Needle Bearing
103	ALL	6076404 P-59	2	Pin
104	ALL	6509718	1	Spring
105	ALL	456A387 P-1	1	Spring
106	ALL	6370095 P-2	1	Pin
107	ALL	269C857 G-6	1	Link Assembly
108	ALL	6370095 P-3	1	Pin
109	ALL	6370095 P-4	1	Pin
110	ALL	269C858 G-1	1	Link
111	ALL	6370646	1	Spring
112	ALL	269C859 P-7	1	Pot
113	ALL	6440893 P-1	1	Shim
114	ALL	269C859 P-9	1	Armature
115	ALL	269C861 P-10	1	Spring
116	ALL	456A866 P-1	1	Cut-off Switch
117	ALL	6076404 P-105	3	Pin
118	ALL	269C858 P-14	1	Pin
119	ALL	269C858 P-13	2	Link
120	ALL	6370289 P-1	2	Crank

PARTS REFERENCED IN FIGS. 20A, 20B AND 20C (Con't.)

REF. NO.	MVA	CAT. NO. FOR AM-4.16-75-1	NO. PER MECHANISM	DESCRIPTION
121	ALL	269C858 G-3	1	Prop
122	ALL	6076404 P-159	1	Pin
123	ALL	6301361	1	Spring
124	ALL	269C860 P-4	1	Support
125	ALL	6370647	1	Spring
126	ALL	6192382 P-6	1	Operation Counter
127	ALL	6477649 G-3	1	Roller
128	ALL	6441826	1	Ball Bearing
129	ALL	269C861 P-11	1	Disc
130	ALL	414A109 P-6	2	Cushion
131	ALL	269C861 P-7	1	Guide
132	ALL	6245880	1	Seat
133	ALL	6210959 P-2	1	Crank
134	ALL	6370095 P-1	1	Pin
135	ALL	269C859 P-10	1	Plunger
138	75	958C645 P-5	1	Prop
139	75	958C645 G-2	1	Stop Blade and Pin
140	75	958C645 P-4	1	Paddle
141	75	958C645 P-9	1	Crank
142	75	258C696 P-5	1	Shaft
143	75	456A866 P-1	1	Interlock Switch
145	ALL	258C694 P-7	1	Shaft
146	ALL	6306734 G-2	1	Closing Coil (125v d-c)
146	ALL	6306734 G-3	1	Closing Coil (250v d-c)
146	ALL	6306734 G-2	1	Closing Coil (230v a-c)
147	ALL	6174599 G-4	1	Potential Trip Coil (125v d-c)
147	ALL	6174599 G-15	1	Potential Trip Coil (250v d-c)
147	ALL	6275084 G-22	1	Potential Trip Coil (230v a-c)
147	ALL	6174599 G-11	1	Potential Trip Coil (24v d-c)
147	ALL	6174599 G-3	1	Potential Trip Coil (48v d-c)
147	ALL	6174599 G-6	1	Capacitor Trip Coil
148	75A	6438456 G-3	1	Trip Arm Bracket Asm.
149	75A	6242840 P-1	1	Crank
150	75A	6242839 P-1	1	Arm
151	75A	6242838 P-1	1	Crank Shaft
152	75A	6242837 P-1	1	Trip Latch
153	75A	6438456 G-4	1	Trip Mechanism, Complete
154	ALL	269C859 G-3	1	Latch Checking Switch and Support
156	ALL	684C642 G-1	1	Terminal Block (6 Point)
157	ALL	6002721 P-114	2	Spacer for Terminal Block
159	ALL	281B792 P-2	1	Plunger
160	ALL	281B792 P-3	1	Rod
161	ALL	281B792 P-4	1	Bracket
162	ALL	269C861 G-1	1	Manual Trip Assembly
163	ALL	414A146 P-4	1	Flex Nut
164	ALL	269C861 G-4	1	Support
165	ALL	269C859 G-2	1	Bracket Assembly
166	ALL	269C859 P-6	1	Plate
167	ALL	269C859 P-8	4	Stud
169	75	958C645 P-3	1	Support
170	75	958C645 P-21	2	Pin
171	75	958C645 P-19	2	Pin
172	75	958C645 P-20	1	Pin
174	75	456A343 P-1	1	Spring
175	ALL	6176109 P-71	2	Spacer
176	ALL	6242834 P-1	2	Spacer
177	ALL	6247762 P-1	2	Pin
178	ALL	269C857 P-32	4	Pin
179	ALL	6370567 P-51	2	Bushing
180	ALL	269C860 P-2	1	Base Plate
181	ALL	269C860 G-2	1	Indicator
182	ALL	269C860 P-6	1	Crank and Pin
183	ALL	269C860 P-9	1	Clevis
184	ALL	269C860 P-10	1	Rod
185	ALL	269C860 P-11	1	Pin
186	ALL	6420279 P-1	1	Support
187	ALL	6076401 P-125	1	Pin
188	ALL	414A146 P-1	1	Flex Nut
189	ALL	269C860 P-20	1	Connection Link

Fig. 21A (8023959)

Fig. 21B (8023958)

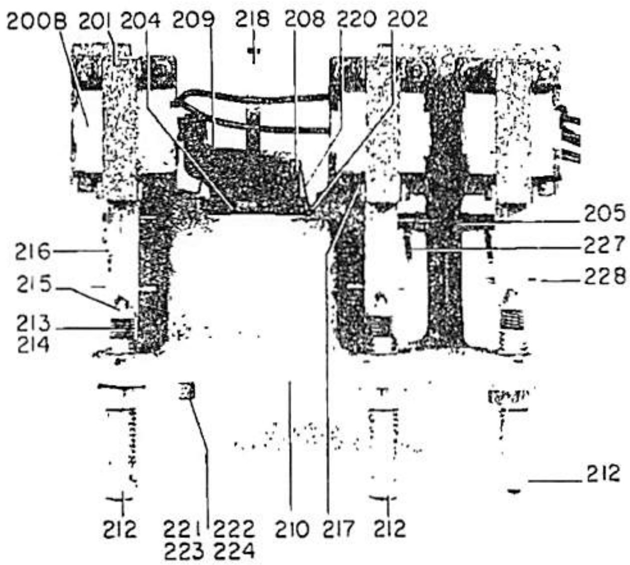


Fig. 21A Front View

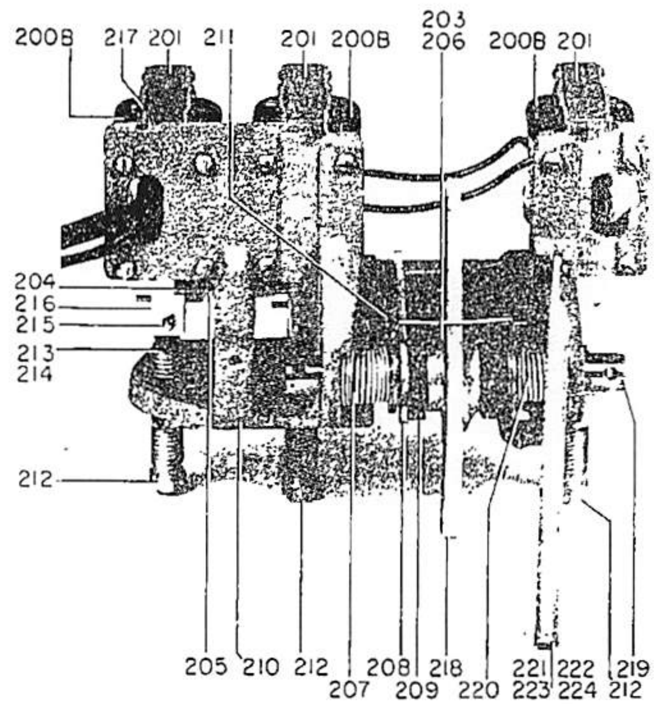


Fig. 21B Rear View

Fig. 21 Current Trip Mechanism (Ref. No. 200)

PARTS REFERENCED IN FIGS. 21A AND 21B

REF. NO.	CAT. NO. FOR AM-4.16-75-1	NO. PER BREAKER	DESCRIPTION
200A	6193957 G-13	1	Current Trip Mechanism
200B	6174599 G-2	3	Coil (3 Amp. a-c)
200C	6193957 G-7	1	Sol. Frames and Armature Assemblies
201	4905058 G-4	3	Solenoid Frame
202	6193957 P-8	2	Bearing
203	6247930 P-1	1	Spring Guide
204	6370224 P-1	1	Shaft
205	6509725 P-1	1	Spring
206	6247928 P-1	1	Pin
207	6247932 P-1	2	Spacer
208	6442898 P-1	1	Cam Latch
209	6508774 P-110	1	Latch Bracket Assembly
210	6327893 P-2	1	Frame
211	6247929 P-2	1	Pin
212	6247924 P-1	3	Calibrating Tube
213	6247925 P-1	3	Guide Pin
214	6477094 P-1	3	Spring
215	6247927 P-1	3	Pin
216	6247926 P-1	3	Armature
217	2236575 P-1	6	Guide
218	269C858 G-4	1	Latch
219	6077971 P-7	1	Shaft
220	6509718 P-1	1	Spring
221	6442397 P-1	1	Guide
222*	6509714 P-1	1	Spring
223*	6508767 P-125	1	Adjusting Rod Assembly
224*	6442895 P-1	1	Clevis
225*	6247919 P-1	3	Calibrating Strip
226*	6370500 P-9	1	Cover
227	6193957 P-209	5	Pin
228	6193957 P-34	3	Pin

* Not Shown

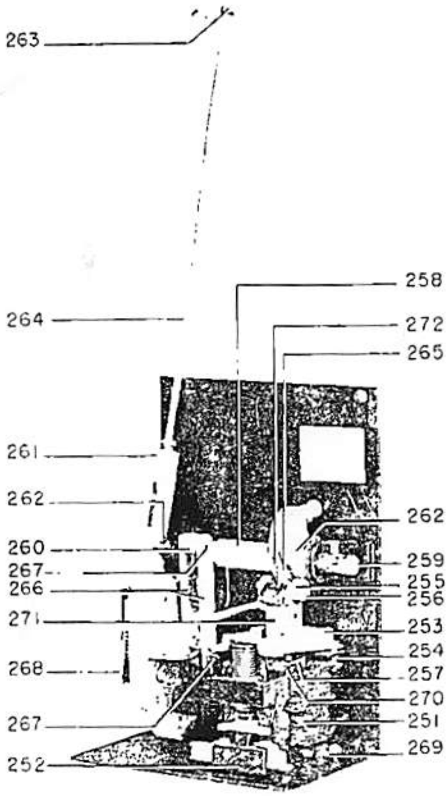


Fig. 22 Undervoltage Device, Cover Removed (Ref. No. 250)

Fig. 22 (8006345)

PARTS REFERENCED IN FIG. 22
FOR PG-6 AND PG-7 UNDERVOLTAGE DEVICES

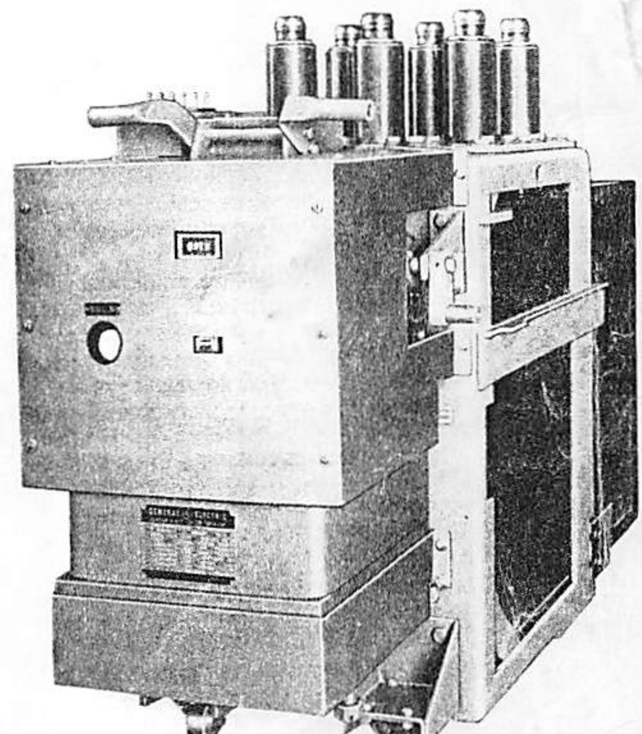
REF. NO.	UNDERVOLTAGE DEVICE TYPE	CAT. NO. FOR AM-4.16-75-1	NO. PER MECHANISM	DESCRIPTION
250	PG-6 INSTANTANEOUS	6476723 G-14	1	Undervoltage Device, Complete
250	PG-7 TIME DELAY	6476723 G-38	1	Undervoltage Device, Complete
251	ALL	6275017 G-12	1	Undervoltage Device, Coil (230v a-c)
252	ALL	6275259 G-1	1	Cut-out Switch
253	ALL	6275264 P-1	1	Operating Lever
254	ALL	2412699 P-1	2	Spring
255	ALL	2437146 P-1	2	Roller
256	ALL	2239800 P-1	1	Pin
257	ALL	2433013 P-1	2	Guide Strip
258	ALL	6172878 P-1	1	Spring
259	ALL	6300040 G-3	1	Crank and Shaft
260	ALL	6243282 P-1	1	Eye Bolt
261	ALL	6440967 P-1	1	Coupling
262	PG-6	6076401 P-101	2	Pin
262	PG-7	6076401 P-101	1	Pin
263	ALL	6440971 P-1	1	Trip Nut
264	ALL	6440966 P-1	1	Trip Rod
265	ALL	6243283 P-1	1	Link
266	PG-7	6243281 P-1	2	Link
267	PG-7	6076401 P-106	2	Pin
268	PG-7	6926026 G-2	1	Escapement Device
269	ALL	2234099 G-1	1	Solenoid Frame
270	ALL	2236258 P-1	2	Spring
271	ALL	2234101 G-1	1	Core
272	ALL	6301233 G-1	1	Adjusting Plate
273*	ALL	6113966 G-4	1	Cover
274*	ALL	6043479 P-1	1	Thumb Nut for Cover

* Not Shown

GEH-2000A
(Supersedes GEH-2000)

INSTRUCTIONS
AND
RENEWAL PARTS

POWER CIRCUIT BREAKERS



Magne-blast Breakers
Types
AM-2.4/4.16-100/150-3
AM-2.4/4.16-100/150A-3
AM-2.4/4.16-150/250-3
AM-2.4/4.16-150/250A-3
With MS-13 Mechanism

MEDIUM VOLTAGE SWITCHGEAR DEPARTMENT
GENERAL ELECTRIC
PHILADELPHIA, PA.

CONTENTS

MAGNE-BLAST CIRCUIT BREAKERS
TYPE AM-2.4/4.16 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 lengthen the arc and forces it into intimate contact with cool dielectric material. A sturdy, reliable operating mechanism assures low maintenance and long life, and the use of Self-X insulation reduces fire hazards to a minimum.

The AM-2.4/4.16 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 information 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.

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.

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

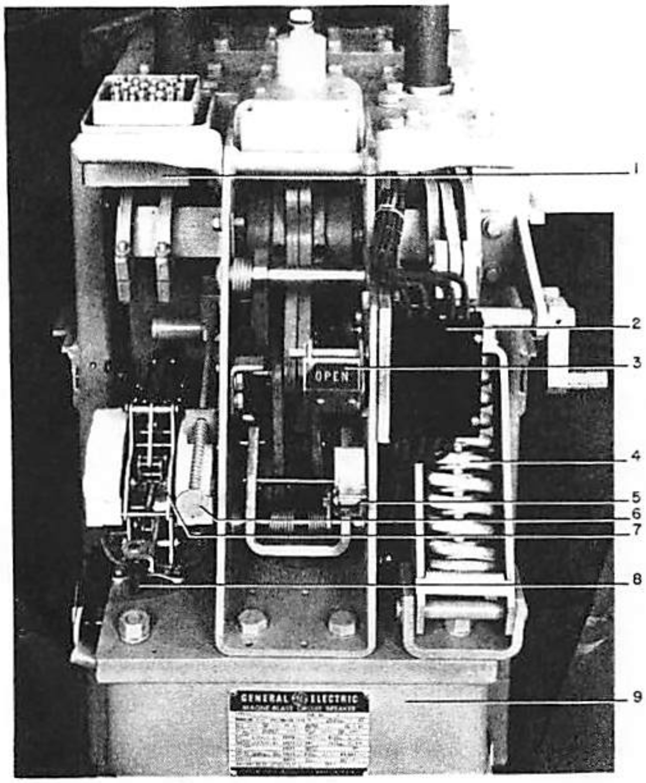


Fig. 1 (8020725)

Fig. 1 MS-13 Operating Mechanism

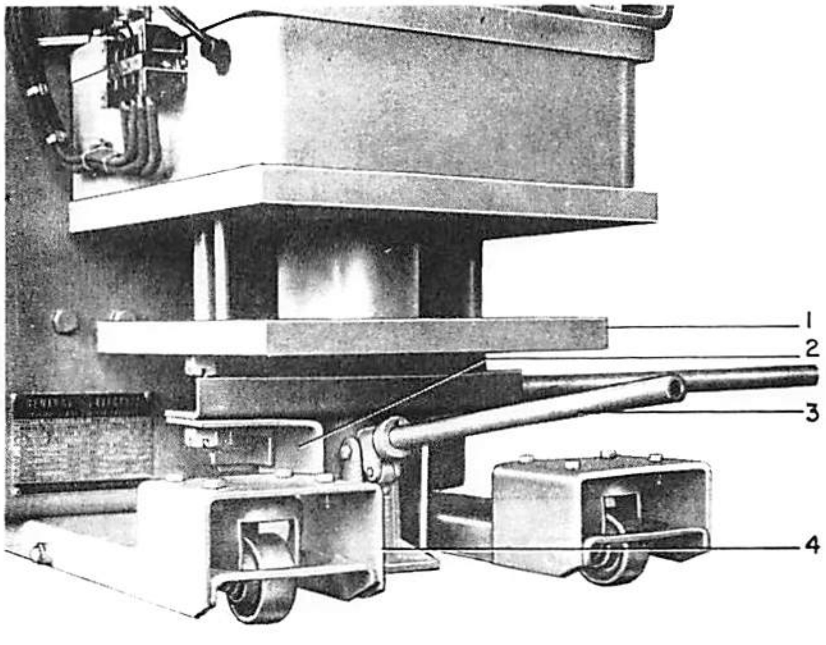
DESCRIPTION

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 is 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 equipment differs somewhat from those designed for M-26 equipment but its operation is principally the same. 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. Closing Armature
2. Maintenance Operating Device
3. Handle
4. Release Valve

Fig. 2 Method of Mounting Maintenance Operating Device

Fig. 2 (8020269)

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.

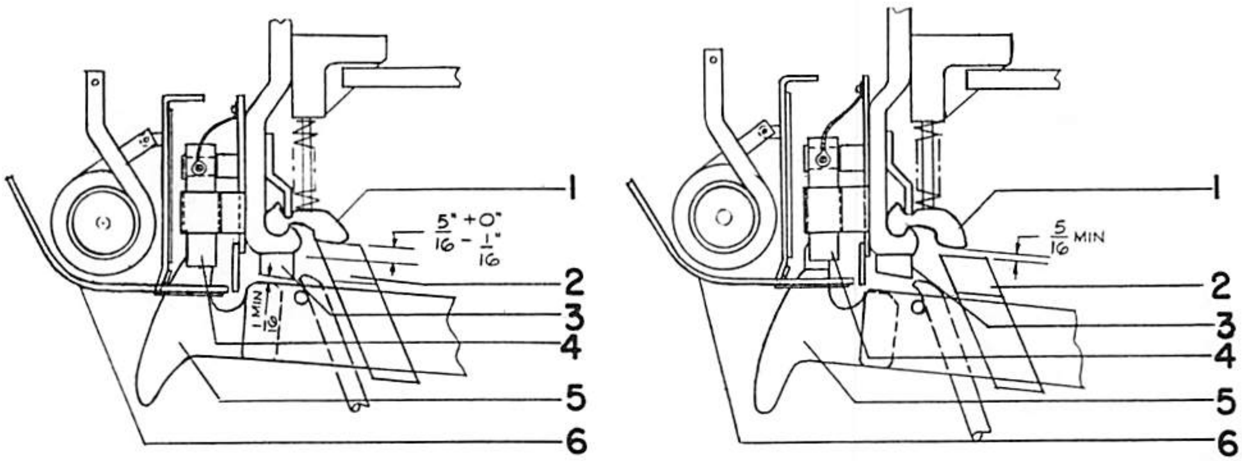


Fig. 3 (258C688)

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

Fig. 3 Contact Adjustments

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).

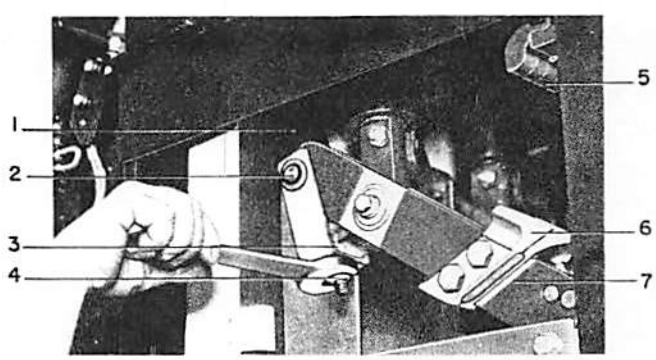
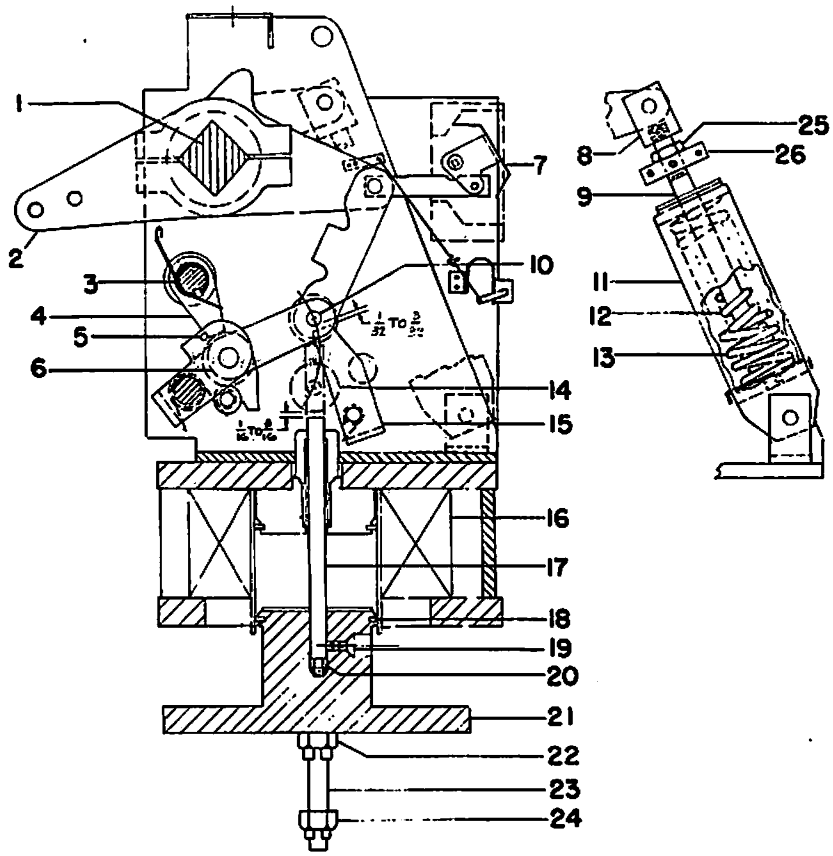


Fig. 4 (8018500)

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

Fig. 4 Adjustable Coupling for Making Primary Contact Wipe Adjustment

Fig. 5 (258C688)



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

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).

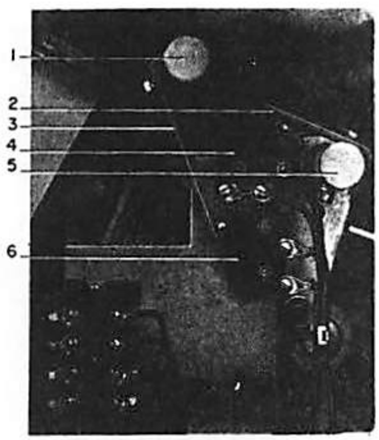
WHEN WORKING ON THE MECHANISM IN THE CLOSED POSITION, KEEP FINGERS CLEAR OF THE LINKAGE, AS ACCIDENTAL TRIPPING CAN CAUSE SEVERE INJURY.

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.



1. Interlock Shaft
2. Latch Ch. Sw. Arm
3. Inter. Sw. Arm
4. Latch Checking Switch
5. Trip Shaft
6. Interlock Switch

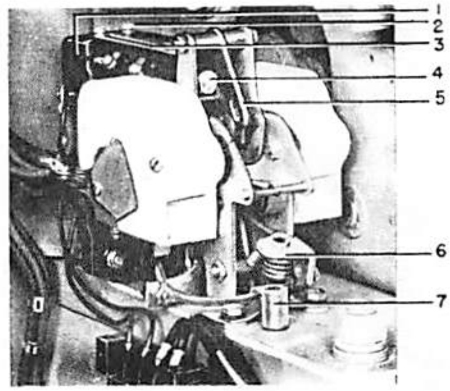
Fig. 6 Interlock Switch and Latch Checking Switch

INTERLOCK SWITCH WIPE

Referring to Fig. #6, rotate the interlock shaft (1) manually clockwise to release the interlock switch arm (3). 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 (3). 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



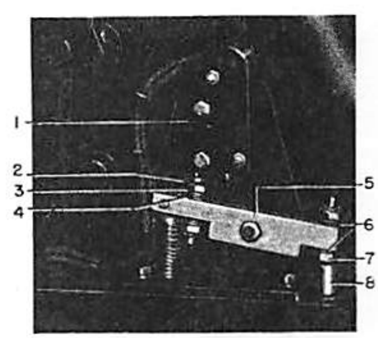
1. Back Auxiliary Switch
2. Mounting Screw
3. Top Auxiliary Switch
4. Plunger
5. Operating Arm
6. Trip Lever
7. Plunger Guide

Fig. 7 Control Device

(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.

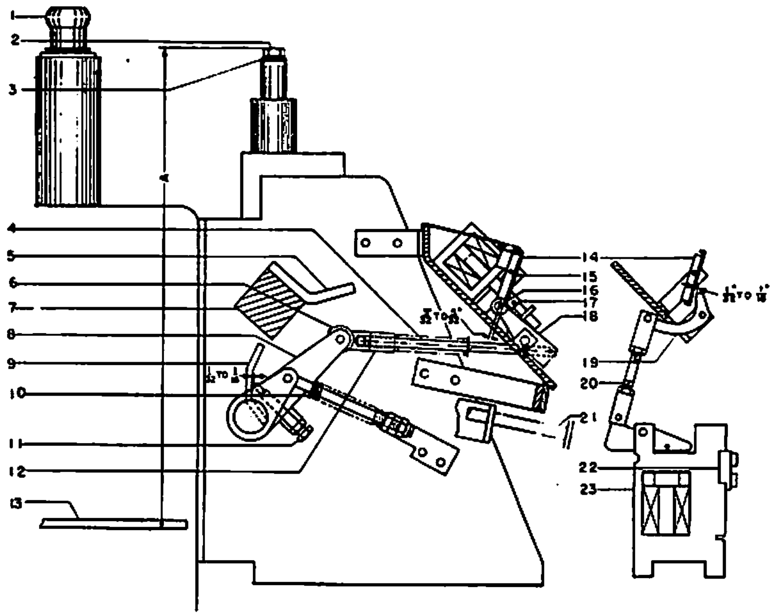


1. Cut-off Switch
2. Switch Plunger
3. Adjusting Bolt
4. Washers
5. Lever Arm
6. Washers
7. Adjustment Screw
8. Plunger Guide

Fig. 8 Cut-off Switch Adjustments

Fig. 6 (8020329)
Fig. 7 (8019972)
Fig. 8 (8011670)

Fig. 9 (T-6195074)



1. Front Disconnect Stud
2. 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 Adjustments On Current Trip Device and Undervoltage Trip Device, Shown With The Breaker In The Closed Position

CUT-OFF SWITCH ADJUSTMENTS
(AM-2.4/4.16-100/150A-3, -150/250A-3)

Refer to Fig. 8. With the breaker in the open position, the clearance between the switch plunger and the adjusting screw is obtained by pushing the switch plunger (2) in as far as possible. In this position the clearance between the switch plunger (2) and the adjustment screw (3) should be not more than 1/32". If adjustment is necessary, add or remove washers (4) as required.

AUXILIARY DEVICES

Latch Checking Switch Wipe

Referring to Fig. #6, rotate the trip shaft (5) 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 (4), bend the latch checking switch arm (2). The roller and crank on the latch checking switch (4) 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.

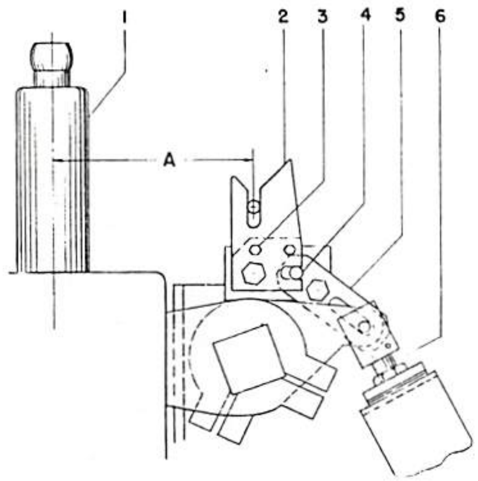
After checking all the mechanical adjustments as outlined above, operate the devices manually to make certain that they trip and reset properly.

Plunger Interlock
(AM-2.4/4.16-100/150-3 and 150/250-3)

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" $\pm$ 1/16". To change this adjustment add or remove washers (3).

Auxiliary Switch Linkage
(Furnished Special on AM-2.4/4.16-100/150A-3 and -150/250A-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 lever in the proper direction. Tighten the lock bolts.



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

Fig. 10 Auxiliary Switch Linkage

FINAL INSPECTION AND TEST

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

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

   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 (100/150-3 and 150/250-3): 15-19/32" ± 1/16".

   o. Auxiliary switch linkage (100/150A-3 and 150/250A-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.

Fig. 10 (M-6291393)

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. DC	90-130V. DC	70-140V. DC
250V. DC	180-260V. DC	140-280V. DC
230V. AC	190-250V. AC	190-250V. AC

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

For AC operation, two copper-oxide rectifiers, mounted elsewhere in the metal-clad unit, are used. A tapped resistor is provided in each rectifier circuit to control the DC voltage. The resistor setting should be adjusted so that the closed circuit voltage at the breaker closing coil terminals is 110 to 120 volts DC. Where repetitive operation is required, the voltage should be set at 105 to 115 volts DC.

*AC Volts (Closed Circuit)	Resistor Setting, Ohms	
	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

* AC Volts as measured across the rectifier and AC series resistor.

The above tabulation is included as a guide for adjusting the resistors for the particular combination of ambient temperature and AC 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.

To check the DC 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 DC 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 DC voltage at the closing coil terminals. Release the closing relay to de-energize the circuit.

DO NOT MAINTAIN VOLTAGE ON THE CLOSING COIL ANY LONGER THAN THE FEW SECONDS REQUIRED TO READ THE VOLTMETER. These coils are designed for intermittent operation and will be damaged by prolonged current flow.

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

1. AC control power source - Decrease the series resistance to increase the DC voltage, or increase the series resistance to decrease the DC voltage. Recheck voltage at the closing coil.

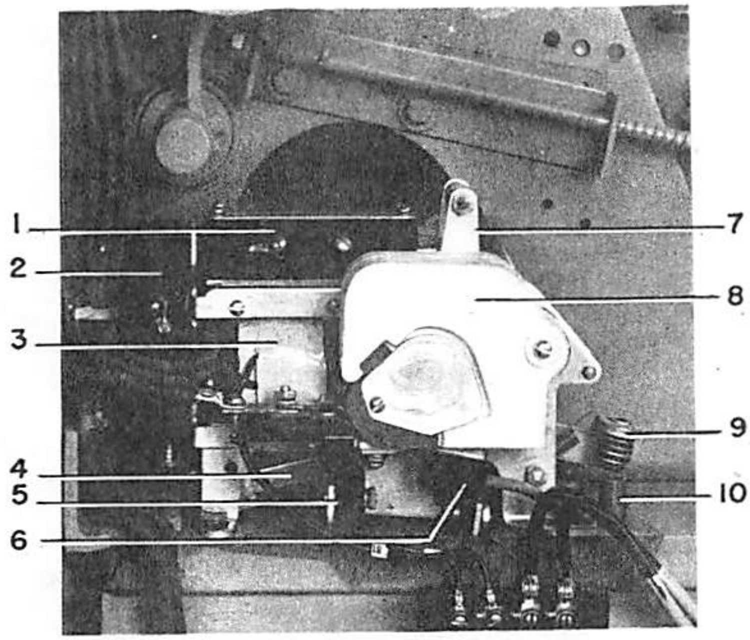
2. DC control power source - Check voltage at the source of power and line drop between the power source and breaker.

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 accomplisned 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.

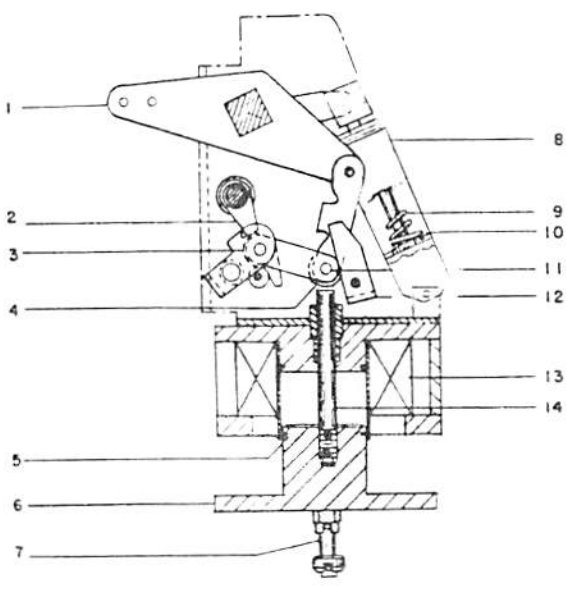
NOTE: This breaker mechanism combination is designed only for electrical closing when in use. NEVER ATTEMPT MANUAL CLOSING WITH THE BREAKER IN SERVICE, for under such conditions, sufficient closing force and speed cannot be applied.



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 (8020729)



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)

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 dash pot to absorb the energy of the mechanism as it approaches the end of its stroke.

Slightly before the mechanism latches, 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 should be 7 to 10 feet per second for the 100/150 MVA breakers and 9 to 12 feet per second for the 150/250 MVA breakers with rated closed circuit voltage at the 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 blow-out 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.

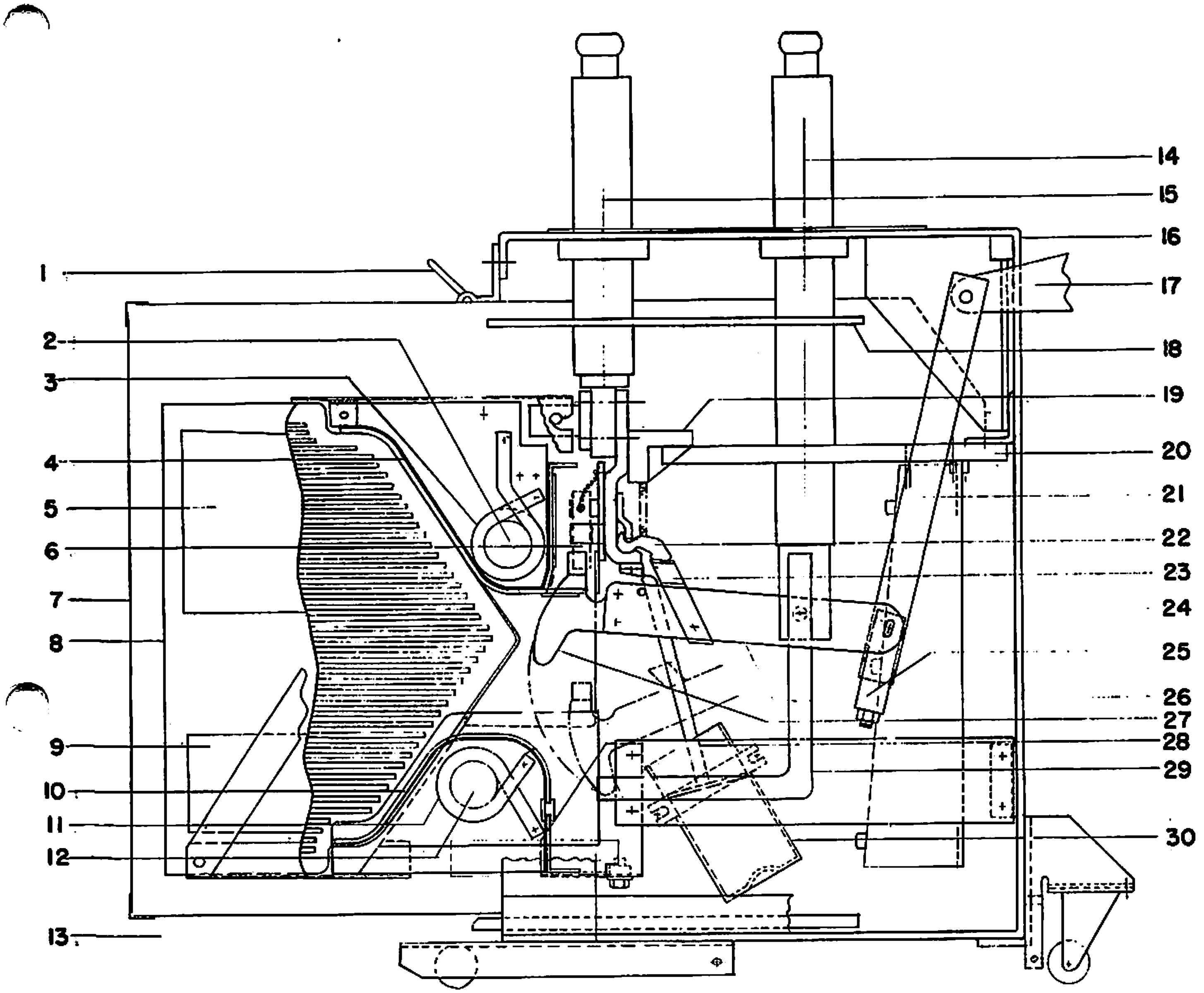


Fig. 13 (258C689)

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. Muffler
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

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.

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 DE-ENERGIZED 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 scheule 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 cracks do not interfere with the operation of the device in any way 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.

* Reg. Trade-Mark of General Electric Co.

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 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 D50H28 is available in 1/4# collapsible tubes. It is so packaged to insure cleanliness and to prevent oxidation.

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

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 above. 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 above and repack with D50H15.
Silver Plated Contacts and Primary Disconnect Studs	Wipe clean and apply D50H28.	Wipe clean and apply D50H28.
Cup Bearing	No lubrication required.	Wipe clean and apply D50H15. (No lubrication is required on the loose rings between bushing and contact arm).

Fig. 14 Lubrication Chart

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.

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 (AC control).
    REMEDY: Install larger control transformer. Check rectifier to be sure it is delivering adequate DC 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.

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 connectors.
REMEDY: Tighten.

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

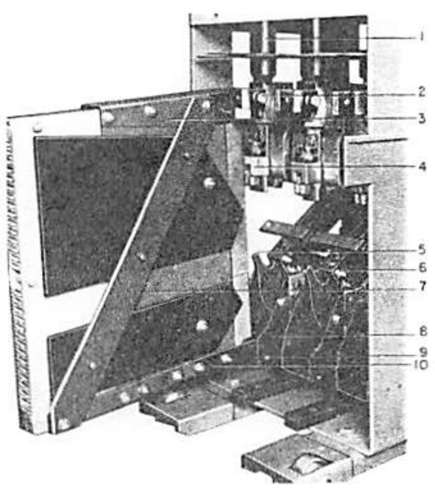
REPAIR AND REPLACEMENT

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.

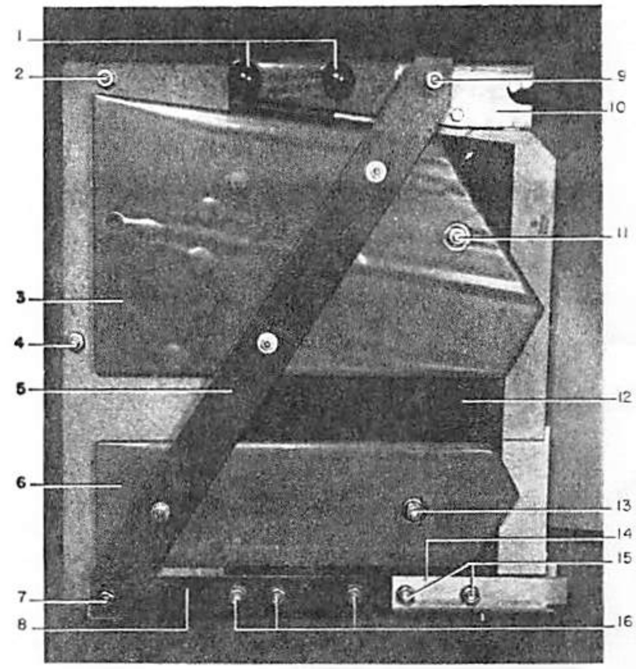
ARC CHUTE

To 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.



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 Molded Caps
2. Assembly Bolts
3. Upper Pole Piece
4. Assembly Bolt
5. Side Brace
6. Lower Pole Piece
7. Assembly Bolt
8. Lower Brace
9. Assembly Bolt
10. Upper Mounting Support
11. Assembly Bolt
12. Side Shield
13. Assembly Bolt
14. Lower Mounting Support
15. Assembly Bolts
16. Assembly Bolts

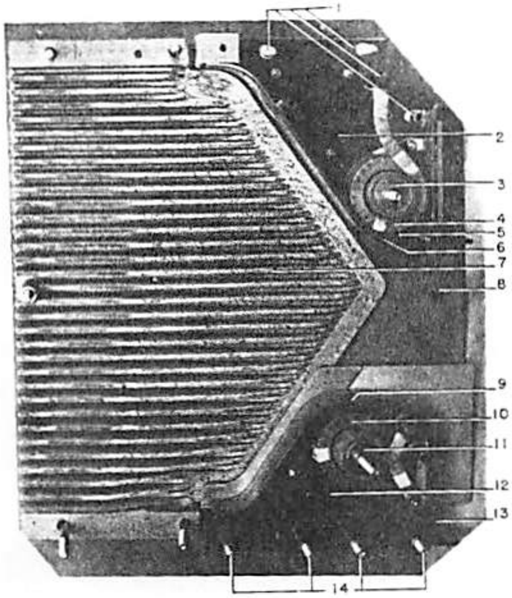
Fig. 16 Arc Chute Assembly Complete

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.

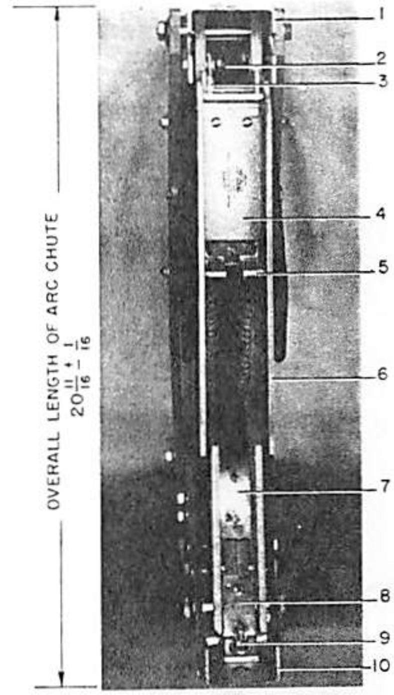
Fig. 17 (8020730)

Fig. 18 (8020726)



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



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

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.

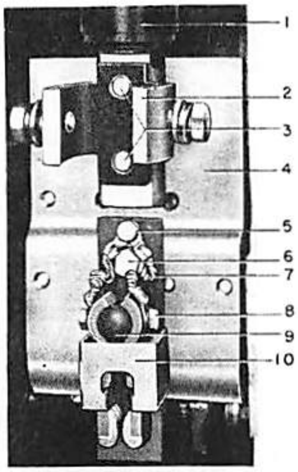
To reassemble the arc chute to the breaker, proceed as follows:

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.



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

Fig. 19 Rear Bushing Assembly

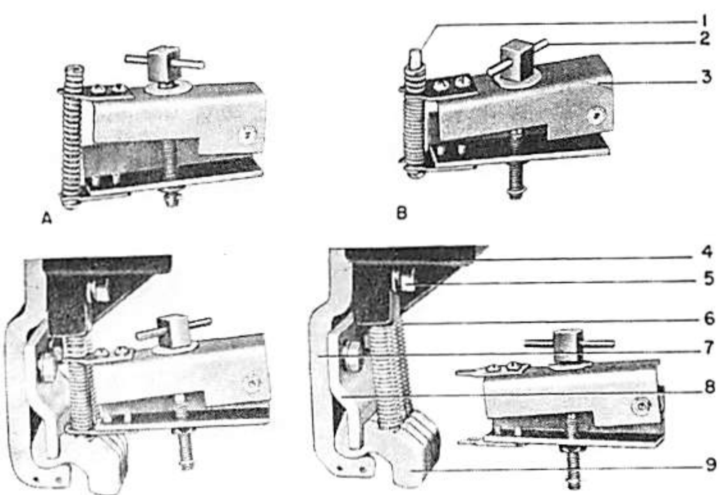
CONTACTS

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.

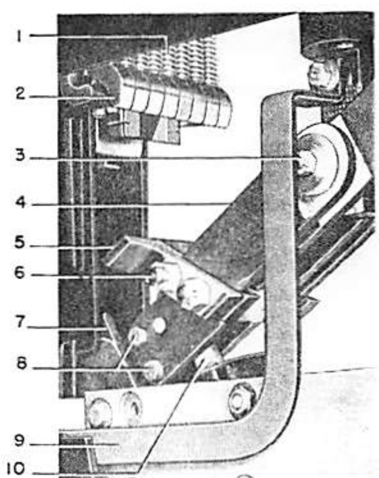
B. Stationary Primary Contacts (9), Fig. 20
1. Compress the contact spring (6).
2. Remove spring and spring guide (1).
3. Raise the contact finger to clear the primary contact stop plate (8) and lift the finger out of contact support (7). Remove one contact finger at a time.

To replace the Stationary Primary Contacts
1. Place the finger (9) 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).



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



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. 19 (8019974) Fig. 20 (8017149) Fig. 21 (8012188)

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.

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.

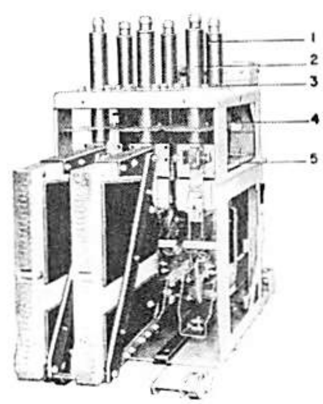
To replace the bushing, proceed as follows:

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

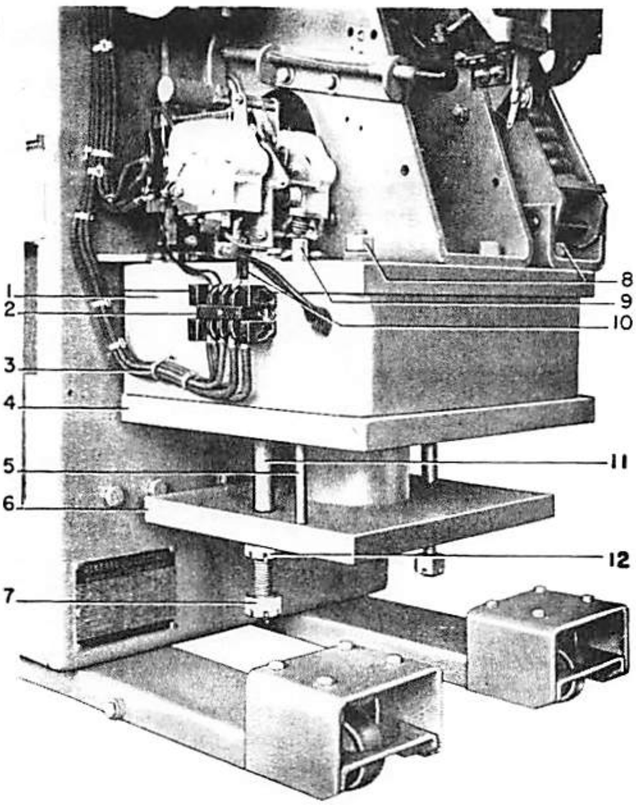
1. Open the breaker and remove the box barrier and arc chutes as already described.
2. Remove the upper and lower horizontal barbiers (4 and 5), Fig. 22.
3. Remove the connection bar (9), Fig. 21, and cup bearing (3).
4. Remove the four bolts at the mounting flange of the front bushing being removed,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



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

Fig. 22 (8019970)



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

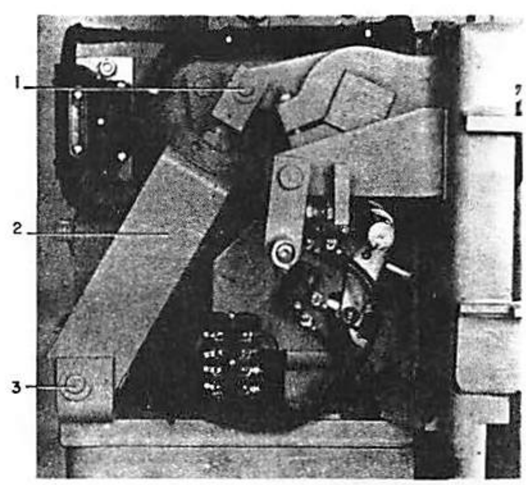
Fig. 23 Closing Solenoid Assembly

Fig. 23 (8020264)

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 (10). Remove the terminal board (2) from the solenoid pot and let it hang by the wires. Also, remove the wire cleat band (3).
3. Remove the stop nuts (7 and 12) on guide studs (11), lower the armature plate (6) 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 (8) at the top of the front studs. This permits the bottom plate, closing coil, solenoid pot (1) and control device plunger guide (9) 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 (9) 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 (8).
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 (5) and armature (6).
10. Recheck the mechanism adjustments as explained under INSTALLATION, ADJUSTMENTS.



1. Pivot Pin
2. Opening Spring Unit
3. Pivot Pin

Fig. 24 Opening Spring Assembly

Fig. 24 (8020728)

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.

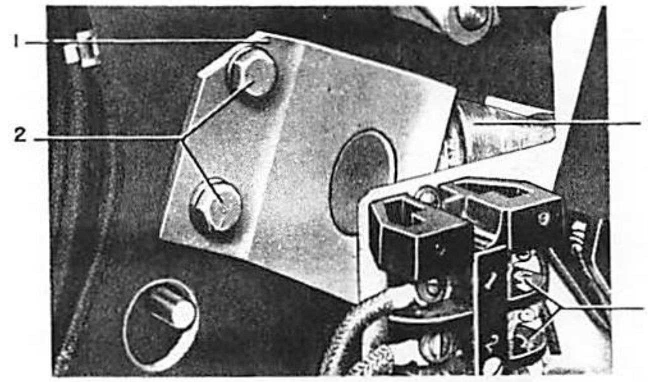
LATCH CHECKING SWITCH

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.

Fig. 25 (8019962)



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

Fig. 25 Potential Trip Coil

RENEWAL PARTS

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
27	130	All	All	258C616 P-9	6	Upper runner insulation
28	165	150	600/1200	236C791 P-8	12	Primary contact finger
28	165	250	1200/2000	236C791 P-8	24	Primary contact finger
29	211	All	All	6496488 P-3	3	Movable arcing contact
28	156	All	All	236C790 G-5	3	Stationary arcing contact asm.
29	212	100/150	600/1200	6591644 P-7	3	Primary contact mov.
29	212	100/150	600/1200	6591644 P-8	3	Primary contact mov.
29	212	150/250	1200	6591644 P-7	6	Primary contact mov.
29	212	150/250	1200	6591644 P-8	6	Primary contact mov.
29	212	All	2000	6591644 P-7	6	Primary contact mov.
29	212	All	2000	6591644 P-8	6	Primary contact mov.
28	160	150	600/1200	414A180	12	Primary contact finger spring
28	160	250	1200/2000	6509787 P-1	24	Primary contact finger spring
28	159	All	All	6445087	3	Buffer
28	168	150	600/1200	6557243 P-1	6	Clamp for buffer
28	168	150	2000	6557243 P-2	6	Clamp for buffer
28	168	250	1200/2000	6557243 P-2	6	Clamp for buffer
27	132	250	All	258C616 P-6	6	Lower barrier
28	158	All	All	414A116 P-4	3	Insulating plate
27	131	All	All	421711	12	Insulating cup
27	126	250	All	383A932 P-1	6	Lower shield
27	117	All	All	414A116 P-2	3	Insulation
27	118	All	All	414A117 P-1	6	Upper insulation
26	7	All	All	281B708 G-4	3	Operating rod
28	155	All	All	236C791 G-1	6	Flex. Conn.
30	261	250	All	6375521 G-2	1	Closing coil (125 V.D.C.)
30	261	150	All	6375521 G-6	1	Closing coil (125 V.D.C.)
30	261	250	All	6375521 G-1	1	Closing coil (250 V.D.C.)
30	261	150	All	6375521 G-2	1	Closing coil (250 V.D.C.)
32	370	All	All	6174582 G-1	1	Potential trip coil (125 V.D.C.)
32	370	All	All	6174582 G-2	1	Potential trip coil (250 V.D.C.)
32	370	All	All	6174582 G-14	1	Potential trip coil (230 V.A.C.)
32	370	All	All	6174582 G-10	1	Potential trip coil (48 V.D.C.)
32	370	All	All	6275070 G-1	1	Potential trip coil (24 V.D.C.)
32	370	All	All	6275070 G-2	1	Potential trip coil (48 V.D.C.)
32	370	All	All	6275070 G-3	1	Potential trip coil (32 V.D.C.)
36	663	All	All	6275017 G-19	1	UVD Coil (125 V.D.C.)
36	663	All	All	6275017 G-20	1	UVD Coil (250 V.D.C.)
36	663	All	All	6275017 G-33	1	UVD Coil (230 V.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 (230 V.A.C.)
38	753	All	All	6275017 G-19	1	Control device coil (125 V.D.C.)
38	753	All	All	6275017 G-20	1	Control device coil (250 V.D.C.)
38	753	All	All	6275017 G-33	1	Control device coil (230 V.A.C. cont.)
38	753	All	All	6275017 G-34	1	Control device coil (230 V.A.C. int.)

PARTS REFERENCED IN FIG. 26 FOR ALL RATINGS

REF. NO.	MVA.	AMPS.	CAT. NO. FOR AM-4.16-(MVA)-3	NO. REQ.	DESCRIPTION
1	All	All	263B293 P-2	3	Booster cylinder
2	All	All	236C789 G-1	1	Box barrier assembly
3	All	All	258C614 P-13	2	Barrier support
4	All	All	258C619 G-3	3	Arc chute clamp
5	All	All	258C614 P-4	3	Arc chute support
6	All	All	9915623 G-1	3	Vertical barrier front
7	All	All	281B708 G-4	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	All	1200	258C613 G-2	3	Bushing (long)
9	All	2000	258C613 G-3	3	Bushing (long)
9	All	600	258C613 G-1	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	Plate
15	All	2000	6592511 P-1	1	Top plate
18	All	All	258C683 G-1	1	Wheel assembly complete (front & rear)
19	All	#	236C767 G-7	1	Wheel base & wheels
19	All	△	236C767 G-9	1	Wheel base & wheels
20	All	All	236C767 G-8	2	Rear wheel asm. complete
21	All	All	6597296 P-6	2	Rear wheel and 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
29	All	600/1200	6591812 P-6	3	Spacer
30	All	600/1200	6509700 P-1	3	Spring
31	All	600/1200	6442317 P-1	3	Bearing
*	All	All	258C672 G-1	1	Mech. covers

Standard breakers have 1-16 point secondary disconnect device.
△ Interchangeable breakers have 2-seven point secondary disconnect devices.
* See cover photograph.

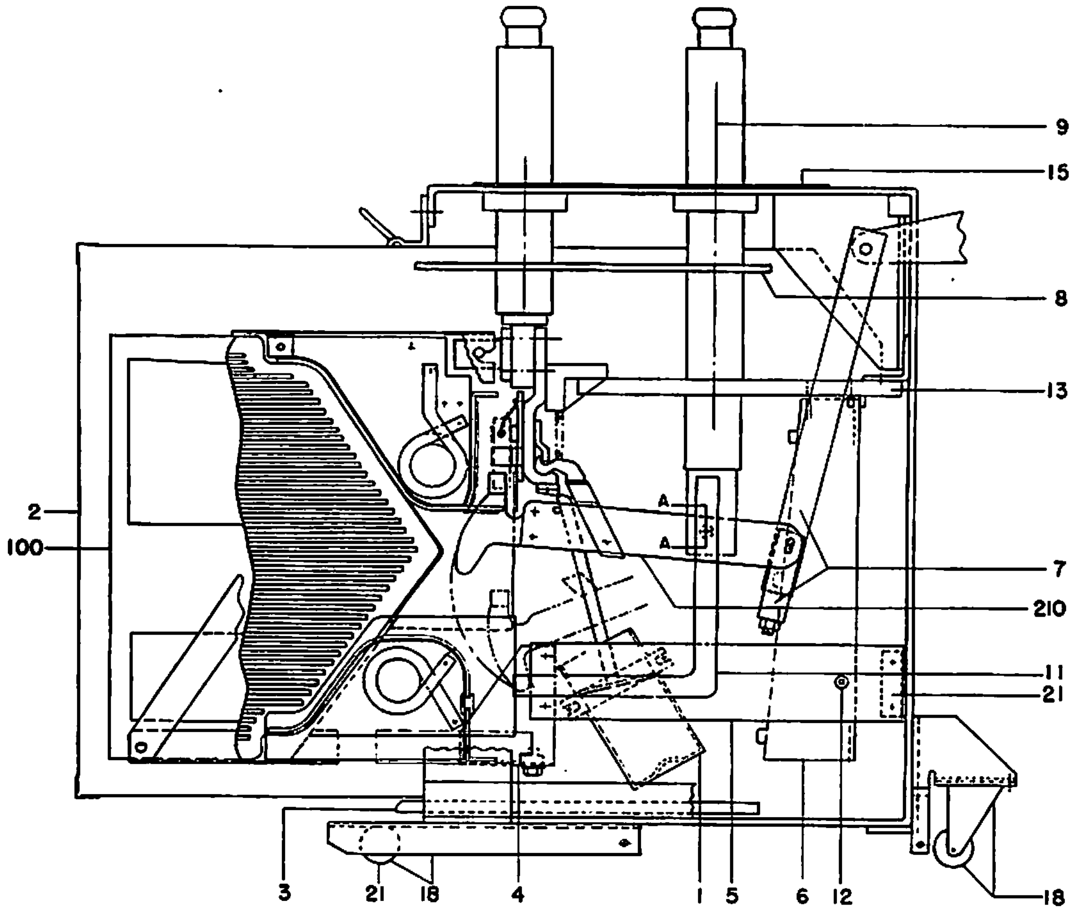


Fig. 26 (258C689)

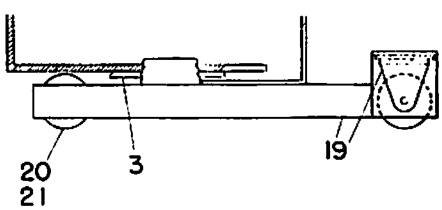


Fig. 26 (281B771)

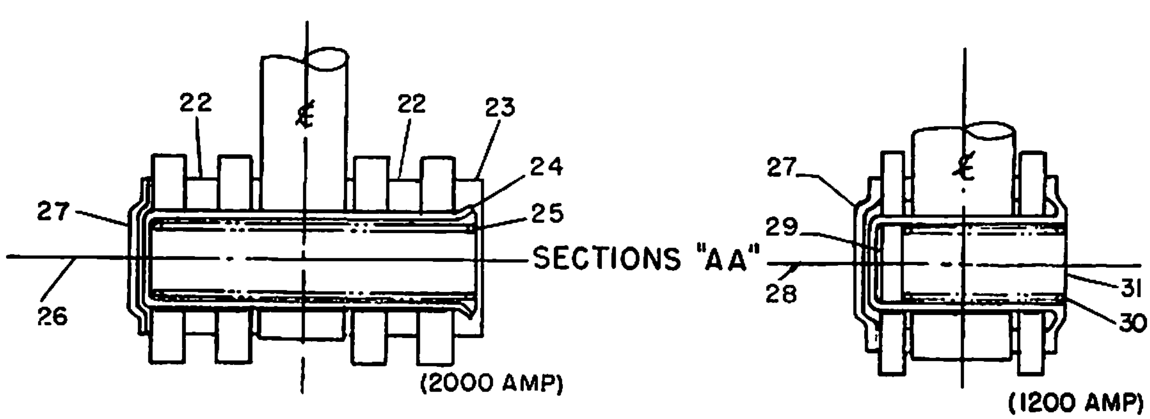


Fig.26 (236C792)

Fig. 26 Cross-sections Type AM 2.4/4.16-3

Fig. 27A (8020884) Fig. 27B (8020730) Fig. 27C (8020726)

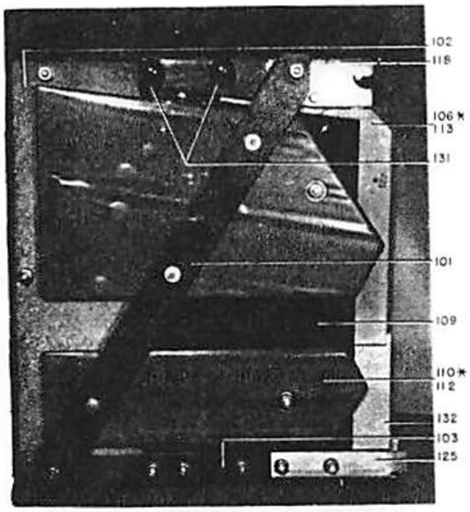


Fig. 27A Complete Assembly

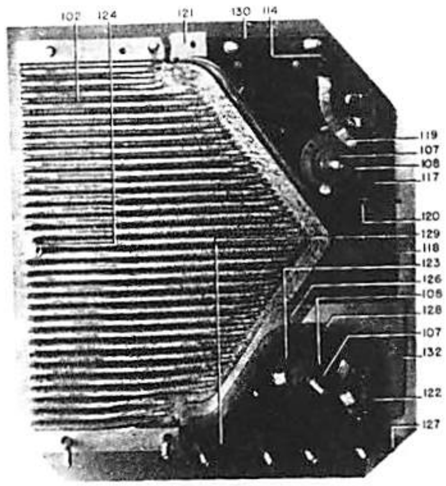


Fig. 27B Side Cover Removed

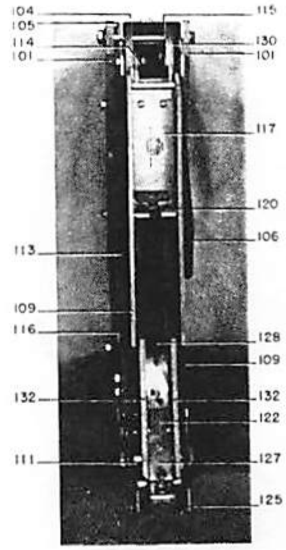


Fig. 27C Front View

Fig. 27 Arc Chute

PARTS REFERENCED IN FIGS. 27A, 27B & 27C FOR ALL RATINGS

REF. NO.	MVA	AMPS	CAT. NO. FOR AM-4.16-(MVA)-3	NO. REQ.	DESCRIPTION
100	150	1200/2000	215D469 G-1	3	Arc chute asm., complete
100	250	1200/2000	215D469 G-2	3	Arc chute asm., complete
101	All	All	258C616 P-1	6	Brace
102	All	All	264B100 G-3	3	Arc chute sides
103	All	All	258C616 P-4	6	Lower support
104	150	1200/2000	258C615 P-10	3	Upper support
104	250	All	258C615 P-9	3	Upper support
105	All	All	6176109 P-73	6	Spacer
106	All	All	258C615 G-2	3	Upper pole piece
107	All	All	258C615 P-26	6	Core
108	All	All	258C616 P-12	6	Core insulating tube
109	All	All	258C616 P-2	6	Shield (Mycalex)
110	250	All	258C615 G-6	3	Lower pole piece
111	All	All	6176109 P-93	24	Spacer
112	250	All	258C615 G-3	3	Lower pole piece
113	All	All	258C615 G-1	3	Upper pole piece
114	All	All	258C615 P-11	3	Connection
115	All	All	6176110 P-82	6	Spacer
116	All	All	432249	12	Spacer
117	All	All	414A116 P-2	3	Insulation
118	All	All	414A117 P-1	6	Upper insulation
119	All	All	366A743 G-1	3	Coil (upper)
120	All	All	258C632 G-1	3	Runner asm.
121	All	All	258C616 P-5	3	Spacer
122	250	All	258C616 P-11	3	Spacer
123	250	All	366A744 G-1	3	Coil (lower)
124	All	All	6445050 P-3	3	Spacer
125	All	All	258C615 P-15	3	Support
126	250	All	383A932 P-1	6	Lower shield (Mycalex)
127	250	All	258C615 G-5	3	Runner asm.
128	250	All	258C615 G-4	3	Connecting strap
129	250	All	258C616 P-3	3	Spacer
130	All	All	285C616 P-9	6	Upper insulation
131	All	All	421711	12	Insulating cap.
132	250	All	258C616 P-6	6	Lower barrier

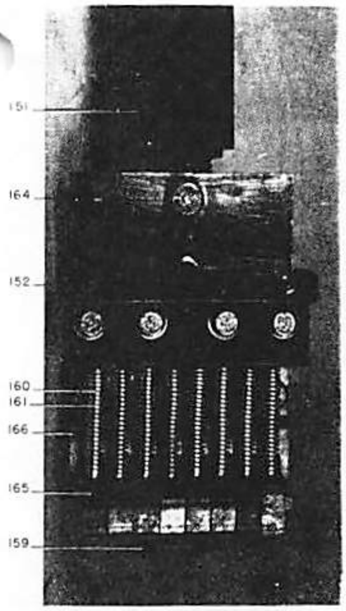


Fig. 28A Front View

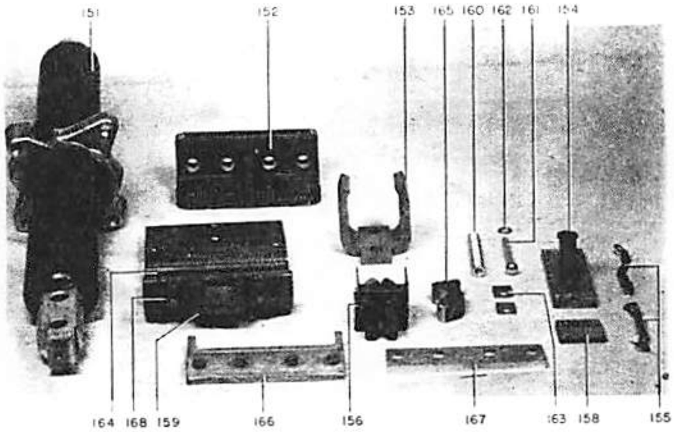


Fig. 28B Component Parts

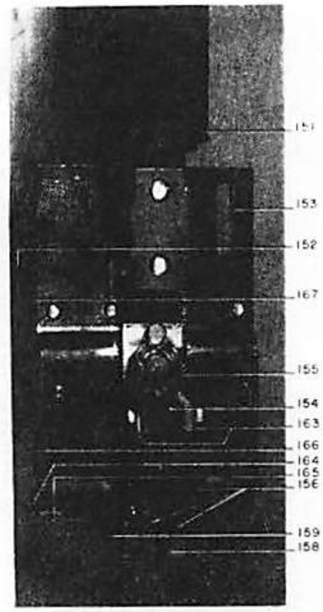


Fig. 28C Back View

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

Fig. 28A (8020428)

Fig. 28B (8020429)

Fig. 28C (8020430)

PARTS REFERENCED IN FIGS. 28A, 28B & 28C FOR ALL RATINGS

REF. NO.	MVA.	AMPS.	CAT. NO. FOR AM-4.16-(MVA)-3	NO. REQ.	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	250/250A	2000	236C790 G-4	3	Rear bushing assembly
151	150/250	1200	258C612 G-2	3	Rear bushing
151	250	2000	258C612 G-3	3	Rear bushing
151	150	600	258C612 G-1	3	Rear bushing
152	150	600/1200	6592330 P-2	3	Spring retainer
152	250	1200/2000	6592331 P-2	3	Spring retainer
153	150/250	600/1200	236C791 P-9	3	Support
153	250	2000	236C791 P-19	3	Support
154	All	All	236C791 G-3	3	Arcing contact support
155	All	All	236C791 G-1	6	Flex. conn.
156	All	All	236C790 G-5	3	Arcing contact asm.
158	All	All	414A116 P-4	3	Insulating plate
159	All	All	6445087	3	Buffer
160	150	600/1200	414A180	12	Spring
160	250	1200/2000	6509787 P-1	24	Spring
161	160	600/1200	236C790 P-22	12	Spring guide
161	250	1200/2000	236C790 P-22	24	Spring guide
162	150	600/1200	Nar Wash 1/2-20	12	Washer for spring guide
162	250	1200/2000	Nar Wash 1/4-20	24	Washer for spring guide
163	All	All	175V557 P-1	12	Lock plate
164	150	600/1200	258C666 P-1	3	Contact support
164	250	1200	258C666 P-3	3	Contact support
164	250	2000	258C666 P-2	3	Contact support
165	150	600/1200	236C791 P-8	12	Contact finger
165	250	1200/2000	236C791 P-8	24	Contact finger
166	150	600/1200	258C666 P-5	3	Primary contact finger retainer
166	250	1200	236C791 P-20	3	Primary contact finger retainer
166	250	2000	236C791 P-3	3	Primary contact finger retainer
167	250	1200	258C666 P-4	3	Spacer
168	150	600/1200	6557243 P-1	6	Clamp for buffer
168	150	2000	6557243 P-2	6	Clamp for buffer
168	250	1200/2000	6557243 P-2	6	Clamp for buffer

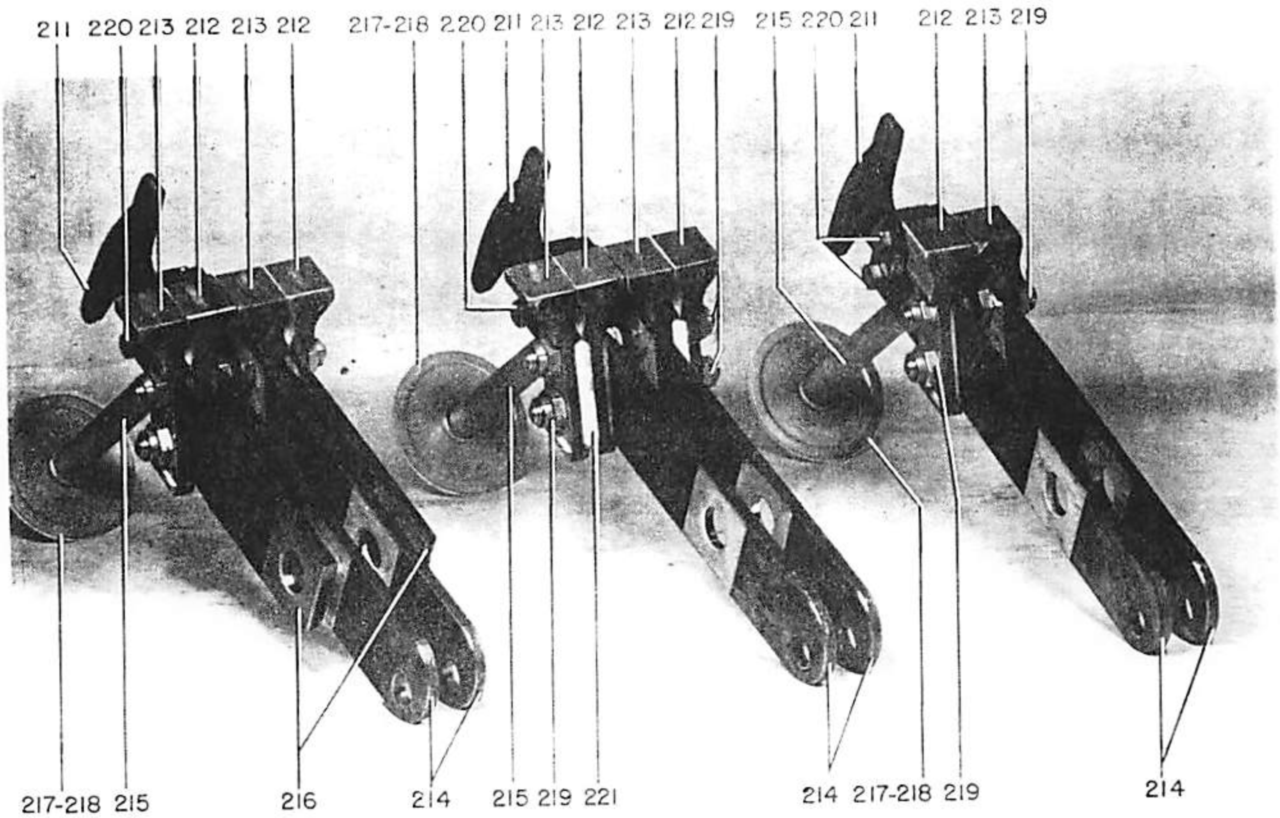


Fig. 29A For 2000 Amp. Breakers, All Ratings

Fig. 29B For 1200 Amp. 150/250 MVA Ratings

Fig. 29C For 600 and 1200 Amp., 100/150 MVA Ratings

Fig. 29 Movable Contact Arm Assembly

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

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

REF. NO.	MVA	AMPS	CAT. NO. FOR AM-4.16-(MVA)-3	NO. REQ.	DESCRIPTION
210	100/150	600/1200	236C792 G-5	3	Movable contact arm assembly
210	100/250	2000	236C792 G-6	3	Movable contact arm assembly
210	150/250	1200	236C792 G-7	3	Movable contact arm assembly
211	100/150	600/1200	6496488 P-3	3	Movable arcing contact
211	150/250	2000	6496488 P-3	3	Movable arcing contact
211	100/250	1200	6496488 P-3	3	Movable arcing contact
212	100/150	600/1200	6591644 P-7	3	Movable primary contact
212	150/250	1200	6591644 P-7	6	Movable primary contact
212	100/250	2000	6591644 P-7	6	Movable primary contact
213	150/150	600/1200	6591644 P-8	3	Movable primary contact
213	150/250	1200	6591644 P-8	6	Movable primary contact
213	100/250	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	236C792 P-22	3	Piston ring
218	All	All	236C792 P-3	3	Piston ring expander
219	All	All	414A146 P-4	12	Flex nut
220	All	All	414A146 P-3	6	Flex nut
221	All	2000	258C619 P-2	6	Spacer

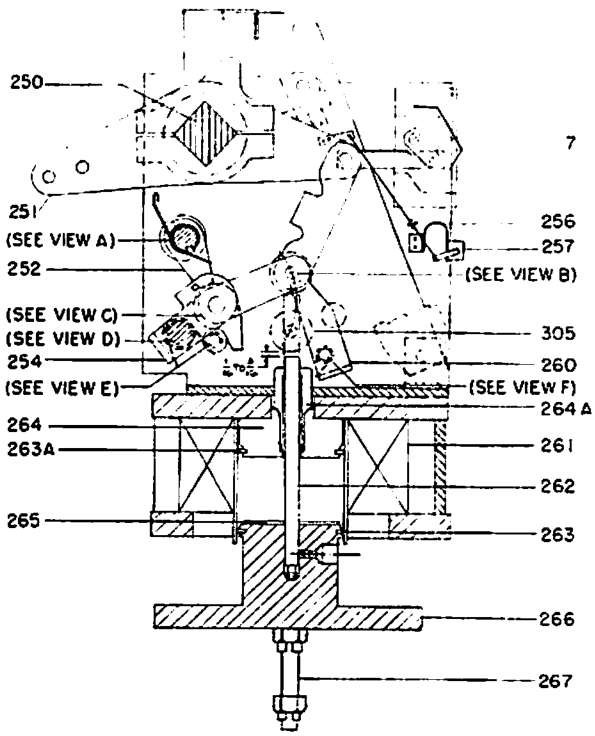


Fig. 30A Cross-section

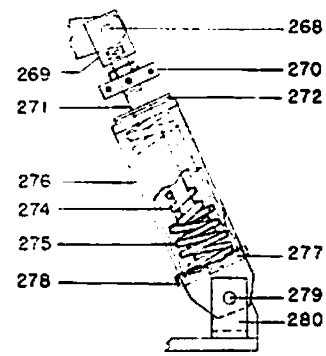


Fig. 30B Complete Spring Assembly

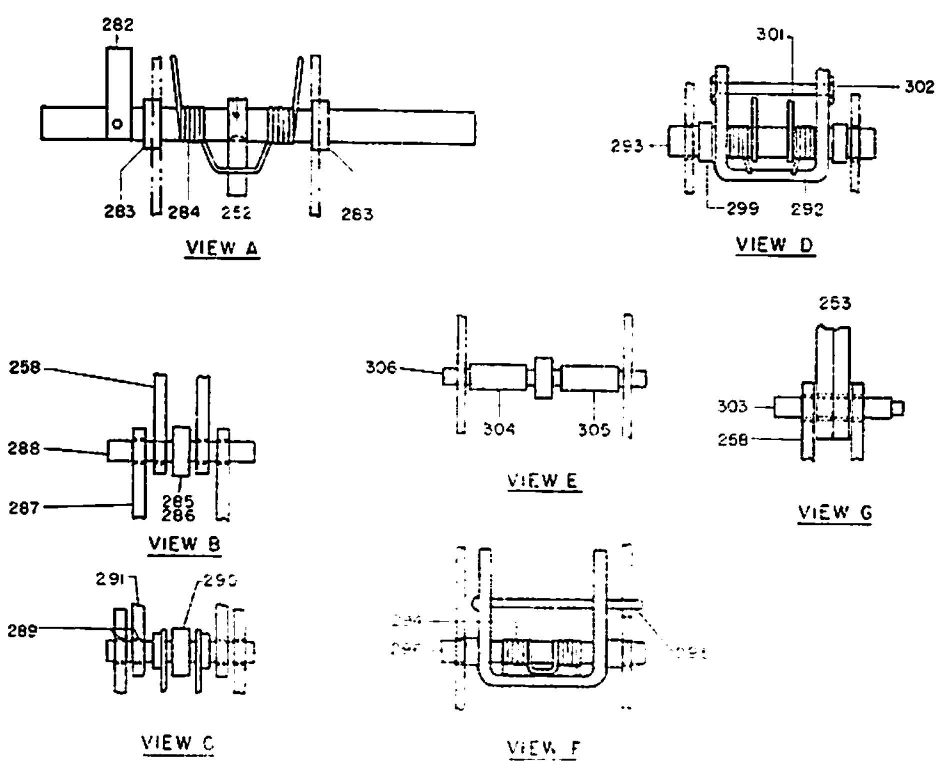


Fig. 30C Detailed Views

Fig. 30 MS-13 Mechanism for AM 2.4/4-.6-3

Fig. 30A (258C688)

Fig. 30B (258C688)

Fig. 30C (215D170)

PARTS REFERENCED IN FIGS. 30A, 30B & 30C 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	258C608 P-1	2	Crank
254	258C608 P-5	1	Link
255	6551742	1	Spring
256	258C604 P-8	1	Spring clip
257	6192382 AB P-1	1	Veeder counter
258	258C608 P-2	1	Link
259	281B711 G-1	1	Indicator assembly
260	258C609 P-1	1	Prop
261	6375521 G-2	1	Closing coil (125 V.D.C.) 250 MVA.
261	6375521 G-6	1	Closing coil (125 V.D.C.) 150 MVA.
261	6375521 G-1	1	Closing coil (250 V.D.C.) 250 MVA.
261	6375521 G-5	1	Closing coil (250 V.D.C.) 150 MVA.
262	236C796 P-5	1	Plunger (AM-4.16-250)
262	236C796 P-6	1	Plunger (AM-4.16-150)
263	6591632 P-1	2	Piston ring (AM-4.16-150 & 250)
263	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	236C795 P-23	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 P-6	1	Plate
271	258C630 P-8	1	Rod
272	414A109 P-2	2	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	6508765	1	Spring
285	6370566 P-75	1	Bushing
286	258C609 P-5	1	Roller
287	258C608 P-4	2	Link
288	258C611 P-3	1	Prop pin
289	414A110 P-1	1	Pin
290	414A112 P-1	1	Trip roller bearing
291	215D470 P-18	2	Spacer
292	6509799	2	Spring
293	414A110 P-3	1	Pin
294	6477094	1	Prop spring
295	414A193 P-5	1	Pin
296	383A926 AF P-41	1	Pin
299	215D470 P-25	2	Spacer
301	258C608 P-3	1	Latch guide
302	258C611 P-5	1	Pin
303	258C609 P-9	1	Pin
304	215D470 P-29	2	Spacer
305	258C607 P-6	1	Roller
306	383A926 AE P-39	1	Pin

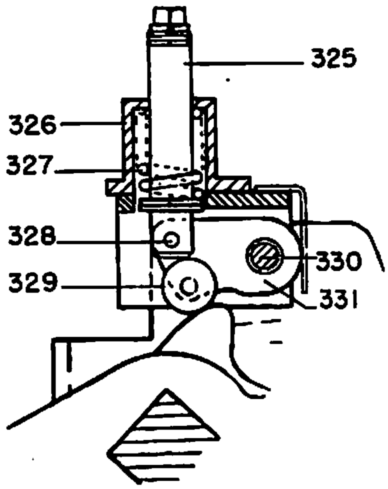


Fig. 31A Early Design

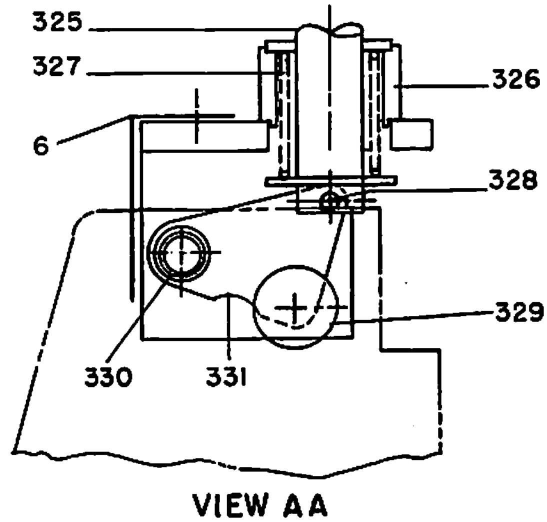


Fig. 31B Present Design

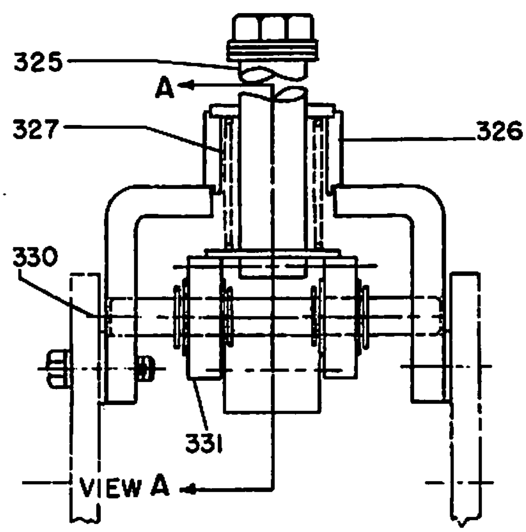


Fig. 31C Present Design

Fig. 31 Interlock Plunger

Fig. 31A (236C731)

Fig. 31B & 31C (236C787)

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

REF. NO.	CATALOG NO. FOR TYPE		NO. PER MECHANISM	DESCRIPTION
	AM-4.16-(MVA)-3 △	AM-4.16-(MVA)-3 ∅		
325	6442255 P-1	236C787 P-12	1	Plunger for interlock
326	264B133 G-1	236C787 G-2	1	Bracket for interlock
327	6509728 P-1	6509728 P-1	1	Spring for interlock
328	6477427 AA P-9	383A926 AD P-1	1	Pin
329	6443714	236C787 P-14	1	Roller
330	6477427 JA P-4	236C787 P-5	1	Pin
331	6597228 P-1	236C787 P-16	2	Crank

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

Fig. 32A (8020728) Fig. 32B (8020725) Fig. 32C (8020729)

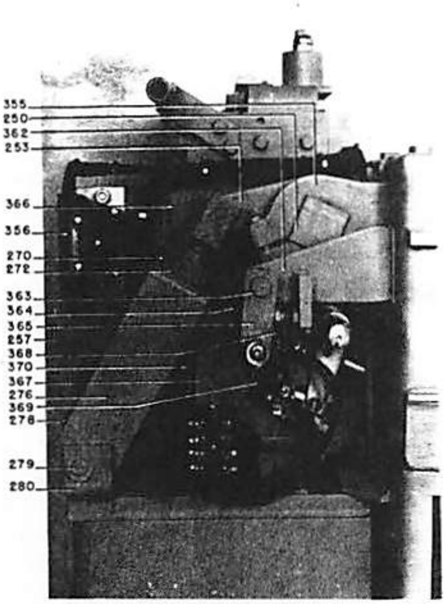


Fig. 32A Right Side View

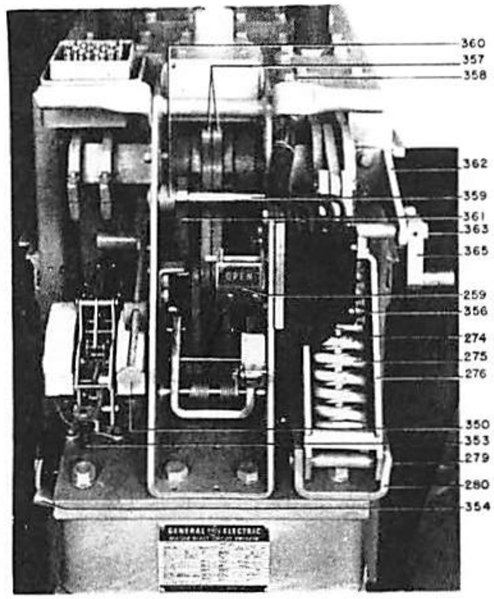


Fig. 32B Front View

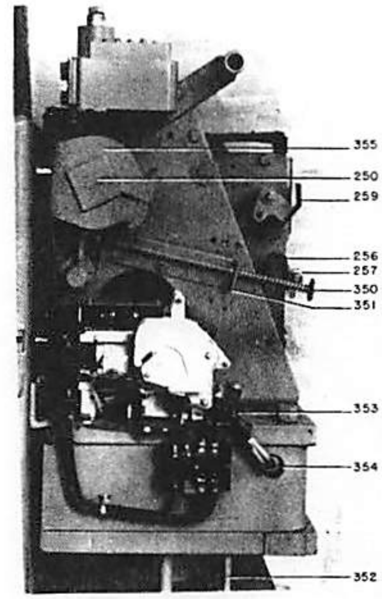
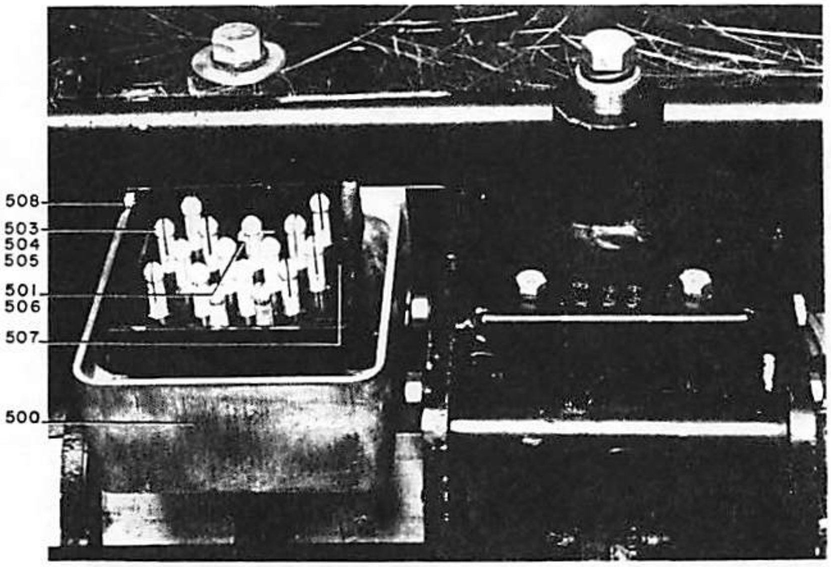


Fig. 32C Left Side View

Fig. 32 MS-13 Mechanism for Type AM 2.4/4.16 Breaker

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

REF. NO.	CAT. NO. TYPE AM-4.16-(MVA)-3	NO. PER MECHANISM	DESCRIPTION
350	258C604 G-3	1	Man. trip rod
351	258C604 P-2	1	Man. trip rod support
352	236C795 P-40	1	Rod
353	174V394	1	Tube
354	6445059	1	Insulating tube
355	258C608 P-6	6	Crank
356	6578509 G-2	1	Aux. Sw.
357	258C608 P-1	2	Crank
358	215D470 P-43	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	6351353 P-41	1	Latch checking switch
369	6351353 P-41	1	Interlock switch
370	6174582 G-1	1	Potential trip coil (125 V.D.C.)
370	6174582 G-2	1	Potential trip coil (250 V.D.C.)
370	6174582 G-10	1	Potential trip coil (48 V.D.C.)
370	6174582 G-14	1	Potential trip coil (220 V.A.C.)
370	6275070 G-1	1	Potential trip coil (24 V.D.C.)
370	6275070 G-2	1	Potential trip coil (48 V.D.C.)
370	6275070 G-3	1	Potential trip coil (32 V.D.C.)



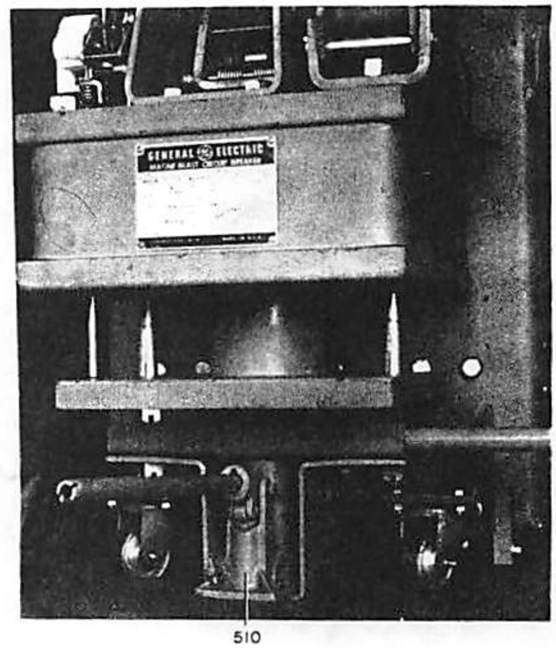


Fig. 33 (8012576)

Fig. 34 (8020882)

Fig. 33 Secondary Disconnecting Device And Mechanism Parts For All Types

Fig. 34 Maintenance Closing Device

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	264B162 G-1	1	Secondary disc. device, complete: 16 point
500	264B173 G-1	1	Secondary disc. device, complete: 7 point
501	366A234 P-1	4	Contact nut
503	6319964 P-2	16	Plug
504	6046942	16	Nut for plug
505	848768 P-1	16	Lock washer for plug
506	6443717	3	Stud
507	6505244 P-1	1	Socket
508	6557827 P-1	4	Shim
510	258C669 G-1	1	Maintenance closing device

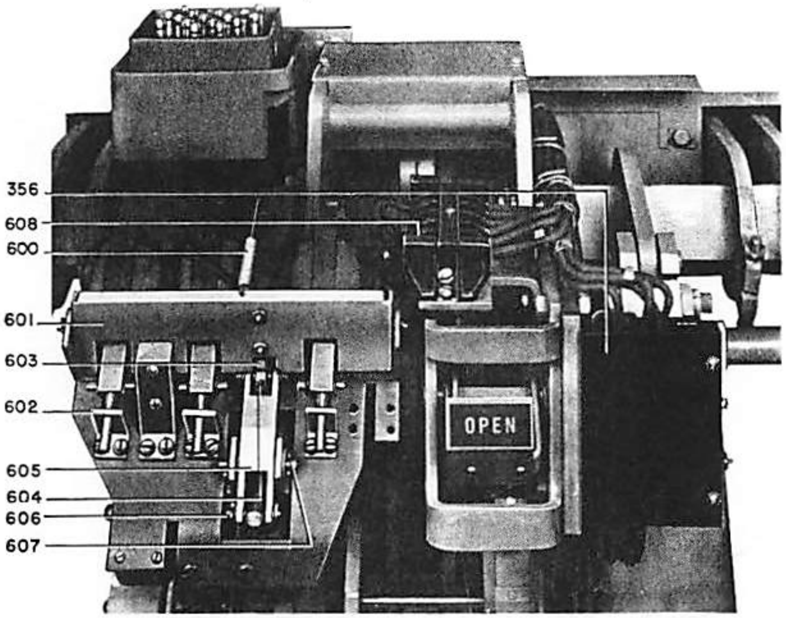


Fig. 35 (8020216)

Fig. 35 Partial View of MS-13 Mechanism with Current Trip (For Details, See Fig. 1)

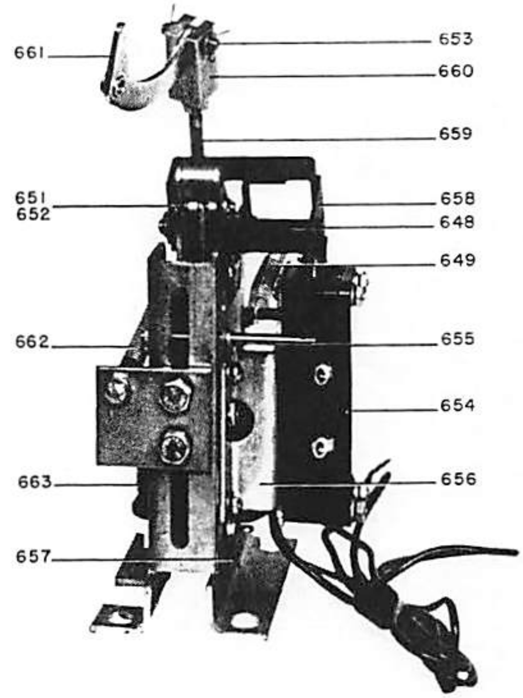


Fig. 36 (8016105)

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	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
608	6556276 G-85	1	Terminal board
647	9915617 AA	1	Undervoltage device complete
648	157V574	1	Stop for DC only
649	369A443	1	Spring for DC only
650	6551726	1	Spring for AC only
651	175V578	1	Pin for DC only
652	6076401 P-309	1	Pin for AC only
653	6076401 P-305	2	Pin
654	6418069 G-6	1	Switch
655	175V576	1	Pin
656	374A246 P-1	1	Bracket
657	175V562 P-1	1	Shim for DC only
658	384A330 G-1	1	Link arm assembly for DC 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 (125 V.D.C.)
663	6275017 G-33	1	Coil (230 V.A.C.)
663	6275017 G-20	1	Coil (250 V.D.C.)

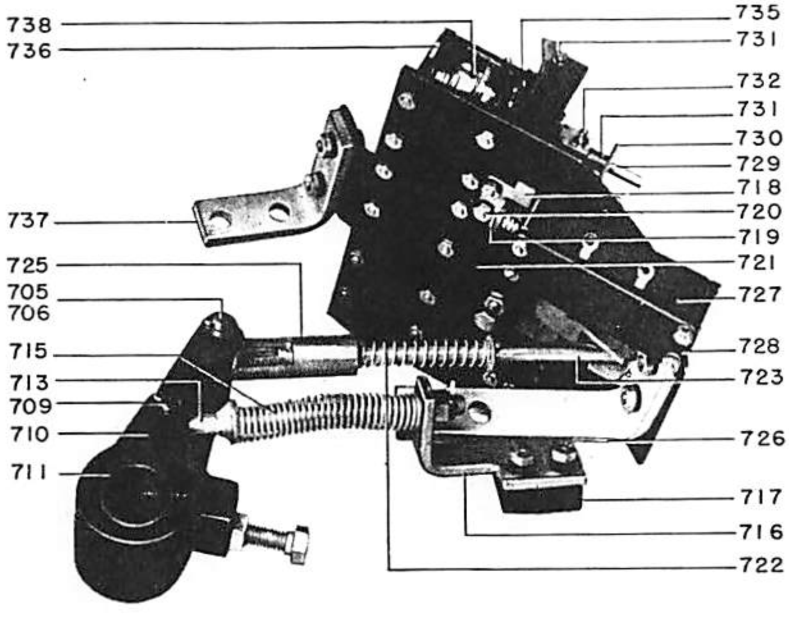


Fig. 37 (8016104)

Fig. 37 Impact Trip Device For All Mechanisms (Ref. 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 P-1	1	Crank
711	6371082 P-3	1	Bushing
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	6418068 G-7	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	6558755 P-2	1	Pin
734	6076401 P-385	1	Pin
735	2236575	2	Guide
736	175V965 P-1	1	Armature 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 230 V.A.C.

Fig. 38 (8011083)

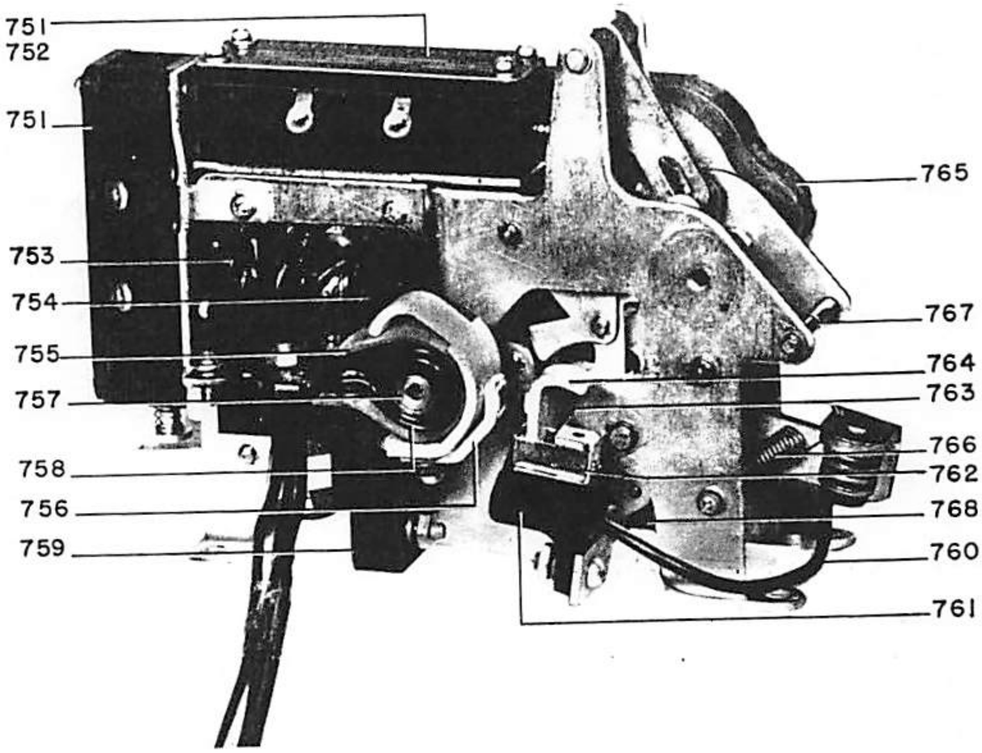


Fig. 38 Control Device for all Mechanisms (Ref. 750)

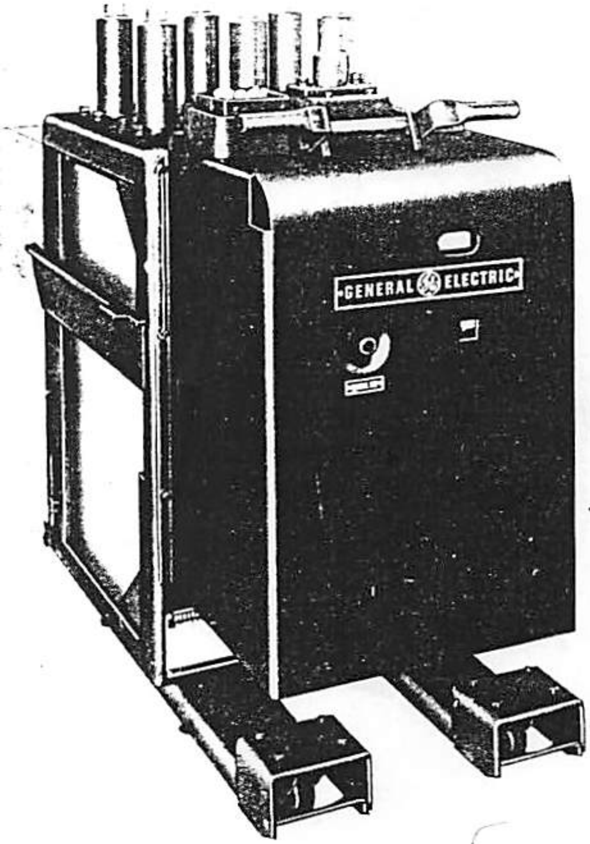
PARTS REFERENCED IN FIG. 38 FOR ALL RATINGS

REF. NO.	CAT. NO. FOR AM-4.16-(MVA)-3	NO. PER MECHANISM	DESCRIPTION
750	6375988 G-5	1	Control device, 125 volt, D-C
750	403A128 G-1	1	Control device, 230 volt, A-C (continuous)
750	6375988 G-6	1	Control device, 250 volt, D-C
750	6375988 G-9	1	Control device, 230 volt, A-C
751	6418068 G-6	1	Auxiliary switch, top or back
752	6418068 G-5	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	365A451	1	Spring (D-C)
767	6370699	1	Spring (A-C)
768	6477063	1	Spring

INSTRUCTIONS

GEH-1804D

MAGNE-BLAST CIRCUIT BREAKERS



Types

AM-2.4/4.16-100/150-1 and -2
AM-2.4/4.16-100/150A-1 and -2
AM-2.4/4.16-150/250-1 and -2
AM-2.4/4.16-150/250A-1 and -2
With MS-13 Mechanism

MEDIUM VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

CONTENTS

MAGNE-BLAST CIRCUIT BREAKERS
TYPE AM-2.4/4.16 WITH MS-13 MECHANISM

INTRODUCTION

The Magne-blast Circuit Breaker is designed for installation in vertical-lift metal-clad switchgear, to provide reliable control and protection of power station equipment. 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. A sturdy, reliable operating mechanism assures low maintenance and long life, and the use of flame-retardant materials reduces fire hazards to a minimum.

The AM-2.4/4.16 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 information 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.

1. Plunger Interlock
2. Secondary Coupler
3. Auxiliary Switch
4. Opening Spring Unit
5. Manual Trip
6. Control Device
7. Closing Solenoid
8. Closing Armature
9. Control Device Plunger

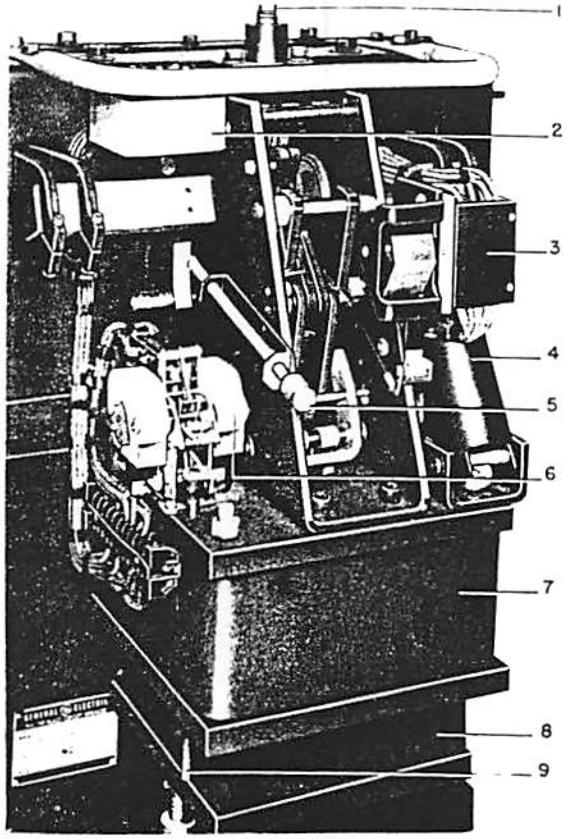


Fig. 1 Type MS-13C Operating Mechanism

Fig. 1 (8014738)

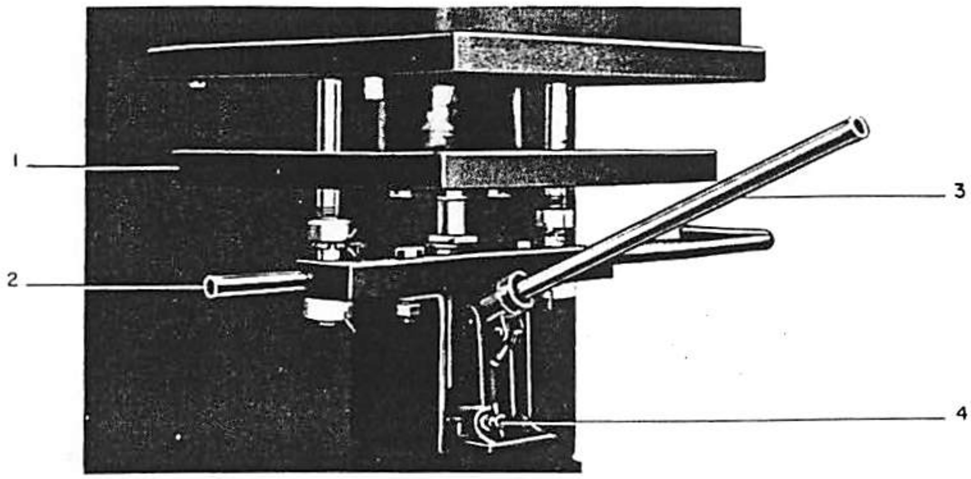
DESCRIPTION

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-13C 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 (6). This 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, two copper-oxide 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 (5). All secondary connections from the breaker to the metal-clad unit are made through the coupler (2).

A plunger interlock (1), Fig. 1, is used where it is desirable to prevent having two adjacent breakers closed at the same time, or it can be used to operate an auxiliary switch mounted in the metal-clad unit. A metal-clad interlock is provided to prevent the breaker from being raised in the metal-clad unit while in the closed position, and to block the breaker open until it is completely raised. It is also used to prevent the breaker from being lowered while in the closed position.

The MS-13F operating mechanism, differs somewhat from the MS-13C but its operation is principally the same. On this mechanism a cut-off switch and relay arrangement is used in place of the control device, and it has two secondary couplers instead of one. Also, instead of the metal-clad interlock, the MS-13F mechanism has a trip interlock, which trips the breaker when any attempt is made to install or remove the breaker from the Metal-clad unit when in the closed position. A fork-type lever can be furnished to operate an auxiliary switch in the metal-clad unit. For a detailed explanation of the operation of the breaker and mechanism refer to the section OPERATION.



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

Fig. 2 Method Of Mounting Maintenance Operating Device

Fig. 2 (8012652)

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 the Metal-Clad Switchgear instruction book. Reference should also be made to the connection diagram that is furnished with each unit.

CAUTION: 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

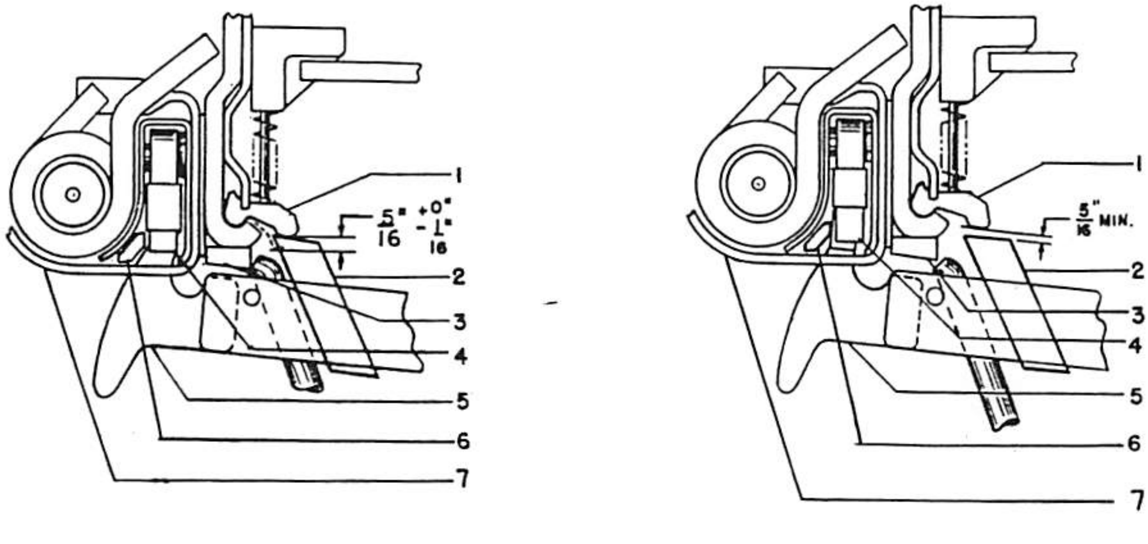
Although the breaker has been completely adjusted and tested at the factory, it is possible that unusually rough handling during transportation may have caused some loosening or disturbance of parts of the apparatus. It is therefore advisable to review all adjustments before placing the breaker in service, 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 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 (8) and turn the jam nut (7). Screwing up on the jam 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 blade (4) and the buffer block (1) should be 1/16" or greater, when the breaker is fully closed.

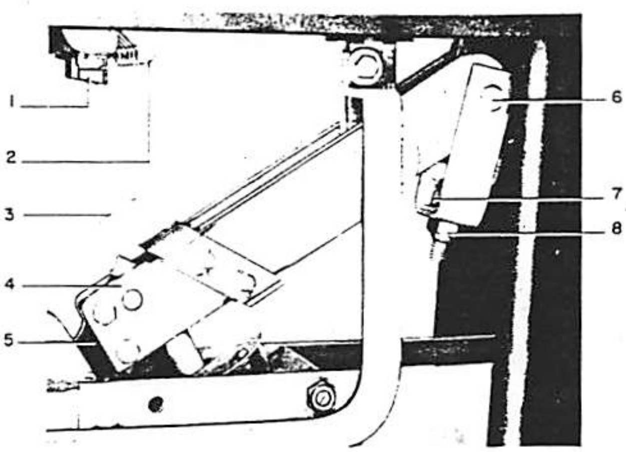


Primary Contact Wipe

Arcing Contact Wipe

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

Fig. 3 Contact Adjustments



1. Buffer Block
2. Stationary Primary Contacts
3. Movable Primary Contacts
4. Contact Arm
5. Movable Arcing Contact
6. Pin
7. Jam Nut
8. Check Nut

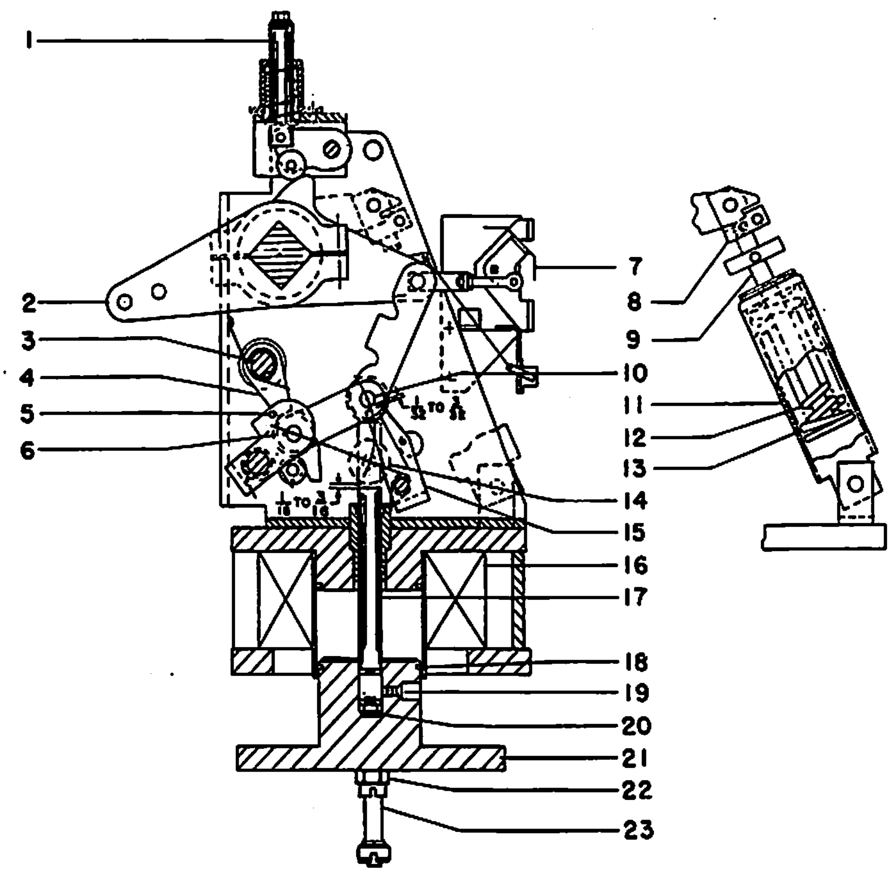
Fig. 4 Adjustable Coupling For Making Primary Contact Wipe Adjustment

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 primary contact fingers (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 (7) without touching.

PRIMARY CONTACT GAP

Refer to Fig. 4. 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 contact (2) and the movable primary contact (3) should be 3-13/16" + 1/8" - 1/16". To obtain this adjustment, first open the breaker. Referring now to Fig. 5, loosen the clevis bolt (8) and turn the adjustable stud (9) of the opening spring housing (11). Unscrewing the cap will decrease the primary contact gap. After making the adjustment, close and trip the breaker and measure the gap once more. If correct, tighten the clevis bolt (8).



1. Plunger Interlock
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 Rod
18. Piston Ring
19. Set Screw
20. Shims
21. Closing Armature
22. Stop Nuts
23. Armature Guide Bolts

Fig. 5 Cross Section Of MS-13 Mechanism

Fig. 5 (286C742)

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).

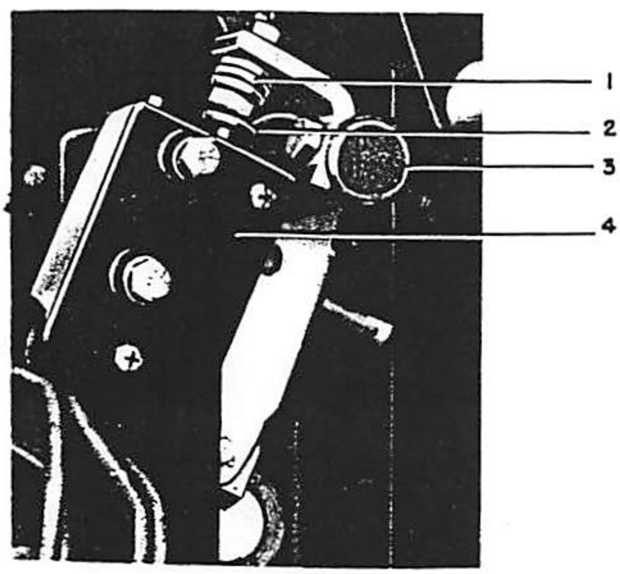
CAUTION: When working on the mechanism in the closed position, keep fingers clear of the linkage, as accidental tripping can cause severe injury.

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. Then remove the two stop nuts (22) being careful not to drop the armature (21). Remove the armature from the breaker. Remove the two set screws (19) and the closing plunger (17) from the armature. 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 nut (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.



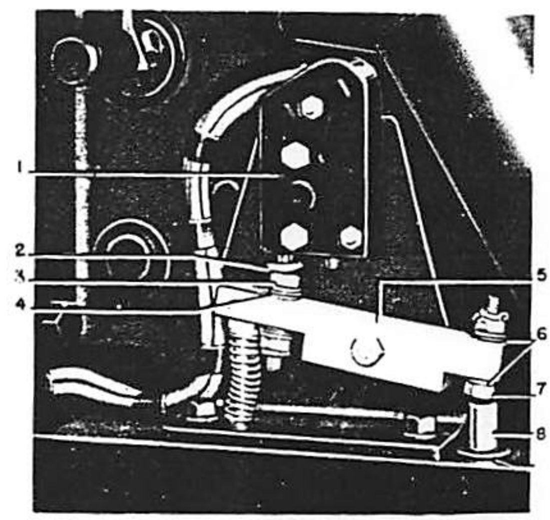
1. Washers
2. Switch Plunger
3. Trip Shaft
4. Latch Checking Switch

Fig. 6 Latch Checking Switch Wipe

Fig. 6 (8010922)

LATCH CHECKING SWITCH WIPE

Referring to Fig. 6, first rotate the trip shaft (3) manually clockwise to release the switch plunger (2). Then, allowing the trip shaft to return to the reset position (counterclockwise), measure the travel of the switch plunger after the contacts make. This is the wipe, and should measure not less than 1/32". Let the trip shaft (3) return to normal, then press the plunger (2) in as far as it will go. This additional motion is the overtravel and should be not more than 1/32". The point of contact can be determined with a light indication or bell set. To change these settings it is only necessary to increase or decrease the number of washers (1).



1. Cut-off Switch
2. Switch Plunger
3. Adjusting Bolt
4. Washers
5. Lever Arm
6. Washers
7. Adjustment Screw
8. Plunger Guide

Fig. 7 Cut-off Switch Adjustments

Fig. 7 (8011670)

CUT-OFF SWITCH ADJUSTMENTS (AM-2.4/4.16-100/150A-1, -150/250A-1)

Refer to Fig. 7. With the breaker in the open position, the clearance between the switch plunger and the adjusting screw is obtained by pushing the switch plunger (2) in as far as it will go. In this position the clearance between the switch plunger (2) and the adjustment screw (3) should be not more than 1/32". This can be obtained by changing the number of washers (4).

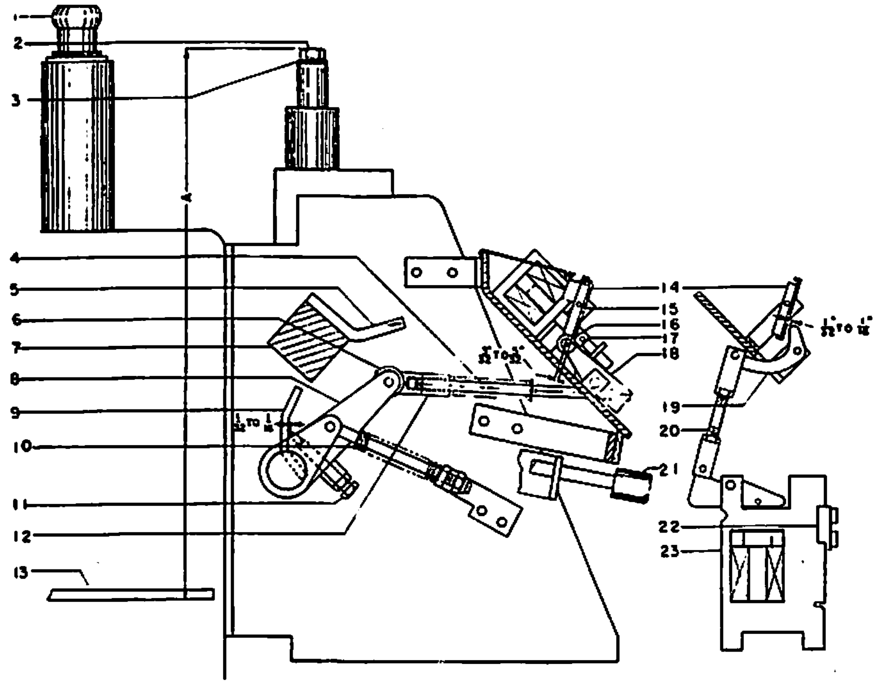


Fig. 8 (T-6195074)

1. Front Disconnect Stud
2. 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. 8 Adjustments On Current Trip Device and Undervoltage Trip Device, Shown With The Breaker In The Closed Position

IMPACT TRIP, CURRENT TRIP, CAPACITOR TRIP, AND UNDERVOLTAGE TRIP DEVICES

Fig. 8 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 pan (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 pan (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-2.4/4.16-100/150-1 and 150/250-1)

Refer to Fig. 8. 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).

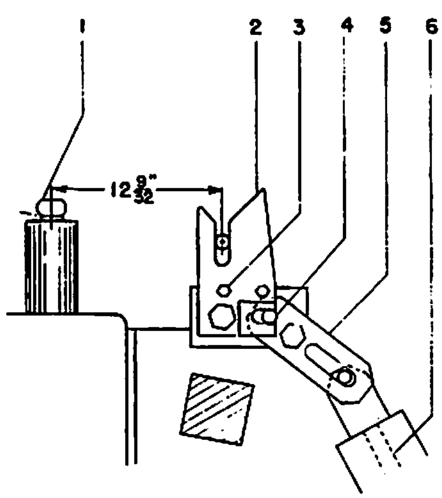
AUXILIARY SWITCH LINKAGE

(Furnished Special on AM-2.4/4.16-100/150A-1 and -150/250A-1).

Refer to Fig. 9. 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 lever 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".
   b. Arcing contact wipe: 5/16" or greater.
   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. Latch checking switch overtravel: 1/32" maximum.
   h. Cut-off switch overtravel: 1/32" maximum.
   i. Impact trip roller wipe: 1/8" ± 1/32".
   j. Impact trip bolt clearance: 3/64" ± 1/64".
   k. Undervoltage trip hammer clearance: 3/64" ± 1/64".
   l. Plunger interlock (100/150-1 and 150/250-1): 15 19/32" ± 1/16".
   m. Auxiliary switch linkage (100/150A-1 and 150/250A-1. 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.



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

Fig. 9 Auxiliary Switch Linkage

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 40 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. CAUTION: Voltage applied to the undervoltage device should be brought up to the pickup value within a period of 20 seconds, to avert damaging the pickup coil. 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

For electrical operation of the breaker, the control power may be either an alternating or direct current source. For AC operation, two rectifiers, mounted elsewhere in the metal-clad unit, are used. A tapped resistor is provided in each AC circuit to control the DC voltage. The resistor setting should be adjusted so that the voltage at the breaker is 110 to 120 volts DC. Where repetitive operation is required, the voltage should be set at 105 to 115V. DC. This resistor should be set under normal summer conditions as described below. To check the resistor setting, proceed as follows:

1. Mechanism with a Control Device - Close the breaker by manually operating the control device contacts (5) and (6) Fig. 12. Hold these contacts in the closed position and read the DC voltage at the closing coil. To de-energize the circuit, release the control device.

2. Mechanism with Cut off Switch, Fig. 9 -

Close the breaker by manually operating the control relay located in the metal-clad unit. Hold this relay closed and read the DC voltage at the closing coil terminals. Release the closing relay to de-energize the circuit.

DO NOT MAINTAIN VOLTAGE ON THE CLOSING COIL ANY LONGER THAN THE FEW SECONDS REQUIRED TO READ THE VOLTMETER. These coils are designed for intermittent operation and will be damaged by prolonged current flow.

The following tabulation in included as a guide for adjusting the resistors for the particular combination of ambient temperature and AC 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.

* AC Volts (Closed Circuit)	Resistor Setting, Ohms	
	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

* AC Volts as measured across the rectifier and AC series resistor.

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. 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. DC	90-130V. DC	70-140V. DC
250V. DC	180-260V. DC	140-280V. DC
230V. AC	190-250V. AC	190-250V. AC

NOTE: Where repetitive operation is required the maximum voltage should be 115 V. DC and 230 V. DC at the nominal voltages of 125 V. DC & 250 V. DC respectively.

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 (5), 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.

CAUTION: 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

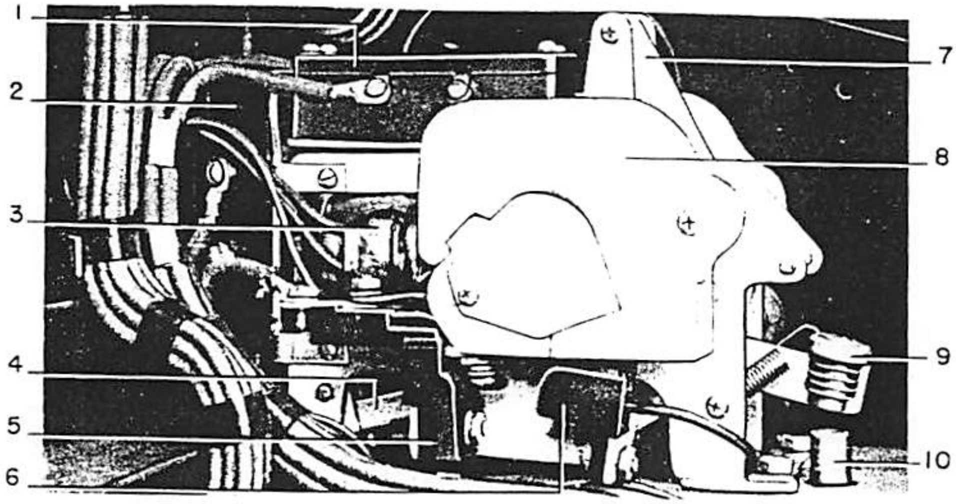
CLOSING OPERATION

Figs. 12 and 13 show the four basic control schemes that are used on Magne-blast breakers. The important difference between Fig. 12 and Fig. 13 is that in the circuits shown in Fig. 12, a control device is used for the closing operation whereas in Fig. 13, a cutoff switch and relay arrangement is used for the same purpose. The reason for this is because all breakers having a control circuit as shown in Fig. 13 are designed primarily to replace breakers of older design that have similar control circuits. It may also be noted that all AC control circuits are equipped with a rectifier, which is used to convert AC power to DC power on which the closing coil operates.

Take for example the AC control circuit shown in Fig. 12 (upper). Closing of the breaker is initiated by actuating the CLOSE control switch on the metal-clad unit. Referring to Fig. 10, the control device coil (3), is immediately energized, and as the control device linkage starts to move, the crank (4) closes the seal-in switch (2) which shunts the CLOSE control switch. With this arrangement, the CLOSE control switch may be released after being closed only momentarily, but the closing operation will continue until completed.

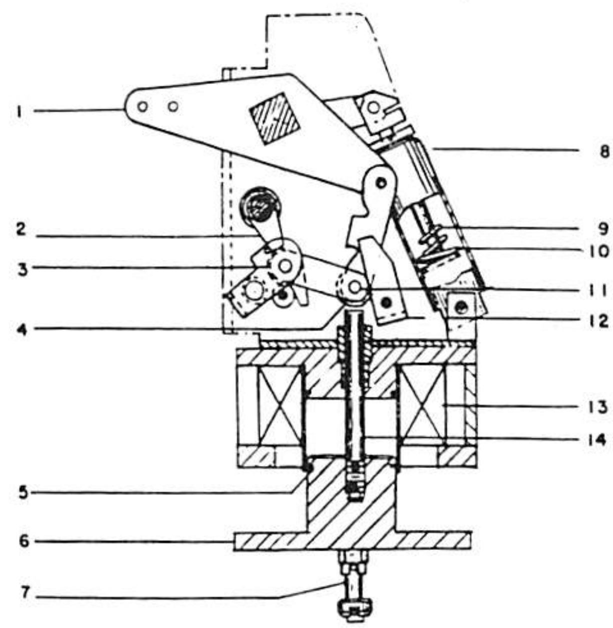
At the same time the control device contacts (5 and 6) are latched in the closed position, energizing the breaker closing coil. Refer now to Fig. 11. The closing armature (6) travels upward, raising the roller (4). This motion is transmitted through the mechanism linkage to rotate the main operating cranks (1), closing the breaker. During the closing operation, the opening springs (9 and 10) are compressed in readiness for the opening operation. At the end of the closing stroke the prop (12) engages the pin (11), latching the breaker closed. The air which is trapped above the closing armature (6) acts as a dashpot, absorbing the remaining kinetic energy of the closing armature.

The plunger (9), Fig. 1, strikes the trip lever (9), Fig. 10, to trip open the control device contacts (5 and 6). This de-energizes the closing coil permitting the closing armature to return by gravity to its original position. The seal-in switch (2) opens but the anti-pump switch (1) will not open unless the close control switch has been released. This is to prevent pumping (reclosing) when the breaker is closed on a fault.



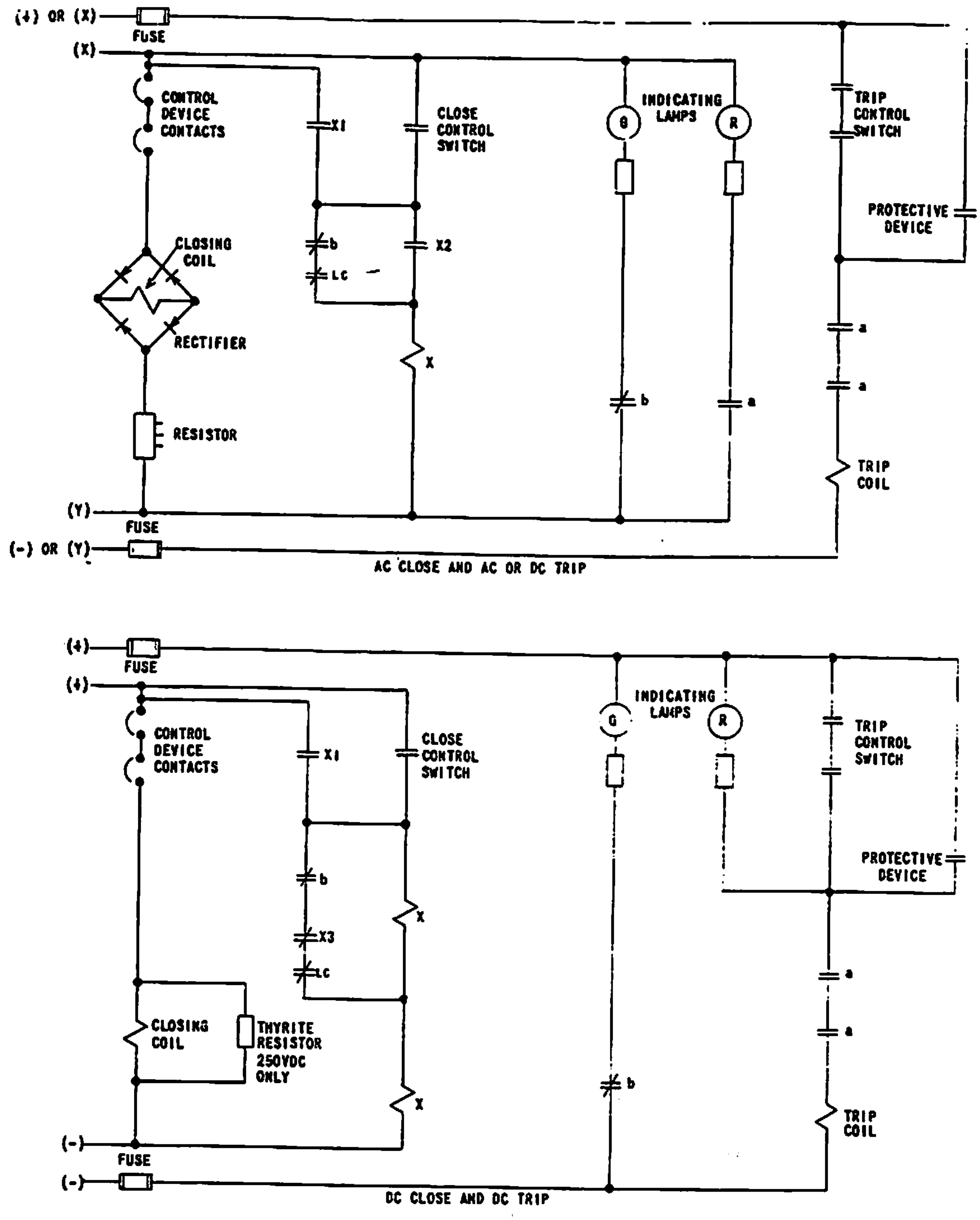
1. Shunting and Anti-Pump Switch
2. Seal-in Switch
3. Operating Coil
4. Crank
5. Stationary Contact Assembly
6. Movable Contact Assembly
7. Arm
8. Arc Quencher
9. Trip Lever
10. Plunger Guide

Fig. 10 Control Device



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

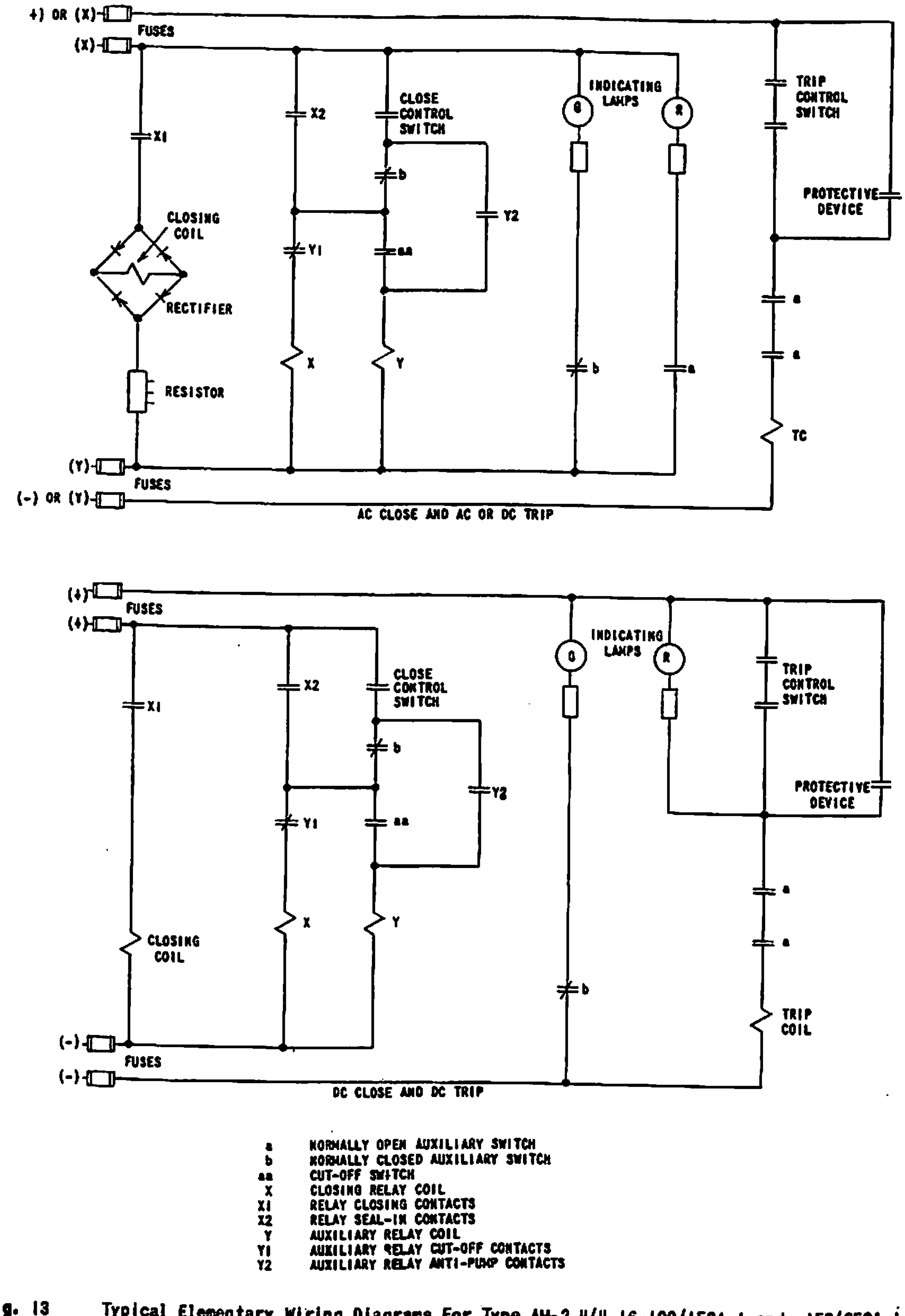
Fig. 11 Cross Section Of MS-13 Operating Mechanism In The Open Position



a	NORMALLY OPEN AUXILIARY SWITCH
b	NORMALLY CLOSED AUXILIARY SWITCH
LC	LATCH CHECKING SWITCH (FOR RECLOSING OPERATION)
X	CONTROL DEVICE OPERATING COIL
X1	CONTROL DEVICE SEAL-IN CONTACTS
X2	CONTROL DEVICE ANTI-PUMP CONTACTS
X3	CONTROL DEVICE SHUNTING CONTACTS (ALSO ANTI-PUMP)

Fig. 12 Typical Elementary Wiring Diagrams For Type AM-2.4/4.16-100/150-1 and -150/250-1 Magne-blast Circuit Breakers, Shown In The De-energized Position

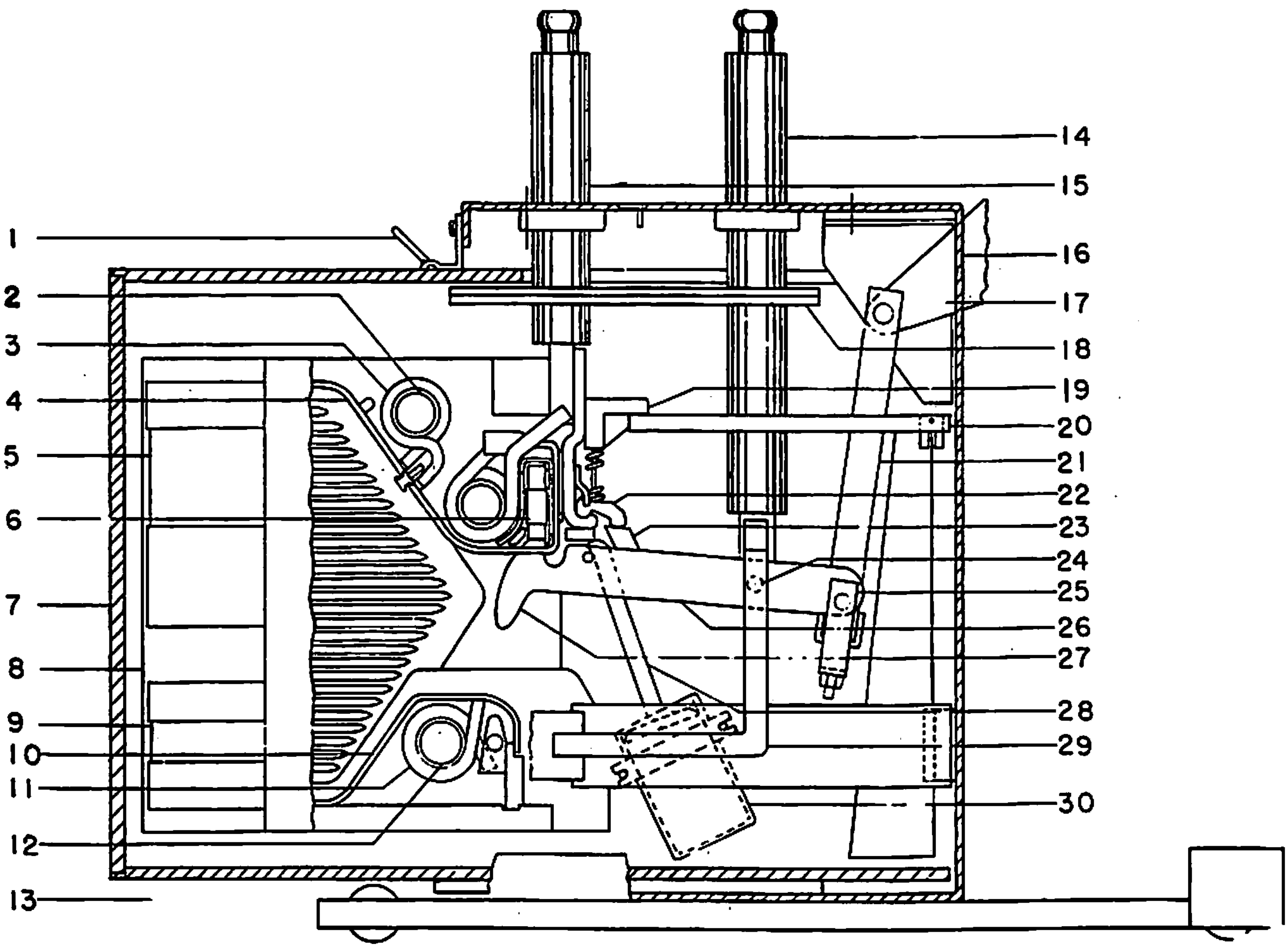
Fig. 12 (7023817)



a	NORMALLY OPEN AUXILIARY SWITCH
b	NORMALLY CLOSED AUXILIARY SWITCH
aa	CUT-OFF SWITCH
X	CLOSING RELAY COIL
X1	RELAY CLOSING CONTACTS
X2	RELAY SEAL-IN CONTACTS
Y	AUXILIARY RELAY COIL
Y1	AUXILIARY RELAY CUT-OFF CONTACTS
Y2	AUXILIARY RELAY ANTI-PUMP CONTACTS

Fig. 13 Typical Elementary Wiring Diagrams For Type AM-2.4/4.16-100/150A-1 and -150/250A-1 Magne-blast Circuit Breakers, Shown In The De-energized Position

Fig. 14 (236C741)



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. Muffler
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. Clevis
26. Movable Contact Arm Assembly
27. Movable Arcing Contact
28. Booster Tube
29. Connection Bar
30. Booster Cylinder and Piston

Fig. 14 Cross Section Of Breaker Pole Unit

The closing speed of the arcing contacts through the arcing zone should be within the range of 10 to 18 feet per second, at rated control voltage.

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. 11, 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. 14. 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 outlet (28) and forces the arc onto the lower arc runner (10). Establishment of the arc on the runners automatically inserts the blow-out coils into the circuit, introducing a magnetic field between the pole pieces which tends to draw the arc away from the arcing contacts. The arc chute contains two upper magnetic blow-out coils electrically connected in series and one lower blow-out coil, each individually connected to a segment of the arc runners. As the arc is forced outward along the diverging arc runners by the magnetic field, the arc transfers from the first segment of the upper arc runner to the second. By this action, the second blow-out coil is inserted into the circuit to produce an additional magnetic force to drive the arc on.

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, elongage 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.

Manual tripping follows the same procedure except that instead of energizing the trip circuit, the manual trip (5), Fig. 1, is used.

The opening speed of the arcing contacts through the arcing zone should be within the range of 10 to 18 feet per second, at rated control voltage.

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. 11, 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.

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.

CAUTION: Before any maintenance work is performed make certain that all control circuits are de-energized and that the breaker primary circuits are open and effectively grounded. Also, 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 inspections 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 if 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 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 cracks do not interfere with the operation of the device in any way and should be disregarded.
3. If the 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 and the arc runner side barrier (11), Fig. 19, 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 Herkolite* 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), clear Glyptal* (GE-1202), or brown Glyptal* (GE-1210). 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. 15. 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 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 is available only in cartons containing twelve collapsible tubes of grease. This is a total of three pounds of grease to the carton. 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
Booster cylinder	Wipe clean and apply thin film of D50H15	Wipe clean and apply thin film of 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 below. 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 below and repack with D50H15
Silver Plated Contacts and Primary Disconnect Studs	Wipe clean and apply D50H28	Wipe clean and apply D50H28

Fig. 15 Lubrication Chart

* Reg. Trade-Mark of General Electric Company

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.

CAUTION: 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.

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 or latch-checking switch.
   REMEDY: Replace defective switch.

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

Fig. 16 (8016455)

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 (AC control).
REMEDY: Install larger control transformer. Check rectifier to be sure it is delivering adequate DC 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.

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 connectors.
REMEDY: Tighten.

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

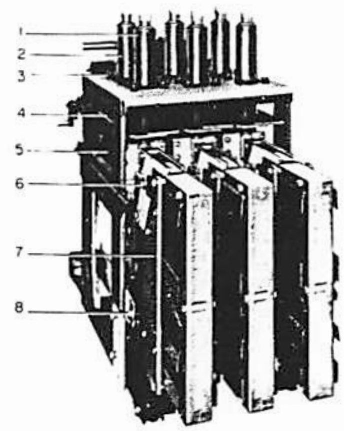
REPAIR AND REPLACEMENT

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 CHUTES AND LOWER ARC RUNNERS

To remove an arc chute, first open the breaker



1. Rear Bushings
2. Front Bushings
3. Mounting Bolts
4. Upper Horizontal Barrier
5. Lower Horizontal Barrier
6. Mounting Bolts
7. Arc Chute Assembly
8. Mounting Nuts

Fig. 16 Rear View Of Breaker With Box Barrier Removed

and remove the box barrier (7), Fig. 14. Remove the mounting bolts (6), Fig. 16, and nuts (8), and the arc chute (7) will be released.

To disassemble the arc chute after it has been removed from the breaker, refer to Fig. 17 and proceed as follows:

1. Remove the assembly hardware (1, 2, 3, 6, and 8) and lift off the arc chute upper half (4). The arc chute side (9) can now be removed.

2. Remove the side piece (7) and the insulation spacer under the side piece. The arc runner (10) and blow-out coil (13) may now be removed.

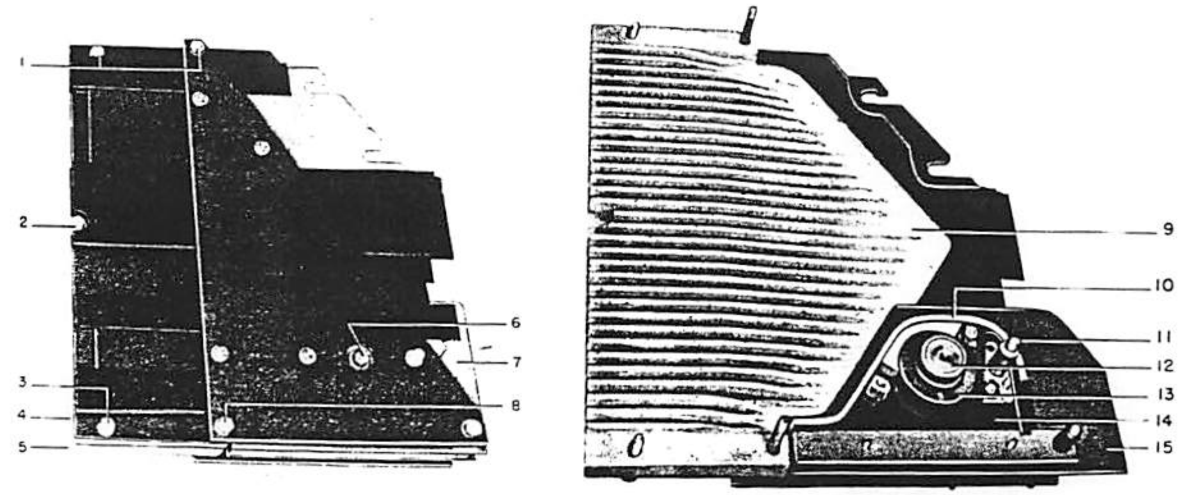
3. Reassemble in the reverse order. Before tightening the assembly hardware, arrange the two halves of the arc chute so that the fins are equally spaced.

CONTACTS

Open the breaker and remove the box barrier and arc chutes as already described. Then proceed as follows:

1. Remove the connection bar (9), Fig. 18.

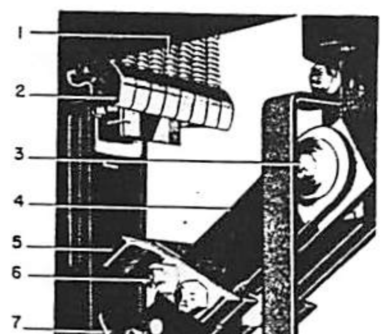
2. Remove the cup bearing (3).



1. Assembly Bolts
2. Assembly Bolt
3. Assembly Bolt
4. Arc Chute Upper Half
5. Arc Chute Lower Half
6. Assembly Bolts
7. Glass Bonded Mica Side Piece
8. Assembly Bolts
9. Arc Chute Side
10. Arc Runner
11. Mounting Stud
12. Blow-out Core
13. Blow-out Coil
14. Insulation Spacer
15. Glass Bonded Mica Side Piece

Fig. 17 Arc Chute Disassembly

Fig. 17 (8012193) & (8016



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

Fig. 18 Removal Of Contacts

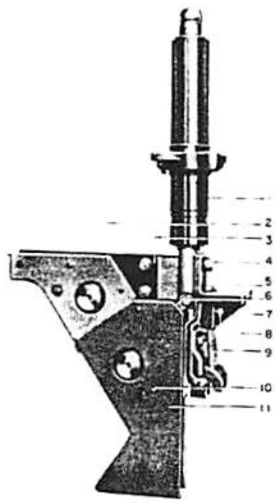
Fig. 18 (8012188)

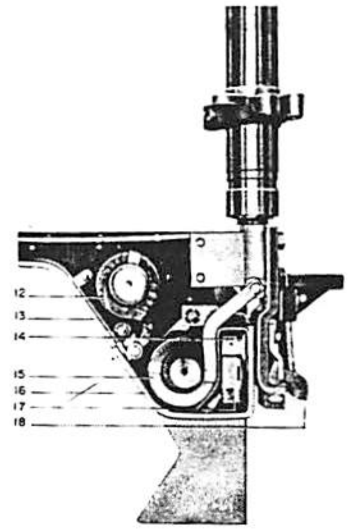
3. Remove the assembly bolts (6) and (8), and the movable primary contacts (5) and movable arcing contact (7) will be removable.
4. To remove the stationary primary contacts (2), compress and remove the contact spring (1) and raise the contact finger and slide it out. When assembling, apply a thin coating of D50H28 grease to the hinge portion of the contacts.
5. To remove the stationary arcing contact (17), Fig. 19, first remove the side piece (11). Remove the screw holding the contact braid (14), then turn the contact finger assembly 90 degrees and pull it out from the side.
6. Reassemble in the reverse order, then check all contact adjustments as described under INSTALLATION, ADJUSTMENTS.

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 reinstalled in the same location.

Fig. 19 (8016318) (8016317)





1. Rear Bushing
2. Upper Insulation
3. Coil Support
4. A sembly Bolts
5. Assembly Bolts
6. Assembly Bolt
7. Spring Retainer
8. Assembly Bolts
9. Contact Springs
10. Coil Protector
11. Glass Bonded Mica Side Piece
12. Blow-out Coil
13. Arc Runner
14. Contact Braid
15. Blow-out Coil
16. Arc Runner
17. Stationary Arcing Contact
18. Stationary Primary Contacts

Fig. 19 Disassembly Of Upper Arc Runner Unit

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 reinstalled.

Rear Bushing and Arc Runner Assembly

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. 16.

3. Remove the four bolts (3) at the mounting flange of the rear bushing being removed, and lower the bushing and arc runner assembly.

4. For further disassembly, refer to Fig. 19. Remove the bolts (8) and the spring retainer (7). Remove the bolts (4, 5, and 6) to remove the bushing (1). The stationary primary contacts (10) may also be removed if necessary.

5. Remove the side pieces (2 and 11) and the insulation (3), making it possible to remove the arc runner segments (13 and 16) and blow-out coils (12 and 15).

6. Reassemble in the reverse order.

Front Bushings

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. 16.

3. Remove the connection bar (9) and cup bearing (3) Fig. 18.

4. Remove the four bolts at the mounting flange of the front bushing being removed, and lower the bushing.

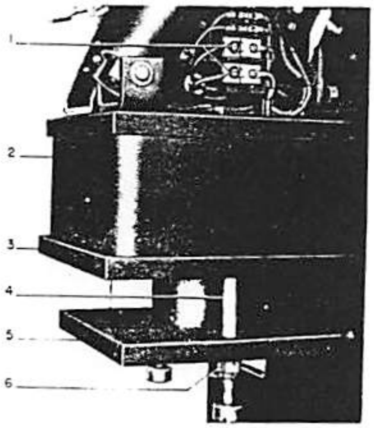
5. When reassembling, first mount the bushing and assemble the cup bearing (3) and contact arm (4), Fig. 18. The contact surfaces at the hinge point of the contact blade and bushing should have a thin coating of D50H28 grease.

6. Reassemble and check all contact adjustments as outlined under INSTALLATION, ADJUSTMENTS.

CLOSING COIL

The closing coil is contained within the solenoid pot (3), Fig. 20. To remove the closing coil proceed as follows.

1. Open the breaker.



1. Closing Coil Lead Wires
2. Solenoid Pot
3. Bottom Plate
4. Guide Bolts
5. Closing Armature
6. Stop Nuts

Fig. 20 Closing Solenoid Assembly

2. Remove the two stop nuts (6), allowing the armature (5) to be lowered from the mechanism.

3. Disconnect the two closing coil lead wires (1).

4. Dismantle the terminal board, which is mounted on the opposite side of the solenoid pot (2).

5. Loosen the four nuts under the bottom plate (3) that hold the pole piece to the mechanism. This permits the solenoid pot (2) to be removed by sliding it forward.

6. Remove the four nuts, to lower the bottom plate (3) and closing coil.

7. Reassemble in the reverse order, then check the mechanism adjustments as explained under INSTALLATION, ADJUSTMENTS.

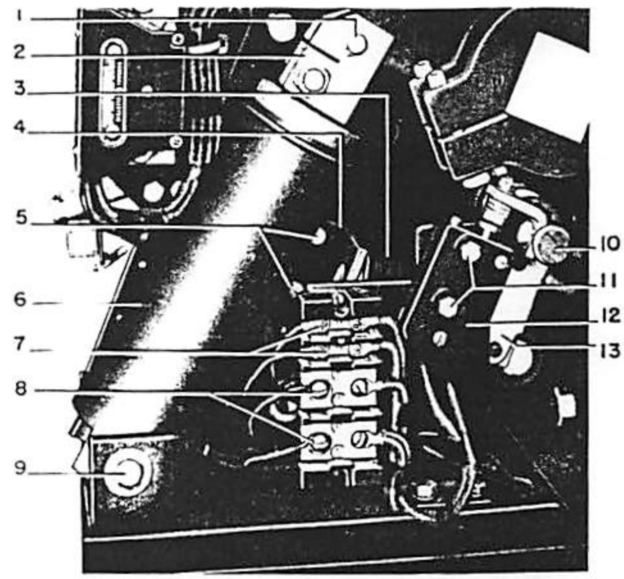
TRIP COIL

To replace the potential trip coil (3), Fig. 21, proceed as follows:

1. Open the breaker and remove the opening spring pivot pin (1) and pull the opening spring unit (6) forward out of the way.

2. Disconnect the two trip coil lead wires (7).

3. Remove the two mounting bolts (5) and the trip coil support (4).



1. Pivot Pin
2. Clevis
3. Trip Coil
4. Trip Coil Support
5. Mounting Bolt
6. Opening Spring Unit
7. Trip Coil Leads
8. Closing Coil Leads
9. Pivot Pin
10. Trip Shaft
11. Bolts
12. Latch Checking Switch
13. Trip Lever

Fig. 21 Latch Checking Switch and Potential Trip

4. Remove the trip coil (3).

5. After reassembling (in the reverse order) check the primary contact gap adjustment as explained under INSTALLATION, ADJUSTMENTS.

LATCH CHECKING SWITCH

To remove the latch checking switch (12), Fig. 21, remove the two mounting bolts (11) and disconnect the lead wires. When remounting the switch, adjust the latch checking switch wipe as explained under INSTALLATION, ADJUSTMENTS.

CUT-OFF SWITCH

To remove the cut-off switch (1), Fig. 7, 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

RECOMMENDATIONS

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.

A complete list of renewal parts is contained in the Renewal Parts Bulletin GEF-3873. Those parts subject to wear in ordinary operation, and to damage or breakage due to possible abnormal conditions, are marked as recommended renewal parts.

ORDERING INSTRUCTIONS

When ordering renewal parts, address the nearest General Electric Sales Office, specifying the quantity required, and describing each part by the catalog number obtained from the Renewal Parts Bulletin.

It is also suggested that complete identification of the breaker be furnished by supplying the information found on the breaker nameplate and, if possible, the number of the requisition on which the breaker was originally furnished.

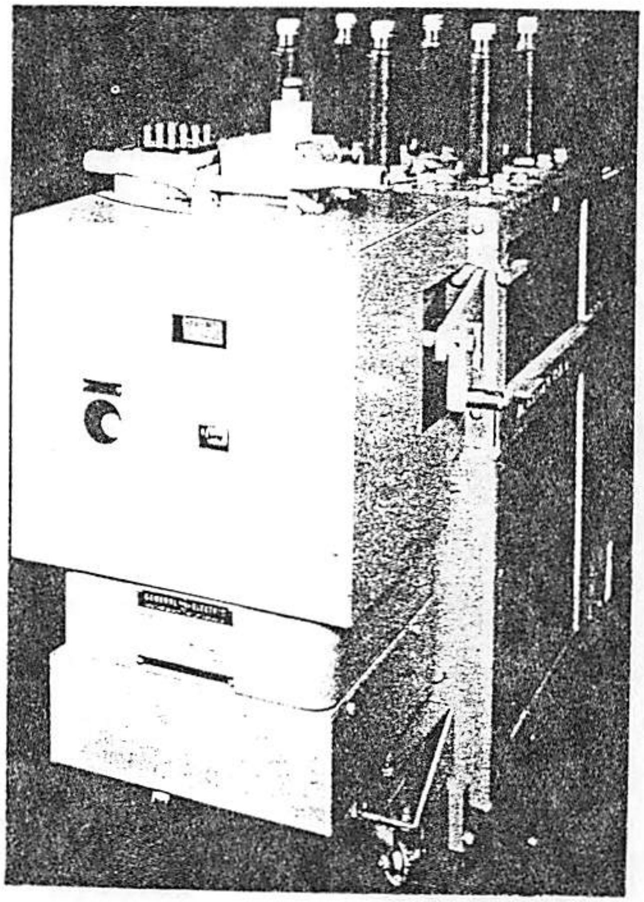
Renewal parts which are furnished may not be identical to the original parts, since improvements are made from time to time. The parts which are furnished, however, will be interchangeable.

INSTRUCTIONS AND RENEWAL PARTS

GEH-2000F
SUPERSEDES GEH-2000E

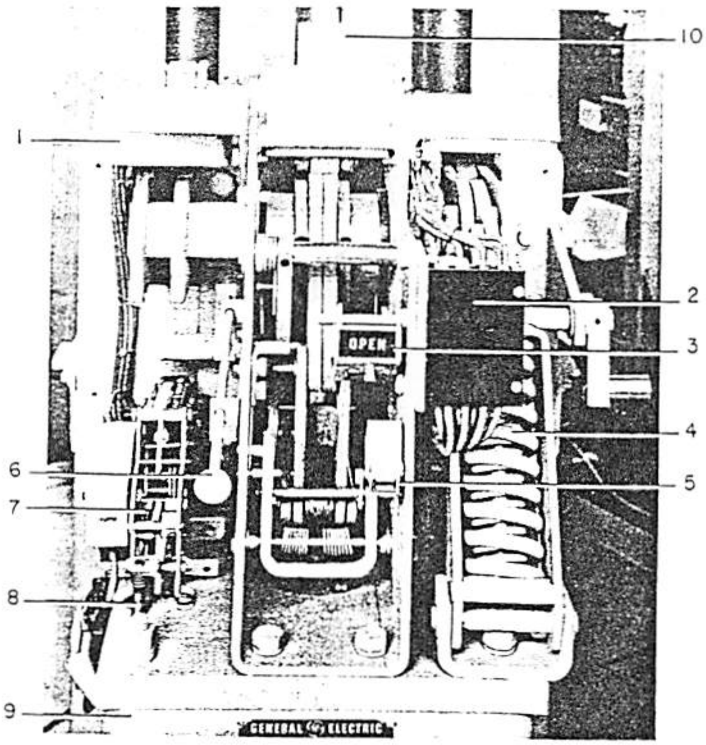
MAGNE-BLAST CIRCUIT BREAKERS

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



CONTENTS

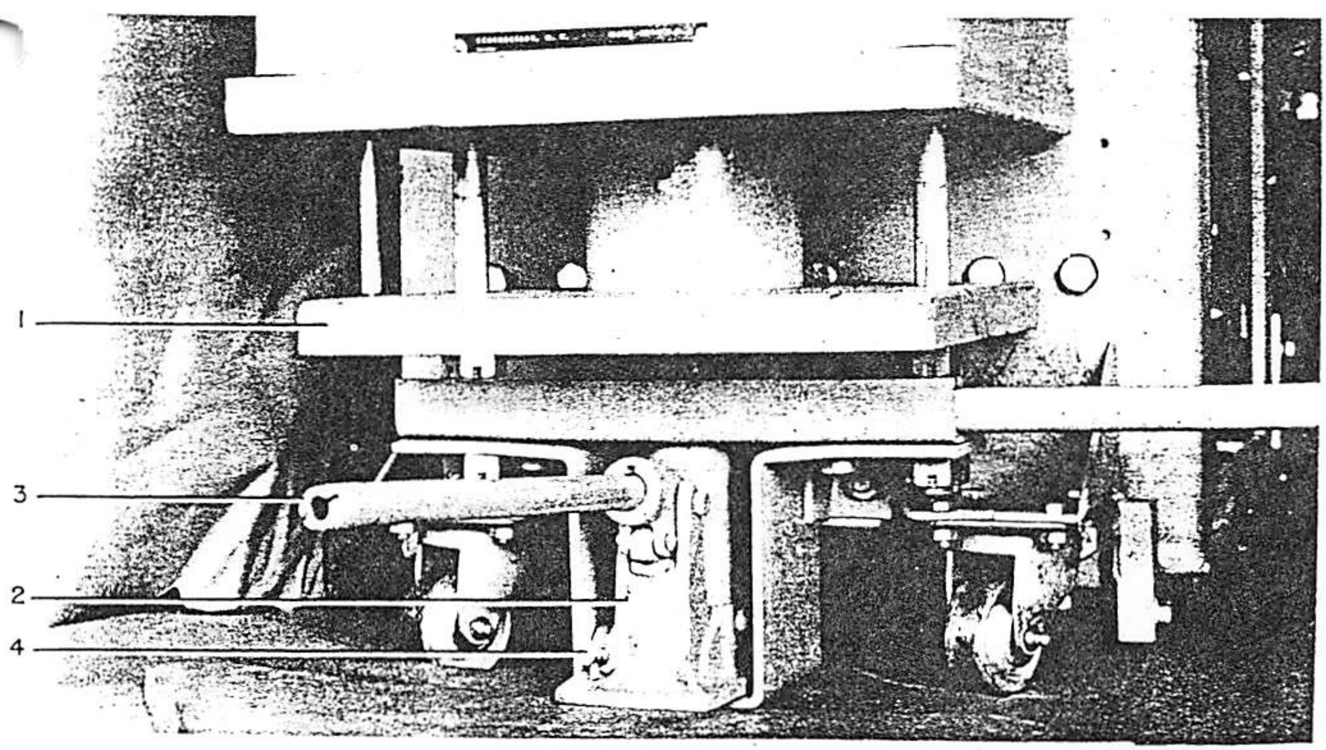
MEDIUM VOLTAGE SWITCHGEAR DEPARTMENT
GENERAL ELECTRIC
PHILADELPHIA, PA.



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 (8024599)

Fig. 1 MS-13 Operating Mechanism



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

Fig. 2 (8020882)

Cover (8022043)

Fig. 2 Method of Mounting Maintenance Operating Device

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.

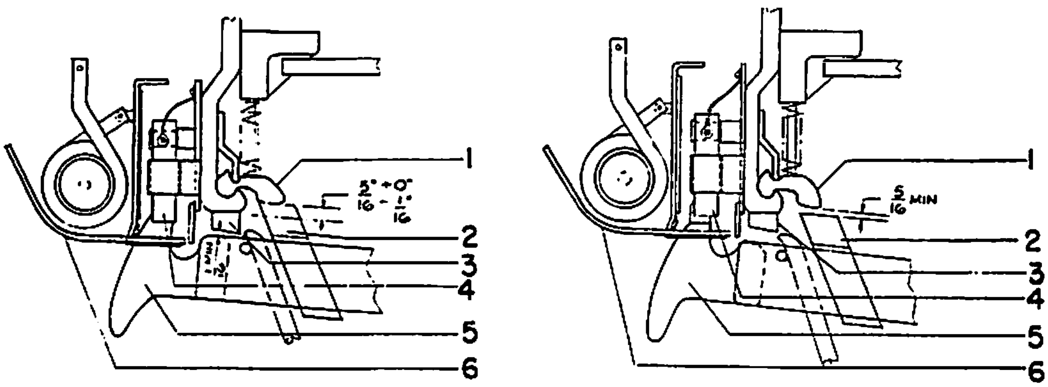
The MS-13 operating mechanism shown in Fig. 1 is of the solenoid type designed to give high speed closing and opening. The closing operation is controlled by the control device (7). The control device also permits trip free operation (tripping the breaker at any time during the closing operation), and 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 (258C688)

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).

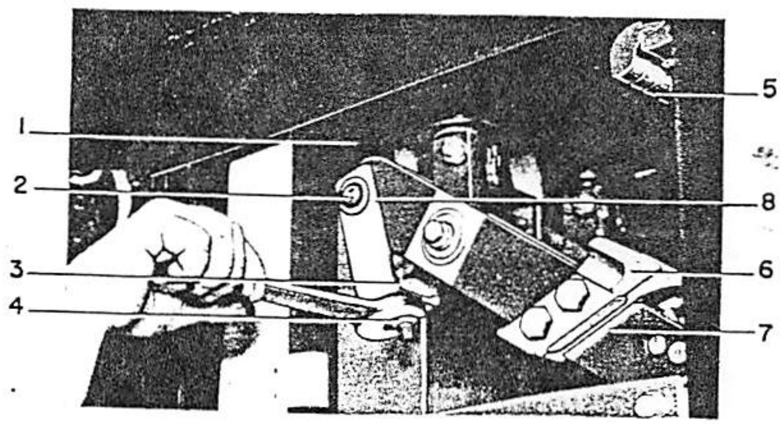
WHEN WORKING ON THE MECHANISM IN THE CLOSED POSITION, KEEP FINGERS CLEAR OF THE LINKAGE, AS ACCIDENTAL TRIPPING CAN CAUSE SEVERE INJURY.

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.

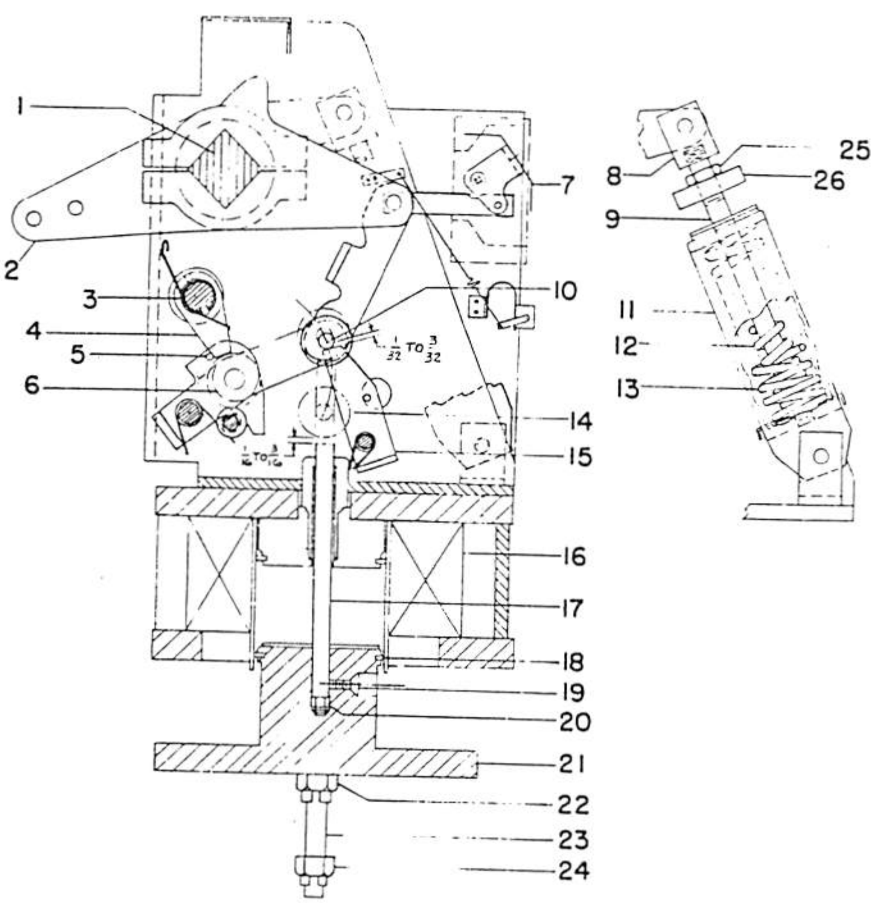
CLOSING PLUNGER CLEARANCE

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.



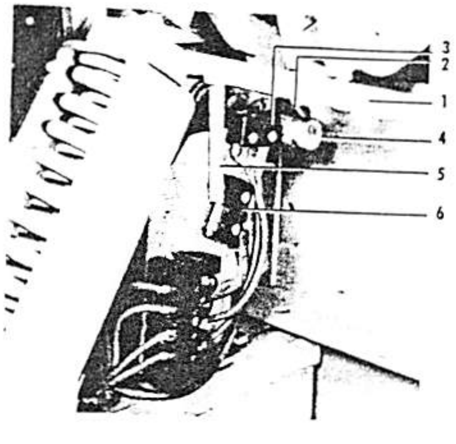
1. Operating Rod
2. Operating Rod Pin
3. Adjusting Nut
4. Check Nut
5. Stationary Primary Contacts
6. Movable Primary Contacts
7. Contact Arm
8. Yoke

Fig. 4 Adjustable Coupling for Making Primary Contact Wipe Adjustment



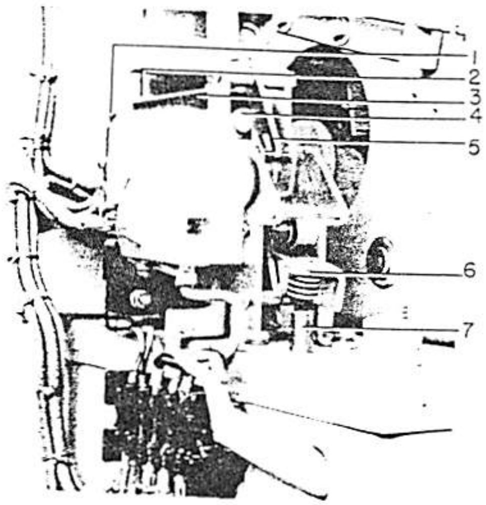
1. Main Oper. Shaft
2. Main Crank
3. Trip Shaft
4. Trip Latch
5. Trip Latch Stop
6. Trip Roller
7. Position Indicator
8. Clevis
9. Adjustable Stud
10. Closing Pin
11. Opening Spring Housing
12. Opening Spring, Inner
13. Opening Spring, Outer
14. Closing Roller
15. Prop
16. Closing Coil
17. Closing Plunger
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

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).

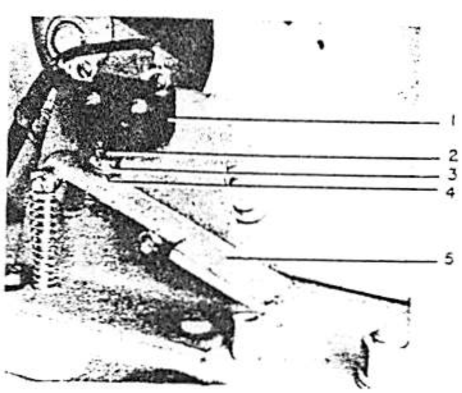
Auxiliary Switch Linkage (Furnished Special on AM-4.16-150A-3 and 250A-3)

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

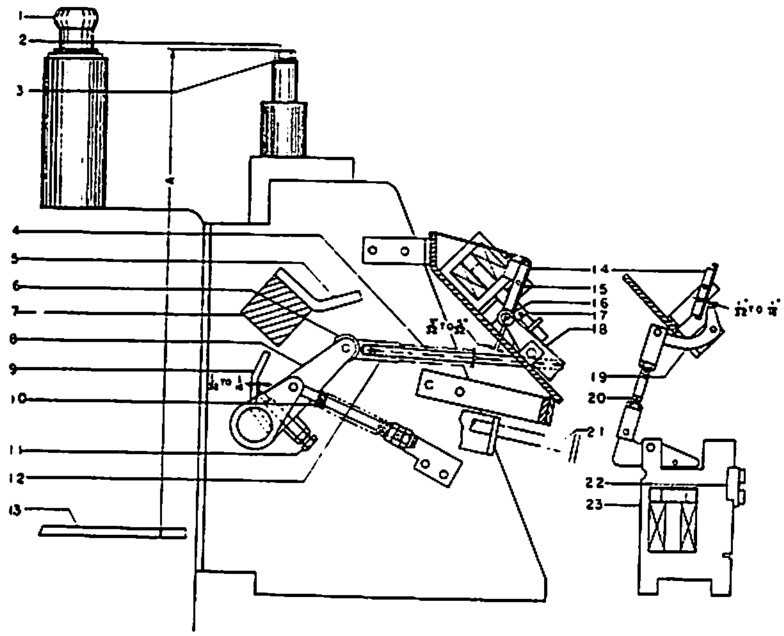
1. For ease in reviewing the adjustments, the following are recapitulated:

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



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

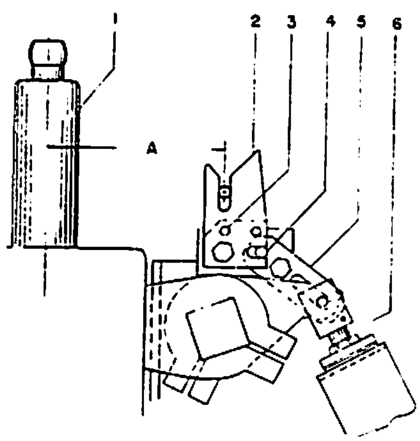
Fig. 8 Cut-off Switch Adjustments



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

Fig. 9 (T-6195074)



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

Fig. 10 Auxiliary Switch Linkage

Fig. 10 (M-6291393)

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

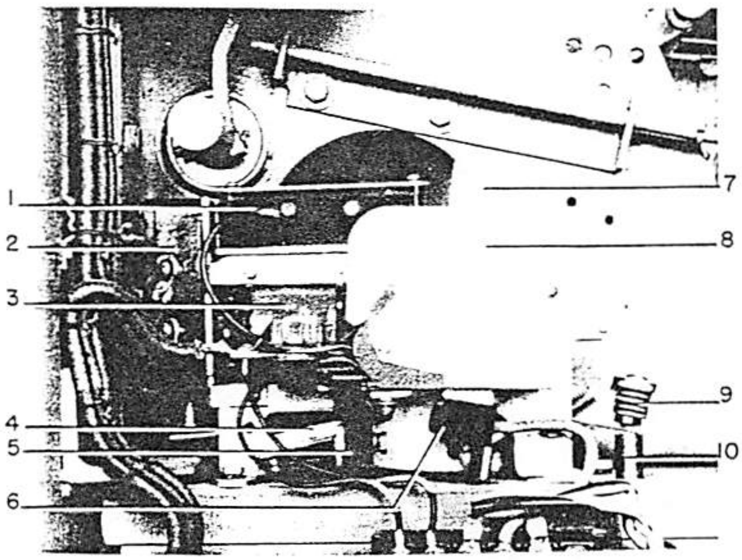
NOTE: When repetitive operation is required from a direct current source, the closed circuit voltage at the closing coil should not exceed 115v d-c and 230v d-c at the nominal voltages of 125v d-c and 250v d-c, respectively.

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:

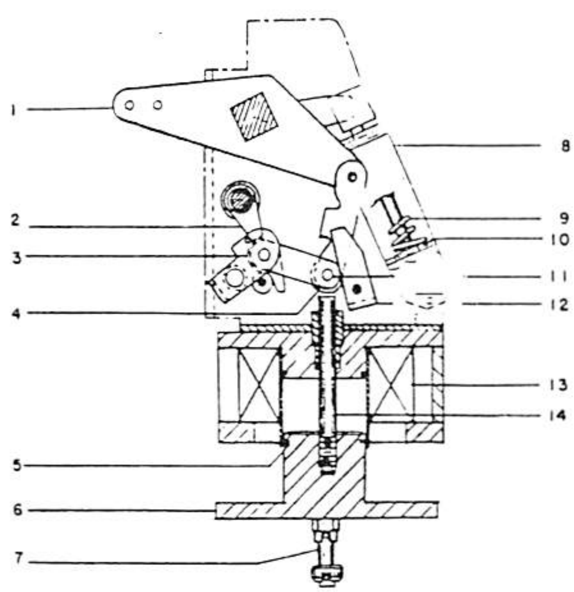
1. A-c control power source using copper oxide rectifiers. Decrease the series



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.

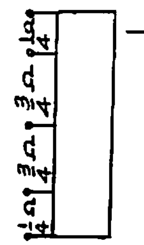
*A-c Volts (Closed Circuit)	Resistor Setting For Each Resistor	
	Summer	Winter
190-196	1/4	0
194-206	1/2	0
204-216	1/2	1/4
214-226	3/4	1/4
224-236	1	1/2
234-246	1-1/4	3/4
244-250	1-1/4	1

*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

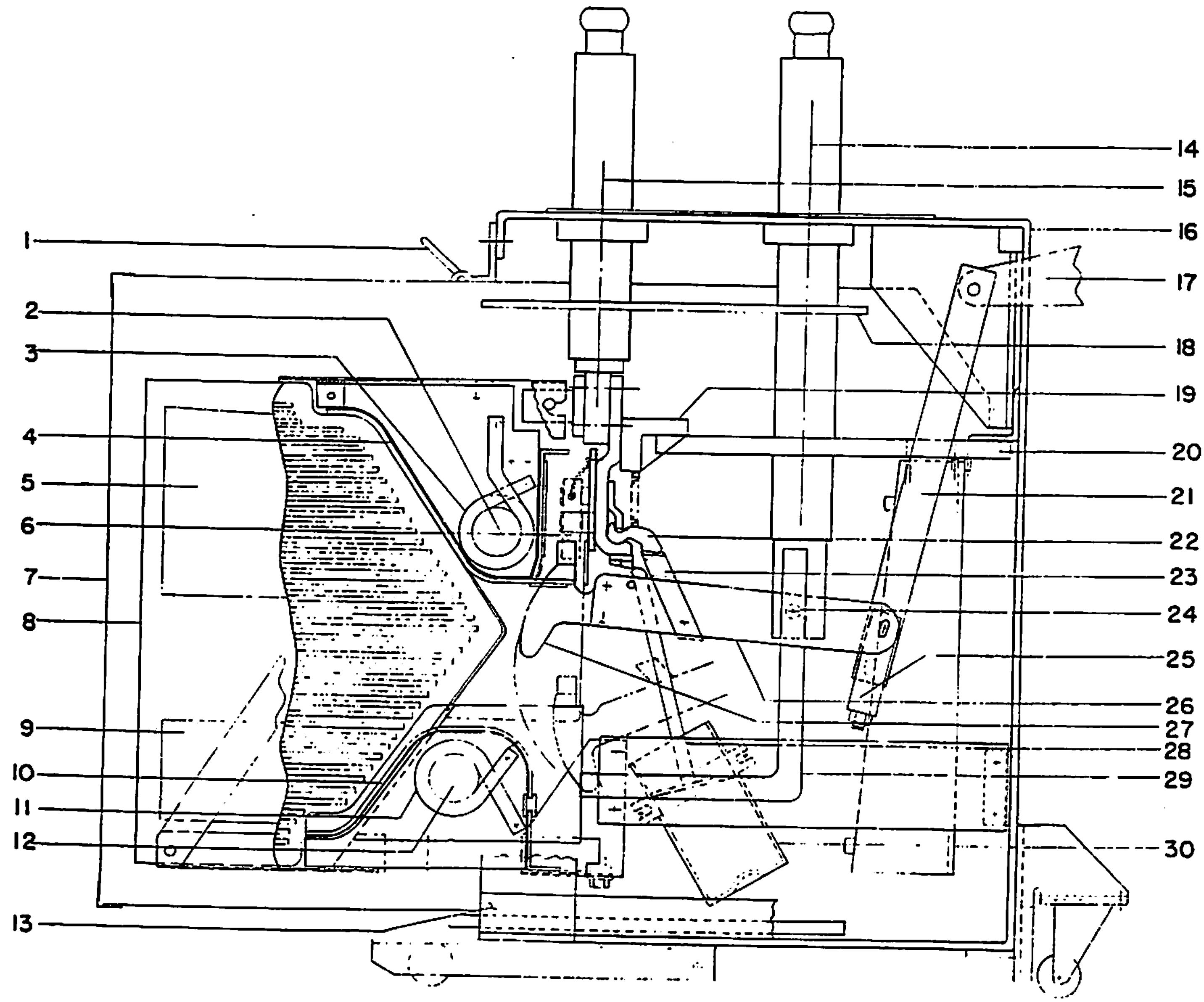
The closing operation of the breaker is primarily controlled by the control device, Fig. 11, mounted on the operating mechanism. The closing sequence is initiated from a control switch mounted on the door of the metal-clad unit or at a remote operating station. Operation of the closing control switch 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



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 <u>must not be removed</u>, 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

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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 disassembled, 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.

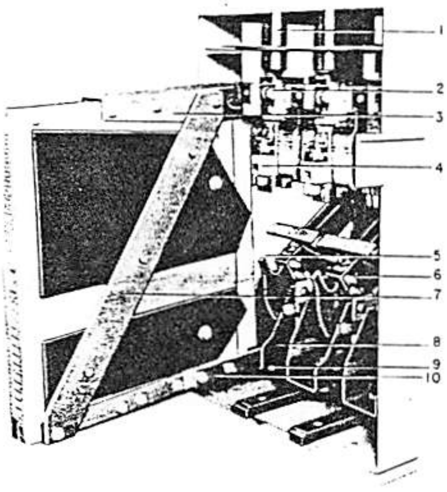
OVERHEATING

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.

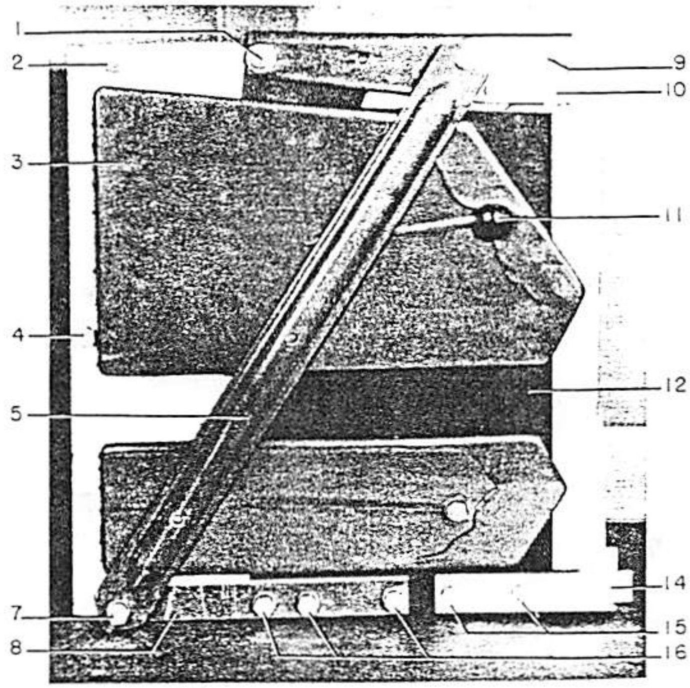
REMEDY: Check all adjustments in accordance with INSTALLATION, ADJUSTMENTS.

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.

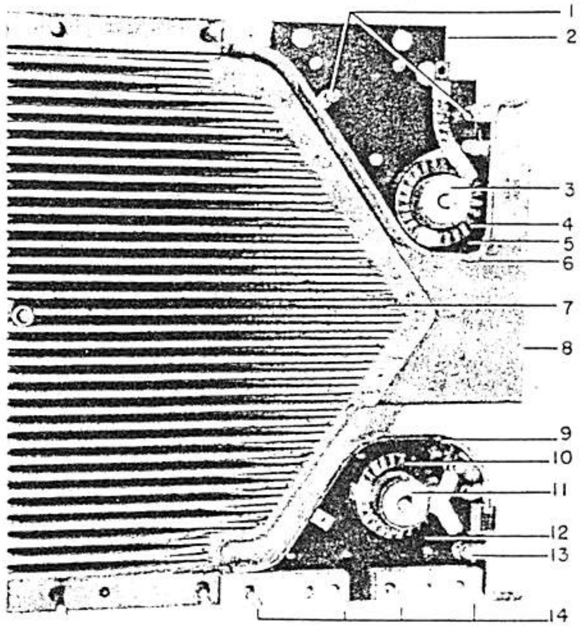
TRIP SHAFT BALL BEARINGS

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.

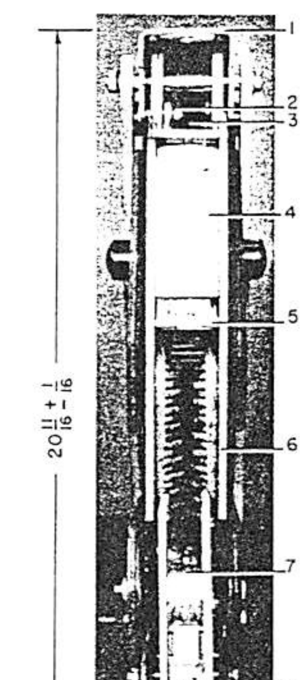
Fig. 17 (8024600)



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

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

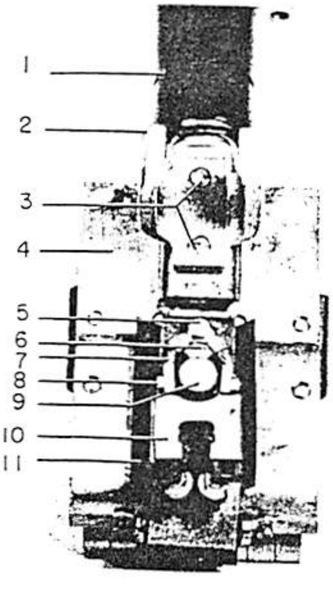
Open the breaker and remove the box barrier and arc chutes as previously described. To remove the contacts, proceed as follows:

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.



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)

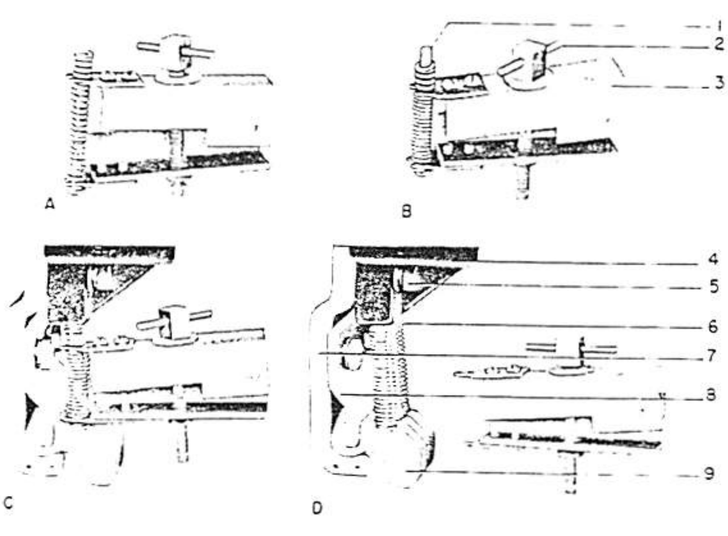
C. Movable Arcing Contact (7), Fig. 21.
  1. Remove the assembly bolts (8).
  2. Reassemble in reverse order.

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. 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

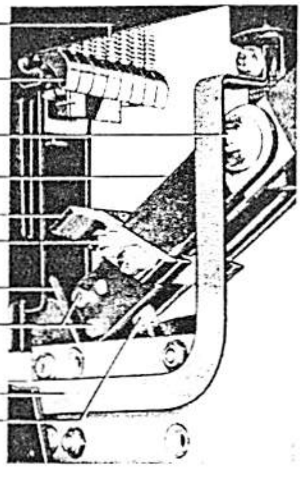
Fig. 20 Method of Installing Primary Contact Springs Using a Spring Compressor

Fig. 20 (8017149)

Fig. 21 (8012188)

Fig. 22 (8022047)

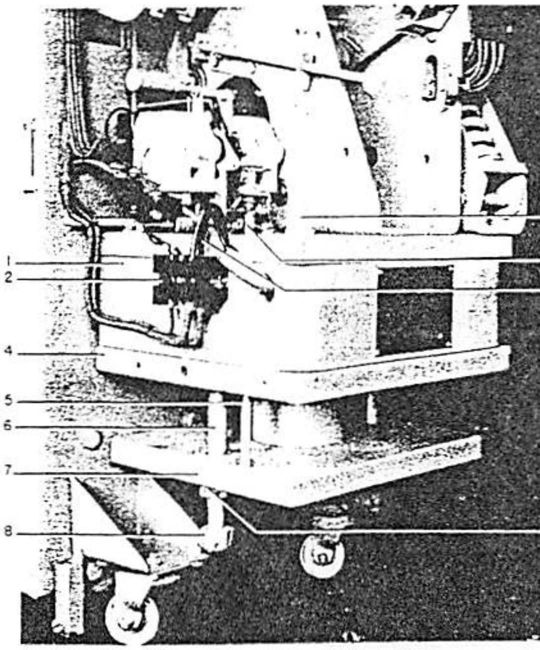
Fig. 23 (8022045)



1. Contact Springs
2. Stationary Primary Contacts
3. Cup Bearing – Cat 6441L17-P1 (Figs 22 & 23 Ref 27)
4. Contact Arm
5. Movable Primary Contacts
6. Assembly Bolts
7. Movable Arcing Contact
8. Assembly Bolts
9. Connection Bar
10. Piston Assembly

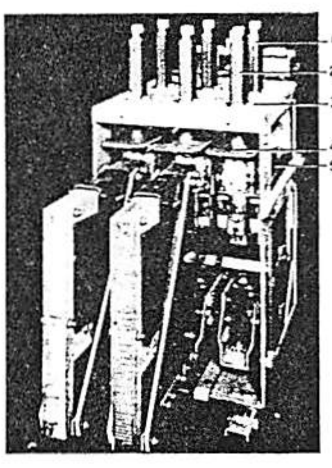
Per R.T. Eichler 9/17/79

Fig. 21 Removal of Contacts



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



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

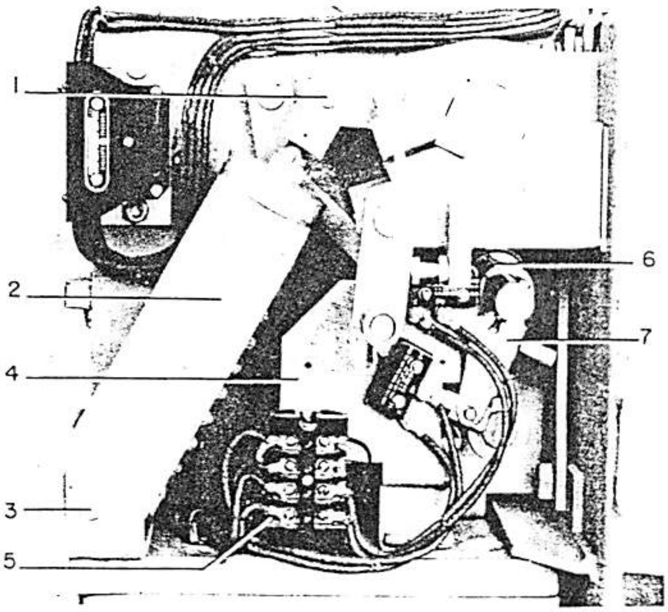
To replace the bushing, proceed as follows:

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.

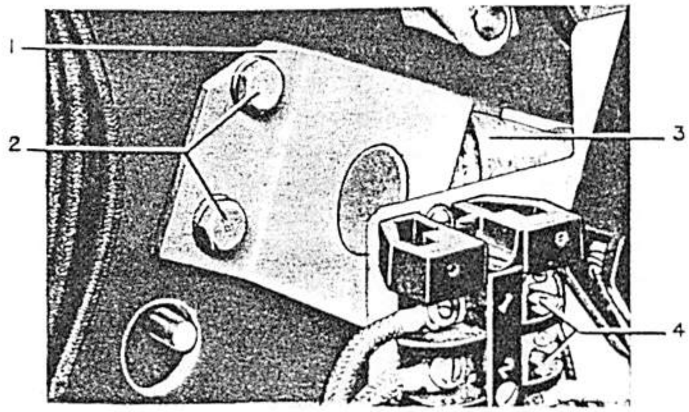
Front Bushing

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

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~~ 137A9164 P-3	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~~ 137A9164 P-4	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. 26B (8024600)

Fig. 26C (8020726)

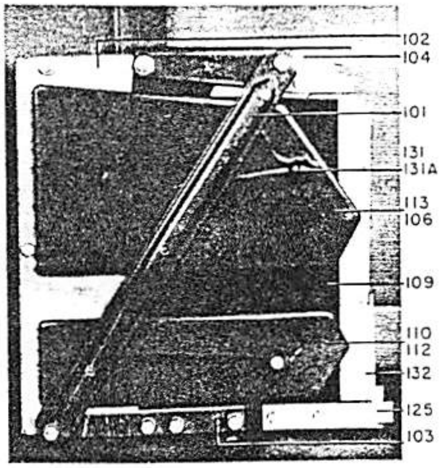


Fig. 26A Complete Assembly (250 mva)

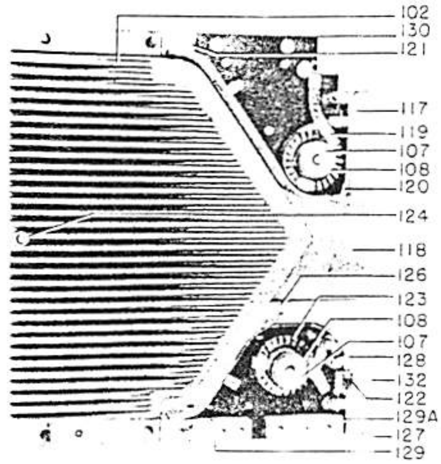


Fig. 26B Side Cover Removed

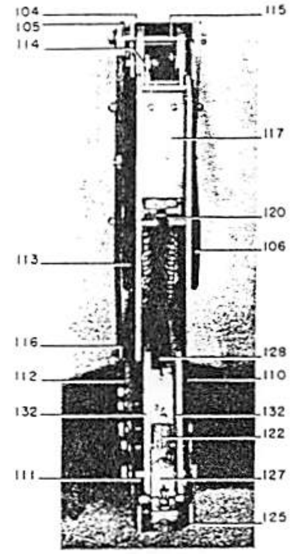


Fig. 26C Front View

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	All	215D469 G-1	3	Arc chute asm., complete
100	250, 250A	All	215D469 G-2	3	Arc chute asm., complete
101	All	All	456A381 P-1	6	Brace
102	All	All	264B100 G-3	3	Arc chute sides
103	All	All	258C616 P-4	6	Lower support
104	150, 150A	All	215D469 G-8	3	Upper support
104	250, 250A	All	215D469 G-9	3	Upper support
105	All	All	6176109 P-78	6	Spacer
106	All	All	258C615 G-2	3	Upper pole piece (right)
107	All	All	258C615 P-29	6	Core
108	All	All	258C616 P-18	6	Core insulating tube
109	All	All	258C616 P-2	6	Shield
110	250, 250A	All	258C615 G-6	3	Lower pole piece (right)
111	All	All	421A208 P-93	24	Spacer
112	250, 250A	All	258C615 G-3	3	Lower pole piece (left)
113	All	All	258C615 G-1	3	Upper pole piece (left)
114	All	All	258C615 P-11	3	Connection
115	All	All	421A209 P-82	6	Spacer
116	All	All	432249 P-1	6	Spacer
117	All	All	414A116 P-2	3	Insulation plates
118	All	All	414A117 P-1	6	Upper runner insulation bottom
119	All	All	366A743 G-1	3	Coil (upper)
120	All	All	688C512 G-1	3	Runner (upper)
121	All	All	258C616 P-5	3	Spacer
122	All	All	258C616 P-11	3	Spacer
123	250, 250A	All	366A744 G-1	3	Coil (lower)
124	All	All	421A208 P-434	3	Spacer
125	All	All	258C615 P-15	3	Support
126	All	All	383A932 P-1	6	Lower shield
127	All	All	258C615 G-5	3	Connection assembly
128	All	All	258C615 G-4	3	Runner (lower)
129	All	All	258C616 P-22	3	Spacer
129A	All	All	258C616 P-21	3	Spacer
130	All	All	258C616 P-9	6	Upper insulation
131	All	All	421711 P-1	6	Insulating cups
131A	All	All	407193 P-1	6	Washer (for insulating cup)
132	250, 250A	All	258C616 P-6	6	Lower barrier
132	150, 150A	All	258C616 P-13	6	Lower barrier

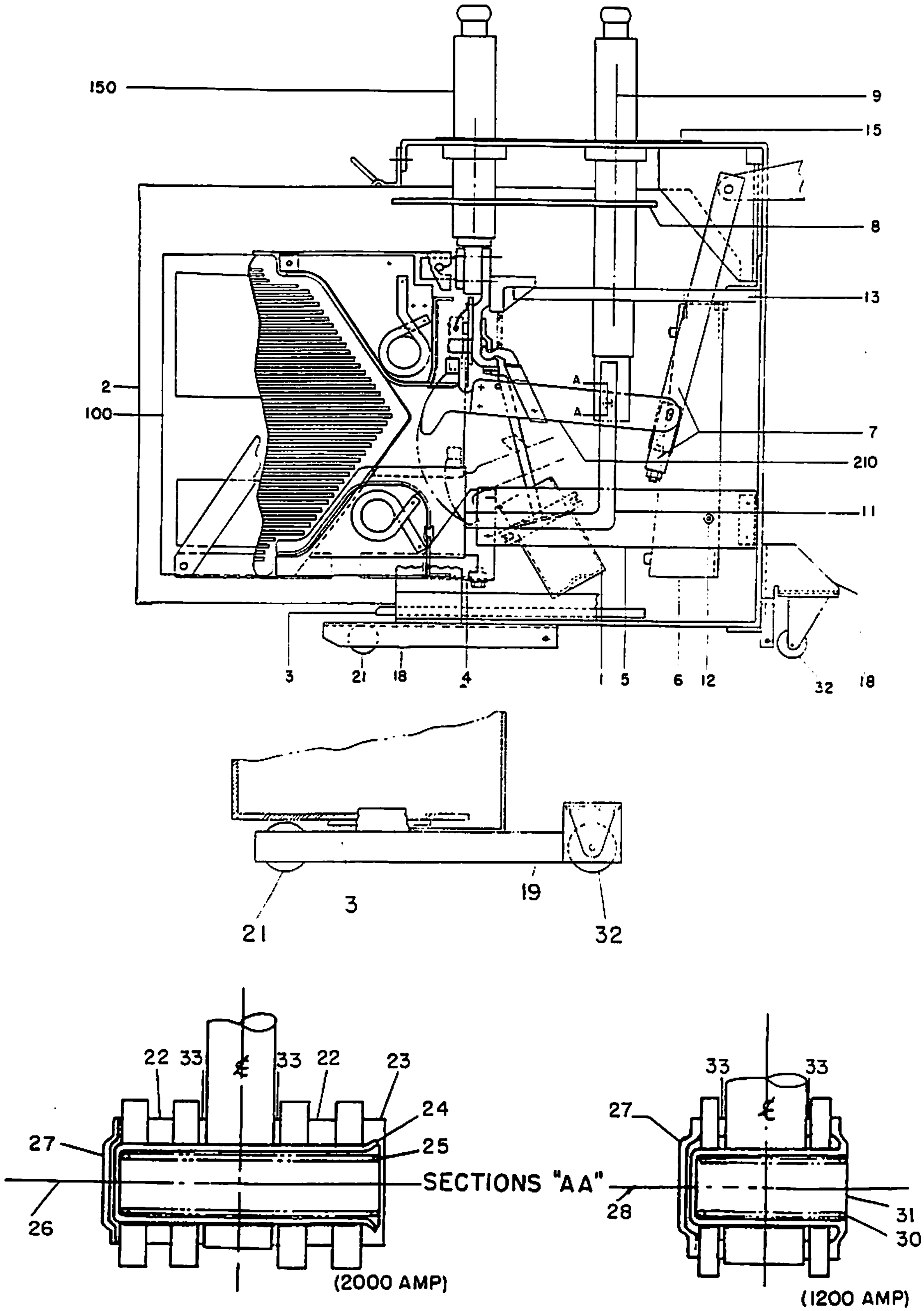


Fig. 27 Cross-section Type AM-4.16-3

Fig. 27 (236C792)

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.

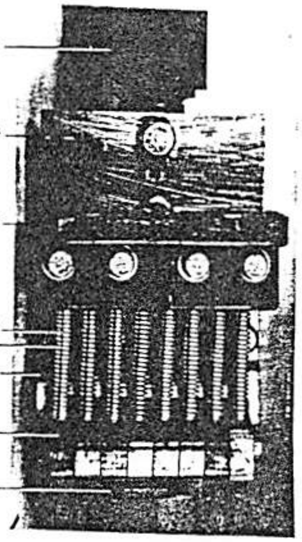


Fig. 28A Front View

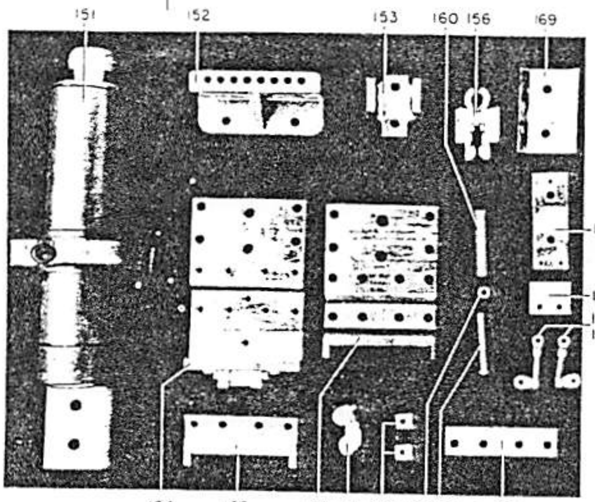


Fig. 28B Component Parts

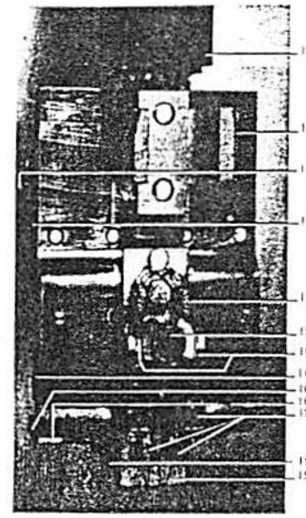


Fig. 28C Back View

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

Fig. 28A (8020428)

Fig. 28B (8022046)

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

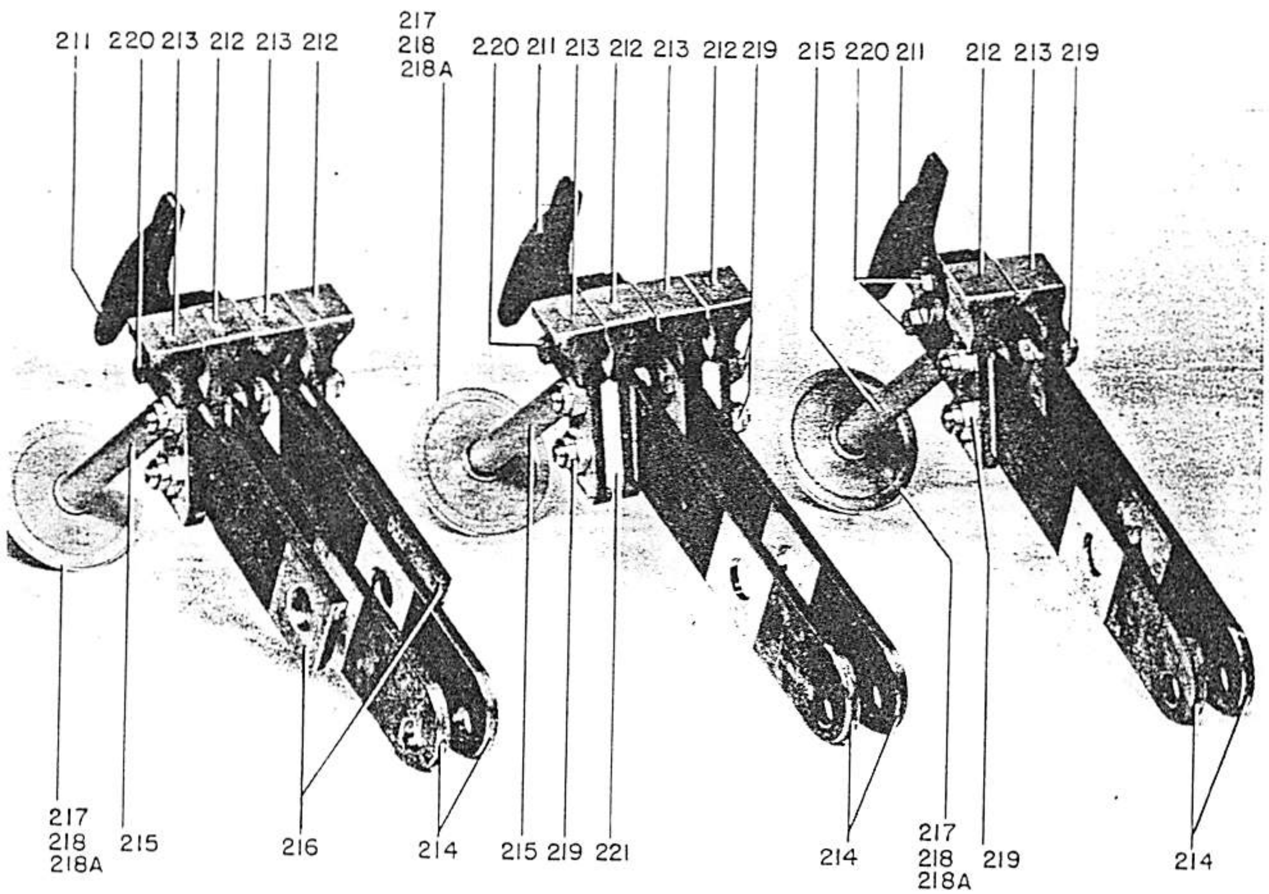


Fig. 29A For 2000 Amp. Breakers, All Ratings

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

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

Fig. 29 Movable Contact Arm Assembly

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

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

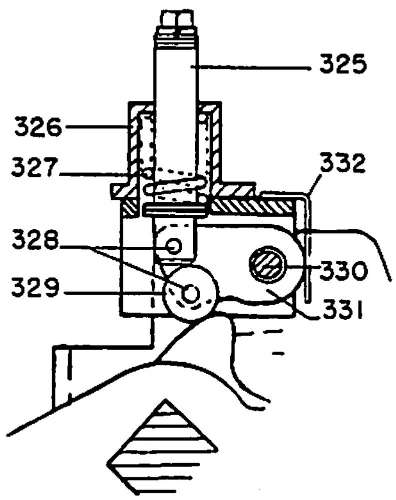


Fig. 30A Early Design

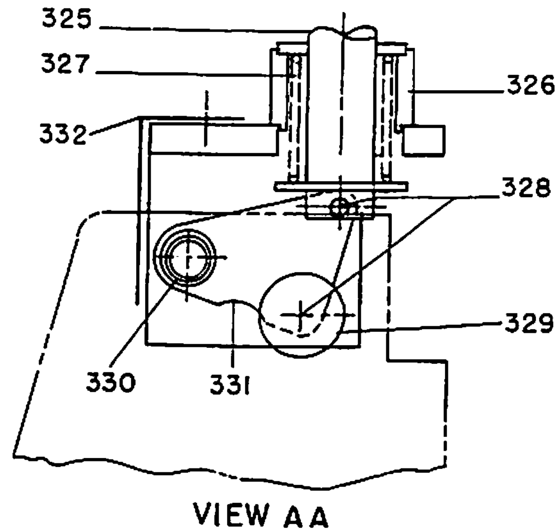


Fig. 30B Present Design

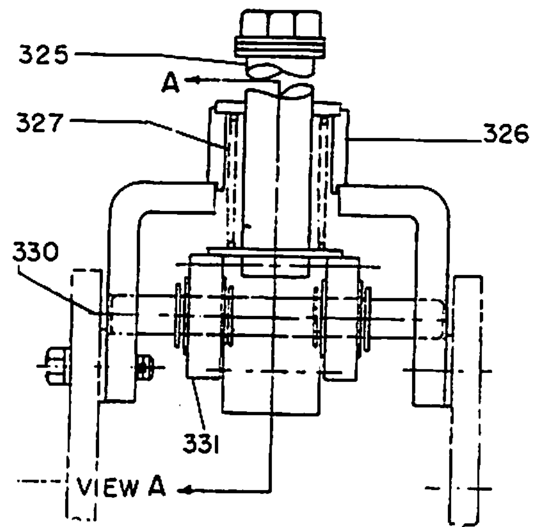


Fig. 30C Present Design

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. 31A (8025739)

Fig. 31B (8024599)

Fig. 31C (8025740)

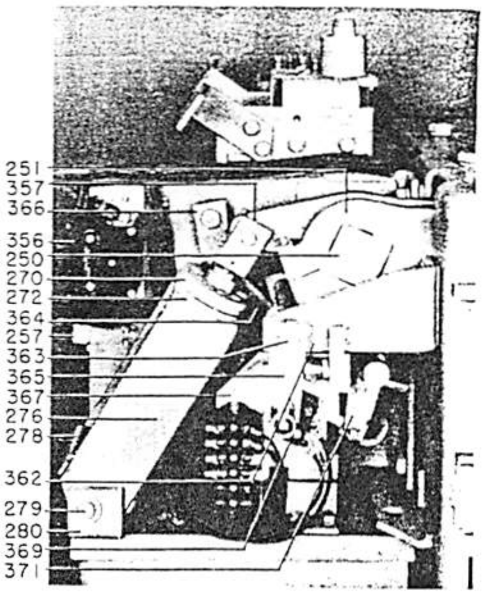


Fig. 31A Right Side View

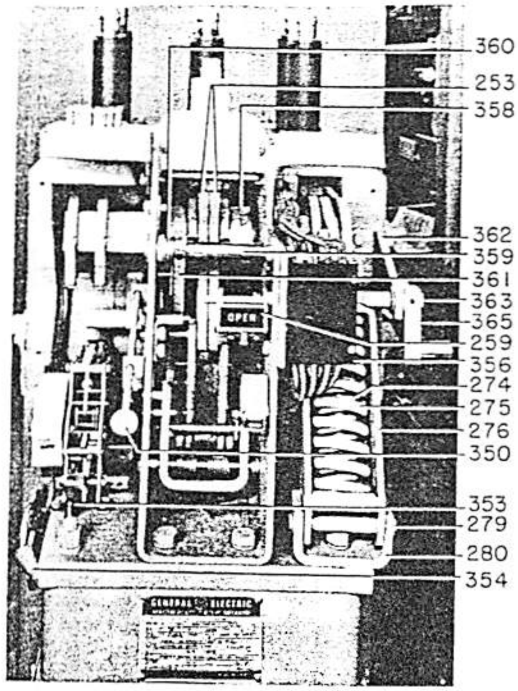


Fig. 31B Front View

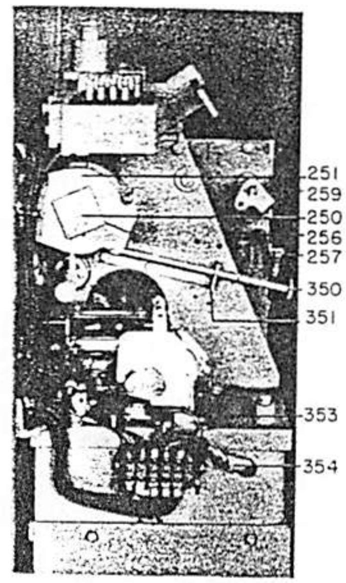


Fig. 31C Left Side View

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~~ 121A7436 [illegible]-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~~ 414A110P-[illegible]	1	Trip roller pin
290	~~421A256 P-1~~ [illegible]	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

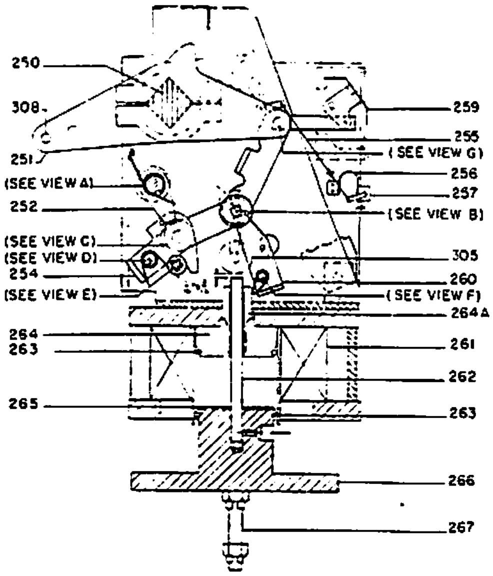


Fig. 32A Cross-section

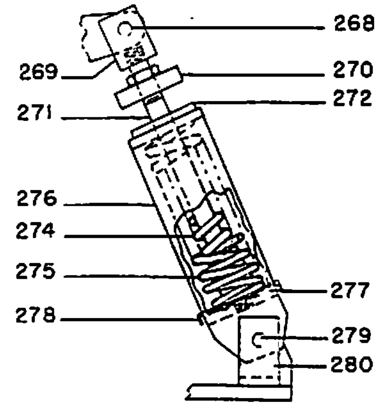


Fig. 32B Complete Spring Assembly (Ref. No. 273)

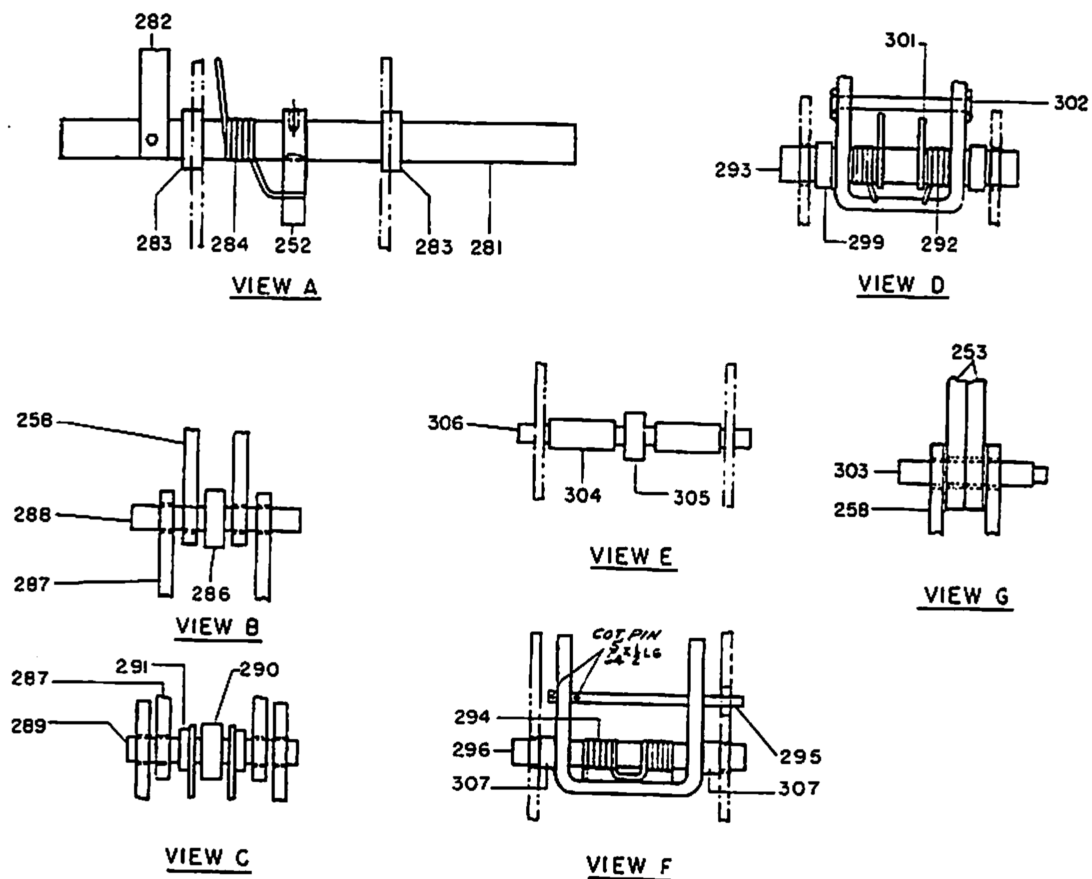


Fig. 32C Detailed Views

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

Fig. 32A (258C688)

Fig. 32B (258C688)

Fig. 32C (215D470)

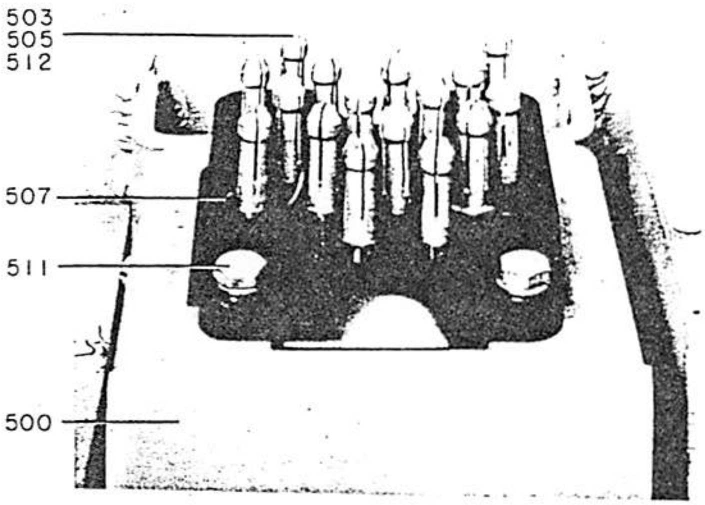


Fig. 33 Secondary Disconnecting Device
(Ref. 500)

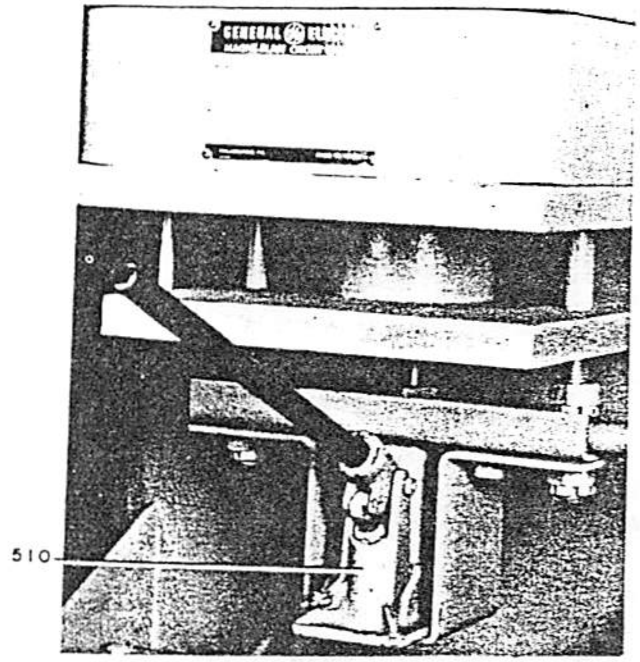


Fig. 34 Maintenance Closing Device
(Ref. 510)

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. 36 (8016105)

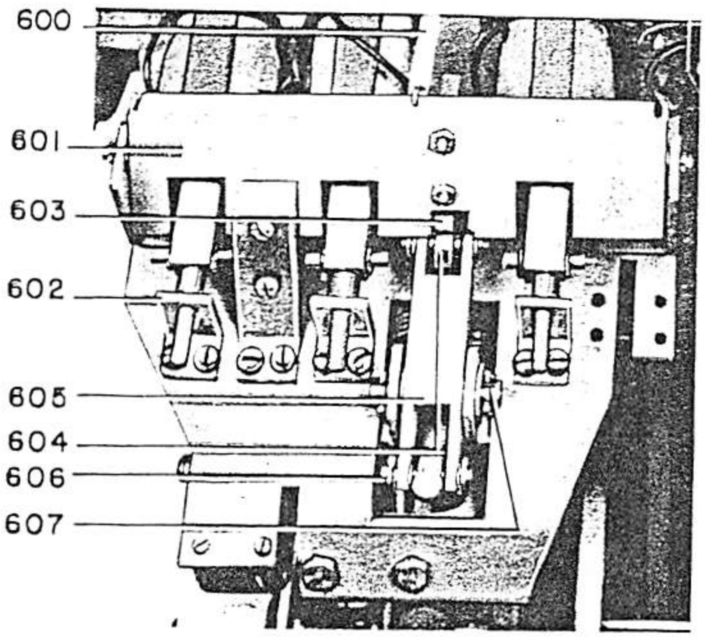


Fig. 35 Partial View of MS-13 Mechanism with Current Trip

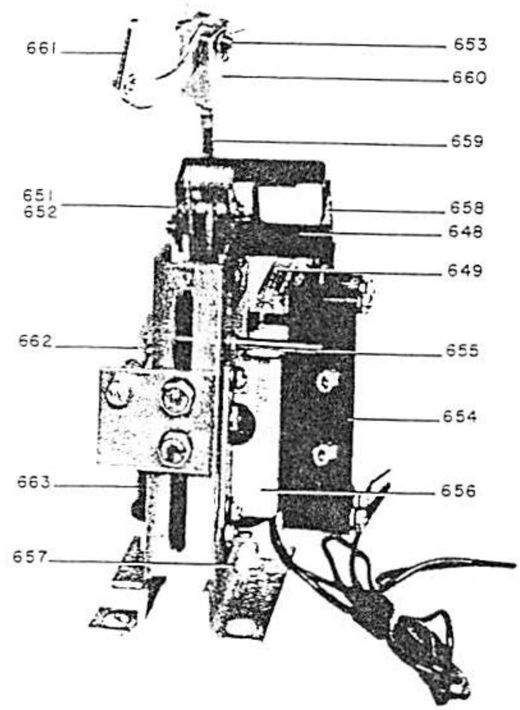


Fig. 36 Undervoltage Device (Ref. 647)

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	~~0915617 AA~~ 213X217G1	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)
663	6275017G37	1	COIL (48VDC)

• Not shown

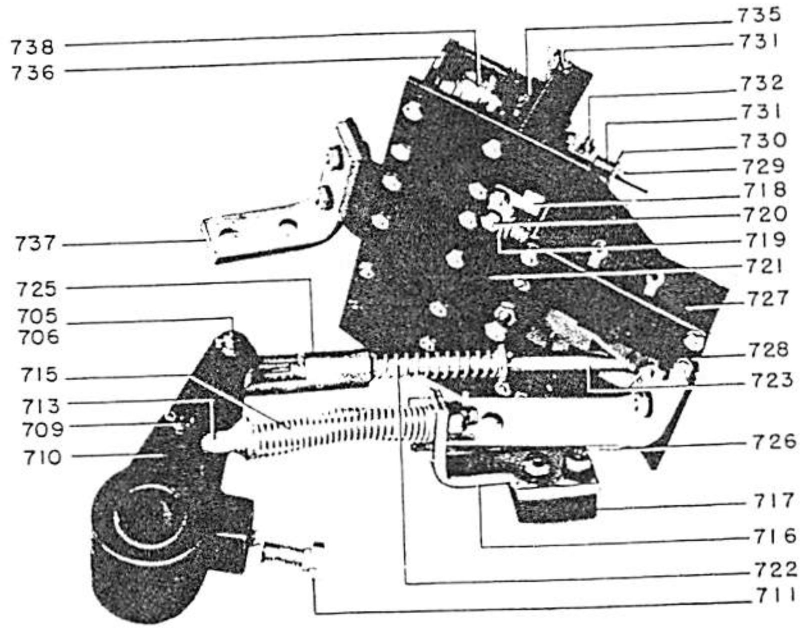


Fig. 37 Impact Trip Device (Ref. No. 702)

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	2	Pin
721	6477401 AA P-3	1	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	3	Angle
731	6049320	1	Felt washer
732	6557068 P-9	1	Pin
734	6076401 P-385	2	Pin
735	2236575	1	Guide
736	4905058 G-4	1	Coil frame
737	6443667	3	Bracket
738	6174599 G-2	1	Coil for current trip 3 Amp. a-c
738	6174599 G-6	1	Coil for capacitor trip 230v a-c
* 739	456A334 P-1		Rubber guard

* Not shown

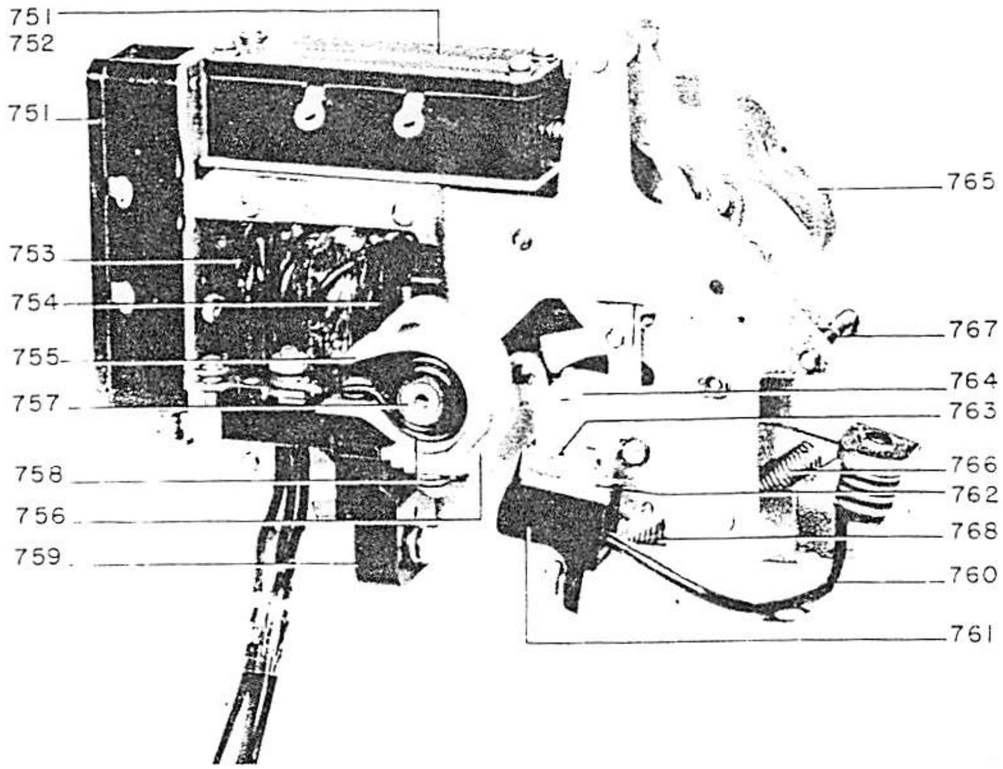


Fig. 38 (8011083)

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	295 ~~387~~B227 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

INSTRUCTIONS
AND
RENEWAL PARTS

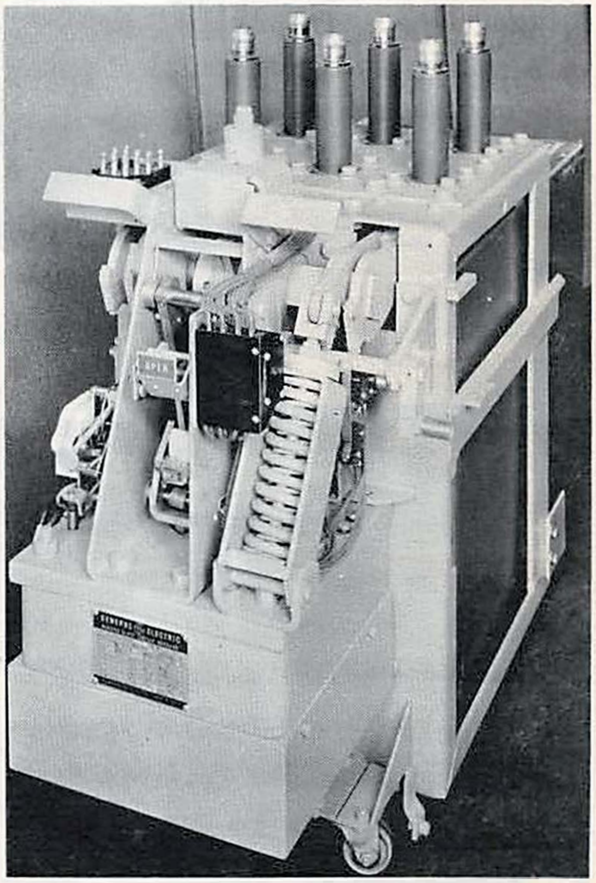
GEH-2054C
SUPERSEDES GEH-2054B

UNIT 4 4KV AUX POWER 4A&4B Bd

MAGNE-BLAST CIRCUIT BREAKERS

Types

AM 4.16-150A-4 and-4S
AM 4.16-250A-4 and-4S
AM 4.16-150H-4 and-4ML
AM 4.16-150H-4S and -4S ML
AM 4.16-250H-4 and -4ML
AM 4.16-250H-4S and -4S ML
with
Operating Mechanisms
ML-11 and MS-13



CONTENTS

MEDIUM VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

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)

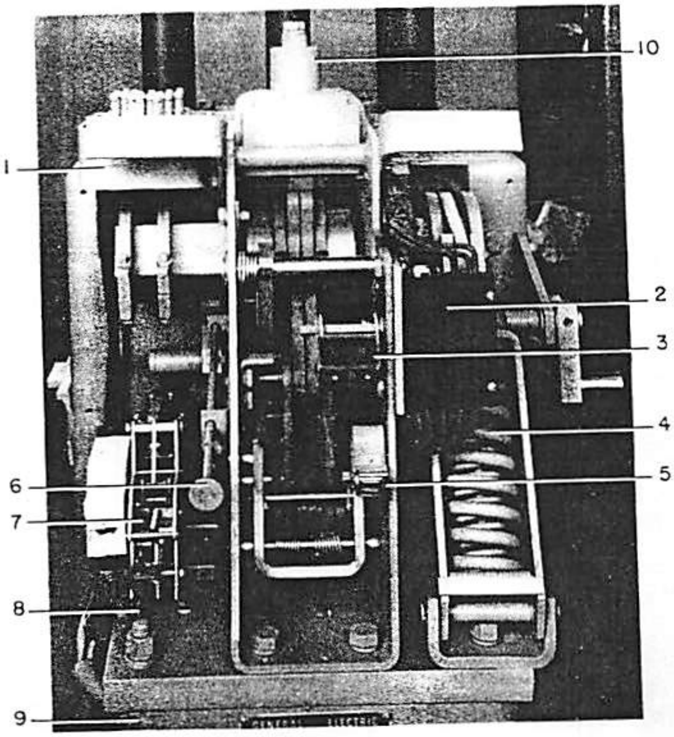
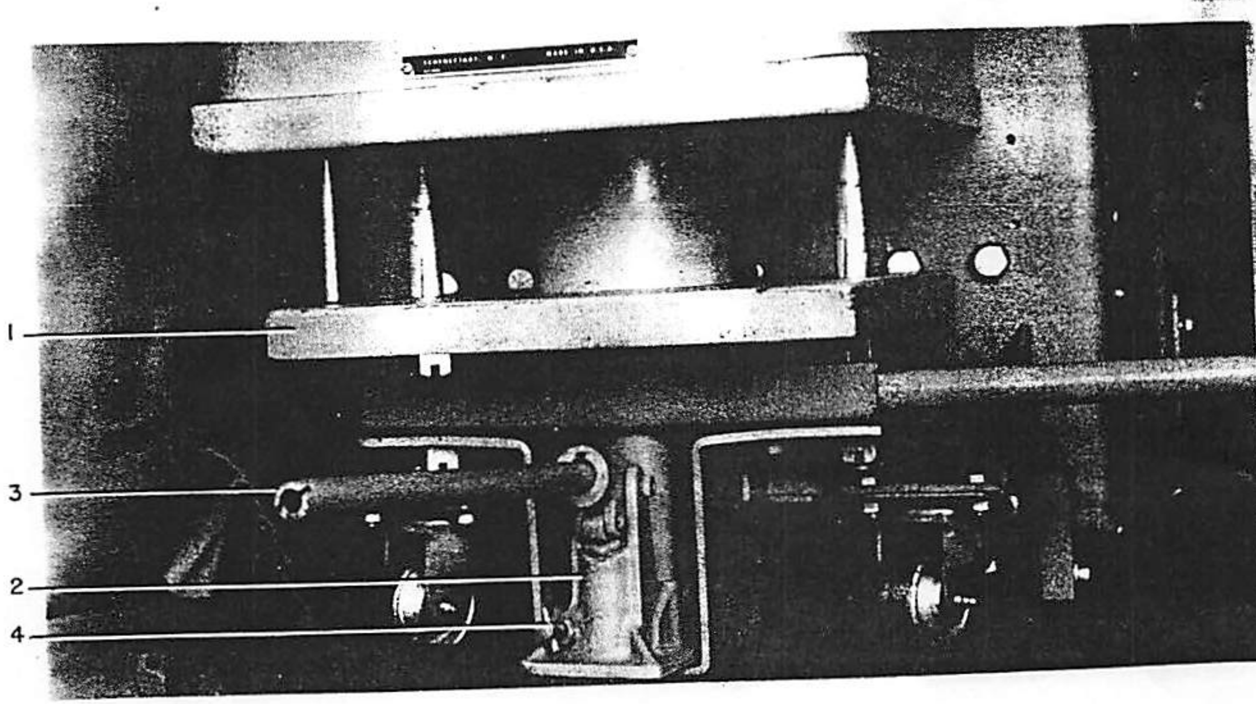


Fig. 1 MS-13 Operating Mechanism



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

Fig. 2 Method of Mounting Maintenance Operating Device

Cover (8022043)

Fig. 1 (8024599)

Fig. 2 (8020882)

MAGNE-BLAST CIRCUIT BREAKERS

TYPE AM 4.16-150A-4 TYPE AM 4.16-150H-4 AND -4ML

TYPE AM 4.16-250A-4 TYPE AM 4.16-250H-4 AND -4ML

INSTRUCTION BOOK GEI-50143 SUPPLEMENTS THIS BOOK FOR BREAKERS WITH ML-11 STORED ENERGY OPERATING MECHANISM (INDICATED BY ML SUBSCRIPT IN TYPE DESIGNATION).

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 information 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. 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. 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.

INSTALLATION

Remove box barrier and mechanism covers and make a visual inspection to ascertain that the breaker is in satisfactory condition. Check all bearing surfaces of the mechanism for lubrication. Refer to the section on LUBRICATION (page 12).

Operate breaker manually using the maintenance closing device provided with the breaker. During the closing operation, check to insure that the mechanism and breaker does not stick or bind during the entire stroke, that it latches securely in the closed position, and that it trips freely when the manual trip plunger is operated. The breaker should not be operated electrically until it has been operated manually to insure this freedom of action.

The following adjustments should be checked at this point.

a. Primary contact wipe (page 6).

b. Primary contact gap (page 6).

c. Prop clearance (page 9).

Attach test coupler to circuit breaker and operate electrically several times. The control voltage should be checked at the breaker as indicated under CONTROL POWER CHECK (page 10).

Remove test coupler, attach mechanism cover and replace box barrier.

If breaker has been stored for a long period of time, it is recommended that the insulation be checked with the standard 60 cycle high potential test -- see INSULATION TEST (page 12).

Lubricate the silver portion of the primary disconnect studs by rubbing a small amount of contact lubricant D50H47 to form a thin coating on the ball contact.

Refer to instruction book GEH-1802 for final instructions before inserting the breaker into the metal-clad unit.

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.

DESCRIPTION OF OPERATION

The magne-blast breaker is operated by either an MS-13 solenoid mechanism or ML-11 stored-energy 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.

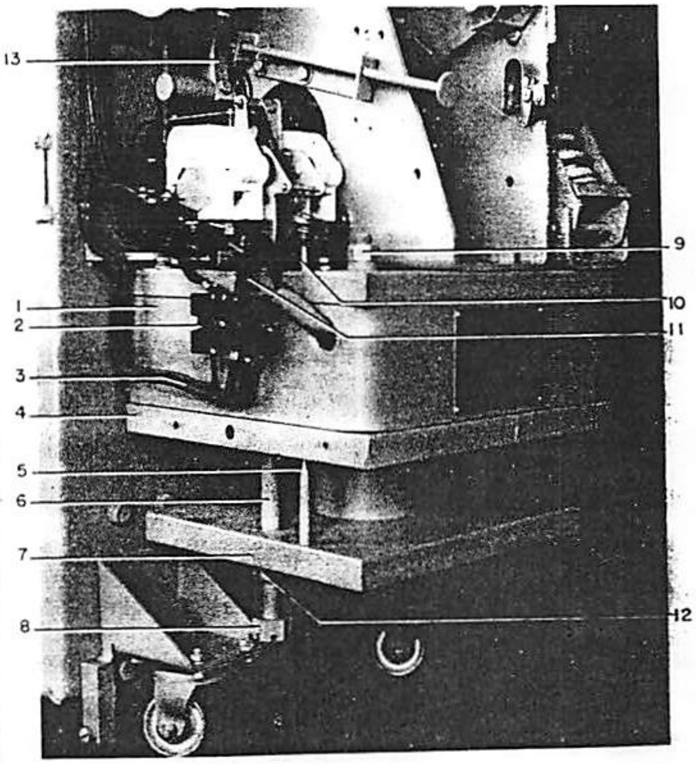
The MS-13 operating mechanism shown in Fig. 1 is of the solenoid type designed to give high speed closing and opening. The closing operation is controlled by the control device (7). The control device also permits trip free operation (tripping the breaker at any time during the closing operation), and prevents solenoid pumping (reclosing) after a trip free operation. For a-c 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 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: (AM 4.16-150A-4). The solenoid 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.

CLOSING OPERATION OF MS-13 SOLENOID OPERATED BREAKER

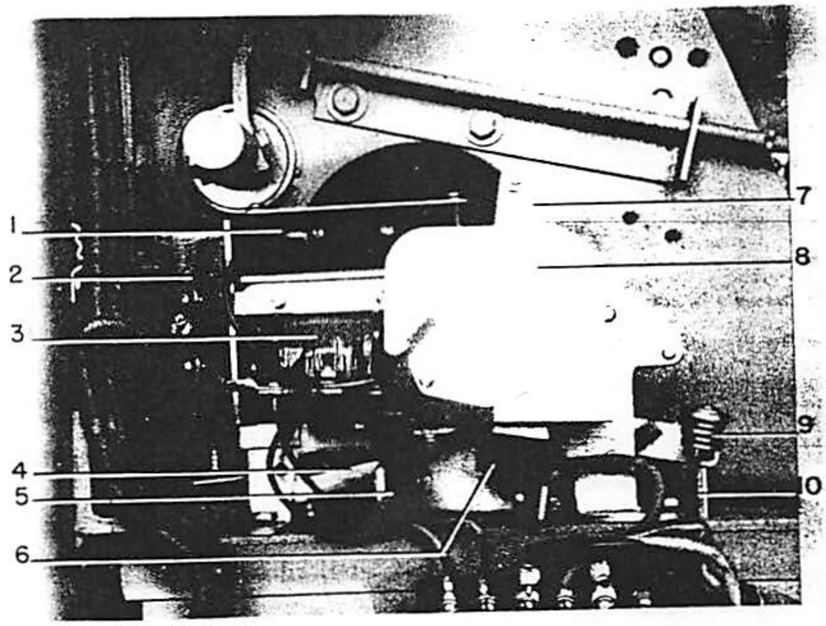
The closing operation of the (see GEI-50143 for description of ML-11 stored-energy mechanism operation) breaker is controlled by the control device, Fig. 4, mounted on the operating mechanism. The closing sequence is initiated from a control switch mounted on the door of the metal-clad unit or at a remote operating station. Operation of the closing control



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

Fig. 3 Closing Solenoid Assembly

Fig. 3 (8022045)



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. 4 Control Device

Fig. 4 (8024603)

itch energizes the pick-up coil of the ntrol device. As the control device oses, 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.

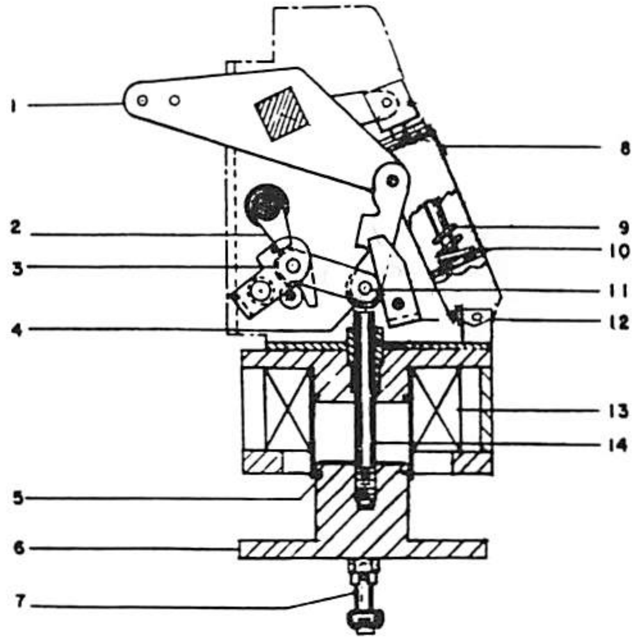
Operation of the control device energizes the breaker closing coil by closing the main control device contacts (5 and 6), Fig. 4. Once the control device contacts are picked up, they are electrically held in the closed position until the breaker closing operation is completed. Energizing the breaker closing coil raises the armature (6), Fig. 5 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. 3, mechanically trips the main control device contacts, de-energizing the closing coil and allowing the armature to return by gravity to its original position. he control device plunger also mechanical- trips the seal-in switch, de-energizing ne 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. 6) 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.

OPENING OPERATION

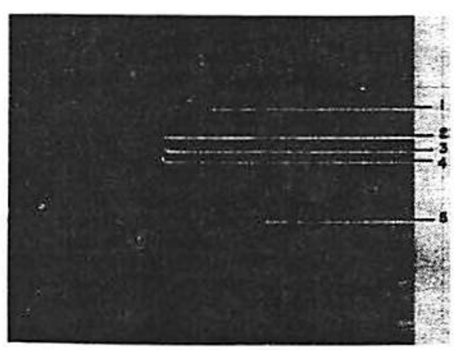
An electrical opening operation is initiated by energizing the trip coil. This is accomplished either by actuating the opening control switch on the metal-clad unit or by a combination of relays and current devices used to detect a fault on the load side of the breaker. By energizing the trip coil, the trip plunger rotates the trip latch (2), Fig. 5, causing the operating mechanism linkage to collapse. The energy stored in the opening springs (9 and 10) is thus released, opening the breaker. During his operation, the trip coil circuit is de- nergized, and upon completion of the openng operation, the operating mechanism is returned to its normal position, ready for closing.



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

Fig. 5 (374A293)



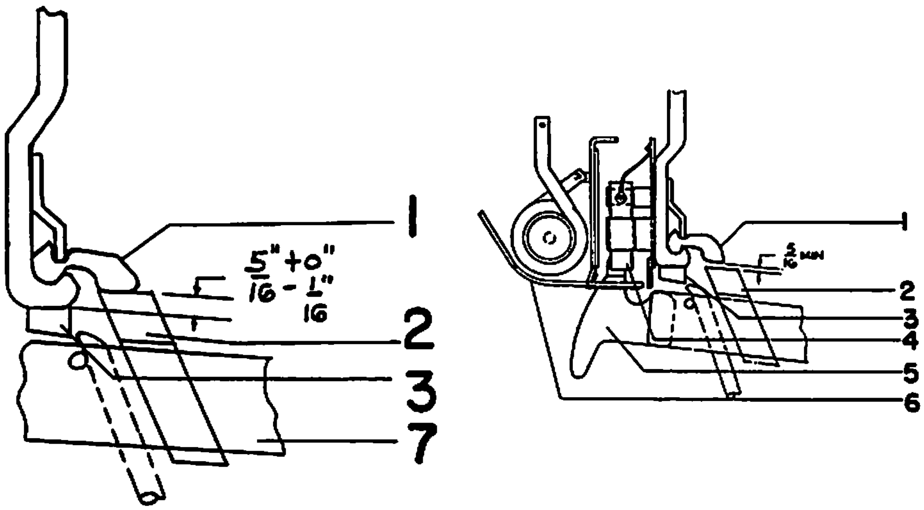
1. Cut-off Switch
2. Switch Roller
3. Striker
4. Washers
5. Lever Arm

Fig. 6 Cut-off Switch Adjustments

Fig. 6 (8021970)

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. 19. 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.

A 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.



Primary Contact Wipe

Arcing Contact Wipe

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

Fig. 7 Contact Adjustments

Fig.7 (258C688 & 836C143)

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.

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. 5, 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.

ADJUSTMENTS

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.

A maintenance operating device is provided for operation of the breaker during 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.

Adjustments should be checked during periodic inspections and whenever it becomes necessary to repair or replace parts that have become worn or defective while in service.

PRIMARY CONTACT WIPE

When the breaker is closed, as shown in Fig. 7, the stationary primary contacts should rise 5/16" + 0-1/16". To obtain this adjustment, open the breaker and, referring to Fig. 8, 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. 7) when the breaker is fully closed.

ARCING CONTACT WIPE

Refer to Fig. 7. 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 indicator 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 where applicable.

PRIMARY CONTACT GAP

Refer to Fig. 8. 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 contacts (6) should be 3-13/16" + 1/8" - 3/16". To change this gap, loosen the check nut (25), Fig. 9, 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).

3 5/16

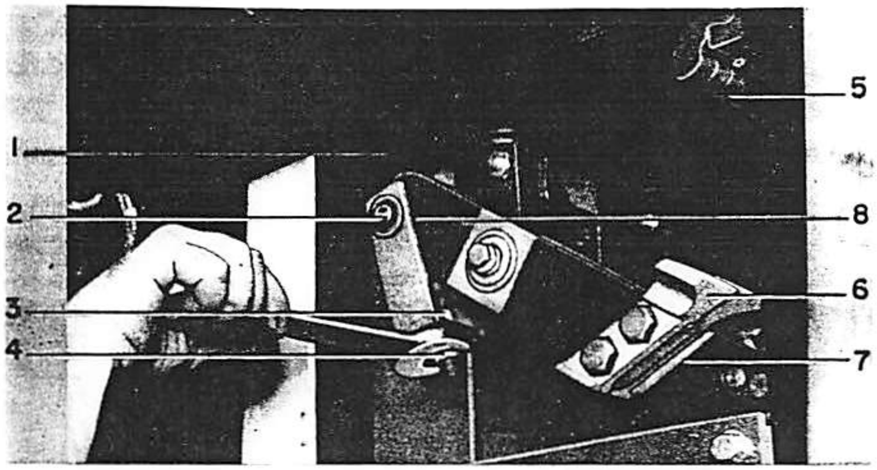
3 15/16

TRIP LATCH WIPE

Refer to Fig. 9. 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 trip latch stop (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.

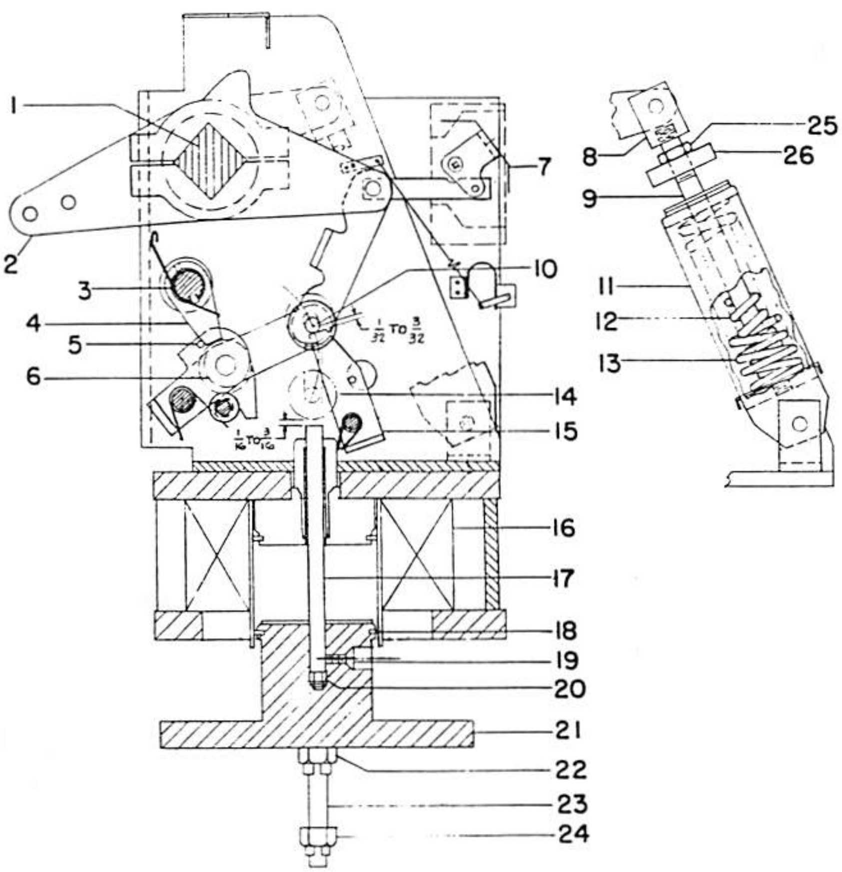
Fig. 8 (8018500)



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

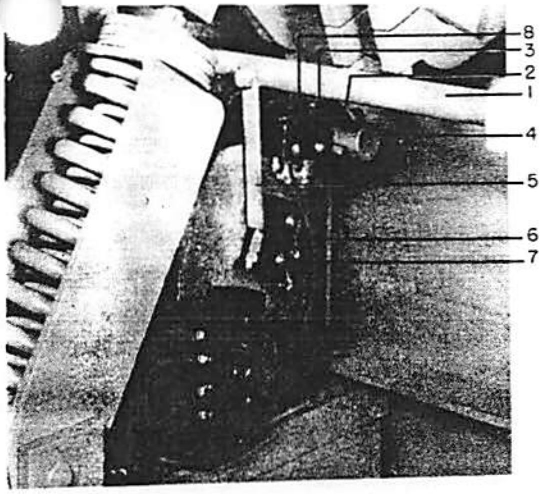
Fig. 8 Adjustable Coupling for Making Primary Contact Wipe Adjustment

Fig. 9 (258C688)



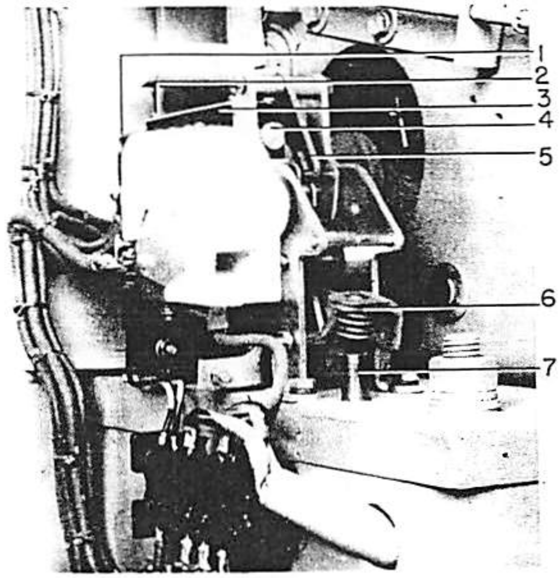
1. Main Operating Shaft
2. Main Crank
3. Trip Shaft
4. Trip Latch
5. Trip Latch Stop Pin
6. Trip Roller
7. Position Indicator
8. Clevis
9. Adjustable Stud
10. Closing Pin
11. Opening Spring Housing
12. Opening Spring, Inner
13. Opening Spring, Outer
14. Closing Roller
15. Prop
16. Closing Coil
17. Closing 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. 9 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
7. Mounting Screw
8. Mounting Screw

Fig. 10 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. 11 Control Device

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

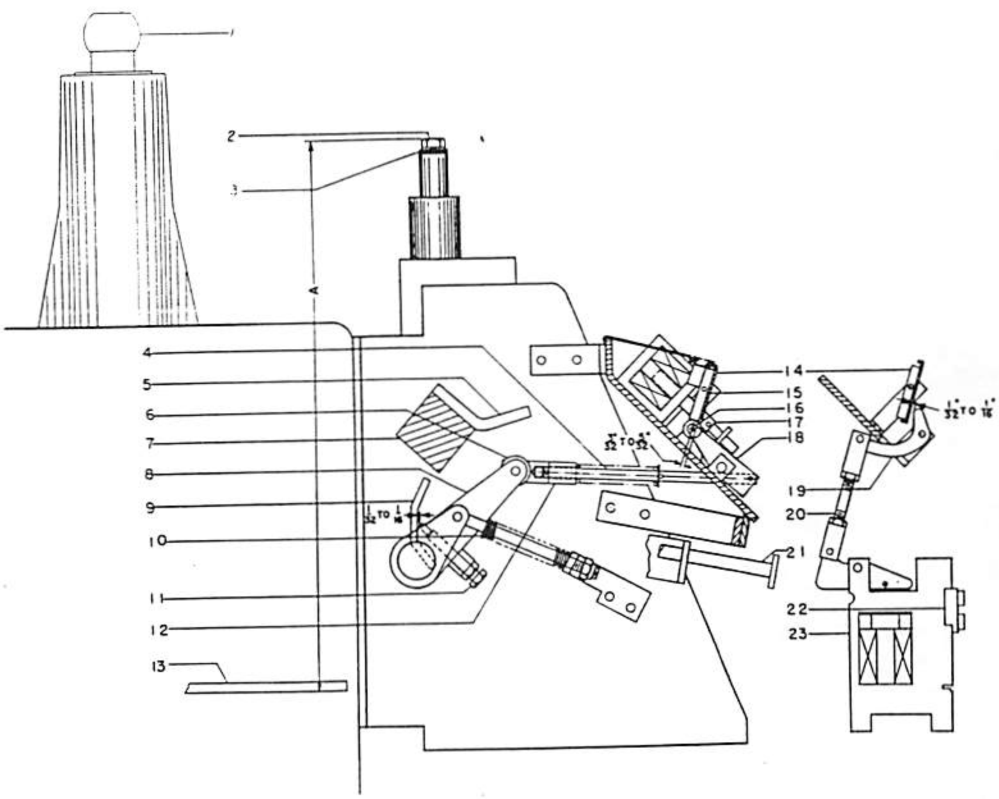


Fig. 12 Adjustments On Current Trip Device and Undervoltage Trip Device, Shown With The Breaker In The Closed Position

Fig. 10 (8024689)

Fig. 11 (8024593)

Fig. 12 (634D336)

PROP CLEARANCE

Refer to Fig. 9. 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 gauge 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. 9. 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 necesssary.

INTERLOCK SWITCH ADJUSTMENT

Referring to Fig. 10, 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. 11, measure the overtravel of the two auxiliary switch plungers. Manually operate the control device by pressing the operating arm (5) with 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-4, 250A-4)

Refer to Fig. 6. The lever 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 Adjustment

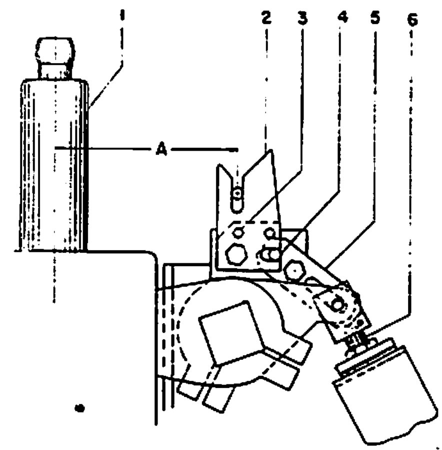
Referring to Fig. 10, rotate the trip shaft (4) manually clockwise to release the latch checking switch arm (2). The point at which the contacts make can be determined with a circuit continuity tester such as a light indicator or bell set. To obtain adjustment on the latch checking switch (3), bend the 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 and Undervoltage Trip Devices

Fig. 12 shows the necesssary 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.



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

Fig. 13 Auxiliary Switch Linkage

Fig. 13 (H-6291393)

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-4.16-150-4 and 250-4)

Refer to Fig. 12. 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-4 and 250A-4)

Refer to Fig. 13. 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 lever in the proper direction. Tighten the lock bolts.

INSPECTION AND TEST

For ease in reviewing the adjustments the following are recapitulated:

a. Primary contact wipe (Fig. 7): 5/16" + 0 - 1/16".

b. Arcing contact wipe (Fig. 7: 5/16" or greater (gap at primary contacts).

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

d. Trip latch wipe (Fig. 9): 3/16" to 1/4" with trip latch resting against stop pin.

e. Prop clearance (Fig. 9): 1/16" ± 1/32".

f. Closing plunger clearance (Fig. 9): 1/16" to 3/16".

g. Interlock switch overtravel (Fig. 10): 1/32" to 1/16".

h. Control device switch overtravel (Fig. 11): 1/32" min.

i. Cut-off switch overtravel (Fig. 6): 1/32" to 1/16".

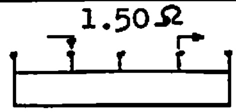
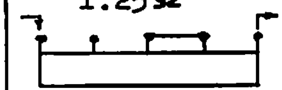
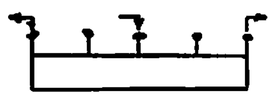
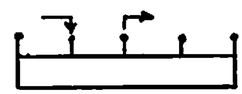
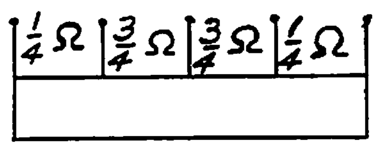
RECTIFIER REFERENCE CHART			
Closing Coil		Rectifier Resistor Setting	
Dwg. No.	Amps.	Germanium	Silicon
6375521G-6	58.0 to 62.0	1.50Ω 	1.25Ω 
6375521G-2	95.0 to 115.0	1.0Ω(ea.bridge) 	0.75Ω 
Resistor Taps 			

Fig. 14

j. Latch checking switch overtravel (Fig. 10): 1/16" to 1/32".

k. Impact trip roller wipe (Fig. 12): 1/8" ± 1/32".

l. Impact trip bolt clearance (Fig. 12): 3/64" ± 1/64".

m. Undervoltage trip hammer clearance (Fig. 12): 3/64" ± 1/64".

n. Plunger interlock (150-4 and 250-4) (Fig. 12): 15-19/32" ± 1/16".

o. Auxiliary switch linkage (150A-4 and 250A-4) (Fig. 13): 12-9/32".

AUXILIARY DEVICES

On breakers that are equipped with auxiliary devices such as a current trip, undervoltage 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.

OPENING AND CLOSING SPEED

The closing speed of the arcing contact should be 7 to 10 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 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.

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.

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 operating 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 125 v 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. 4. 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. 6. 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:

For D-c Operation

Check voltage at the source of power and line drop between the power source and breaker.

For A-c Operation (Fig. 14)

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.

The 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.

* 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.

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 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. Before the breaker is raised into position in the metal-clad unit, rub a small amount of G.E. Contact Lubricant D50H47 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.

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 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 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 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 bushings should be kept clean and unmarred. If the insulation surface should become damaged, it should be sanded, cleaned and refinished.

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.

I[illegible]ion Test

[illegible]hen insulation has been repaired or replaced or when the breaker has been stored under adverse conditions, 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.

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 [illegible]ng surfaces. A simple lubrication [illegible]often clear up minor disturbances [illegible]n 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. 15. 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. 15) 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.
Trip Shaft Dry Bearings	No lubrication required.	No lubrication required.

** D50H47 supersedes D50H28.

Fig. 15 Lubrication Chart

METHOD OF CLEANING BEARINGS

[illegible]Wherever cleaning is required, as in[illegible]ed 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. With a clean, dry cloth wipe all insulating parts including the bushings to clean off smoke deposit and dust. The inside of the box barrier should also be cleaned.

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 the 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 AND 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 2000 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 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 disassembled, inspected, cleaned and relubricated 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 2000 operations and properly adjusted before being put back into service.

TROUBLE SHOOTING

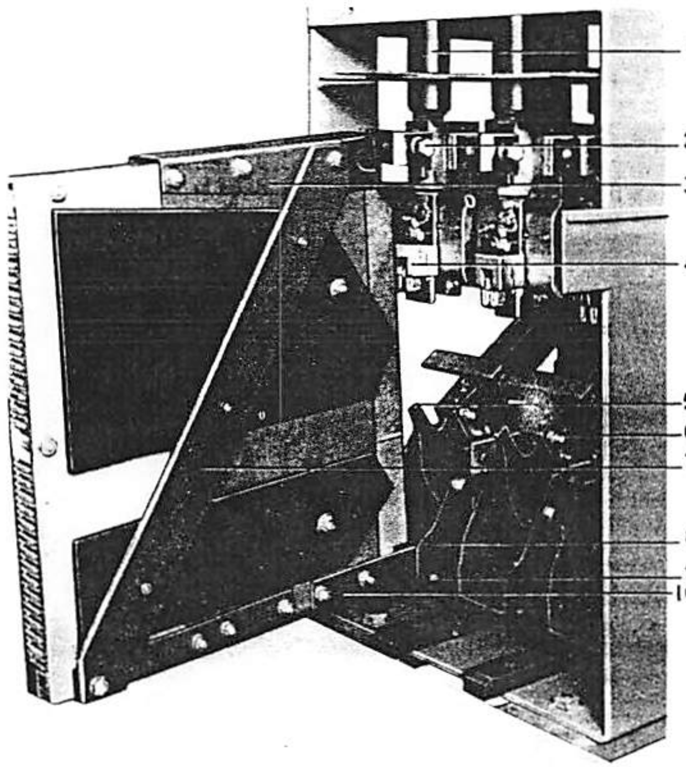
Failure of a breaker to operate properly will generally fall within three general classes: Failure to trip, failure to close or latch closed, and overheating. The following is a brief outline showing particular types of distress that might be encountered, together with suggestions for remedying the trouble:

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

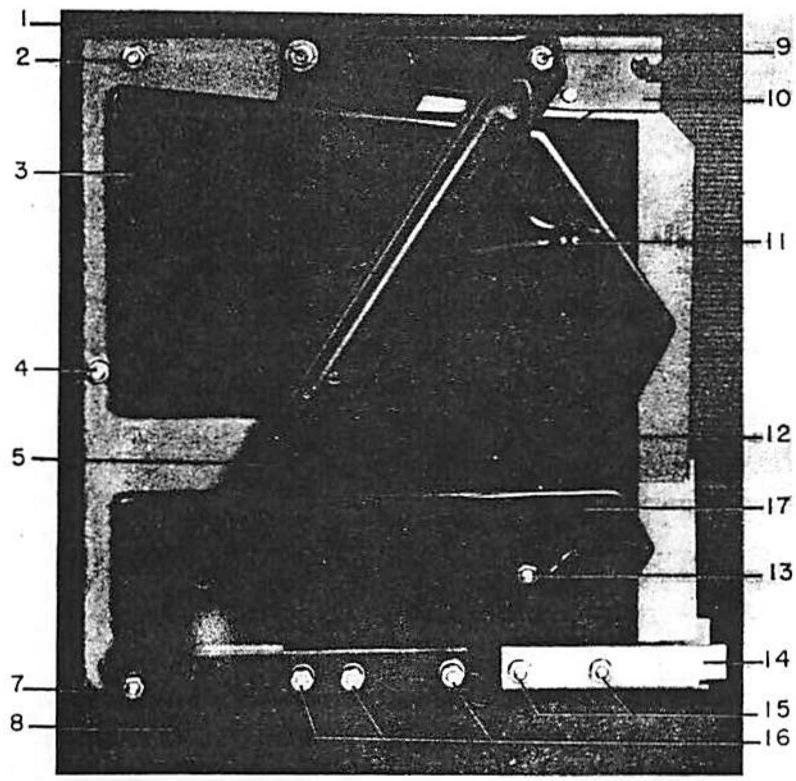
1. Mechanism binding or sticking caused by lack of lubrication.
   REMEDY: Lubricate complete mechanism.
2. Mechanism binding or sticking caused by being out of adjustment.
   REMEDY: Check all mechanism adjustments, latches, stops, auxiliary devices, etc., in accordance with INSTALLATION, ADJUSTMENTS. 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.



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. 16 (8019971)

Fig. 16 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. Assembly Bolt
10. Upper Mounting Support
11. Insulating Cap
12. Side Shield
13. Assembly Bolt
14. Lower Mounting Support
15. Assembly Bolts
16. Assembly Bolts
17. Lower Pole Piece

Fig. 17 (8025741)

Fig. 17 Arc Chute Assembly Complete

. 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.

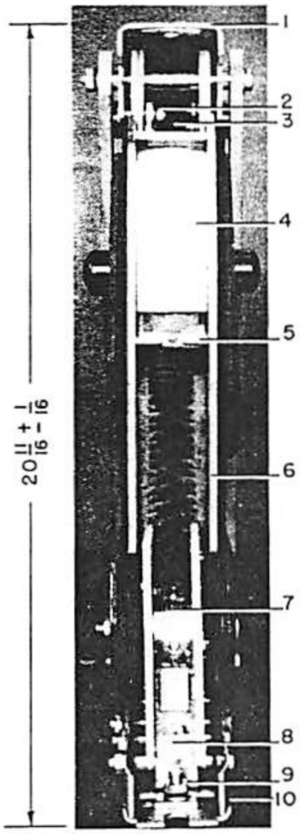
4. Overloading.
REMEDY: Replace breaker with one of adequate rating for present or future load, or re-arrange circuits so as to remove excess load.

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.

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

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 blown-out coils)

To remove an arc chute, first open the breaker and remove the box barrier (7), Fig. 19. Loosen the two upper supporting bolts (2), Fig. 16, and the one lower support 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. 16.

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

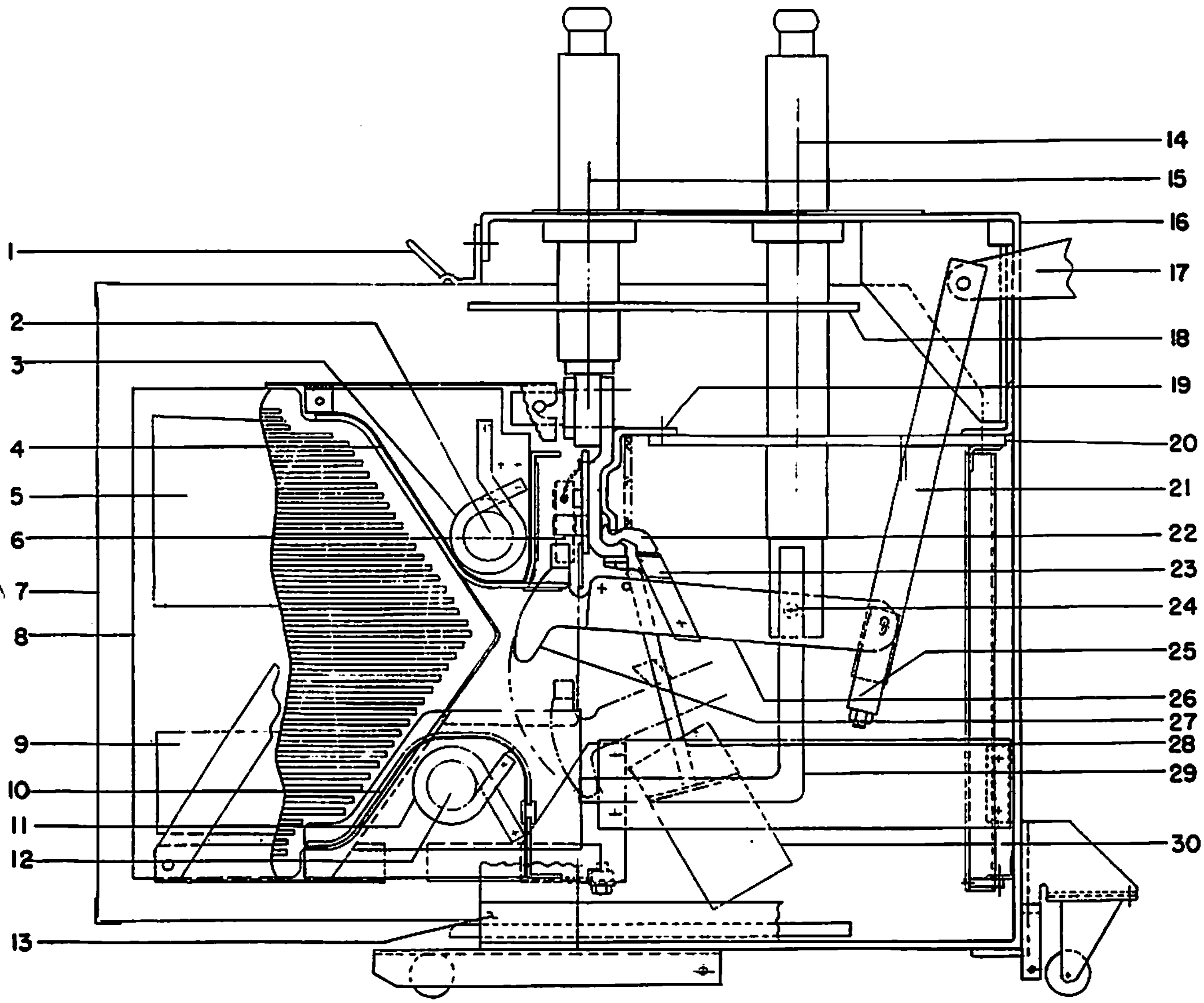
1. Remove the caps and assembly bolts (7, 9, 11 and 13), Fig. 17.
2. Remove the side brace (5) and pole pieces (3 and 17), Fig. 17.
3. To remove the upper mounting support (10), Fig. 17, remove the assembly bolt (1), Fig. 16 and connection bolt (2), Fig. 18.
4. Remove the assembly bolts (16), Fig. 17 to remove the lower brace (8).
5. Remove the lower mounting support (14), Fig. 17, 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. 22.
8. The arc chute sides, Fig. 22, can be separated by removal of assembly bolts (2 and 4), Fig. 17.

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

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 14), Fig. 22, 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 (8), Fig. 22, and the arc chute side (7) is a minimum.
5. Make certain that the electrical connections (2 and 9), Fig. 18 are tight.

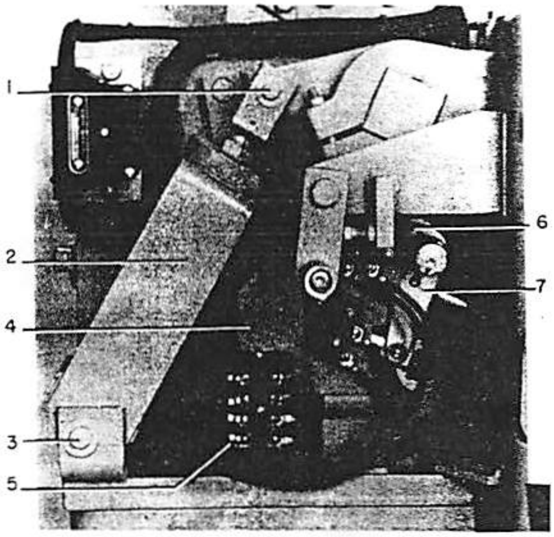
To reassemble the arc chute to the breaker proceed as follows:

1. Rest the lower mounting support (10) on the arc chute mounting bracket (8) as shown in Fig. 16.
2. Slide the arc chute forward and lift it slightly to engage the supporting bolts (2), Fig. 16, in the slots of the upper mounting support (3).
3. Tighten the supporting bolts (2 and 9), Fig. 16. These bolts serve as both the electrical and mechanical connections between the bushing and the arc runners.



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
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

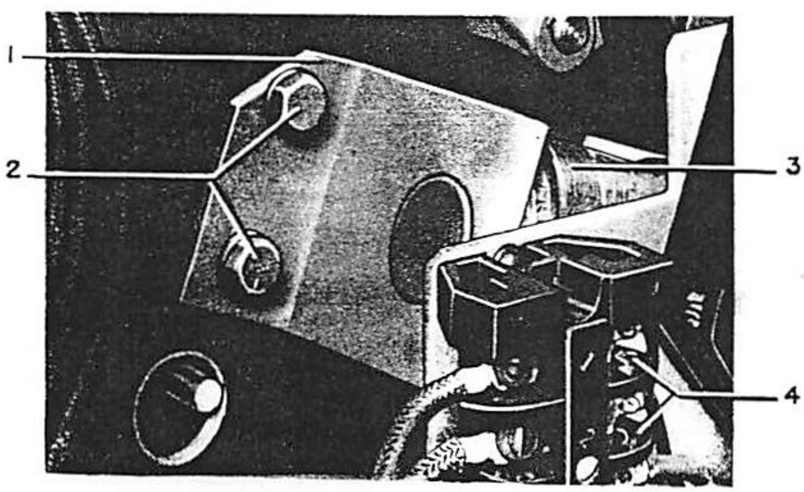
Fig. 19 Cross Section Of Breaker Pole Unit



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. 20 Opening Spring Assembly

Fig. 20 (8020728)



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

Fig. 21 Potential Trip Coil

Fig. 21 (8019962)

4. Check that the movable arcing contact (5), Fig. 7, passes through the slot in the upper arc runner (6) without touching.

Trip Shaft and Self Lubricating Bearings

1. Remove mechanism cover.

2. Remove mounting bolts for control device (7), Fig. 1, letting control device hang free. Do not remove wiring.

3. Remove the trip coil frame mounting bolts (2), Fig. 21, letting frame hang free. Also, remove trip coil leads (4) from terminal board (4), Fig. 21.

4. Remove the trip coil and plunger bracket (7), Fig. 20, from trip shaft using snap ring pliers on ring holding trip coil plunger assembly.

5. Remove switch bar (6), Fig. 20, from latch shaft and snap ring and washers near bearing.

6. Remove stop bar (13), Fig. 27, 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 and bearing housing 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:
#1 When removing the left hand bearing, brass rod as mentioned above may have to be bent in order to clear latch.

#2 The bearings are self-lubricating and do not need lubrication.

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.

Trip Latch Roller Bearing

1. Remove mechanism cover.

2. Remove mounting bolts on control device (7), Fig. 1, leaving control device hang free. Do not remove wiring.

3. Place block between manual trip rod (6), Fig. 1, 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, using snap ring pliers.

5. Slide trip roller pin 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 Contact (10) Fig. 23

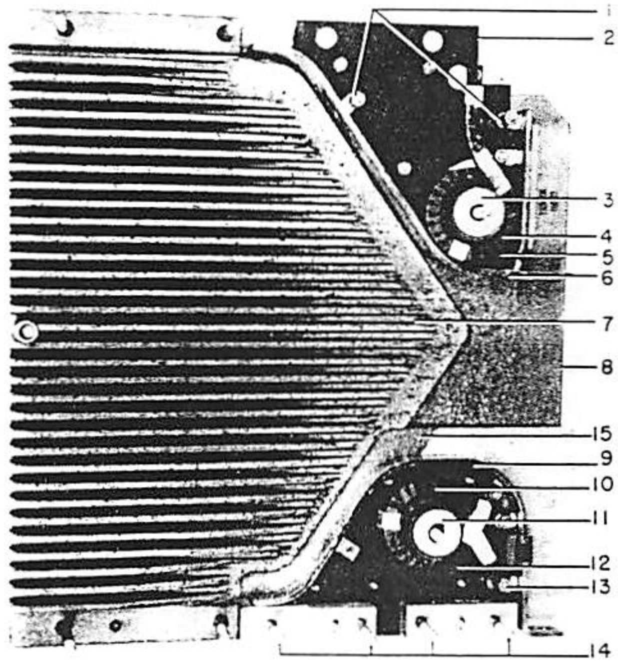
1. Disconnect the contact braids from contact fingers by removing two bolts (8), Fig. 23.
2. Grasp the lower end of the contact fingers with pliers and pull contact assembly downward to remove from stud assembly.
3. To disassemble braids from stud assembly, remove one bolt (5).
4. To disassemble stud assembly from contact support, remove two bolts (6).
5. Reassemble in the reverse order.

B. Stationary Primary Contacts (9), Fig. 24

1. Compress the contact spring (6).
2. Remove spring and spring guide (1).
3. Raise the contact finger to clear the primary contacts stop plate (8) and lift the finger out of contact support (7).

To replace the Stationary Primary Contacts:

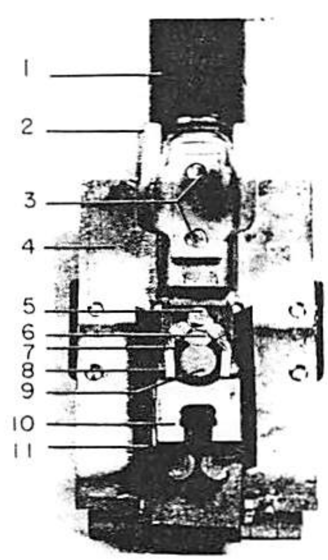
1. Apply a thin coating of D50H47 grease on the hinged end of the finger (9) then place it on contact support (7) so that it is retained by stop plate (8).
2. Open spring compressor (3) and assemble spring guide, spring and spring compressor (Fig. 24A).
3. Turn handle (2) in clockwise direction to compress contact spring (Fig. 24B). 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. 24C).



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
15. Lower Shield

Fig. 22 Arc Chute Assembly with Side Removed

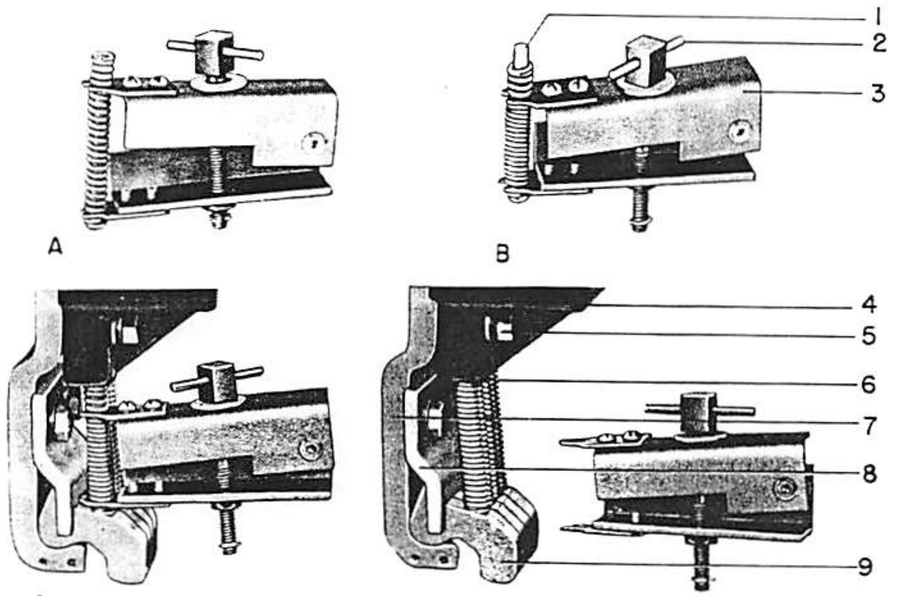
Fig. 22 (8024600)



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

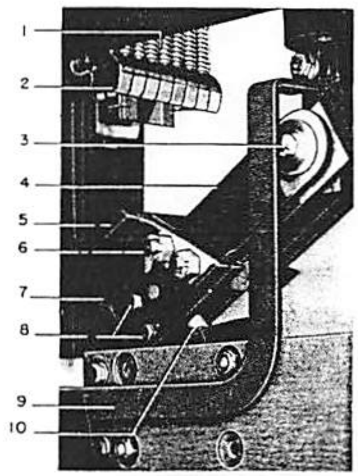
Fig. 23 Rear Bushing Assembly

Fig. 23 (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. 24 Method of Installing Primary Contact Springs Using a Spring Compressor



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. 25 Removal of Contacts

5. Hold spring asembly firmly in place and remove spring compressor.

C. Movable Arcing Contact (7), Fig. 25

1. Remove the assembly bolts (8).
2. Reassemble in reverse order.

D. Movable Primary Contacts (5), Fig. 25

(1200 Amp Breaker)

1. Remove the nuts from assembly bolts (6).
2. Remove the primary contacts (5) 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. 25

1. Remove the connection bar (9).
2. Remove the cup bearing (3), Fig. 25, and the pin (2) Fig. 8.
3. When reassembling, first insert the piston assembly (10), Fig. 25, into the booster cylinder and reassemble the cup bearing (3).
4. Replace pin (2), Fig. 8, and connection bar (9), Fig. 25.

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

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.

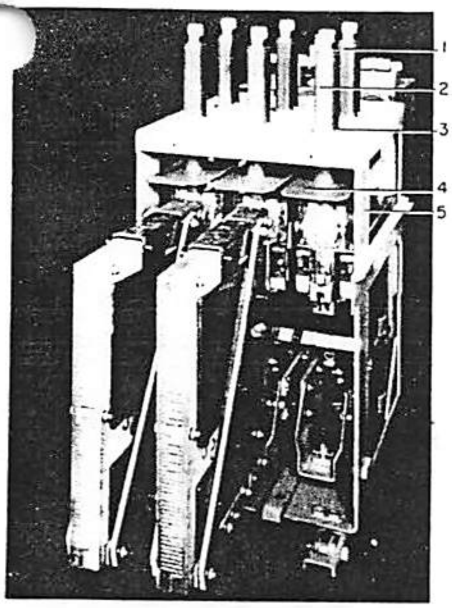
To replace the bushing, proceed as follows:

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. 26.
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. 24, disassemble the primary contact springs (6) as previsously described.
5. Disassemble the spring retainer (4) by removing mounting bolts (5).
6. Referring to Fig. 23, disassemble the contact support (4) and guide and support for arc chute (2) by removing two bolts (3).
7. Reassemble in the reverse order. The guide and support for arc chute (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.

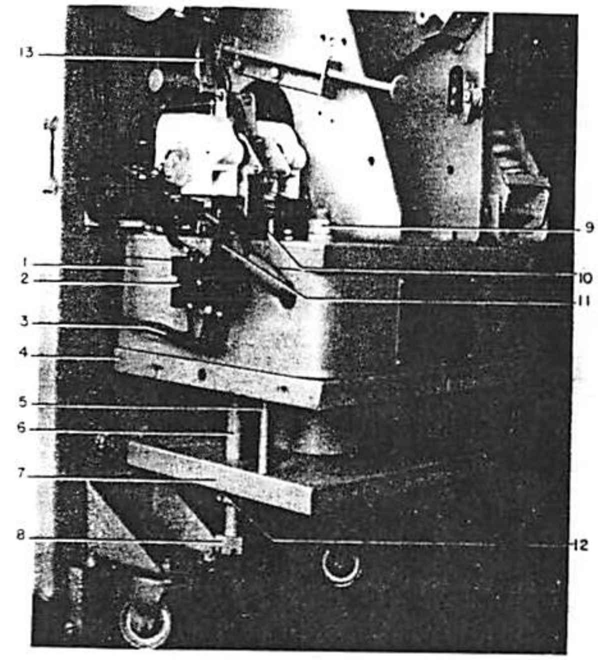
Front Bushing

1. Open the breaker and remove the box barrier and arc chutes as already described.



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

Fig. 26 Rear View of Breaker with One Arc Chute Removed



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

Fig. 27 Closing Solenoid Assembly

Fig. 26 (8022047)

Fig. 27 (8022045)

2. Remove the upper and lower horizontal barriers (4 and 5), Fig. 26.
3. Remove the connection bar (9), Fig. 25, and cup bearing (3).
4. Remove operating rod pin (2), Fig. 8.
5. Remove the four bolts at the mounting flange of the front bushing being removed, and lower the bushing.
6. When reassembling, first mount the bushing and assemble operating rod pin (2), Fig. 8, the cup bearing (3) and contact arm (4), Fig. 25. The contact surface at the hinge point of the contact blade and cup bearing should have a thin coating of D50H47 grease.
7. Check all contact adjustments as outlined under INSTALLATION, ADJUSTMENTS.

Closing Coil

The closing coil is contained within the solenoid pot (1), Fig. 27. 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 strap (3).
3. Remove the stop nuts (8 and 12) on guide studs (6), lower the armature (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 underside 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. 4, proceed as follows:

1. Open the breaker and remove the opening spring unit (2), Fig. 20, by removing the pivot pins (1 and 3).
2. Disconnect the two trip coil lead wires (4), Fig. 21.
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 (6), Fig. 10, remove the two mounting screws 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 (3), Fig. 10, (when furnished), remove the two mounting screws 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. 6, 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.

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

RATING IN MVA	RATING IN AMPS	CATALOG # FOR TYPE AM 4.16 (MVA)-4	NO. PER BREAKER	DESCRIPTION
ALL	ALL	619C444 G-5	3	Booster Cylinder
ALL	ALL	281B708 G-2	3	Operating Rod
ALL	ALL	414A116 P-2	3	Insulating Plate
ALL	ALL	414A117 P-1	6	Upper Runner Insulation Bottom
ALL	ALL	383A932 P-1	6	Lower Shield
ALL	ALL	258C616 P-9	6	Upper Runner Insulation
ALL	ALL	421711	6	Insulating Cap
ALL	ALL	407193	6	Washer
150, 150A	ALL	258C616 P-13	6	Lower Barrier
250, 250A	ALL	258C616 P-6	6	Lower Barrier
ALL	ALL	236C791 G-1	3	Flexible Conn. (Right)
ALL	ALL	236C791 G-4	3	Flexible Conn. (Left)
ALL	ALL	236C790 G-5	3	Stationary Arcing Contact Assembly
ALL	ALL	414A116 P-4	3	Insulating Plate
ALL	ALL	6445087 P-1	3	Buffer
150A	600	414A180	12	Primary Contact Finger Spring
150, 150A	1200	414A180	12	Primary Contact Finger Spring
250, 250A	1200	121A5964	12	Primary Contact Finger Spring
ALL	2000	6509787 P-1	24	Primary Contact Finger Spring
150A	600	236C791 P-8	12	Primary Contact Finger
ALL	1200	236C791 P-8	12	Primary Contact Finger
ALL	2000	236C791 P-8	24	Primary Contact Finger
150A	600	6557243 P-1	6	Clamp For Buffer
ALL	1200	6557243 P-1	6	Clamp For Buffer
ALL	2000	6557243 P-2	6	Clamp For Buffer
ALL	ALL	802B742 G-1	3	Movable Arcing Contact
150A	600	K-6591644 P-7	3	Movable Primary Contact
ALL	1200	K-6591644 P-7	3	Movable Primary Contact
ALL	2000	K-6591644 P-7	6	Movable Primary Contact
150A	600	K-6591644 P-8	3	Movable Primary Contact
ALL	1200	K-6591644 P-8	3	Movable Primary Contact
ALL	2000	K-6591644 P-8	6	Movable Primary Contact
ALL	ALL	456A864 P-26	1	Capacitor
ALL	ALL	6375521 G-2	1	Closing coil (125v d-c)
150, 150A	ALL	6375521 G-6	1	Closing coil (125v d-c)
ALL	ALL	6375521 G-1	1	Closing coil (250v d-c)
150, 150A	ALL	6375521 G-5	1	Closing coil (250v d-c)
ALL	ALL	6174582 G-1	1	Potential trip coil (125v d-c)
ALL	ALL	6174582 G-2	1	Potential trip coil (250v d-c)
ALL	ALL	6174582 G-14	1	Potential trip coil (230v a-c)
ALL	ALL	6275070 G-1	1	Potential trip coil (24v d-c)
ALL	ALL	6275070 G-2	1	Potential trip coil (48v d-c)
ALL	ALL	6275017 G-19	1	UVD Coil (125v d-c)
ALL	ALL	6275017 G-20	1	UVD Coil (250v d-c)
ALL	ALL	6275017 G-33	1	UVD Coil (230v a-c)
ALL	ALL	6174599 G-2	3	Current trip coil (3 Amp. a-c)
ALL	ALL	6174599 G-6	1	Capacitor trip coil (230v a-c)
ALL	ALL	6275017 G-19	1	Control device coil (125v d-c)
ALL	ALL	6275017 G-20	1	Control device coil (250v d-c)
ALL	ALL	6275017 G-33	1	Control device coil (230v a-c) (continuous)
ALL	ALL	6275017 G-34	1	Control device coil (230v a-c) (intermittent)

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INSTRUCTIONS
AND
RENEWAL PARTS

GEI-88761E
SUPERSEDES GEI-8876[illegible]

MAGNE-BLAST CIRCUIT BREAKER

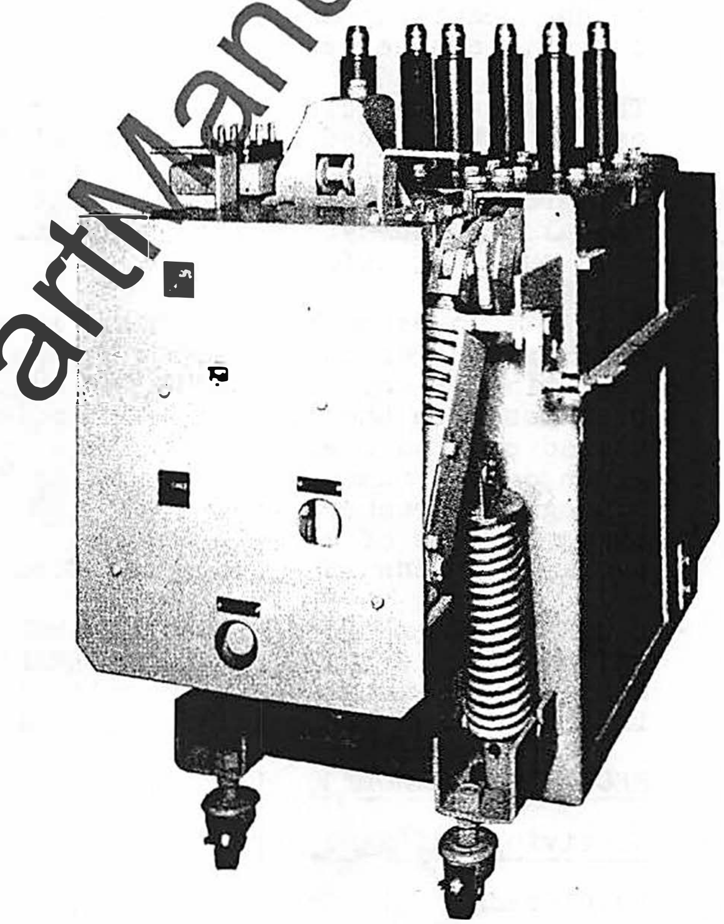
TYPES

AM-4.16-250-6C

AM-4.16-250-6H

AM-4.16-250-7C

AM-4.16-250-7H



CONTENTS

SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

MAGNE-BLAST CIRCUIT BREAKER

AM-4.16-250-6 (△)
AM-4.16-250-7 (△)

△ Letter Designation -B,C, and H, used immediately following the model number indicates basic design features.

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 maneuverability, 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. A sturdy, reliable operating mechanism assures low maintenance and long life.

The AM-4.16 magne-blast breaker is available in a number of current 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 information 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

> 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.

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. 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.

INSTALLATION

1. Remove the box barrier and front cover and make a visual inspection to ascertain that the breaker and mechanism is in satisfactory condition. Check all bearing surfaces of the mechanism for lubrication. Refer to section on Lubrication (page 14)

2. Charge the breaker closing springs manually using a 5/8" ratchet wrench to turn the driving eccentric (6) Fig. (4). Turning the eccentric counter clockwise will advance the ratcher wheel and compress the springs.

   When the springs have reached the fully charged position the indicator (10) Fig. (4) will read "CHARGED", and the driving pawl will be raised from the ratchet wheel teeth. Additional turning of the eccentric will not advance the ratchet wheel.

Insert the spring blocking device (4) Fig. (4) and manually discharge the springs against the pins by pushing the manual release button (1) Fig. (4). The springs are now blocked and slow closing of the breaker contacts can be accomplished by again turning the driving eccentric with a 5/8 ratchet wrench.

During the slow closing operation check to insure that the mechanism does not stick or bind during the entire stroke, that it latches securely in the closed position, and that it trips freely when the manual trip lever is operated. The breaker should not be operated electrically until it has been operated several times manually to insure freedom of action. At this time, also check the following adjustments:

a. Primary contact wipe (Refer to page 7)
b. Arcing contact wipe (Refer to page 7)
c. Primary contact gap (Refer to page 7)

"DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS PRECAUTION IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING."

After the adjustments have been checked, the springs can be unblocked. Rotate the driving eccentric until the indicator reads "CHARGED" and the ratchet wheel no longer is advanced. The blocking device can now be removed.

3. Attach test coupler to circuit breaker and operate electrically several times. Check the control voltage as described under "CONTROL POWER CHECK".

   NOTE: If the breaker secondary wiring is to be given a hi-potential test at 1500 volts, remove both the motor leads from the terminal connection. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

4. Remove the test coupler and replace box barrier.

5. If breaker has been stored for a long period of time, it is recommended that the insulation be checked with a standard 60 cycle high potential test. Refer to Insulation Test (page 13).

6. Lubricate the silver portion of the primary disconnect studs by rubbing a small amount of contact lubricant D50H47 to form a thin coating on the ball contact.

7. Refer to metal-clad instruction book GEH-1802 for final instructions before inserting the breaker into the metal-clad unit.

DESCRIPTION OF OPERATION

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 ML-13 operating mechanism shown in Figures 1, 2, and 3 is of the stored energy type designed to give high speed closing and opening. The mechanism will operate on a-c or d-c voltage as indicated on the breaker name plate. Closing and opening operations are controlled electrically by the metal-clad or remote relaying, and mechanically by the manual close and trip levers on the breaker. All secondary connections from the breaker to the metal-clad unit are made through the coupler (1) Fig. (1).

A positive interlock (2) Fig. (3) and interlock switch (2) Fig. (1) are provided between the breaker and metal-clad unit to prevent raising or lowering of the breaker in the unit while in a closed position and to prevent a closing operation when the breaker is not in either the fully raised or lowered position. A plunger can also be provided to operate an additional auxiliary switch mounted in the metal-clad unit.

When the breaker is interchangeable with MS-13 solenoid operated breakers in M-26 metal-clad units, motor circuit fuses are mounted on the breaker for protection. These breakers are identified by the "C" suffix in the breaker nomenclature.

In case when breakers with ML-13 operating mechanisms must match and line up with breakers having ML-11 mechanisms the spring charging circuit should be fused with Buss Company Fusetrons as follows:'

Control Voltage	Fuse Size	Cat. No.
48v - d-c	10A	FRN 10
110v - d-c	4A	FRN 4
125v - d-c	4A	FRN 4
115v - a-c	4A	FRN 4
220v - d-c	2.5A	FRN 2.5
250v - d-c	2.5A	FRN 2.5
230v - a-c	2.5A	FRN 2.5

Spring Charging

The mechanism consists of a high speed gear motor that compresses a set of closing springs through the action of a simple eccentric, ratchet, and pawl assembly. The rotary action of the motor (2) Fig. (4) is converted to a short straight stroke pumping action through the eccentric (3) and a lever that carries a spring loaded driving pawl (5).

The pawl advances the ratchet wheel (3) Fig. (3) only a few degrees each stroke where it is held in position by the latching pawls (5). When the ratchet wheel has been rotated approximately 180 degrees the closing springs (6) will be fully compressed. As the ratchet wheel continues to rotate, the spring load will shift over center and attempt to discharge. After only a few degrees of rotation, the closing roller (10) Fig. (1) will engage the closing latch (11) and the compressed springs will be held in repose until a closing operation is required. During the last few degrees of the ratchet wheel rotation the motor and interlock switches (6) are released and the driving pawl is raised from the ratchet wheel surface. This allows the motor and driving mechanism to coast to a natural stop expending all residual energy.

During the time the springs are being compressed a relay (6) Fig. (6) locks the closing power circuits open and the relay will remain energized until the springs are fully charged and the control contacts are re-set.

The closing springs may be charged manually if control voltage is lost. A 5/8" ratchet wrench can be used to rotate the eccentric in a counter clockwise direction until the indicator reads "CHARGED" and the driving pawl no longer engages the ratchet wheel. The use of the ratchet wrench provides for maximum safety in the event that control power is suddenly restored without warning. In this event, the motor drive will take over again and continues to charge the springs.

Closing Operation

Closing the breaker is accomplished by energizing the closing solenoid or by manually pressing the close button. In either case, the closing latch is removed from the spring blocking location allowing the springs to discharge. The energy of the springs is applied to the rotation of a cam (16) Fig. (5) that closes the breaker through a simple linkage that remains trip free at all times. A monitoring switch (11) Fig. (6) on the closing latch will start the spring charging motor after it is fully reset.

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 (7), Fig. (5), causing the operating mechanism linkage to collapse. The energy stored in the opening springs is thus released, opening the breaker. During this operation, the trip coil circuit is deenergized, 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. (7). As the movable arcing contact (27) is withdrawn through the slot or between the arcing probes on 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 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 reestablish itself, and interruption occurs.

Manual tripping follows the same procedure except that instead of energizing the trip circuit, the manual trip (11), Fig. (2) is used.

Trip Free Operation

If the trip coil circuit is energized while the breaker is closing, the trip plunger will force the trip latch (8) Fig. (5) away from the trip roller (9) causing the mechanism linkage to collapse and the breaker to re-open. The closing cam (16) will complete its closing stroke and the springs will re-charge as in a normal closing operation.

ADJUSTMENTS

All adjustments should be checked 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 barriers and front cover.

"DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING."

Primary Contact Wipe

When the breaker is closed, as shown in Fig. (8), the stationary primary contacts (1) should rise 5/16" + 0 - 1/16". Before checking this dimension be sure the mechanism is re-set so that the prop pin (13) Fig. (5) is resting on the prop. To obtain the proper contact adjustment, open the breaker and, referring to Fig. (9), 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 (6) and the buffer block should be 1/16" or greater (as shown in Fig. 8) when the breaker is fully closed.

Arcing Contact Wipe

Refer to Fig. (8). 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 indicator 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 between the slots or the arcing probes on the upper arc runner without touching, whichever is applicable.

Primary Contact Gap

Refer to Fig. (9). 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 (17), Fig. (5) and turn the adjusting nut (18) on stud (19). 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. [illegible]. The wipe of the trip latch (8) on the trip roller (9) should be from 3/16" to 1/4". This can be measured by putting a film of grease on the latch (8), closing the breaker part way, and tripping. The mechanism has the proper trip latch wipe when the latch rests against the stop pin (23). 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 (7).

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

Trip Latch Clearance

Refer to Fig. (5). With the breaker in the tripped position and the closing springs charged, check the clearance between the trip latch (8) and the trip roller (9). It should measure 1/32" to 1/16".

Prop Clearance

Refer to Fig. (5). With the breaker closed as far as possible, that is, with the springs blocked and the cam (16) rotated so that the prop pin (13) is at its maximum height over the prop (14), the clearance between the prop and prop pin should be 1/16" to 5/32". No adjustment is provided and a visual inspection is usually all that is required.

Release Latch Wipe

Refer to Fig. (6). The wipe between the release latch (3) and roller (2) should be 3/16" to 1/4". If re-setting is required, loosen, set, and re-tighten adjustment nut and screw (4).

Release Latch Monitoring Switch

The release latch must be fully re-set and the monitoring switch operated before the motor will start. The switch should be wiped by the striker so that the clearance between the striker and switch mounting bracket (20) Fig. (6) is 1/32" or less. To obtain this adjustment bend the switch striker. Be sure the latch is fully re-set before making any adjustments.

Motor and Relay Switches

With the closing springs blocked rotate the switch cam (1) Fig. (6) until the switch striker (8) has traveled the maximum amount (about 180 degrees rotation of cam). Loosen mounting bolt (14) and rotate switch support (15) until the gap between the striker (8) and support (15) is 1/32" or less.

Interlock Switch Wipe

Refer to Fig. (10). Rotate the interlock shaft (1) manually clockwise to release the interlock 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 interlock switch (3), bend the interlock switch arm (2) until there is a maximum of 1/32" clearance to the switch mounting plate (4).

Auxiliary Switch

The auxiliary switch (9), Fig. (11) is mounted on the left side of the operating mechanism. The shaft of the position indicator (8) operates the auxiliary switch shaft which opens and closes the "a" and "b" contacts. The "a" contacts are open when the breaker is open and the "b" contacts are open when the breaker is closed. The "a" contacts should close when the breaker primary contact gap is a minimum of 1". The "b" contacts need only to be checked to see that they are open when the breaker is closed. No adjustment is provided and a visual inspection is usually all that is required.

Driving Pawl Adjustment

The driving pawl (5) Fig. (4) must advance the ratchet wheel (3) Fig. (3) sufficiently on each stroke to allow the latching pawls (1) to fall into the ratchet teeth. This should be checked with the maximum closing spring load against the driving members. With the mechanism unblocked, hand charge the closing springs with the manual charging wrench until they are slightly more than half charged. Slowly rotate the charging wrench until the driving pawl (5) Fig. 4 has traveled through its return stroke and check the maximum clearance between the pawl and the ratchet tooth. Rotate the charging wrench until the driving pawl has advanced the ratched tooth to its maximum travel. Now check the clearance between the ratchet tooth and the latching pawl (1) Fig. (3). The clearance should be approximately equal for both the driving and latching pawls and not less than .015" in either case.

If adjustment is required for either pawl the springs must first be fully charged and blocked. Loosen seven motor support bolts (1) Fig. (15) and move entire motor assembly to the rear if the clearance is under the minimum at the latching pawls, and to the front if the clearance is under the minimum at the driving pawl. Move the motor assembly approximately twice the dimensional increase required at the pawl. Be certain the motor assembly is moved straight forward or rearward and tighten the one bolt on the right side of the mounting frome first to assure proper alignment. After tightening the remaining bolts the springs should be released and the clearance again checked as described above.

AUXILIARY DEVICES

Latch Checking Switch

Refer to Fig. (12). Rotate the trip latch (4) clockwise (looking at the left side of the mechanism) by pressing the manual trip lever to open the latch checking switch operating arm (3). Allow the trip latch to reset slowly and determine the point at which the contacts make by using a circuit continuity tester, such as a light indicator or bell set. The contacts of the latch checking switch should just make when the gap between the trip latch (4) and the stop pin (5) located on the crank (7) is 1/16". There should be a minimum of 1/64" between the operating arm (3) Fig. (12) and the switch support (1). To obtain adjustment of the latch checking switch (2) bend the latch checking switch operating arm (3).

Plunger Interlock

Refer to Fig. (13). With the breaker in the closed position, the vertical distance "A" from the top of the interlock bolt (1) to the bottom of the elevating bar (3) should be 16-21/32" plus or minus 1/16". To change this adjustment, add or remove washers (2).

Spring Release Interlock

A spring release interlock shown in Fig. (14) will assure that the breaker contacts are open and the closing springs discharged when inserting or removing the breaker from the metal-clad unit. If the closing springs are charged and/or the breaker is in the closed position when being inserted or withdrawn from the metal-clad unit, the release interlock will trip the breaker open and hold the mechanism in a trip-free position while discharging the closing springs.

Auxiliary Fuses

Refer to Fig. (15). On breakers with "C" suffix, a set of protecting fuses (4) are mounted on the front of the breaker. These fuses will be the primary protection devices for the closing control circuits on those breakers that are used in metal-clad units designed for solenoid operated breakers.

Inspection and Test

1. For ease in reviewing the adjustments, the following are recapitulated:
   a. Primary contact wipe: 5/16" + 0 - 1/16".
   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. Trip latch clearance: 1/32" to 1/16".
   f. Prop clearance: 1/16" to 3/32".
   g. Release latch wipe: 3/16" to 1/4".
   h. Release latch monitoring switch: maximum clearance 1/32".
   i. Motor and relay switch: maximum clearance 1/32".
   j. Interlock switch: maximum clearance 1/32".
   k. Auxiliary switch "a" contacts close when breaker primary contact gap is 1" or greater.
   l. Driving and Latching Pawl: minimum clearance to ratchet teeth .015".
   m. Latch checking switch contacts make when the gap between the trip latch and the stop pin is 1/16".
   n. Plunger interlock: 16-21/32" plus or minus 1/16" with breaker closed.

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 manual charging wrench 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 is repainted immediately.

7. Check the trip coil plunger and the release coil plunger to see that they move freely.

Opening and Closing Speeds

The closing speed of the arcing contact of the breaker should be a minimum of 11 feet per second. This represents the average speed of the movable arcing contact from a point 1" before the tip is tangent to the lower surface of the slot or probes on the upper arc runner to the tangent position.

The opening speed of the arcing contact should be a minimum of 12 feet per second. This represents the average speed over 3" from the point when the tip on the movable contact is tangent to the lower surface of the slot or probes on the upper runner.

Control Power Check

After the mechanism has been closed and opened slowly several times with the maintenance closing wrench and the mechanism adjustments are checked as described, the operating voltages should be checked at the release coil, trip coil, and motor terminals. For electrical operation of the mechanism, 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. The following ranges are standard:

Nominal Voltage	Closing Range			Tripping Range		
	Min.		Max.	Min.		Max.
48v d-c	34	-	50v d-c	28	-	60v d-c
110v d-c	90	-	115v d-c	60	-	125v d-c
125v d-c	90	-	130v d-c	70	-	140v d-c
220v d-c	160	-	230v d-c	120	-	250v d-c
250v d-c	180	-	260v d-c	140	-	280v d-c
115v a-c	95	-	125v a-c	95	-	125v a-c
230v a-c	190	-	250v a-c	190	-	250v a-c

If the closed circuit voltage at the terminals of the coil or motor does not fall in the specified range, check the voltage at the source of power and line drop between the power source and breaker.

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 or motor 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 or close the breaker manually by pressing the manual trip lever (11) Fig. (2) or the manual close button (7).

Before the breaker is finally raised into position in the metal-clad unit, rub a small amount of G-E contact lubricant D50H47 on the silvered portion of the breaker studs to form a thin coating for contacting purposes.

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. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE THE SPRINGS ARE CHARGED UNLESS THEY ARE SECURED IN THAT POSITION BY THE MAINTENANCE SPRING BLOCKING DEVICE.

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 cracks do not interfere with the operation of the device in any way 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. Small broken corners on the exhaust end of the chute will not interfere with its performance and can also be disregarded.
4. The plastisol flexible covering for the pole pieces (17 & 18) Fig. (16) and the upper mounting support (10) Fig. (16) should be inspected for breaks in the insulation. If there are holes or breaks in the insulation they should be repaired or the part replaced.

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 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 manual charging wrench, 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 ADJUSTMENTS. Check all terminal connections.

Bushings and Insulation

The surface of the 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 or clear resin. 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.

Insulation Test

When insulation has been repaired or replaced, or when breaker has been stored under adverse conditions, 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 open 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.

If the breaker secondary wiring is to be given a hi-potential test at 1500 volts, remove both of the motor leads from the terminal board. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

LUBRICATION

In order to maintain reliable operation, it is important that all circuit breakers be properly lubricated at all times. Most of the bearings and rolling surfaces utilize a new type of dry lubrication that will require no maintenance and will last the life of the equipment. Only few bearings and surfaces listed in the chart Fig. (20) require lubrication. These have been properly lubricated, during assembly at the factory, using the finest grades 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. (20). 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. (20) 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 Lubricants D50H15 and D50H47 are available in 1/4# collapsible tubes. It is so packaged to insure cleanliness and to prevent oxidation.

Method of Cleaning Bearings

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

Sleeve Bearings

The sleeve bearings used throughout the linkage utilize Teflon surfaces and do not require lubrication. After a number of operations, the surface will acquire a thin black film. Do not remove this film unless there is evidence of outside contaminates, such as dry or hardened grease. If contaminants are present they should be removed by immersing the link and bearing in clean petroleum solvent or similar cleaner and using a stiff brush. Do not remove the bearings from the links. DO NOT USE CARBON TETRACHLORIDE.

The hinge of the primary contact arm (24) Fig. (7) should be disassembled, cleaned, and lubricated with G-E D50H47 lubricant at general overhaul periods.

The main shaft bearings (24) Fig. (5) and the driving pawl lever bearing should be removed, cleaned, and lubricated with G-E D50H15 lubricant at general overhaul periods.

Roller & Needle Bearings

The cam follower bearings (6) Fig. (5), latch roller bearing (9), and cam shaft bearings (25) Fig. (5) should be first removed from the mechanism and the inner race disassembled. 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 inductive 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 the light oil and draining should follow immediately, then apply the lubricant.

Bearings that are pressed into the frame or other members such as the eccentric drive bearings (7) Fig. (15) should not be removed. After removing the shaft and inner race the bearing can usually be cleaned satisfactorily with petroleum solvent or a similar cleaner and a stiff brush. Follow the procedure outlined above using a light machine oil and G-E lubricant D50H15 before reassembling the inner race and shaft.

Rolling Surfaces

A number of rolling and rubbing surfaces in the mechanism have been lubricated with a baked-on, dry, molybdenum disulfide coating. This requires no maintenance and should last the life of the breaker.

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

1. Magne-blast breakers applied to repetitive operation such as switching arc furnaces 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.

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

      3. All areas in the throat area of the arc chute 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.

      4. 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 primary contacts should be greased lightly with D50H47.

      5. 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 condition 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.

      6. Check the breaker and mechanism adjustments as summarized under INSPECTION AND TEST. The necessary readjustments should be made as described under ADJUSTMENTS.

      7. 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.

8. The contacts of the control relay should be inspected for wear and cleaned if necessary.

9. Lubricate the breaker operating mechanism in accordance with the table under LUBRICATION.

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

11. After the breaker has been serviced, it should be slowly closed and opened, as described in INSTALLATION, to be sure there is no binding or friction and that the 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, blow-out coils, arc runners and assemblies which can become contaminated by arc products.

2. 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.

3. 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.

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

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

6. 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.

7. The cup bearing and the contact ring at the hinge point of the contact blade should be disassembled, inspected, cleaned, and relubricated with G-E contact lubricant D50H47. The contact ring should be inspected for wear and replaced when reduced in thickness to less than 1/32".

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. All roller and needle bearings in the operating mechanism should be disassembled, cleaned, and repacked with G-E lubricant D50H15 as described under LUBRICATION.

3. 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.

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

2. Magne-blast breakers applied to repetitive operation such as capacitor switching should be serviced and maintained according to the preceeding recommendations, and in addition, should have items 1A1, 1A2, and 1A3 repeated at 500 operation intervals.

TROUBLE SHOOTING

Failure of a breaker to operate properly will generally fall within four general classes; failure to trip, failure to close or latch closed, closing springs will not recharge, 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 section on 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 section on ADJUSTMENTS. Examine latch and roller surfaces for corrosion.

3. Damaged or dirty contacts in control circuit including control relay.
   REMEDY: Recondition or replace contacts.

4. Damaged spring release coil.
   REMEDY: Replace damaged coil.

5. Defective latch-checking switch, or interlock switch.
   REMEDY: Replace defective switch.

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

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

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

9. Insufficient control voltage caused by poor regulation (a-c control).
   REMEDY: Install larger control transformer.

Failure to Recharge Springs

1. Defective motor cut-off switch, interlock switch, or closing latch monitoring switch.
   REMEDY: Replace switch.

2. Damaged or dirty contacts in control circuit.
   REMEDY: Recondition or replace contacts.

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

4. Faulty connection in charging circuit.
   REMEDY: Repair broken or loose wires and see that all binding screws are tight.

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 section on 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.

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 connectors.
   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. (7). Loosen the two upper supporting bolts (2) Fig. (19) and the one lower support 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. 19.

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

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

2. Remove the side brace (5) and pole pieces (3 and 17), Fig. 16.

3. To remove the upper mounting support (10), Fig. 16 remove the assembly bolt (1), Fig. 16 and connection bolt (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 side shields (12), Fig. 16, the upper arc runner assembly (4), Fig. 18 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 (7) 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. Fig. 21.

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 (8), Fig. 17, and the arc chute side (7) 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. 19.

2. Slide the arc chute forward and lift it slightly to engage the supporting bolts (2), Fig. 19, in the slots of the upper mounting support (3).

3. Check the spring baffle (11) Fig. 22, to assure that it closes the gap between the upper insulation (18), Fig. 16, and the back of the contact support (4), Fig. 22 (-6C and 6H designs only)

4. Tighten the supporting bolts (2 and 9), Fig. 19. These bolts serve as both the electrical and mechanical connections between the bushing and the arc runners.

5. Check that the movable arcing contact (5), Fig. 19, passes through the slot or between the probes on the upper arc runner (5), Fig. 18, without touching.

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. 22.

1. Disconnect the contact braids from contact fingers by removing two bolts (8), Fig. 22.

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. 23

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). Remove one contact finger at a time.

To replace the Stationary Primary Contacts:

1. Apply a thin coating of D50H47 grease on the hinged edge of the finger (9) then place it on the contact support (7) so that it is retained by stop plate (8).

2. Open spring compressor (3) and assemble spring guide, spring and spring compressor (Fig. 23A).

3. Turn nut (2) in clockwise direction to compress contact spring (Fig. 23B). Hold spring firmly in yoke on spring compressor to prevent 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 cutout in primary finger (Fig. 23C).

5. Hold spring assembly firmly in place and remove spring compressor.

C. Movable Arcing Contacts (7), Fig. 24

1. Remove the assembly bolts (8).

2. Reassemble in reverse order.

D. Movable Primary Contacts (5), Fig. 24
(All 1200 Amp Breakers & 2000 Amp -7 Breakers)

1. Remove the nuts from assembly bolts (6).

2. Remove the primary contacts.

3. Reassemble in reverse order.

(2000 Amp -6 Breakers).

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. 24

1. Remove the connection bar (9).

2. Remove the cup bearing (3) and the pin (11).

3. When reassembling, first insert the piston assembly (10), into the booster cylinder and reassemble the cup bearing (3).

4. Replace pin (11), and connection bar (9).

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

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 reinstalled 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 reinstalled.

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 (18 and 20), Fig. 7.

3. Remove the four bolts at the mounting flange of the rear bushing being removed and lower the bushing assembly.

4. Referring to Fig. 23 disassemble the primary contact springs (6) as previously described.

5. Disassemble the spring retainer (4) by removing mounting bolts (5).

6. Referring to Fig. 22, 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 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 (18 and 20) Fig. 7.

3. Remove the connection bar (9), Fig. 24, cup bearing (3), and pin (11).

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) contact arm (4), and replace pin (11). The contact surfaces at the hinge point of the contact blade and bushing should have a thin coating of D50H47 grease.

6. Check all contact adjustments as outlined under ADJUSTMENTS.

INTERLOCK SWITCH

To remove the interlock switch (3), Fig. 10 remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

LATCH CHECKING SWITCH

To remove the latch checking switch (7), Fig. 10 (when furnished), remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

MOTOR, RELAY and LIGHT SWITCHES

The three switches are mounted in tandem as shown in Fig. (6).

1. Remove the opening spring per instructions below.

2. Remove (2) mounting bolts (14) from switch bracket (15).

3. Remove the (2) mounting screws of the lower switch.

4. Remove the (2) mounting screws of the center switch.

5. Remove the (2) mounting screws of the upper switch.

6. Disconnect the lead wires of switch to be replaced.

7. Reassemble in the reverse order and check switch adjustment as explained under ADJUSTMENTS.

TRIP SHAFT AND LATCH

1. Remove latch checking switch arm (10) Fig. 11 (when supplied).
2. Remove cotter pins on both ends of the shaft (12).
3. Remove set screw in latch (11).
4. Remove trip coil linkage bolt (6).
5. Place a block between the latch and frame (either side) and drive shaft until the latch is free of the key.
6. Remove key and all burrs that may be raised around the keyway on the shaft. Burrs will scar or shave the Teflon bearing surfaces if they are not removed.
7. Reassemble the parts in the reverse order. Be sure the latch spring is properly installed and the latch is aligned in the center of the latch roller. Check latch adjustment as described under ADJUSTMENTS.

TRIP LATCH ROLLER BEARING

1. Remove (2) cotter pins at ends of shaft (8) Fig. 12.
2. Partially remove shaft out right side of frame until latch roller (6) is free.
3. Reassemble in reverse order with proper spacing of washers. Be sure latch roller rotates freely.

CLOSING LATCH

1. Remove cotter pins at both ends of latch shaft (19) Fig. 6.
2. Remove spring and paddle (16) Fig. 6.
3. Remove set screw from latch (3) Fig. (6).
4. Move shaft (19) to left (away from frame) by tapping lightly on the inside end of shaft. Rotate shaft and continue tapping until shaft is free. Shaft will push outside needle bearing from housing.
5. Reassemble in reverse order putting bearing into frame last. Use a small piece of tubing or pipe when inserting bearing to assure proper alignment.
6. Check latch adjustments as described under ADJUSTMENTS.

MOTOR SUPPORT

1. To remove motor support (8) Fig. (15) first remove the latch spring (16) Fig. (6).

2. Remove the retaining ring (9) Fig. (15) and link (10).

3. Remove motor leads from the terminal board.

4. Remove six 3/8" bolts (1) Fig. (15) on bottom and one 3/8" bolt on the right side (not shown).

5. Remove four mounting bolts from motor (not shown).

6. Remove the retaining ring (7) from the eccentric (2) Fig. (15).

7. Reassemble all parts of the motor support in the reverse order and re-align it properly as described under DRIVING PAWL ADJUSTMENTS.

CAM

1. Remove 2 set screws from ratchet wheel (3) Fig. (3) and remove wheel from main shaft (8).

2. Remove 2 set screws from cam (12) Fig. (1).

3. Remove prop reset spring (10) Fig. (2).

4. Remove 2 set screws from cam (16) Fig. (5) and move cam to the right on the shaft as far as it will go. Slide the shaft to the left until key is fully exposed. Remove key and check shaft for burrs.

5. Remove shaft out left side of frame.

6. Reassemble in reverse order using the correct number of washers and spacers to properly locate the parts.

7. Rotate the mechanism through a closing operation using the manual charging wrench. Check the location of the cam follower (6) Fig. (5) on the cam (16). If necessary, move the cam to correct the alignment. Complete the closing operation and check the location of the prop pin (13) Fig. (5) on the prop (14). It should be approximately centered.

TRIP COIL

To replace the potential trip coil (2) Fig. (11) proceed as follows:

1. With the breaker in the open position, remove the two mounting bolts (3).

2. Remove upper support (1) and spacers.

3. Cut wires at the butt connectors and remove coil.

4. When replacing the coil be sure to assemble the correct fiber spacers at the ends before bolting support (1).

5. Adjust coil location to allow approximately 1/4" of armature travel before latch starts to move.

6. Butt connect wires and check operation of solenoid electrically and mechanically.

SPRING RELEASE COIL

To remove the spring release coil (5) Fig. (6) proceed as follows:

1. Block the closing springs as described in INSTALLATION.

2. Remove the left hand closing spring as described in CLOSING SPRING below.

3. Remove two mounting bolts (17), coil support (18), and spacers.

4. Cut wires at the butt connectors and remove coil.

5. Replace the coil and the correct number of fiber spacers before bolting support.

6. Butt connect wires and check that the armature is not binding. Check coil for electrical operation.

CLOSING SPRINGS

The closing springs (6) Fig. (3) can be removed as follows:

1. Charge the springs with the manual charging wrench and apply the spring blocking device as described in INSTALLATION.

2. Discharge springs by pushing manual close button (7) Fig. (2).

3. Rotate cam shaft (8) Fig. (3) by using the manual charging wrench until the gap between the spring (6) and the bearing block (10) is 2 inches or more.

4. Lift both springs until they clear the lower supports, then pull forward and down until the top supports are free.

5. Either discharge the opening springs by pushing the manual trip lever or block the opening springs with a suitable blocking device.

OPENING SPRINGS

To remove the opening springs (9) Fig. (3) proceed as follows:

1. Charge and block the closing springs as described under INSTALLATION.

2. Push manual trip lever (11) Fig. (2) to be sure the opening springs are fully discharged.

3. Remove upper pin (12) Fig. (3) and lower pin (11).

4. After reassembling springs check the primary opening as described under PRIMARY CONTACT GAP.

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 minimize service interruptions caused by breakdowns, and saves time and expense. When continuous operation is a primary consideration, more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

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

The Renewal Parts List covers the following types of breakers:

AM-4.16-250-6C	1200A & 2000A
AM-4.16-250-6CR	1200A & 2000A
AM-4.16-250-6H	1200A & 2000A
AM-4.16-250-6HR	1200A & 2000A
AM-4.16-250-7C	1200A & 2000A
AM-4.16-250-7CR	1200A & 2000A
AM-4.16-250-7H	1200A & 2000A
AM-4.16-250-7HR	1200A & 2000A
AM-4.16-250-7HB	1200A & 2000A
AM-4.16-250-7HBR	1200A & 2000A

NOTE: The listed terms "Right" and "Left" apply when facing the 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.

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.

Fig. No.	Ref. No.	Ampere Rating	Type	Catalog No. for Type AM-4.16-(MVA)- -6 Design	-7 Design	No. Req'd	Description
7	21	All	**	0281B0708 G-002	0281B0708 G-002	3	Operating Rod
7	21	All	B		0281B0708 G-008	3	Operating Rod
16	11	All	All	000421711 P-001	000421711 P-001	6	Insulating Cap
16	11	All	All	000407193 P-001	000407193 P-001	6	Washer (For Insulating Cap)
17	8	All	All	0414A0117 P-001		6	Throat Insulation
17	8	All	All		0108B1965 G-001	3	Throat Insulation (Right)
17	8	All	All		0108B1965 G-002	3	Throat Insulation (Left)
17	15	All	All	0383A0932 P-001	0161A5906 P-001	6	Lower Shield
17	16	All	All	0258C0616 P-009	0836C0197 P-014	6	Upper Runner Insulation
17	17	All	All	0258C0616 P-006	0114C5381 P-001	6	Lower Barrier
18	4	All	All	0414A0616 P-002	0114C5381 P-004	3	Insulating Plate
22	7	All	All	0236C0791 G-001	0236C0791 G-001	3	Flexible Connection (Right)
22	7	All	All	0236C0791 G-004	0236C0791 G-004	3	Flexible Connection (Left)
22	10	All	All	0236C0790 G-009	0236C0790 G-009	3	Arcing Contact Assembly
22	12	All	All	0414A0116 P-004	0414A0116 P-004	3	Insulating Plate
24	1	1200	All	0121A5964 P-001		[illegible]	Primary Contact Finger Spring
24	1	2000	All	006509787 P-001		[illegible]	Primary Contact Finger Spring
24	1	All	**		0121A5964 P-001	1[illegible]	Primary Contact Finger Spring
24	1	All	B		0121A5964 P-001	24	Primary Contact Finger Spring
24	2	1200	All	0236C0791 P-008		[illegible]	Primary Contact Finger
24	2	2000	All	0236C0791 P-008		[illegible]4	Primary Contact Finger
24	2	All	**		0114C5382 P-002	1[illegible]	Primary Contact Finger
24	2	All	B		0114C5382 P-00[illegible]	[illegible]	Primary Contact Finger
24	5	1200	All	0137A9164 P-003		3	Movable Primary Contact
24	5	2000	All	0137A9164 P-003		6	Movable Primary Contact
24	5	1200	All	0137A9164 P-004		3	Movable Primary Contact
24	5	2000	All	0137A9164 P-004		6	Movable Primary Contact
24	5	All	**		0114[illegible] P-004	6	Movable Primary Contact
24	5	All	B		013[illegible]A916[illegible] P-[illegible]	6	Movable Primary Contact
24	5	All	B		01[illegible]A91[illegible] P-004	6	Movable Primary Contact
24	7	All	**	0802B0742 G-001	080[illegible]42 G-001	3	Movable Arcing Contact
24	7	All	B		[illegible]02B0[illegible]42 G-002	3	Movable Arcing Contact
24	10	1200	All	0213X0343 G-043	021[illegible]034[illegible] G-043	3	Tube and Piston Assembly
24	10	2000	All	0213X0343 G-044	[illegible]13X0[illegible]43 G-044	3	Tube and Piston Assembly
6	12	All	All	0105C9393 P-001	01[illegible]C9393 P-001	1	Motor - 48 V-dc
6	12	All	All	0105C9393 P-002	[illegible]05[illegible]9393 P-002	1	Motor - 110 & 125 V-dc & 115 V-ac
6	12	All	All	0105C9393 P-0[illegible]	[illegible]C9393 P-003	1	Motor - 220 & 250 V-dc & 230 V-ac
6	6	All	All	0137A7575 P-[illegible]43	[illegible]137A7575 P-004	Δ 1	Relay - 48 V-dc
6	6	All	All	0137A757[illegible] P-[illegible]42	[illegible]137A7575 P-001	Δ 1	Relay - 110 & 125 V-dc
6	6	All	All	0137A7575 [illegible]-04[illegible]	[illegible]108B1978 G-001	Δ 1	Relay - 220 & 250 V-dc
6	6	All	All	0137A757[illegible] P-[illegible]47	0137A7575 P-005	Δ 1	Relay - 115 V-ac
6	6	All	All	0137A75[illegible] P-04[illegible]	0137A7575 P-002	Δ 1	Relay - 230 V-ac
11	2	All	All	0061[illegible]82 [illegible]-001	006174582 G-001	1	Potential Trip Coil - 110 & 125 V-dc
11	2	All	All	00617[illegible]2 G-015	006174582 G-015	1	Potential Trip Coil - 220 V-dc
11	2	All	All	006[illegible]458[illegible]-002	006174582 G-002	1	Potential Trip Coil - 250 V-dc
11	2	All	All	00[illegible]1745[illegible]2 G-010	006174582 G-010	1	Potential Trip Coil - 115 V-ac
11	2	All	All	00[illegible]745[illegible]2 G-014	006174582 G-014	1	Potential Trip Coil - 230 V-ac
11	2	All	All	[illegible]0 G-001	006275070 G-001	1	Potential Trip Coil - 24 V-dc
11	2	All	All	0[illegible]275070 G-002	006275070 G-002	1	Potential Trip Coil - 48 V-dc
6	5	All	[illegible]11	[illegible]061[illegible]4582 G-001	006174582 G-001	1	Spring Release Coil - 110 & 125 V-dc
6	5	All	A[illegible]	[illegible]74582 G-015	006174582 G-015	1	Spring Release Coil - 220 V-dc
6	5	All	All	006174582 G-002	006174582 G-002	1	Spring Release Coil - 250 V-dc
6	5	All	A[illegible]1	[illegible]06174582 G-010	006174582 G-010	1	Spring Release Coil - 115 V-ac
6	5	Al[illegible]	[illegible]11	006174582 G-014	006174582 G-014	1	Spring Release Coil - 230 V-ac
6	5	All	All	006275070 G-002	006275070 G-002	1	Spring Release Coil - 48 V-dc
6	10	All	A[illegible]	0456A0866 P-005	0456A0866 P-005	5	Switch, Normally Open
6	10	All	A[illegible]	0456A0866 P-006	0456A0866 P-006	1	Switch, Normally Closed
11	9	All	All	0137A9192 G-003	0137A9192 G-003	1	Auxiliary Switch
6	16	All	All	0161A4231 P-001	0161A4231 P-001	1	Closing Latch Spring
11	13	All	All	0137A9252 P-001	0137A9252 P-001	1	Prop Spring
4	5	All	All	0161A4241 P-001	0161A4241 P-001	1	Driving Pawl Spring
3	1	All	All	0161A5909 P-001	0161A5909 P-001	*2	Latching Pawl Spring

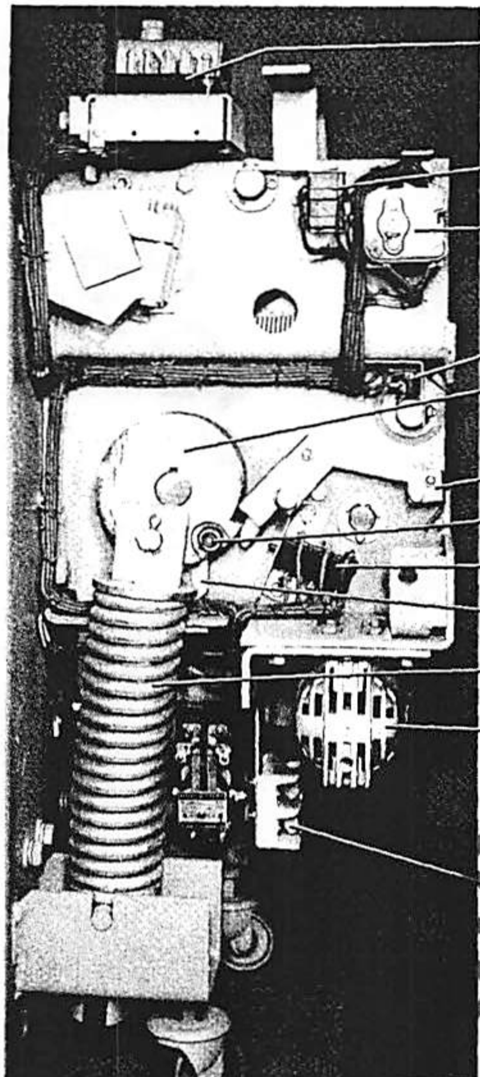
Δ [illegible] (2) relays required on special control circuits. Check breaker and connection diagram.

* [illegible]urnish 0161A4241 P-001 for breakers not having closing spring discharge mechanism.

[illegible] All except breakers with "B" in suffix.

Fig. 2 8034471

Fig. 1 8034473



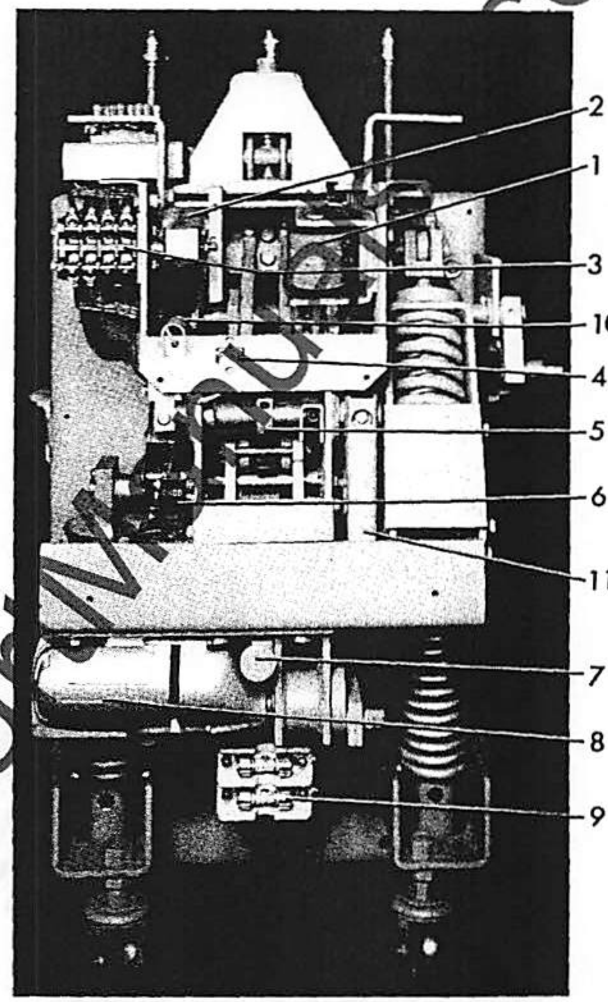
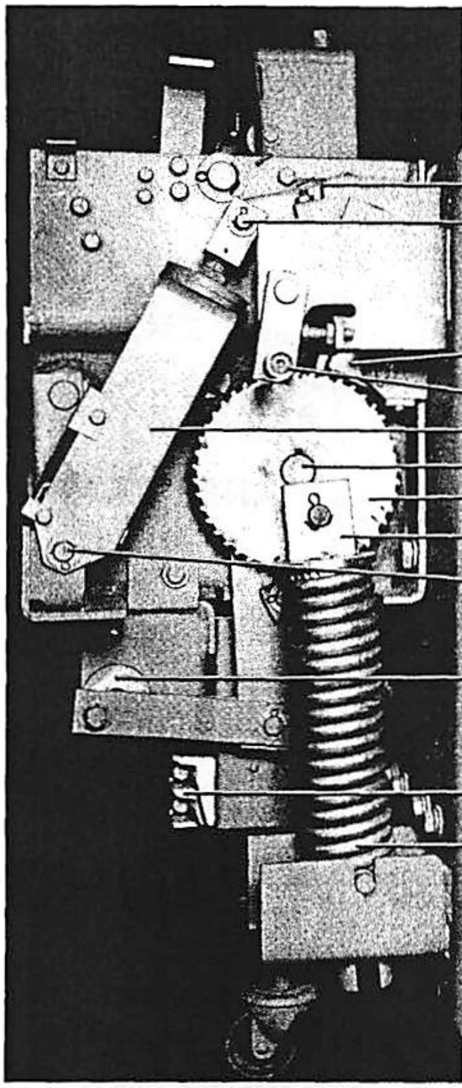


Fig. 1 Left Side View ML-13
Operating Mechanism

1. Secondary Coupler
2. Interlock Switches
3. Auxiliary Switch
4. Latch Checking Switch
5. Charge-Discharge Indicator
6. Power Switches
7. Closing Springs
8. Motor
9. Fuses
10. Closing Latch Roller
11. Closing Latch
12. Switch Cam

Fig. 2 Front View ML-13
Operating Mechanism

1. Trip Coil
2. Open - Close Indicator
3. Auxiliary Switch
4. Counter
5. Trip Latch
6. Charge-Discharge Indicator
7. Close Button
8. Motor
9. Fuse
10. Prop Spring
11. Trip Lever



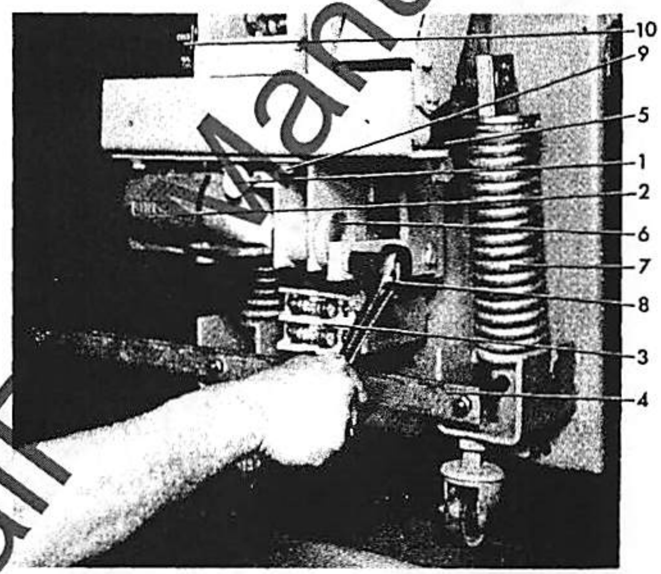


Fig. 4 8034475

Fig. 3 8034463

Fig. 3 Right Side View ML-13 Operating Mechanism

1. Latching Pawls
2. Positive Interlock Roller
3. Ratchet Wheel
4. Eccentric
5. Fuse
6. Closing Spring
7. Main Shaft Bearing
8. Cam Shaft
9. Opening Spring
10. Guide Block
11. Lower Spring Pin
12. Upper Spring Pin

Fig. 4 Spring Blocking Device

1. Close Button
2. Motor
3. Fuse
4. Spring Blocking Device
5. Driving Pawl
6. Eccentric
7. Closing Spring
8. Manual Charging Wrench
9. Support Bolts
10. Charge-Discharge Indicator

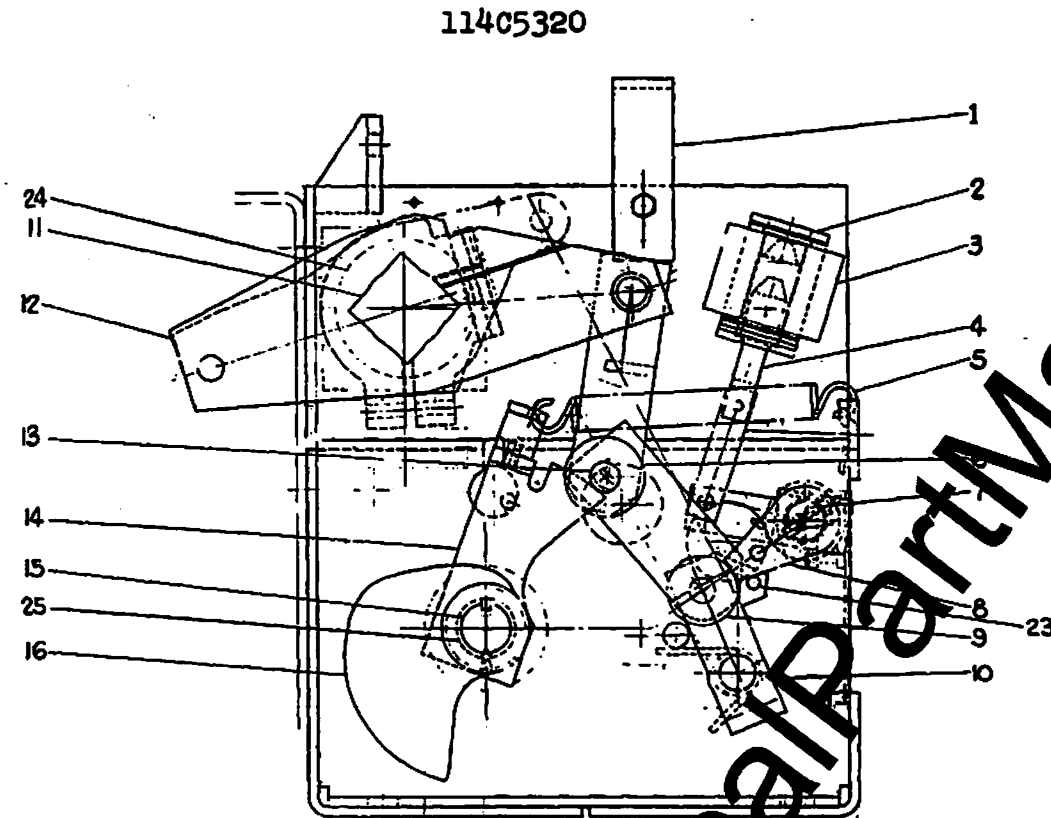
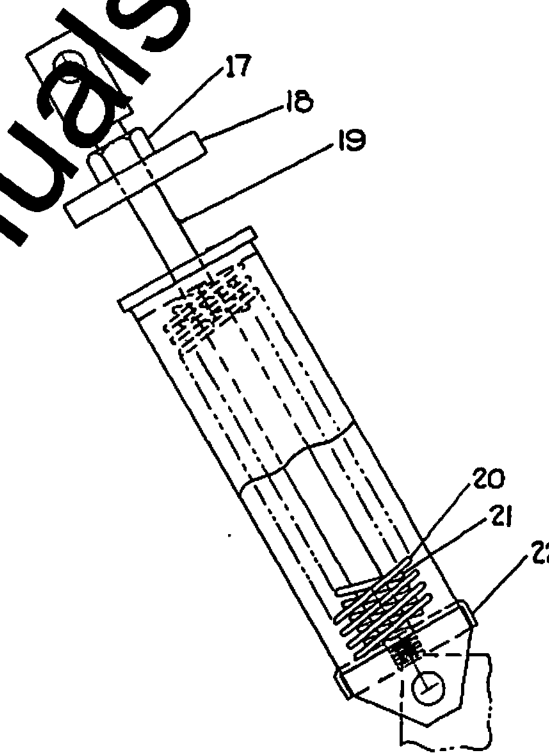
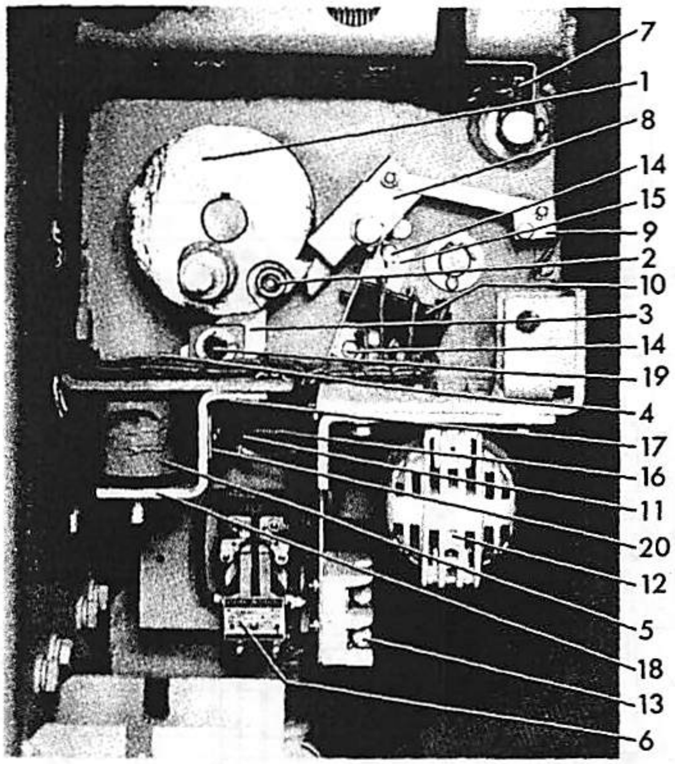


Fig. 5 Sectional Side View of Mechanism



Opening Spring

1. Handle
2. Trip Coil Support
3. Trip Coil
4. Trip Armature
5. Prop Reset Spring
6. Cam Follower Roller
7. Trip Shaft
8. Trip Latch
9. Trip Latch Roller
10. Trip Latch Roller Support
11. Crank Shaft
12. Cranks
13. Prop Pin
14. Prop
15. Drive Shaft
16. Cam
17. Check Nut
18. Stop Plate
19. Spring Rod
20. Spring
21. Spring
22. Guide
23. Stop Pin
24. Main Shaft Bearing
25. Cam Shaft Bearing



1. Switch Cam
2. Closing Latch Roller
3. Closing Latch
4. Latch Adjusting Screw
5. Spring Release Solenoid
6. Control Relay
7. Latch Checking Switch ◆
8. Switch Striker
9. Charge-Discharge Indicator
10. Power Switches
11. Latch Monitoring Switch
12. Motor
13. Fuse
14. Switch Support Bolts
15. Switch Support
16. Closing Latch Spring
17. Release Coil Bolts
18. Release Coil Support
19. Closing Latch Shaft
20. Switch Mounting Bracket

Fig. 6 8034467

Fig. 6 Control Mechanism

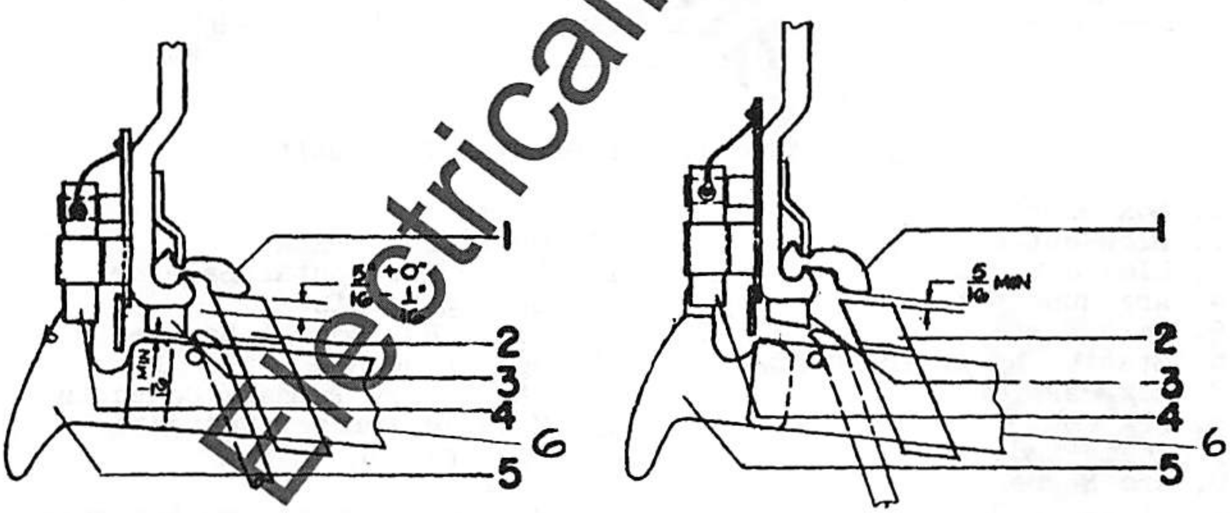


Fig. 8 114C5320

Primary Contact Wipe   Arcing Contact Wipe

Fig. 8 Contact Adjustments

1. Stationary Primary Contacts
2. Movable Primary Contacts
3. Buffer Block
4. Stationary Arcing Contacts
5. Movable Arcing Contacts
6. Contact Arm

Fig. 7 258C689

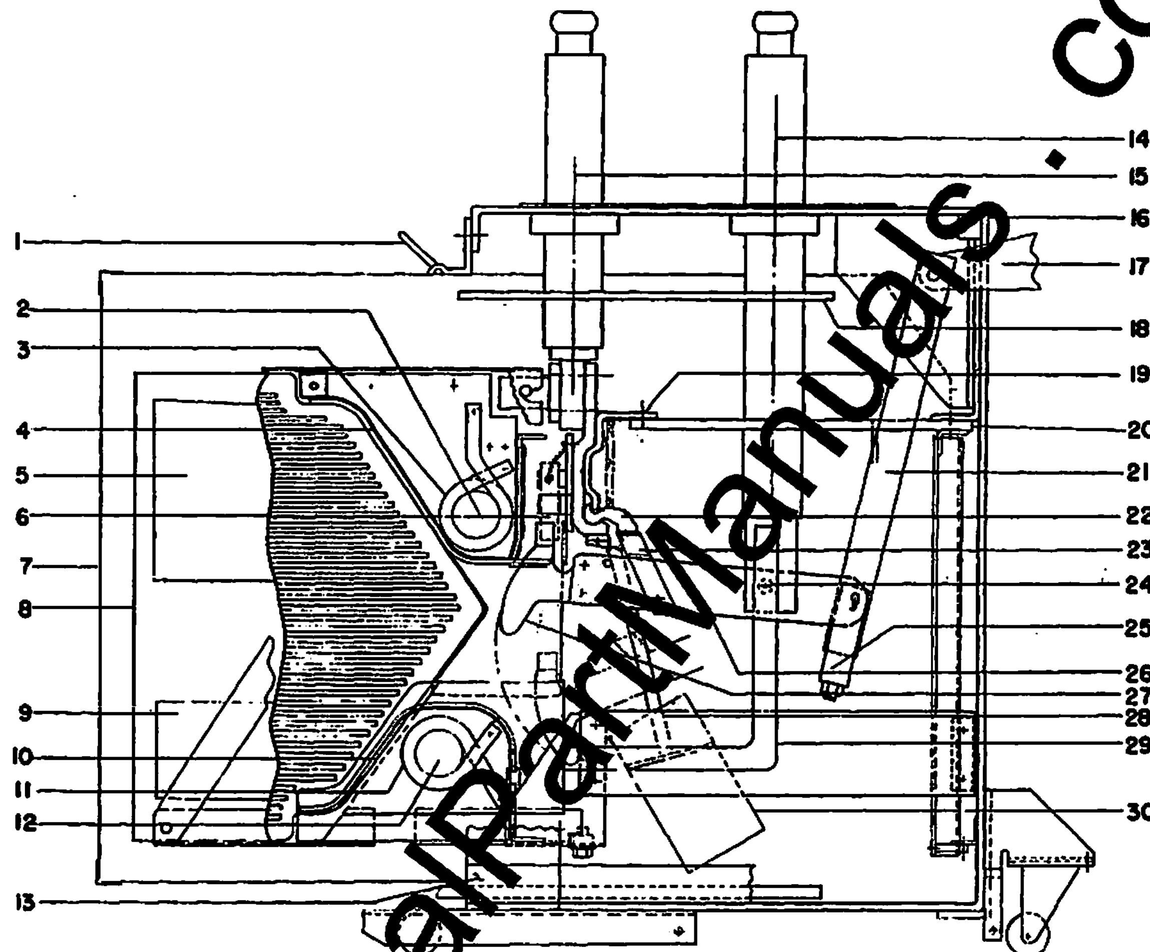


Fig. 7 Cross Section of Breaker Pole Unit

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. Lower 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

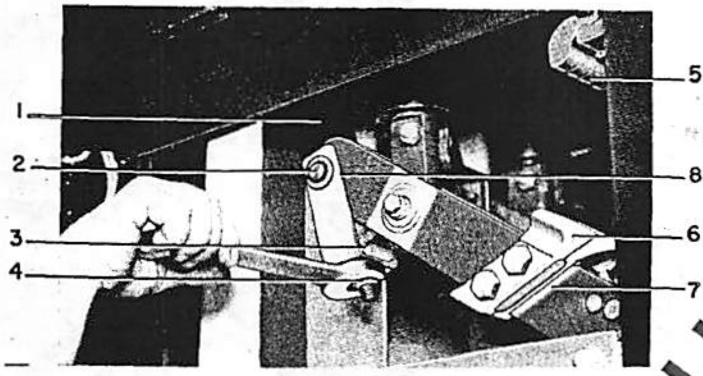


Fig. 9 Adjustable Coupling for Making
Primary Contact Wipe Adjustments

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. 9 8018500

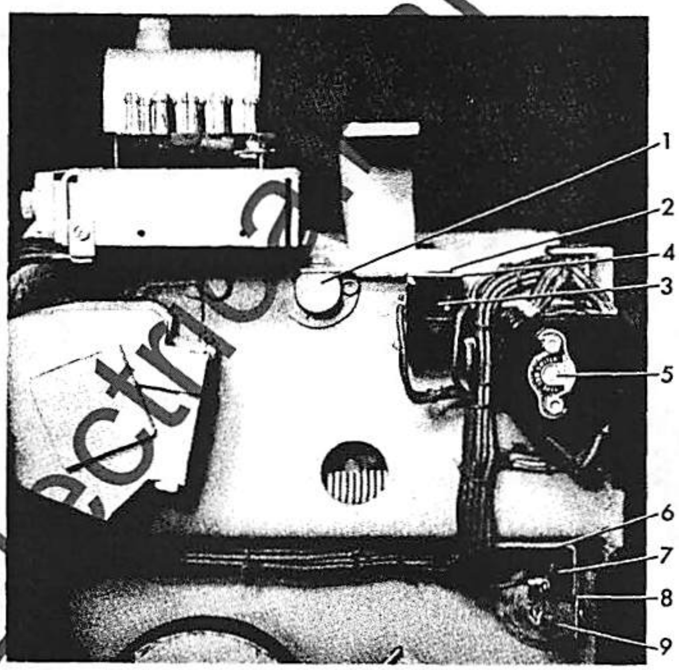


Fig. 10 Positive Interlock Switch

1. Positive Interlock Shaft
2. Switch Arm
3. Interlock Switch
4. Switch Support
5. Auxiliary Switch
6. Switch Support
7. Latch Checking Switch
8. Switch Arm
9. Trip Shaft

Fig. 10 8034474

Fig. 11 8034470

1. Trip Coil Support
2. Trip Coil
3. Mounting Bolts
4. Counter
5. Trip Latch
6. Trip Arm Screw
7. Manual Trip Lever
8. Open-Close Indicator
9. Auxiliary Switch
10. Switch Arm
11. Latch Set Screw
12. Cotter Pin
13. Prop Spring

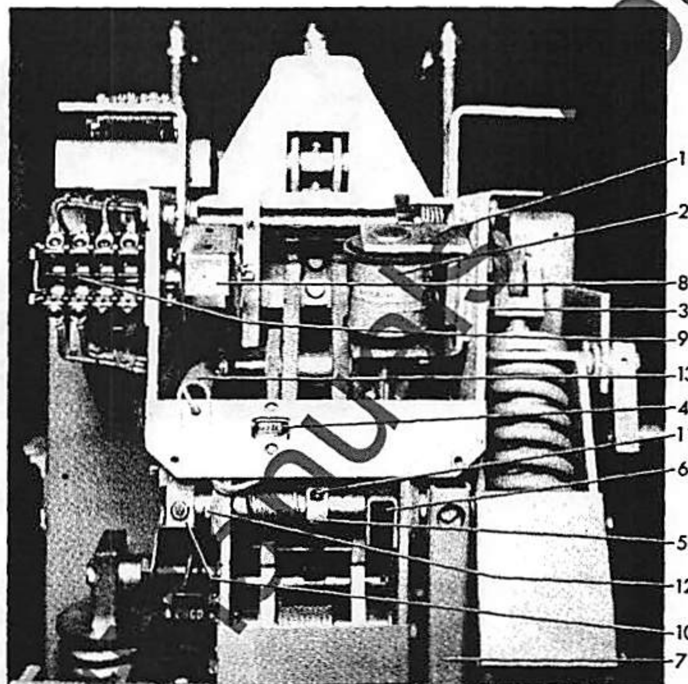


Fig. 11 Auxiliary Switch and Trip Coil

Fig. 12 114C5320

1. Switch Support
2. Latch Checking Switch
3. Switch Arm
4. Trip Latch
5. Reset Pin Stop
6. Latch Roller
7. Latch Roller Link
8. Latch Roller Pin

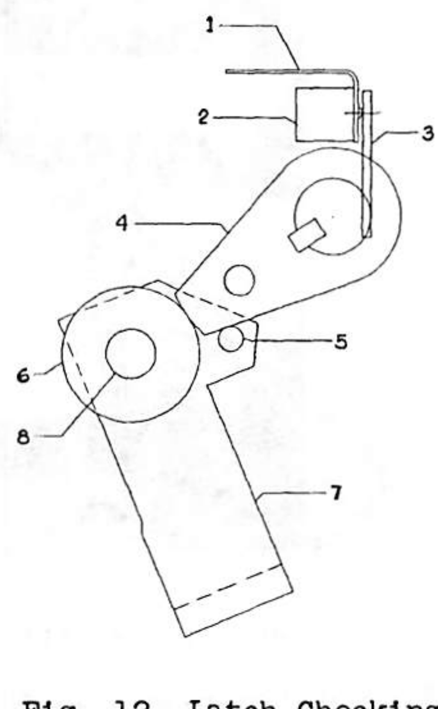
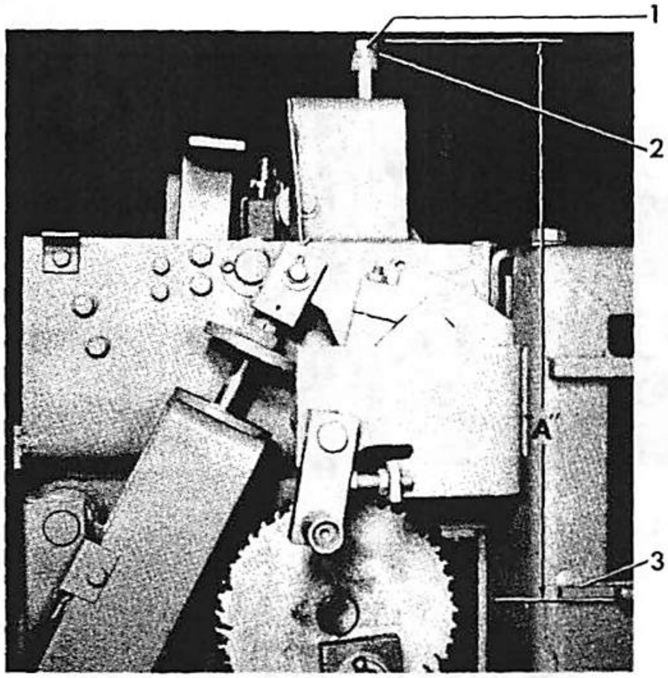


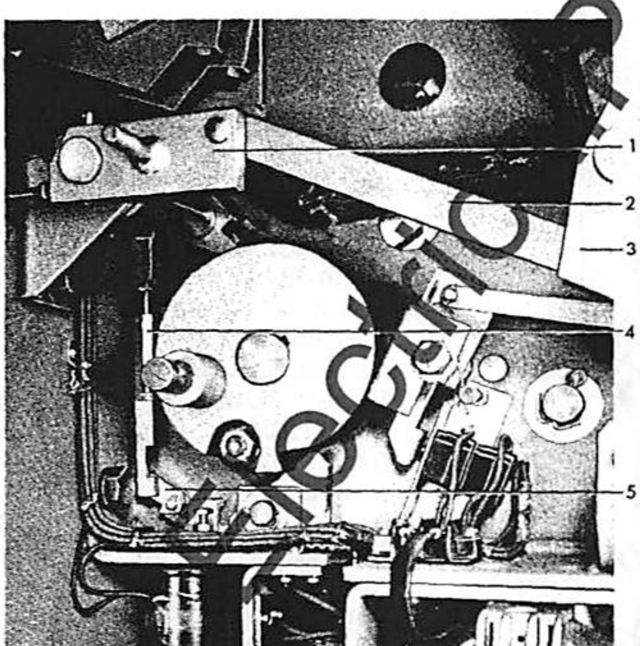
Fig. 12 Latch Checking Switch



1. Plunger Bolt
2. Washer
3. Breaker Lifting Rail

Fig. 13 8034464

Fig. 13 Plunger Interlock



1. Actuating Crank
2. Link
3. Tripping Crank
4. Turnbuckle
5. Spring Release Crank

Fig. 14 8036489

Fig. 14 Spring Release Interlock

Fig. 15 8034471

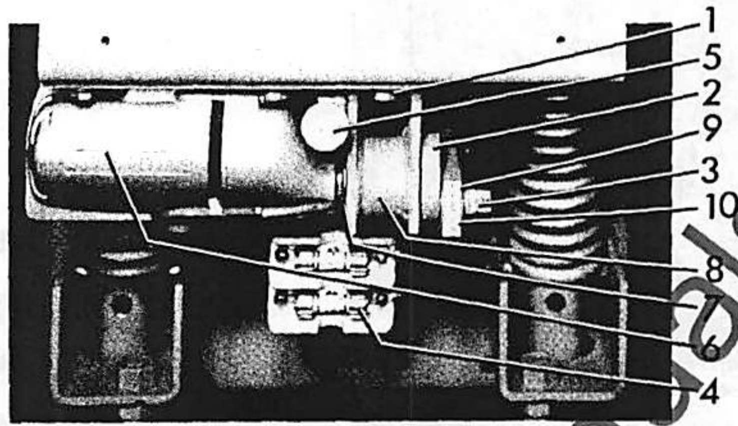
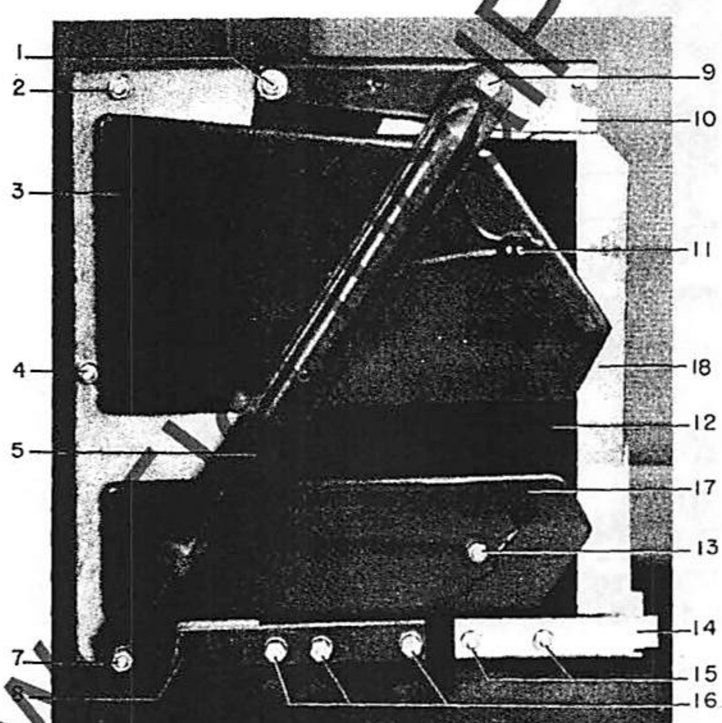


Fig. 15 Driving Elements

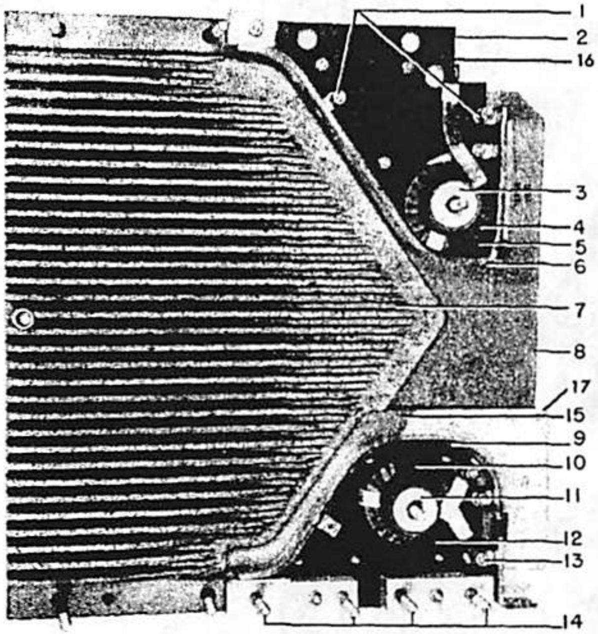
1. Mounting Bolts
2. Eccentric
3. Hex Charging Stud
4. Fuse
5. Manual Close Button
6. Motor
7. Retaining Ring
8. Motor Support
9. Retaining Ring
10. Driving Link

Fig. 16 8025741



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. Assembly Bolt
10. Upper Mounting Support
11. Insulating Cap
12. Side Shield
13. Assembly Bolt
14. Lower Mounting Support
15. Assembly Bolts
16. Assembly Bolts
17. Lower Pole Piece
18. Upper Insulation

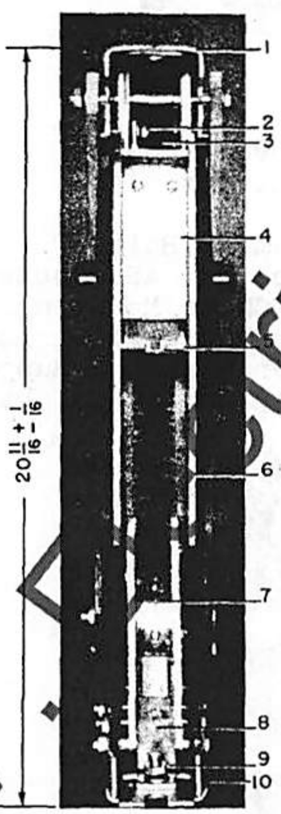
Fig. 16 Arc Chute Assembly



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
15. Lower Shield
16. Upper Insulation
17. Lower Insulation

Fig. 17 8024600

Fig. 17 Arc Chute Assembly
with Side Removed



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 8024605

Fig. 18 Front View
Arc Chute Assembly

Fig. 19 8019971

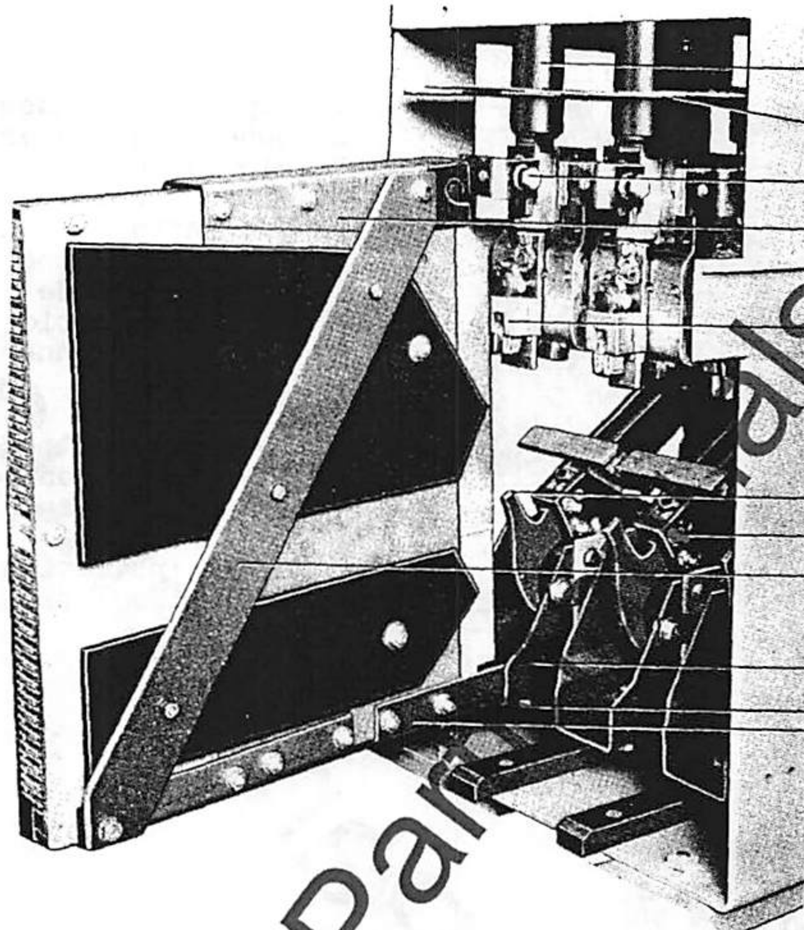


Fig. 19 Arc Chute Partially Removed Showing Accessibility of Arcing Contacts

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
11. Upper Horizontal Barriers

Fig. 21 8029373

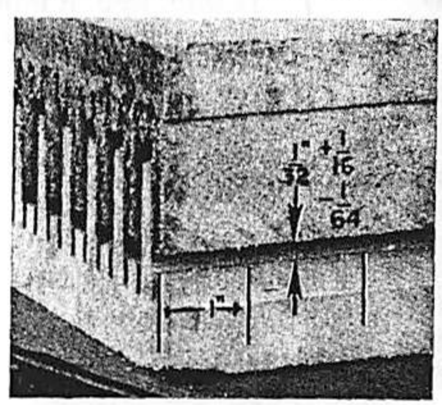


Fig. 21 Arc Chute Fin Spacing

PART	LUBRICATION AT MAINTENANCE PERIOD	ALTERNATE LUBRICATION (REQUIRES DISASSEMBLY)
Sleeve Bearings - links, trip shaft, etc. (Teflon coated bearings)	No lubrication required.	No lubrication required.
Sleeve Bearings - main crank shaft, driving pawl lever. (Bronze or cast iron)	Light application of machine oil SAE 20 or SAE 30.	Remove bearings or links, clean per instructions and apply D50H15 lubricant liberally.
Contact Arm Hinge Assembly Cup bearing Loose rings between bushing and contact arm.	No lubrication required.	Wipe clean and apply D50H47.
Roller and Needle Bearings	Light application of machine oil SAE 20 or SAE 30.	Clean per instructions and repack with D50H15 lubricant.
Ground surfaces such as cams, ratchet teeth, etc. (Surfaces coated with M_oS_2)	No lubrication required.	No lubrication required.
Ground surfaces such as latches, rollers, prop, etc.	Wipe clean and apply D50H15 lubricant.	Wipe clean and apply D50H15 lubricant.
Silver plated contacts and primary disconnect studs.	Wipe clean and apply D50H47.	Wipe clean and apply D50H47.
Booster Cylinder	Do not Lubricate.	Do not lubricate.
Arcing Contacts	Do not Lubricate.	Do not lubricate.

Fig. 20 LUBRICATION CHART

Fig. 23D 8034468 Fig. 23C 8034469 Fig. 23B 8034465 Fig. 23A 8034466

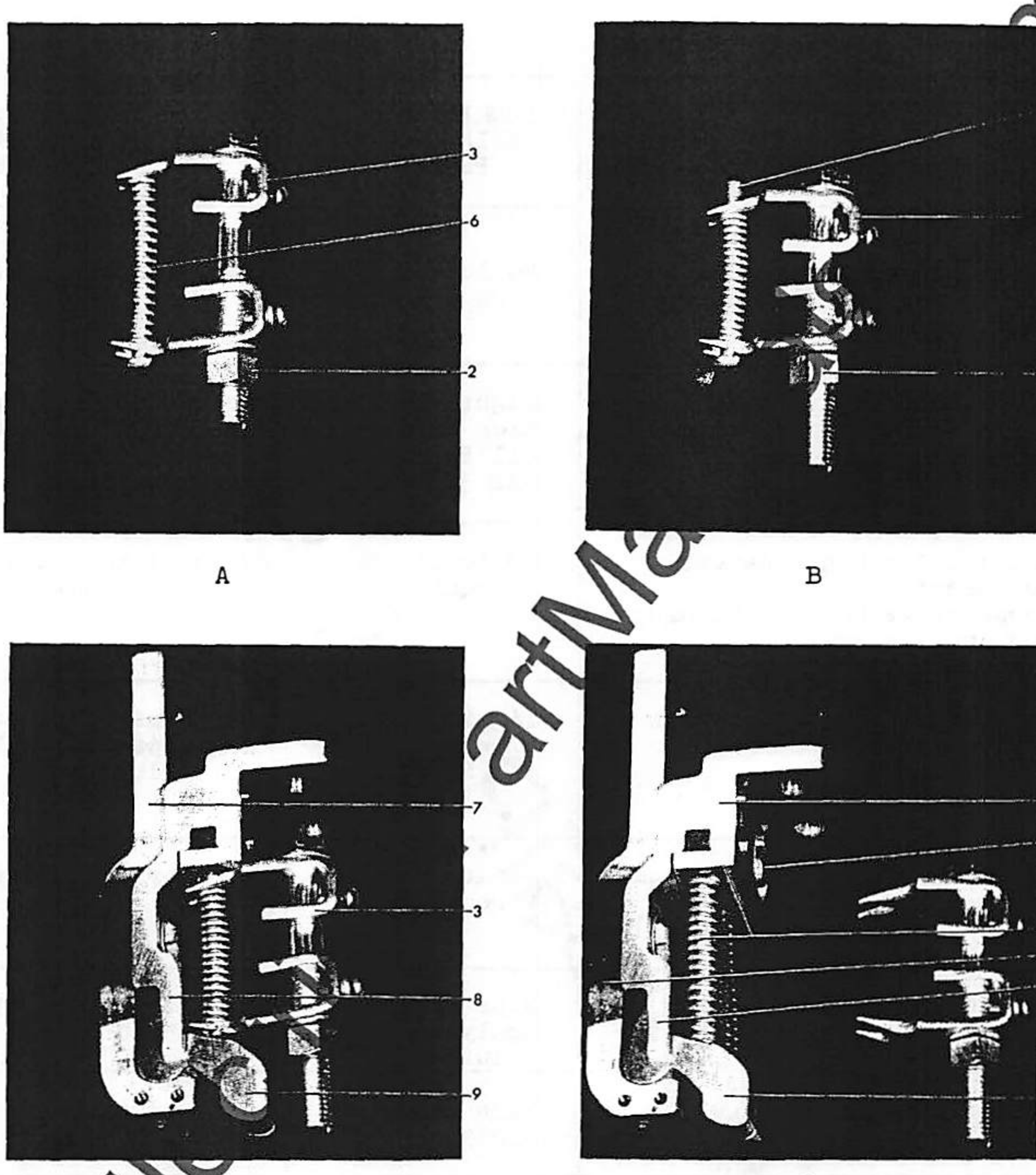


Fig. 23 Method of Installing Primary Contact Springs Using a Spring Compressor

1. Spring Guide
2. Compressor Nut
3. Spring Compressor
4. Spring Retainer
5. Assembly Bolts
6. Spring
7. Contact Support
8. Stop Plate
9. Stationary Primary Finger

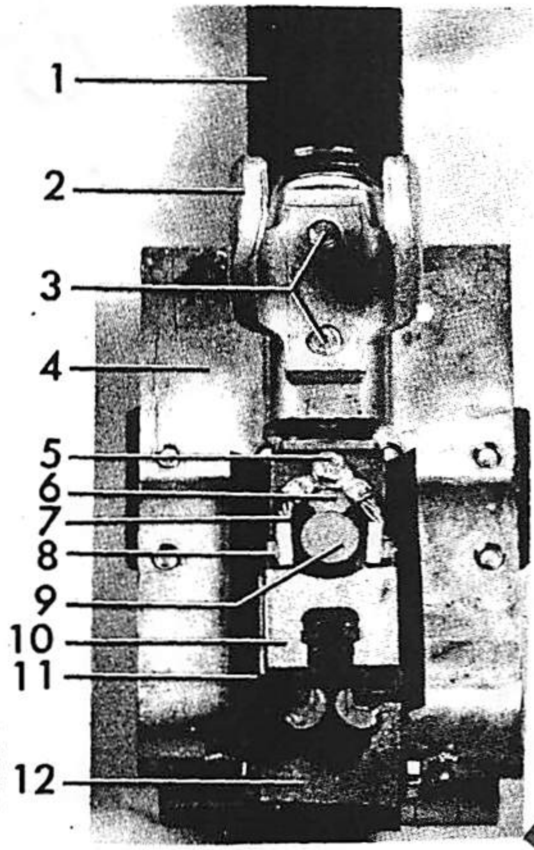


Fig. 22 Rear Bushing Assembly

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
12. Insulating Plate

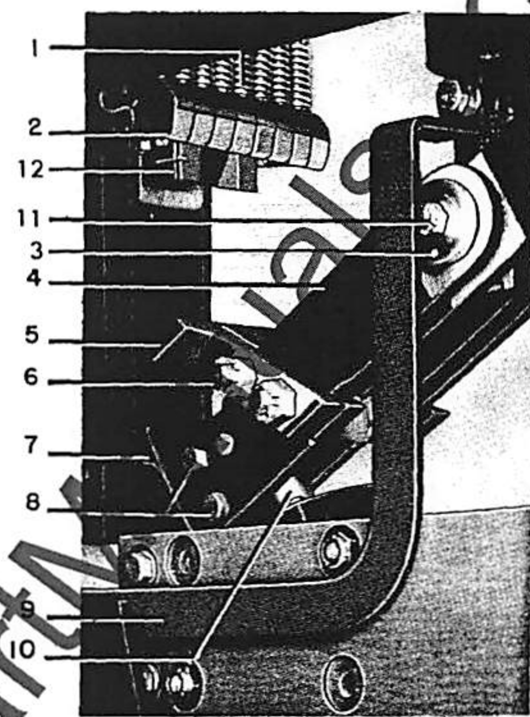


Fig. 24 Removal of Contacts

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
11. Hinge Pin
12. Buffer

Fig. 24 8012188

Fig. 22 8025170

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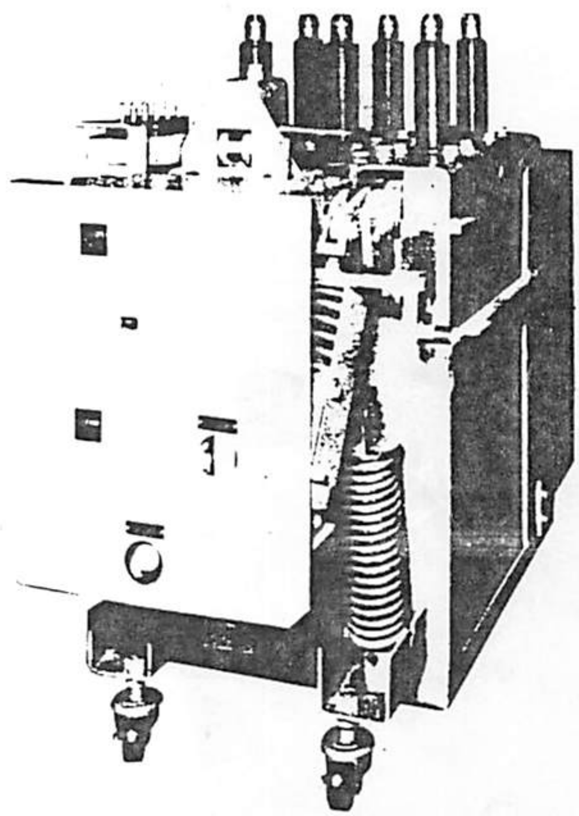
BUS 31
BREAKERS

MAGNE-BLAST CIRCUIT BREAKER

Type:

AM-4.16-250-9
1200 & 2000 Amperes
With ML-13 Mechanism



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GENERAL ELECTRIC

manual close and trip levers on the breaker. All secondary connections from the breaker to the metal clad unit are made through the coupler (1) Fig. 2.

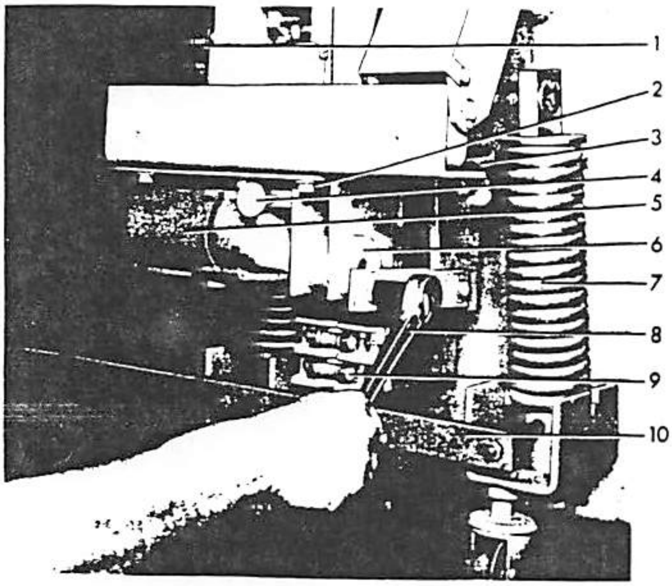

Figure 1. (8034475) Spring Blocking Device

1. Charge-Discharge Indicator
2. Support Bolts
3. Driving Pawl
4. Manual Close Lever
5. Motor
6. Eccentric
7. Closing Spring
8. Manual Charging Wrench
9. Fuse
10. Spring Blocking Device

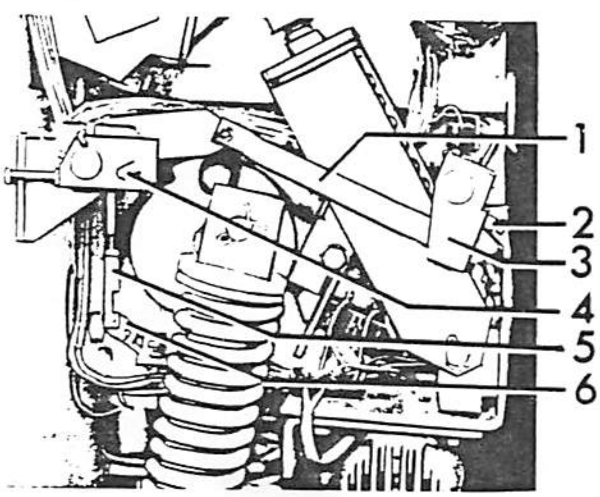

Figure 3. (8038805) Spring Discharge Linkage

1. Link
2. Adjusting Bolt
3. Trip Latch Crank
4. Discharge Crank
5. Adjusting Clevis
6. Spring Release Crank

A spring release interlock, Fig 3, is provided to discharge both the closing and opening springs when the breaker is withdrawn from or inserted into the Metal Clad unit.

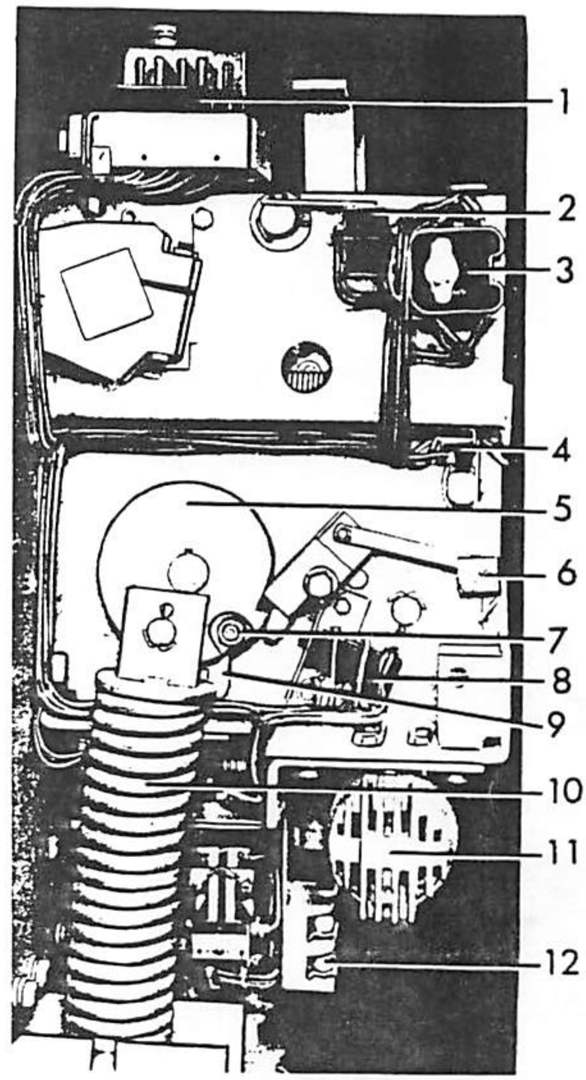

Figure 2. (8034473) Left Side View ML-13 Operating Mechanism

1. Secondary Coupler
2. Interlock Switches
3. Auxiliary Switch
4. Latch Checking Switch
5. Switch Cam
6. Charge-Discharge Indicator
7. Closing Latch Roller
8. Power Switches
9. Closing Latch
10. Closing Springs
11. Motor
12. Fuses

A positive interlock (3) Figure 4 and interlock switch (2) Figure 2, are provided between the breaker and metal-clad unit to prevent raising or lowering of the breaker in the unit while in a closed position and to prevent a closing operation when the breaker is not in either the fully raised or lowered position. To insure that this interlock will function during manual, as well as during electrical operation of the equipment, both mechanical and electrical blocking is provided. If for any reason the closing springs should be discharged against the positive interlock the mechanism will be jammed and be inoperable. The mechanism can be released and returned to the reset position by pushing in on the trip lever (8) Figure 5. It may require more than normal force to release the interlock.

A plunger interlock, Figure 14 can be provided when required to operate a stationary auxiliary switch and/or a rod interlock mounted in the metal-clad unit.

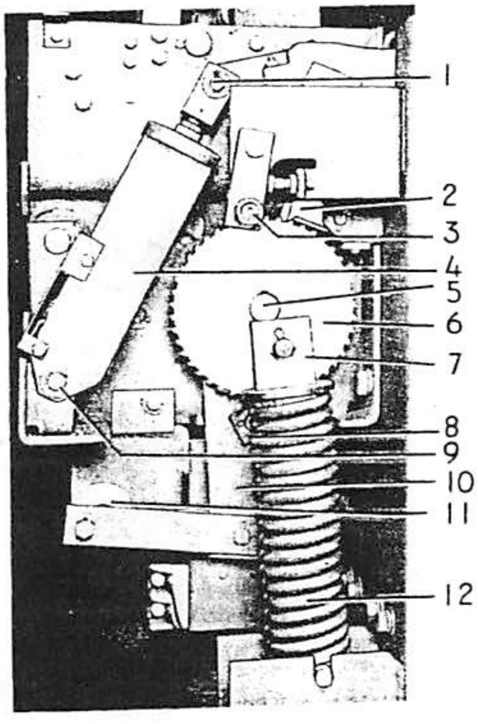

Figure 4. (8034463) Right Side View ML-13 Operating Mechanism

1. Upper Spring Pin
2. Latching Pawls
3. Positive Interlock Roller
4. Opening Spring
5. Cam Shaft
6. Ratchet Wheel
7. Bearing Block
8. Driving Pawl
9. Lower Spring Pin
10. Driving Pawl Lever
11. Eccentric
12. Closing Spring

When the breaker is used interchangeably with type MS-13 solenoid operated breakers in M-26 metal-clad units, fuses (12) Figure 2, are mounted on the breaker for protection of the motor and closing circuit. These breakers are identified by a "C" or "K" suffix in the breaker nomenclature.

In cases where breakers with type ML-13 mechanisms must match and line up with breakers having type ML-11 mechanisms the spring charging circuit for both mechanisms should be fused with Buss Company Fusetrons as follows:

Cont. Volt.	Fuse Size	Cat. No.
48v d-c	10A	FRN 10
110v d-c	4A	FRN 4
125v d-c	4A	FRN 4
115v a-c	4A	FRN 4
220v d-c	2.5A	FRN 2.5
250v d-c	2.5A	FRN 2.5
230v a-c	2.5A	FRN 2.5

Spring Charging

The mechanism has a high speed gear motor (10) Figure 5, that compresses a set of closing springs through the action of an eccentric, ratchet, and pawl assembly. The rotary action of the motor is converted to a straight stroke through the eccentric (11) Figure 4, and a lever that carries a spring loaded driving pawl (3) Figure 1.

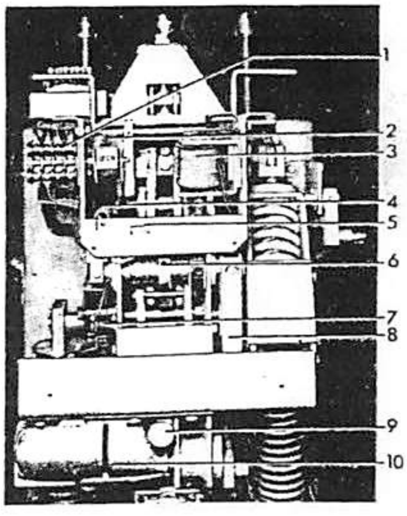

Figure 5. (8034471) Front View ML-13 Operating Mechanism

1. Auxiliary Switch
2. Open - Close Indicator
3. Trip Coil
4. Prop Spring
5. Operation Counter
6. Trip Latch
7. Charge-Discharge Indicator
8. Manual Trip Lever
9. Manual Close Lever
10. Motor

The pawl advances the ratchet wheel (6) Figure 4 a few degrees each stroke where it is held in position by the latching pawls (2). When the ratchet wheel has been rotated approximately 180 degrees the closing springs (12) will be fully compressed. As the ratchet wheel continues to rotate, the spring load will shift over center and attempt to discharge. After a few degrees of rotation, the closing roller (7) Figure 2, will engage the closing latch (9) and the compressed springs will be held by the latch until a closing operation is required. During the last few degrees of the ratchet wheel rotation the power switches (8) are opened and the driving pawl is raised from the ratchet wheel surface. This allows the motor and driving mechanism to coast to a natural stop expending all residual energy.

During the time the springs are being compressed a relay (17) Figure 6, is energized to hold the closing circuit open. The relay remains energized until the springs are fully charged and the control switch contacts are re-set.

The closing springs may be charged manually if control voltage is lost. A 5/8" ratchet wrench can be used to rotate the eccentric in a counter clockwise direction until the indicator reads "Charged" and the driving pawl is raised from the ratchet wheel. The use of the ratchet wrench provides for maximum safety in the event that control power is suddenly restored without warning. In this event, the motor drive will override the ratchet wrench and continues to charge the springs.

Closing Operation

The breaker can be closed electrically by energizing the spring release solenoid (15) Figure 6, or manually by pushing the close button (9) Figure 5. In either method the closing latch is rotated from under the closing roller to release the closing springs (10) Figure 2. The energy in the springs is used to rotate a cam (16) Figure 7 and close the breaker through the operating mechanism linkage. During the closing operation the mechanism is trip-free at all times. The breaker is held closed by the closing prop (14) moving into position under the prop pin (13). During the closing operation the opening springs (4) Figure 4, are compressed and held ready for an opening operation with the trip latch (8) Figure 7 bearing against the trip latch roller (9).

When the closing operation of the breaker is completed and the closing latch is fully reset,

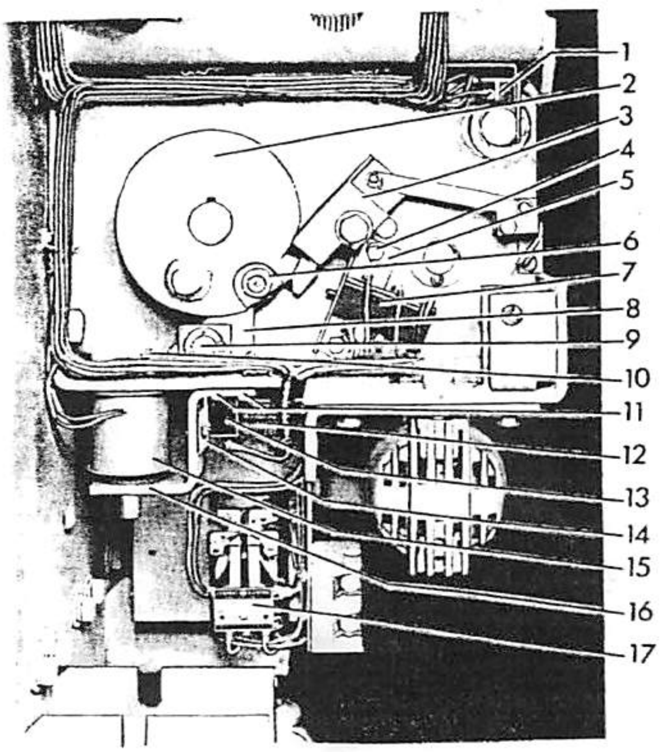

Figure 6. (8034467) Control Mechanism

1. Latch Checking Switch
2. Switch Cam
3. Switch Striker
4. Switch Support Bolts
5. Switch Support
6. Closing Latch Roller
7. Power Switches
8. Closing Latch
9. Closing Latch Shaft
10. Latch Adjusting Screw
11. Release Coil Bolts
12. Closing Latch Spring
13. Latch Monitoring Switch
14. Switch Mounting Bracket
15. Spring Release Solenoid
16. Release Coil Support
17. Control Relay

the contacts of the latch monitoring switch closes to permit the spring charging motor to be energized and recharge the closing springs.

Opening Operation

The breaker can be opened either electrically by energizing the trip coil (3) Figure 5, or manually by pushing the trip lever (8). In each method the trip latch is rotated off the trip latch roller, permitting the operating mechanism linkage to collapse. The energy stored in the opening springs is released to provide the required opening speed for successful interruption of the circuit.

As the breaker opens to interrupt a current, the arc first starts at the arcing contacts (6 & 27) Figure 8, transfers to the arc runner (4 & 10) and energizes the blow-out coils (3 & 11). This action introduces a magnetic field between the pole pieces (5 & 9) of the interrupter that forces the arc deeper into the arc chute (8). At the time the arcing contacts part a discharge of air is expelled through the booster tube (28) across the arc. This air flow assists the arc transfer and interruption by blowing the arc away from the contacts and into the arc chute. The magnetic field forces the arc deeper into the interrupter along the diverging arc runners.

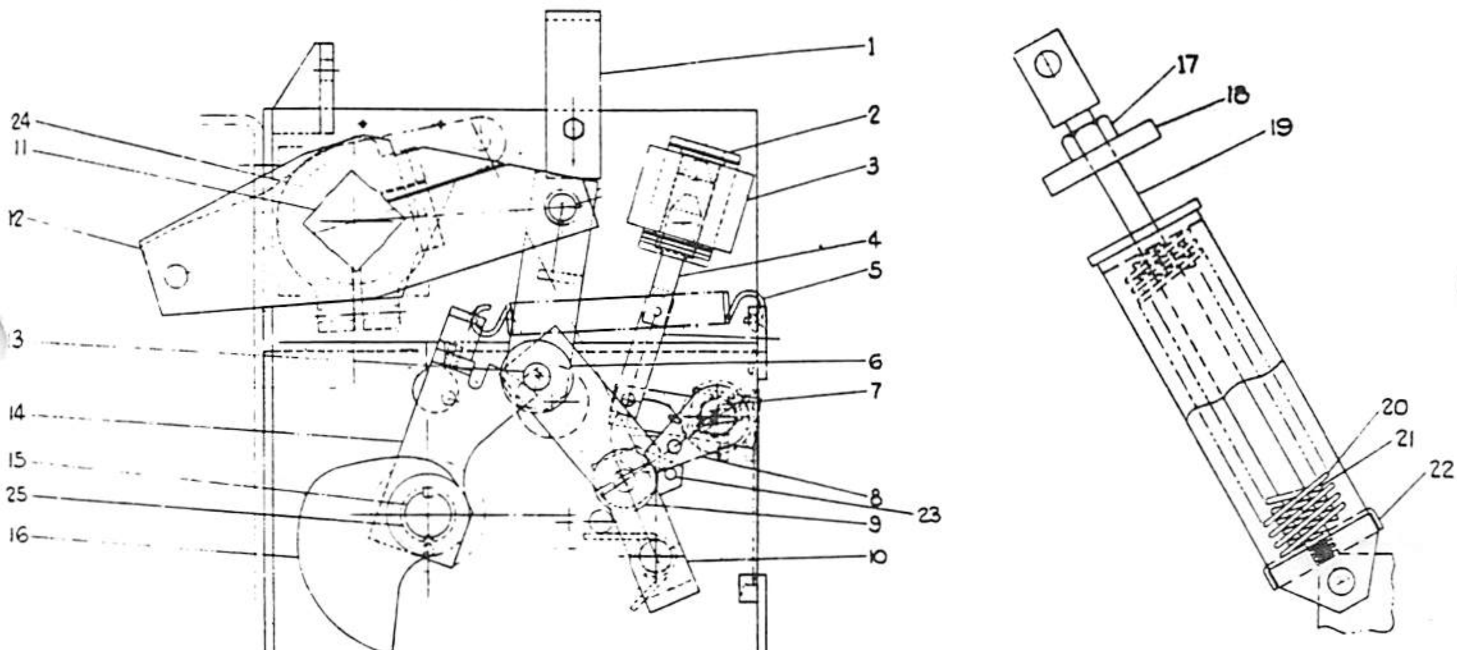

Fig. 7 (0114C5320) Sectional Side View of Mechanism

1. Handle
2. Trip Coil Support
3. Trip Coil
4. Trip Armature
5. Prop Reset Spring
6. Cam Follower Roller
7. Trip Shaft
8. Trip Latch
9. Trip Latch Roller
10. Trip Latch Roller Support
11. Crank Shaft
12. Cranks
13. Prop Pin
14. Prop
15. Drive Shaft
16. Cam
17. Check Nut
18. Stop Plate
19. Spring Rod
20. Spring
21. Spring
22. Spring Guide
23. Stop Pin
24. Main Shaft Bearing
25. Cam Shaft Bearing

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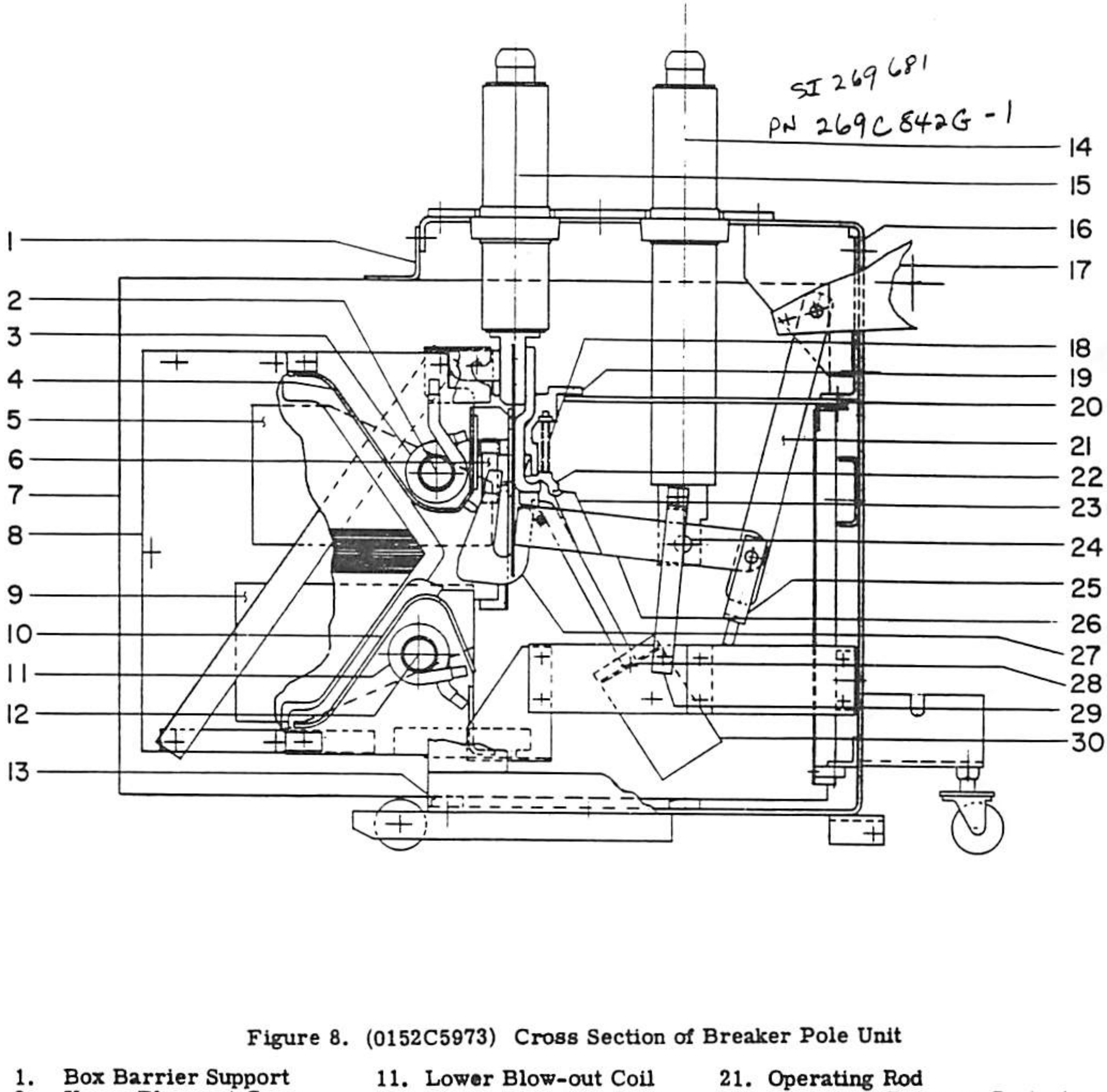


Figure 8. (0152C5973) Cross Section of Breaker Pole Unit

1. Box Barrier Support
2. Upper Blow-out Core
3. Upper Blow-out Coil
4. Upper Arc Runner
5. Upper Pole Piece
6. Stationary Arcing Contact
7. Box Barrier
8. Arc Chute Side
9. Lower Pole Piece
10. Lower Arc Runner
11. Lower Blow-out Coil
12. Lower Blow-out Core
13. Box Barrier Guide
14. Front Bushing
15. Rear Bushing
16. Frame
17. Main Operating Crank
18. Primary Contact Springs
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 and Piston
29. Connection Bar
30. Booster Cylinder

The arc chute has a series of interleaving ceramic fins, Figure 19. As the arc is forced into the interrupter it is lengthened in the gradually deepening serpentine path between the fins so that the electrical resistance of the arc is rapidly increased and its heat is absorbed by the ceramic material. The increased resistance reduces the magnitude and phase angle of the current and at an early current zero the arc cannot re-establish itself and interruption occurs.

Trip Free Operation

If the trip coil circuit is energized while the breaker is closing, the trip armature will force the trip latch (8) Figure 7 away from the trip roller (9) causing the mechanism linkage to collapse and the breaker to re-open. The closing cam (16) will complete its closing stroke and the springs will re-charge as in a normal closing operation.

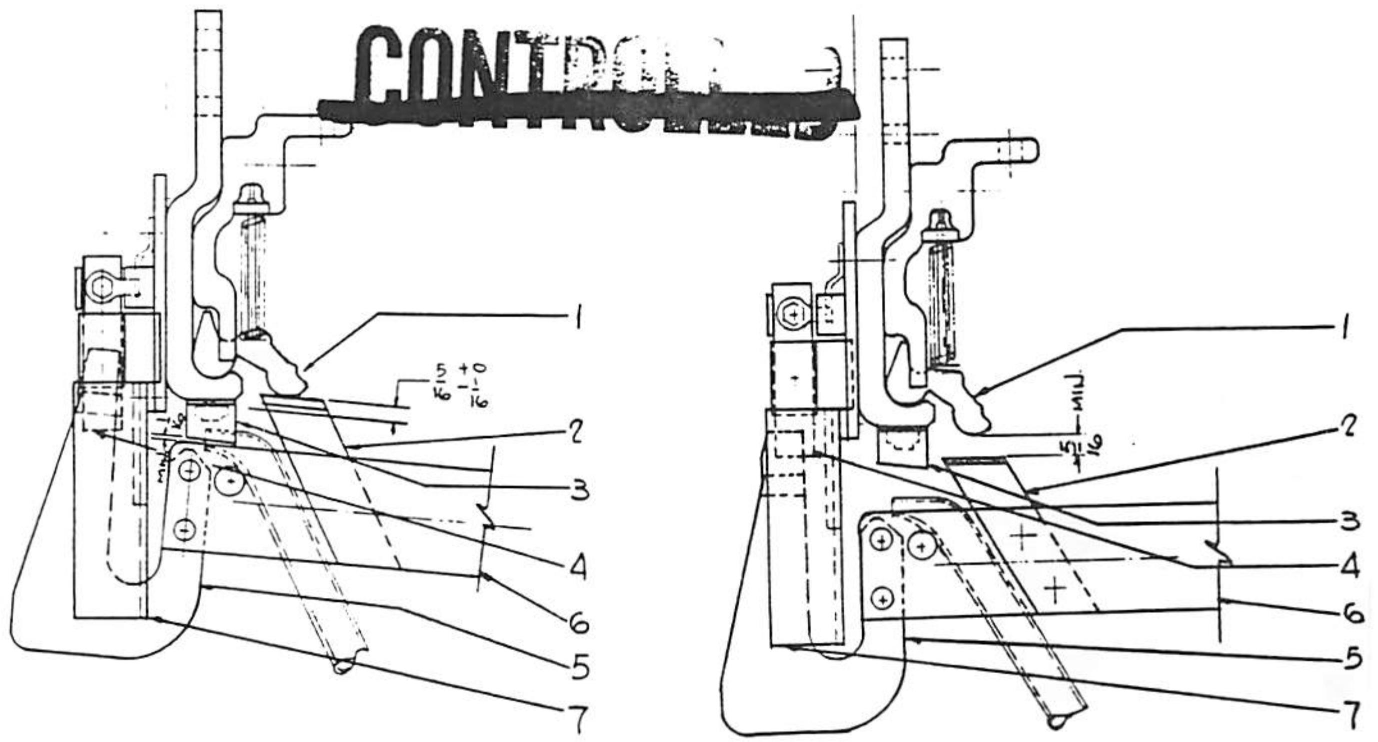
ADJUSTMENTS

All adjustments should be checked 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 after removing the box barriers and front cover from the breaker.

DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING.

Arcing Contact Wipe

Refer to Figure 9. Close the breaker until



Primary Contact Wipe

Arcing Contact Wipe

Figure 9. "-9" Contact Structure (0132C2709)

Figure 9 Contact Adjustments

1. Stationary Primary Contacts
2. Movable Primary Contacts
3. Buffer Block
4. Stationary Arcing Contacts
5. Movable Arcing Contacts
6. Contact Arm
7. Throat Baffle

the arcing contacts just touch. This can be determined with the use of a circuit continuity tester such as a light indicator 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 an indication that the arcing contacts need to be replaced. When making this check, see that the movable arcing contact (5) passes between the probes on the upper arc runner without touching. On the "-9" design, check for clearance between the arcing contact (5) and the slot in the throat baffle (7) during entire stroke of the moving contact assembly.

Primary Contact Wipe

Refer to Figure 9, when the breaker is closed the stationary primary contacts (1) should rise from 1/4" to 5/16". Before checking this dimension be sure the mechanism is re-set so that the prop pin (13) Figure 7 is resting on the prop. To obtain the proper contact adjustment, open the breaker and, referring to Figure 10, 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 (6) Figure 9 and the buffer block (3) should be 1/16" or greater when the breaker is fully closed.

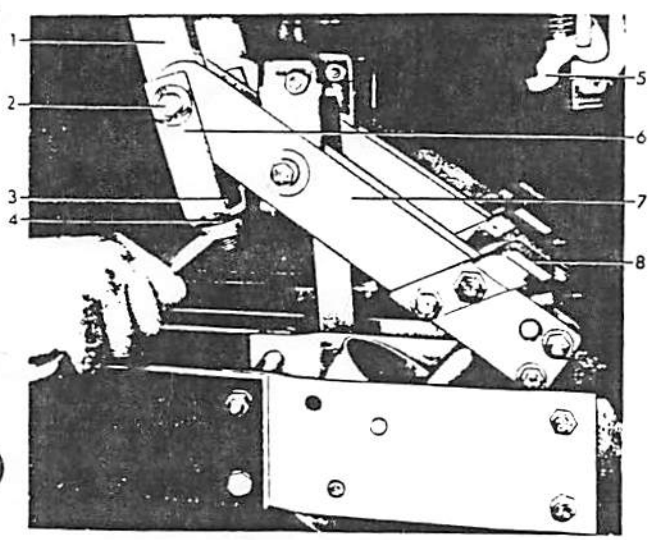


Figure 10. (8039618) Adjustable Coupling For Making Primary Contact Wipe Adjustments

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

Primary Contact Gap

Refer to Figure 10. 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 (8) measured between the closest points, should be 3 5/8" to 3 15/16". To change this gap, loosen the check nut (17) Figure 7, and turn the adjusting nut (18) on stud (19). Screwing the adjusting nut down will decrease the primary contact gap. Tighten the check nut and re-measure the contact gap (close and trip the breaker before checking the measurement). Whenever the primary contact gap is changed, the primary contact wipe should be rechecked and, if necessary, readjusted.

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

Trip Latch Wipe

Refer to Figure 7. The wipe of the trip latch (8) on the trip roller (9) should be from 3/16" to 1/4". This can be measured by putting a film of grease on the latch (8), closing the breaker part way, and tripping. The mechanism has the proper trip latch wipe when the latch rests against the stop pin (23). 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 (7).

Trip Armature Travel

* Refer to Figure 7. The trip armature (4) should have 1/16" to 3/16" travel before the trip latch (8) starts to move plus 1/32" minimum overtravel after tripping.
This can be adjusted by moving the trip coil support (2) and/or by adjusting the trip armature screw (12) Figure 11. A locking screw located behind the trip armature screw must first be loosened. Retighten locking screw after making adjustment.

Release Latch Wipe

Refer to Figure 6. The wipe between the release latch (8) and roller (6) should be 3/16" to 1/4". If re-setting is required, loosen, set, and retighten adjustment nut and screw (10).

Release Latch Monitoring Switch

Refer to Figure 6. The release latch must be fully re-set and the latch monitoring switch (13) operated before the motor will start. When the latch is fully reset the clearance between the switch striker arm and the switch mounting bracket (14) is 1/32" or less, this can be adjusted by bending the striker arm.

Motor and Relay Switches

Refer to Figure 6. With the closing springs blocked rotate the switch cam (2) until the switch

* Indicates revision

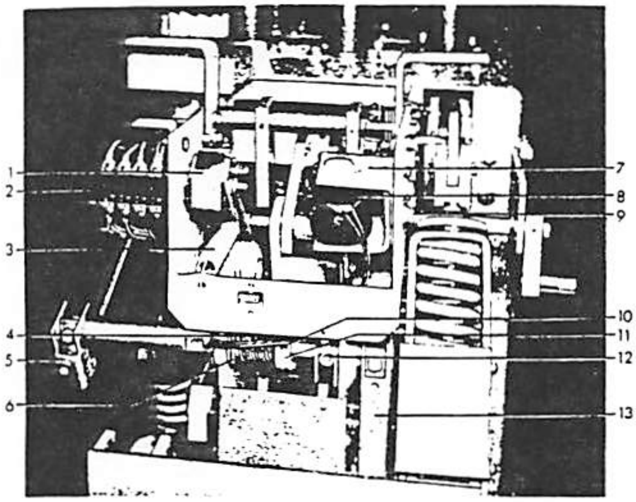


Figure 11. (8039585) Auxiliary Switch and Trip Coil

1. Open - Close Indicator
2. Auxiliary Switch
3. Prop Spring
4. Trip Latch Spring
5. Spring Discharge Crank
6. Cotter Pin
7. Trip Coil Support
8. Trip Coil
9. Mounting Bolts
10. Latch Set Screw
11. Trip Latch
12. Trip Arm Screw
13. Manual Trip Lever

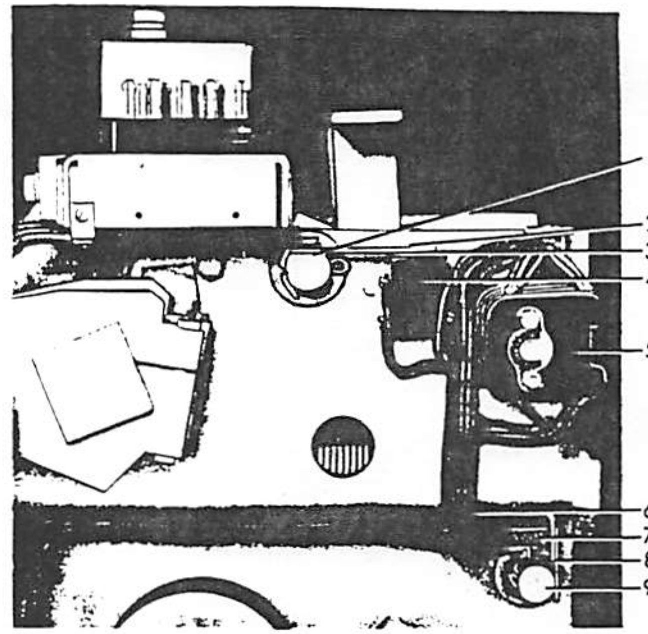


Figure 12. (8034474) **Positive Interlock Switch**

1. **Positive Interlock Shaft**
2. **Switch Arm**
3. **Switch Support**
4. **Interlock Switch**
5. **Auxiliary Switch**
6. **Switch Support**
7. **Latch Checking Switch**
8. **Switch Arm**
9. **Trip Shaft**

striker (3) has traveled the maximum amount (about 180 degrees rotation of cam). At this point the clearance between the striker and the switch support (5) should be 1/32" or less. This can be adjusted by loosening the switch support mounting bolts (4) and rotating the support.

Interlock Switch Wipe

Refer to Figure 12. With the positive interlock in the reset, or normal position the clearance between the interlock switch arm (2) and the switch mounting plate (3) should be 1/32" or less. This can be adjusted by bending the switch arm.

Driving Pawl Adjustment

Refer to Figure 4. The driving pawl (8) must advance the ratchet wheel (6) sufficiently on each stroke to allow the latching pawls (2) to fall into the ratchet teeth. This should be checked with the closing spring load against the driving members. With the mechanism unblocked, hand charge the closing springs with the manual charging wrench until they are slightly more than half charged. Slowly rotate the charging wrench until the driving pawl has traveled through its return stroke and check the maximum clearance between the pawl and the ratchet tooth. Rotate the charging wrench until the driving pawl has advanced the ratchet tooth to its maximum travel. Now check the clearance between the ratchet tooth and the latching pawl. The clearance should be approximately equal for both the driving and latching pawls and not less than .015" in either case.

If adjustment is required for either pawl the springs must first be fully charged and blocked. Loosen seven motor support bolts (2) Figure 1 and move entire motor assembly to the rear if the clearance is under the minimum at the latching pawls, and to the front if the clearance is under the minimum at the driving pawl. Move the motor assembly approximately twice the dimensional increase required at the pawl. Be certain the motor assembly is moved straight forward or rearward and tighten the one bolt on the right side of the mounting frame first to assure proper alignment. After tightening the remaining bolts the springs should be released and the clearance again checked as described above.

* Crank Shaft End Play

The outboard cranks (12) Figure 7 on the crank shaft should be adjusted so the end play side to side is less than 0.015 inch. After this adjustment is made, the clearance of the prop pin (13) Figure 7 to the frame is a minimum of 0.025 inch.

AUXILIARY DEVICES

Latch Checking Switch

Refer to Figure 13. Charge the closing springs sufficiently to reset the mechanism linkage. Rotate the trip latch (4) by pressing the manual trip lever

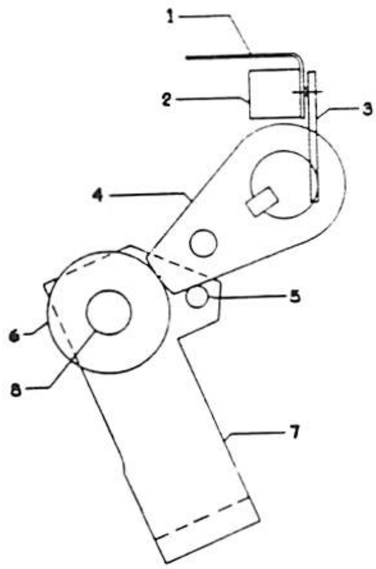


Figure 13. (0114C5320) Latch Checking Switch

1. Switch Support
2. Latch Checking Switch
3. Switch Arm
4. Trip Latch
5. Reset Pin Stop
6. Latch Roller
7. Latch Roller Link
8. Latch Roller Pin

to open the latch checking switch (2). Allow the trip latch to reset slowly and determine the point at which the contacts are made by using a circuit continuity tester (light indicator, bell set, etc). The contacts of the latch checking switch should just make when the gap between the trip latch (4) and the stop pin (5) located on the latch roller link (7) is 1/16". There should be a minimum of 1/64" between the switch arm (3) and the switch support (1). To obtain adjustment of the latch checking switch, bend the latch checking switch arm (3).

Plunger Interlock

Refer to Figure 14. With the breaker in the closed position, the vertical distance "A" from the top of the plunger bolt (1) to the bottom of the breaker lifting rail (3) should be 16-19/32" to 16-23/32". To change this adjustment, add or remove washers (2).

Auxiliary Fuses

Refer to Figure 15. On breakers with a "C" or "K" suffix, a set of protecting fuses (10) are mounted on the front of the breaker. These fuses are the primary protective devices for the closing control circuit on those breakers that are used in metal-clad units designed for solenoid operated breakers.

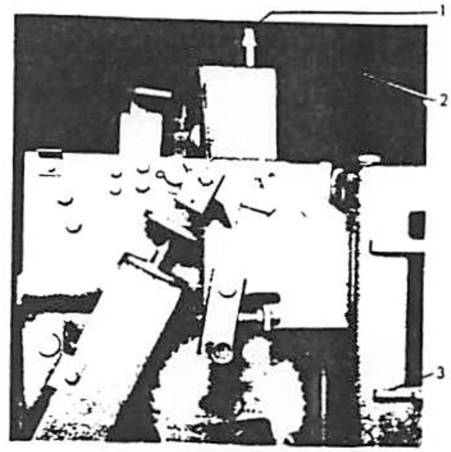


Figure 14. (8034464) Plunger Interlock

1. Plunger Bolt
2. Washer
3. Breaker Lifting Rail

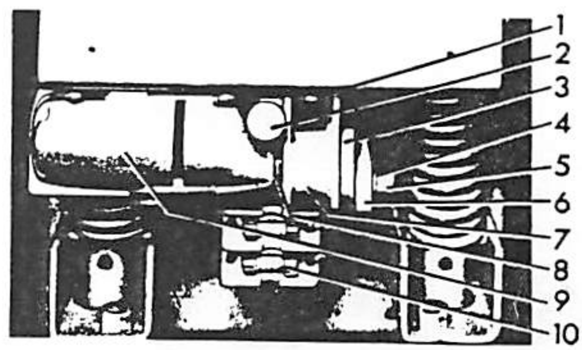


Figure 15. (8034471) Driving Elements

1. Mounting Bolts
2. Manual Close Button
3. Eccentric
4. Retaining Ring
5. Hex Charging Stud
6. Driving Link
7. Motor Support
8. Retaining Ring
9. Motor
10. Fuse

Inspection and Test

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

   a. Primary contact wipe: 1/4" to 5/16".
   b. Arcing contact wipe: 5/16" or greater gap at primary contacts.
   c. Primary contact gap: 3-5/8" to 3-15/16".
   d. Trip latch wipe: 3/16" to 1/4" with trip latch resting against stop pin.

   * e. Trip armature travel 1/16" to 3/16" plus 1/32" minimum overtravel.

   f. Release latch wipe: 3/16" to 1/4".
   g. Release latch monitoring switch: Maximum clearance 1/32".

* Indicates revision

h. Motor and relay switch: maximum clearance 1/32".
i. Interlock switch: maximum clearance 1/32".
j. Driving and Latching Pawl: minimum clearance to ratchet teeth .015".
k. Latch checking switch contacts make when the gap between the trip latch and the stop pin is 1/16".
l. Plunger interlock: 16-19/32" to 16-23/32".

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. (Page 16 and Figure 17).

5. Operate the breaker slowly with the manual charging wrench 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 is repainted immediately.

7. Check the trip coil plunger and the release coil plunger to see that they move freely.

Opening and Closing Speeds

The closing speed of the arcing contact of the breaker should be a minimum of 11 feet per second. This represents the average speed of the movable arcing contact from a point 3" before the tip is tangent to the lower surface of the probes on the upper arc runner to the tangent position.

The opening speed of the arcing contact should be a minimum of 12 feet per second. This 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 probes on the upper runner. Proper servicing and lubrication of the breaker and its operating mechanism should maintain these speeds and no adjustment is provided.

Control Power Check

After the breaker has been operated several times with the manual charging wrench and the mechanism adjustments are checked as described, the operating voltages should be checked at the release coil, trip coil, and motor terminals. Control Power for electrical operation of the breaker may be from either an alternating or direct current source. The operating ranges for the closing and tripping voltages as given on the breaker nameplate, are as follows:

Nominal Voltage	Closing Range	Tripping Range
24v d-c	- -	14 - 30v d-c
48v d-c	34 - 50v d-c	28 - 60v d-c
110v d-c	80 - 115v d-c	60 - 125v d-c
125v d-c	90 - 130v d-c	70 - 140v d-c
220v d-c	160 - 230v d-c	120 - 250v d-c
250v d-c	180 - 260v d-c	140 - 280v d-c
115v a-c	95 - 125v a-c	95 - 125v a-c
230v a-c	190 - 250v a-c	190 - 250v a-c

If the closed circuit voltage at the terminals of the coil or motor does not fall in the specified range, check the voltage at the source of power and line drop between the power source and breaker.

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 or motor of each breaker must fall within the specified limits.

Electrical closing or opening is accomplished by 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 or close the breaker manually by pressing the manual trip lever (8) Figure 5 or the manual close button (9).

GENERAL MAINTENANCE

General

Safe and dependable service from electrical apparatus and power systems is contingent upon reliable performance of power circuit breakers. To obtain maximum reliability the breaker should be inspected and maintained on a regular schedule. The breakers are designed in accordance with applicable standards which require that they be capable of performing up to 5000 operations for 1200 ampere breakers and 3000 operations for 2000 ampere breakers switching rated continuous current before any replacement of parts should be necessary. This requirement is based on the breakers being serviced, or maintained, at least every 2000 operations, or once per year, whichever comes first. If the breaker is also required to interrupt fault currents during this period of time additional maintenance and replacement of parts may be necessary.

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

VENT ACCIDENTAL TRIPPING. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE THE SPRINGS ARE CHARGED UNLESS THEY ARE SECURED IN THAT POSITION BY THE MAINTENANCE SPRING BLOCKING DEVICE.

Periodic Inspection

The frequency of the inspection and maintenance operations required should be determined by each operating company and will depend on the application of the breakers and the operating conditions. Factors which should be considered are: Importance to overall plant or system operation; number of operations and magnitude of currents switched by breaker; frequency of fault interruptions; and the atmospheric conditions in which the breaker normally operates. Extreme conditions of dust, moisture, corrosive gases etc., can indicate that inspection and maintenance will be required more frequently than every 2000 operations. Very clean dry operating conditions with low current switching duty can justify a longer period of time between inspections. Any time a breaker is known to have interrupted a fault at or near its rating it is recommended that the breaker be inspected and necessary maintenance be performed as soon after the interruption as is practical. The following instructions give the items that should be included in an inspection and general recommendations on the maintenance of breakers.

Interrupters

Since there are no moving parts, the interrupters of a magne-blast breaker will normally require little or no inspection unless there is evidence of damage to the arc chutes sides or contamination in the throat area. If either of these conditions are present the interrupters should be removed from the breaker and the following points noted:

1. The throat area of the interrupter should be cleaned with sandpaper (Do Not use emery cloth or other metallic abrasives). All flat areas on either side of the movable arcing contact travel should be sanded. Do not sand or otherwise attempt to clean the ceramic fins of the arc chute sides. Heavily contaminated parts should be replaced.

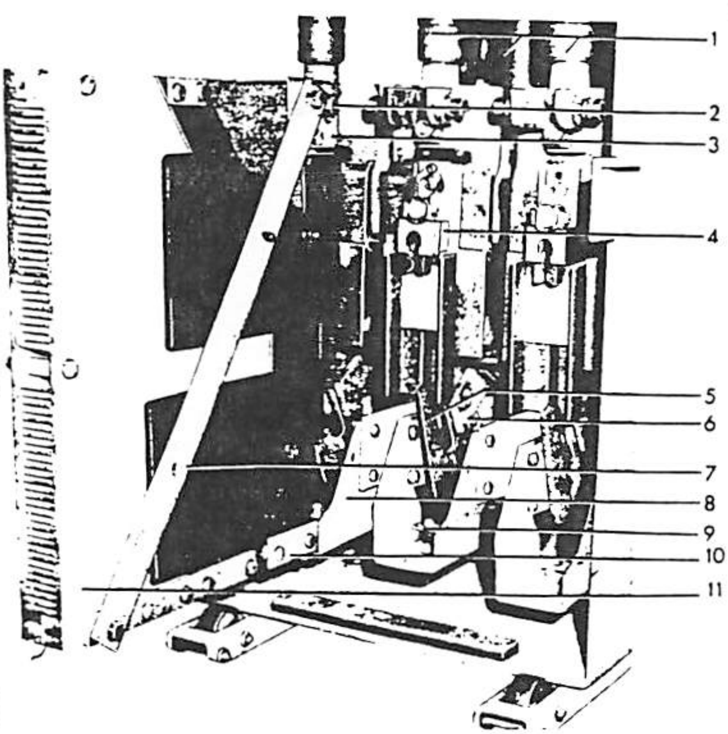
2. Cracks which have formed in the fins of the arc chute are to be expected in ceramic materials of this type when subjected to the severe heat of an arc. These cracks do not interfere with the operation of the device in any way and should be disregarded.

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 will be necessary. Small broken corners on the exhaust end of the arc chute sides will not interfere with its performance and can be disregarded.

4. The plastisol flexible covering for the pole pieces (3 & 6) Figure 18 should be inspected for breaks in the insulation. If there are holes or breaks in the insulation they should be repaired or the part replaced.

* Electrical Connections

To assure that the electrical connections have remained tight, they should be checked during installation as well as during each maintenance inspection. This check of electrical connections is particularly necessary on breakers used in nuclear generating stations and other critical applications. The bolted braid connections on the stationary arcing contacts should be checked for tightness by removing the arc chutes as described on page 15.



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

Figure 16. (8917442A) Interrupter Removed Showing Accessibility of Arcing Contacts

* Indicates revision

The lubrication chart, Figure 17, 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, and should be used when a general overhaul of the breaker is necessary.

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

*

PARTS	LUBRICATION AT MAINTENANCE PERIOD	ALTERNATE LUBRICATION (REQUIRES DISASSEMBLY)
Prop & Trip Shaft Bearings (Teflon coated bearings)	No lubrication required	No lubrication required
Sleeve Bearings - main crank shaft, mechanism pawls, spring charging and operating linkages, etc. (Bronze)	Light application of machine oil SAE 20 or SAE 30.	Remove bearings or links, clean per instructions and apply D50H15 lubricant liberally.
Contact Arm Hinge Assembly Cup Bearing Loose rings between bushing and contact arm	No lubrication required	Wipe clean and apply D50H47.
Roller and Needle Bearings	Light application of machine oil SAE 20 or SAE 30.	Clean per instructions and repack with D50H15 lubricant.
Ground surfaces such as cams, ratchet teeth, etc. (Surfaces coated with MoS_2)	No lubrication required.	No lubrication required.
Ground surfaces such as latches, rollers, prop, etc.	Wipe clean and apply D50H15 lubricant	Wipe clean and apply D50H15 lubricant.
Silver plated contacts and primary disconnect studs	Wipe clean and apply D50H47 lubricant	Wipe clean and apply D50H47 lubricant.
Booster Cylinder	Do not lubricate	Do not lubricate
Arcing Contacts	Do not lubricate	Do not lubricate

Figure 17. Lubrication Chart

* METHOD OF CLEANING BEARINGS

Whenever cleaning of bearings is required, as indicated in the lubrication chart, the following procedures are recommended.

Sleeve Bearings

The sleeve bearings used in the prop (14) Figure 7 and the bearings for the trip shaft (7) utilize Teflon surfaces and do not require lubrication. After a number of operations, the surface will ac-

* Indicates revision

* quire a thin black film. Do not remove this film unless there is evidence of outside contaminants, such as dry or hardened grease. If contaminants are present they should be removed by immersing the prop and bearing in clean petroleum solvent, or similar cleaner, and using a stiff brush. Do not remove the bearings from the prop or frame. DO NOT USE CARBON TETRACHLORIDE.

The remaining sleeve bearings located in the driving element and the mechanism linkage and frame should be cleaned and relubricated with G-E D50H15 lubricant at general overhaul periods. This includes the bearings in the driving link (6) Figure 15, driving pawl lever (10) Figure 4, driving pawl (8), latching pawls (2), trip latch roller support (10) Figure 7, cranks (3), and the bearings in the mechanism frame and interconnecting links. Bearings that are pressed into the frame or other mechanism members should not be removed.

The cup bearing (24) Figure 8 of the primary contact arm should be disassembled, cleaned, and lubricated with G-E D50H47 lubricant at general overhaul periods.

The main shaft bearings (24) Figure 7 should be removed, cleaned, and lubricated with G-E D50H15 lubricant at general overhaul periods.

Roller and Needle Bearings

Refer to Figure 7. The cam follower bearings (6), latch roller bearing (9), and cam shaft bearings (25) should be removed from the mechanism and the inner race disassembled. 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 inductive 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 inner races should then be assembled.

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. 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 the light oil, draining and repacking with lubricant D50H15 should follow immediately.

Bearings that are pressed into the frame or other members such as the motor support (7) Figure 15, should not be removed. After removing the shaft and inner race the bearing can be cleaned satisfactorily with petroleum solvent or a similar cleaner and a stiff brush. Follow the procedure outlined above using a light machine oil and G-E lubricant D50H15 before reassembling the inner race and shaft.

Rolling Surfaces

A number of rolling and rubbing surfaces in the mechanism have been lubricated with a baked-on dry, molybdenum disulfide coating. This lubrication, which can be recognized by its dark, almost black color (e.g. Face of switch cam (5) Figure 2) requires no maintenance and should last the life of the breaker.

Other rolling or rubbing surfaces that are not lubricated with molybdenum disulfide should have the dried, dirty grease removed and a thin film of fresh lubricant D50H15 applied.

MAINTENANCE

Magne-blast breakers used for switching arc furnaces or capacitors will require more frequent and more detailed inspection and maintenance because of the repetitive nature of the applications. The following schedule is recommended for such breakers:

A. Every 500 Operations, or Every Six Months-Whichever Comes First:

1. Remove the box barriers.

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

3. All flat parts in the throat area of the interrupters should be thoroughly cleaned by using sandpaper. This cleaning should be performed any time the interrupter is removed. The fins on the arc chute sides should not be cleaned. Whenever the interrupter is removed, loose dust and dirt should be blown out before replacing arc chutes. Throat insulation which is heavily contaminated should be replaced.

B. Every 2000 Operations, or Every Six Months Whichever Comes First:

1. In addition to the servicing done each 500 operations, the following inspection should be made and work done when required.

2. Primary Contacts (3 and 10 Figure 23). 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 primary contacts should be greased lightly with D50H47.

3. Arcing Contacts (6 and 27 Figure 8). 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 interrupters for this 2000 operation servicing unless inadequate wipe or contact condition indicate a need for replacement. If the interrupters are removed, the contact braids, and other parts subject to arcing should be checked for possible cleaning or replacement. <u>Do not grease the arcing contacts under any circumstances.</u>

4. Check the breaker and mechanism adjustments as summarized under INSPECTION AND TEST. The necessary readjustments should be made as described under ADJUSTMENTS.

5. 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.

6. The contacts of the control relay (17) Figure 6, should be inspected for wear and cleaned if necessary.

7. Lubricate the breaker operating mechanism in accordance with instructions under LUBRICATION, page 16 and the lubrication chart Figure 17.

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

9. After the breaker has been serviced, it should be operated manually 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.

C. After Every 10,000 Operations:

1. In addition to the servicing done each 2000 operations, the interrupters should be removed from the breaker and disassembled to permit a detailed inspection of insulation, blow-out coils, arc runners and assemblies which can become contaminated by arc products.

2. 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.

3. 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.

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

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

6. 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.

7. The cup bearing and the contact ring at the hinge point of the contact blade should be disassembled, inspected, cleaned, and relubricated with G-E contact lubricant D50H47. The contact ring should be inspected for wear and replaced when reduced in thickness to less than 1/32". When reassembling the cup bearing, be sure the cotter pin is properly assembled in the castle nut on the hinge pin (7) Figure 23. This assures proper contact pressure at the hinge.

D. Every 20,000 operations or Approximately Every Five Years - Whichever comes first:

1. The breaker should be given a general inspection and overhaul as required. All excessively worn parts in both the mechanism and breaker should be replaced. Such wear will usually be indicated when the breaker cannot be adjusted to indicated tolerances. This overhaul and inspection is more detailed and will require disassembly of mechanism and breaker operating parts.

2. All roller and needle bearings in the operating mechanism should be disassembled, cleaned, and repacked with G. E. lubricant D50H15 as described under LUBRICATION.

3. The stationary primary contact fingers (3) Figure 23, should be disassembled and the silver-plated pivot area of the contact and contact support cleaned and lubricated with G-E lubricant D50H47.

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

REPAIR AND REPLACEMENT

This section covers the proper method of removing and replacing those parts of the breaker subject to damage and wear that may require repair or replacement at the installation. 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 and arc runners):

With the breaker open and the closing springs in the blocked position, remove the box barriers (7) Figure 8. The interrupter can now be removed as described under INTERRUPTER REMOVAL AND REPLACEMENT page 16.

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

NOTE: When disassembling the arc chute and its components some small washers, spacers, etc., will be found that cannot be identified in these instructions. Care should be taken to collect and identify these items so they can be reassembled correctly.

1. Remove the assembly bolts (7, 9, 11, &13) Figure 18.

2. Remove the side brace (5), and pole pieces (3 & 6).

3. To remove the upper arc runner assembly (4) Figure 20, remove assembly bolt (1) Figure 18.

4. Remove the assembly bolts (15) Figure 18 to remove the lower brace (8).

5. Remove the lower interrupter support (13) by removing the assembly bolts (14) and the connection nut (8) Figure 20.

6. At this point, the throat shields (5) Figure 20, and the lower arc runner assembly (6) can be removed.

7. Further disassembly of both the upper and lower arc runner assemblies can be done by removing the various screws and assembly bolts (not illustrated) as shown in Figure 19.

8. The arc chute sides (6) Figure 19, can also be separated for inspection after removing assembly bolts (2 & 4) Figure 18.

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

1. The fins of the arc chute sides should be equally spaced and aligned before bolting together. The front edge (along the runner) of the two arc chute sides should be parallel and in line.

2. The gap between the fins at the rear of the arc chute sides measured at least 1" in from the back end of the arc chute (See Figure 21) should be 1/64" to 3/32".

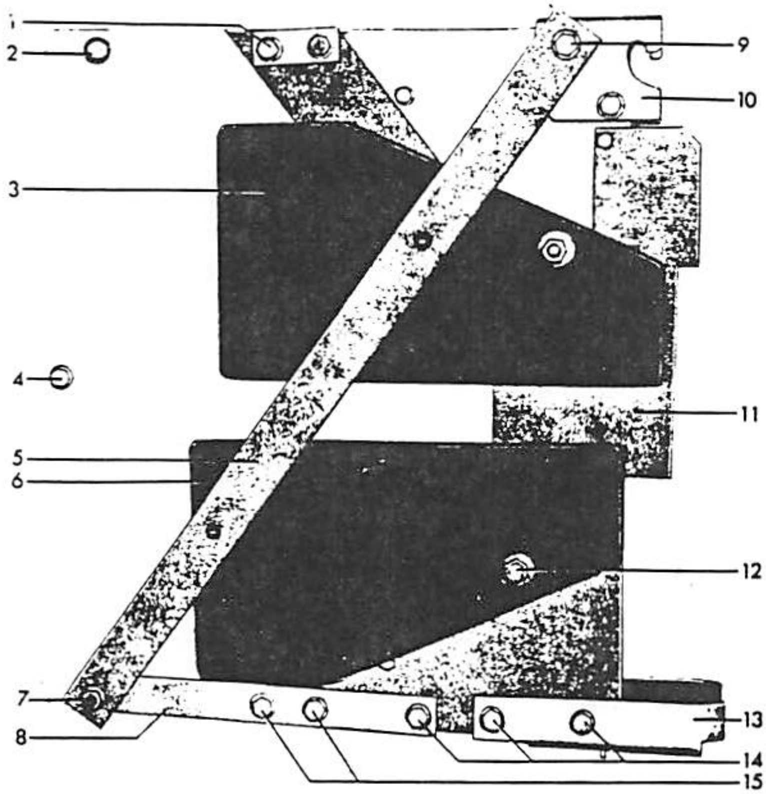
3. Check to insure that electrical connections to the blowout coils are tight.

4. When reassembling the arc runner assemblies, check that the spacers are correctly installed.

5. Before bolting the upper supports in place, make certain that the upper arc runner assembly is tight against the arc chute side so that the gap between the throat insulation (7) Figure 19, and the arc chute sides (6) is a minimum.

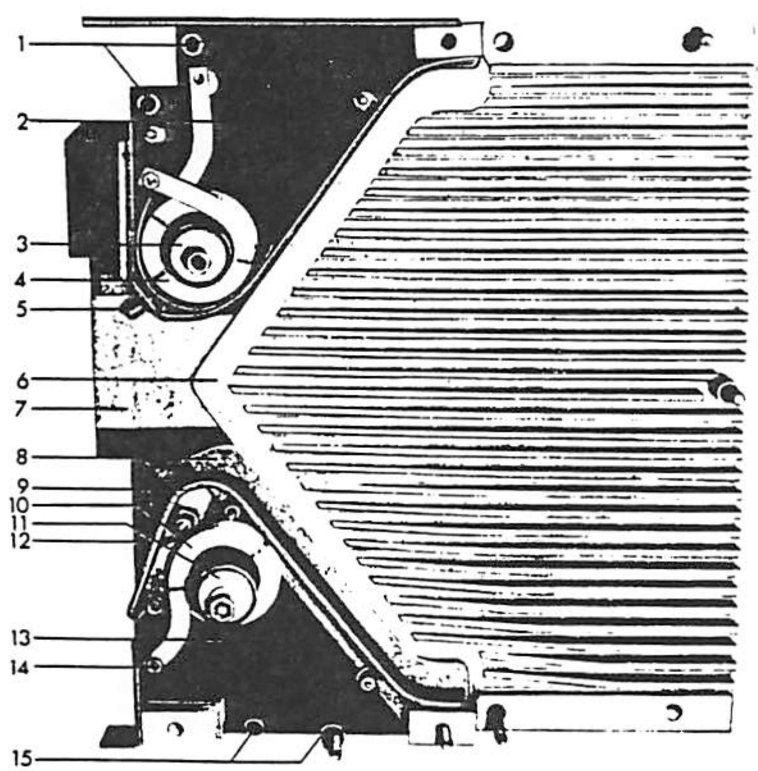
6. Make certain that the electrical connections (2 & 8) Figure 20 are tight.

Reassemble the arc chute on the breaker as described under INTERRUPTER REMOVAL AND REPLACEMENT, page 16.



1. Assembly Bolts and Bushing
2. Assembly Bolts
3. Upper Pole Piece
4. Assembly Bolt
5. Side Brace
6. Lower Pole Piece
7. Assembly Bolt
8. Lower Brace
9. Assembly Bolt
10. Upper Interrupter Support
11. Throat Shield
12. Assembly Bolt
13. Lower Interrupter Support
14. Assembly Bolts
15. Assembly Bolts

Figure 18. (8917442E) Interrupter Assembly



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

Figure 19. (8917442D) Interrupter Assembly with Side Removed

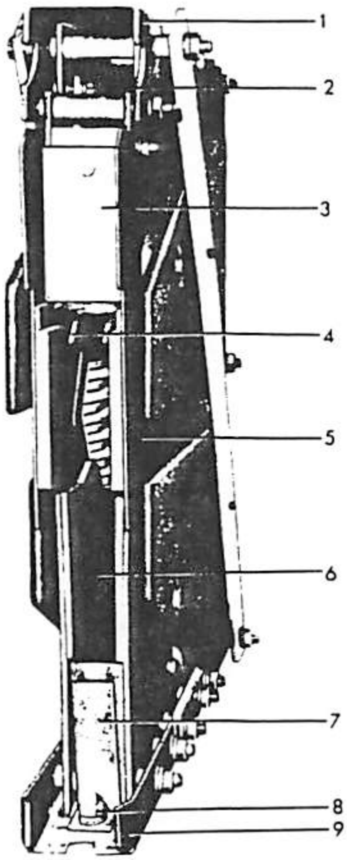


Figure 20. (8917442C) Interrupter Assembly

1. Upper Mounting Support
2. Connection Bolt
3. Insulation Plate
4. Upper Arc Runner Assembly
5. Throat Shield
6. Lower Arc Runner Assembly
7. Lower Coil Connection
8. Connection Nut
9. Lower Mounting Support

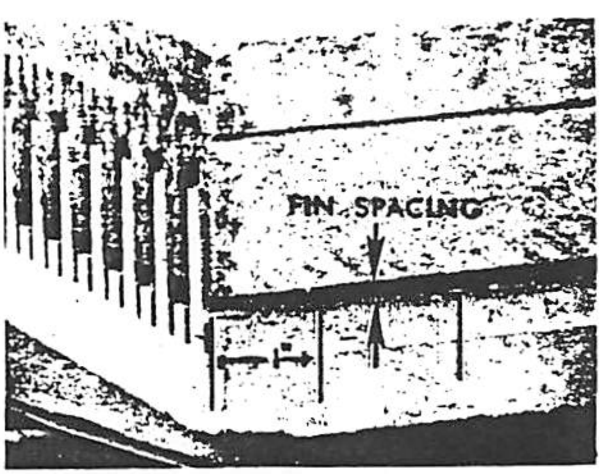


Figure 21. (8029373) Arc Chute Fin Spacing

CONTACTS

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

A. Stationary Arcing Contacts (10) Figure 22.

1. Disconnect the contact braids (7) from the contact fingers by removing two bolts and locking plates (8).

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 plate remove one bolt (5).

4. To disassemble stud plate from contact support, remove two bolts (6).

5. Reassemble in the reverse order, make sure locking plates are properly re-assembled with bolts (8).

B. Movable Arcing Contact (14) Figure 23.

1. Remove the assembly bolts (12) making note of quantity and location of shims and spacers used between contacts and contact arms.

2. Reassemble in reverse order, re-using the shims and spacers.

3. Close the breaker slowly to check that the movable arcing contact is approximately centered on the stationary arcing contact and that it does not rub on either side of the throat barrier (9).

NOTE: Whenever it is found necessary to replace arcing contacts on any pole of a breaker it is recommended that both the stationary and movable contacts on that pole be replaced at the same time.

C. Stationary Primary Contacts (9) Figure 24.

1. Compress the contact spring (6) by use of the spring compressor.

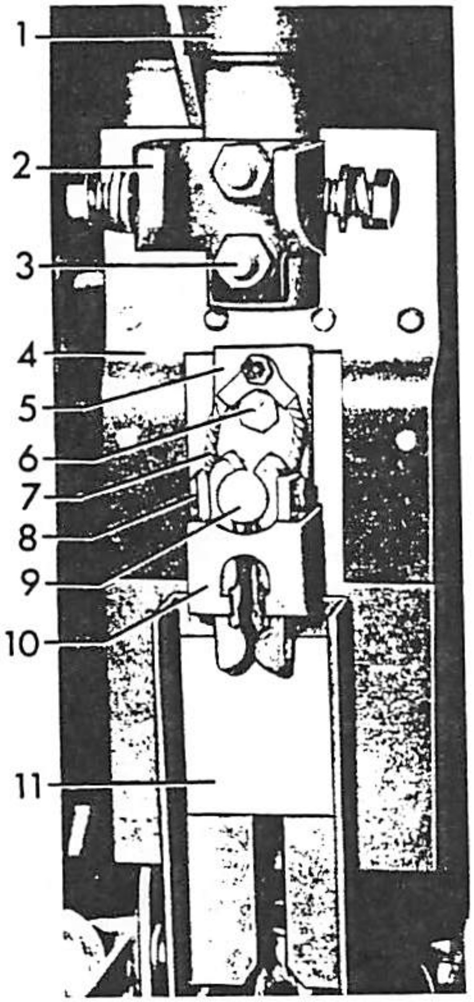
2. Remove spring and spring guide (1).

3. Raise the contact finger to clear the primary contact stop plate (8) and lift the finger out of contact support (7). Remove one contact finger at a time.

To replace the Stationary Primary Contacts:

1. Apply a thin coating of D50H47 grease on the hinged edge of the finger (9) then place it on the contact support (7) so

CONTROLLED



1. Rear Bushing
2. Guide and Support for Interrupter
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. Throat Baffle

Figure 22. (8917442B) Rear Bushing Assembly

that it is retained by stop plate (8).

2. Open spring compressor (3) and assemble spring guide, spring and spring compressor (Figure 24A).

3. Turn nut (2) in clockwise direction to compress contact spring (Figure 24B). Hold spring firmly in yoke on spring compressor to prevent 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 cutout in primary finger (Figure 24C).

5. Hold spring assembly firmly in place and remove spring compressor.

D. Movable Primary Contacts (10) Figure 23.

To replace the movable primary contacts on a 1200 ampere breaker proceed as follows:

1. Disassemble nuts from assembly bolts (11) and remove the movable primary contacts (10).

2. Reassemble in reverse order.

To replace the movable primary contacts on a 2000 ampere breaker it is first necessary to disassemble the movable arcing contacts, then proceed as follows:

1. Disassemble operating rod pin (4), first noting quantity and location of washers in the assemble.

 [redacted]

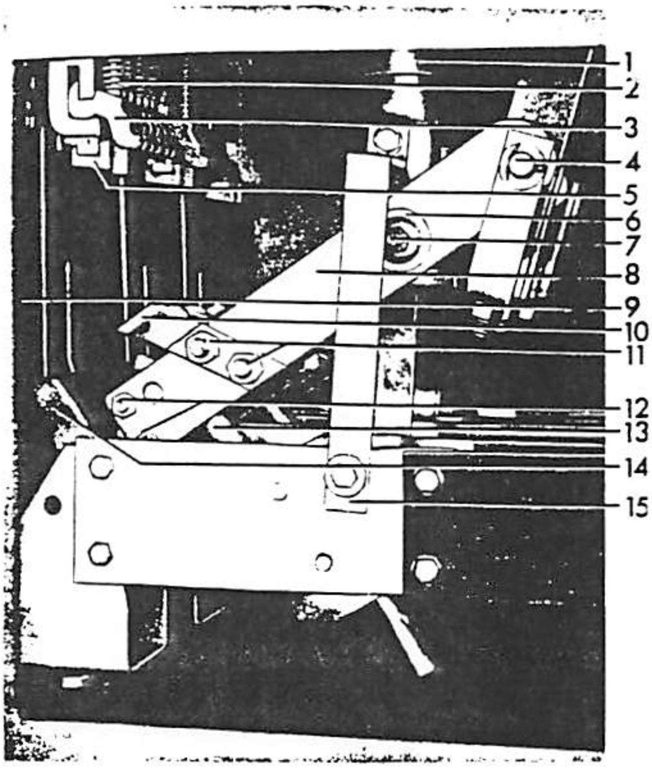


Figure 23. (8039588) Contact Assembly

1. Front Bushing
2. Contact Springs
3. Stationary Primary Contacts
4. Operating Rod Pin
5. Buffer
6. Cup Bearing
7. Hinge Pin
8. Contact Arm
9. Throat Barrier
10. Movable Primary Contacts
11. Assembly Bolts
12. Assembly Bolts
13. Piston Assembly
14. Movable Arcing Contact
15. Connection Bar

2. Pry contact arms (8) apart enough to disengage pivot pins of piston assembly (13) allowing piston to drop down into its booster cylinder.

3. Rotate the two parts of the contact arm assembly away from each other so assembly bolts (11) are accessible and movable primary contacts (10) can be removed.

4. Reassemble in reverse order.

E. Contact Arm Assembly (8, 10, 12, 14, Figure 23).

1. Remove connection bar (15).

2. Disassemble hinge pin (7), cup bearing (6), and operating rod pin (4) noting quantity and location of any washers and spacers used in assemblies.

3. The contact arm assembly including the piston assembly (13) can now be removed.

4. When reassembling, first insert piston tube assembly (13) into the booster cylinder and reassemble the cup bearing, making sure the silvered contact washers between the bushing and contact arms (both sides) are in place.

5. Reassemble operating rod pin (4) and connection bar (15).

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

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 insure interchangeability of the breakers in the metal-clad units. 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 reinstalled in the same location.

However, it is 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 interrupters are reinstalled.

To replace the bushing, proceed as follows:

Rear Bushing

1. Open the breaker and remove the box barrier and interrupters as already described.

2. Remove the upper and lower horizontal barriers (18 and 20) Figure 8.

3. Remove the four bolts at the mounting flange of the rear bushing being removed and lower the bushing assembly.

NOTE: Shims may be found between the breaker mounting plate and the bushing

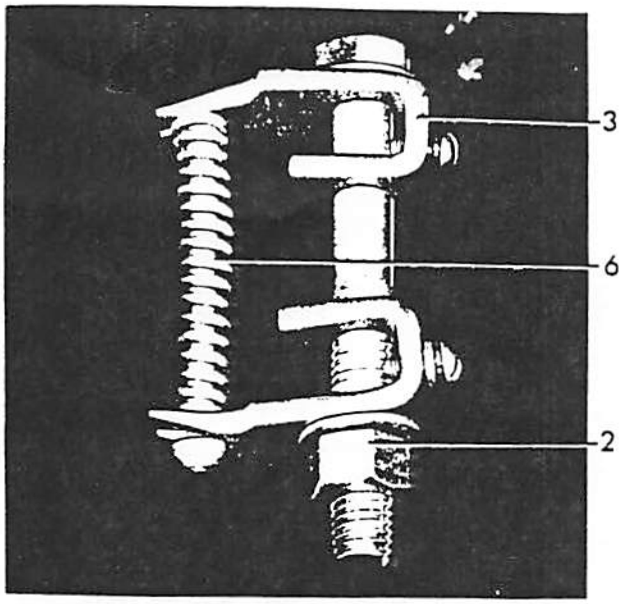


Figure 24A (8034466)

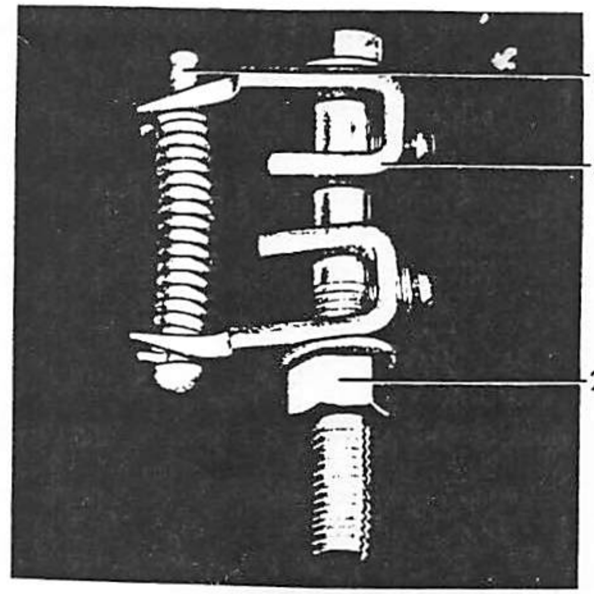


Figure 24B (8034465)

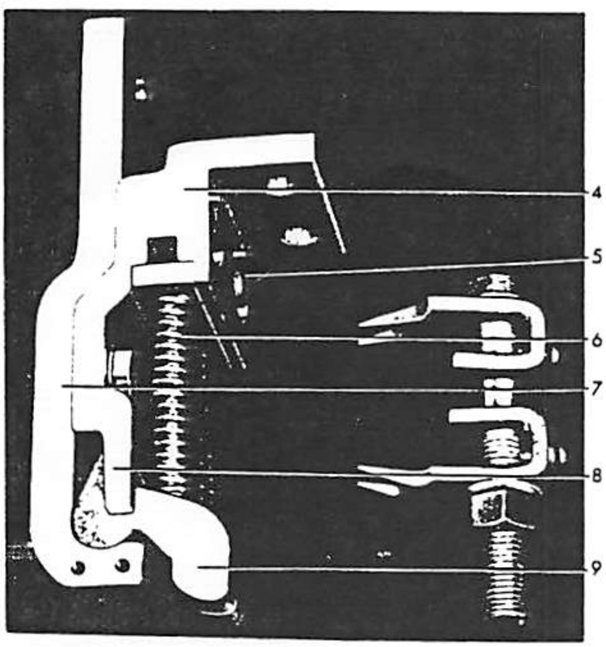


Figure 24C (8034469)

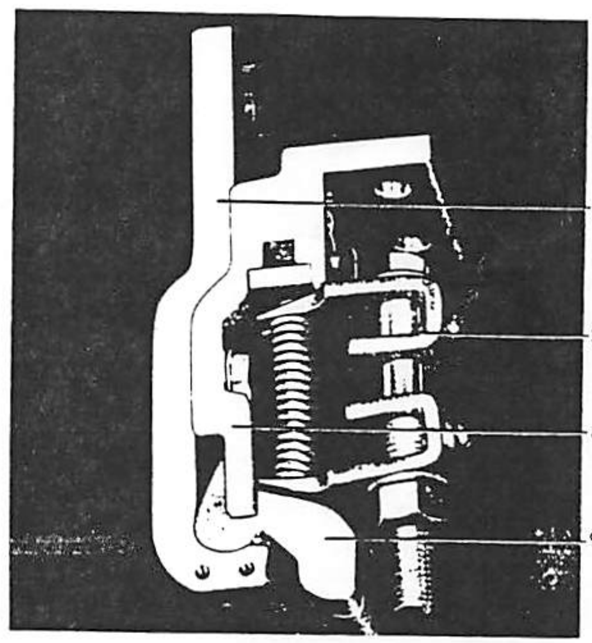


Figure 24D (8034468)

Figure 24. Method of Installing Primary Contact Springs Using a Spring Compressor

1. Spring Guide
2. Compressor Nut
3. Spring Compressor
4. Spring Retainer
5. Assembly Bolts
6. Spring
7. Contact Support
8. Stop Plate
9. Stationary Primary Finger

mounting flange on some, or all bolts. These shims are for squaring up the bushing and may be required when new bushings are assembled.

4. Referring to Figure 24, disassemble the primary contact springs (6) as previously described.

5. Disassemble the spring retainer (4) by removing mounting bolts (5).

6. Referring to Figure 22, disassemble the contact support (4) and interrupter mounting bracket (2) removing two bolts (3).

7. Reassemble in the reverse order. The interrupter mounting bracket (2) is not symmetrical and must be assembled correctly to orient the interrupter 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 interrupters as already described.

2. Remove the upper and lower horizontal barriers (18 and 20) Figure 8.

3. Remove the connection bar (15) Figure 23, cup bearing (6) and hinge pin (7).

4. Remove the four bolts at the mounting flange of the front bushing being removed, and lower the bushing. (See note under rear bushings concerning use of shims.)

5. When reassembling, first mount the bushing and assemble the cup bearing(6), contact arm (8), and replace pin (7) being sure the silvered contact washers between the bushing and contact arms are in place. The contact surfaces at the hinge point of the contact blade and bushing should have a thin coating of D50H47 grease.

6. Check all contact adjustments as outlined under ADJUSTMENTS.

INTERLOCK SWITCH

To remove the interlock switch (4) Figure 12, remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

LATCH CHECKING SWITCH

To remove the latch checking switch (7) Figure 12, (when furnished), remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

MOTOR, RELAY AND LIGHT SWITCHES

Two or three switches (7) Figure 6, are mounted in tandem as required by the application.

1. Remove the opening spring per instructions below.

2. Remove (2) mounting bolts (4) from switch bracket (5).

3. Remove the (2) mounting screws of the lower switch.

4. Remove the (2) mounting screws of the center switch.

5. Remove the (2) mounting screws of the upper switch.

6. Disconnect the lead wires of switch to be replaced.

7. Reassemble in the reverse order and check switch adjustment as explained under ADJUSTMENTS.

TRIP SHAFT AND LATCH (See Figure 11)

1. Remove spring discharge crank (5), manual trip lever (13) and if furnished, the latch checking switch operating arm (8) Figure 12 from the trip shaft.

2. Disengage trip latch spring (4) Figure 11.

3. Remove three (3) cotter pins from trip shaft.

4. Remove trip arm screw (12) and trip latch set screw (10).

5. Place a block between the trip latch (11) and the left side of the mechanism frame. Drive the trip shaft to the left until the latch is free of the key, then remove the key.

6. Check for and remove any burrs raised around the keyway on the shaft to avoid damaging the trip shaft bearings.

7. Shaft, latch, etc., may now be removed by driving it to the left. Note quantity and location of washers used as spacers in the assembly.

8. Reassemble parts in reverse order. Be sure trip latch is aligned in center of trip latch roller and that the latch spring is properly installed. Check latch adjustment as described under ADJUSTMENTS.

TRIP LATCH ROLLER BEARING

1. Remove (2) cotter pins at ends of trip latch roller shaft (8) Figure 13.

2. Partially remove shaft out right side of frame until latch roller (6) is free.

3. Reassemble in reverse order with proper spacing of washers. Be sure latch roller rotates freely.

CLOSING LATCH

1. Remove cotter pins at both ends of closing latch shaft (9) Figure 6.
2. Remove spring and paddle (12).
3. Remove set screws from latch (8).
4. Move shaft (9) to left (away from frame) by tapping lightly on the inside end of shaft. Rotate shaft and continue tapping until shaft is free. Shaft will push outside needle bearing from housing.
5. Reassemble in reverse order putting bearing into frame last. Use a small piece of tubing or pipe when inserting bearing to assure proper alignment.
6. Check closing latch adjustments as described under ADJUSTMENTS.

MOTOR SUPPORT

1. To remove motor support (7) Figure 15, first remove the closing latch spring (12) Figure 6.
2. Remove the retaining ring (4) Figure 15, and driving link (6).
3. Remove motor leads from the terminal board.
4. Remove six 3/8" bolts (1) Figure 15, on bottom and one 3/8" bolt on the right side (not shown).
5. Remove four mounting bolts from motor (not shown).
6. Remove the retaining ring (8) from the eccentric (3).
7. Reassemble all parts of the motor support in the reverse order and re-align it properly as described under DRIVING PAWL ADJUSTMENTS.

CAM

1. Remove 2 set screws from ratchet wheel (6) Figure 4 and remove wheel from main shaft (5).
2. Remove 2 set screws from switch cam (5) Figure 2 and remove cam from the main shaft.
3. Remove prop reset spring (4) Fig. 5.
4. Remove 2 set screws from cam (16) Figure 7, and move cam to the right on the shaft as far as it will go. Slide the shaft to the left until key is fully exposed. Remove key and check shaft for burrs.
5. Remove shaft out left side of frame.
6. Reassemble in reverse order using the correct number of washers and spacers to properly locate the parts.
7. Rotate the mechanism through a closing operation using the manual charging wrench. Check the location of the cam follower (6) Figure 7, on the cam (16). If necessary, move the cam to correct the alignment. Complete the closing operation and check the location of the prop pin (13) on the prop (14). It should be approximately centered.

TRIP COIL

To replace the potential trip coil (8) Figure 11, proceed as follows :

1. With the breaker in the open position, remove the two mounting bolts (9).
2. Remove trip coil support (7) and spacers.
3. Cut wires at the butt connectors and remove coil.
4. When replacing the coil be sure to assemble the correct fiber spacers at the ends before bolting support (7).
5. Adjust coil location to allow approximately 1/4" of armature travel before latch starts to move.
6. Butt connect wires and check operation of solenoid electrically and mechanically.

SPRING RELEASE COIL

To remove the spring release coil (15) Figure 6, proceed as follows:

1. Block the closing springs as described in INSTALLATION.
2. Remove the left hand closing spring as described in CLOSING SPRINGS below.
3. Remove two mounting bolts (11), coil support (16), and spacers.
4. Cut wires at the butt connectors and remove coil.
5. Replace the coil and the correct number of fiber spacers before bolting support.
6. Butt connect wires and check that the armature is not binding. Check coil for electrical operation.

CLOSING SPRINGS

The closing springs (12) Figure 4, can be removed as follows:

1. Charge the springs with the manual charging wrench and apply the spring blocking device as described in INSTALLATION.

2. Discharge springs by pushing manual close button (9) Figure 5.

3. Rotate cam shaft (5) Figure 4, by using the manual charging wrench until the gap between the spring (12) and the bearing block (7) is 2 inches or more.

4. Lift both springs until they clear the lower supports, then pull forward and down until the top supports are free.

5. Either discharge the opening springs by pushing the manual trip lever or block the opening springs with a suitable blocking device.

OPENING SPRINGS

To remove the opening springs (4) Figure 4, proceed as follows:

1. Charge and block the closing springs as described under INSTALLATION.

2. Push manual trip lever (8) Figure 5, to be sure the opening springs are fully discharged.

3. Remove upper pin (1) Figure 4, and lower pin (9).

4. After reassembling springs check the open gap at the primary contacts as described under PRIMARY CONTACT GAP.

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 minimize service interruptions caused by breakdowns, and saves time and expense. When continuous operation is a primary consideration, more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

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

NOTE: The listed terms "Right" and "Left" apply when facing the 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., are not listed and should be purchased locally.

4. For prices, refer to the nearest office of the General Electric Company.

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

In the following tabulations are listed those parts of the breaker and operating mechanism which are usually recommended for stock for normal maintenance. Other parts can be obtained by contacting the nearest office of the General Electric Company.

CONTROLLED

RECOMMENDED RENEWAL PARTS FOR
TYPE ML-13 STORED ENERGY MECHANISM
USED FOR AM-4.16-250-9 (*) 1200 & 2000 AMPE
(*) SUFFIX LETTERS - H, C, K, N, R

Fig. No.	Ref. No.	No. Req'd	Description	Catalog No.
5	10	1	Spring Charging Motor - **	
			48 V-DC	0105C9393P001
			110 & 125 V-DC & 115 V-AC, 60 Hz	0105C9393P002
			220 & 250 V-DC & 230 V-AC, 60 Hz	0105C9393P003
6	17	1	Relay - **, #	
			48 V-DC	0137A7575P004
			110 & 125 V-DC	0137A7575P001
			220 & 250 V-DC	0108B5565G004
			115V-AC, 60 Hz	0137A7575P005
			230V-AC, 60 Hz	0137A7575P002
5	3	1	Potential Trip Coil - **	
			110 & 125 V-DC	006174582G001
			220 V-DC	006174582G015
			250 V-DC	006174582G002
			115 V-AC, 60 Hz	006174582G013
			230 V-AC, 60 Hz	006174582G032
			24 V-DC	006275070G001
			48 V-DC	006174582G034
6	15	1	Closing Coil - **	
			110 & 125 V-DC	006174582G001
			220 V-DC	006174582G015
			250 V-DC	006174582G002
			115 V-AC, 60 Hz	006174582G010
			230 V-AC, 60 Hz	006174582G014
			48 V-AC	006174582G034
6	7	5	Switch, Normally Open	0456A0866P005
6	7	1	Switch, Normally Closed	0456A0866P006
5	1	1	Auxiliary Switch	0137A9192G011
6	12	1	Closing Latch Spring	0161A4231P001
5	4	1	Prop Spring	0137A9252P001
4	8	1	Driving Pawl Spring	0161A4241P001
4	2	2	Latching Pawl Spring - ø	0161A5909P001

** Refer to breaker nameplate or summary for proper voltage rating.

\# Quantity two (2) relays required on special control circuits. Check breaker and connection diagram.

ø Furnish 0161A4241P001 for breakers without closing spring discharge mechanism.

RECOMMENDED RENEWAL PARTS FOR

MAGNE-BLAST BREAKERS

TYPE AM-4.16-250-9△ 1200 & 2000 AMPERES

(△SUFFIX LETTERS H, C, N, K, B, & R)

Fig. No.	Ref. No.	Ampere Rating	Type	Catalog No.	No. Req'd.	Description
8	21	All	* *	0281B0708G002	3	Operating Rod Assembly
		All	B	0281B0708G008	3	
22	7	All	All	0236C0791G001	3	Flexible Conn. Right
22	7	All	All	0236C0791G004	3	Flexible Conn. Left
22	11	All	All	0195A7388G002	3	Throat Barrier Assembly
22	10	All	All	0236C0790G009	3	Arcing Contact Assembly
23	2	All	* *	0121A5964P001	18	Primary Contact Finger Spring
		All	B	0121A5964P001	24	
23	3	All	* *	0114C5382P002	18	Primary Contact Finger
		All	B	0114C5382P002	24	
23	10	All	* *	0114C5382P004	6	Movable Primary Contact
		All	B	0137A9164P003	6	
		All	B	0137A9164P004	6	
23	14	All	All	0108B5543G001	3	Movable Arcing Contact
23	13	2000	All	0213X0343G091	3	Tube & Piston Assembly
		1200	* *	0213X0343G090	3	
		1200	B	0213X0343G091	3	
19	7	All	All	0152C5960G001	3	Throat Insulation (Right)
		All	All	0152C5960G002	3	Throat Insulation (Left)
19	8	All	All	0227A5367P001	6	Lower Runner Shield
19	12	All	All	0152C5961P003	6	Lower Insulation Barrier

* * All Except Breakers with "B" in Suffix

CONTROLLED

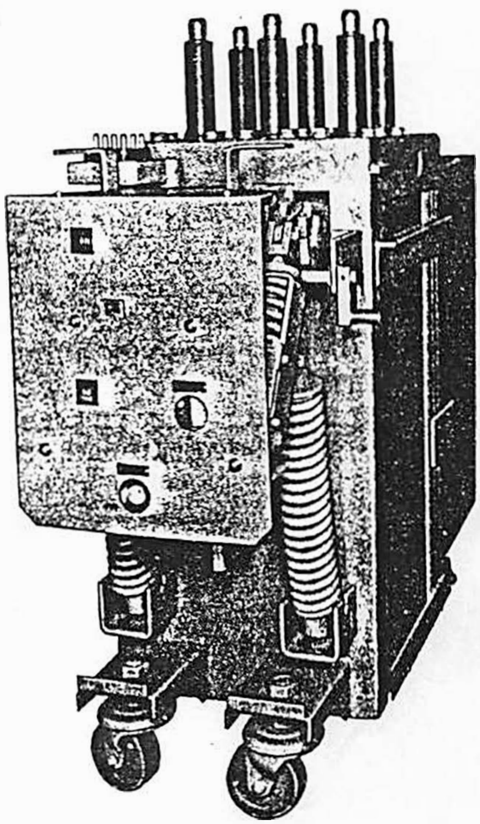
INSTRUCTIONS

GEI-88762A

MAGNE-BLAST CIRCUIT BREAKER

TYPES

AM-4.16-350-1C
AM-4.16-350-1H



CONTENTS

SWITCHGEAR PRODUCTS DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

MAGNE-BLAST CIRCUIT BREAKER

AM-4.16-350-1 (Δ)

Δ Letter Designation C, and H, used immediately following the model number indicates basic deisgn feature

INTRODUCTION

The magne-blast circuit breaker is the removable interrupting element for use in vertical-lift metal-clad switchgear, providing 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 maneuverability, 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. A sturdy, reliable operating mechanism assures low maintenance and long life.

The AM-4.16 magne-blast breaker is available in a number of current 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 ign, all instructions will be of a general character and all illust: ons 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 information for placing magne-blast breakers 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. 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 condenstation, 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.

INSTALLATION

1. Remove the box barrier and front cover and make a visual inspection to ascertain that the breaker and mechanism is in satisfactory condition. Check all bearing surfaces of the mechanism for lubrication. Refer to section on LUBRICATION (Page 15).

Charge the breaker closing springs manually using a 5/8" ratchet wrench to turn the driving eccentric (6) Fig. 4. Turning the eccentric counter clockwise will advance the ratchet wheel and compress the springs.

When the springs have reached the fully charged position the indicator (10) Fig. 4 will read "CHARGED", and the driving pawl will be raised from the ratchet wheel teeth. Additional turning of the eccentric will not advance the ratchet wheel.

Insert the spring blocking device (4) Fig. 4 and manually discharge the springs against the pins by pushing the manual release button (1) Fig. 4. The springs are now blocked and slow closing of the breaker contacts can be accomplished by again turning the driving eccentric with a 5/8" ratchet wrench.

During the slow closing operation check to insure that the mechanism does not stick or bind during the entire stroke, that it latches securely in the closed position, and that it trips freely when the manual trip lever is operated. The breaker should not be operated electrically until it has been operated several times manually to insure freedom of action. At this time, also check the following adjustments:

a. Primary contact wipe (Refer to page 7)
b. Arcing contact wipe (Refer to page 7)
c. Primary contact gap (Refer to page 7)

" DO NOT WORK ON EITHER THE BREAKER TO MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS PRECAUTION IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING."

After the adjustments have been checked, the springs can be unblocked. Rotate the driving eccentric until the indicator reads "CHARGED" and the ratchet wheel no longer is advanced. The blocking device can now be removed.

3. Attach test coupler to circuit breaker and operate electrically several times. Check the control voltage as described under "CONTROL POWER CHECK" (Page 11 and 12).

NOTE: If the breaker secondary wiring is to be given a hi-potential test at 1500 volts, remove both the motor leads from the terminal connection. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

4. Remove the test coupler and replace box barrier.

5. If breaker has been stored for a long period of time, it is recommended that the insulation be checked with a standard 60 cycle high potential test. Refer to INSULATION TEST (Page 14).

6. Lubricate the silver portion of the primary disconnect studs by rubbing a small amount of contact lubricant D50H47 to form a thin coating on the ball contact.

7. Refer to metal-clad instruction book GEH-1802 for final instructions before inserting the breaker into the metal-clad unit.

DESCRIPTION OF OPERATION

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 ML-13 operating mechanism shown on Figures 1, 2 and 3 is of the stored energy type designed to give high speed closing and opening. The mechanism will operate on a-c or d-c voltage as indicated on the breaker name plate. Closing and opening operations are controlled electrically by the metal-clad or remote relaying, and mechanically by the manual close and trip levers on the breaker. All secondary connections from the breaker to the metal-clad unit are made through the coupler (1) Fig. 1.

A positive interlock (2) Fig. 3 and interlock switch (2) Fig. 1 are provided between the breaker and metal-clad unit to prevent raising or lowering of the breaker in the unit while in a closing position and to prevent a closing operation when the breaker is not in either the fully raised or lowered position. A plunger can also be provided to operate an additional auxiliary switch mounted in the metal-clad unit.

When the breaker is interchangeable with MS-13 solenoid operated breakers in M-26 or M-36 metal-clad units, motor circuit fuses are mounted on the breaker for protection. These breakers are identified by the "C" suffix in the breaker nomenclature.

Spring Charging

The mechanism consists of a high speed gear motor that compresses a set of closing springs through the action of a simple eccentric, ratchet, and pawl assembly. The rotary action of a motor (2) Fig. 4 is converted to a short straight stroke pumping action through the eccentric (6) and a lever that carries a spring loaded driving pawl (5).

The pawl advances the ratchet wheel (3) Fig. 3 only a few degrees each stroke where it is held in position by the latching pawls (1). When the ratchet wheel has been rotated approximately 180 degrees the closing springs (6) will be fully compressed. As the ratchet wheel continues to rotate, the spring load will shift over center and attempt to discharge. After only a few degrees of rotation, the closing roller (10) Fig. 1 will engage the closing latch (11) and the compressed springs will be held in repose until a closing operation is required. During the last few degrees of the ratchet wheel rotation the motor and interlock switches (6) are released and the driving pawl is raised from the ratchet wheel surface. This allows the motor and driving mechanism to coast to a natural stop expending all residual energy.

During the time the springs are being compressed a relay (6) Fig. 6 locks the closing power circuits open and the relay will remain energized until the springs are fully charged and the control contacts are re-set.

The closing springs may be charged manually if control voltage is lost. A 5/8" ratchet wrench can be used to rotate the eccentric in a counter clockwise direction until the indicator reads "CHARGED" and the driving pawl no longer engages the ratchet wheel. The use of the ratchet wrench provides for maximum safety in the event that control power is suddenly restored without warning. In this event, the motor drive will take over again and continues to charge the springs.

Closing Operation

Closing the breaker is accomplished by energizing the closing solenoid or by manually pressing the close button. In either case, the closing latch is removed from the spring blocking location allowing the springs to discharge. The energy of the springs is applied to the rotation of a cam (16) Fig. 5 that closes the breaker ough a simple linkage that remains trip free at all times. A monitc switch (11) Fig. 6 on the closing latch will start the spring charg- motor after it is fully reset.

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 (7), Fig. 5, causing the operating mechanism linkage to collapse. The energy stored in the opening springs is thus released, opening the breaker. During this operation, the trip coil circuit is de-energizing, 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. 8. As the movable arcing contact (7) is withdrawn through the opening 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 emmitted from the booster tube (25) and forces the arc onto the lower arc runner (8). 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 dras the arc away from the arcing contacts. The interrupter contains three upper blowout coils and three lower blowout coils each individually connected in series with its respective section of arc runner. As the arc is forced outward along the diverging arc runners, the magnetic field is progressively increased with addition of each coil in the curcuit.

At the same time, the arc is being forced into the arc chute (3) 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 reestablish itself and, interruption occurs.

Manual tripping follows the same procedure except that instead of energizing the trip circuit, the manual trip (11) Fig. 2 is used.

Trip Free Operation

If the trip coil circuit is energized while the breaker is closing, the trip plunger will force the trip latch (8) Fig. 5 away from the trip roller (9) causing the mechanism linkage to collapse and the breaker to re-open. The closing cam (16) will complete its closing stroke and the springs will re-charge as in a closing operation.

ADJUSTMENTS

All adjustments should be checked 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 barriers and front cover.

"DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING."

Primary Contact Wipe

When the breaker is closed, as shown in Fig. 7, the stationary primary contacts (1) should rise to 5/16" +0 -1/16" for 1200A and 1/4" +0 -1/16" for 3000 A contact. Before checking this dimension be sure the mechanism is re-set so that the prop pin (13) fig. 5 is resting on the prop. To obtain the proper contact adjustment, open the breaker and, referring to Fig. 9, 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 (6) and the buffer block should be 1/16" or greater (as shown in Fig. 7) when the breaker is fully closed.

Arcing Contact Wipe

Refer to Fig. 7. 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 indicator 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 for 1200A and 3/8" or greater for 3000A. 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 between the opening in the upper arc runner without touching.

Primary Contact Gap

Refer to Fig. 9. 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 (17), Fig. 5 and turn the adjusting nut (18) on stud (19). Screwing the adjusting nut down will decrease the primary contact gap. Tighten the check nut and re-measure 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 (8) on the trip roller (9) should be from 3/16" to 1/4". this can be measured by putting a film of grease on the latch (8), closing the breaker part way, and tripping. The mechanism has the proper trip latch wipe when the latch rests against the stop pin (23). No adjustment is provided and the visual inspection is usually all that is required. If this setting is not correct, look for insufficient travel of the trip shaft (7).

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

Trip Latch Clearance

Refer to Fig. 5. With the breaker in the tripped position and the closing springs charged, check the clearance between the trip latch (8) and the trip roller (9). It should measure 1/32" to 1/16".

Prop Clearance

Refer to Fig. 5. With the breaker closed as far as possible, that is, with the springs blocked and the cam (16) rotated so that the prop pin (13) is at its maximum height over the prop (14), the clearance between the prop and the prop pin should be 1/16" to 5/32". No adjustment is provided and a visual inspection is usually all that is required.

Release Latch Wipe

Refer to Fig. 6. The wipe between the release latch (3) and the roller (2) should be 3/16" to 1/4 . If re-setting is required, loosen, set, and re-tighten adjustment nut and screw (4).

Release Latch Monitoring Switch

.he release latch must be fully re-set and the monitoring switch operated before the motor will start. The switch should be wiped by the striker so that the clearance between the striker and the switch mounting bracket (20) Fig. 6 is 1/32" or less. To obtain this adjustment bend the switch striker. Be sure the latch is fully re-set before making any adjustments.

Motor and Relay Switches

With the closing springs blocked rotate the switch cam (1) Fig. 6 until the switch striker (8) has traveled the maximum amount (about 180 degrees rotation of cam). Loosen mounting bolt (14) and rotate switch support (15) until the gap between the striker (8) and support (15) is 1/32" or less.

Interlock Switch Wipe

Refer to Fig. 10. Rotate the interlock shaft (1) manually clockwise to release the interlock 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 interlock switch (3), bend the interlock switch arm (2) until there is a maximum of 1/32" clearance to the switch mounting plate (4).

Auxiliary Switch

The auxiliary switch (9), Fig. 11 is mounted on the left side of the operating mechanism. The shaft of the position indicator (8) operates the auxiliary switch shaft which opens and closes the "a" and "b" contacts. The "a" contacts are open when the breaker is open and the "b" contacts are open when the breaker is closed. The "a" contacts should close when the breaker primary contact gap is a minimum of 1". The "b" contacts need only to be checked to see that they are open when the breaker is closed. No adjustment is provided and a visual inspection is usually all that is required.

Driving Pawl Adjustment

The driving pawl (5) Fig. 4 must advance the ratchet wheel (3) Fig. 3 sufficiently on each stroke to allow the latching pawls (1) to fall into the ratchet teeth. This should be checked with the maximum closing spring load against the driving members. With the mechansim unblocked, hand charge the closing springs with the manual charging wrench until they are slightly more than half charged. Slowly rotate the charging wrench until the driving pawl (5) Fig. 4 has traveled through its return stroke and check the maximum clearance between the pawl and the ratchet tooth. Rotate the charging wrench until the driving pawl has advanced the ratchet tooth to its maximum travel. Now check the clearance between the ratchet tooth and the latching pawl (1) Fog. 3. The clearance should be approximately equal for both the driving and latching pawls and not less than .015" in either case.

If adjustment is required for either pawl the springs must first be fully charged and blocked. Loosen seven motor support bolts (1) Fig. 14 and move entire motor assembly to the rear if the clearance is under the minimum at the latching pawls, and to the front if the clearance is under the minimum at the driving pawl. Move the motor assembly approximately twice the dimensional increase required at the pawl. Be certain the motor assembly is move straight forward or rearward and tighten the one bolt on the right side of the mounting frame first to assure proper alignment. After tightening the remaining bolts the springs should be released and the clearance again checked as described above.

AUXILIARY DEVICES

Latch Checking Switch

Refer to Fig. 12. Rotate the trip latch (4) clockwise (looking at the left side of the mechanism) by pressing the manual trip lever to open the latch checking switch operating arm (3). Allow the trip latch to reset slowly and determine the point at which the contacts make by using a circuit continuity tester, such as a light indicator or bell set. The contacts of the latch checking switch chould just make when the gap between the trip latch (4) and the stop pin (5) located on the crank (7) is 1/16". There should be a minimum of 1/64" between the operating arm (3) Fig. 12 and the switch support (1). To obtain adjustment of the latch checking switch (2) bend the latch checking switch operating arm (3).

Plunger Interlock

Refer to Fig. 13. With the breaker in the open position, the vertical distance "A" from the top of the interlock bolt (1) to the bottom of the elevating bar (3) should be 10-7/32" plus or minus 1/16". To change this adjustment, add or remove washers (2).

Auxiliary Fuses

Refer to Fig. 14 on breaker with "C" suffices, a set of protecting fuses (4) are mounted on the front of the breaker. These fuses will be the primary protection devices for the closing control circuits on these breakers that are used in metal-clad units designed for solenoid operated breakers.

Inspection and Test

1. For ease in reviewing the adjustments, the following are recapitulated:
   a. Primary contact wipe: 5/16" + 0 - 1/16". 1200A, 1/4" + 0 - 1/16" 3000A.
   b. Arcing contact wipe: 5/16" for 1200A, 3/8" for 3000A 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. Trip latch clearance: 1/32" to 1/16".
   f. Prop clearance: 1/16" to 5/32".
   g. Release latch wipe: 3/16" to 1/4"
   h. Release latch monitoring switch: maximum clearance 1/32"
   i. Motor and relay switch: maximum clearance 1/32"
   j. Interlock switch: maximum clearance 1/32"
   k. Auxiliary switch "a" contacts close when breaker primary contact gap is 1" or greater.
   l. Driving and Latching Pawl: minimum clearance to ratchet teeth .015".
   m. Latch checking switch contacts make when the gap between the trip latch and the stop pin is 1/16"
   n. Plunger interlock: 10-7/32" plus or minus 1/16"
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 mechansim have been lubricated. Refer to the section on LUBRICATION.

5. Operate the breaker slowly with the manual charging wrench 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 is repainted immediately.

7. Check the trip coil plunger and the release coil plunger to see that they move freely.

Opening and Closing Speeds

The closing speed of the arcing contact of the breaker should be a minimum of 14 feet per second. This represents 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.

The opening speed of the arcing contact should be aminimum of 15 feet per second. This represents the average speed over 3" from the point when the tip on the movable contact is tangent to the lower surface of the upper runner.

Control Power Check

After the mechanism has been closed and opened slowly several times with the maintenance closing wrench and the mec [illegible]ism adjustments are checked as described, the operating voltages shou[illegible] e checked at the release coil, trip coil, and motor terminals. Fo[illegible] ectrical operation of the mechanism, 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. The following ranges are standard:

Nominal Voltage	Closing range		Tripping Range	
	Min.	Max.	Min.	Max.
48V d-c	34	50v d-c	28	60v d-c
110v d-c	80	115v d-c	60	125v d-c
125v d-c	90	130v d-c	70	140v d-c
220v d-c	160	230v d-c	120	250v d-c
250v d-c	180	260v d-c	140	280v d-c
115v a-c	95	125v a-c	95	125v a-c
230v a-c	190	250v a-c	190	250v a-c

If the closed circuit voltage at the terminals of the coil or motor does not fall in the specified range, check the voltage at the source of power and line drop between the power source and breaker.

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 or motor of each breaker must fall within the specified limits.

Electricalls 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 or close the breaker manually by pressing the manual trip lever (11) Fig. 2 or the manual close button (7).

Before the breaker is finally raised into position in the metal-clad unit, rub a small amount of G-E contact lubricant D50H47 on the silvered portion of the breaker studs to form a thin coating for contacting purposes.

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. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE THE SPRINGS ARE CHARGED UNLESS THEY ARE SECURED IN THAT POSITION BY THE MAINTENANCE SPRING BLOCKING DEVICE.

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 cracks do not interfere with the operation of the device in any way and should be disregarded.
3. If the arc chute has suffered any mechanical injury due to dropping or accidental striking, resulting in actual breaking off of fins, replacement of the chute will be necessary. Small broken corners on the exhaust end of the chute will not interfere with its performance and can also be disregarded.
4. The plastisol flexible covering (20) for the pole pieces (18) Fig. 18 should be inspected for breaks in the insulation. If there are holes or breaks in the insulation they should be repaired or the part replaced.

Arc Chute Removal

The arc chutes of the 4.16 KV 350 MVA breakers require a mechanical aid to remove and replace them at general maintenance periods. This can be accomplished by an overhead crane, a portable hoist, or by an arc chute lifter especially designed for this purpose.

The Arc Chute Lifter (16) Fig. 18 bolts on the top plate of the breaker, in line with the chute to be removed, and 1 lift, transport, and release the chute as necessary.

To use the Arc Chute Lifter proceed as follows:

1. Remove box barrier (2) Fig. 8.
2. Bolt angle support (22) Fig. 18 in place on the top of the breaker.
3. Place the arc chute lifter (16) Fig. 18 over the rear bushing and into the proper slots.
4. Lower grappling hooks (11) by turning handle (14) clockwise until hooks can be placed in lifting supports (21) in arc chute (19).
5. Turn handle counter-closkwise until hooks begin to lift arc chute.
6. Loosen the three upper supporting bolts (2) Fig. 18 and the one lower supporting bolt (3) by using a 3/4" wrench.
7. Turn handle of arc chute lifter counter-clockwise and move chute gently from side to side until both support catches and mounting stud are clear.

8. Move trolly (15) Fig. 18 of the arc chute lifter to the rear
9. Turn handle of arc chute lifter clockwise until arc chute is resting on the floor and hook can be removed.

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 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 manual charging wrench, 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 ADJUSTMENTS. Check all terminal connections.

Bushings and Insulation

The surface of the 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 or clear resin. 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.

Insulation Test

When insulation has been repaired or replaced, or when breaker has been stored under adverse conditions, it is recommended that the insulation be checked before the breaker is replaced 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 open 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.

If the breaker secondary wiring is to be given a hi-potential test at 1500 volts, remove both of the motor leads from the terminal boards. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

LUBRICATION

In order to maintain reliable operation, it is important that all circuit breakers be properly lubricated at all times. Most of the bearings and rolling surfaces utilize a new type of dry lubrication that will require no maintenance and will last the life of the equipment. Only few bearings and surfaces listed in the chart, Fig. 22, require lubrication. These have been poperly lubricated, during assembly at the factory, using the finest grades 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. 22. 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. 22 is divided into two methods of lubrication. The first method outlined 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 Lubricants D50H15 and D50H47 are available in 1/4 # collapsible tubes. It is so packaged to insure cleanliness and to prevent oxidation.

Method of Cleaning Bearings

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

Sleeve Bearings

The sleeve bearings used throughout the linkage utilize Teflon surfaces and do not require lubrication. After a number of operations, the surface will acquire a thin black film. Do not remove this film unless there is evidence of outside contaminates, such as dry or hardened grease. If contaminants are present they should be removed by immersing the link and bearing in clean petroleum solvent or similar cleaner and using a stiff brush. Do not remove the bearings from the links. DO NOT USE CARBON TETRACHLORIDE.

The hinge of the primary contact arm (24) Fig. 8 should be disassembled, cleaned, and lubricated with G-E D50H47 lubricant at general overhaul periods.

The main shaft bearings (24) Fig. 5 and the driving pawl lever bearing should be removed, cleaned, and lubricated with G-E D50H15 lubricant at general overhaul periods.

Roller & Needle Bearings

The cam follower bearings (6) Fig. 5, latch roller bearing (9), and cam shaft bearings (25) Fig. 5 should be first removed from the mechanism and the inner race disassembled. They should then be placed in a container of clean petroleum solvent or similar cleaner. DO NOT USE CARBON TETROCHLORIDE. 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 inductive 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. By wearing rubber gloves precautions against the toxic effects of the alcohol can be exercised and by using the alcohol in a well ventilated room: excessive exposure to the fumes is sometimes unpleasant to personnel. Washing the bearings in the light oil and draining should follow immediately, then apply the lubricant.

Bearings that are pressed into the frame or other members such as the eccentric drive bearings (7) Fig. 14 should not be removed. After removing the shaft and inner race the bearing can usually be cleaned satisfactorily with petroleum solvent or a similar cleaner and a stiff brush. Follow the procedure outlined above using a light machine oil and G-E lubricant D50H14 before reassembling the inner race and shaft.

Rolling Surfaces

A number of rolling and rubber surfaces in the mechanism have been lubricated with a baked-on, dry, molybdenum disulfide coating. This requires no maintenance and should last the life of the breaker.

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

1. Magne-blast breakers applied to repetitive operation such as switching arc furnaces 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.

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

      3. All areas in the throat area of the arc chute 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. Whene[illegible] the arc chute is removed, loose dust and dirt should be blo[illegible] [illegible]t before replacing arc chutes.

      4. 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 primary contacts should be greased lightly with D50H47.

      5. Arcing Contacts - When the arcing contact wipe is less then 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

condition 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.

6. Check the breaker and mechanism adjustments as summarized under INSPECTION AND TEST. The necessary readjustments should be made as described under adjustments.

7. 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.

8. The contacts of the control relay should be inspected for wear and cleaned if necessary.

9. Lubricate the breaker operating mechanism in accordance with the table under LUBRICATION.

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

11. After the breaker has been serviced, it should be slowly closed and opened, as described in INSTALLATION, to be sure there is no binding or friction and that the 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. <u>After Every 5,000 Operations</u>

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, blow-out coils, arc runners and assemblies which can become contaminated by arc products.

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

3. 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.

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

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

6. Any parts damaged or severaly 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.

7. The cup bearing and the contact ring at the hinge point of the contact blade should be disassembled, inspected, cleaned, and relubricated with G-E contact lubricant D50H47. The contact ring should be inspected for wear and replaced when reduced in thickness to less than 1/32"

C <u>Every 10,000 Operations or Approximately Every Five Years - Which ever Comes First.</u>

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

2. All roller and needle bearings in the operating mechanism should be disassembled, cleaned, and repacked with G.E. lubricant D50H15 as described under LUBRICATION.

3. 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.

4. 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 four general classes: failure to trip, failure to close or latch closed, closing springs will not recharge, 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. Mechansim 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 mechansim adjustments, latches, stops, auxiliary devices, etc., in accordance with section on 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 on 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 section on ADJUSTMENTS. Examine latch and roller surfaces for corrosion.
3. Damaged or dirty contacts in control circuit including control relay.
   REMEDY: Recondition or replace contacts.
4. Damaged spring release coil
   REMEDY: Replace damaged coil
5. Defective latchchecking switch, or interlock switch.
   REMEDY: Replace defective switch.

6. Blown fuse in closing circuit.
   REMEDY: Replace blown fuse after determining cuase of failure

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

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

9. 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.

Failure to Recharge Springs

1. Defective motor cut-off switch, interlock switch, or closing latch monitoring switch.
   REMEDY: Replace switch

2. Damaged or dirty contacts in control circuit.
   REMEDY: Recondition or replace contacts.

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

4. Faulty connection in charging circuit.
   REMEDY: Repair broken or loose wires and see that all binding screws are tight.

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 section on ADJUSTMENTS.

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

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 connectors
   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. INPORTANT: 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 AND LOWER ARC RUNNERS (To inspect or replace blow-out coils)

To remove an arc chute, first open the breaker and remove the box barrier (2) Fig. 8. Then attach the arc chute remover to the breaker frame as it is described under arc chute removal instructions Fig. 20. Insert the lifting hooks into the arc chute lifting holes and take up the slack by turning the crank (14) Fig. 18. Remove the mounting hardware at (3) and (5) Fig. 20. Then pull the arc chute (4) Fig. 20 out of the breaker.

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

1. Remove the assembly hardware (1, 2, 5 and 9) and lift off the arc chute upper half (6) Fig. 16.

2. Remove the blow-out coil cores (5). The arc chutes side (3) may now be removed if necessary, Fig. 17.

3. Remove the assembly hardware (6, 11, 7 and 12) Fig. 16, in the order given so as to remove the side piece (2) Fig. 17 and the piece of insulation under it.
   Each arc runner segment or blow-out coil may now be removed.

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 tightening the assembly hardware.

2. The gap between the fins at the rear of the arc chute should be 3/64" to 3/32" measured at least 1" in from the back end of the arc chute (See Fib. 19).

3. Check to insure that electrical connections to the blow-out coils are tight.

4. When reassembling the lower arc runner assembly, check that the spacers at positions 1 and 6 , Fig. 17, are correctly installed.

5. Make certain that the electrical connections are tight.

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

1. Rest the mounting stud (3) on the arc chute support bracket (7) as shown in Fib. 18.

2. Slide the arc chute forward and lift it slightly to engage the support supporting bolts (2) Fig. 18 in the support catches (3) Fig. 20.

3. Check to assure that upper arc runner unit is properly assembled; if not follow instructions in page (25 and 26).

4. Tighten the supporting bolts (2 and 3) Fig. 18. The bolts (2) are mechanical connections, but the lower supporting bolt (3) serves as both the electrical and mechanical connection.

CONTACTS

Open the breaker and remove the box barrie[illegible]) side barriers (30). Fig. 8, and arc chutes as previously desc[illegible]. To remove contacts, proceed as follows:

A. Stationary Arcing Contacts (19) Fig. 15B.

   1. Remove the glass bonded mica side piece (11) Fig. 15C

   2. Remove the screw holding the contacts braid (16) Fig. 15B.

   3. Turn the contact braid 90 degress and pull out of the arcing contact finger assembly.

   4. Reassemble in the reverse order.

B. Stationary Primary Contacts (9) Fig. 23

   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). Remove one contact finger at a time.

To replace the stationary Primary Contacts:

1. Apply a thin coating of D50H47 grease on the hinged edge of the finger (9) then place it on the contact support (7) so that it is retained by stop plate (8).

2. Open spring compressor (3) and assemble spring guide, spring and spring compressor (Fig. 23A).

3. Turn nut (2) in clockwise direction to compress contact spring (Fig. 23B). Hold spring firmly in yoke on spring compressor to prevent 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 cutout in primary finger (Fig. 23C).

5. Hold spring assembly firmly in place and remove spring compressor.

C. Movable Arcing Contact (9), Fig. 21.

1. Remove the assembly bolts (8).

2. Reassemble in reverse order.

D. Movable Primary Contacts (6), Fig. 21 (1200 AmO. Breaker)

1. Remove the two lower nuts from assembly bolts (7).
2. Remove the primary contacts.
3. Reassemble in reverse order.

(3000 Amp. Breaker)

1. Remove the nuts from assembly bolts (7)
2. Remove the connection bar (13).
3. Remove the cup bearing (12).
4. Spread the contact arms (5) and remove the primary contacts (4).
5. Reassemble in the reverse order.

E. Contact Blade Assembly (4, 5 & 9) Fig. 21.

1. Remove the connection bar (13).

2. Remove the cup bearing (12) and the pin (11).

3. When reassembling, first insert the piston assembly (16), into the booster cylinder (17) and reassemble the cup bearing (12).

4. Replace pin (11), and connection bar (13).

F. Tertiary Contact Finger (14) Fig. 21.

1. Compress and remove the contact springs (15).

2. Raise the tertiary contact fingers (14) and slide them out.

3. When reassembling apply a thin coating of D50H47 grease to the hinged portion of the contacts.

G. Tertiary contact Pad (1) Fig. 21.

1. Remove two upper nuts from assembly bolts (7).

2. Remove the tertiary contact pad.

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

<u>Bushings</u>

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 distande from that particular bushing to the adjacent bushings in both directions, so that it may be reinstalled 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 reinstalled.

To replace the bushings, proceed as follows:

1. Open the breaker and remove the box barrier and arc chutes as already described.

2. Remove the upper and lower horizontal barriers (14 and 18) Fig. 8.

3. Remove the four bolts at the mounting flangeof the rear bushing being removed, and lower the bushing and arc runner assembly.

4. For further disassembly refer to Fig. 15.

   a) Remove the bolts (8) and spring retainer (7).

   b) Remove the nuts from assembly bolts (5 and 6).

   c) Remove the bushing (1).

   d) The stationary primary contacts (20) may also be removed if necessary.

5. Remove the upper and lower side pieces (2 and 11) and the insulation (3).

   a) Remove the arc runner segments and blow-out coils, Fig. 15A.

6. Reassemble in the reverse order. Check that the movable arching contact passes between the opening of the upper arc runner, Fig. 21.

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 (18 and 20) Fig. 8.

3. Remove the connection bar (13), Fig. 21, cup bearing (12), and pin (11).

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 (12) contact arm (5), and replace pin (11). The contact surfaces at the hinge point of the contact blade and bushing should have a thin coating of D50H47 grease.

6. Check all contact adjustments as outlined under ADJUSTMENTS.

INTERLOCK SWITCH

To remove the interlock switch (3), Fig. 10 remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

LATCH CHECKING SWITCH

To remove the latch checking switch (7), Fig. 10 (when furnished), remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

MOTOR, RELAY AND LIGHT SWITCHES

The three switches are mounted in tandem as shown on Fig. 6.

1. Remove the opening spring per instructions below.

2. Remove (2) mounting bolts (14) from switch bracket (15).

3. Remove the (2) mounting screws of the lower switch.

4. Remove the (2) mounting screws of the center switch.

5. Remove the (2) mounting screws of the upper switch.

6. Disconnect the lead wires of switch to be replaced.

7. Reassemble in the reverse order and check switch adjustment as explained under ADJUSTMENTS.

TRIP SHAFT AND LATCH

1. Remove latch checking switch arm (10) Fig. 11 (when supplied).

2. Remove cotter pins on both ends of the shaft (12).

3. Remove set screw in latch (11).

4. Remove trip coil linkage bolt (6).

5. Place a block between the latch and frame (either side) and drive shaft until the latch is free of the key.

6. Remove key and all burrs that may be raised around the keyway on the shaft. Burrs will scar to shave the Teflon bearing surfaces if they are not removed.

7. Reassemble the parts in the reverse order. Be sure the latch spring is properly installed and the latch is aligned in the center of the latch roller. Check latch adjustment as described under ADJUSTMENTS.

TRIP LATCH ROLLER BEARING

1. Remove (2) cotter pins at ends of shaft (8) Fig. 12.

2. Partially remove shaft out right side frame until latch roller (6) is free.

3. Reassemble in reverse order with proper spacing of washers. Be sure latch roller rotates freely.

CLOSING LATCH

1. Remove cotter pins at both ends of latch shaft (19) Fig. 6.

2. Remove spring and paddle (16) Fig. 6.

3. Remove set screws from latch (3) Fig. 6.

4. Move shaft (14) to left (away from frame) by tapping lightly on the inside end of shaft. Rotate shaft and continue tapping until shaft is free. Shaft will push outside needle bearing from housing.

5. Reasse ble in reverse order putting bearing into frame last. Use a small piece of tubing or pipe when inserting bearing to assure proper alignment.

6. Check latch adjustments as described under ADJUSTMENTS.

MOTOR SUPPORT

1. To remove motor support (8) Fig. 14 first remove the latch spring (16) Fig. 6.

2. Remove the retaining ring (9) Fig. 14 and link (10).

3. Remove motor leads from the terminal board.

4. Remove six 3/8" bolts (1) Fig. 14 on bottom and one 3/8" bolt on the right side (not shown).

5. Remove four mounting bolts from motor (not shown).

6. Remove the retaining ring (7) from the eccentric (2) Fig. 14.

7. Reassemble all parts of the motor support in the reverse order and re-align it properly as describedunder DRIVING PAWL ADJUSTMENTS.

CAM

1. Remove 2 set screws from ratchet wheel (3) Fig. 3 and remove wheel from main shaft (8).

2. Remove 2 set screws from cam (12) Fig. 1.

3. Remove prop reset spring (10) Fig. 2.

4. Remove 2 set screws from cam (16) Fig. 5, and move cam to the right on the shaft as far as it will go. Slide the shaft to the left until key is fully exposed. Remove key and check shaft for the burrs.

5. Remove shaft out left side of frame.

6. Reassemble in reverse order using the correct number of washers and spacers to properly locate the parts.

7. Rotate the mechanism through a closing operation using the manual charging wrench. Check the location of the cam follower (6), Fig. 5, on the cam (16). If necessary, move the cam to correct the alignment. Complete the closing operation and check the location of the prop pin (13), Fig. 5 on the prop (14). It should be approximately centered.

TRIP COIL

To replace the potential trip coil (2), Fig. 11 proceed as follows:

1. With the breaker in the open position, remove the two mounting bolts (3).
2. Remove upper support (1) and spacers.
3. Cut wires at the butt connections and remove coil.
4. When replacing the coil be sure to assemble the correct fiber spacers at the ends before bolting support (1).
5. Adjust coil location to allow approximately 1/8" of armature travel before latch starts to move.
6. Butt connect wires and check operation of solenoid electrically and mechanically.

SPRING RELEASE COIL

To remove the spring release coil (5) Fig. 6 proceed as follows:

1. Block the closing springs as described in INSTALLATION.
2. Remove the left hand closing spring as described in CLOSING SPRINGS below.
3. Remove two mounting bolts (17), coil support (18) and spacers.
4. Cut wires at the butt connectors and ove coil.
5. Replace the coil and the correct numb of fiber spacers before bolting support.
6. Butt connect wires and check that the armature is not binding. Check coil for electrical operation.

CLOSING SPRINGS

The closing springs (6) Fig. 3 can be removed as follows:

1. Charge the springs with the manual charging wrench and apply the spring blocking device as described in INSTALLATION.
2. Discharge springs by pushing manual close button (7) Fig. 2.

3. Rotate cam shaft (8) Fig. 3 by using the manual charging wrench until the gap between the spring (6) and the bearing block (10) is $1\frac{1}{2}$ inches or more.

4. Lift both springs until they clear the lower supports, then pull forward and down until the top supports are free.

5. Either discharge the opening springs by pushing the manual trip lever or block the opening springs with a suitable blocking device.

OPENING SPRINGS

To remove the opening springs (9) Fig. 3 proceed as follows:

1. Charge and block the closing springs as described under INSTALLATION.

2. Push manual trip lever (11) Fig. 2 to be sure the opening springs are fully discharged.

3. Remove upper pin (12) Fig. 3 and lower Pin (11).

4. After reassembling springs check the primary opening as described under PRIMARY CONTACT GAP.

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 minimize service interruptions caused by breakdowns, and saves time and expense. When continuous operation is a primary consideration, more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

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

The Renewal parts list covers the following types of breakers:

AM-4.16-350-1H	1200A and 3000A
AM-4.10-350-1C	1200A and 3000A

NOTE: The listed terms "Right" and "Left" apply when facing the mechanism end of the breaker.

ORDERNING INSTRUCTIONS

1. Always specify the complete maneplate 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.

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.

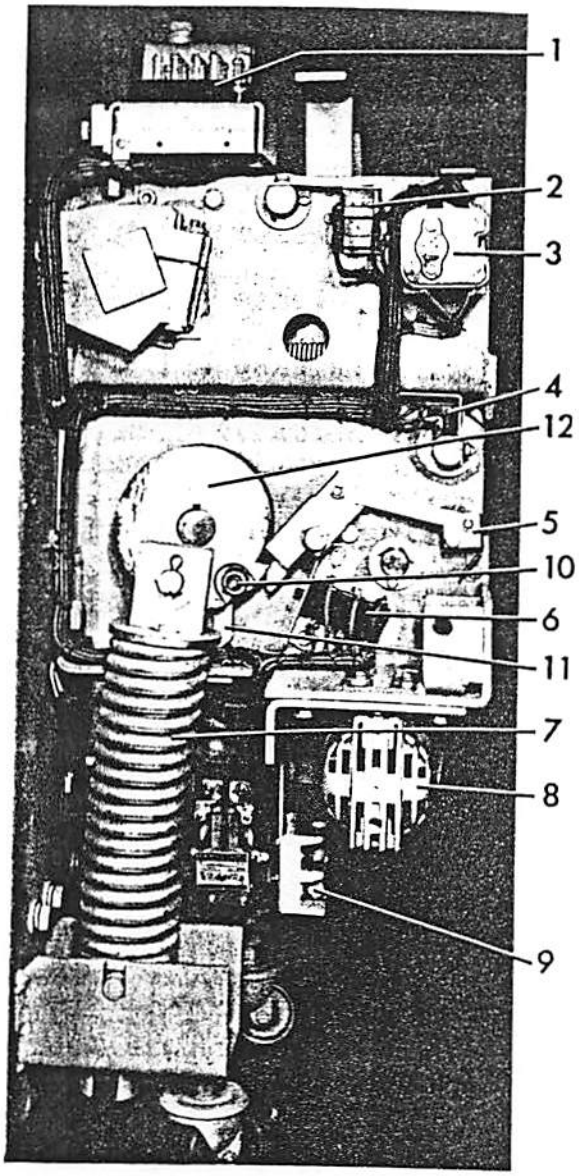
Fig. No.	Ref. No.	Amps	Type	Catalog No.	No. Per Brkr.	Description
8	29	All	All	619C479 P17	3	Booster Cylinder
8	19	1200	All	281B708 G2	3	Operating Rod Assembly
8	19	3000	All	802B730 G1	3	Operating Rod Assembly
15	24	All	All	366A413 G1	3	Flexible Lead
17	2	All	All	802B724 P1	6	Arc Chute Insulating Plate (Mycalex)
7	3	All	All	619C464 P9	3	Buffer
7	3	All	All	6557243 P2	6	Buffer Clamp
7	4	All	All	383A903 G1	3	Stationary Arcing Contact Asm
7	5	All	All	802B742 G2	3	Arcing Tip Movable
21	3	1200	All	414A180 P1	24	Primary Contact Finger Spring
21	3	3000	All	414A180 P1	36	Primary Contact Finger Spring
21	4	1200	All	236C791 P8	24	Primary Contact Finger
21	4	3000	All	236C791 P8	36	Primary Contact Finger
21	6	1200	All	6591644 P7	6	Movable Primary Contact
21	6	1200	All	6591644 P8	6	Movable Primary Contact
21	6	3000	All	114C5382 P12	6	Movable Primary Contact
21	6	3000	All	114C5382 P11	6	Movable Primary Contact
21	14	3000	All	236C791 P8	12	Tertiary Contact Stationary
21	1	3000	All	619C469 P3	6	Tertiary Contact Movable
17	4	All	All	802B724 P2	6	Cover
2	15C	All	All	6591742 P1	6	Upper Runner Insulation
11	15C	All	All	6592336 P2	6	Upper Runner Insulation
6	12	All	All	105C9393 P1	1	Motor 48 VDC
6	12	All	All	105C9393 P2	1	Motor 110 VDC - 125 VDC
6	12	All	All	105C9393 P3	1	Motor 220 VDC - 250 VDC
6	12	All	All	105C9393 P2	1	Motor 115 VAC
6	12	All	All	105C9393 P3	1	Motor 230 VAC
6	6	All	All	137A7575 P43	1△	Relay 48 VDC
6	6	All	All	137A7575 P42	1△	Relay 110 VDC - 125 VDC
6	6	All	All	137A7575 P41	1△	Relay 220 VDC - 250 VDC
6	6	All	All	137A7575 P47	1△	Relay 115 VAC
6	6	All	All	137A7575 P45	1△	Relay 230 VAC
11	2	All	All	6275070 G1	1	Trip Coil - 24 VDC
11	2	All	All	6275070 G2	2‡	Spring Release & Trip Coil
6	5					48 VDC
6	5					110 VDC
11	2	All	All	6174582 G1	2‡	Spring Release & Trip Coil
11	2	All	All	6174582 G1	2‡	Spring Release & Trip Coil
6	5					125 VDC

Fig. No.	Ref. No	Amps	Type	Catalog No.	No. Per Brkr.	Description
11 6	2 5	All	All	6174582 G15	2‡	Spring Release & Trip Coil 220 VDC
11 6	2 5	All	All	6174582 G2	2‡	Spring Release & Trip Coil 250 VDC
11 6	2 5	All	All	6174582 G10	2‡	Spring Release & Trip Coil 115 VAC
11 6	2 5	All	All	6174582 G14	2‡	Spring Release & Trip Coil 230 VAC
6	10	All	All	456A866 P5	5	Switch Normally Open
6	10	All	All	456A866 P6	1	Switch Normally Closed
11	9	All	All	10AX006 G4	1	Auxiliary Switch
6	16	All	All	161A4231	1	Closing Latch Spring
11	13	All	All	137A9252	1	Prop Spring
3	1	All	All	161A5909	3	Pawl Spring

△ Check connection diagram for (1) or (2) relay requirements.

‡ (1) required for spring release and (1) required for tripping. May be different voltages - check nameplate for requirements.

Ø Not shown.



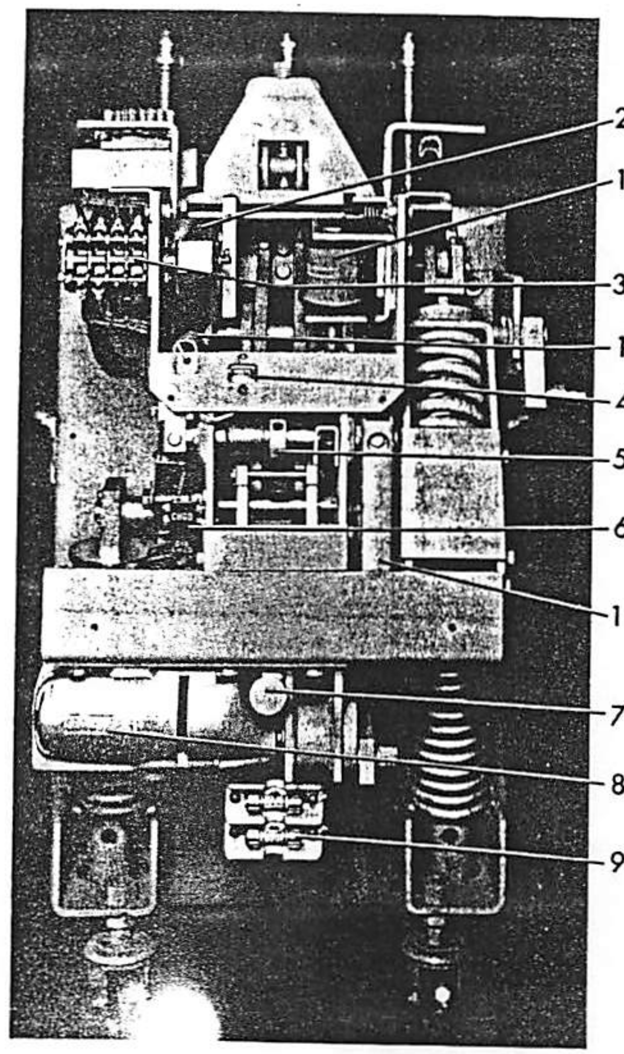


Fig. 1 8034473

Fig. 2 8034471

Fig. 1 Left Side View ML-13
Operating Mechanism

1. Secondary Coupler
2. Interlock Switches
3. Auxiliary Switch
4. Latch Checking Switch
5. Charge-Discharge Indicator
6. Power Switches
7. Closing Springs
8. Motor
9. Fuses
10. Closing Latch Roller
11. Closing Latch
12. Switch Cam

Fig. 2 Front View ML-13
Operating Mechanism

1. Trip Coil
2. Open - Close Indicator
3. Auxiliary Switch
4. Counter
5. Trip Latch
6. Charge-Discharge Indicator
7. Close Button
8. Motor
9. Fuse
10. Prop Spring
11. Trip Lever

Fig. 3 8034463

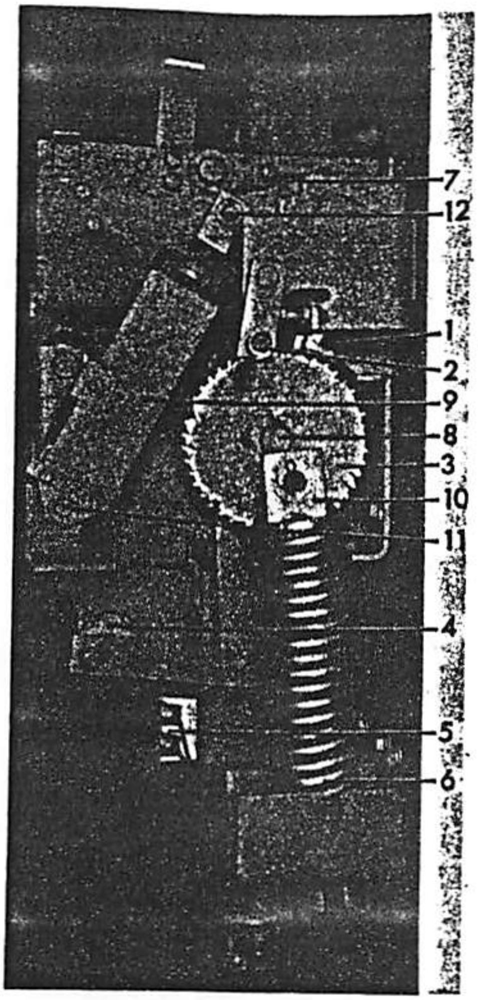


Fig. 3 Right Side View ML-13

1. Latching Pawls
2. Positive Interlock Roller
3. Ratchet Wheel
4. Eccentric
5. Fuse
6. Closing Spring
7. Main Shaft Bearing
8. Cam Shaft
9. Opening Spring
10. Guide Block
11. Lower Spring Pin
12. Upper Spring Pin

Fig. 4 8034475

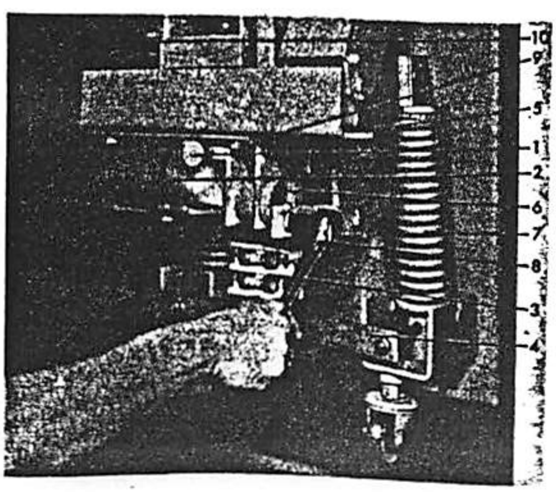


Fig. 4 Spring Blocking Device

1. Close Button
2. Motor
3. Fuse
4. Spring Blocking Device
5. Driving Pawl
6. Eccentric
7. Closing Spring
8. Manual Charging Wrench
9. Support Bolts
10. Charge-Discharge Indicator

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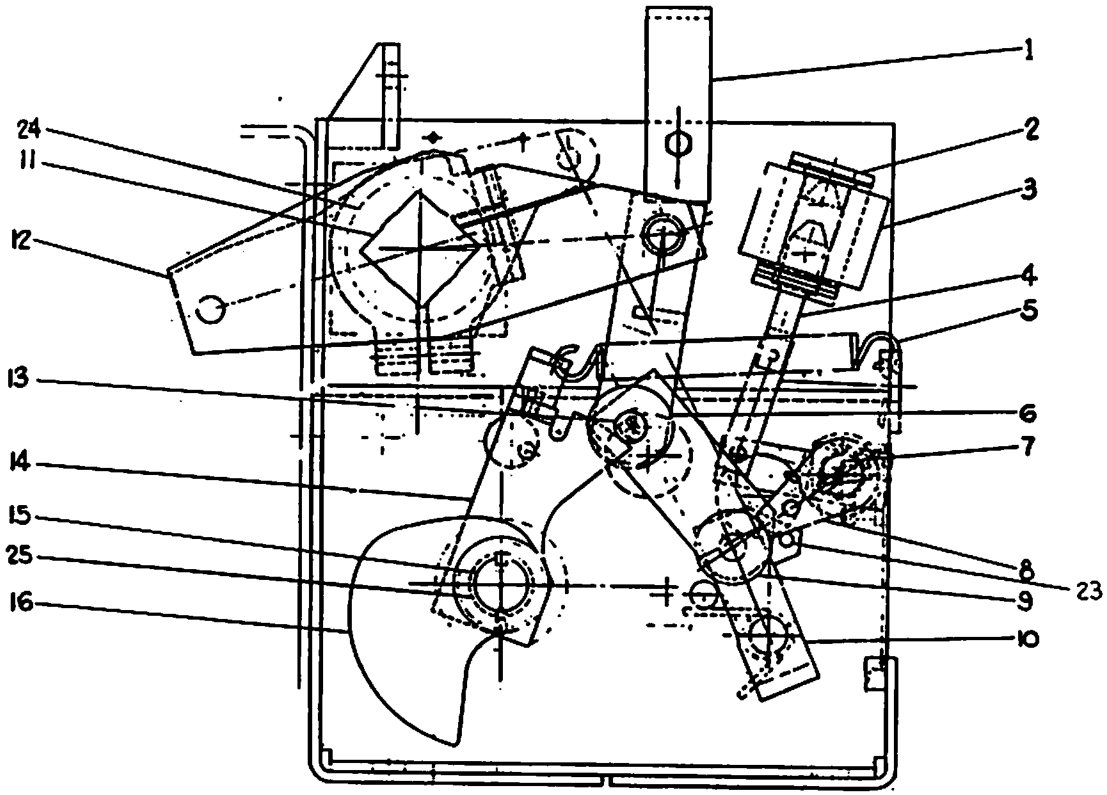
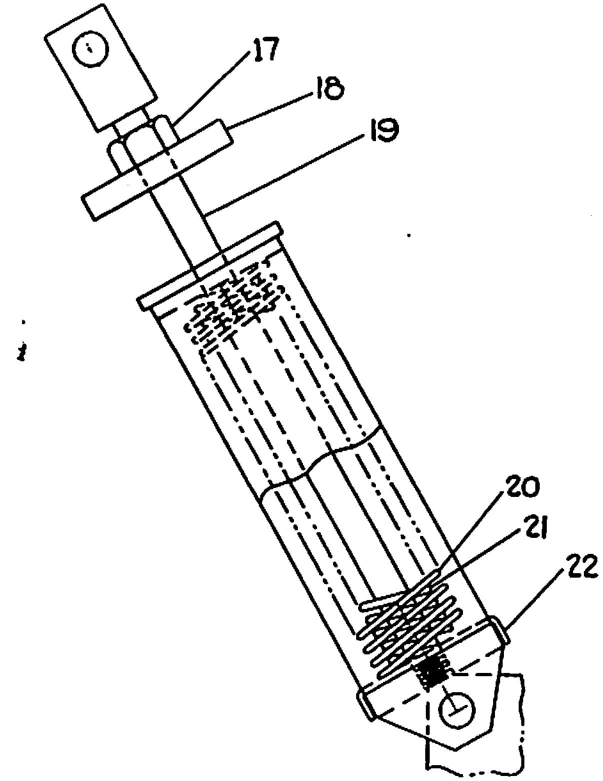


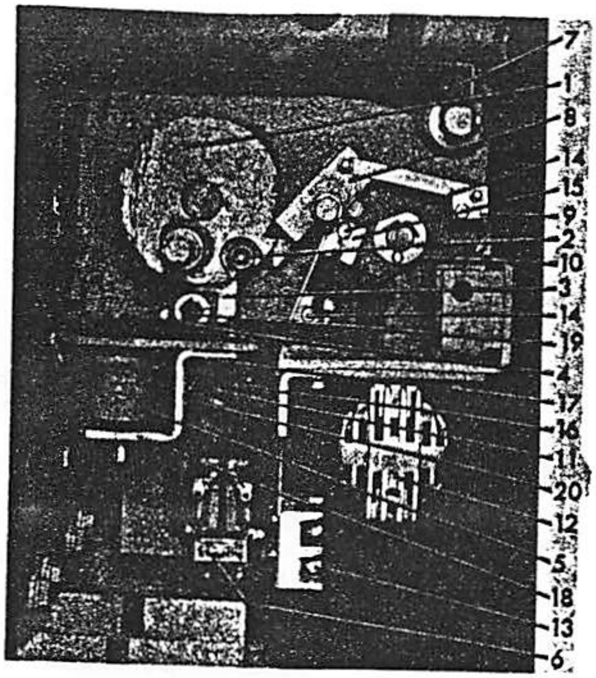
Fig. 5 Sectional Side View of Mechanism



Opening Spring

1. Handle
2. Trip Coil Support
3. Trip Coil
4. Trip Armature
5. Prop Reset Spring
6. Cam Follower Roller
7. Trip Shaft
8. Trip Latch
9. Trip Latch Roller
10. Trip Latch Roller Support
11. Crank Shaft
12. Cranks
13. Prop Pin
14. Prop
15. Drive Shaft
16. Cam
17. Check Nut
18. Stop Plate
19. Spring Rod
20. Spring
21. Spring
22. Spring Guide
23. Stop Pin
24. Main Shaft Bearing
25. Cam Shaft Bearing

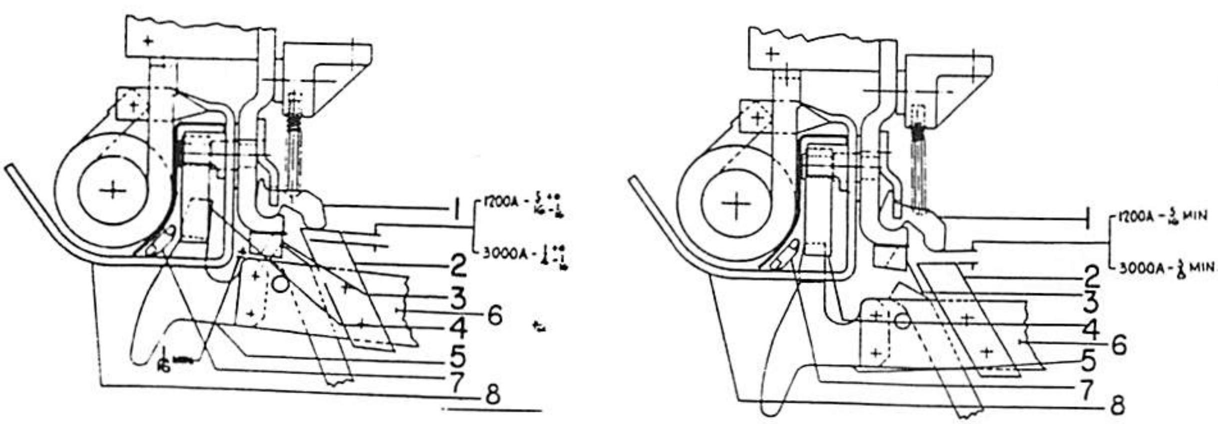
Fig. 6 8034467



1. Switch Cam
2. Closing Latch Roller
3. Closing Latch
4. Latch adjusting Screw
5. Spring Release Solenoid
6. Control Relay
7. Latch Checking Switch
8. Switch Striker
9. Charge-Discharge Indicator
10. Power Switches
11. Latch Monitoring Switch
12. Motor
13. Fuse
14. Switch Support Bolts
15. Switch Support
16. Closing Latch Spring
17. Release Coil Bolts
18. Release Coil Support
19. Closing Latch Shaft
20. Switch Mounting Bracket

Fig. 6 Control Mechanism

Fig. 7 (A) 114C5390 (B) 114C5391



Primary Contact Wipe (A)

Arcing Contact Wipe (B)

Fig. 7 Contact Adjustments

1. Stationary Primary Contacts
2. Movable Primary Contacts
3. Buffer Block
4. Stationary Arcing Contacts
5. Movable Arcing Contacts
6. Contact Arm
7. Coil Protector
8. Arc Runner

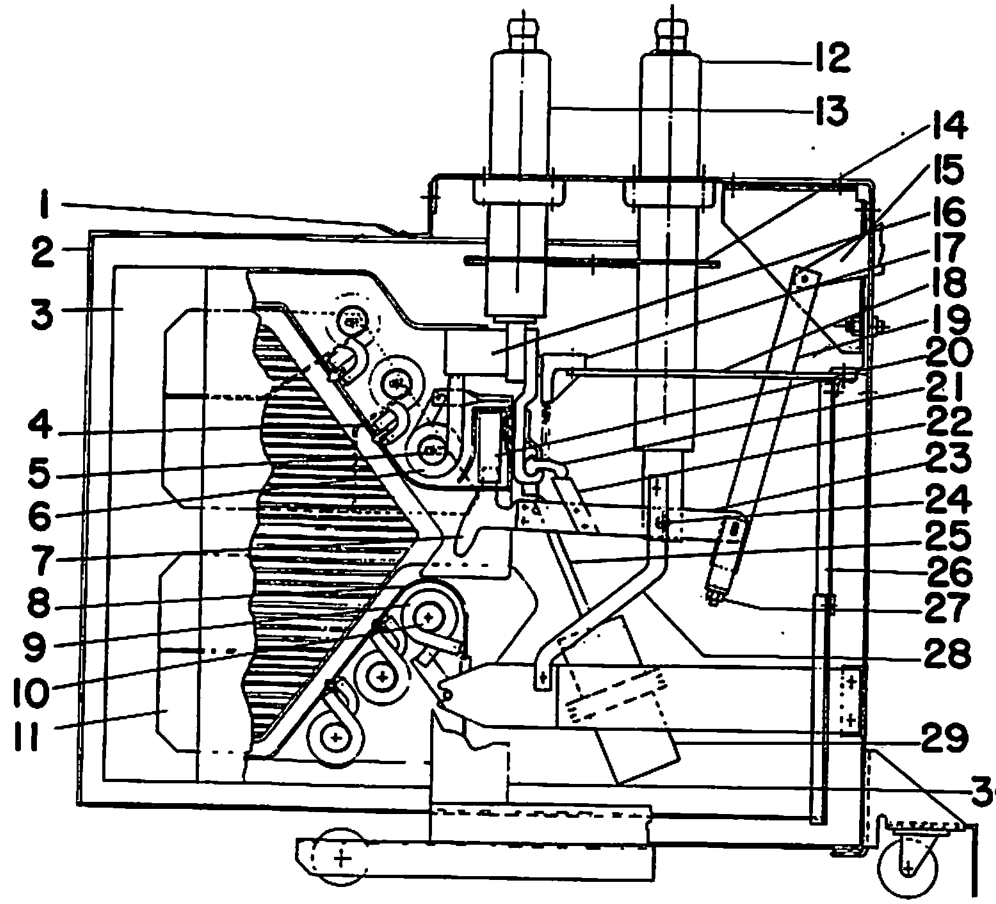


Fig. 7 828C825

1. Box Barrier Catch
2. Box Barrier
3. Arc Chute
4. Arc Runner, Upper
5. Blow Out Coil, Upper
6. Blow Out Core, Upper
7. Movable Arcing Contact
8. Arc Runner, Lower
9. Blow Out Coil, Lower
10. Blow Out Core, Lower
11. Pole Pieces
12. Front Bushing
13. Rear Bushing
14. Upper Horizontal Barrier
15. Main Operating Crank
16. [illegible]c Chute Support
17. [illegible]ring Retainer
18. [illegible]wer Horizontal Barrier
19. [illegible]perating Rod
20. Stationary Arcing Contact
21. Stationary Primary Contact
22. Movable Primary Contact
23. Movable Contact Arm Asm.
24. Cup Bearing
25. Booster Tube
26. Front Vertical Barrier
27. Check Nut
28. Connection Bar
29. Booster Cylinder & Piston
30. Side Barrier

Fig. 8 Cross Section of Breaker Pole Unit

Fig. 9 8018500

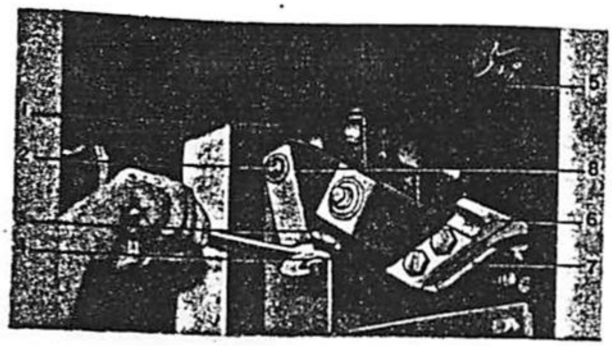


Fig. 9 Adjustable Coupling for Making Primary Contact Wipe Adjustments

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

Fig. 10 8034474

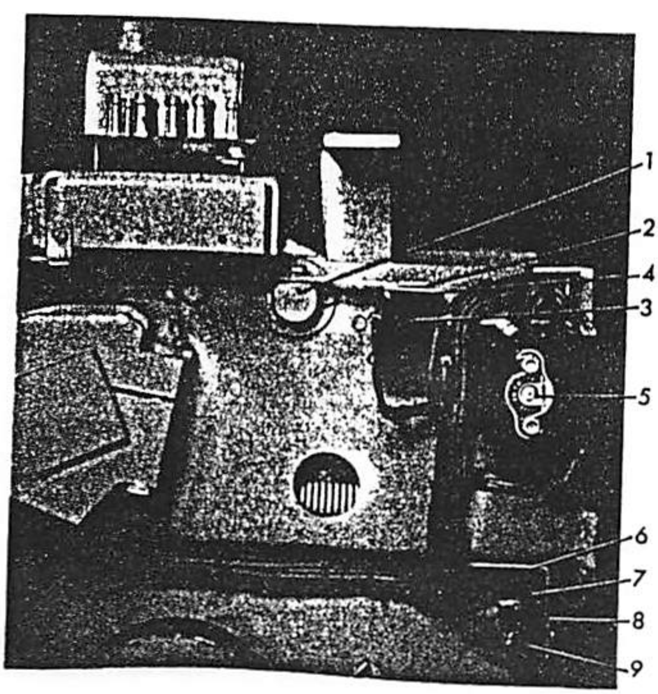


Fig. 10 Positive Interlock Switch

1. Positive Interlock Switch
2. Switch Arm
3. Interlock Switch
4. Switch Support
5. Auxiliary Switch
6. Switch Support
7. Latch Checking Switch
8. Switch Arm
9. Trip Shaft

Fig. 11 8034470

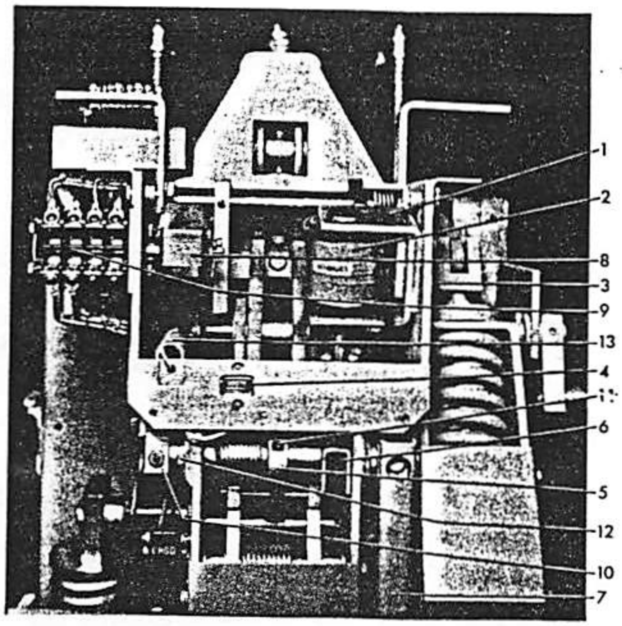


Fig. 11 Auxiliary Switch and Trip Coil

1. Trip Coil Support
2. Trip Coil
3. Mounting Bolts
4. Counter
5. Trip Latch
6. Trip Arm Screw
7. Manual Trip Lever
8. Open-Close Indicator
9. Auxiliary Switch
10. Switch Arm
11. Latch Set Screw
12. Cotter Pin
13. Prop Spring

Fig. 12 114C5320

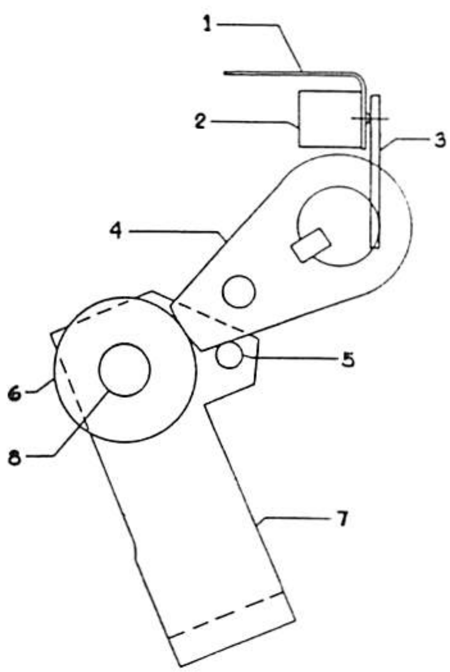
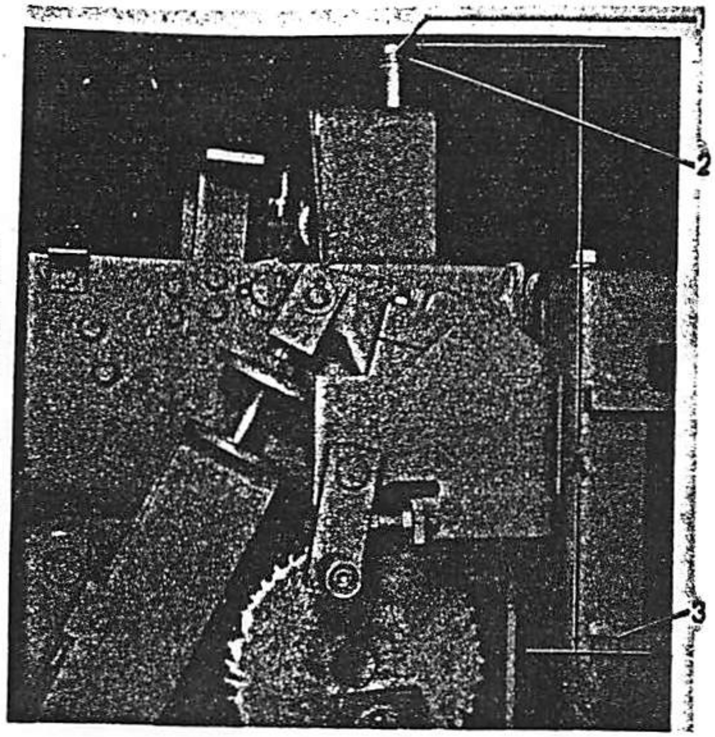


Fig. 12 Latch Checking Switch

1. Switch Support
2. Latch Checking Switch
3. Switch Arm
4. Trip Latch
5. Reset Pin Stop
6. Latch Roller
7. Latch Roller Link
8. Latch Roller Pin

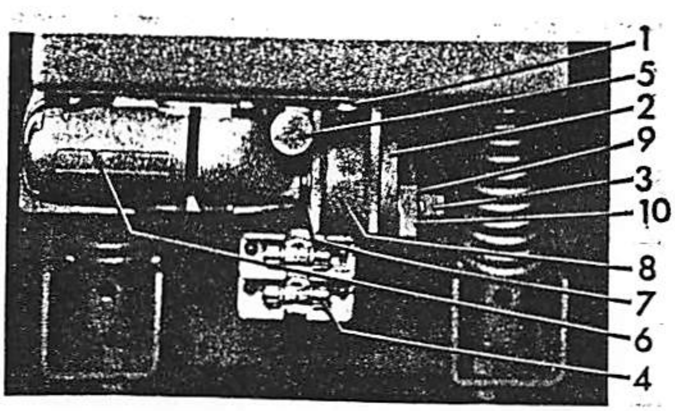
Fig. 13 8034464



1. Plunger Bolt
2. Washer
3. Breaker Lifting Rail

Fig. 13 Plunger Interlock

Fig. 14 8034471



1. Mounting Bolts
2. Eccentric
3. Hex Charging Stud
4. Fuse
5. Manual Close Button
6. Motor
7. Retaining Ring
8. Motor Support
9. Retaining Ring
10. Driving Link

Fig. 14 Driving Elements

Fig. 15A 8026159

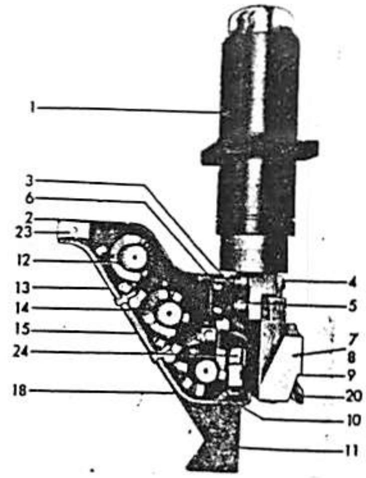


Fig. 15B 8026160

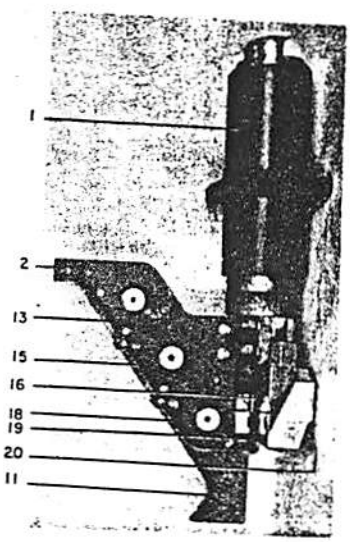
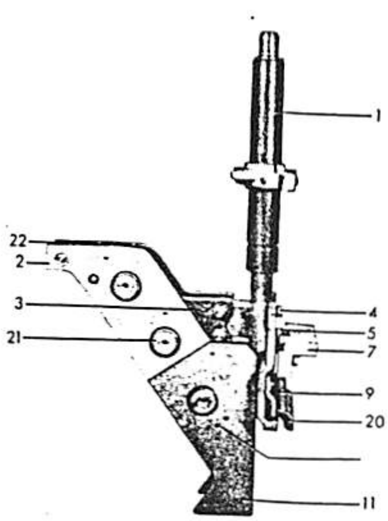


Fig. 15C 8026388



1. Rear Bushing
2. Upper Insulation
3. Coil Support
4. Assembly Bolts
5. Assembly Bolts
6. Assembly Bolt
7. Spring Retainer
8. Assembly Bolts
9. Contact Springs
10. Coil Protector
11. Glass Bonded Mica Side Piece
12. Blow Out Coil
13. Arc Runner
14. Blow Out Coil
15. Arc Runner
16. Contact Braid
17. Blow Out Coil
18. Arc Runner
19. Stationary Arcing Contact
20. Stationary Primary Contacts
21. Core

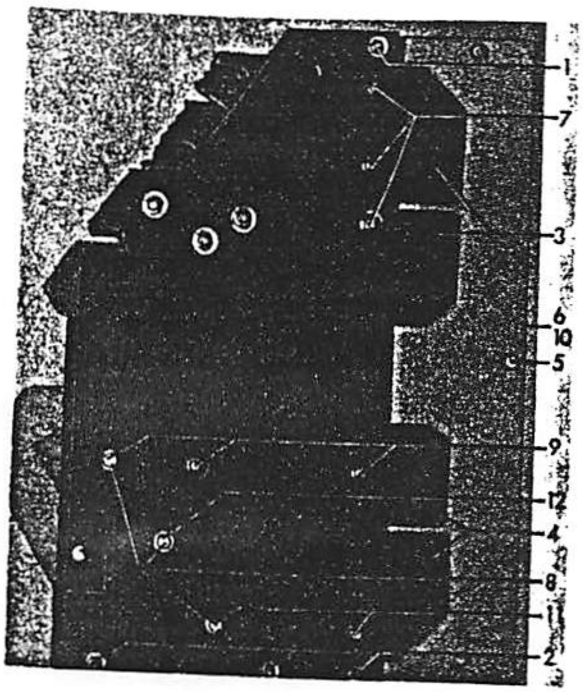
22 .H. Coil Support

2 pacer

2 lexible Lead

Fig. 15 Disassembly of Upper Arc Runner Unit

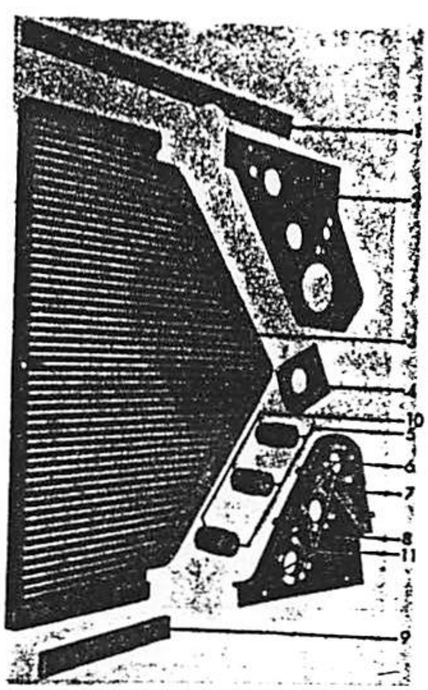
Fig. 16 8026193



1. Upper Assembly Bolts
2. Lower Assembly Bolts
3. Upper Pole Pieces
4. Lower Pole Pieces
5. Assembly Bolts
6. Arc Chute, Upper Half
7. Pole Piece Bolts
8. Pole Piece Core Bolts
9. Bolts
10. Arc Chute, Lower Half
11. Nuts
12. Nut

Fig. 16 Arc Chute Assembly

Fig. 17 8026191



1. Lower Runner Support
2. Lower Runner Insulation (Mycalex)
3. Arc Chute Side
4. Insulation (Cover)
5. Blow-out Coil Cores
6. Spacers
7. Coil Connection
8. Lower Runner Assembly
9. Upper Runner Support Spacer
10. Insulating Tube for Core
11. Blow-out Coils

Fig. 17 Arc Chute Assembly
with Side Removed

Fig. 18 8035724

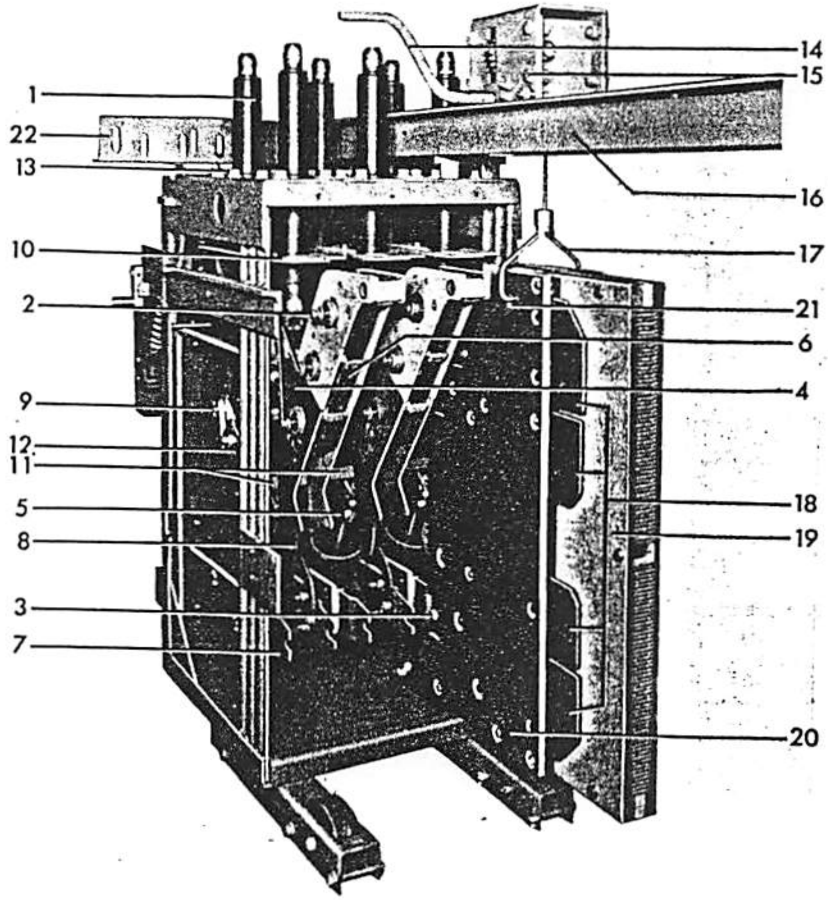


Fig. 18 Arc Chute Partially Removed Showing Accessibility of Arcing Contacts

1. Rear Bushing
2. Supporting Bolt
3. Mounting Stud, Lower Supporting Bolt
4. Upper Arc Runner Unit
5. Mounting Bolts
6. Arc Runner
7. Support Bracket
8. Arcing Contact
9. Pin
10. Horizontal Barriers
11. Primary Contacts
12. Contact Arm.
13. Arc Chute Lifter Bolt
14. Handle
15. Trolly
16. Arc Chute Lifter
17. Grappling Hooks
18. Pole Pieces
19. Arc Chute Assembly
20. Plastisol Flexible Cover
21. Lifting Supports
22. Angle Support

Fig. 19 8029373

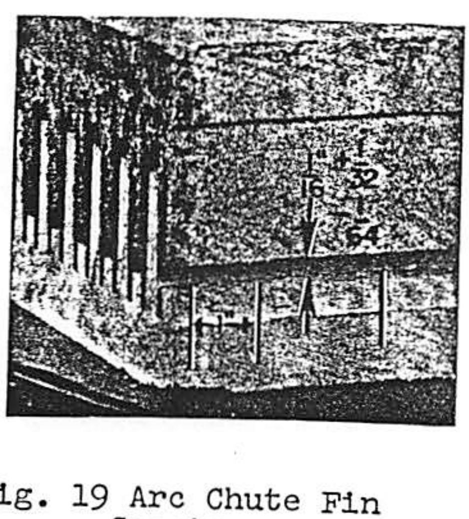


Fig. 19 Arc Chute Fin Spacing

Fig. 20 8025830

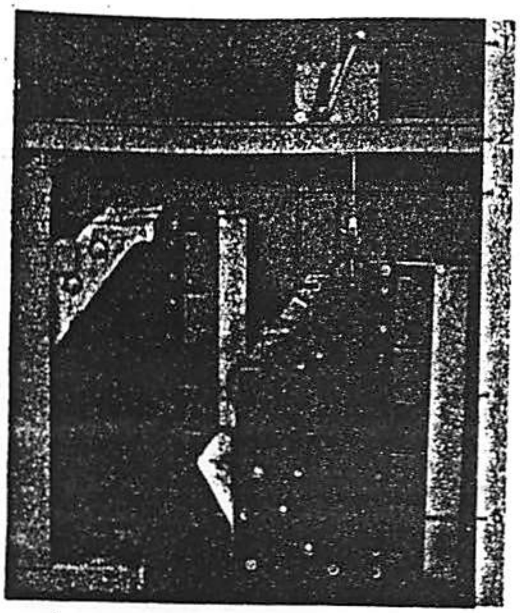


Fig. 20 Method of Removing the Arc Chute

1. Crank
2. Arc Chute Lifter
3. Support Catches
4. Arc Chute
5. Mounting Stud

Fig. 21 8023159

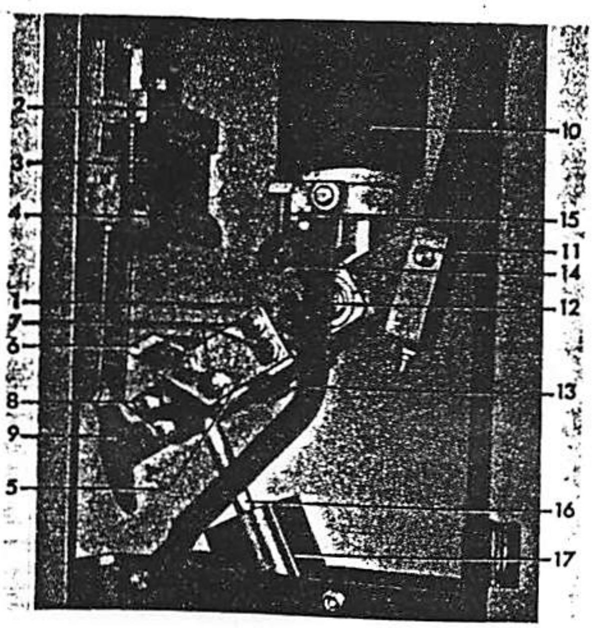


Fig. 21 Removal of Contacts

1. Lower Horizontal Barrier
2. Spring Retainer
3. Contact Springs
4. Primary Contacts
5. Contact Arm
6. Primary Contacts
7. Assembly Bolts
8. Assembly Bolts
9. Arcing Contact
10. Front Bushing
11. Pin
12. Cup Bearing
13. Connection Bar
14. Tertiary Contact Fingers
15. Contact Spring
16. Piston Assembly
17. Booster Cylinder

PART	LUBRICATION AT MAINTENANCE PERIOD	ALTERNATE LUBRICATION (REQUIRES DISASSEMBLY)
Sleeve Bearings - Links, trip shaft, etc. (Teflon coated bearings)	No lubrication required.	No lubrication required.
Sleeve Bearings - main crank shaft, driving pawl lever. (Bronze or cast iron)	Light application of machine oil SAE 20 or SAE 30.	Remove bearings or links, clean per instructions and apply D50H15 lubricant liberally.
Contact Arm Hinge Assembly Cup Bearing Loose rings between bushing and contact arm.	No lubrication required.	Wipe clean and apply D50H47
Roller and Needle Bearings	Light Application of machine oil SAE 20 or SAE 30.	Clean per instructions and repack with D50H15 Lubricant.
Ground surfaces such as cams, ratchet teeth, etc. (Surfaces coated with M_oS_2)	No lubrication required.	No lubrication required
Ground surfaces such as latches, rollers, prop, etc.	Wipe clean apply D50H1 lubricant.	Wipe clean and apply D50H15 lubricant
Silver plated contacts and primary disconnect studs	Wipe clean and apply D50H47	Wipe clean and apply D50H47
Booster Cylinder	Do not lubricate.	Do not lubricate
Arcing Contacts	Do not lubricate.	Do not lubricate

Fig. 22 LUBRICATION CHART

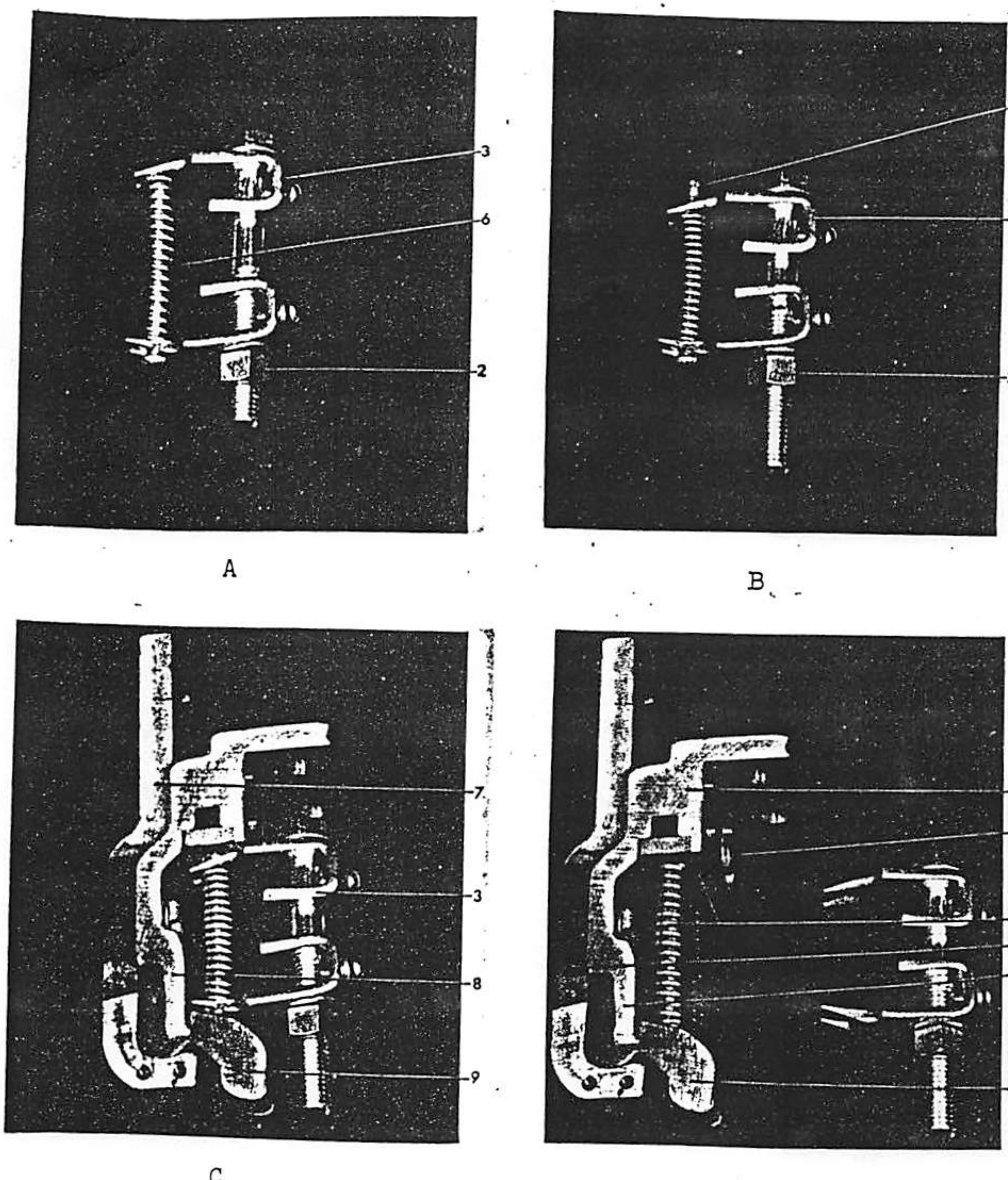


Fig. 23 Method of Installing Primary Contact Springs Using a Spring Compressor

1. Spring Guide
2. Compressor Nut
3. Spring Compressor
4. Spring Retainer
5. Assembly Bolts
6. Spring
7. Contact Support
8. Stop Plate
9. Stationary Primary Finger

Fig. 23A 8034466 Fig. 23B 8034465 Fig. 23C 8034469 Fig. 23D 8034468

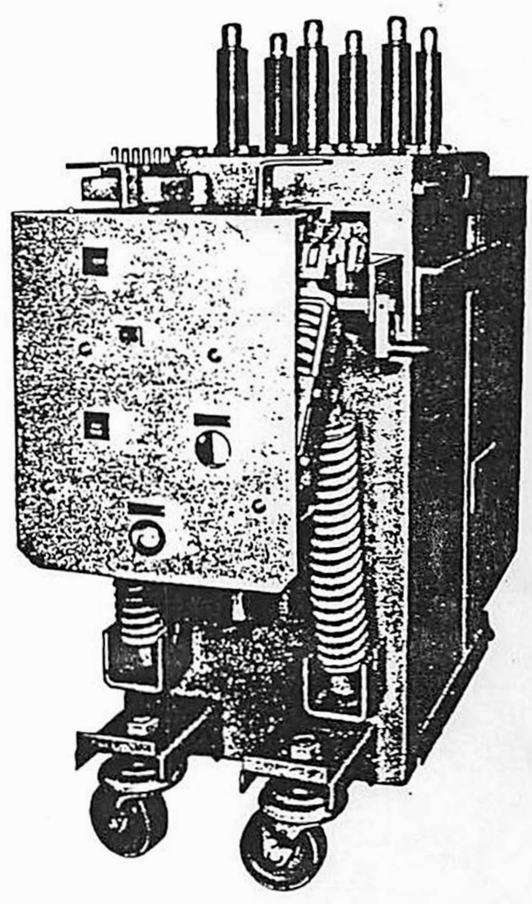
INSTRUCTIONS

GEK-7320F
Supersedes GEK-7320E

MAGNE BLAST CIRCUIT BREAKER

TYPES

AM-4.16-350-2C
AM-4.16-350-2H



CONTENTS

GENERAL ELECTRIC

MAGNE-BLAST CIRCUIT BREAKER
AM-4.16-350-2 (△)

△ Letter Designation C, and H, used immediately following the model number indicates basic design features.

INTRODUCTION

The magne-blast breaker is the removable and interchangeable interrupting element used in metal-clad switchgear to provide reliable control and protection of electrical apparatus and power systems.

The AM-4.16-350 Magne-blast Breaker is available with continuous current ratings of 1200 amperes and 3000 amperes in accordance with applicable industry standards. Refer to the breaker name-plate for complete rating information of any particular breaker. The nameplate also describes the control power requirements for that breaker. The application of a breaker must be such that its voltage, current, and interrupting ratings are never exceeded. Since this book is written to include all ratings of the breaker as well as several design variations, the 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 information for placing magne-blast breakers in service and for maintaining satisfacotry operation.

RECEIVING, HANDLING AND STORAGE

Receiving and Handling

Each breaker is carefully inspected and packed for shipment. Immediately upon receipt of the circuit breaker, and 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. 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 out-door 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. Unfinished surfaces of rollers, latches, etc., of the operating mechanism should be coated with 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, it should be cleaned and dried out before being placed in service.

(Cover Photo 8035726)

INSTALLATION

Each breaker has been tested and inspected before shipment from the factory; however, before placing the breaker in service the following items should be checked to assure that no change has occurred during shipment and storage.

1. Remove the box barriers and mechanism cover and make a visual inspection to ascertain that the breaker and mechanism is in satisfactory condition. Check all bearing surfaces of the mechanism for lubrication. Refer to section on LUBRICATION page 16 and Figure 17.

2. Charge the breaker closing springs manually using a 5/8" ratchet wrench to turn the driving eccentric (6) Figure 1. Turning the eccentric counterclockwise will advance the ratchet wheel and compress the springs.

When the springs have reached the fully charged position the indicator (1) will read "CHARGED", and the driving pawl will be raised from the ratchet wheel teeth. Additional turning of the eccentric will not advance the ratchet wheel.

Insert the spring blocking device (9) and manually discharge the springs against the pins by pushing the manual release button (4). The springs are now blocked and slow closing of the breaker contacts can be accomplished by again turning the driving eccentric with a 5/8" ratchet wrench.

During the slow closing operation check to insure that the mechanism does not stick or bind during the entire stroke, that it latches securely in the closed position, and that it trips freely when the manual trip lever is operated. At this time, also check the following adjustments:

a. Arcing contact wipe (Refer to page 10)
b. Primary contact wipe (Refer to page 10)
c. Primary contact gap (Refer to page 10)

DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALL[Y] BLOCKED. THIS PRECAUTION IS REQUIRED T[O] PREVENT ACCIDENTAL CLOSING OR TRIPPI[NG]

The closing springs should now be unblocked. Rotate the driving eccentric until the indicator reac[ds] "CHARGED" and the ratchet wheel does not advance. The spring blocking device can now be removec[d].

3. To assure that the electrical connection[s] have remained tight, they should be checked during installation as well as during each maintenance inspection. This check of electrical connections is particularly necessary on breakers used in nuclear generating stations and other critical applications. The bolted braid connections on the stationary arcing contacts should be checked for tightness by removing the arc chutes as described on page 15.

4. Connect the test coupler to the circuit breaker and operate it electrically several times. Check the control voltage as described under "CONTROL POWER CHECK" (Page 14).

5. Disconnect the test coupler and before replacing the box barrier, the primary bushings and other insulation should be wiped clean.

6. If the breaker has been stored for a long period of time, it is recommended that the insulation be checked with a standard 60 hertz high potential test. Refer to Insulation Test (Page 16).

NOTE: If the breaker secondary wiring is to be [illegible] a hi-potential test at 1500 volts, remove both [illegible] motor leads from the terminal connection. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

7. Lubricate the silver portion of the ball contact at the top of the breaker bushing and the rear portion of the ground shoe, by applying a thin film of contact lubricant D50H47.

8. Refer to metal-clad instruction book GEH-1802 for instructions on inserting the breaker into the metal-clad unit.

DESCRIPTION OF OPERATION

The magne-blast breaker has two principal components; the breaker element and the operating mechanism.

The breaker element is three similar pole units, each of which includes the current carrying parts, main and arcing contacts, interrupter, and an enclosing barrier system that provides insulation between poles, or phases and to ground. The primary connections to the associated metal-clad switchgear are made through the ball contacts at the top of the breaker bushings.

The operating mechanism type ML-13 is of the stored energy type designed to give high speed closing and opening. The mechanism will operate

 * Indicates revision

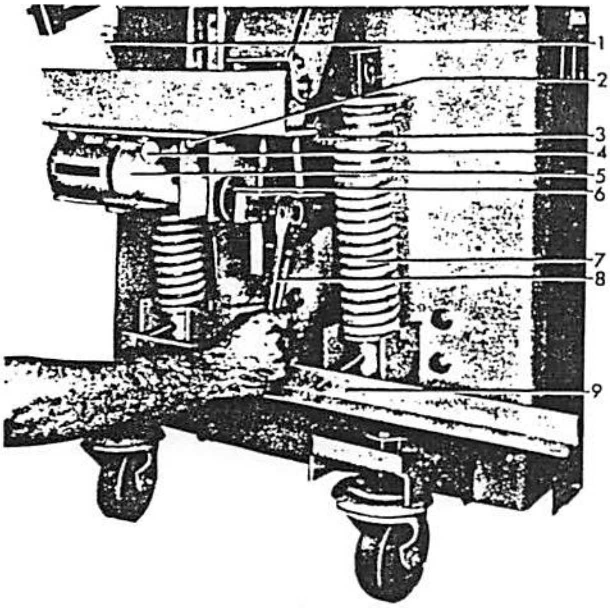


Figure 1. (8040407) Spring Blocking Device

1. Charge-Discharge Indicator
2. Support Bolts
3. Driving Pawl
4. Manual Close Lever
5. Motor
6. Eccentric
7. Closing Spring
8. Manual Charging Wrench
9. Spring Blocking Device

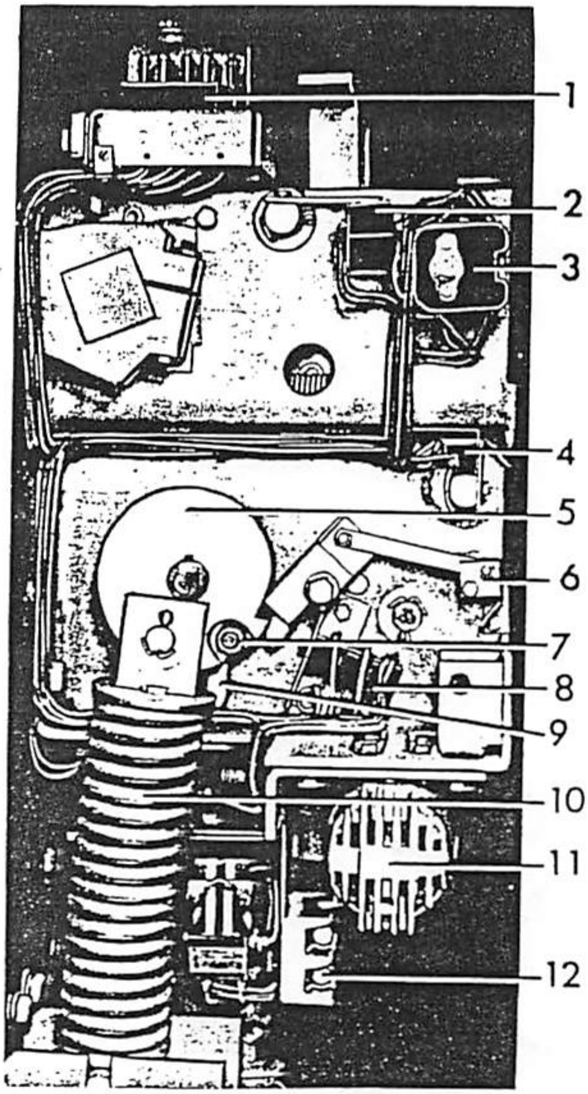


Figure 2. (8034473) Left Side View ML-13 Operating Mechanism

1. Secondary Coupler
2. Interlock Switches
3. Auxiliary Switch
4. Latch Checking Switch
5. Switch Cam
6. Charge-Discharge Indicator
7. Closing Latch Roller
8. Power Switches
9. Closing Latch
10. Closing Springs
11. Motor
12. Fuses

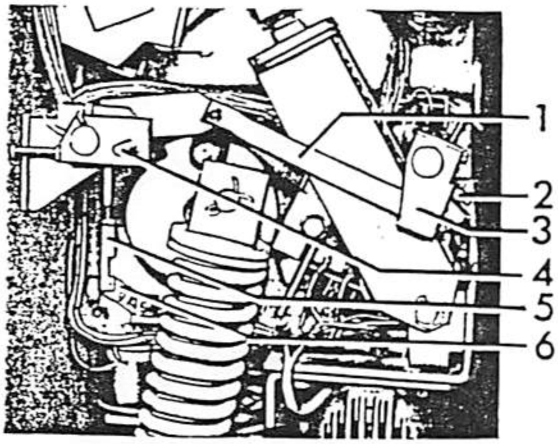


Figure 3. (8038805) Spring Discharge Linkage

1. Link
2. Adjusting Bolt
3. Trip Latch Crank
4. Discharge Crank
5. Adjusting Clevis
6. Spring Release Crank

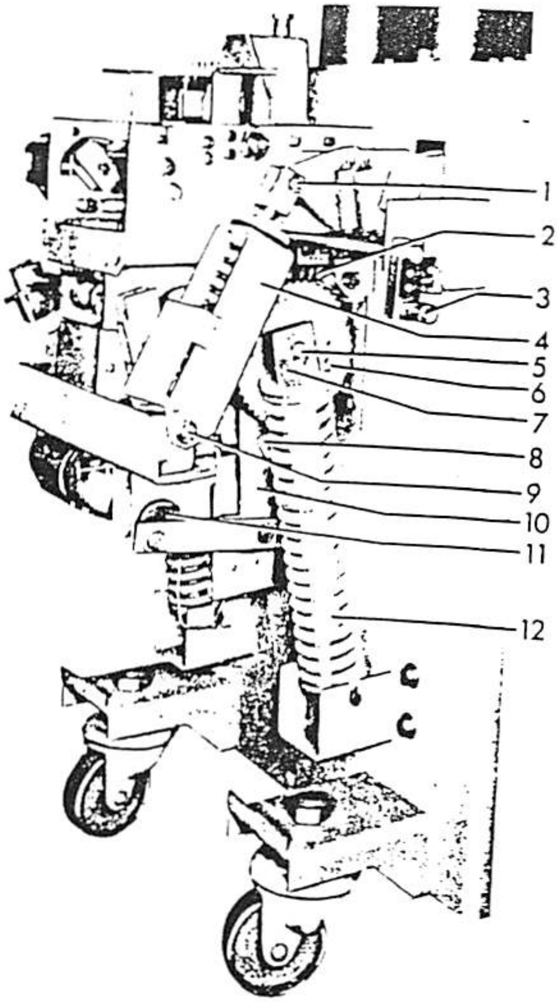


Figure 4. (8040405) Right Side View ML-13 Operating Mechanism

1. Upper Spring Pin
2. Latching Pawls
3. Positive Interlock Roller
4. Opening Spring
5. Cam Shaft
6. Ratchet Wheel
7. Bearing Block
8. Driving Pawl
9. Lower Spring Pin
10. Driving Pawl Lever
11. Eccentric
12. Closing Spring

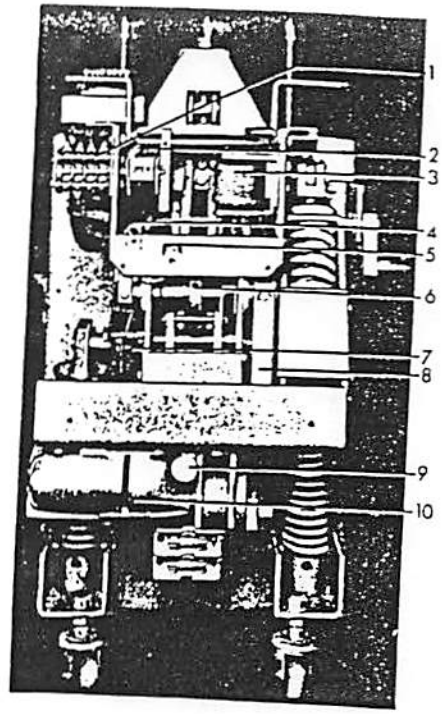


Figure 5. (8034471) Front View ML-13 Operating Mechanism

1. Auxiliary Switch
2. Open - Close Indicator
3. Trip Coil
4. Prop Spring
5. Operation Counter
6. Trip Latch
7. Charge - Discharge Indicator
8. Manual Trip Lever
9. Manual Close Lever
10. Motor

on a-c or d-c voltage as indicated on the breaker nameplate. Closing and opening operations are controlled either electrically from the metal-clad unit and remote location, or mechanically by the manual close and trip levers on the breaker. All secondary connections from the breaker to the metal-clad unit are made through the coupler (1) Fig. 2.

A spring release interlock, Fig. 3, is provided to discharge both the closing and opening springs when the breaker is withdrawn from or inserted into the metal-clad unit.

A positive interlock (3) Figure 4 and interlock switch (2) Figure 2, are provided between the breaker and metal-clad unit to prevent raising or lowering of the breaker in the unit while in a closed position and to prevent a closing operation when the breaker is not in either the fully raised or lowered position. To insure that this interlock will function during manual, as well as during electrical operation of the equipment, both mechanical and electrical blocking is provided. If for any reason the closing springs should be discharged against the positive interlock the mechanism will be jammed and be inoperable. The mechanism can be released and returned to the reset position by pushing in on the trip lever (8) Figure 5. It may require more than normal force to release the interlock.

A plunger interlock, Figure 14 can be provided when required to operate a stationary auxiliary switch and/or a rod interlock mounted in the metal-clad unit.

When the breaker is used interchangeable with type MS-13 solenoid operated breakers in M-26H metal-clad units, fuses (12) Figure 2, are mounted on the breaker for protection of the motor and closing circuit. These breakers are identified by "C" suffix in the breaker nomenclature.

1. Latch Checking Switch
2. Switch Cam
3. Switch Striker
4. Switch Support Bolts
5. Switch Support
6. Closing Latch Roller
7. Power Switches
8. Closing Latch
9. Closing Latch Shaft
10. Latch Adjusting Screw
11. Release Coil Bolts
12. Closing Latch Spring
13. Latch Monitoring Switch
14. Switch Mounting Bracket
15. Spring Release Solenoid
16. Release Coil Support
17. Control Relay

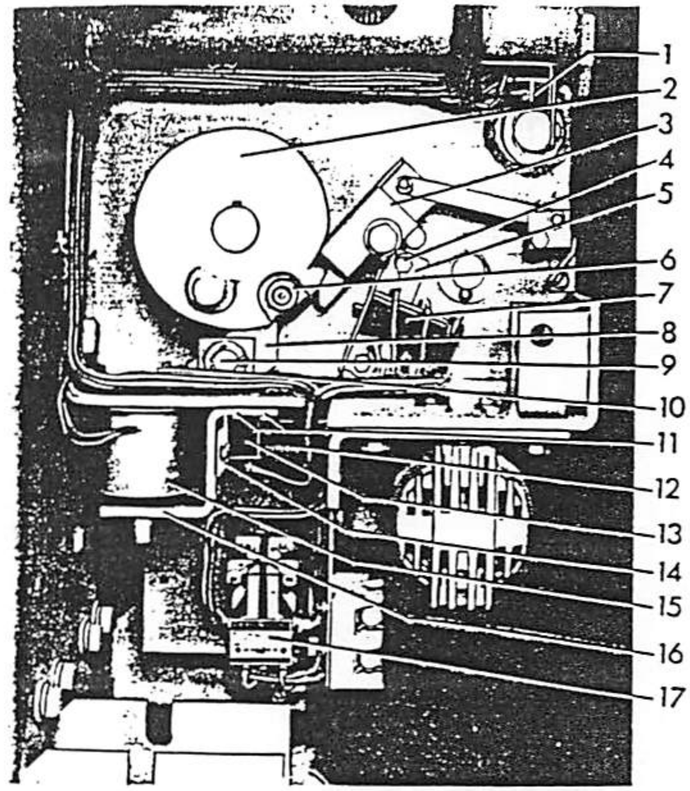


Figure 6. (8034467) Control Mechanism

In cases where breakers with type ML-13 mechanisms are to be used interchangeably with breakers having type ML-12 mechanisms, the spring charging circuit should be fused in accordance with the following table, depending on which type mechanism is used.

CONTROL VOLTAGE	ML-13 MECHANISM		ML-12 MECHANISM	
	FUSE RATING	BUSS CO. CAT. NO. •	FUSE RATING	BUSS CO. CAT. NO. •
48v d-c	30A	NON 30	10A	NON 10
110v d-c 125v d-c 115v a-c	15A	NON 15	1.8A	FRN 1.8 (FUSETRON)
220v d-c 250v d-c 230v a-c	10A	NON 10	3A	NON 3

•Or Equivalent

Spring Charging

The mechanism has a high speed gear motor (10) Figure 5, that compresses a set of closing springs through the action of an eccentric, ratchet, and pawl assembly. The rotary action of the motor is converted to a straight stroke through the eccentric (11) Figure 4, and a lever that carries a spring loaded driving pawl (3) Figure 1.

The pawl advances the ratchet wheel (6) Figure 4 a few degrees each stroke where it is held in position by the latching pawls (2). When the ratchet wheel has been rotated approximately 180 degrees the closing springs (12) will be fully compressed. As the ratchet wheel continues to rotate, the spring load will shift over center and attempt to discharge. After a few degrees of rotation, the closing roller (7) Figure 2, will engage the closing latch (9) and the compressed springs will be held by the latch until a closing operation is required. During the last few degrees of the ratchet wheel rotation the power switches (8) are opened and the driving pawl is raised from the ratchet wheel surface. This allows the motor and driving mechanism to coast to a natural stop expending all residual energy.

During the time the springs are being compressed a relay (17) Figure 6, is energized to hold the closing circuit open. The relay remains energized until the springs are fully charged and the control switch contacts are re-set.

The closing springs may be charged manually if control voltage is lost. A 5/8" ratchet wrench can be used to rotate the eccentric in a counter clockwise direction until the indicator reads "Charged" and the driving pawl is raised from the ratchet wheel. The use of the ratchet wrench provides for maximum safety in the event that control power is suddenly restored without warning. In this event, the motor drive will override the ratchet wrench and continues to charge the springs.

Closing Operation

The breaker can be closed electrically by energizing the spring release solenoid (15) Figure 6, or manually by pushing the close button (9)

Figure 5. In either method the closing latch is rotated from under the closing roller to release the closing springs (10) Figure 2. The energy in the springs is used to rotate a cam (8) Figure 7 and close the breaker through the operating mechanism linkage. During the closing operation the mechanism is trip-free at all times. The breaker is held closed by the closing prop (5) moving into position under the prop pin (4). During the closing operation the opening springs (4) Figure 4, are compressed and held ready for an opening operation with the trip latch (17) Figure 7 bearing against the trip latch roller (19).

When the closing operation of the breaker is completed and the closing latch is fully reset, the contact of the latch monitoring switch closes to permit the spring charging motor to be energized and recharge the closing springs.

Opening Operation

The breaker can be opened either electrically by energizing the trip coil (3) Figure 5, or manually by pushing the trip lever (8). In each method the trip latch is rotated off the trip latch roller, permitting the operating mechanism linkage to collapse. The energy stored in the opening sprin is released to provide the required opening spe for successful interruption of the circuit.

As the breaker opens to interrupt a curre the arc first starts at the arcing contacts(5 & Figure 8, transfers to the arc runner (3 & 8 and energizes the blow-out coils (2 & 7). Th action introduces a mangetic field between th pole pieces (4 & 9) of the interrupter that force the arc deeper into the arc chute(6). At the tim the arcing contacts part a discharge of air expelled through the booster tube (22) acros the arc. This air flow assists the arc transfe and interruption by blowing the arc away from th contacts and into the arc chute. As the magnet field forces the arc deeper into the interrupte along the diverging arc runners, the field i increased by the insertion of additional blow-out coils into the circuit.

The arc chute has a series of interleaving ceramic fins, Figure 19. As the arc is forced into the interrupter it is lengthened in the gradually deepening serpentine path between the fins so that the electrical resistance of the arc is rapidly increased and its heat is absorbed by the ceramic material.

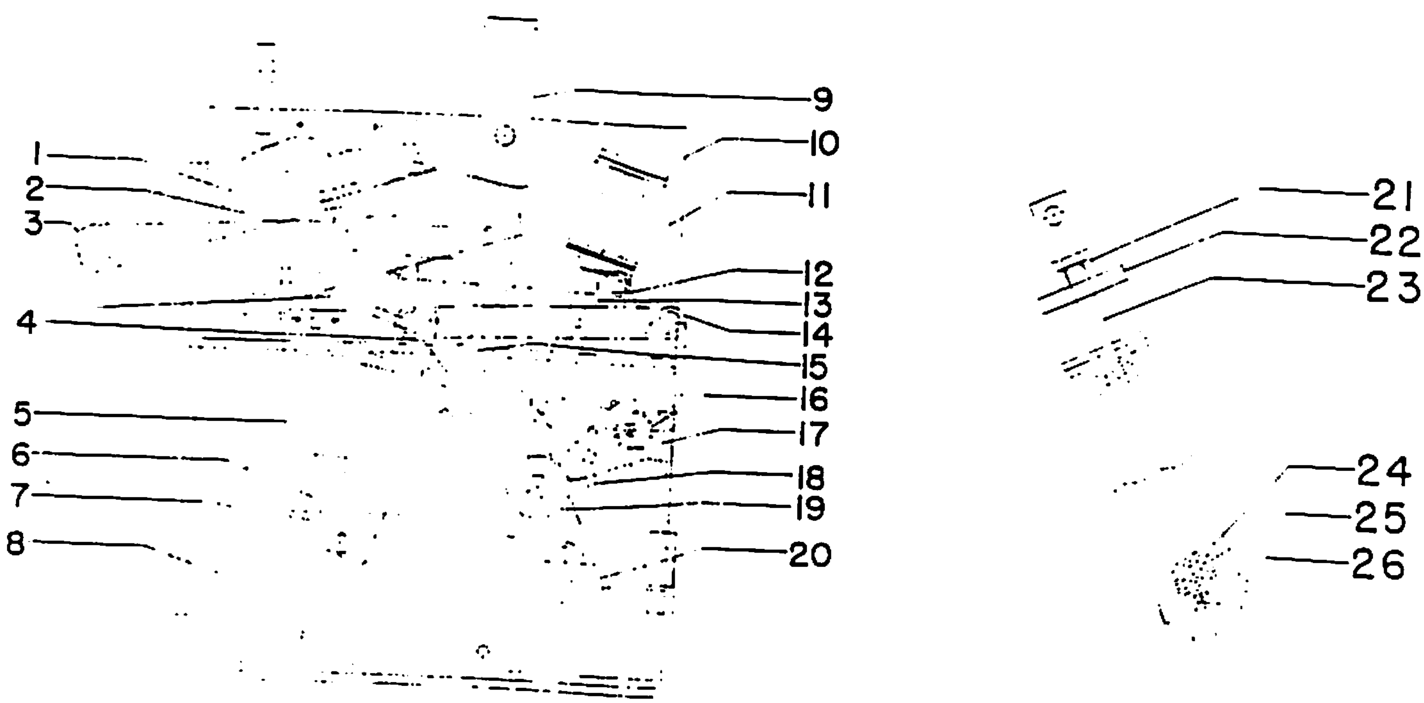


Figure 7 (0134C3583) Sectional Side View of Mechanism

1. Main Shaft Bearing
2. Crank Shaft
3. Cranks
4. Prop Pin
5. Prop
6. Cam Shaft
7. Cam Shaft Bearing
8. Cam
9. Handle
10. Trip Coil Support
11. Trip Coil
12. Upper Prop Spring
13. Trip Armature
14. Lower Prop Spring
15. Cam Follower Roller
16. Trip Shaft
17. Trip Latch
18. Stop Pin
19. Trip Latch Roller
20. Trip Latch Roller Support
21. Check Nut
22. Stop Plate
23. Spring Rod
24. Spring
25. Spring Guide
26. Spring Guide

The increased resistance reduces the magnitude and phase angle of the current and at an early current zero the arc cannot re-establish itself and interruption occurs.

Trip Free Operation

If the trip coil circuit is energized while the breaker is closing, the trip armature will force the trip latch (17) Figure 7 away from the trip roller (19) causing the mechanism linkage to collapse and the breaker to re-open. The closing cam (8) will complete its closing stroke and the springs will re-charge as in a normal closing operation.

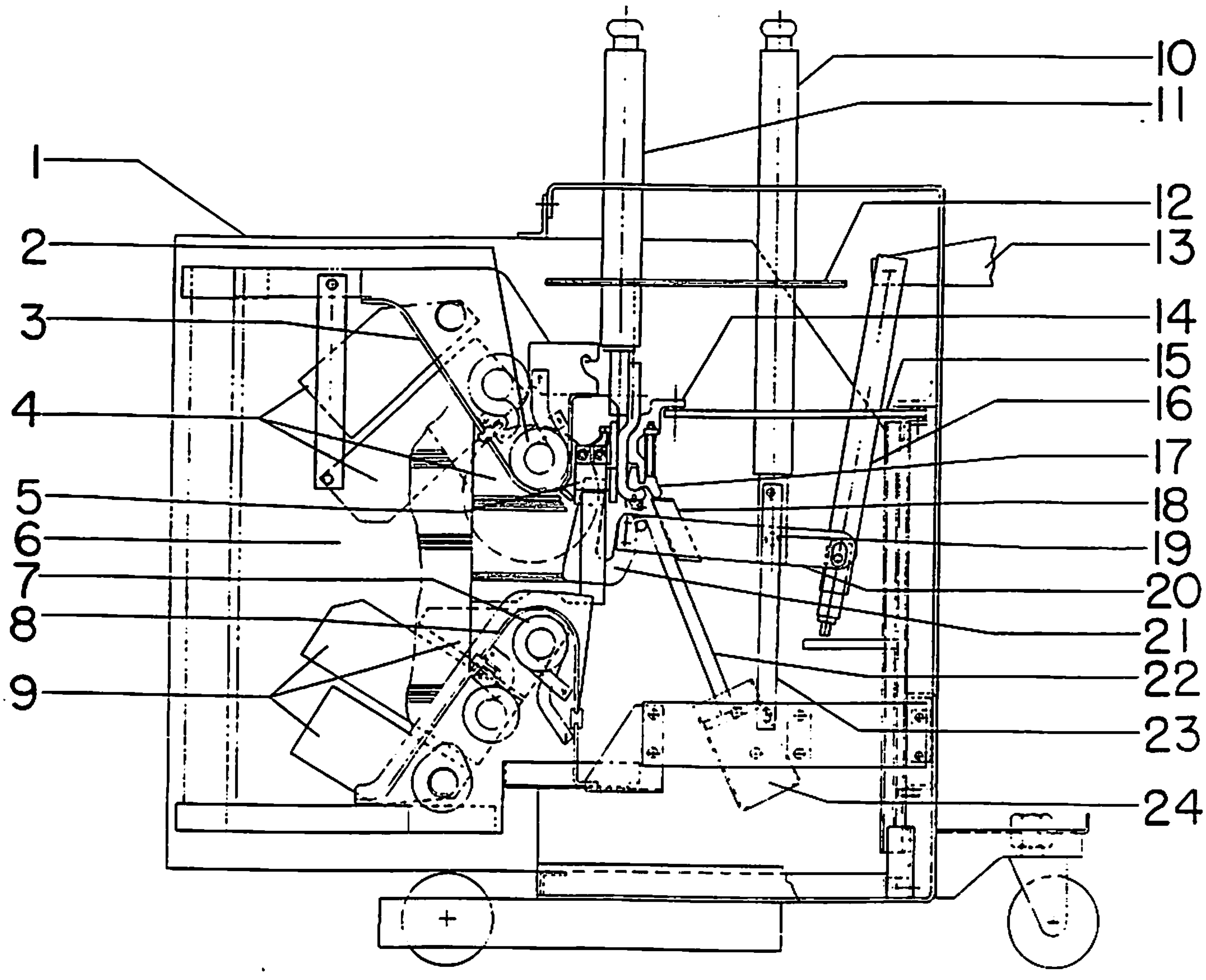


Figure 8 (0134C3584) Cross Section of Breaker Pole Unit

1. Box Barrier
2. Upper Blow-out Coil
3. Upper Arc Runner
4. Upper Pole Pieces
5. Stationary Arcing Contact
6. Arc Chute Side
7. Lower Blow-out Coil
8. Lower Arc Runner
9. Lower Pole Pieces
10. Front Bushing
11. Rear Bushing
12. Upper Horizontal Barrier
13. Main Operating Crank
14. Spring Retainer
15. Lower Horizontal Barrier
16. Operating Rod
17. Stationary Primary Contacts
18. Movable Primary Contacts
19. Cup Bearing
20. Movable Contact Arm Assembly
21. Movable Arcing Contact
22. Booster Tube and Piston
23. Connection Bar
24. Booster Cylinder

ADJUSTMENTS

All adjustments should be checked 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 after removing the box barriers and front cover from the breaker.

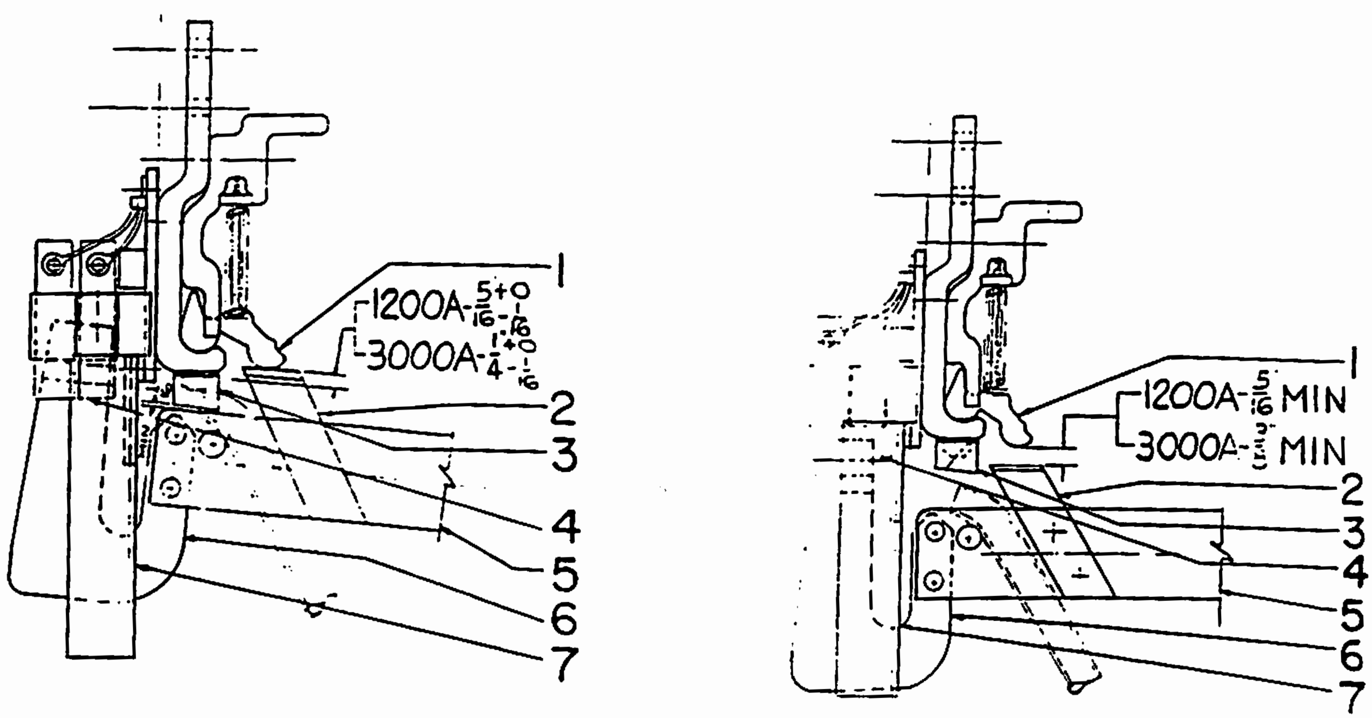
DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING.

Arcing Contact Wipe

Refer to Figure 9. 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 indicator 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 for 1200A and 3/8" or greater for 3000A. This setting has been made in the factory and no adjustment is provided. Insufficient wipe is an indication that the arcing contacts need to be replaced. When making this check, see that the movable arcing contact (6) passes between the probes on the upper arc runner without touching. Also check for clearance between the arcing contact (6) and the slot in the throat baffle (7) during entire stroke of the moving contact assembly.

Primary Contact Wipe

Refer to Figure 9, when the breaker is closed the stationary primary contacts (1) should rise from 1/4" to 5/16" for 1200A and from 3/16" to 1/4" for 3000A. Before checking this dimension be sure the mechanism is re-set so that the prop pin (4) Figure 7 is resting on the prop. To obtain the proper contact adjustment, open



Primary Contact Wipe

Arcing Contact Wipe

Figure 9 (0134C3564) Contact Adjustments

1. Stationary Primary Contacts
2. Movable Primary Contacts
3. Buffer Block
4. Stationary Arcing Contacts
5. Contact Arm
6. Movable Arcing Contacts
7. Throat Baffle

the breaker and, referring to Figure 10, 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 (5) Figure 9 and the buffer block (3) should be 1/16" or greater when the breaker is fully closed.

Primary Contact Gap

Refer to Figure 10. 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 (8) measured between the closest points, should be 3 5/8" to 3 15/16". To change this gap, loosen the check nut (21) Figure 7, and turn the adjusting nut (22) on stud (23). Screwing the adjusting nut down will decrease the primary contact gap. Tighten the check nut and re-measure the contact gap (close and trip the breaker before checking the measurement). Whenever the primary contact gap is changed, the primary contact wipe should be rechecked and, if necessary, readjusted.

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

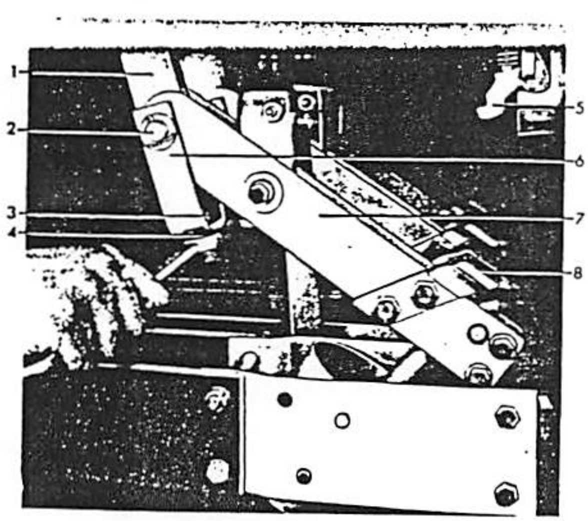


Figure 10. (8039618) Adjustable Coupling For Making Primary Contact Wipe Adjustments

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

* Indicates revision

Trip Latch Wipe

Refer to Figure 7. The wipe of the trip latch (17) on the trip roller (19) should be from 3/16" to 1/4". This can be measured by putting a film of grease on the latch (17), closing the breaker part way, and tripping. The mechanism has the proper trip latch wipe when the latch rests against the stop pin (18). 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 (16).

Trip Armature Travel

* Refer to Fig. 7. The armature (13) should have 1/16" to 3/16" travel before the trip latch (17) starts to move plus 1/32" minimum overtravel after tripping. This can be adjusted by moving the trip coil support (10) and/or by adjusting the trip armature screw (12) Figure 11. A locking screw located behind the trip armature screw must first be loosened. Retighten locking screw after making adkustment.

Release Latch Wipe

Refer to Figure 6. The wipe between the release latch (8) and roller (6) should be 3/16" to 1/4". If re-setting is required, loosen, set, and retighten adjustment nut and screw (10).

Release Latch Monitoring Switch

Refer to Figure 6. The release latch must be fully re-set and the latch monitoring switch (13) operated before the motor will start. When the latch is fully reset the clearance between the switch striker arm and the switch mounting bracket (14) is 1/32" or less, this can be adjusted by bending the striker arm.

Motor and Relay Switches

Refer to Figure 6. With the closing springs blocked rotate the switch cam (2) until the switch striker (3) has traveled the maximum amount (about 180 degrees rotation of cam). At this point the clearance between the striker and the switch support (5) should be 1/32" or less. This can be adjusted by loosening the switch support mounting bolts (4) and rotating the support.

Interlock Switch Wipe

Refer to Figure 12. With the positive interlock in the reset, or normal position the clearance between the interlock switch arm (2) and the switch mounting plate (3) should be 1/32" or less. This can be adjusted by bending the switch arm.

Driving Pawl Adjustment

Refer to Figure 4. The driving pawl (8) must advance the ratchet wheel (6) sufficiently on each stroke to allow the latching pawls (2) to fall into the ratchet teeth. This should be checked with the closing spring load against the driving members. With the mechanism unblocked, hand charge the

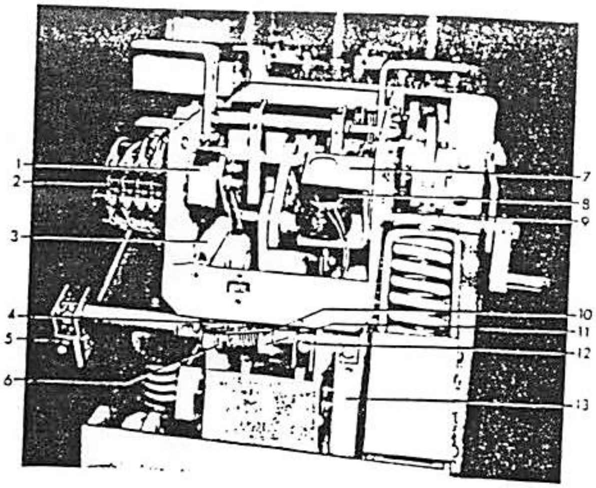


Figure 11. (8039585) Auxiliary Switch and Trip Coil

1. Open - Close Indicator
2. Auxiliary Switch
3. Prop Spring
4. Trip Latch Spring
5. Spring Discharge Crank
6. Cotter Pin
7. Trip Coil Support
8. Trip Coil
9. Mounting Bolts
10. Latch Set Screw
11. Trip Latch
12. Trip Arm Screw
13. Manual Trip Lever

closing springs with the manual charging wrench until they are slightly more than half charged. Slowly rotate the charging wrench until the driving pawl has traveled through its return stroke and check the maximum clearance between the pawl and the ratchet tooth. Rotate the charging wrench until the driving pawl has advanced the ratchet tooth to its maximum travel. Now check the clearance between the ratchet tooth and the latching pawl. The clearance should be approximately equal for both the driving and latching pawls and not less than .015" in either case.

If adjustment is required for either pawl the springs must first be fully charged and blocked. Loosen seven motor support bolts (2) Figure 1 and move entire motor assembly to the rear if the clearance is under the minimum at the latching pawls, and to the front if the clearance is under the minimum at the driving pawl. Move the motor assembly approximately twice the dimensional increase required at the pawl. Be certain the motor assembly is moved straight forward or rearward and tighten the one bolt on the right side of the mounting frame first to assure proper alignment. After tightening the remaining bolts the springs should be released and the clearance again checked as described above.

Crank Shaft End Play

The outboard cranks (3) Figure 7 on the crank shaft should be adjusted so the end play side to side is less than 0.015 inch. After this adjustment is made, the clearance of the prop pin (4) Figure 7 to the frame is a minimum of 0.025 inch.

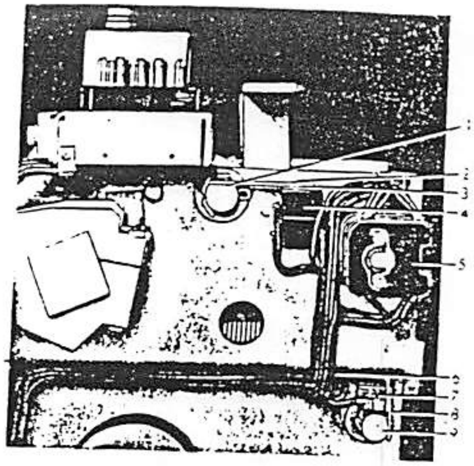


Figure 12. (8034474) Positive Interlock Switch

1. Positive Interlock Shaft
2. Switch Arm
3. Switch Support
4. Interlock Switch
5. Auxiliary Switch
6. Switch Support
7. Latch Checking Switch
8. Switch Arm
9. Trip Shaft

AUXILIARY DEVICES

Latch Checking Switch

Refer to Figure 13. Charge the closing springs sufficiently to reset the mechanism linkage. Rotate the trip latch (4) by pressing the manual trip lever to open the latch checking switch (2). Allow the trip latch to reset slowly and determine the point at which the contacts are made by using a circuit continuity tester (light indicator, bell set, etc.). The contacts of the latch checking switch should just make when the gap between the trip latch (4) and the stop pin (5) located on the latch roller link (7) is 1/16". There should be a minimum of 1 64" between the switch arm (3) and the switch support (1). To obtain adjustment of the latch checking switch, bend the latch checking switch arm (3).

Plunger Interlock

Refer to Figure 14. With the breaker in the closed position, the vertical distance "A" from the top of the plunger bolt (1) to the bottom of the breaker lifting rail (3) should be 11-7/32" to 11-11/32". To change this adjustment, add or remove washers (2).

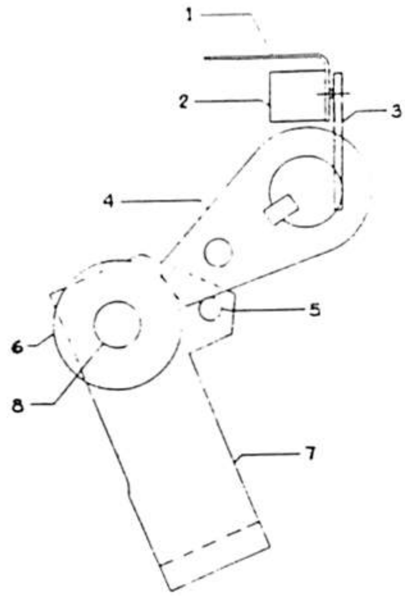


Figure 13. (0114C5320) Latch Checking Switch

1. Switch Support
2. Latch Checking Switch
3. Switch Arm
4. Trip Latch
5. Reset Pin Stop
6. Latch Roller
7. Latch Roller Link
8. Latch Roller Pin

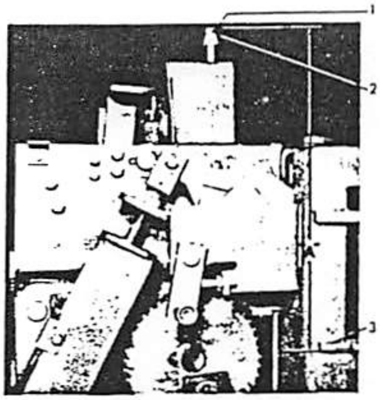


Figure 14. (8034464) Plunger Interlock

1. Plunger Bolt
2. Washer
3. Breaker Lifting Rail

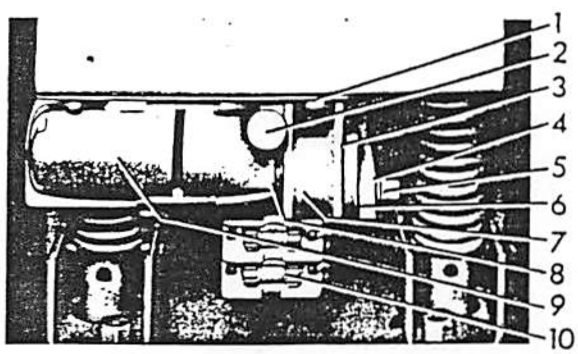


Figure 15. (8034471) Driving Elements

1. Mounting Bolts
2. Manual Close Button
3. Eccentric
4. Retaining Ring
5. Hex Charging Stud
6. Driving Link
7. Motor Support
8. Retaining Ring
9. Motor
10. Fuse

Auxiliary Fuses

Refer to Figure 15. On breakers with "C" suffix, a set of protecting fuses (10) are mounted on the front of the breaker. These fuses are the primary protective devices for the closing control circuit on those breakers that are used in metal-clad units designed for solenoid operated breakers.

Inspection and Test

1. For ease in reviewing the adjustments, the following are recapitulated:
   a. Arcing contact wipe:
      (gap at primary contacts)
      1200A - 5/16" min.
      3000A - 3/8" min.
   b. Primary contact wipe:
      1200A - 1/4" to 5/16".
      3000A - 3/16" to 1/4".
   c. Primary contact gap: 3-5/8" to 3-15/16".
   d. Trip armature travel 1/16" to 3/16" plus 1/32" overtravel.
   * e. Trip armature travel 1/16" to 3/16" plus 1/32" minimum overtravel.
   f. Release latch wipe: 3/16" to 1/4".
   g. Release latch monitoring switch: Maximum clearance 1/32".
   h. Motor and relay switch: maximum clearance 1/32".
   i. Interlock switch: maximum clearance 1/32".
   j. Driving and Latching Pawl: minimum clearance to ratchet teeth .015".
   k. Latch checking switch contacts make when the gap between the trip latch and the stop pin is 1/16".
   l. Plunger interlock: 11-7/32" to 11-11/32".
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,

* Indicates revision

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. (Page 16 and Figure 17.

5. Operate the breaker slowly with the manual charging wrench 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 is repainted immediately.

7. Check the trip coil plunger and the release coil plunger to see that they move freely.

Opening and Closing Speeds

The closing speed of the arcing contact of the breaker should be a minimum of 14 feet per second. This represents the average speed of the movable arcing contact from a point 3" before the tip is tangent to the lower surface of the probes on the upper arc runner to the tangent position.

The opening speed of the arcing contact should be a minimum of 15 feet per second for 1200 A. and 11 ft. per second for 3000 A. This 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 probes on the upper runner. Proper servicing and lubrication of the breaker and its operating mechanism should maintain these speeds and no adjustment is provided.

Control Power Check

After the breaker has been operated several times with the manual charging wrench and the mechanism adjustments are checked as describ... the operating voltages should be checked at ... release coil, trip coil, and motor termina... Control Power for electrical operation of t... breaker may be from either an alternating ... direct current source. The operating ranges ... the closing and tripping voltages as given on t... breaker nameplate, are as follows:

Nominal Voltage	Closing Range	Tripping Range
24v d-c	- -	14 - 30v d-c
48v d-c	34 - 50v d-c	28 - 60v d-c
110v d-c	80 - 115v d-c	60 - 125v d-c
125v d-c	90 - 130v d-c	70 - 140v d-c
220v d-c	160 - 230v d-c	120 - 250v d-c
250v d-c	180 - 260v d-c	140 - 280v d-c
115v a-c	95 - 125v a-c	95 - 125v a-c
230v a-c	190 - 250v a-c	190 - 250v a-c

If the closed circuit voltage at the terminals of the coil or motor does not fall in the specified range, check the voltage at the source of power and line drop between the power source and breaker.

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 or motor of each breaker must fall within the specified limits.

Electrical closing or opening is accomplished by 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 or close the breaker manually be pressing the manual trip ...ver (8) Figure 5 or the manual close butt...).

GENERAL MAINTENANCE

General

Safe and dependable service from electrical apparatus and power systems is contingent upon reliable performance of power circuit breakers. To obtain maximum reliability the breaker should be inspected and maintained on a regular schedule. The breakers are designed in accordance with applicable standards which require that they be capable of performing up to 2500 operations, switching rated continuous current, before any replacement of parts should be necessary. This requirement is based on the breakers being serviced, or maintained, at least every 1000 operations, or once per year, whichever comes first. If the breaker is also required to interrupt fault currents during this period of time additional maintenance and replacement of parts may be necessary.

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

Periodic Inspection

The frequency of the inspection and maintenance operations required should be determined by each operating company and will depend on the application of the breakers and the operating conditions. Factors which should be considered are: Importance to overall plant or system operation; number of operations and magnitude of currents switched by breaker; frequency of fault interruptions; and the atmospheric conditions in which the breaker normally operates. Extreme conditions of dust, moisture, corrosive gases etc., can indicate that inspection and maintenance will be required more frequently than every 1000 operations. Very clean dry operating conditions with low current switching duty can justify a longer period of time between inspections. Any time a breaker is known to have interrupted a fault at or near its rating it is recommended that the breaker be inspected and necessary maintenance be performed as soon after the interruption as is practical. The following instructions give the items that should be included in an inspection and general recommendations on the maintenance of breakers.

Interrupters

Since there are no moving parts, the interrupters of a magne-blast breaker will normally require little or no inspection unless there is evidence of damage to the arc chutes sides or contamination in the throat area. If either of these conditions are present the interrupters should be removed from the breaker and the following points noted:

1. The throat area of the interrupter should be cleaned with sandpaper (Do Not use emery cloth or other metallic abrasives). All flat areas on either side of the movable arcing contact travel should be sanded. Do not sand or otherwise attempt to clean the ceramic fins of the arc chute sides or throat pieces. Heavily contaminated parts should be replaced.

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 cracks do not interfere with the operation of the device in any way 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 will be necessary. Small broken corners on the exhaust end of the arc chute sides will not interfere with its performance and can be disregarded.

4. The plastisol flexible covering for the pole pieces (3 & 8) Figure 18 and the upper mounting support (12) should be inspected for breaks in the insulation. If there are holes or breaks in the insulation they should be repaired or the part replaced.

Interrupter Removal and Replacement

Refer to Figure 16. An arc chute lifter is normally furnished with the metal-clad switchgear for use in removing and replacing the interrupters of the AM-4.16-350 breakers. When the lifter is not available an overhead crane or portable hoist may be used. The arc chute lifter is assembled to the top plate of the breaker as shown in the reference figure. Before assembling the lifter on the breaker it is necessary to remove the box barrier(s). Bolt the angle support (5) across the front of the top plate using the two (2) 5/8" tapped holes provided. Position the arc chute lifter (4) over the rear bushing and into the proper slots in the support angle.

Lower the grappling hooks (6) by turning the handle (1) clockwise until they can be placed over the lifting bolts (7) on the interrupter. Turn the handle counter-clockwise until the hooks begin to lift the arc chute.

To remove the interrupter, loosen the two upper supporting bolts (8) and the one lower support bolt (11) using a standard 3/4" wrench. Raise the assembly approximately 3/8" and continue to raise the interrupter and gently move it from side to side until both upper and lower supports are disconnected. Move the trolley (2) of the arc chute lifter towards the rear of the breaker and lower the interrupter to a resting position on the floor. Support the interrupter from falling over and remove the grappling hooks.

To reassemble the interrupter to the breaker, rest the lower interrupter support (12) on the support bracket (10). Slide the arc chute forward, lifting it slightly to engage the supporting bolts (8) in the slots of the upper interrupter support. Check to assure that the upper insulation (17) Figure 18, is properly positioned within the barrier (12) Figure 22 suspended from the stationary contact support.

Tighten the supporting bolts (8) and (11), Figure 16. These bolts serve as both the electrical and mechanical connections between the bushings and the arc runners within the interrupter. Check that the movable arcing contact (9) passes between the probes on the upper arc runner (3) Figure 20 without touching.

Breaker Contacts

By removing the box barrier(s) 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 interrupter. If the contacts are burned or pitted, they can be made smooth with a fine file.

After completing inspection of the contacts, check the contact adjustments as specified under 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 manual charging wrench, 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 ADJUSTMENTS. Check the

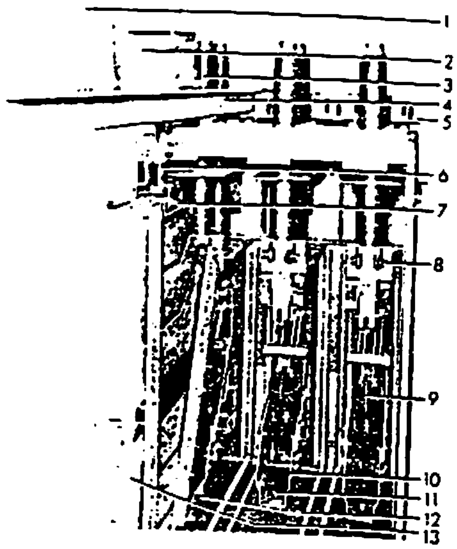


Figure 16 (8034810) Interrupter Partially Removed Showing Accessibility of Arcing Contacts

1. Handle
2. Trolley
3. Rear Bushing
4. Arc Chute Lifter
5. Angle Support
6. Grappling Hooks
7. Lifting Bolt
8. Upper Supporting Bolt
9. Movable Arcing Contact
10. Support Bracket
11. Lower Supporting Bolt
12. Lower Interrupter Support
13. Arc Chute

control wiring for tightness of connections and damaged insulation.

Electrical Connections

To assure that the electrical connections have remained tight, they should be checked during installation as well as during each maintenance inspection. This check of electrical connections is particularly necessary on breakers used in nuclear generating stations and other critical applications. The bolted braid connections on the stationary arcing contacts should be checked for tightness by removing the arc chutes as described on page 15.

Bushings and Insulation

The surface of the 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 or clear resin. 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 in the metal-clad switchgear to insure dryness.

Insulation Test

When insulation has been repaired or replaced, or when breaker has been operating in adverse moisture conditions, it is recommended that the insulation be checked before the breaker is placed back in service. A standard 60 hertz high potential test at 14,000 volts RMS for one minute will normally indicate whether the breaker is satisfactory for service. With the breaker contacts in the fully opened position, apply the test potential to each terminal of the breaker individually 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 repair or replace insulation that may have been affected by moisture absorption.

If the breaker secondary wiring is to be given a high-potential test at 1500 volts, remove both of the motor leads from the terminal board. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

Lubrication

In order to maintain reliable operation, it is important that all circuit breakers be properly lubricated at all times. Some of the bearings and rolling surfaces utilize a new type of dry lubrication that will require no maintenance and will last the life of the equipment. The remaining bearings and surfaces require lubrication as listed in the lubrication chart, Figure 17. These have been properly lubricated during assembly at the factory, using the finest grades 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.

It is recommended that lubrication of the breaker and its operating mechanism be a part of the periodic inspection and maintenance program, with not more than a two year period between lubrications. It is also recommended that all circuit breakers be operated at regular intervals, at least once a year, to insure the lubrication is in good condition and the breaker is operable.

The lubrication chart, Figure 17, 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, and should be used when a general overhaul of the breaker is necessary.

General Electric Lubricants D50H15 and D50H4 are available in 1/4 lb. collapsible tubes. It i so packaged to insure cleanliness and to pre vent oxidation.

PARTS	LUBRICATION AT MAINTENANCE PERIOD	ALTERNATE LUBRICATION (REQUIRES DISASSEMBLY)
Prop & Trip Shaft Bearings (Teflon coated bearings)	No lubrication required	No lubrication required
Sleeve Bearings - main crank shaft, mechanism pawls, spring charging and operating linkages, etc. (Bronze)	Light application of machine oil SAE 20 or SAE 30.	Remove bearings or links, clean per instructions and apply D50H15 lubricant liberally.
Contact Arm Hinge Assembly Cup Bearing Loose rings between bushing and contact arm	No lubrication required	Wipe clean and apply D50H47.
Roller and Needle Bearings	Light application of machine oil SAE 20 or SAE 30.	Clean per instructions and repack with D50H15 lubricant.
Ground surfaces such as cams, ratchet teeth, etc. (Surfaces coated with MoS_2)	No lubrication required.	No lubrication required.
Ground surfaces such as latches, rollers, prop, etc.	Wipe clean and apply D50H15 lubricant	Wipe clean and apply D50H15 lubricant.
Silver plated contacts and primary disconnect studs	Wipe clean and apply D50H47 lubricant	Wipe clean and apply D50H47 lubricant.
Booster Cylinder	Do not lubricate	Do not lubricate
Arcing Contacts	Do not lubricate	Do not lubricate

Figure 17 Lubrication Chart.

METHOD OF CLEANING BEARINGS

Whenever cleaning of bearings is required, as indicated in the lubrication chart, the following procedures are recommended.

Sleeve Bearings

The sleeve bearings used in the prop (5) Figure 7 and the bearings for the trip shaft (16) utilize Teflon surfaces and do not require lubrication. After a number of operations, the surface will acquire a thin black film. Do not remove this film unless there is evidence of outside contaminants.

such as dry or hardened grease. If contaminants are present they should be removed by immersing the prop and bearing in clean petroleum solvent, or similar cleaner, and using a stiff brush. Do not remove the bearings from the prop or frame. DO NOT USE CARBON TETRACHLORIDE.

The remaining sleeve bearings located in the driving element and the mechanism linkage and frame should be cleaned and relubricated with G-E D50H15 lubricant at general overhaul periods. This includes the bearings in the driving link (6) Figure 15, driving pawl lever (10) Figure 4, driving pawl (8), latching pawls (2), trip latch roller support (20) Figure 7, cranks (3), and the bearings in the mechanism frame and interconnecting links. Bearings that are pressed into the frame or other mechanism members should not be removed.

The cup bearing (19) Figure 8 of the primary contact arm should be disassembled, cleaned, and lubricated with G-E D50H47 lubricant at general overhaul periods.

The main shaft bearings (1) Figure 7 should be removed, cleaned, and lubricated with G-E D50H15 lubricant at general overhaul periods.

Roller and Needle Bearings

Refer to Figure 7. The cam follower bearings (15), latch roller bearing (19), and cam shaft bearings (7) should be removed from the mechanism and the inner race disassembled. 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 inductive 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 inner races should then be assembled.

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. 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 the light oil, draining and repacking with lubricant D50H15 should follow immediately.

Bearings that are pressed into the frame or other members such as the motor support (7) Figure 15, should not be removed. After removing the shaft and inner race the bearing can be cleaned satisfactorily with petroleum solvent or a similar cleaner and a stiff brush. Follow the procedure outlined above using a light machine oil and G-E lubricant D50H15 before reassembling the inner race and shaft.

Rolling Surfaces

A number of rolling and rubbing surfaces in the mechanism have been lubricated with a baked-on dry, molybdenum disulfide coating. This lubrication, which can be recognized by its dark, almost black color (e.g. Face of switch cam (5) Figure 2) requires no maintenance and should last the life of the breaker.

Other rolling or rubbing surfaces that are not lubricated with molybdenum disulfide should have the dried, dirty grease removed and a thin film of fresh lubricant D50H15 applied.

MAINTENANCE

Magne-blast breakers used for switching arc furnaces or capacitors will requre more frequent and more detailed inspection and maintenance because of the repetitive nature of the applications. The following schedule is recommended for such breakers:

A. Every 500 Operations, or Every Six Months-Whichever Comes First:

1. Remove the box barriers.

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

3. All flat parts in the throat area of the interrupters should be thoroughly cleaned by using sandpaper. This cleaning should be performed any time the interrupter is removed. The arc chute sides and throat cooler fins should not be cleaned. Whenever the interrupter is removed, loose dust and dirt should be blown out before replacing arc chutes. Throat coolers which are heavily contaminated should be replaced.

B. Every 1000 Operations, or Every Six Months Whichever Comes First:

1. In addition to the servicing done each 500 Operations, the following inspection should be made and work done when required.

2. Primary Contacts (3 and 10 Figure 23). 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 primary contacts should be greased lightly with D50H47.

3. Arcing Contacts (4 and 5 Figure 9). 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 interrupters for this 1000 operation servicing unless inadequate wipe or contact condition indicate a need for replacement. If the interrupters are removed, the contact braids, and other parts subject to arcing should be checked for possible cleaning or replacement. Do not grease the arcing contacts under any circumstances.

4. Check the breaker and mechanism adjustments as summarized under INSPECTION AND TEST. The necessary readjustments should be made as described under ADJUSTMENTS.

5. 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.

6. The contacts of the control relay (17) Figure 6, should be inspected for wear and cleaned if necessary.

7. Lubricate the breaker operating mechanism in accordance with instructions under LUBRICATION page 16 and the lubrication chart Figure 17.

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

9. After the breaker has been serviced, it should be operated manually 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.

C. After Every 5,000 operations:

1. In addition to the servicing done each 1000 operations, the interrupters should be removed from the breaker and disassembled to permit a detailed inspection of insulation, blow-out coils, arc runners and assemblies which can become contaminated by arc products.

2. The blow-out coils should be carefully examined and if the insulation has been cracked, shrunk or erodes 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.

3. The arc runners should be inspected and replaced when the arc resistant coating on the runner surface has been penetrated as a result of arc erosion.

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

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

6. 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.

7. The cup bearing and the contact ring at the hinge point of the contact blade should be disassembled, inspected, cleaned, and relubricated with G-E contact lubricant D50H47. The contact ring should be inspected for wear and replaced when reduced in thickness to less than 1/32". When reassembling the cup bearing, be sure the cotter pin is properly assembled in the castle nut on the hinge pin (7) Figure 23. This assures proper contact pressure at the hinge.

D. Every 10,000 operations or Approximately Every Five Years - Whichever comes first:

1. The breaker should be given a general inspection and overhaul as required. All excessively worn parts in both the mechanism and breaker should be replaced. Such wear will usually be indicated when the breaker cannot be adjusted to indicated tolerances. This overhaul and

inspection is more detailed and will require disassembly of mechanism and breaker operating parts.

2. All roller and needle bearings in the operating mechanism should be disassembled, cleaned, and repacked with G. E. lubricant D50H15 as described under LUBRICATION.

3. The stationary primary contact fingers (3) Figure 23, should be disassembled and the silver-plated pivot area of the contact and contact support cleaned and lubricated with G-E lubricant D50H47.

4. The breaker and operating mechanism should be serviced as described for every 1,000 operations and properly adjusted before being put back into service.

REPAIR AND REPLACEMENT

This section covers the proper method of removing and replacing those parts of the breaker subject to damage and wear that may require repair or replacement at the installation. 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 and arc runners):

With the breaker open and the closing springs in the blocked position, remove the box barrier(s) (1) Figure 8. The interrupter can now be removed as described under INTERRUPTER REMOVAL AND REPLACEMENT page 15.

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

NOTE: When disassembling the arc chute and its components some small washers, spacers, etc., will be found that cannot be identified in these instructions. Care should be taken to collect and identify these items so they can be reassembled correctly.

1. Remove the assembly bolts (1, 2,6,9,11, 13,16 and 19), Figure 18.

2. Remove the side brace (7) and rear brace (5), the upper pole pieces (3), the lower pieces (8), and the rear muffler assembly (4).

3. To remove the upper supports (12), and upper interrupter support (15) remove the assembly bolts (14) and the bolted connection between the upper interrupter support and the blowout coil.

4. Remove the assembly bolt (22) to remove the lower brace (10).

5. Remove the lower interrupter support (20) by removing the assembly bolts (21) Figure 18 and the connection nut (7) Figure 20.

6. At this point the throat cooler assembly (4) Figure 20, and the upper arc runner assembly (3) Figure 20, can be removed. The throat cooler assembly is a permanently cemented sub-assembly consisting of the upper insulation (17) Figure 18, side shield (18) Figure 18, upper insulation (7) Figure 19, and the throat cooler (8) Figure 19.

7. Further disassembly of both the upper and lower arc runner assemblies can be done by removing the various screws and assembly bolts (not illustrated) as shown in Figure 19.

8. The arc chute sides (6) Figure 19, can also be separated for inspection.

9. Do not disassemble the muffler assembly (4) Figure 18.

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

1. The fins of the arc chute sides should be equally spaced and aligned before bolting together. The front edge (along the runner) of the two arc chute sides should be parallel and in line.

2. The gap between the fins at the rear of the arc chute sides measured at least 1" from the back end of the arc chute (See Figure 21) should be 0" to 1/16".

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

4. When reassembling the arc runner assemblies check that the spacers (1 and 11) Figure 19, are correctly installed.

5. Before bolting the upper supports in place, make certain the upper arc runner assembly and the throat cooler assembly are tight against the arc chute side.

6. Make certain that the electrical connections are tight.

Reassemble the arc chute on the breaker as described under ARC CHUTE REMOVAL AND REPLACEMENT, Page 15.

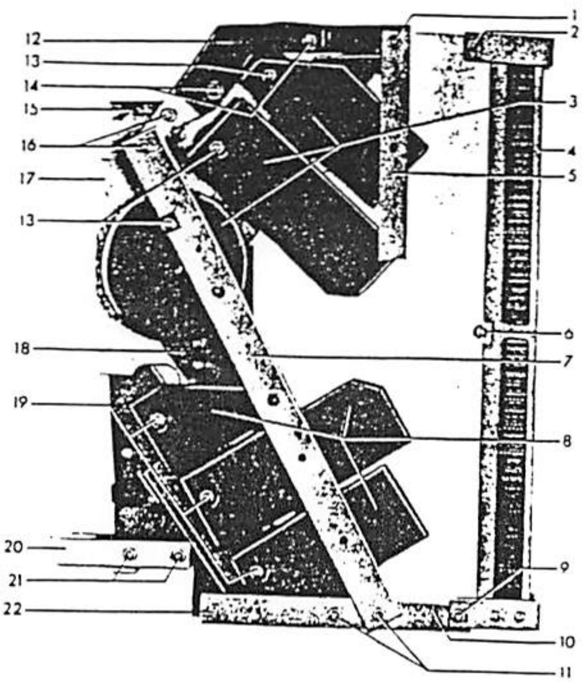


Figure 18 (8040401) Interrupter Assembly

1. Assembly Bolts
2. Assembly Bolt
3. Upper Pole Pieces
4. Muffler Assembly
5. Rear Brace
6. Assembly Bolt
7. Side Brace
8. Lower Pole Pieces
9. Assembly Bolt
10. Lower Brace
11. Assembly Bolts
12. Upper Support
13. Assembly Bolts
14. Assembly Bolts
15. Upper Interrupter Support
16. Assembly Bolts
17. Upper Insulation
18. Side Shield
19. Assembly Bolts
20. Lower Interrupter Support
21. Assembly Bolts
22. Assembly Bolt

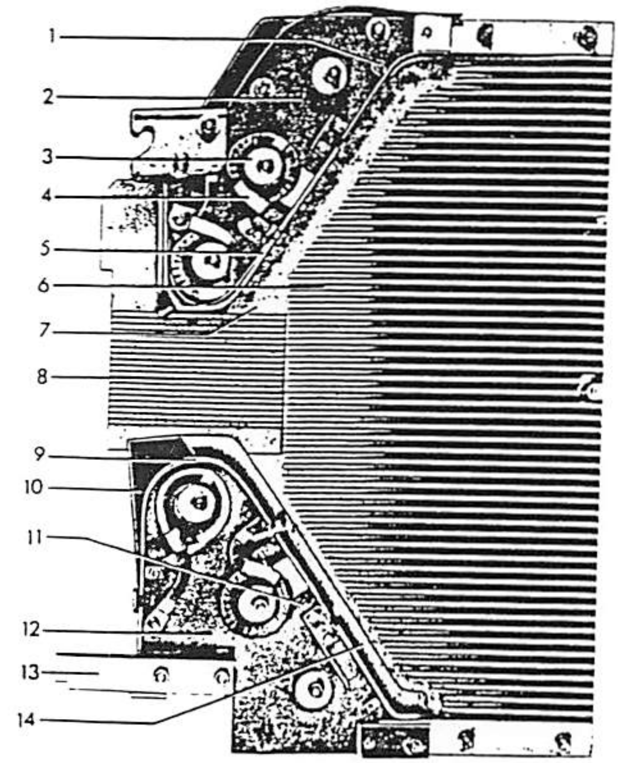


Figure 19 (8040408) Interrupter Assembly with Muffler and Side Removed

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

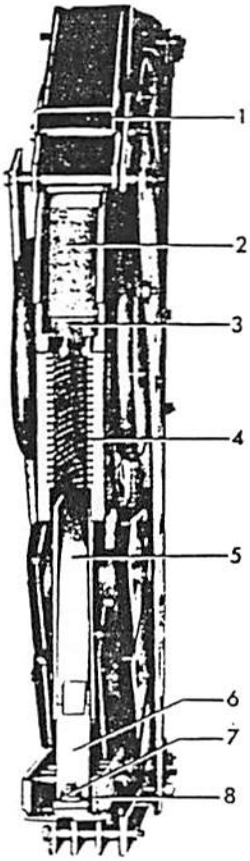


Figure 20. (8040402) Interrupter Assembly

1. Upper Mounting Support
2. Insulation Plate
3. Upper Arc Runner Assembly
4. Throat Cooler Assembly
5. Lower Arc Runner Assembly
6. Lower Coil Connection
7. Connection Nut
8. Lower Mounting Support

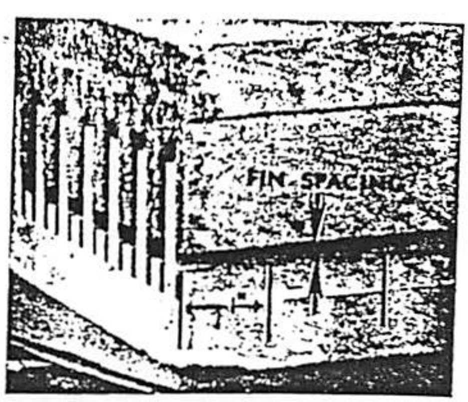


Figure 21 (8029373) Arc Chute Fins Spacing

CONTACTS

Open the breaker and remove the box barrier(s) and interrupters as previously described. To remove the contacts, proceed as follows:

A. Stationary Arcing Contacts (10) Figure 22.

1. Disconnect the contact braids (7) from the contact fingers by removing bolts and locking plates (8).

2. Grasp the lower end of the contact fingers with pliers and move the contact assembly towards rear of stud to remove from stud assembly.

3. To disassemble braids from stud plate remove one bolt(5).

4. To disassemble stud plate from contact support, remove two bolts (6).

5. Reassemble in the reverse order, make sure locking plates are properly re-assembled with bolts (8).

B. Movable Arcing Contact (14) Figure 23.

1. Remove the assembly bolts (12) making note of quantity and location of shims and spacers used between contacts and contact arms.

2. Reassemble in reverse order, re-using the shims and spacers.

3. Close the breaker slowly to check that the movable arcing contact is approximately centered on the stationary arcing contact and that it does not rub on either side of the throat barrier (9).

NOTE: Whenever it is found necessary to replace arcing contacts on any pole of a breaker it is recommended that both the stationary and movable contacts on that pole be replaced at the same time.

C. Stationary Primary Contacts (9) Figure 24.

1. Compress the contact spring (6) by use of the spring compressor.

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). Remove one contact finger at a time.

To replace the Stationary Primary Contacts:

1. Apply a thin coating of D50H47 grease on the hinged edge of the finger (9) then place it on the contact support (7) so

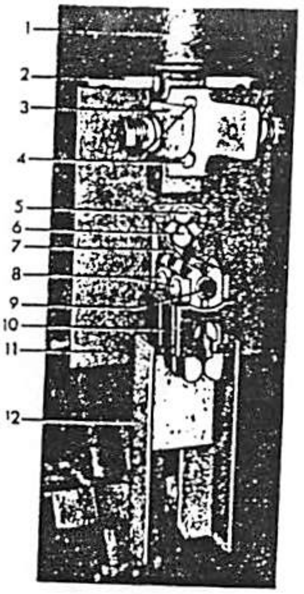


Figure 22A (8039457)

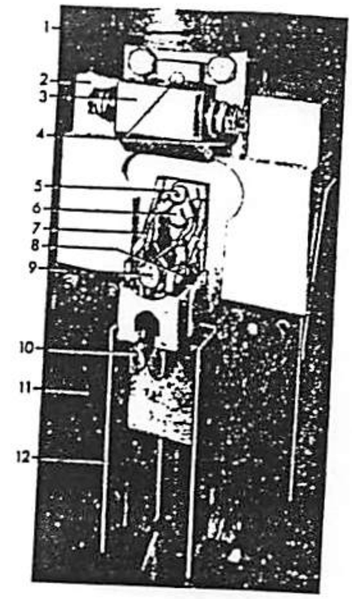


Figure 22B (8040406)

Figure 22. Rear Bushing Assembly

1. Rear Bushing
2. Contact Support
3. Guide and Support for Interrupter
4. Bolts forContact 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. Baffle
12. Throat Baffle

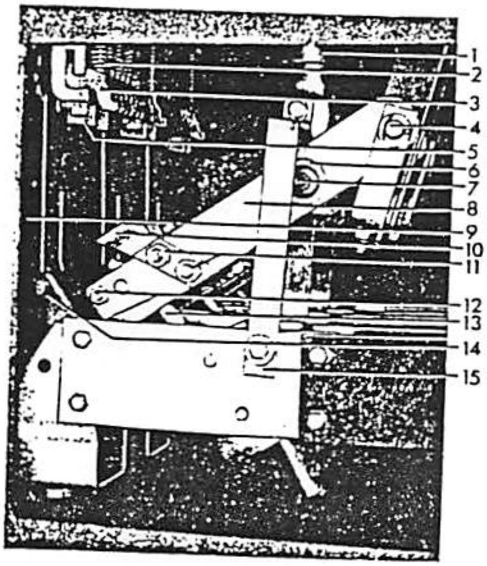


Figure 23A (8039588)

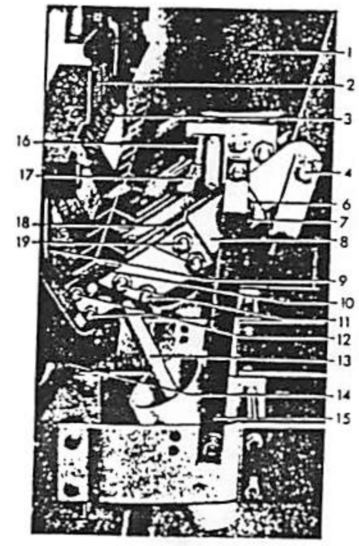


Figure 23B (8040403)

Figure 23. Primary Contact Assembly

1. Front Bushing
2. Contact Springs
3. Stationary Primary Contacts
4. Operating Rod Pin
5. Buffer
6. Cup Bearing
7. Hinge Pin
8. Contact Arm
9. Throat Barrier
10. Movable Primary Contacts
11. Assembly Bolts
12. Assembly Bolts
13. Piston Assembly
14. Movable Arcing Contact
15. Connection Bar
16. Tertiary Contact Springs
17. Tertiary Contact Finger
18. Tertiary Contact Pad
19. Assembly Bolts

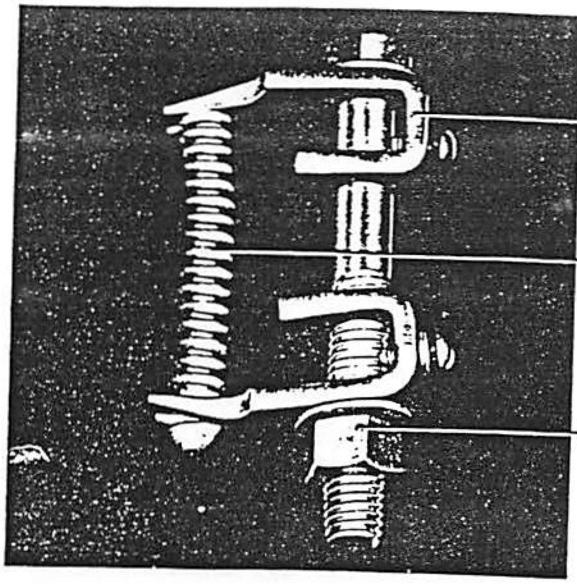


Figure 24A (8034466)

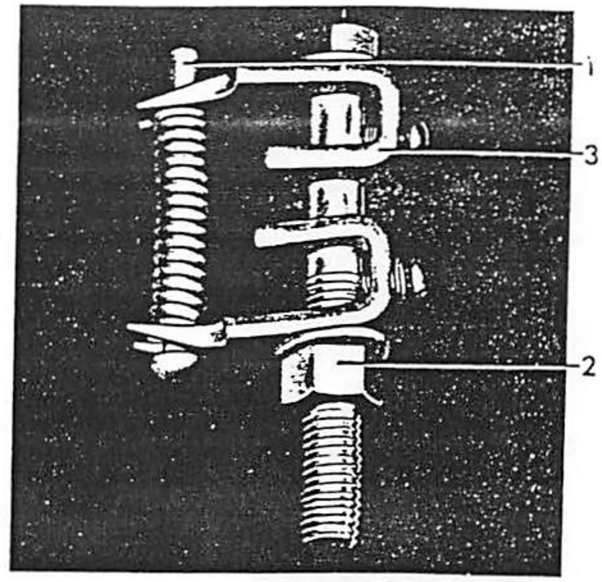


Figure 24B (8034465)

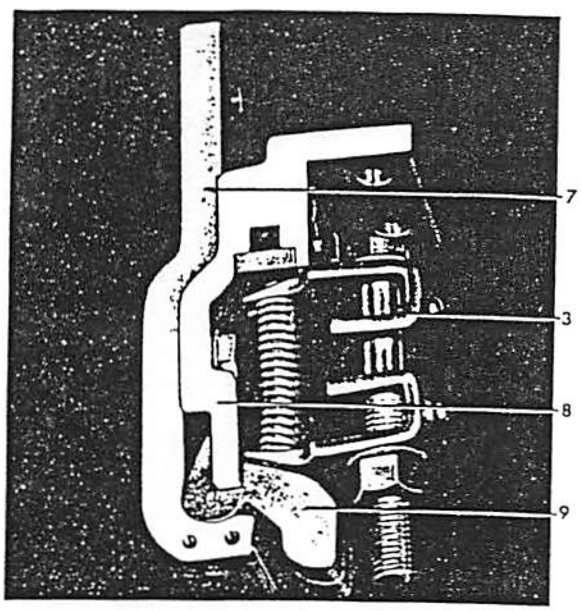


Figure 24C (8034469)

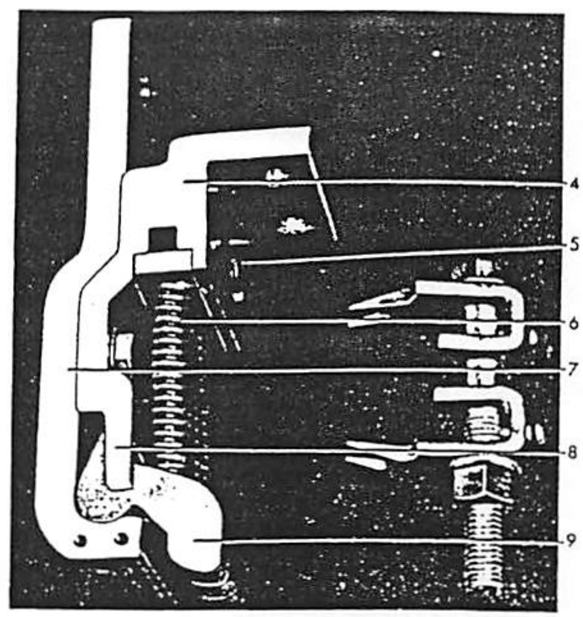


Figure 24D (8034468)

Figure 24. Method of Installing Primary Contact Springs Using a Spring Compressor

1. Spring Guide
2. Compressor Nut
3. Spring Compressor
4. Spring Retainer
5. Assembly Bolts
6. Spring
7. Contact Support
8. Stop Plate
9. Stationary Primary Finger

that it is retained by stop plate (8)

2. Open spring compressor (3) and assemble spring guide, spacer (1200 amp. only - not shown), spring, and spring compressor (Figure 24A).

3. Turn nut (2) in clockwise direction to compress contact spring (Figure 24B). Hold spring firmly in yoke on spring compressor to prevent 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 cutout in primary finger (Figure 24C).

5. Hold spring assembly firmly in place and remove spring compressor.

D. Movable Primary Contacts (10) Figure 23.

To replace the movable primary contacts on a 1200 ampere breaker proceed as follows:

1. Disassemble nuts from assembly bolts (11) and remove the movable primary contacts (10).

2. Reassemble in reverse order.

To replace the movable primary contacts on a 3000 ampere breaker it is first necessary to disassemble the movable arcing contacts, then proceed as follows:

1. Disassemble operating rod pin (4), first noting quantity and location of washers in the assembly.

2. Pry contact arms (8) apart enough to disengage pivot pins of piston assembly (13) allowing piston to drop down into its booster cylinder.

3. Rotate the two parts of the contact arm assembly away from each other so assembly bolts (11) are accessible and movable primary contacts (10) can be removed.

4. Reassemble in reverse order.

E. Contact Arm Assembly (8, 10, 12, 14, Figure 23).

1. Remove connection bar (15).

2. Disassemble hinge pin (7), cup bearing (6), and operating rod pin (4) noting quantity and location of any washers and spacers used in assemblies.

3. The contact arm assembly including the piston assembly (13) can now be removed.

4. When reassembling, first insert piston tube assembly (13) into the booster cylinder and reassemble the cup bearing, making sure the silvered contact washers between the bushing and contact arms (both sides) are in place.

5. Reassemble operating rod pin (4) and connection bar (15).

F. Tertiary Contact Finger (17) Figure 23B.

1. Using the method previously described, compress the contact spring (16) and remove the spring and guide.

2. Raise the tertiary contact fingers and remove, one at a time.

3. Apply a thin coating of D50H47 grease to the hinged edge of the contacts when reassembling.

G. Tertiary Contact Pad (18) Figure 23B.

To replace the tertiary contact pads (18) it is first necessary to disassemble the movable arcing contact (14), operating rod pin (4), drop the booster cylinder piston (13), and rotate the connection arms away from each other as previously described, then proceed as follows:

1. Remove two nuts and bolts (19).

2. Remove the tertiary contact pad (18).

3. Reassemble in reverse order.

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

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 insure interchangeability of the breakers in the metal clad units. 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 reinstalled in the same location.

However, it is 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 interrupters are reinstalled.

To replace the bushing, proceed as follows:

Rear Bushing

1. Open the breaker and remove the box barriers and interrupters as already described.

2. Remove the upper and lower horizontal barriers (12 and 15) Figure 8.

3. Remove the four bolts at the mounting flange of the rear bushing being removed and lower the bushing assembly.

   NOTE: Shims may be found between breaker mounting plate and the bushing mounting flange on some, or all bolts. These shims are for squaring up the bushing and may be required when new bushings are assembled.

4. Referring to Figure 24, disassemble the primary contact springs (6) as previously described.

5. Disassemble the spring retainer (4) by removing mounting bolts (5).

6. Referring to Figure 22, disassemble the contact support (2) and interrupter mounting bracket (3) removing bolts (4).

7. Reassemble in the reverse order. The interrupter mounting bracket (3) is not symmetrical and must be assembled correctly to orient the interrupter properly on the breaker. Refer to Figure 22 for correct position of bracket (3).

Front Bushing

1. Open the breaker and remove the box barriers and interrupters as already described.

2. Remove the upper and lower horizontal barriers (12 and 15) Figure 8.

3. Remove the connection bar (15) Figure 23, cup bearing (6) and hinge pin (7).

4. Remove the four bolts at the mounting flange of the front bushing being removed, and lower the bushing. (See note under rear bushings concerning use of shims.)

5. When reassembling, first mount the bushing and assemble the cup bearing (6), contact arm (8), and replace pin (7) being sure the silvered contact washers between the bushing and contact arms are in place. The contact surfaces at the hinge point of the contact blade and bushing should have a thin coating of D50H47 grease.

6. Check all contact adjustments as outlined under ADJUSTMENTS.

INTERLOCK SWITCH

To remove the interlock switch (4) Figure 12, remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

LATCH CHECKING SWITCH

To remove the latch checking switch (7) Figure 12 (when furnished), remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

MOTOR, RELAY AND LIGHT SWITCHES

Two or three switches (7) Figure 6, are mounted in tandem as required by the application.

1. Remove the opening spring per instructions below.

2. Remove two mounting bolts (4) from switch bracket (5).

3. Remove the two mounting screws of the lower switch.

4. Remove the two mounting screws of the center switch.

5. Remove the two mounting screws of the upper switch.

6. Disconnect the lead wires of switch to be replaced.

7. Reassemble in the reverse order and check switch adjustment as explained under ADJUSTMENTS.

TRIP SHAFT AND LATCH (See Figure 11)

1. Remove spring discharge crank (5), manual trip lever (13) and if furnished, the latch checking switch operating arm (8) Figure 12 from the trip shaft.

2. Disengage trip latch spring (4) Figure 11.

3. Remove three (3) cotter pins from trip shaft.

4. Remove trip arm screw (12) and trip latch set screw (10).

5. Place a block between the trip latch (11) and left side of the mechanism frame. Drive the trip shaft to the left until the latch is free of the key, then remove the key.

6. Check for and remove any burrs raised around the keyway on the shaft to avoid damaging the trip shaft bearings.

7. Shaft, latch, etc. may now be removed by driving it to the left. Note quantity and location of washers used as spacers in the assembly.

8. Reassemble parts in reverse order. Be sure trip latch is aligned in center of trip latch roller and that the latch spring is properly installed. Check latch adjustment as described under ADJUSTMENTS.

TRIP LATCH ROLLER BEARING

1. Remove two cotter pins at ends of trip latch roller shaft (8) Figure 13.

2. Partially remove shaft out right side of frame until latch roller (6) is free.

3. Reassemble in reverse order with proper spacing of washers. Be sure latch roller rotates freely.

CLOSING LATCH

1. Remove cotter pins at both ends of closing latch shaft (9) Figure 6.

2. Remove spring and paddle (12).

3. Remove set screws from latch (8).

4. Move shaft (9) to left (away from frame) by tapping lightly on the inside end of shaft. Rotate shaft and continue tapping until shaft is free. Shaft will push outside needle bearing from housing.

5. Reassemble in reverse order putting bearing into frame last. Use a small piece of tubing or pipe when inserting bearing to assure proper alignment.

6. Check closing latch adjustments as described under ADJUSTMENTS.

MOTOR SUPPORT

1. To remove motor support (7) Figure 15, first remove the closing latch spring (12) Figure 6.

2. Remove the retaining ring (4) Figure 15, and driving link (6).

3. Remove motor leads from the terminal board.

4. Remove six 3/8" bolts (1) Figure 15, on bottom and one 3/8" bolt on the right side (not shown).

5. Remove four mounting bolts from motor (not shown).

6. Remove the retaining ring (8) from the eccentric (3).

7. Reassemble all parts of the motor support in the reverse order and re-align it properly as described under DRIVING PAWL ADJUSTMENTS.

CAM

1. Remove 2 set screws from ratchet wheel (6) Figure 4 and remove wheel from main shaft (5).

2. Remove 2 set screws from switch cam (5) Figure 2 and remove cam from the main shaft.

3. Remove prop reset spring (4) Figure 5.

4. Remove 2 set screws from cam (8) Figure 7, and move cam to the right on the shaft as far as it will go. Slide the shaft to the left until key is fully exposed. Remove key and check shaft for burrs.

5. Remove shaft out left side of frame.

6. Reassemble in reverse order using the correct number of washers and spacers to properly locate the parts.

7. Rotate the mechanism through a closing operation using the manual charging wrench. Check the location of the cam follower (15) Figure 7, on the cam (8). If necessary, move the cam to correct the alignment. Complete the closing operation and check the location of the prop pin (4) on the prop (5). It should be approximately centered.

TRIP COIL

To replace the potential trip coil (8) Figure 11, proceed as follows:

1. With the breaker in the open position, remove the two mounting bolts (9).

2. Remove trip coil support (7) and spacers.

3. Cut wires at the butt connectors and remove coil.

4. When replacing the coil be sure to assemble the correct fiber spacers at the ends before bolting support (7).

5. Adjust coil location to allow approximately 1/4" of armature travel before latch starts to move.

6. Butt connect wires and check operation of solenoid electrically and mechanically.

SPRING RELEASE COIL

To remove the spring release coil (15) Figure 6, proceed as follows:

1. Block the closing springs as described in INSTALLATION.

2. Remove the left hand closing spring as described in CLOSING SPRINGS below.

3. Remove two mounting bolts (11), coil support (16) and spacers.

4. Cut wires at the butt connectors and remove coil.

5. Replace the coil and the correct number of fiber spacers before bolting support.

6. Butt connect wires and check that the armature is not binding. Check coil for electrical operation.

CLOSING SPRINGS

The closing springs (12) Figure 4, can be removed as follows:

1. Charge the springs with the manual charging wrench and apply the spring blocking device as described in INSTALLATION.

2. Discharge springs by pushing manual close button (9) Figure 5.

3. Rotate cam shaft (5) Figure 4, by using the manual charging wrench until the gap between the spring (12) and the bearing block (7) is 2 inches or more.

4. Lift both springs until they clear the lower supports, then pull forward and down until the top supports are free.

5. Either discharge the opening springs by pushing the manual trip lever or block the opening springs with a suitable blocking device.

OPENING SPRINGS

To remove the opening springs (4) Figure 4, proceed as follows:

1. Charge and block the closing springs as described under INSTALLATION.

2. Push manual trip lever (8) Figure 5, to be sure the opening springs are fully discharged.

3. Remove upper pin (1) Figure 4, and lower pin (9).

4. After reassembling springs check the open gap at the primary contacts as described under PRIMARY CONTACT GAP.

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 minimize service interruptions caused by breakdowns, and saves time and expense. When continuous operation is a primary consideration, more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

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

NOTE: The listed terms "Right" and "Left" apply when facing the 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., are not listed and should be purchased locally.

4. For prices, refer to the nearest office of the General Electric Company.

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

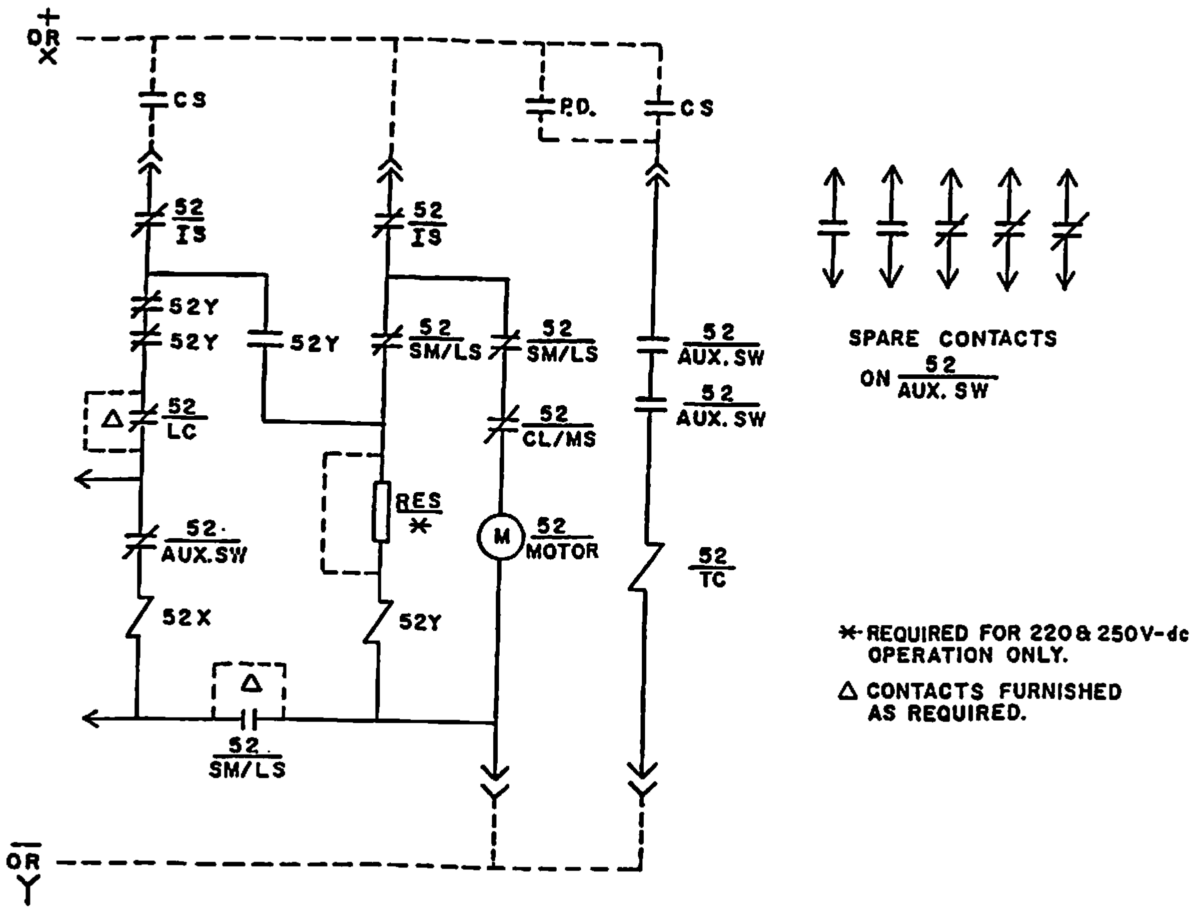
In the following tabulations are listed those parts of the breaker and operating mechanism which are usually recommended for stock for normal maintenance. Other parts can be obtained by contacting the nearest office of the General Electric Company.

RECOMMEND RENEWAL PARTS FOR
TYPE ML-13 STORED ENERGY MECHANISM
USED FOR AM-4.16-350-2 (*), 1200 & 3000 AMPERE
(* SUFFIX LETTERS - C, H)

Fig. No.	Ref. No.	No. Req'd.	Description	Catalog No.
5	10	1	Spring Charging Motor - **	
			48 V-DC	0105C9393P001
			110 & 125 V-DC & 115 V-AC, 60 Hz	0105C9393P002
			220 & 250 V-DC & 230 V-AC, 60 Hz	0105C9393P003
6	17	1	Relay - **, #	
			48 V-DC	0137A7575P004
			110 & 125 V-DC	0137A7575P001
			220 & 250 V-DC	0108B5565G002
			115 V-AC, 60 Hz	0137A7575P005
			230 V-AC, 60 Hz	0137A7575P002
5	3	1	Potential Trip Coil - **	
			110 & 125 V-DC	006174582G001
			220 V-DC	006174582G015
			250 V-DC	006174582G002
			115 V-AC, 60 Hz	006174582G013
			230 V-AC, 60 Hz	006174582G032
			24 V-DC	006275070G001
			48 V-DC	006174582G034
6	15	1	Spring Release Coil - **	
			110 & 125 V-DC	006174582G001
			220 V-DC	006174582G015
			250 V-DC	006174582G002
			115 V-AC, 60 Hz	006174582G010
			230 V-AC, 60 Hz	006174582G014
			48 V- DC	006174582G034
6	7	5	Switch, Normally Open	0456A0866P005
6	7	1	Switch, Normally Closed	0456A0866P006
5	1	1	Auxiliary Switch	△
6	12	1	Closing Latch Spring	0161A4231P001
7	12	1	Prop Spring (Upper)	006071231P001
7	14	1	Prop Spring (Lower)	0137A9252P001
4	8	1	Driving Pawl Spring	0161A4241P001
4	2	2	Latching Pawl Spring - Φ	0161A5909P001

** Refer to breaker nameplate or summary for proper voltage rating.
\# Quanitity Two (2) relays required on special control circuits. Check breaker and connection diagram.
Φ Furnish 0161A4241P001 for breakers without closing spring discharge mechanism.
△ Refer to breaker auxiliary switch nameplate for proper model
Type SBM 0137A9192G003
Type SB-12 0137A9192G011

TYPICAL ELEMENTARY WIRING FOR MAGNE-BLAST BREAKERS



(0165B7906)

	FIG. NO.	REF. NO.	DESCRIPTION
52 / AUX SW	5	1	AUXILIARY SWITCH
52X	6	15	CLOSING COIL
52Y	6	17	CONTROL RELAY
52 / TC	5	3	TRIP COIL
52 / IS	2	2	INTERLOCK SWITCHES
52 / CL/MS	6	13	CLOSING LATCH MONITORING SWITCH
52 / LC	6	1	LATCH CHECKING SWITCH
52 / MOTOR	2	11	SPRING CHARGING MOTOR

RECOMMENDED RENEWAL PARTS FOR MAGNEBLAST BREAKERS

TYPE AM-4.16-350-2 (*) 1200 & 3000 AMPERE

(* SUFFIX LETTERS H, C, R)

Fig. No.	Ref. No.	Ampere Rating	Catalog No.	No. Req'd	Description
8	16	1200	0281B0708G008	3	Operating Rod Assembly
8	16	3000	0802B0730G001	3	Operating Rod Assembly
22	7	ALL	0208A8017G001	3	Flexible Connector (Left, Long)
22	7	ALL	0208A8017G002	3	Flexible Connector (Right, Long)
22	7	ALL	0208A8017G003	3	Flexible Connector (Left, Short)
22	7	ALL	0208A8017G004	3	Flexible Connector (Right, Short)
22	12	ALL	0208A8016G001	3	Throat Barrier Assembly
22	10	ALL	0213X0344G032	3	Arcing Contact Assembly
24	6	1200	0121A5964P001	24	Primary Contact Finger Spring
24	6	3000	0414A0180P001	36	Primary Contact Finger Spring
24	9	1200	0114C5382P002	24	Primary Contact Finger
24	9	3000	0114C5382P002	36	Primary Contact Finger
23	17	3000	0114C5382P002	12	Tertiary Contact Finger
23	10	1200	0137A9164P005	6	Movable Primary Contact
23	10	1200	0137A9164P006	6	Movable Primary Contact
23	10	3000	0114C5382P011	6	Movable Primary Contact
23	10	3000	0114C5382P012	6	Movable Primary Contact
23	18	3000	0619C0469P003	6	Movable Tertiary Contact
23	15	1200	0227A5306G001	3	Movable Arcing Contact
23	15	3000	0227A5306G002	3	Movable Arcing Contact
23	13	1200	0213X0343G094	3	Tube & Piston Assembly
23	13	3000	0132C2748G003	3	Tube & Piston Assembly
20	4	ALL	0134C3595G001	3	Throat Cooler Assembly (Right)
20	4	ALL	0134C3595G002	3	Throat Cooler Assembly (Left)
19	10	ALL	0132C2735P007	6	Lower Runner Barrier
20	2	ALL	0108B5520P001	3	Insulation Plate
Φ	Φ	ALL	0265C0163P009	6	Upper Runner Insulation
19	14	ALL	0421A0201P001	6	Lower Runner Shield

Φ Not Illustrated

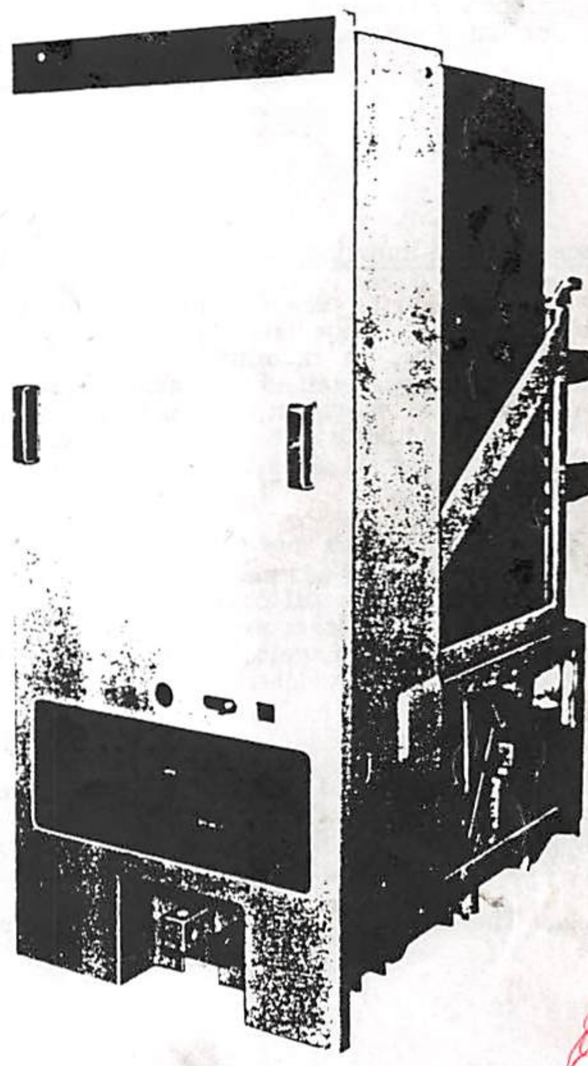
INSTRUCTIONS

GEI-88771 D
Supersedes GEI-88771 C

MAGNE-BLAST CIRCUIT BREAKER

TYPE

AMH-4.76-250-0D
AMH-4.76-250-1D



GENERAL ELECTRIC

MAGNE-BLAST CIRCUIT BREAKER
AMH-4.76-250-0D AMH-4.76-250-1D

INTRODUCTION

The magneblast breaker is the removable and interchangeable interrupting element used in metal-clad switchgear to provide reliable control and protection of electrical apparatus and power systems.

The AMH-4.76-250 Magneblast Breaker is available with continuous current ratings of 1200 amperes and 2000 amperes in accordance with applicable industry standards. Refer to the breaker nameplate for complete rating information of any particular breaker. The nameplate also describes the control power reauirements for that breaker. The application of a breaker must be such that its voltage, current, and interrupting ratings are never exceeded. Since this book is written to include all ratings of the breaker as well as several design variations, the 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 information for placing magne-blast breakers in service and for maintaining satisfactory operation.

RECEIVING, HANDLING AND STORAGE

Receiving and Handling

Each breaker is carefully inspected and packed for shipment. 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. 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. Unfinished surfaces of rollers, latches etc., of the operating mechanism should be coated with 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, it should be cleaned and dried out before being placed in service.

(Cover photo [illegible]

INSTALLATION

1. Remove the top cover and box barrier. Do not remove side or front covers. (See note under Repair and Replacement, page 22.) Make a visual inspection to ascertain that the breaker and mechanism is in satisfactory condition. Check all bearing surfaces of the mechanism for lubrication. Refer to section on lubrication page 18 and Figure 16.

2. Charge the breaker closing springs manually using a 5/8" ratchet wrench to turn the manual charging shaft (3) Figure 1. Turning the shaft counter clockwise will advance the ratchet wheel and compress the springs.

   When the springs have reached the fully charged position the indicator (5) Figure 2 will read "CHARGED", and the driving pawl will be raised from the ratchet wheel teeth. Additional turning of the charging shaft will not advance the ratchet wheel.

   Insert the spring blocking devices into a hole (2) Figure 1 on each side of breaker, and manually discharge the springs against the pins by pushing the manual close button (6) Figure 2. The springs are now blocked and slow closing of the breaker contacts can be accomplished by again turning the manual charging shaft with a 5/8" ratchet wrench.

   During the slow closing operation check to insure that the mechanism does not stick or bind during the entire stroke, that it latches securely in the closed position, and that it trips freely when the manual trip lever is operated. At this time, also check the following adjustments:

   a. Arcing contact wipe (Refer to page 12).
   b. Primary contact wipe (Refer to page 13).
   c. Primary contact gap (Refer to page 13).

   DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS PRECAUTION IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING.

   The closing springs should now be unblocked. Rotate the charging shaft until the indicator reads "CHARGED" and the ratchet wheel does not advance. The spring blocking devices can now be removed.

3. Connect the test coupler to the right hand secondary coupler or insert the breaker into the metalclad housing to the test position. Operate it electrically several times. Check the control voltage as described under "CONTROL POWER CHECK" (Page 16).

4. Disconnect the test coupler, or remove breaker from housing, and replace box barrier and top cover.

5. If the breaker has been stored for a long period of time, it is recommended that the insulation be checked with a standard 60 Hertz high potential test. Refer to Insulation Test (Page 18).

   NOTE: If the breaker secondary wiring is to be given a hi-potential test at 1500 volts, remove both the motor leads from the terminal connection. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

6. Lubricate the inside silver portion of the primary disconnect fingers by applying a thin film of contact lubricant D50H47. The lubricant should extend approximately one inch (1") from the end of the finger.

7. Refer to metal-clad instruction book GEI-88775 for instructions on inserting the breaker into the metal-clad unit.

DESCRIPTION OF OPERATION

The Magneblast Breaker has two principal components; the breaker element and the operating mechanism:

The breaker element is three similar pole units, each of which includes the current carrying parts, main and arcing contacts, interrupter, and an enclosing barrier system that provides insulation between poles, or phases and to ground. The primary connections to the associated metal-clad switchgear are made through the primary disconnect fingers at the rear of the breaker.

The operating mechanism type ML-13A is of the stored energy type designed to give high speed closing and opening. The mechanism will operate on a-c or d-c voltage as indicated on the breaker nameplate. Closing and opening operations are controlled either electrically from the metal-clad unit and remote location, or mechanically by the manual close and trip buttons on the breaker. All secondary connections from the breaker to the metal clad unit are made through the coupler (1) Fig. 1.

A spring release interlock, Fig. 4 is provided to discharge both the closing and opening springs when the breaker is withdrawn from or inserted into the Metal Clad unit.

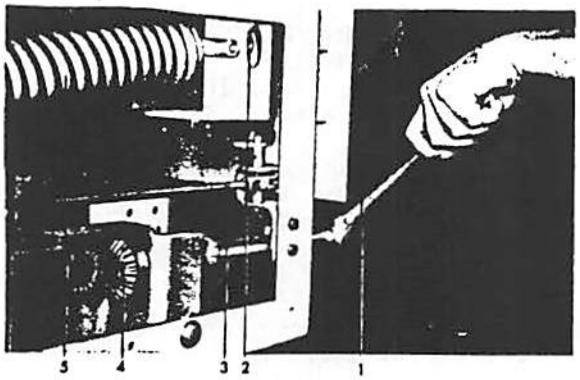


Fig. 1 (8037382) Manual Charging

1. Manual Charging Wrench
2. Hole for Spring Blocking Pin
3. Manual Charging Shaft
4. Bevel Gears
5. Closing Spring

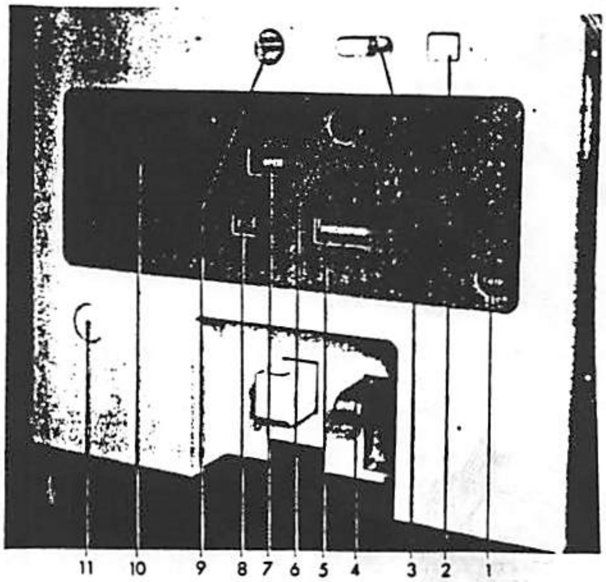
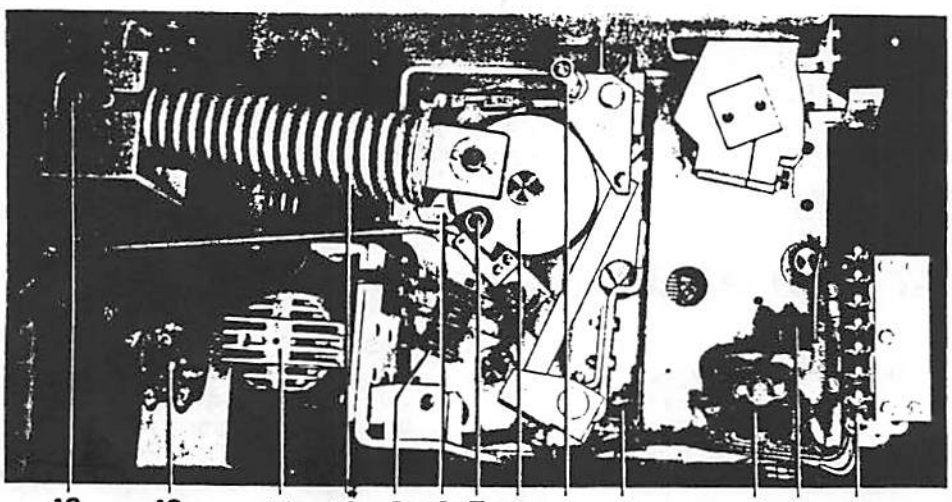


Fig. 2 (8037380) Control Panel

1. Trip Button
2. Position Indicator
3. Racking Screw Shutter
4. Position Stop Release
5. Charge-Discharge Indicator
6. Close Button
7. Open-Close Indicator
8. Operation Counter
9. Racking Screw Hole
10. Padlock Hole Cover
11. Hand-Charge Hole Cover



1. Secondary Coupler
2. Interlock Switches
3. Auxiliary Switch
4. Latch Checking Switch
5. Spring Discharge Roller
6. Switch Cam
7. Closing Latch Roller
8. Closing Latch
9. Power Switches
10. Closing Spring
11. Motor
12. Control Relay
13. Spring Blocking Pin

Fig. 3 (8037375) Right Side View ML-13A Operating Mechanism

1. Spring Discharge Stop
2. Spring Discharge Roller
3. Spring Discharge Crank
4. Turnbuckle
5. Closing Latch Stop
6. Spring Discharge Stop
7. Trip Link
8. Closing Latch Roller
9. Switch Cam
10. Switch Striker
11. Switch Support Bolt
12. Switch Support
13. Power Switches
14. Closing Latch
15. Switch Support Bolt
16. Motor Terminal Board
17. Closing Latch Shaft
18. Closing Latch Spring
19. Motor
20. Latch Monitoring Switch
21. Latch Switch Support
22. Spring Release Solenoid
23. Closing Coil Support

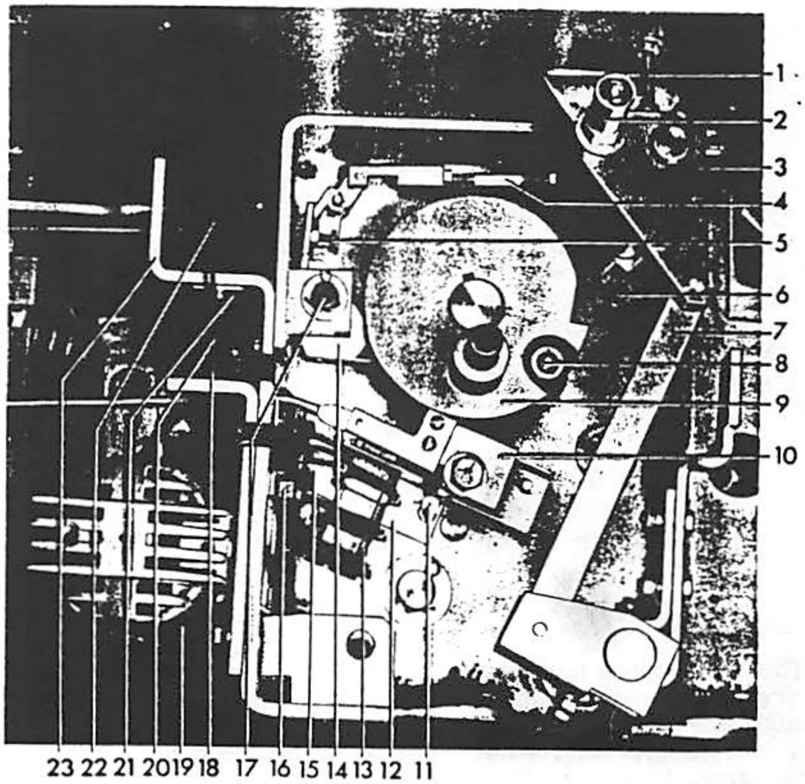


Fig. 4 (8037379) Control Mechanism and Spring Discharge Link

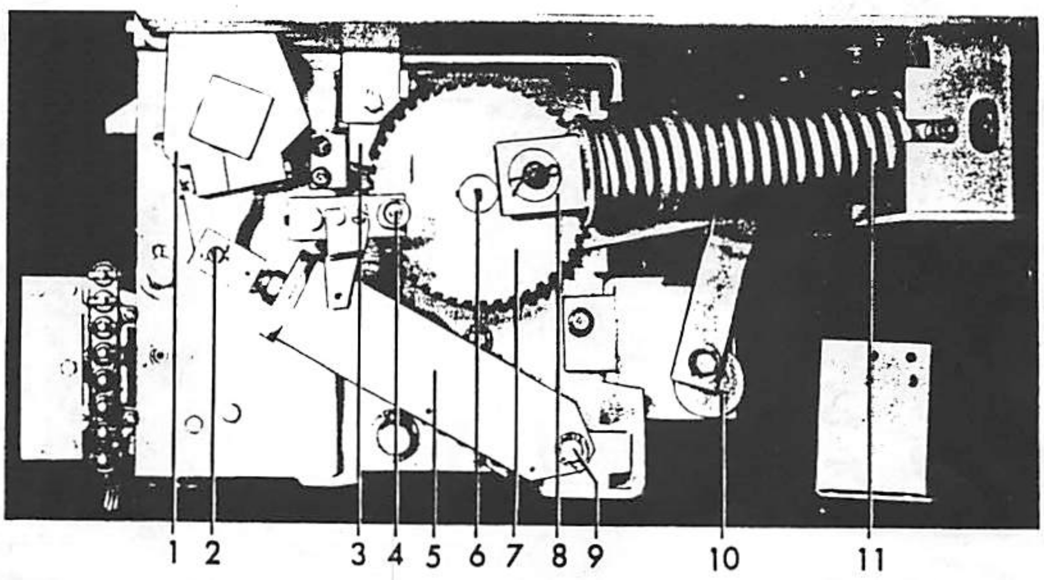


Fig. 5 (8037377) Left Side View ML-13A Operating Mechanism

1. Main Shaft Bearing
2. Rear Spring Pin
3. Latching Pawls
4. Positive Interlock Roller
5. Opening Spring
6. Cam Shaft
7. Ratchet Wheel
8. Guide Block
9. Front Spring Pin
10. Eccentric
11. Closing Spring

A positive interlock (4) Figure 5 and interlock switch (2) Figure 3, are provided between the breaker and metal-clad unit and work with the rack screw shutter to prevent insertion or removal of the breaker in the unit while in a closed position and to prevent a closing operation when the breaker is not in either the fully connected or test position. To insure that this interlock will function during manual, as well as during electrical operation of the equipment, both mechanical and electrical blocking is provided. If for any reason the closing springs should be discharged against the positive interlock the mechanism will be jammed and be inoperable. The mechanism can be released and returned to the reset position by pushing in on the trip lever (1) Figure 2. It may require more than normal force to release the interlock.

An auxiliary switch operator (3) Figure 6 can be provided when required to operate a stationary auxiliary switch mounted in the metal clad unit.

Spring Charging

The mechanism has a high speed gear motor (1) Figure 7, that compresses a set of closing springs through the action of an eccentric, ratchet, and pawl assembly. The rotary action of the motor is converted to a straight stroke through the eccentric (5), and a lever (6) that carries a spring loaded driving pawl.

The pawl advances the ratchet wheel (7) Figure 5 a few degrees each stroke where it is held position by the latching pawls (3). When the ratchet wheel has been rotated approximately 180 degrees the closing springs (11) will be fully compressed. As the ratchet wheel continues to rotate, the spring load will shift over center and attempt to discharge. After a few degrees of rotation, the closing roller (7) Figure 3, will engage the closing latch(8) and the compressed springs will be held by the latch until a closing operation is required. During the last few degrees of the ratchet wheel rotation the power switches (9) are opened and the driving pawl is raised from the ratchet wheel surface. This allows the motor and driving mechanism to coast to a natural stop expending all residual energy.

During the time the springs are being compressed a relay (12) is energized to hold the closing circuit open. The relay remains energized until the springs are fully charged and the control switch contacts are re-set.

The closing springs may be charged manually if control voltage is lost. A 5/8" ratchet wrench can be used to rotate the manual charging shaft in a counter clockwise direction until the indicator reads "Charged" and the driving pawl is raised from the ratchet wheel. The use of the ratchet wrench provides for maximum safety in the event that the control power is suddenly restored without warning. In this event, the motor drive will override the ratchet wrench and continues to charge the springs.

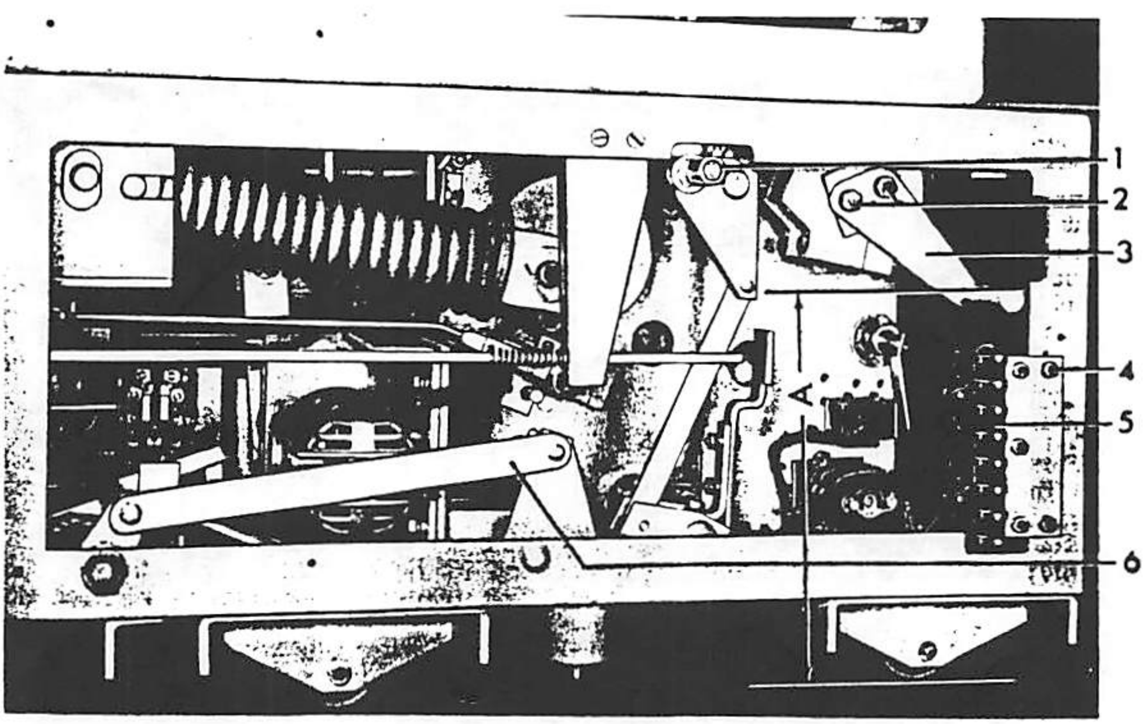
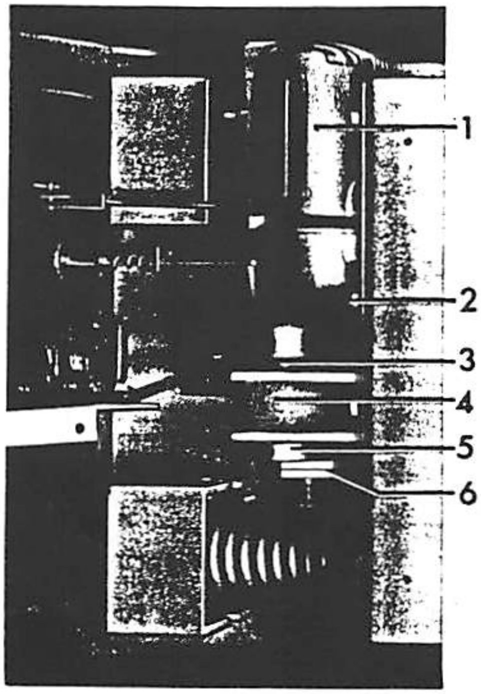


Fig. 6 (8037376) Auxiliary Switch Operator

1. Spring Discharge Crank
2. Mounting Bolts
3. Auxiliary Switch Operator
4. Mounting Bolts
5. Secondary Disconnect
6. Treadle Link



1. Motor
2. Mounting Bolt
3. Retaining Ring
4. Motor Mount
5. Eccentric
6. Driving Link

Fig. 7 (8037378) Driving Elements)

Closing Operation

The breaker can be closed electrically by energizing the spring release solenoid (22) Figure 4, or manually by pushing the close button (6) Figure 2. In either method the closing latch is rotated from under the closing roller to release the closing springs (10) Figure 3. The energy in the springs is used to rotate a cam (16) Figure 8 and close the breaker through the operating mechanism linkage. During the closing operation the mechanism is trip-free at all times. The breaker is held closed by the closing prop (14) moving into position under the prop pin (13). During the closing operation the opening springs (17) Figure 9, are compressed and held ready for an opening operation with the trip latch (8) Figure 8 bearing against the trip latch roller (9).

When the closing operation of the breaker is completed and the closing latch is fully reset, the contacts of the latch monitoring switch (20) Figure 4, closes to permit the spring charging motor to be energized and recharge the closing springs.

Opening Operation

The breaker can be opened either electrically by energizing the trip coil (13) Figure 9, or manually by pushing the trip lever (1) Figure 2. In each method the trip latch is rotated off the trip latch roller, permitting the operating mechanism linkage to collapse. The energy stored in the opening springs is released to provide the required opening speed for successful interruption of the circuit.

As the breaker opens to interrupt a current, the arc first starts at the arcing contacts (6 & 27) Figure 10, transfers to the arc runner (4 & 10) and energizes the blow-out coils (3 & 11). This action introduces a magnetic field between the pole pieces 5 & 9) of the interrupter that forces the arc deeper into the arc chute (8). At the time the arcing contacts part a discharge of air is expelled through the booster tube (28) across the arc. This air flow assists the arc transfer and interruption by blowing the arc away from the contacts and into the arc chute. The magnetic field forces the arc deeper into the interrupter along the diverging arc runners.

The arc chute has a series of interleaving ceramic fins, Figure 18. As the arc is forced into the interrupter it is lengthened in the gradually deepening serpentine path between the fins so that the electrical resistance of the arc is rapidly increased and its heat is absorbed by the ceramic material. The increased resistance reduces the magnitude and phase angle of the current and at an early current zero the arc cannot re-establish itself and interruption occurs.

Trip Free Operation

If the trip coil circuit is energized while the breaker is closing, the trip armature will force the trip latch (8) Figure 8 away from the trip roller (9) causing the mechanism linkage to collapse and the breaker to re-open. The closing cam (16) will complete its closing stroke and the springs will re-charge as in a normal closing operation.

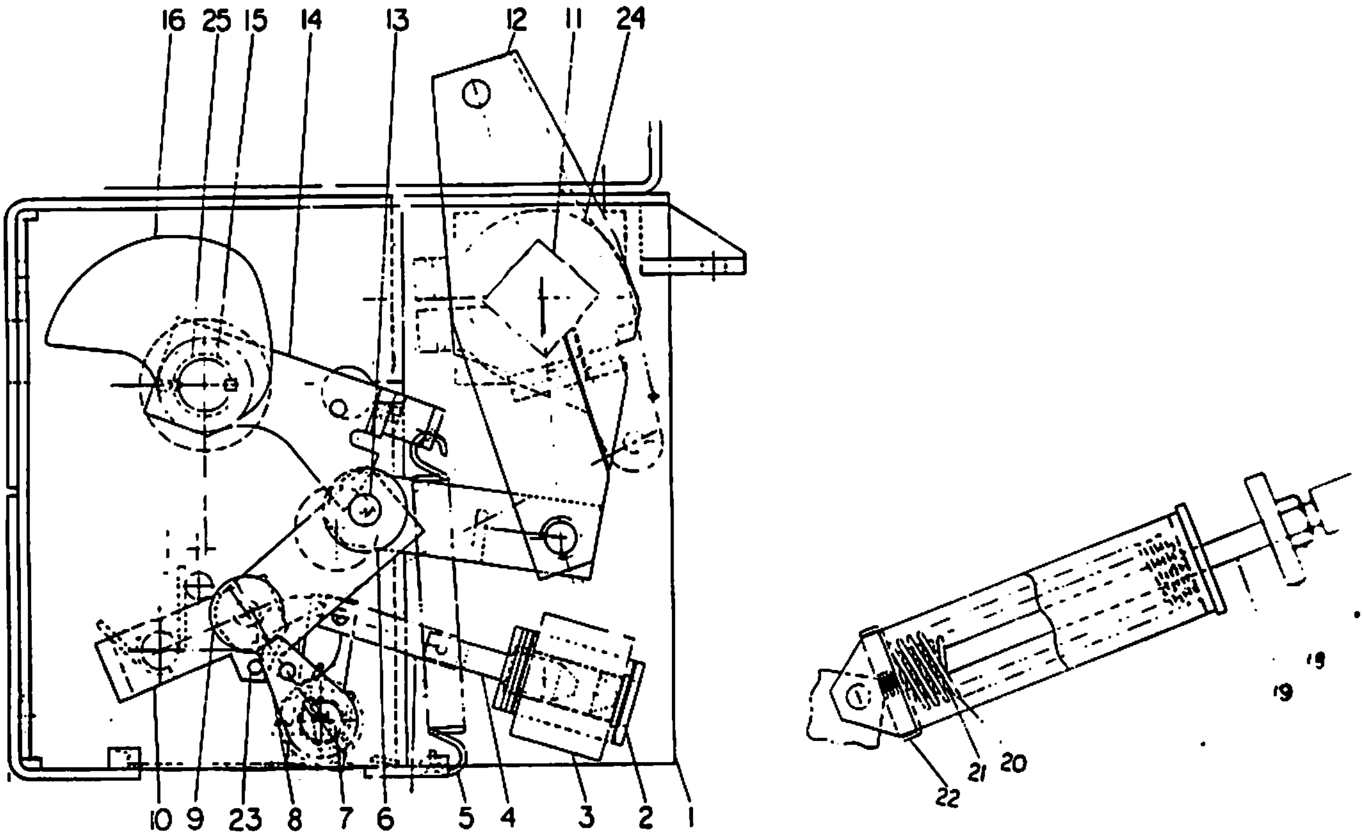


Fig. 8 (0121C8152) Sectional Side View of Mechanism

1. Frame
2. Trip Coil Support
3. Trip Coil
4. Trip Armature
5. Prop Reset Spring
6. Cam Follower Roller
7. Trip Shaft
8. Trip Latch
9. Trip Latch Roller
10. Trip Latch Roller Support
11. Crank Shaft
12. Cranks
13. Prop Pin
14. Prop
15. Drive Shaft
16. Cam
17. Check Nut
18. Stop Plate
19. Spring Rod
20. Spring
21. Spring
22. Spring Guide
23. Stop Pin
24. Main Shaft Bearing
25. Cam Shaft Bearing

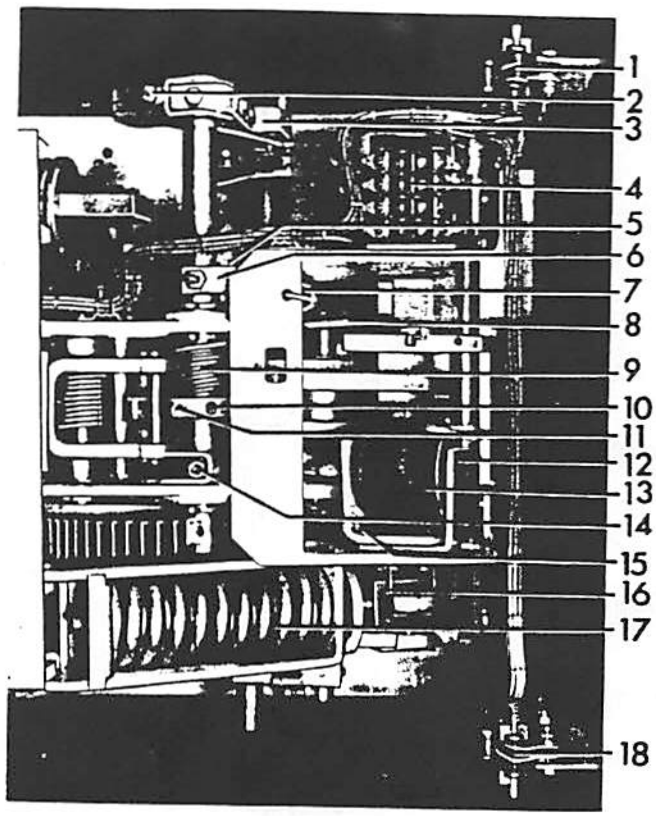


Fig. 9 (8037378) Bottom View of ML-13A Operating Mechanism

1. Secondary Disconnect
2. Trip Adjusting Nut
3. Manual Trip Lever
4. Auxiliary Switch
5. Latch Check Switch
6. Latch Check Switch Arm
7. Prop Spring
8. Auxiliary Switch Link
9. Trip Latch Spring
10. Latch Set Screw
11. Trip Latch
12. Trip Coil Support
13. Trip Coil
14. Trip Arm Screw
15. Trip Coil Support
16. Coil Mounting Bolts
17. Opening Springs
18. Secondary Disconnect

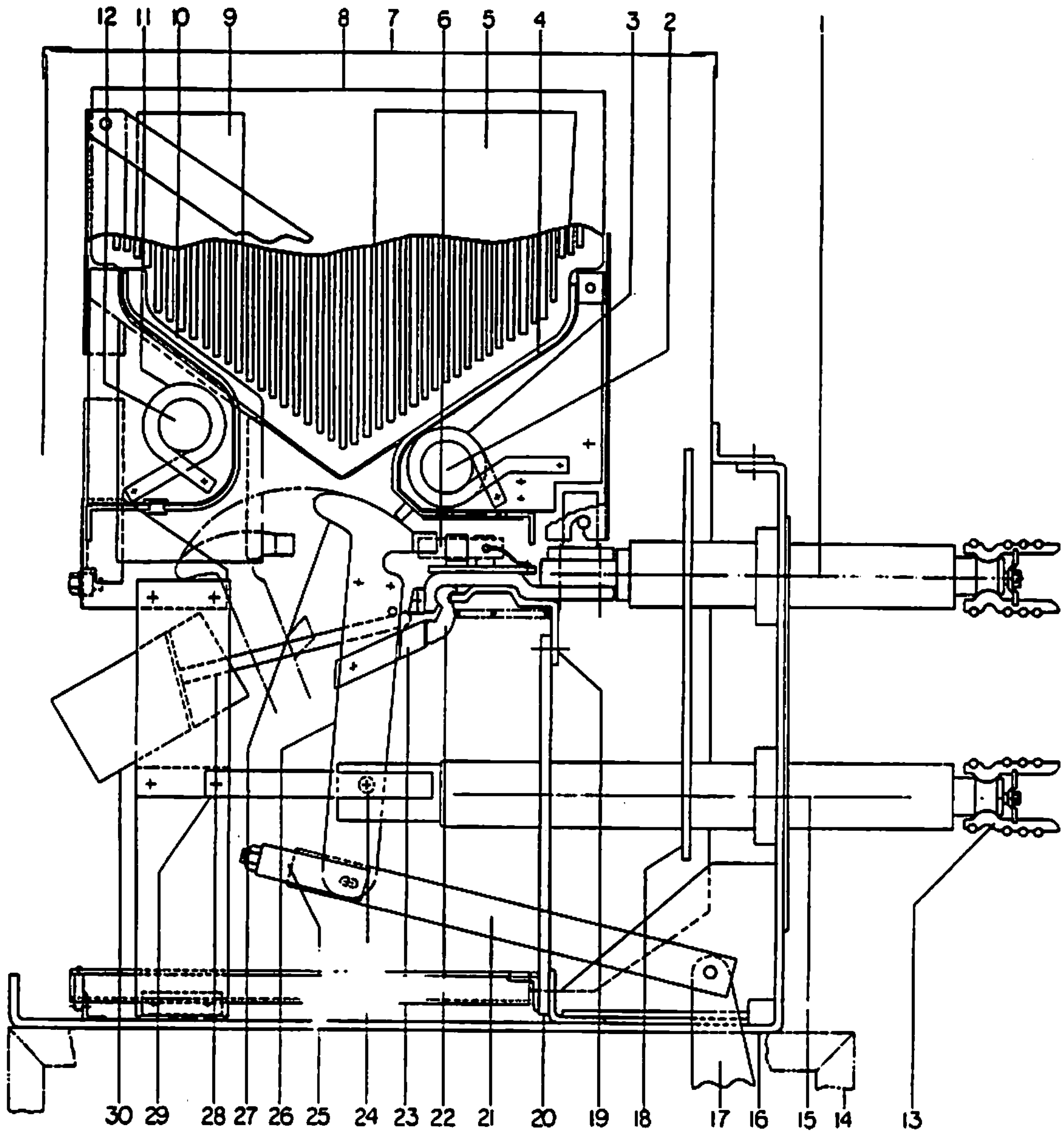


Fig. 10 (0121C8153) Cross Section of Breaker Pole Unit

1. Upper Bushing
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. Disconnect Fingers
14. Lower Frame
15. Lower Bushings
16. Frame
17. Operating Crank
18. Rear Vertical Barrier
19. Spring Retainer
20. Lower Vertical 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

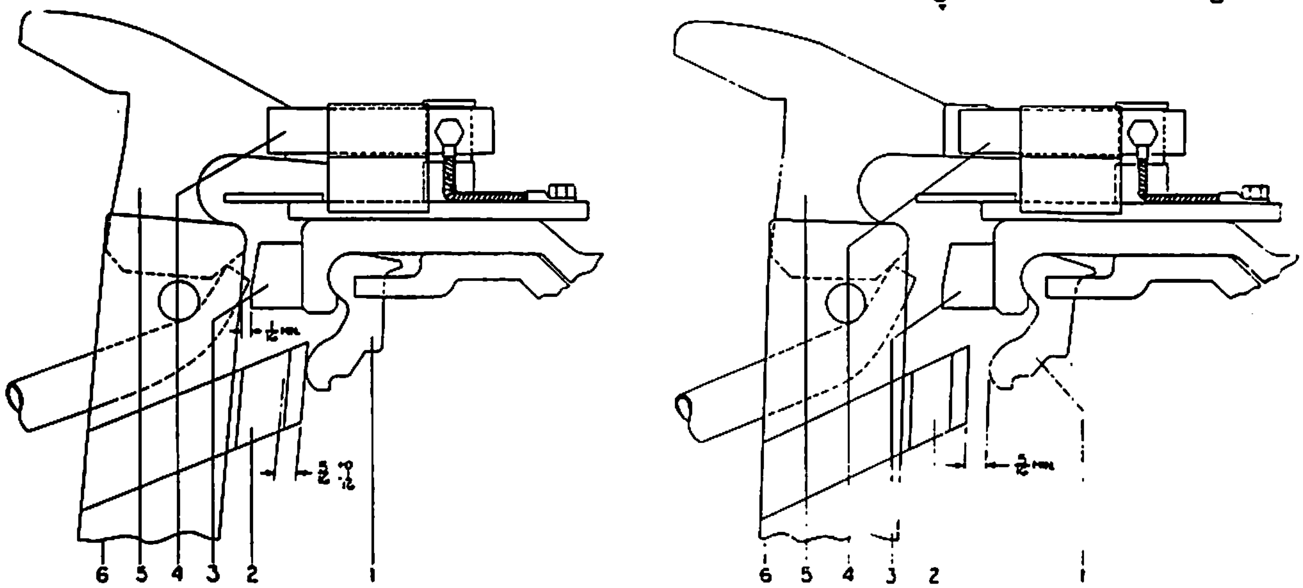
ADJUSTMENTS

All adjustments should be checked 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 after removing the top cover and box barrier from the breaker.

DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING.

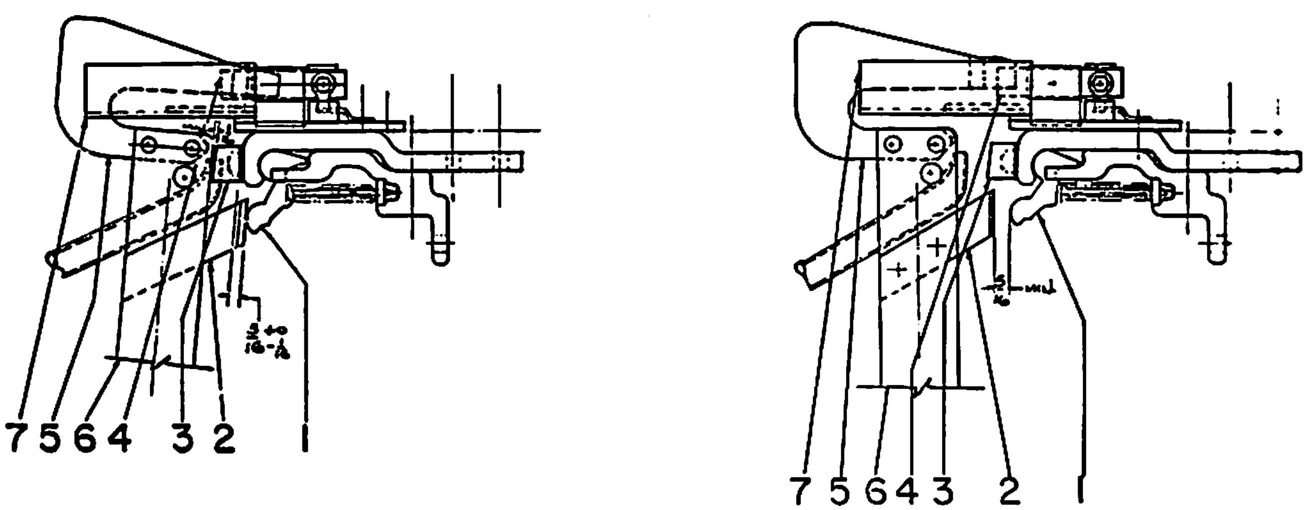
Arcing Contact Wipe

Refer to Figure 11. 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 indicator 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



Primary Contact Wipe　　　　Arcing Contact Wipe

Figure 11A. "-OD" Contact Structure (0121C8152)



Primary Contact Wipe　　　　Arcing Contact Wipe

Figure 11B "-1D" Contact Structure (0132C2794)

Figure 11 Contact Adjustments

1. Stationary Primary Contacts
2. Movable Primary Contacts
3. Buffer Block
4. Stationary Arcing Contacts
5. Movable Arcing Contacts
6. Contact Arm
7. Throat Baffle

made in the factory and no adjustment is provided. A wipe of less than 5/16" is an indication that the arcing contacts need to be replaced. When making this check, see that the movable arcing contact (5) passes between the probes on the upper arc runner without touching. On the "-1D" design, also check for clearance between the arcing contact (5) and the slot in the throat baffle (7) during entire stroke of the moving contact assembly.

Primary Contact Wipe

Refer to Figure 11, when the breaker is closed the stationary primary contacts (1) should rise from 1/4" to 5/16". Before checking this dimension be sure the mechanism is re-set so that the prop pin (13) Figure 8 is resting on the prop. To obtain the proper contact adjustment, open the breaker and, referring to Figure 12, loosen the check nut (13) and turn the adjusting nut(12). Screwing the adjusting nut toward the operating rod (11) will decrease the primary contact wipe, toward the end of the stud (14) 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 (6) Figure 11 and the buffer block (3) should be 1/16" or greater when the breaker is fully closed.

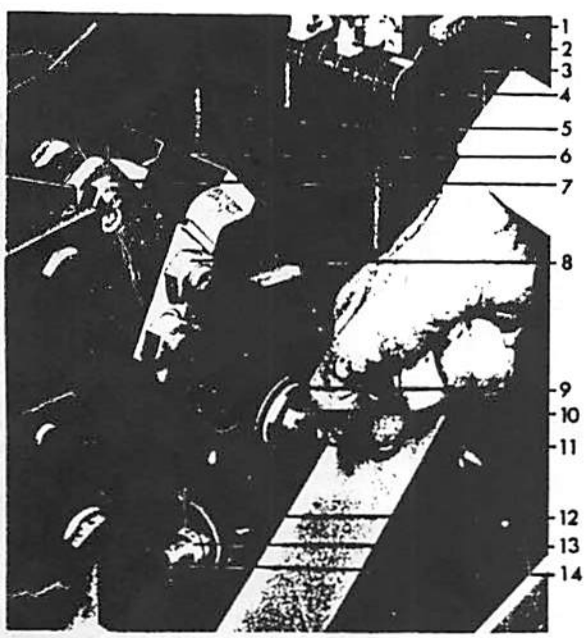


Fig. 12 (8037374) Primary Contact Adjustment

1. Contact Spring
2. Buffer Retainer
3. Buffer Block
4. Stationary Primary Contact
5. Movable Arcing Contact
6. Movable Primary Contact
7. Arcing Contact Bolts
8. Primary Contact Bolts
9. Cupped Hinge Washer
10. Hinge Nut
11. Operating Rod
12. Adjusting Nut
13. Check Nut
14. Operating Rod Stud

Primary Contact Gap

Refer to Figure 12. 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 (4) and the movable primary contact (6) measured between the closest points, should be 3-5/8" to 3-15/16". To change this gap, loosen the check nut (17), Figure 8, and turn the adjusting nut (18) on stud (19). Screwing the adjusting nut down will decrease the primary contact gap. Tighten the check nut and re-measure the contact gap (close and trip the breaker before checking the measurement). Whenever the primary contact gap is changed, the primary contact wipe should be rechecked and, if necessary, readjusted.

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

Trip Latch Wipe

Refer to Figure 8. The wipe of the trip latch (8) on the trip roller (9) should be from 3/16" to 1/4". This can be measured by putting a film of grease on the latch (8), closing the breaker part way, and tripping. The mechanism has the proper trip latch wipe when the latch rests against the stop pin (23). 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 (7).

Trip Armature Travel

Refer to Figure 8. The trip armature should have 7/32" to 9/32" travel before the trip latch (8) starts to move. This can be adjusted by moving the trip coil support (2) and/or by adjusting the trip armature screw (14), Figure 9. A locking screw located behind the trip armature screw must first be loosened. Retighten locking screw after making adjustment.

Release Latch Wipe

Refer to Figure 4. The wipe between the release latch (14) and roller (8) should be 3/16" to 1/4". If re-setting is required, loosen, set, and re-tighten adjustment nut and screw (5).

Release Latch Monitoring Switch

Refer to Figure 4. The release latch must be fully re-set and the latch monitoring switch (20) operated before the motor will start. When the latch is fully reset the clearance between the switch striker arm and the switch mounting bracket (21) is 1/32" or less, this can be adjusted by bending the striker arm.

Motor and Relay Switches

Refer to Figure 4. With the closing springs blocked rotate the switch cam (9) until the switch striker (10) has traveled the maximum amount (about 180 degrees rotation of cam). At this point the clearance between the striker and the switch support (12) should be 1/32" or less. This can be adjusted by loosening the switch support mounting bolts (15) and rotating the support.

Interlock Switch Wipe

Refer to Figure 13. With the positive interlock in the reset, or normal position the clearance between the interlock switch arm (4) and the switch mounting plate should be 1/32" or less. This can be adjusted by bending the switch arm.

Driving Pawl Adjustment

Refer to Figure 5. The driving pawl must advance the ratchet wheel (7) sufficiently on each stroke to allow the latching pawls (3) to fall into the ratchet teeth. This should be checked with the closing spring load against the driving members. With the mechanism unblocked, hand charge the closing springs with the manual charging wrench until they are slightly more than half charged. Slowly rotate the charging wrench until the driving pawl has traveled through its return stroke and check the maximum clearance between the pawl and the ratchet tooth. Rotate the charging wrench until the driving pawl has advanced the ratchet tooth to its maximum travel. Now check the clearance between the ratchet tooth and the latching pawl. The clearance should be approximately equal for both the driving and latching pawls and not less than .015" in either case.

If adjustment is required for either pawl the springs must first be fully charged and blocked. Loosen seven motor support bolts (2) Figure 7 and move entire motor assembly up if the clearance is under the minimum at the latching pawls, and down if the clearance is under the minimum at the driving pawl. Move the motor assembly approximately twice the dimensional increase required at the pawl. Be certain the motor assembly is moved straight up or down and tighten the one bolt on the left of the mounting frame first to assure proper alignment. After tightening the remaining bolts the springs should be released and the clearance again checked as described above.

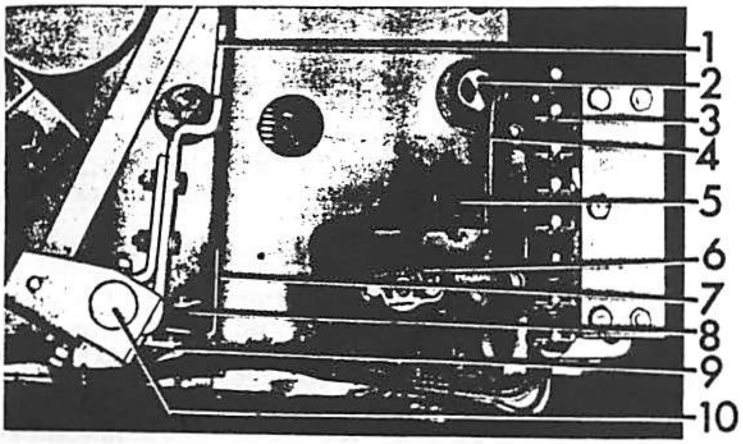


Fig. 13 (8037375) Interlock Switches

1. Manual Trip Lever
2. Interlock Shaft
3. Secondary Coupler
4. Interlock Switch Arm
5. Interlock Switch
6. Auxiliary Switch
7. Switch Support
8. Latch Check Switch
9. Switch Arm
10. Trip Shaft

AUXILIARY DEVICES

atch Checking Switch

Refer to Figure 14. Charge the closing springs sufficiently to reset the mechanism linkage. Rotate the trip latch (4) by pressing the manual trip lever to open the latch checking switch (2). Allow the trip latch to reset slowly and determine the point at which the contacts are made by using a circuit continuity tester (light indicator, bell set, etc). The contacts of the latch checking switch should just make when the gap between the trip latch (4) and the stop pin (5) located on the latch roller link (7) is 1/16". There should be a minimum of 1/64" between the switch arm (3) and the switch support (1). To obtain adjustment of the latch checking switch, bend the latch checking switch arm (3).

Auxiliary Switch Operator

Refer to Figure 6. With the breaker in the closed position, the vertical distance "A" from the top of the roller on the crank (3) to the floor line should be 14-3/8" to 14-7/16". This adjustment is set and pinned at the factory and no adjustment is provided.

Inspection and Test

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

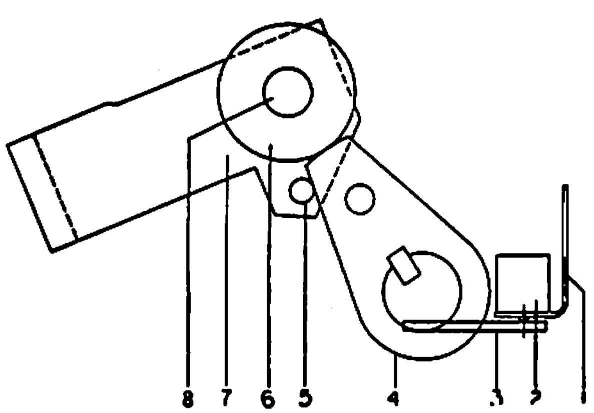


Figure 14 (0121C8152) Latch Checking Switch

1. Switch Support
2. Latch Checking Switch
3. Switch Arm
4. Trip Latch
5. Reset Pin Stop
6. Latch Roller
7. Latch Roller Link
8. Latch Roller Pin

   a. Primary contact wipe: 1/4" to 5/16".
   b. Arcing contact wipe: 5/16" or greater gap at primary contacts.
   c. Primary contact gap: 3-5/8" to 3-15/16".
   d. Trip latch wipe: 3/16" to 1/4" with trip latch resting against stop pin.
   e. Trip armature travel 7/32" to 9/32".
   f. Release latch wipe: 3/16" to 1/4".
   g. Release latch monitoring switch: Maximum clearance 1/32".
   h. Motor and relay switch: maximum clearance 1/32".
   i. Interlock switch: maximum clearance 1/32".
   j. Driving and Latching Pawl: minimum clearance to ratchet teeth .015".
   k. Latch checking switch contacts make when the gap between the trip latch and the stop pin is 1/16".
   l. Auxiliary switch operator - 14-3/8" to 14- 7/16".

2. Check all nuts, washers, bolts, cotter pins, and terminal connection 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. (Page 18 and Figure 16).

5. Operate the breaker slowly with the manual charging wrench 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 is repainted immediately.

7. Check the trip coil plunger and the release coil plunger to see that they move freely.

Opening and Closing Speeds

The closing speed of the arcing contact of the breaker should be a minimum of 11 feet per second. This represents the average speed of the movable arcing contact from a point 3" before the tip is tangent to the lower surface of the probes on the rear arc runner to the tangent position.

The opening speed of the arcing contact should be a minimum of 12 feet per second. This 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 probes on the rear runner. Proper servicing and lubrication of the breaker and its operating mechanism should maintain these speeds and no adjustment is provided.

Control Power Check

After the breaker has been operated several times with the manual charging wrench and the mechanism adjustments are checked as described, the operating voltages should be checked at the release coil, trip coil, and motor terminals. Control Power for electrical operation of the breaker may be from either an alternating or direct current source. The operating ranges for the closing and tripping voltages as given on the breaker nameplate, are as follows:

Nominal Voltage	Closing Range	Tripping Range
24v d-c	- -	14 - 30v d-c
48v d-c	34 - 50v d-c	28 - 60v d-c
110v d-c	80 - 115v d-c	60 - 125v d-c
125v d-c	90 - 130v d-c	70 - 140v d-c
220v d-c	160 - 230v d-c	120 - 250v d-c
250v d-c	180 - 260v d-c	140 - 280v d-c
115v a-c	95 - 125v a-c	95 - 125v a-c
230v a-c	190 - 250v a-c	190 - 250v a-c

If the closed circuit voltage at the terminals of the coil or motor does not fall in the specified range, check the voltage at the source of power and line drop between the power source and breaker.

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 or motor of each breaker must fall within the specified limits.

Electrical closing or opening is accomplished by 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 or close the breaker manually by pressing the manual trip lever (1) Figure 2 or the manual close button (6).

GENERAL MAINTENANCE

General

Safe and dependable service from electrical apparatus and power systems is contingent upon reliable performance of power circuit breakers. To obtain maximum reliability the breaker should be inspected and maintained on a regular schedule. The breakers are designed in accordance with applicable standards which require that they be capable of performing up to 5000 operations for 1200 ampere breakers and 3000 operations for 2000 ampere breakers switching rated continuous current before any replacement of parts should be necessary. This requirement is based on the breakers being serviced, or maintained, at least every 2000 operations, or once per year, whichever comes first. If the breaker is also required to interrupt fault currents during this period of time additional maintenance and replacement of parts may be necessary.

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

Periodic Inspection

The frequency of the inspection and maintenance operations required should be determined by each operating company and will depend on the application of the breakers and the operating conditions. Factors which should be considered are: Importance of the breakers to overall plant or system operation; number of operations and magnitude of currents switched by breaker; frequency of fault interruptions; and the atmospheric conditions in which the breaker normally operates. Extreme conditions of dust, moisture, corrosive gases etc., can indicate that inspection and maintenance will be required more frequently than every 2000 operations. Very clean dry operating conditions with low current switching duty can justify a longer period of time between inspections. Any time a breaker is known to have interrupted a fault at or near its rating it is recommended that the breaker be inspected and necessary maintenance be performed as soon after the interruption as is practical. The following instructions give the items that should be included in an inspection and general recommendations on the maintenance of breakers.

Interrupters

Since there are no moving parts, the interrupters of a magneblast breaker will normally require little or no inspection unless there is evidence of damage to the arc chutes sides or contamination in the throat area. If either of these conditions are present the interrupters should be removed from the breaker and the following points noted:

1. The throat area of the interrupter should be cleaned with sandpaper (Do Not use emery cloth or other metallic abrasives. All flat areas on either side of the [illegible] arcing contact travel should be sanded. Do not sand or otherwise attempt to clean

the ceramic fins of the arc chute sides. Heavily contaminated parts should be replaced.

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 cracks do not interfere with the operation of the device in any way 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 will be necessary. Small broken corners on the exhaust end of the arc chute sides will not interfere with its performance and can be disregarded.

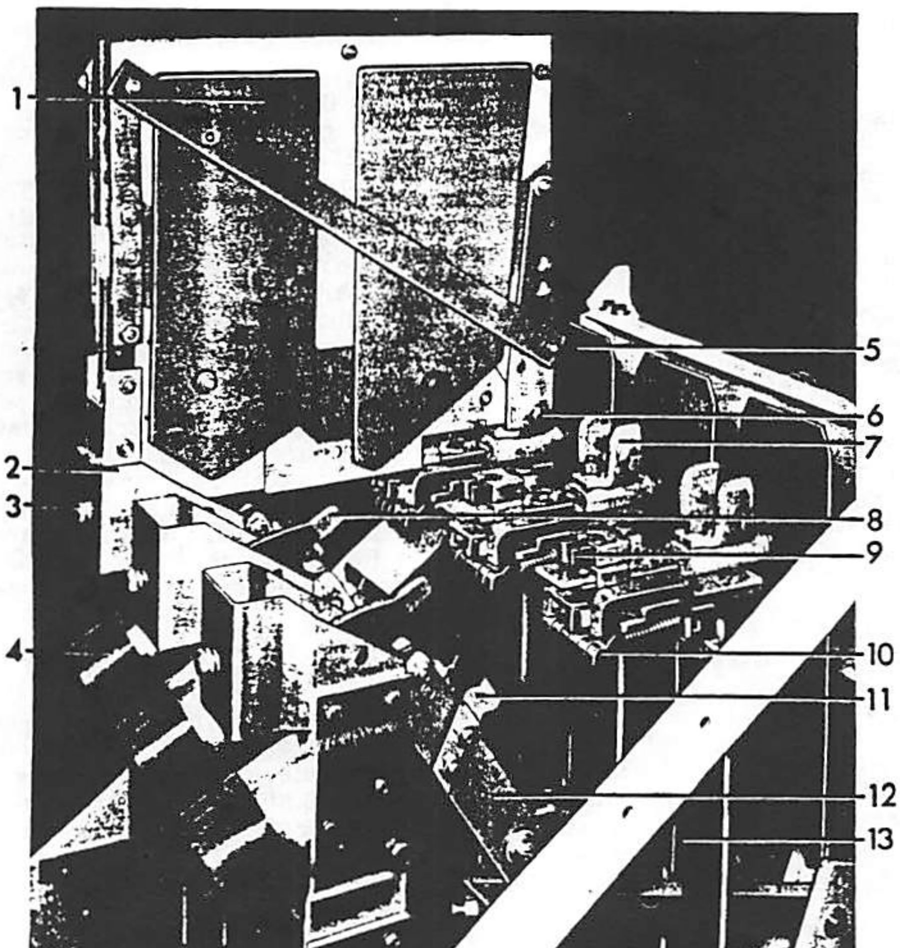
4. The plastisol flexible covering for the pole interrupter support (10) ahould be inspected for breaks in the insulation. If there are holes or breaks in the insulation they should be repaired or the part replaced.

Interrupter Removal And Replacement

To remove an interrupter, open the breaker contacts and remove the top cover and box barrier. Referring to Figure 15, loosen the two rear support bolts (6) and the one front support bolt (3) using a standard 3/4" wrench. Slide the complete interrupter assembly approximately 3/8" toward the rear and remove by lifting straight up.

To reassemble the interrupter to the breaker, lower the interrupter into the front support (2) and over the rear support (7). Slide the interrupter assembly toward the front making certain that the cut-out in the interrupter support engages the bolt (6). On the "-1D" design check to assure that the throat insulation (7), Figure 18 in the interrupter is properly positioned within the throat barrier extending from the stationary contact support (5), Figure 21.

Tighten the supporting bolts (3) and (6), Figure



1. Interrupter
2. Front Interrupter Support
3. Front Support Bolts
4. Booster Cylinder
5. Rear Vertical Barriers
6. Rear Support Bolt
7. Rear Interrupter Support
8. Movable Arcing Contact
9. Stationary Arcing Contact
10. Primary Finger
11. Movable Primary Contact
12. Contact Arm
13. Front Vertical Barriers

Fig. 15 (8037385) Interrupters partially removed showing accessibility of Arcing Contacts

15. These bolts serve as both the electrical and mechanical connections between the bushings and the arc runners within the interrupter. Check that the movable arcing contact (8) passes between the probes on the rear arc runner (5) Figure 18 without touching.

Breaker Contacts

By removing the top cover and 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 interrupter. If the contacts are burned or pitted, they can be made smooth with a fine file.

After completing inspection of the contacts, check the contact adjustments as specified under 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 manual charging wrench, 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 ADJUSTMENTS. Check the control wiring for tightness of connections and damaged insulation.

Bushings and Insulation

The surface of the 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 or clear resin. 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 in the metal clad switchgear to insure dryness.

Insulation Test

When insulation has been repaired or replaced, or when breaker has been operating in adverse moisture conditions, it is recommended that the insulation be checked before the breaker is placed back in service. A standard 60 hertz high potential test at 14,000 volts RMS for one minute will normally indicate whether the breaker is satisfactory for service. With the breaker contacts in the fully opened position, apply the test potential to each terminal of the breaker individually 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 repair or replace insulation that may have been affected by moisture absorption.

If the breaker secondary wiring is to be given a high potential test at 1500 volts, remove both of the motor leads from the terminal board. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

Lubrication

In order to maintain reliable operation, it is important that all circuit breakers be properly lubricated at all times. Most of the bearings and rolling surfaces utilize a new type of dry lubrication that will require no maintenance and will last the life of the equipment. Only few bearings and surfaces listed in the chart, Figure 16, require lubrication. These have been properly lubricated during assembly at the factory, using the finest grades of lubricants available. However, even the finest oils and greases have a tendency to oxidize with age, as evidence 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.

It is recommended that lubrication of the breaker and its operating mechanism be a part of the periodic inspection and maintenance program, with not more than a two year period between lubrications. It is also recommended that all circuit breakers be operated at regular intervals, at least once a year, to insure the lubrication is in good condition and the breaker is operable.

The lubrication chart, Figure 16, 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, and should be used when a general overhaul of the breaker is necessary.

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

METHOD OF CLEANING BEARINGS

Whenever cleaning of bearings is required, as indicated in the lubrication chart, the following procedures are recommended:

Sleeve Bearings

The sleeve bearings used throughout the linkage

PART	LUBRICATION AT MAINTENANCE PERIOD	ALTERNATE LUBRICATION (REQUIRES DISASSEMBLY)
Sleeve Bearings - links, trip shaft, etc. (Teflon coated bearings)	No lubrication required.	No lubrication required.
Sleeve Bearings - main crank shaft, driving pawl lever. (Bronze or cast iron)	Light application of machine oil SAE 20 or SAE 30.	Remove bearings or links clean per instructions and apply D50H15 lubricant liberally.
Contact Arm Hinge Assembly Cup bearing Loose rings between bushing and contact arm.	No lubrication required.	Wipe clean and apply D50H47.
Roller and Needle Bearings	Light application of machine oil SAE 20 or SAE 30.	Clean per instructions and repack with D50H15 lubricant.
Ground surfaces such as cams, ratchet teeth, etc. (Surfaces coated with M_oS_2)	No lubrication required.	No lubrication required.
Ground surfaces such as latches, rollers, prop, etc.	Wipe clean and apply D50H15 lubricant.	Wipe clean and apply D50H15 lubricant.
Silver plated contacts and primary disconnect studs.	Wipe clean and apply D50H47.	Wipe clean and apply D50H47.
Booster Cylinder	Do not Lubricate.	Do not lubricate.
Arcing Contacts	Do not Lubricate.	Do not lubricate.

Figure 16 Lubrication Chart

utilize Teflon surfaces and do not require lubrication. After a number of operations, the surface will acquire a thin black film. Do not remove this film unless there is evidence of outside contaminates, such as dry or hardened grease. If contaminants are present they should be removed by immersing the link and bearing in clean petroleum solvent, or similar cleaner, and using a stiff brush. Do not remove the bearings from the links. DO NOT USE CARBON TETRACHLORIDE.

The hinge of the primary contact arm (22) Figure 21, should be disassembled, cleaned, and lubricated with G-E D50H47 lubricant at general overhaul periods.

The main shaft bearings (24) Figure 8 and the bearings in driving pawl lever (6) Figure 7, should be removed, cleaned, and lubricated with G-E D50H15 lubricant at general overhaul periods.

Roller and Needle Bearings

Refer to Figure 8. The cam follower bearings (6), latch roller bearing (9), and cam shaft bearings (25) should be removed from the mechanism and the inner race disassembled. They should then be placed in a container of clean petroleum solvent or similar cleaner. DO NOT USE CARBON TETROCHLORIDE. 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 inductive 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 inner races should then be assembled.

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. 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 the light oil, draining and repacking with lubricant D50H15 should follow immediately.

Bearings that are pressed into the frame or other members such as the motor support (4) Figure 7, should not be removed. After removing the shaft and inner race the bearing can be cleaned satisfactorily with petroleum solvent or a similar cleaner and a stiff brush. Follow the procedure outlined above using a light machine oil and G-E lubricant D50H15 before reassembling the inner race and shaft.

Rolling Surfaces

A number of rolling and rubbing surfaces in the mechanism have been lubricated with a baked-on dry, molybdenum disulfide coating. This lubrication, which can be recognized by its dark, almost black color (e.g. Face of switch cam (9) Figure 4) requires no maintenance and should last the life of the breaker.

Other rolling or rubbing surfaces that are not lubricated with molybdenum disulfide should have the dried, dirty grease removed and a thin film of fresh lubricant D50H15 applied.

MAINTENANCE

Magne-Blast breakers used for switching arc furnaces or capacitors will require more frequent and more detailed inspection and maintenance because of the repetitive nature of the applications. The following schedule is recommended for such breakers:

A. Every 500 Operations, or Every Six Months-Whichever Comes First:

1. Remove the top cover and box barrier.
2. Wipe all insulating parts clean of smoke deposit and dust with a clean dry cloth, including the bushings, and the inside of the box barrier.
3. All flat parts in the throat area of the interrupters should be thoroughly cleaned by using sandpaper. This cleaning should be performed any time the interrupter is removed. The fins on the arc chute sides should not be cleaned. Whenever the interrupter is removed, loose dust and dirt should be blown out before replacing arc chutes. Throat insulation which is heavily contaminated should be replaced.

B. Every 2000 Operations, or Every Six Months Whichever Comes First:

1. In addition to the servicing done each 500 operations, the following inspection should be made and work done when required.
2. Primary Contacts (19 and 20 Figure 21). 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 rough-

ened or galled, they should be smoothed with crocus cloth or draw filed. After contact dressing the primary contacts should be greased lightly with D50H47.

3. Arcing Contacts (2 and 7 Figure 21). 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 interrupters for this 2000 operation servicing unless inadequate wipe or contact condition indicate a need for replacement. If the interrupters are removed, the contact braids, and other parts subject to arcing should be checked for possible cleaning or replacement. Do not grease the arcing contacts under any circumstances.

4. Check the breaker and mechanism adjustments as summarized under INSPECTION AND TEST. The necessary readjusments should be made as described under ADJUSTMENTS.

5. 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.

6. The contacts of the control relay (12) Figure 3, should be inspected for wear and cleaned if necessary.

7. Lubricate the breaker operating mechanism in accordance with instructions under LUBRICATION, page 18 and the lubrication chart Figure 16.

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

9. After the breaker has been serviced, it should be operated manually 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 position or the test couplers.

C. After Every 10,000 Operations:

1. In addition to the servicing done each 2000 operations, the interrupters should be removed from the breaker and disassembled to permit a detailed inspection of insulation, blow-out coils, arc runners and assemblies which can become contaminated by arc products.

2. 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.

3. 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.

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

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

6. Any parts damaged or severely burned and/or eroded from arc action should be replaced.

NOTE: Fine cracks may develop on 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.

7. The cup bearing (23) Figure 21 and the contact ring at the hinge point of the contact blade should be disassembled, inspected, cleaned, and relubricated with G-E contact lubricant D50H47. The contact ring should be inspected for wear and replaced when reduced in thickness to less than 1/32". When reassembling the cup bearing, be sure the cotter pin is properly assembled in the castle nut on the hinge pin (24). This assures proper contact pressure at the hinge.

D. Every 20,000 Operations or Approximately Every Five Years - Whichever comes first

1. The breaker should be given a general inspection and overhaul as required. All excessively worn parts in both the mechanism and breaker should be replaced. Such wear will usually be indicated when the breaker cannot be adjusted to indicated tolerances. This

overhaul and inspection is more detailed and will require disassembly of mechanism and breaker operating parts.

2. All roller and needle bearings in the operating mechanism should be disassembled, cleaned, and repacked with G. E. lubricant D50H15 as described under LUBRICATION.

3. The stationary primary contact fingers (19) Figure 21, should be disassembled and the silver-plated pivot area of the contact and contact support cleaned and lubricated with G-E. lubricant D50H47.

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

REPAIR AND REPLACEMENT

This section covers the proper method of removing and replacing those parts of the breaker subject to damage and wear that may require repair or replacement at the installation. 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.

In general, repair work can be accomplished with the removal of the top cover and box barrier only. However, when it is necessary to remove the side covers and front cover, they should be removed as an integral unit. When re-assembling, the dowel pins will reposition the covers to assure satisfactory alignement within the metal-clad unit.

ARC CHUTE (to inspect or replace blow-out coils and arc runners):

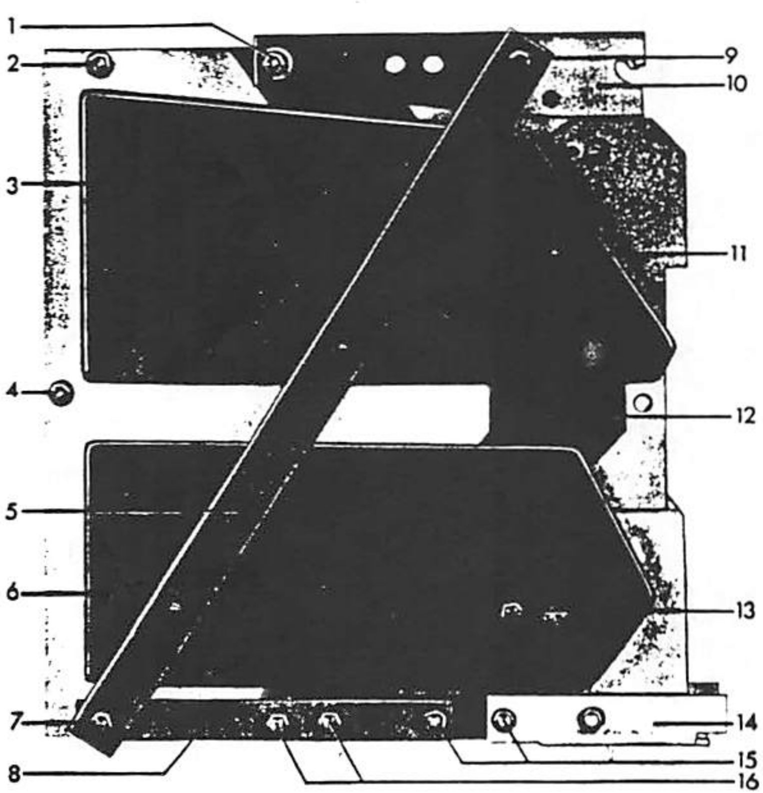
With the breaker open and the closing springs in the blocked position, remove the top cover and the box barrier (7), Figure 10. The interrupter can now be removed as described under REMOVAL AND REPLACEMENT page 17.

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

NOTE: When disassembling the arc chute and its components some small washers, spacers, etc., will be found that cannot be identified in these instructions. Care should be taken to collect and identify these items so they can be reassembled correctly.

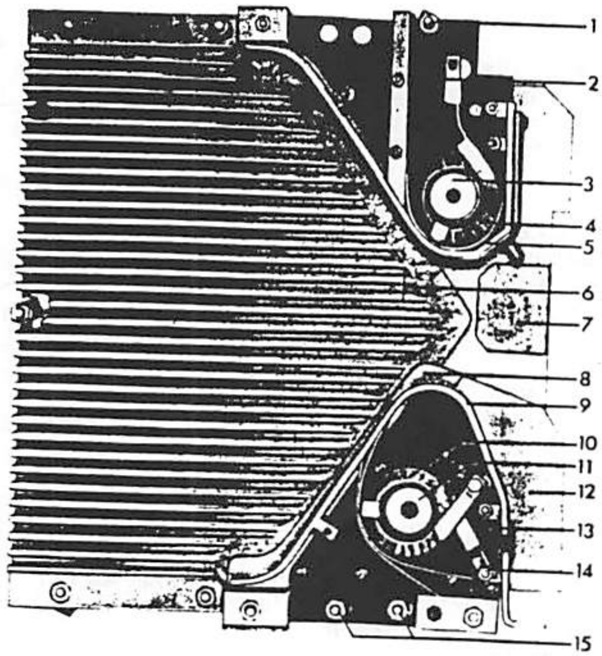
1. Remove the caps and assembly bolts (7, 9, 11, & 13), Figure 17.

2. Remove the side brace (5), and pole pieces (3 & 6).



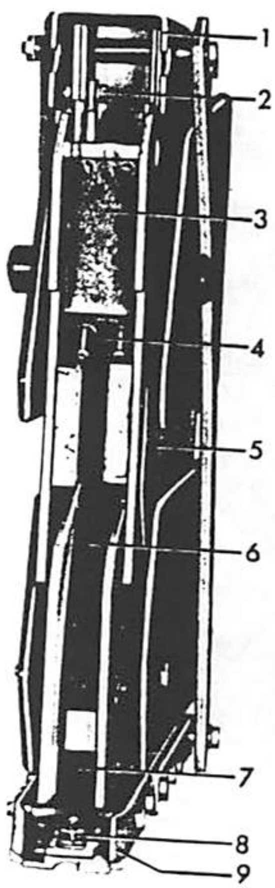
1. Assembly Bolts and Bushing
2. Assembly Bolts
3. Rear Pole Piece
4. Assembly Bolt
5. Side Brace
6. Front Pole Piece
7. Assembly Bolt
8. Front Brace
9. Assembly Bolt
10. Rear Interrupter Support
11. Insulating Cap
12. Side Shield
13. Assembly Bolt
14. Front Interrupter Support
15. Assembly Bolts
16. Assembly Bolts

Fig. 17 (8039601) Interrupter Assembly



1. Rear Arc Runner Spacer
2. Rear Arc Runner Assembly
3. Blowout Core
4. Blowout Coil
5. Rear Arc Runner
6. Arc Chute Side
7. Throat Insulation
8. Front Runner Shield
9. Front Arc Runner
10. Blowout Coil
11. Blowout Core
12. Front Insulation
13. Front Arc Runner Assembly
14. Front Coil Connection
15. Front Arc Runner Spacers

Fig. 18 (8039603) Interrupter Assembly with Side Removed



1. Rear Mounting Support
2. Connection Bolt
3. Insulation Plate
4. Rear Arc Runner Assembly
5. Side Shield
6. Front Arc Runner Assembly
7. Front Coil Connection
8. Connection Nut
9. Front Mounting Support

Fig. 19 (8039604) Interrupter Assembly

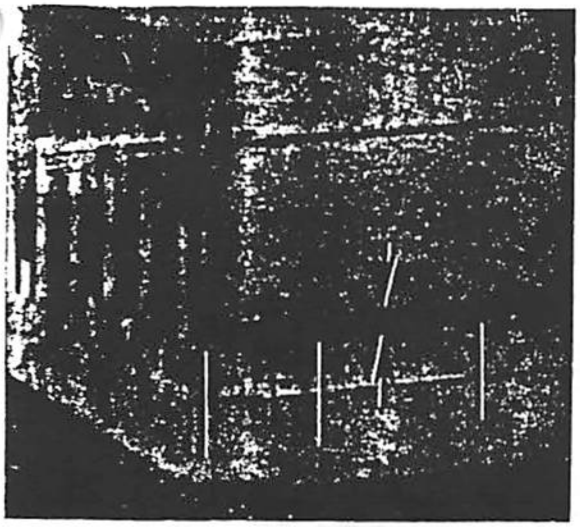


Fig. 20 (8029373) Arc Chute Fin Spacing

3. To remove the rear interrupter support (10) remove the assembly bolt (1), and the bolted connection (2) Figure 19 between the rear interrupter support and the blowout coil.

4. Remove the assembly bolt (16), Figure 17 to remove the front brace (8).

5. Remove the front interrupter support (14) by removing the assembly bolts (15) and the connection nut (8), Figure 19.

6. At this point, the side shields (12), Figure 17, and the arc runner assemblies (4 & 6), Figure 19 can be removed.

7. Further disassembly of both the rear and front arc runner assemblies can be done by removing the various screws and assembly bolts (not illustrated) as shown in Figure 18.

8. The arc chute sides (6) Figure 18, can also be separated for inspection after removing assembly bolts (2 & 4), Figure 17.

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

1. The fins of the arc chute sides should be equally spaced and aligned before bolting together. The front edge (along the runner) of the two arc chute sides should be parallel and in line.

2. The gap between the fins at the rear of the arc chute sides measured at least 1" in from the back end of the arc chute (See Figure 20) should be 1/64" to 3/32".

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

4. When reassembling the arc runner assemblies, check that the spacers are correctly installed.

5. Before bolting the rear supports in place, make certain that the rear arc runner assembly is tight against the arc chute side so that the gap between the throat insulation (7), Figure 18, and the arc chute sides (6) is a minimum.

6. Make certain that the electrical connections (2 & 8), Figure 19 are tight.

Reassemble the arc chute on the breaker as described under INTERRUPTER REMOVAL AND REPLACEMENT, page 17.

CONTACTS

Open the breaker and remove the top cover, box barrier, and interrupters as previously described. To remove the contacts, proceed as follows:

A. Stationary Arcing Contacts (2), Figure 21.

1. Disconnect the contact braids (4) from the contact fingers by removing two bolts and locking plates (14).

2. Grasp the front end of the contact fingers with pliers and pull contact assembly forward to remove from stud assembly.

3. To disassemble braids from stud plate remove one bolt (13).

4. To disassemble stud plate from contact support, remove two bolts (3).

5. Reassemble in the reverse order, make sure locking plates are properly reassembled with bolts (14).

B. Movable Arcing Contact (7) Figure 21.

1. Remove the assembly bolts (8) making note of quantity and location of shims and spacers used between contacts and contact arms.

2. Reassemble in reverse order, re-using the shims and spacers.

3. Close the breaker slowly to check that the movable arcing contact is approximately centered on the stationary arcing contact and that it does not rub on either side of the throat

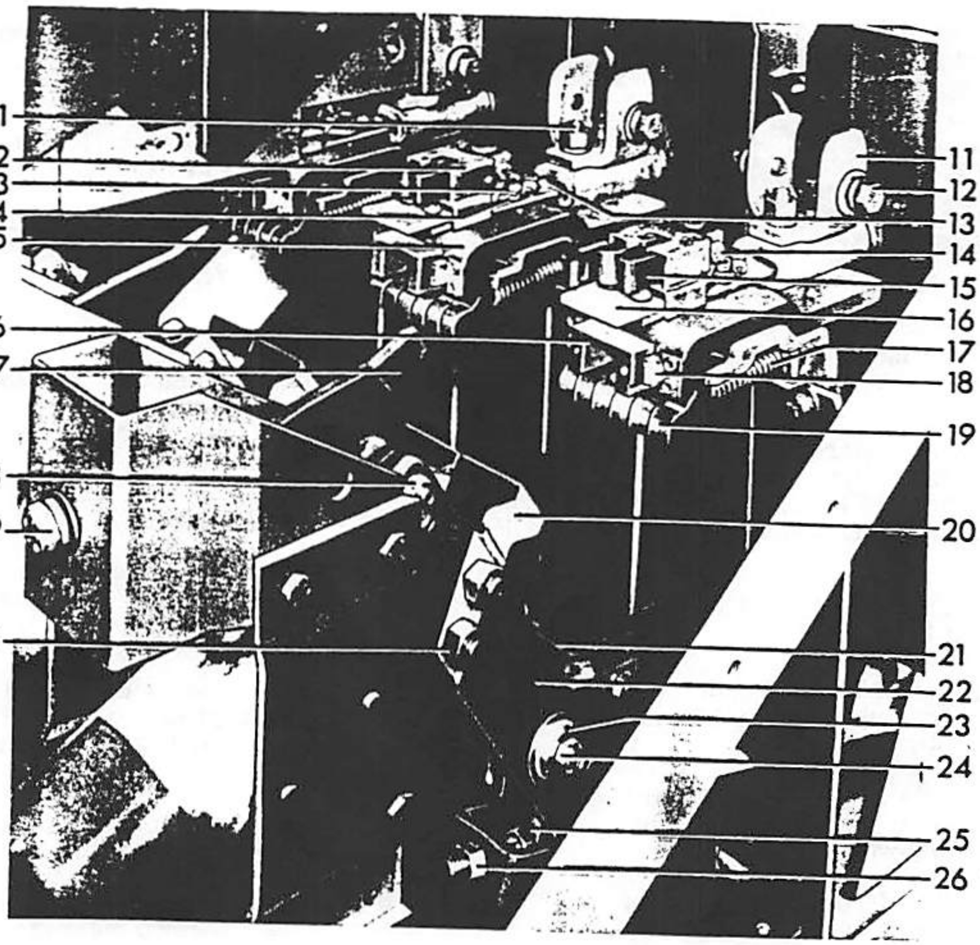


Fig. 21 (8037373) Contact Assembly

1. Bolts for Contact Support
2. Stationary Arcing Contact Asm.
3. Mounting Bolt
4. Flexible Braid
5. Contact Support
6. Buffer
7. Movable Arcing Contact
8. Assembly Bolts
9. Front Support Bolt
10. Assembly Bolts
11. Rear Interrupter Support
12. Rear Support Bolt
13. Bolt for Flexible Braids
14. Connection Bolt
15. Arcing Contact Finger
16. Insulation Plate
17. Contact Spring
18. Buffer Retainer
19. Stationary Primary Contact
20. Movable Primary Contact
21. Connection Bar
22. Contact Arm
23. Cup Bearing
24. Hinge Pin and Nut
25. Operating Rod
26. Adjusting Nut

barrier (7) Figure 11.

NOTE: Whenever it is found necessary to replace arcing contacts on any pole of a breaker it is recommended that both the stationary and movable contacts on that pole be replaced at the same time.

C. Stationary Primary Contacts (9), Figure 22.

1. Compress the contact spring (6) by use of the spring compressor.

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). Remove one contact finger at a time.

To replace the Stationary Primary Contacts:

1. Apply a thin coating of D50H47 grease on the hinged edge of the finger (9) then place it on the contact support (7) so that it is retained by stop plate (8).

2. Open spring compressor (3) and assemble spring guide, spring and spring compressor (Figure 22A).

3. Turn nut (2) in clockwise direction to compress contact spring (Figure 22B). Hold spring firmly in yoke on spring compressor to prevent 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 cutout in primary finger (Figure 22C).

5. Hold spring assembly, firmly in place and remove spring compressor.

D. Movable Primary Contacts (20), Figure 21.

To replace the movable primary contacts on a 1200 ampere breaker proceed as follows:

1. Disassemble nuts from assembly bolts (10) and remove the movable primary contacts (20).

2. Reassemble in reverse order.

To replace the movable primary contacts on a 2000 ampere breaker it is first necessary to disassemble the movable arcing contacts, then proceed as follows:

1. Disassemble operating rod pin, first noting quantity and location of washers in the assembly.

2. Pry contact arms (22) apart enough to disengage pivot pins of piston assembly (28), Figure 10, allowing piston to drop down into its booster cylinder.

3. Rotate the two parts of the contact arm assembly away from each other so assessible and movable primary contacts (20) can be removed.

4. Reassemble in reverse order.

E. Contact Arm Assembly (7, 20, 22, Figure 21).

1. Remove connection bar (21).

2. Disassemble hinge pin (24), cup bearing (23), and operating rod pin noting quantity and location of any washers and spacers used in assemblies.

3. The contact arm assembly including the piston assembly (28), Figure 10 can now be removed.

4. When reassembling, first insert piston tube assembly into the booster cylinder and reassemble the cup bearing, making sure the silvered contact washers between the bushing and contact arms (both sides) are in place.

5. Reassemble operating rod pin and connection bar (21).

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

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 insure interchangeability of the breakers in the metal-clad units. 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 reinstalled in the same location.

However, it is 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 interrupters are reinstalled.

To replace the bushing, proceed as follows

Upper Bushing

1. Open the breaker and remove the [illegible]

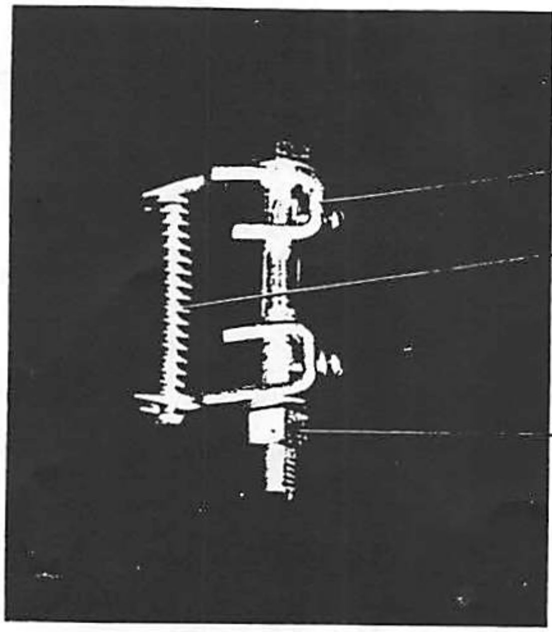


Figure 22A (8034466)

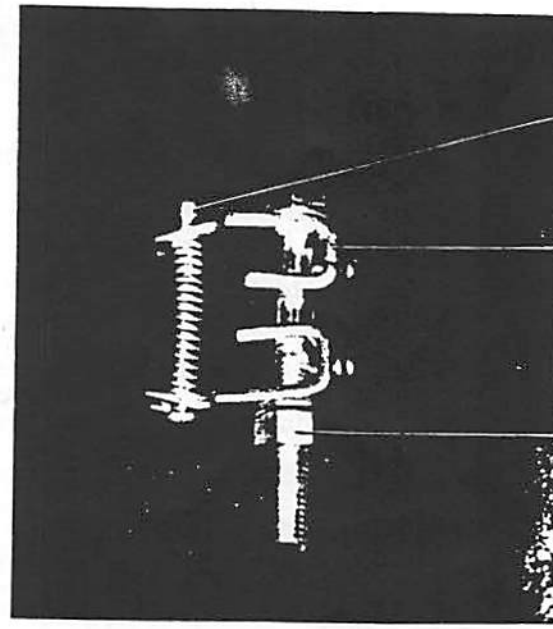


Figure 22B (8034465)

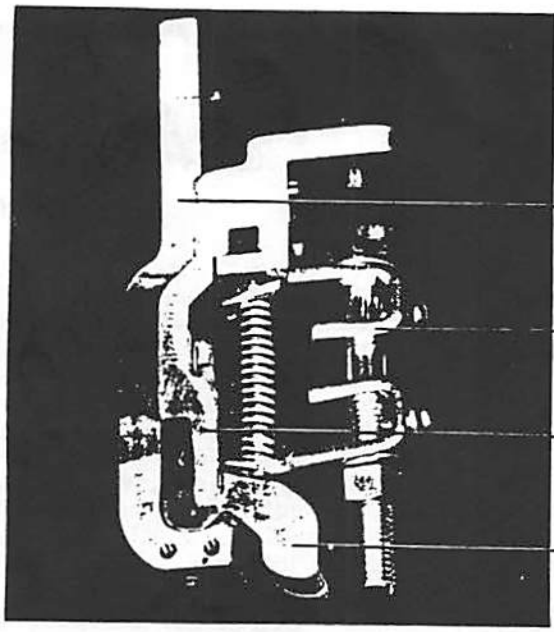


Figure 22C (8034469)

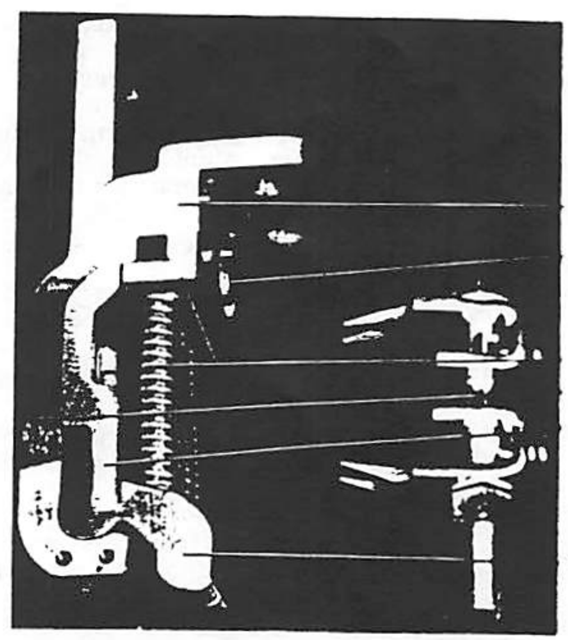


Figure 22D (8034468)

Figure 22. Method of Installing Primary Contact Springs Using a Spring Compressor

1. Spring Guide
2. Compressor Nut
3. Spring Compressor
4. Spring Retainer
5. Assembly Bolts
6. Spring
7. Contact Support
8. Stop Plate
9. Stationary Primary Finger

cover, box barrier, and interrupters as already described.

2. Remove the vertical barriers (5 and 13), Figure 15.

3. Remove the four bolts at the mounting flange of the top bushing being removed and move the bushing assembly toward the front of the breaker.

   NOTE: Shims may be found between the breaker mounting plate and the bushing mounting flange on some, or all bolts. These shims are for squaring up the bushing and may be required when new bushings are assembled.

4. Referring to Figure 22, disassemble the primary contact springs (6) as previously described.

5. Disassemble the spring retainer (4) by removing mounting bolts (5).

6. Referring to Figure 21, disassemble the contact support (5) and interrupter mounting bracket (11) removing two bolts (1).

7. Reassemble in the reverse order. The interrupter mounting bracket (11) is not symmetrical and must be assembled correctly to orient the interrupter properly on the breaker. The longest projection of the bracket should be toward the front end of the bushing.

Lower Bushing

1. Open the breaker and remove the top cover, box barrier, and interrupters as already described.

2. Remove the vertical barriers (5 and 13) Figure 15.

3. Remove the connection bar (21), Figure 21, cup bearing (23), and hinge pin (24).

4. Remove the four bolts at the mounting flange of the lower bushing being removed, and move the bushing assembly toward the front of the breaker. (See note under rear bushings concerning use of shims).

5. When reassembling, first mount the bushing and assemble the cup bearing (23), contact arm (22), and replace pin (24) being sure the silvered contact washers between the bushing and contact arms are in place. The contact surfaces at the hinge point of the contact blade and bushing should have a thin coating of D50H47 grease.

6. Check all contact adjustments as outlined under ADJUSTMENTS.

INTERLOCK SWITCH

To remove the interlock switch (5), Figure 13, remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

LATCH CHECKING SWITCH

To remove the latch checking switch (8), Figure 13, (when furnished), remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

MOTOR, RELAY AND LIGHT SWITCHES

Two or three switches (13) Figure 4, are mounted in tandem as required by the application.

1. Remove the opening spring per instructions below.

2. Remove (2) mounting bolts (11 & !%) from switch bracket (12).

3. Remove the (2) mounting screws of the lower switch.

4. Remove the (2) mounting screws of the center switch.

5. Remove the (2) mounting screws of the upper switch.

6. Disconnect the lead wires of switch to [illegible] replaced.

7. Reassemble in the reverse order and check switch adjustment as explained under A[illegible] JUSTMENTS.

TRIP SHAFT AND LATCH (See Figure 9)

1. Remove manual trip lever (3) and [illegible] nished, the latch checking switch [illegible] ing arm (6) from the trip shaft.

2. Disengage trip latch spring (9).

3. Remove three (3) cotter pins from trip [illegible]

4. Remove trip arm screw (14) and trip [illegible] set screw (10).

5. Place a block between the trip [illegible] and the right side of the mechanism [illegible] Drive the trip shaft to the right [illegible] latch is free of the key, then remove [illegible]

6. Check for and remove any burrs [illegible] around the keyway on the shaft [illegible] damaging the trip shaft bearings.

7. Shaft, latch, etc., may now be re[illegible] driving it to the right through [illegible]

in the angle of the lower frame. Note quantity and location of washers used as spacers in the assembly.

8. Reassemble parts in reverse order. Be sure trip latch is aligned in center of trip latch roller and that the latch spring is properly installed. Check latch adjustment as described under ADJUSTMENTS.

TRIP LATCH ROLLER BEARING

1. Remove (2) cotter pins at ends of trip latch roller shaft (8) Figure 14.
2. Partially remove shaft out right side of frame until latch roller (6) is free.
3. Reassemble in reverse order with proper spacing of washers. Be sure latch roller rotates freely.

CLOSING LATCH

1. Remove cotter pins at both ends of closing latch shaft (17) Figure 4.
2. Remove spring and paddle (18).
3. Remove set screws from latch (14).
4. Move shaft (17) to right (away from frame) by tapping lightly on the inside end of shaft. Rotate shaft and continue tapping until shaft is free. Shaft will push outside needle bearing from housing.
5. Reassemble in reverse order putting bearing into frame last. Use a small piece of tubing or pipe when inserting bearing to assure proper alignment.
6. Check closing latch adjustments as described under ADJUSTMENTS.

MOTOR

1. To remove motor (11) Figure 3, first remove the cotter pin from the rear end of the treadle link (6), Figure 6. Rotate link up to clear motor.
2. Remove motor leads from the terminal board.
3. Remove four mounting bolts from motor (not shown).
4. Reassemble the motor in the reverse order and re-align it properly as described under DRIVING PAWL ADJUSTMENTS.

CAM

1. Remove 2 set screws from ratchet wheel (7) Figure 5 and remove wheel from main shaft (6).
2. Remove 2 set screws from switch cam (..) Figure 4 and remove cam from the ... shaft.
3. Remove prop reset spring (7) Figure ...
4. Remove 2 set screws from cam (16), Figure 8, and move cam to the right on the shaft as far as it will go. Slide the shaft to the left until key is fully exposed. Remove key and check shaft for burrs.
5. Remove shaft out left side of frame.
6. Reassemble in reverse order using the correct number of washers and spacers to properly locate the parts.
7. Rotate the mechanism through a closing operation using the manual charging wrench. Check the location of the cam follower (6), Figure 8, on the cam (16) If necessary, move the cam to correct the alignment. Complete the closing operation and check the location of the prop pin (13) on the prop (14). It should be approximately centered.

TRIP COIL

To replace the potential trip coil (13), Figure 9, proceed as follows:

1. With the breaker in the open position, re... the two mounting bolts (16).
2. Remove trip coil support (12) and spa...
3. Cut wires at the butt connectors and re... coil.
4. When replacing the coil be sure to ... the correct fiber spacers at the ends ... bolting support (12).
5. Adjust coil location to allow approxi... 1/4" of armature travel before lat... to move.
6. Butt connect wires and check opera... solenoid electrically and mechanic...

SPRING RELEASE COIL

To remove the spring release coil (2... 4, proceed as follows:

1. Block the closing springs as ... in INSTALLATION.
2. Remove the right hand closing ... described in CLOSING SPRI...
3. Remove two mounting bolts, co... (23), and spacers.
4. Cut wires at the butt connectors ... move coil.

5. Replace the coil and the correct number of fiber spacers before bolting support.

6. Butt connect wires and check that the armature is not binding. Check coil for electrical operation.

CLOSING SPRINGS

The closing springs (10) Figure 3, can be removed as follows:

1. Charge the springs with the manual charging wrench and apply the special short blocking pins (13) supplied in the tool kit. Insert pin so that it is centered in the spring support.

2. Discharge springs by pushing manual close button (6) Figure 2.

3. Rotate cam shaft (6) Figure 5, by using the manual charging wrench until the gap between the spring (11) and the bearing block (8) is a maximum (approximately 3").

4. Remove cotter pin and washer from spring guide pin and remove closing spring (11) and upper spring guide (8) as a unit.

5. Either discharge the opening springs by pushing the manual trip lever or block the opening springs with a suitable blocking device.

OPENING SPRINGS

To remove the opening springs (5) Figure 5, proceed as follows:

1. Charge and block the closing springs as described under INSTALLATION.

2. Push manual trip lever (1) Figure 2, to be sure the opening springs are fully discharged.

3. Remove rear pin (2) Figure 5, and front pin (9).

4. After reassembling springs check the open gap at the primary contacts as described under PRIMARY CONTACT GAP.

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 minimize service interruptions caused by breakdowns, and saves time and expense. When continuous operation is a primary consideration, more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

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

NOTE: The listed terms "Right" and "Left" apply when facing the front or panel 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., are not listed and should purchased locally.

4. For prices, refer to the nearest office of the General Electric Company.

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

In the following tabulations are listed those parts of the breaker and operating mechanism which are usually recommended for stock for normal maintenance. Other parts can be obtained by contacting the nearest office of the General Electric Company.

RECOMMENDED RENEWAL PARTS FOR

TYPE ML-13A STORED ENERGY MECHANISM

USED FOR AMH-4.76-250-0D & 1D, 1200 & 2000 AMPERE

Fig. No.	Ref. No.	No. Req'd.	Description	Catalog No.
3	11	1	Spring Charging Motor - **	
			48 V-DC	0105C9393P001
			110 & 125 V-DC & 115 V-AC, 60 Hz	0105C9393P002
			220 & 250 V-DC & 230 V-AC, 60 Hz	0105C9393P003
3	12	1	Relay - **, #	
			48 V-DC	0137A7575P004
			110 & 125 V-DC	0137A7575P001
			220 & 250 V-DC	0108B1978G001
			115 V-AC, 60 Hz	0137A7575P005
			230 V-AC, 60 Hz	0137A7575P002
9	13	1	Potential Trip Coil - **	
			110 & 125 V-DC	006174582G001
			220 V-DC	006174582G015
			250 V-DC	006174582G002
			115 V-AC, 60 Hz	006174582G013
			230 V-AC, 60 Hz	00 6174582G032
			24 V-DC	006275070G001
			48 V-DC	006174582G034
4	22	1	Spring Release Coil - **	
			110 & 125 V-DC	006174582G001
			220 V-DC	006174582G015
			250 V-DC	006174582G002
			115 V-AC, 60 Hz	006174582G010
			230 V-AC, 60 Hz	006174582G014
			48 V-DC	006174582G034
4	13	5	Switch, Normally Open	0456A0866P005
4	13	1	Switch, Normally Closed	0456A0866P006
9	4	1	Auxiliary Switch	△
4	18	1	Closing Latch Spring	0161A4231P001
9	7	1	Prop Spring	0137A9252P001
*		1	Driving Pawl Spring	0161A4241P001
5	3	2	Latching Pawl Spring	0161A5909P001

* Not Illustrated
** Refer to breaker nameplate or summary for proper voltage rating.
\# Quantity Two (2) relays required on special control circuits. Check breaker and connection diagram.
△ Refer to breaker auxiliary switch for proper model
Type SBM - 0137A9192G003
Type SB-12 - 0137A9192G011

* Indicates Revision

RECOMMENDED RENEWAL PARTS FOR MAGNEBLAST BREAKERS

TYPE AMH-4.76-250-0D & -1D, 1200 & 2000 AMPERES

Fig. No.	Ref. No.	Ampere Rating	Catalog No. For Type AMH-4.76-250 -0D	-1D	No. Req"d.	Description
10	13	1200	0195A4091G001	0195A4091G001	6	Primary Disconnect Fingers
10	13	2000	0195A4091G002	0195A4091G002	6	Primary Disconnect Fingers
10	21	ALL	0137B7902G001	0137B7902G001	3	Operating Rod Assembly
10	28	1200	0213X0343G043	0213X0343G090	3	Tube & Piston Assembly
10	28	2000	0213X0343G044	0213X0343G091	3	Tube & Piston Assembly
21	2	ALL	0236C0790G009	0236C0790G009	3	Arcing Contact Assembly
21	4	ALL	0236C0791G001	0236C0791G001	3	Flexible Connector (Left)
21	4	ALL	0236C0791G004	0236C0791G004	3	Flexible Connector (Right)
21	7	ALL	0802B0742G001	0227A5306G004	3	Movable Arcing Contact
21	16	ALL	0414A0116P004	-	3	Insulating Plate
21	17	ALL	0121A5964P001	0121A5964P001	18	Primary Contact Finger Spring
21	19	ALL	0114C5382P002	0114C5382P002	18	Primary Contact Finger
21	20	ALL	0114C5382P004	0114C5382P004	6	Movable Primary Contact
17	11	ALL	000421711P001	000421711P001	6	Insulating Cap
17	11	ALL	000407193P001	000407193P001	6	Threaded Washer (For Insul. Cap)
18	7	ALL	0108B1965G001	0195A7377G001	3	Throat Insulation (Left)
18	7	ALL	0108B1965G002	0195A7377G002	3	Throat Insulation (Right)
18	8	ALL	0161A5906P001	0161A5906P001	6	Front Runner Shield
18	12	ALL	0114C5381P001	0114C5381P010	6	Front Insulation
19	3	ALL	0114C5381P004	0414A0116P002	3	Insulating Plate
*		ALL	0836C0197P014	0836C0197P014	6	Rear Runner Insulation
11	7	ALL		0195A7388G002	3	Throat Barrier Assembly

* Not Illustrated

GENERAL ELECTRIC BREAKERS
TYPE AMH 4.76-250-0D, MAX. VOLTS 4760
MAX. AMPS 1200, 60 HZ MECH TPE ML-13A

Disassemble breaker. Inspect the movable and stationary primary contacts and movable arcing contacts. All cam, roller and latch surfaces should be inspected for any evidence of damage or excessive wear. Check for loose nuts or bolts and broken retaining rings.

Replace all teflon sleeve bearings with aluminized brass bearings (see G.E. specification).

Remove and inspect main shaft bearing, driving pawl bearing and all needle and roller bearings. Remove and inspect the cam follower bearings, latch roller bearings and cam shaft bearings.

Remove arc chutes -- meggar and ductor to determine if disassembly is needed. Arc chutes contain blowout coils, arc runners and assemblies.

All lubrication of bearings and other wear surfaces shall be in accordance with G.E. updated specifications.

All adjustments to the breakers shall be made to G.E. specifications or noted as out of tolerance.

All renewable parts installed shall be recommended G.E. replacement parts or equivalent.

Breakers shall be hi pot tested using ANSI standards. Bushings shall be Doble tested. The breaker operating mechanism shall be tested with a time motion analyzer for three phase contact closure.

B. Connell

MTC BULL GEI 55771

GESCO. LARRY GEISS 312-573-3069
GE EDAC.

DIANE RIZENSKI
LOCAL CONTACT.

1800 GE 1STOP

jek:bc0418

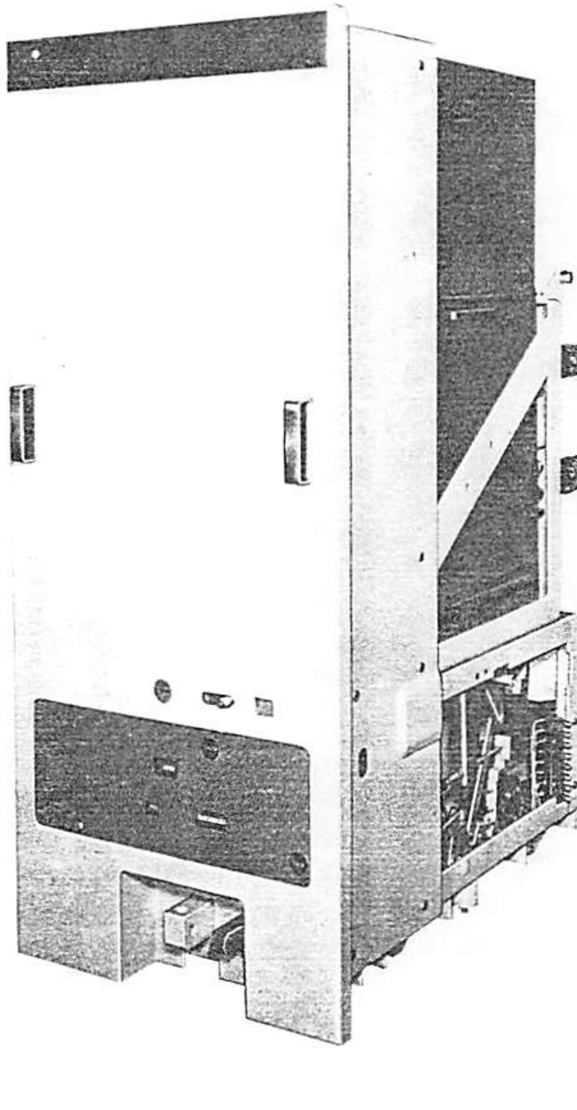
GEI-88771A
Supersedes GEI-88771
1-25-71-RP

INSTRUCTIONS AND RECOMMENDED PARTS FOR MAINTENANCE

MAGNE-BLAST CIRCUIT BREAKER

TYPE

AMH-4.76-250-0D
AMH-4.76-250-1D



Stolen from
G. E. Service man
August 1975

MEDIUM VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

MAGNE-BLAST CIRCUIT BREAKER
AMH-4.76-250-OD AMH-4. 16-250-1D

INTRODUCTION

The magneblast breaker is the removable and interchangeable interrupting element used in metal-clad switchgear to provide reliable control and protection of electrical apparatus and power systems.

The AMH-4.76-250 Magneblast Breaker is available with continuous current ratings of 1200 amperes and 2000 amperes in accordance with applicable industry standards. Refer to the breaker nameplate for complete rating information of any particular breaker. The nameplate also describes the control power reauirements for that breaker. The application of a breaker must be such that its voltage, current, and interrupting ratings are never exceeded. Since this book is written to include all ratings of the breaker as well as several design variations, the 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 information for placing magne-blast breakers in service and for maintaining satisfactory operation.

RECEIVING, HANDLING AND STORAGE

Receiving and Handling

Each breaker is carefully inspected and packed for shipment. 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. 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. Unfinished surfaces of rollers, latches etc., of the operating mechanism should be coated with 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, it should be cleaned and dried out before being placed in service.

(Cover photo 8037386)

INSTALLATION

1. Remove the top cover and box barrier. Do not remove side or front covers. (See note under Repair and Replacement, page 22.) Make a visual inspection to ascertain that the breaker and mechanism is in satisfactory condition. Check all bearing surfaces of the mechanism for lubrication. Refer to section on lubrication page 18 and Figure 16.

2. Charge the breaker closing springs manually using a 5/8" ratchet wrench to turn the manual charging shaft (3) Figure 1. Turning the shaft counter clockwise will advance the ratchet wheel and compress the springs.

   When the springs have reached the fully charged position the indicator (5) Figure 2 will read "CHARGED", and the driving pawl will be raised from the ratchet wheel teeth. Additional turning of the charging shaft will not advance the ratchet wheel.

   Insert the spring blocking devices into a hole (2) Figure 1 on each side of breaker, and manually discharge the springs against the pins by pushing the manual close button (6) Figure 2. The springs are now blocked and slow closing of the breaker contacts can be accomplished by again turning the manual charging shaft with a 5/8" ratchet wrench.

   During the slow closing operation check to insure that the mechanism does not stick or bind during the entire stroke, that it latches securely in the closed position, and that it trips freely when the manual trip lever is operated. At this time, also check the following adjustments:

   a. Arcing contact wipe (Refer to page 12).
   b. Primary contact wipe (Refer to page 13).
   c. Primary contact gap (Refer to page 13).

   DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS PRECAUTION IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING.

   The closing springs should now be unblocked. Rotate the charging shaft until the indicator reads "CHARGED" and the ratchet wheel does not advance. The spring blocking devices can now be removed.

3. Connect the test coupler to the right hand secondary coupler or insert the breaker into the metalclad housing to the test position. Operate it electrically several times. Check the control voltage as described under "CONTROL POWER CHECK" (Page 16).

4. Disconnect the test coupler, or remove breaker from housing, and replace box barrier and top cover.

5. If the breaker has been stored for a long period of time, it is recommended that the insulation be checked with a standard 60 Hertz high potential test. Refer to Insulation Test (Page 18).

   NOTE: If the breaker secondary wiring is to be given a hi-potential test at 1500 volts, remove both the motor leads from the terminal connection. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

6. Lubricate the inside silver portion of the primary disconnect fingers by applying a thin film of contact lubricant D50H47. The lubricant should extend approximately one inch (1") from the end of the finger.

7. Refer to metal-clad instruction book GEI-88775 for instructions on inserting the breaker into the metal-clad unit.

DESCRIPTION OF OPERATION

The Magneblast Breaker has two principal components; the breaker element and the operating mechanism:

The breaker element is three similar pole units, each of which includes the current carrying parts, main and arcing contacts, interrupter, and an enclosing barrier system that provides insulation between poles, or phases and to ground. The primary connections to the associated metal-clad switchgear are made through the primary disconnect fingers at the rear of the breaker.

The operating mechanism type ML-13A is of the stored energy type designed to give high speed closing and opening. The mechanism will operate on a-c or d-c voltage as indicated on the breaker nameplate. Closing and opening operations are controlled either electrically from the metal-clad unit and remote location, or mechanically by the manual close and trip buttons on the breaker. All secondary connections from the breaker to the metal clad unit are made through the coupler (1) Fig. 3.

A spring release interlock, Fig. 4 is provided to discharge both the closing and opening springs when the breaker is withdrawn from or inserted into the Metal Clad unit.

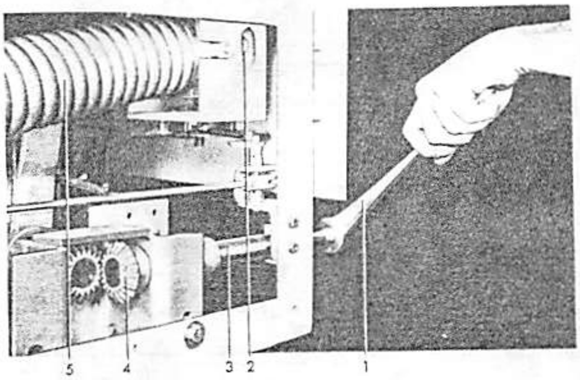


Fig. 1 (8037382) Manual Charging

1. Manual Charging Wrench
2. Hole for Spring Blocking Pin
3. Manual Charging Shaft
4. Bevel Gears
5. Closing Spring

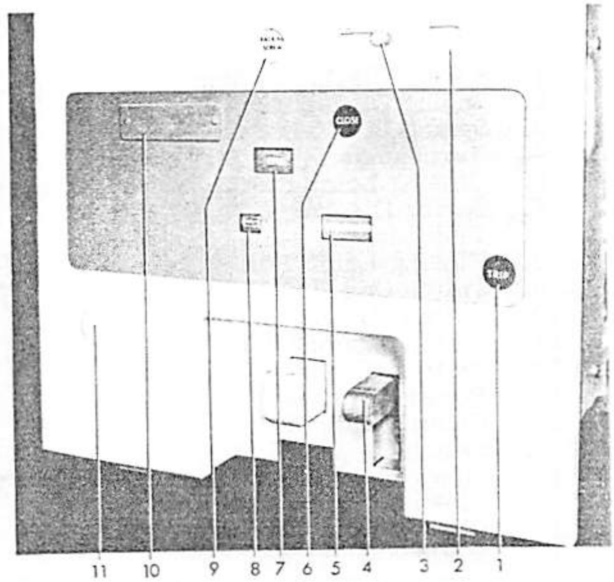
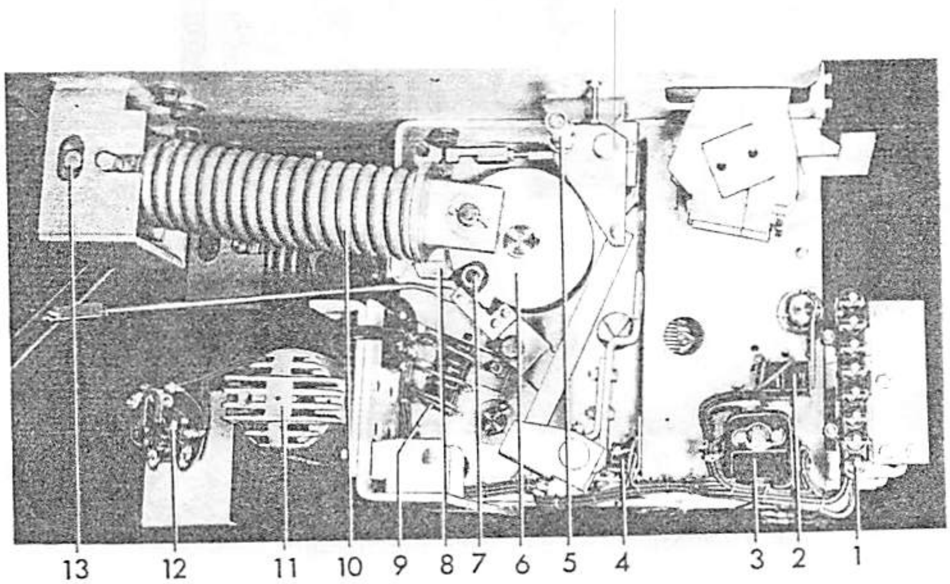


Fig. 2 (8037380) Control Panel

1. Trip Button
2. Position Indicator
3. Racking Screw Shutter
4. Position Stop Release
5. Charge-Discharge Indicator
6. Close Button
7. Open-Close Indicator
8. Operation Counter
9. Racking Screw Hole
10. Padlock Hole Cover
11. Hand-Charge Hole Cover



1. Secondary Coupler
2. Interlock Switches
3. Auxiliary Switch
4. Latch Checking Switch
5. Spring Discharge Roller
6. Switch Cam
7. Closing Latch Roller
8. Closing Latch
9. Power Switches
10. Closing Spring
11. Motor
12. Control Relay
13. Spring Blocking Pin

Fig. 3 (8037375) Right Side View ML-13A Operating Mechanism

1. Spring Discharge Stop
2. Spring Discharge Roller
3. Spring Discharge Crank
4. Turnbuckle
5. Closing Latch Stop
6. Spring Discharge Stop
7. Trip Link
8. Closing Latch Roller
9. Switch Cam
10. Switch Striker
11. Switch Support Bolt
12. Switch Support
13. Power Switches
14. Closing Latch
15. Switch Support Bolt
16. Motor Terminal Board
17. Closing Latch Shaft
18. Closing Latch Spring
19. Motor
20. Latch Monitoring Switch
21. Latch Switch Support
22. Spring Release Solenoid
23. Closing Coil Support

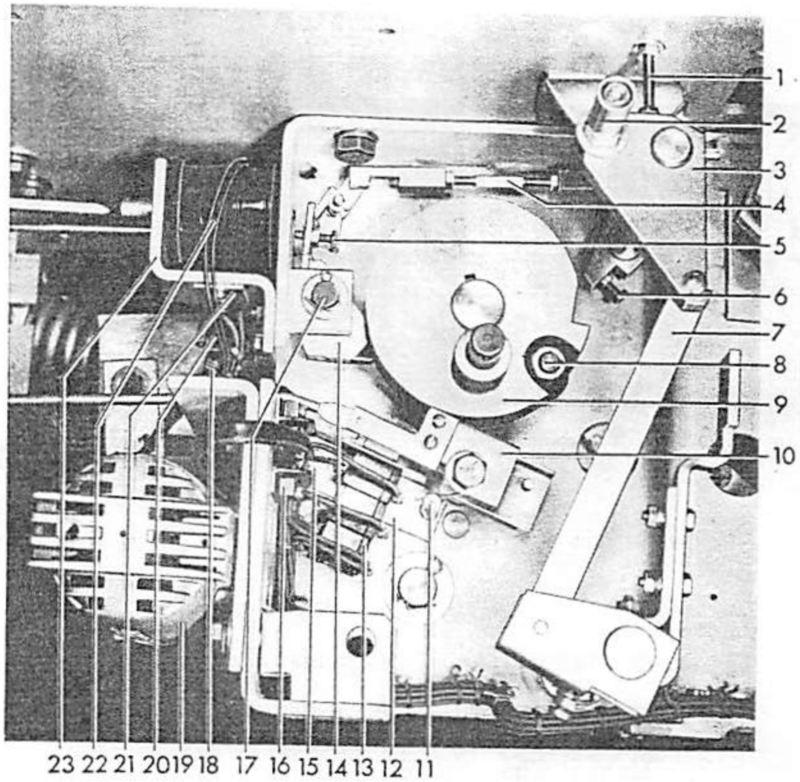


Fig. 4 (8037379) Control Mechanism and Spring Discharge Link

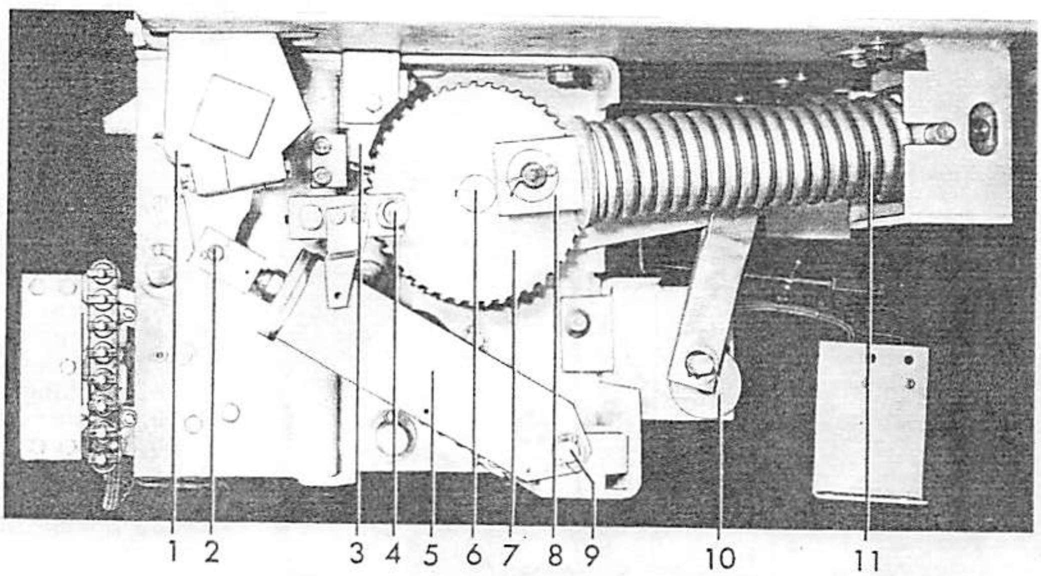


Fig. 5 (8037377) Left Side View ML-13A Operating Mechanism

1. Main Shaft Bearing
2. Rear Spring Pin
3. Latching Pawls
4. Positive Interlock Roller
5. Opening Spring
6. Cam Shaft
7. Ratchet Wheel
8. Guide Block
9. Front Spring Pin
10. Eccentric
11. Closing Spring

Apositive interlock (4) Figure 5 and interlock switch (2) Figure 3, are provided between the breaker and metal-clad unit and work with the rack screw shutter to prevent insertion or removal of the breaker in the unit while in a closed position and to prevent a closing operation when the breaker is not in either the fully connected or test position. To insure that this interlock will function during manual, as well as during electrical operation of the equipment, both mechanical and electrical blocking is provided. If for any reason the closing springs should be discharged against the positive interlock the mechanism will be jammed and be inoperable. The mechanism can be released and returned to the reset position by pushing in on the trip lever (1) Figure 2. It may require more than normal force to release the interlock.

An auxiliary switch operator (3) Figure 6 can be provided when required to operate a stationary auxiliary switch mounted in the metal clad unit.

Spring Charging

The mechanism has a high speed gear motor (1) Figure 7, that compresses a set of closing springs through the action of an eccentric, ratchet, and pawl assembly. The rotary action of the motor is converted to a straight stroke through the eccentric (5), and a lever (6) that carries a spring loaded driving pawl.

The pawl advances the ratchet wheel (7) Figure 5 a few degrees each stroke where it is held in position by the latching pawls (3). When the ratchet wheel has been rotated approximately 180 degrees the closing springs (11) will be fully compressed. As the ratchet wheel continues to rotate, the spring load will shift over center and attempt to discharge. After a few degrees of rotation, the closing roller (7) Figure 3, will engage the closing latch(8) and the compressed springs will be held by the latch until a closing operation is required. During the last few degrees of the ratchet wheel rotation the power switches (9) are opened and the driving pawl is raised from the ratchet wheel surface. This allows the motor and driving mechanism to coast to a natural stop expending all residual energy.

During the time the springs are being compressed a relay (12) is energized to hold the closing circuit open. The relay remains energized until the springs are fully charged and the control switch contacts are re-set.

The closing springs may be charged manually if control voltage is lost. A 5/8" ratchet wrench can be used to rotate the manual charging shaft in a counter clockwise direction until the indicator reads "Charged" and the driving pawl is raised from the ratchet wheel. The use of the ratchet wrench provides for maximum safety in the event that the control power is suddenly restored without warning. In this event, the motor drive will override the ratchet wrench and continues to charge the springs.

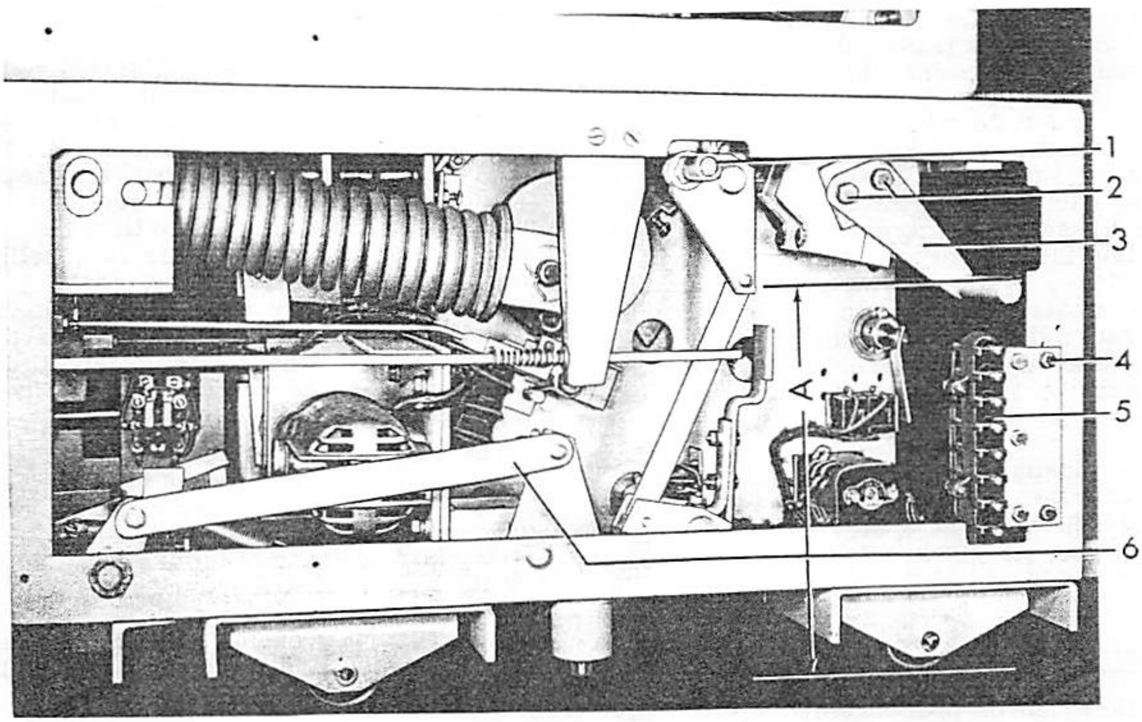
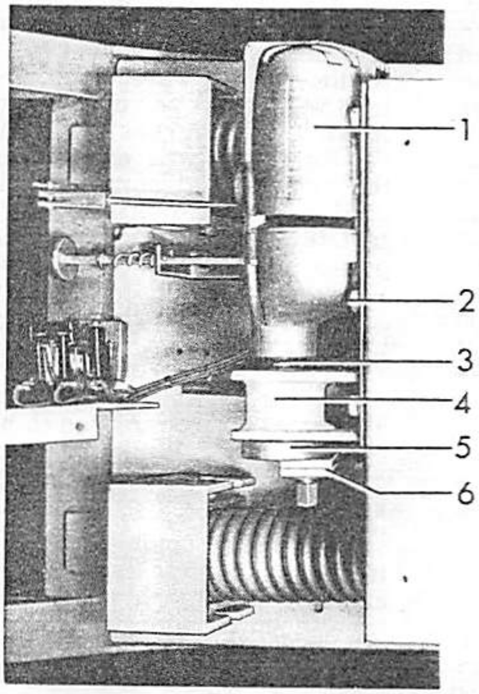


Fig. 6 (8037376) Auxiliary Switch Operator

1. Spring Discharge Crank
2. Mounting Bolts
3. Auxiliary Switch Operator
4. Mounting Bolts
5. Secondary Disconnect
6. Treadle Link



1. Motor
2. Mounting Bolt
3. Retaining Ring
4. Motor Mount
5. Eccentric
6. Driving Link

Fig. 7 (8037378) Driving Elements)

Closing Operation

The breaker can be closed electrically by energizing the spring release solenoid (22) Figure 4, or manually by pushing the close button (6) Figure 2. In either method the closing latch is rotated from under the closing roller to release the closing springs (10) Figure 3. The energy in the springs is used to rotate a cam (16) Figure 8 and close the breaker through the operating mechanism linkage. During the closing operation the mechanism is trip-free at all times. The breaker is held closed by the closing prop (14) moving into position under the prop pin (13). During the closing operation the opening springs (17) Figure 9, are compressed and held ready for an opening operation with the trip latch (8) Figure 8 bearing against the trip latch roller (9).

When the closing operation of the breaker is completed and the closing latch is fully reset, the contacts of the latch monitoring switch (20) Figure 4, closes to permit the spring charging motor to be energized and recharge the closing springs.

Opening Operation

The breaker can be opened either electrically by energizing the trip coil (13) Figure 9, or manually by pushing the trip lever (1) Figure 2. In each method the trip latch is rotated off the trip latch roller, permitting the operating mechanism linkage to collapse. The energy stored in the opening springs is released to provide the required opening speed for successful interruption of the circuit.

As the breaker opens to interrupt a current, the arc first starts at the arcing contacts (6 & 27) Figure 10, transfers to the arc runner (4 & 10) and energizes the blow-out coils (3 & 11). This action introduces a magnetic field between the pole pieces 5 & 9) of the interrupter that forces the arc deeper into the arc chute (8). At the time the arcing contacts part a discharge of air is expelled through the booster tube (28) across the arc. This air flow assists the arc transfer and interruption by blowing the arc away from the contacts and into the arc chute. The magnetic field forces the arc deeper into the interrupter along the diverging arc runners.

The arc chute has a series of interleaving ceramic fins, Figure 18. As the arc is forced into the interrupter it is lengthened in the gradually deepening serpentine path between the fins so that the electrical resistance of the arc is rapidly increased and its heat is absorbed by the ceramic material. The increased resistance reduces the nagnitude and phase angle of the current and at an early current zero the arc cannot re-establish itself and interruption occurs.

Trip Free Operation

If the trip coil circuit is energized while the breaker is closing, the trip armature will force the trip latch (8) Figure 8 away from the trip roller (9) causing the mechanism linkage to collapse and the breaker to re-open. The closing cam (16) will complete its closing stroke and the springs will re-charge as in a normal closing operation.

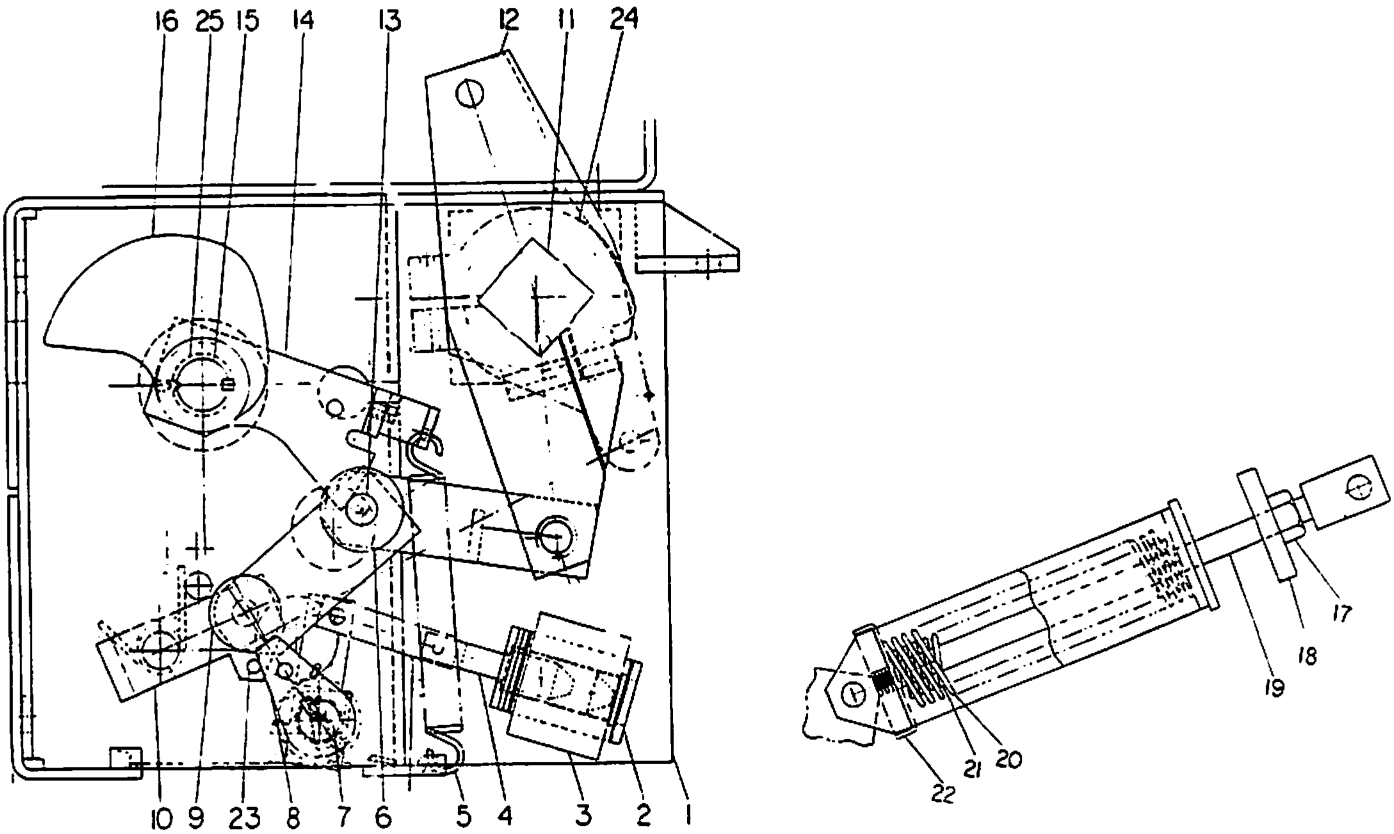


Fig. 8 (0121C8152) Sectional Side View of Mechanism

1. Frame
2. Trip Coil Support
3. Trip Coil
4. Trip Armature
5. Prop Reset Spring
6. Cam Follower Roller
7. Trip Shaft
8. Trip Latch
9. Trip Latch Roller
10. Trip Latch Roller Support
11. Crank Shaft
12. Cranks
13. Prop Pin
14. Prop
15. Drive Shaft
16. Cam
17. Check Nut
18. Stop Plate
19. Spring Rod
20. Spring
21. Spring
22. Spring Guide
23. Stop Pin
24. Main Shaft Bearing
25. Cam Shaft Bearing

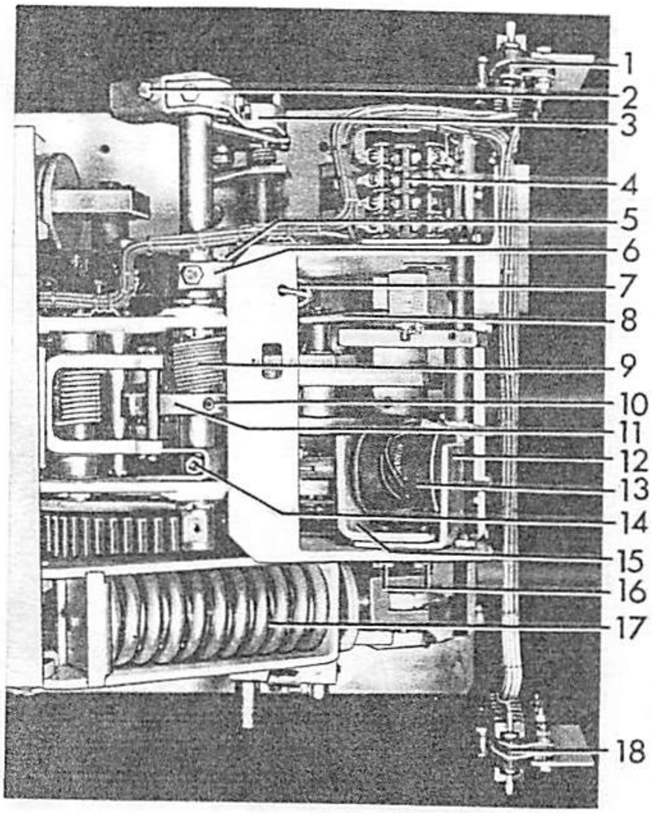


Fig. 9 (8037378) Bottom View of ML-13A Operating Mechanism

1. Secondary Disconnect
2. Trip Adjusting Nut
3. Manual Trip Lever
4. Auxiliary Switch
5. Latch Check Switch
6. Latch Check Switch Arm
7. Prop Spring
8. Auxiliary Switch Link
9. Trip Latch Spring
10. Latch Set Screw
11. Trip Latch
12. Trip Coil Support
13. Trip Coil
14. Trip Arm Screw
15. Trip Coil Support
16. Coil Mounting Bolts
17. Opening Springs
18. Secondary Disconnect

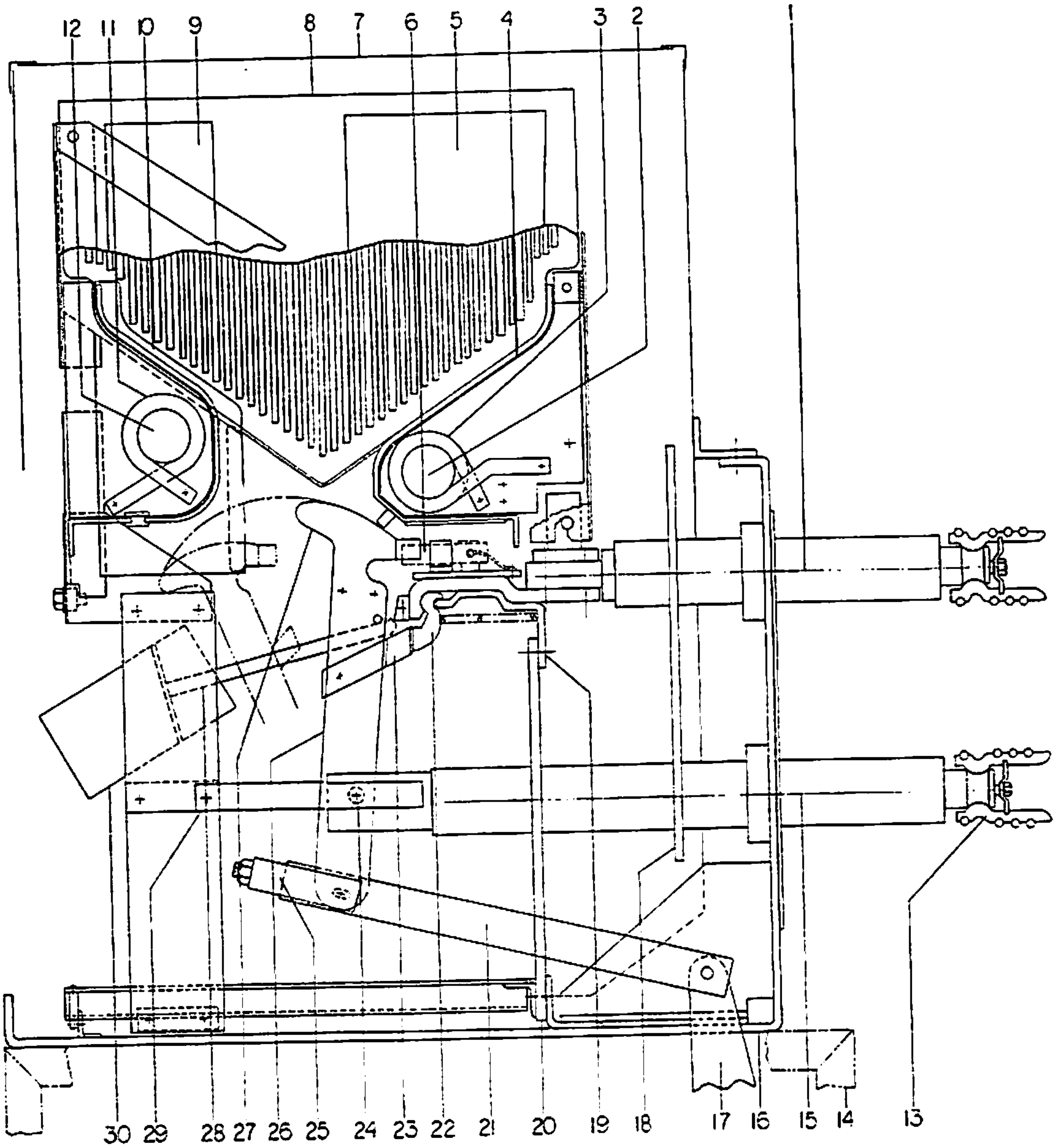


Fig. 10 (0121C8153) Cross Section of Breaker Pole Unit

1. Upper Bushing
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. Disconnect Fingers
14. Lower Frame
15. Lower Bushings
16. Frame
17. Operating Crank
18. Rear Vertical Barrier
19. Spring Retainer
20. Lower Vertical 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

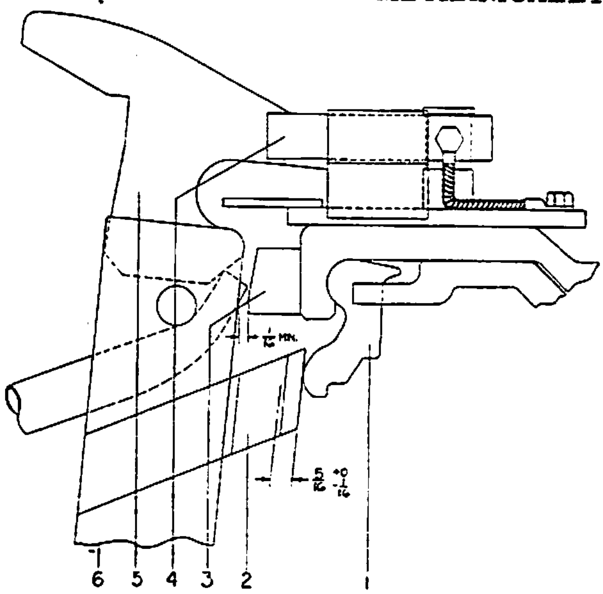
ADJUSTMENTS

All adjustments should be checked 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 after removing the top cover and box barrier from the breaker.

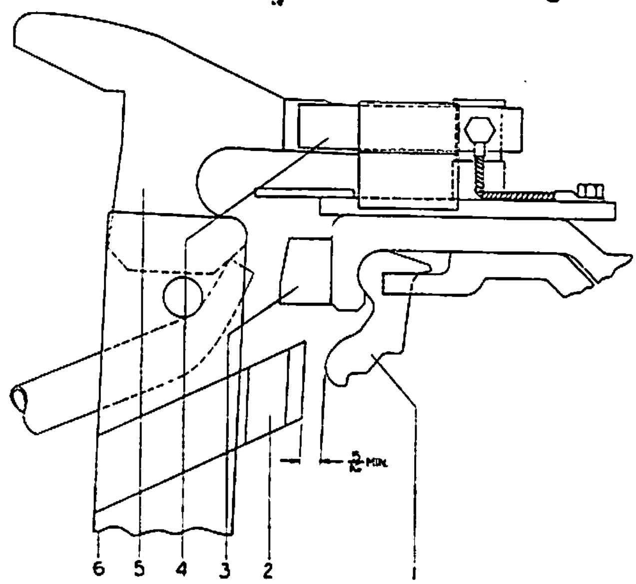
DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING.

Arcing Contact Wipe

Refer to Figure 11. 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 indicator 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

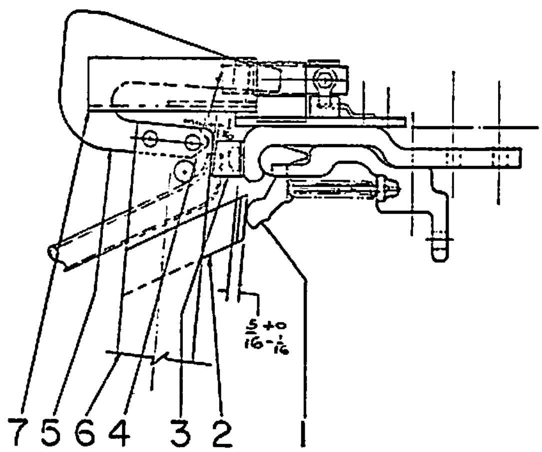


Primary Contact Wipe

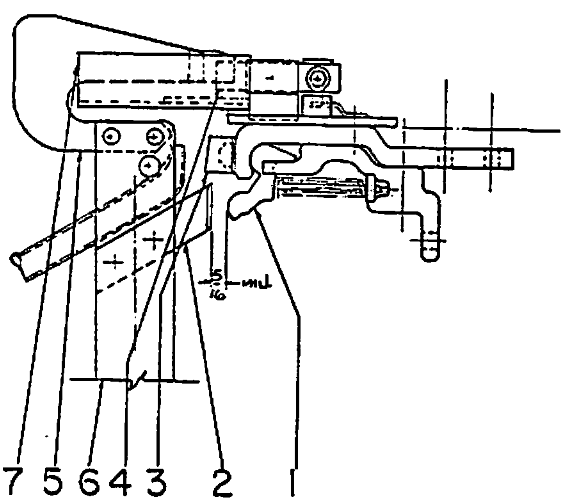


Arcing Contact Wipe

Figure 11A. "-OD" Contact Structure (0121C8152)



Primary Contact Wipe



Arcing Contact Wipe

Figure 11B "-1D" Contact Structure (0132C2794)

Figure 11 Contact Adjustments

1. Stationary Primary Contacts
2. Movable Primary Contacts
3. Buffer Block
4. Stationary Arcing Contacts
5. Movable Arcing Contacts
6. Contact Arm
7. Throat Baffle

made in the factory and no adjustment is provided. A wipe of less than 5/16" is an indication that the arcing contacts need to be replaced. When making this check, see that the movable arcing contact (5) passes between the probes on the upper arc runner without touching. On the "-1D" design, also check for clearance between the arcing contact (5) and the slot in the throat baffle (7) during entire stroke of the moving contact assembly.

Primary Contact Wipe

Refer to Figure 11, when the breaker is closed the stationary primary contacts (1) should rise from 1/4" to 5/16". Before checking this dimension be sure the mechanism is re-set so that the prop pin (13) Figure 8 is resting on the prop. To obtain the proper contact adjustment, open the breaker and, referring to Figure 12, loosen the check nut (13) and turn the adjusting nut(12). Screwing the adjusting nut toward the operating rod (11) will decrease the primary contact wipe, toward the end of the stud (14) 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 (6) Figure 11 and the buffer block (3) should be 1/16" or greater when the breaker is fully closed.

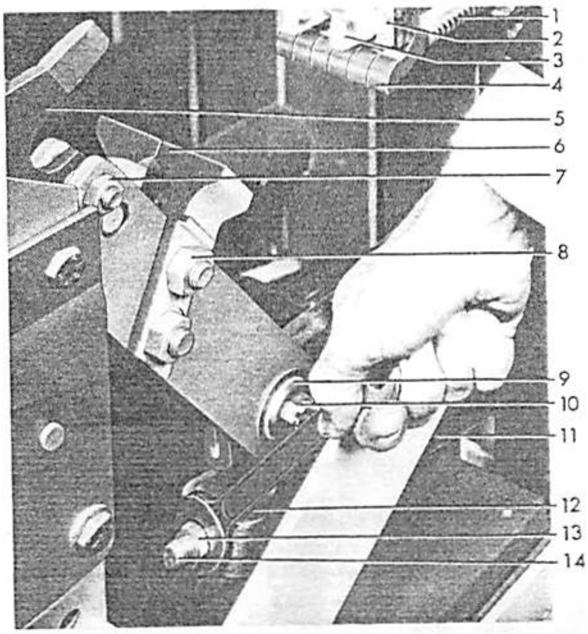


Fig. 12 (8037374) Primary Contact Adjustment

1. Contact Spring
2. Buffer Retainer
3. Buffer Block
4. Stationary Primary Contact
5. Movable Arcing Contact
6. Movable Primary Contact
7. Arcing Contact Bolts
8. Primary Contact Bolts
9. Cupped Hinge Washer
10. Hinge Nut
11. Operating Rod
12. Adjusting Nut
13. Check Nut
14. Operating Rod Stud

Primary Contact Gap

Refer to Figure 12. 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 (4) and the movable primary contact (6) measured between the closest points, should be 3-5/8" to 3-15/16". To change this gap, loosen the check nut (17), Figure 8, and turn the adjusting nut (18) on stud (19). Screwing the adjusting nut down will decrease the primary contact gap. Tighten the check nut and re-measure the contact gap (close and trip the breaker before checking the measurement). Whenever the primary contact gap is changed, the primary contact wipe should be rechecked and, if necessary, readjusted.

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

Trip Latch Wipe

Refer to Figure 8. The wipe of the trip latch (8) on the trip roller (9) should be from 3/16" to 1/4". This can be measured by putting a film of grease on the latch (8), closing the breaker part way, and tripping. The mechanism has the proper trip latch wipe when the latch rests against the stop pin (23). 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 (7).

Trip Armature Travel

Refer to Figure 8. The trip armature (4) should have 7/32" to 9/32" travel before the trip latch (8) starts to move. This can be adjusted by moving the trip coil support (2) and/or by adjusting the trip armature screw (14), Figure 9. A locking screw located behind the trip armature screw must first be loosened. Retighten locking screw after making adjustment.

Release Latch Wipe

Refer to Figure 4. The wipe between the release latch (14) and roller (8) should be 3/16" to 1/4". If re-setting is required, loosen, set, and retighten adjustment nut and screw (5).

Release Latch Monitoring Switch

Refer to Figure 4. The release latch must be fully re-set and the latch monitoring switch (20) operated before the motor will start. When the latch is fully reset the clearance between the switch striker arm and the switch mounting bracket (21) is 1/32" or less, this can be adjusted by bending the striker arm.

Motor and Relay Switches

Refer to Figure 4. With the closing springs blocked rotate the switch cam (9) until the switch striker (10) has traveled the maximum amount (about 180 degrees rotation of cam). At this point the clearance between the striker and the switch support (12) should be 1/32" or less. This can be adjusted by loosening the switch support mounting bolts (15) and rotating the support.

Interlock Switch Wipe

Refer to Figure 13. With the positive interlock in the reset, or normal position the clearance between the interlock switch arm (4) and the switch mounting plate should be 1/32" or less. This can be adjusted by bending the switch arm.

Driving Pawl Adjustment

Refer to Figure 5. The driving pawl must advance the ratchet wheel (7) sufficiently on each stroke to allow the latching pawls (3) to fall into the ratchet teeth. This should be checked with the closing spring load against the driving members. With the mechanism unblocked, hand charge the closing springs with the manual charging wrench until they are slightly more than half charged. Slowly rotate the charging wrench until the driving pawl has traveled through its return stroke and check the maximum clearance between the pawl and the ratchet tooth. Rotate the charging wrench until the driving pawl has advanced the ratchet tooth to its maximum travel. Now check the clearance between the ratchet tooth and the latching pawl. The clearance should be approximately equal for both the driving and latching pawls and not less than .015" in either case.

If adjustment is required for either pawl the springs must first be fully charged and blocked. Loosen seven motor support bolts (2) Figure 7 and move entire motor assembly down if the clearance is under the minimum at the latching pawls, and up if the clearance is under the minimum at the driving pawl. Move the motor assembly approximately twice the dimensional increase required at the pawl. Be certain the motor assembly is moved straight up or down and tighten the one bolt on the left of the mounting frame first to assure proper alignment. After tightening the remaining bolts the springs should be released and the clearance again checked as described above.

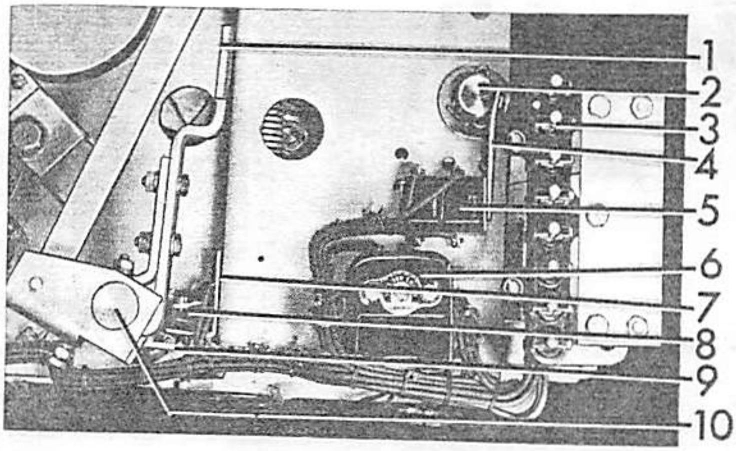


Fig. 13 (8037375) Interlock Switches

1. Manual Trip Lever
2. Interlock Shaft
3. Secondary Coupler
4. Interlock Switch Arm
5. Interlock Switch
6. Auxiliary Switch
7. Switch Support
8. Latch Check Switch
9. Switch Arm
10. Trip Shaft

AUXILIARY DEVICES

Latch Checking Switch

Refer to Figure 14. Charge the closing springs sufficiently to reset the mechanism linkage. Rotate the trip latch (4) by pressing the manual trip lever to open the latch checking switch (2). Allow the trip latch to reset slowly and determine the point at which the contacts are made by using a circuit continuity tester (light indicator, bell set, etc). The contacts of the latch checking switch should just make when the gap between the trip latch (4) and the stop pin (5) located on the latch roller link (7) is 1/16". There should be a minimum of 1/64" between the switch arm (3) and the switch support (1). To obtain adjustment of the latch checking switch, bend the latch checking switch arm (3).

Auxiliary Switch Operator

Refer to Figure 6. With the breaker in the closed position, the vertical distance "A" from the top of the roller on the crank (3) to the floor line should be 14-3/8" to 14-7/16". This adjustment is set and pinned at the factory and no adjustment is provided.

Inspection and Test

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

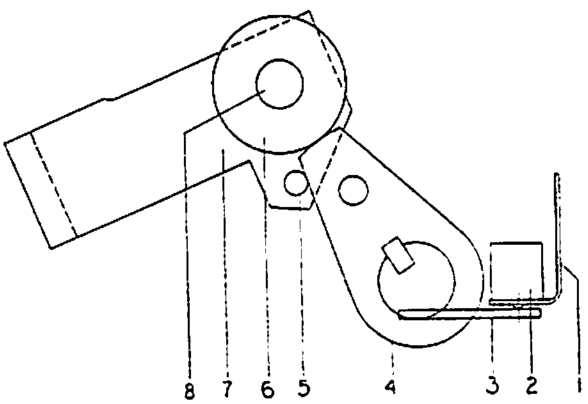


Figure 14 (0121C8152) Latch Checking Switch

1. Switch Support
2. Latch Checking Switch
3. Switch Arm
4. Trip Latch
5. Reset Pin Stop
6. Latch Roller
7. Latch Roller Link
8. Latch Roller Pin

   a. Primary contact wipe: 1/4" to 5/16".
   b. Arcing contact wipe: 5/16" or greater gap at primary contacts.
   c. Primary contact gap: 3-5/8" to 3-15/16".
   d. Trip latch wipe: 3/16" to 1/4" with trip latch resting against stop pin.
   e. Trip armature travel 7/32" to 9/32".
   f. Release latch wipe: 3/16" to 1/4".
   g. Release latch monitoring switch: Maximum clearance 1/32".
   h. Motor and relay switch: maximum clearance 1/32".
   i. Interlock switch: maximum clearance 1/32".
   j. Driving and Latching Pawl: minimum clearance to ratchet teeth .015".
   k. Latch checking switch contacts make when the gap between the trip latch and the stop pin is 1/16".
   l. Auxiliary switch operator - 14-3/8" to 14- 7/16".

2. Check all nuts, washers, bolts, cotter pins, and terminal connection 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. (Page 18 and Figure 16).

5. Operate the breaker slowly with the manual charging wrench 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 is repainted immediately.

7. Check the trip coil plunger and the release coil plunger to see that they move freely.

Opening and Closing Speeds

The closing speed of the arcing contact of the breaker should be a minimum of 11 feet per second. This represents the average speed of the movable arcing contact from a point 3" before the tip is tangent to the lower surface of the probes on the rear arc runner to the tangent position.

The opening speed of the arcing contact should be a minimum of 12 feet per second. This 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 probes on the rear runner. Proper servicing and lubrication of the breaker and its operating mechanism should maintain these speeds and no adjustment is provided.

Control Power Check

After the breaker has been operated several times with the manual charging wrench and the mechanism adjustments are checked as described, the operating voltages should be checked at the release coil, trip coil, and motor terminals. Control Power for electrical operation of the breaker may be from either an alternating or direct current source. The operating ranges for the closing and tripping voltages as given on the breaker nameplate, are as follows:

Nominal Voltage	Closing Range	Tripping Range
24v d-c	- -	14 - 30v d-c
48v d-c	34 - 50v d-c	28 - 60v d-c
110v d-c	80 - 115v d-c	60 - 125v d-c
125v d-c	90 - 130v d-c	70 - 140v d-c
220v d-c	160 - 230v d-c	120 - 250v d-c
250v d-c	180 - 260v d-c	140 - 280v d-c
115v a-c	95 - 125v a-c	95 - 125v a-c
230v a-c	190 - 250v a-c	190 - 250v a-c

If the closed circuit voltage at the terminals of the coil or motor does not fall in the specified range, check the voltage at the source of power and line drop between the power source and breaker.

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 or motor of each breaker must fall within the specified limits.

Electrical closing or opening is accomplished by 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 or close the breaker manually by pressing the manual trip lever (1) Figure 2 or the manual close button (6).

GENERAL MAINTENANCE

General

Safe and dependable service from electrical apparatus and power systems is contingent upon reliable performance of power circuit breakers. To obtain maximum reliability the breaker should be inspected and maintained on a regular schedule. The breakers are designed in accordance with applicable standards which require that they be capable of performing up to 5000 operations for 1200 ampere breakers and 3000 operations for 2000 ampere breakers switching rated continuous current before any replacement of parts should be necessary. This requirement is based on the breakers being serviced, or maintained, at least every 2000 operations, or once per year, whichever comes first. If the breaker is also required to interrupt fault currents during this period of time additional maintenance and replacement of parts may be necessary.

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

Periodic Inspection

The frequency of the inspection and maintenance operations required should be determined by each operating company and will depend on the application of the breakers and the operating conditions. Factors which should be considered are: Importance of the breakers to overall plant or system operation; number of operations and magnitude of currents switched by breaker; frequency of fault interruptions; and the atmospheric conditions in which the breaker normally operates. Extreme conditions of dust, moisture, corrosive gases etc., can indicate that inspection and maintenance will be required more frequently than every 2000 operations. Very clean dry operating conditions with low current switching duty can justify a longer period of time between inspections. Any time a breaker is known to have interrupted a fault at or near its rating it is recommended that the breaker be inspected and necessary maintenance be performed as soon after the interruption as is practical. The following instructions give the items that should be included in an inspection and general recommendations on the maintenance of breakers.

Interrupters

Since there are no moving parts, the interrupters of a magneblast breaker will normally require little or no inspection unless there is evidence of damage to the arc chutes sides or contamination in the throat area. If either of these conditions are present the interrupters should be removed from the breaker and the following points noted:

1. The throat area of the interrupter should be cleaned with sandpaper (Do Not use emery cloth or other metallic abrasives). All flat areas on either side of the movable arcing contact travel should be sanded. Do not sand or otherwise attempt to clean

the ceramic fins of the arc chute sides. Heavily contaminated parts should be replaced.

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 cracks do not interfere with the operation of the device in any way 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 will be necessary. Small broken corners on the exhaust end of the arc chute sides will not interfere with its performance and can be disregarded.

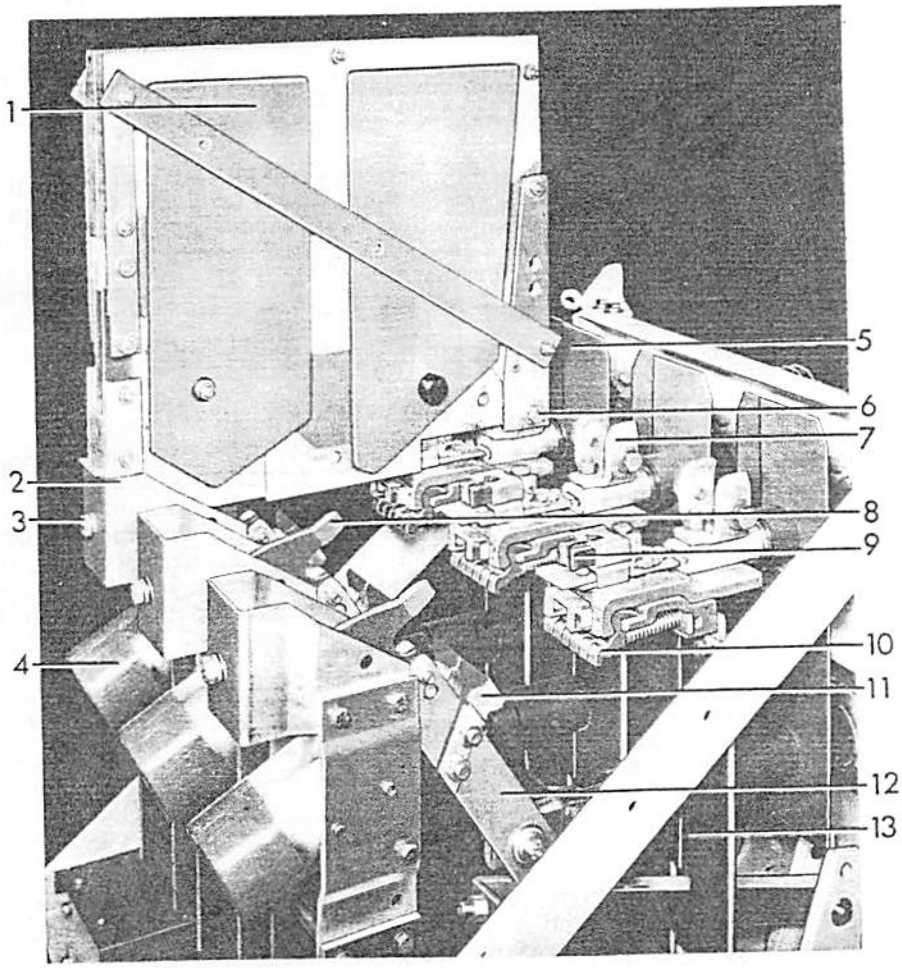
4. The plastisol flexible covering for the pole interrupter support (10) ahould be inspected for breaks in the insulation. If there are holes or breaks in the insulation they should be repaired or the part replaced.

Interrupter Removal And Replacement

To remove an interrupter, open the breaker contacts and remove the top cover and box barrier. Referring to Figure 15, loosen the two rear support bolts (6) and the one front support bolt (3) using a standard 3/4" wrench. Slide the complete interrupter assembly approximately 3/8" toward the rear and remove by lifting straight up.

To reassemble the interrupter to the breaker, lower the interrupter into the front support (2) and over the rear support (7). Slide the interrupter assembly toward the front making certain that the cut-out in the interrupter support engages the bolt (6). On the "-1D" design check to assure that the throat insulation (7), Figure 18 in the interrupter is properly positioned within the throat barrier extending from the stationary contact support (5), Figure 21.

Tighten the supporting bolts (3) and (6), Figure



1. Interrupter
2. Front Interrupter Support
3. Front Support Bolts
4. Booster Cylinder
5. Rear Vertical Barriers
6. Rear Support Bolt
7. Rear Interrupter Support
8. Movable Arcing Contact
9. Stationary Arcing Contact
10. Primary Finger
11. Movable Primary Contact
12. Contact Arm
13. Front Vertical Barriers

Fig. 15 (8037385) Interrupters partially removed showing accessibility of Arcing Contacts

15. These bolts serve as both the electrical and mechanical connections between the bushings and the arc runners within the interrupter. Check that the movable arcing contact (8) passes between the probes on the rear arc runner (5) Figure 18 without touching.

Breaker Contacts

By removing the top cover and 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 interrupter. If the contacts are burned or pitted, they can be made smooth with a fine file.

After completing inspection of the contacts, check the contact adjustments as specified under 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 manual charging wrench, 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 ADJUSTMENTS. Check the control wiring for tightness of connections and damaged insulation.

Bushings and Insulation

The surface of the 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 or clear resin. 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 in the metal clad switchgear to insure dryness.

Insulation Test

When insulation has been repaired or replaced, or when breaker has been operating in adverse moisture conditions, it is recommended that the insulation be checked before the breaker is placed back in service. A standard 60 hertz high potential test at 14,000 volts RMS for one minute will normally indicate whether the breaker is satisfactory for service. With the breaker contacts in the fully opened position, apply the test potential to each terminal of the breaker individually 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 repair or replace insulation that may have been affected by moisture absorption.

If the breaker secondary wiring is to be given a high potential test at 1500 volts, remove both of the motor leads from the terminal board. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

Lubrication

In order to maintain reliable operation, it is important that all circuit breakers be properly lubricated at all times. Most of the bearings and rolling surfaces utilize a new type of dry lubrication that will require no maintenance and will last the life of the equipment. Only few bearings and surfaces listed in the chart, Figure 16, require lubrication. These have been properly lubricated during assembly at the factory, using the finest grades of lubricants available. However, even the finest oils and greases have a tendency to oxidize with age, as evidence 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.

It is recommended that lubrication of the breaker and its operating mechanism be a part of the periodic inspection and maintenance program, with not more than a two year period between lubrications. It is also recommended that all circuit breakers be operated at regular intervals, at least once a year, to insure the lubrication is in good condition and the breaker is operable.

The lubrication chart, Figure 16, 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, and should be used when a general overhaul of the breaker is necessary.

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

METHOD OF CLEANING BEARINGS

Whenever cleaning of bearings is required, as indicated in the lubrication chart, the following procedures are recommended:

Sleeve Bearings

The sleeve bearings used throughout the linkage

PART	LUBRICATION AT MAINTENANCE PERIOD	ALTERNATE LUBRICATION (REQUIRES DISASSEMBLY)
Sleeve Bearings - links, trip shaft, etc. (Teflon coated bearings)	No lubrication required.	No lubrication required.
Sleeve Bearings - main crank shaft, driving pawl lever. (Bronze or cast iron)	Light application of machine oil SAE 20 or SAE 30.	Remove bearings or links clean per instructions and apply D50H15 lubricant liberally.
Contact Arm Hinge Assembly Cup bearing Loose rings between bushing and contact arm.	No lubrication required.	Wipe clean and apply D50H47.
Roller and Needle Bearings	Light application of machine oil SAE 20 or SAE 30.	Clean per instructions and repack with D50H15 lubricant.
Ground surfaces such as cams, ratchet teeth, etc. (Surfaces coated with M_oS_2)	No lubrication required.	No lubrication required.
Ground surfaces such as latches, rollers, prop, etc.	Wipe clean and apply D50H15 lubricant.	Wipe clean and apply D50H15 lubricant.
Silver plated contacts and primary disconnect studs.	Wipe clean and apply D50H47.	Wipe clean and apply D50H47.
Booster Cylinder	Do not Lubricate.	Do not lubricate.
Arcing Contacts	Do not Lubricate.	Do not lubricate.

Figure 16 Lubrication Chart

utilize Teflon surfaces and do not require lubrication. After a number of operations, the surface will acquire a thin black film. Do not remove this film unless there is evidence of outside contaminates, such as dry or hardened grease. If contaminants are present they should be removed by immersing the link and bearing in clean petroleum solvent, or similar cleaner, and using a stiff brush. Do not remove the bearings from the links. DO NOT USE CARBON TETRACHLORIDE.

The hinge of the primary contact arm (22) Figure 21, should be disassembled, cleaned, and lubricated with G-E D50H47 lubricant at general overhaul periods.

The main shaft bearings (24) Figure 8 and the bearings in driving pawl lever (6) Figure 7, should be removed, cleaned, and lubricated with G-E D50H15 lubricant at general overhaul periods.

Roller and Needle Bearings

Refer to Figure 8. The cam follower bearings (6), latch roller bearing (9), and cam shaft bearings (25) should be removed from the mechanism and the inner race disassembled. They should then be placed in a container of clean petroleum solvent or similar cleaner. DO NOT USE CARBON TETROCHLORIDE. 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 inductive 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 inner races should then be assembled.

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. 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 the light oil, draining and repacking with lubricant D50H15 should follow immediately.

Bearings that are pressed into the frame or other members such as the motor support (4) Figure 7, should not be removed. After removing the shaft and inner race the bearing can be cleaned satisfactorily with petroleum solvent or a similar cleaner and a stiff brush. Follow the procedure outlined above using a light machine oil and G-E lubricant D50H15 before reassembling the inner race and shaft.

Rolling Surfaces

A number of rolling and rubbing surfaces in the mechanism have been lubricated with a baked-on dry, molybdenum disulfide coating. This lubrication, which can be recognized by its dark, almost black color (e.g. Face of switch cam (9) Figure 4) requires no maintenance and should last the life of the breaker.

Other rolling or rubbing surfaces that are not lubricated with molybdenum disulfide should have the dried, dirty grease removed and a thin film of fresh lubricant D50H15 applied.

MAINTENANCE

Magne-Blast breakers used for switching arc furnaces or capacitors will require more frequent and more detailed inspection and maintenance because of the repetitive nature of the applications. The following schedule is recommended for such breakers:

A. Every 500 Operations, or Every Six Months-Whichever Comes First:

1. Remove the top cover and box barrier.

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

3. All flat parts in the throat area of the interrupters should be thoroughly cleaned by using sandpaper. This cleaning should be performed any time the interrupter is removed. The fins on the arc chute sides should not be cleaned. Whenever the interrupter is removed, loose dust and dirt should be blown out before replacing arc chutes. Throat insulation which is heavily contaminated should be replaced.

B. Every 2000 Operations, or Every Six Months Whichever Comes First:

1. In addition to the servicing done each 500 operations, the following inspection should be made and work done when required.

2. Primary Contacts (19 and 20 Figure 21). 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 rough-

ened or galled, they should be smoothed with crocus cloth or draw filed. After contact dressing the primary contacts should be greased lightly with D50H47.

3. Arcing Contacts (2 and 7 Figure 21). 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 interrupters for this 2000 operation servicing unless inadequate wipe or contact condition indicate a need for replacement. If the interrupters are removed, the contact braids, and other parts subject to arcing should be checked for possible cleaning or replacement. Do not grease the arcing contacts under any circumstances.

4. Check the breaker and mechanism adjustments as summarized under INSPECTION AND TEST. The necessary readjusments should be made as described under ADJUSTMENTS.

5. 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.

6. The contacts of the control relay (12) Figure 3, should be inspected for wear and cleaned if necessary.

7. Lubricate the breaker operating mechanism in accordance with instructions under LUBRICATION, page 18 and the lubrication chart Figure 16.

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

9. After the breaker has been serviced, it should be operated manually 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 position or the test couplers.

C. After Every 10,000 Operations:

1. In addition to the servicing done each 2000 operations, the interrupters should be removed from the breaker and disassembled to permit a detailed inspection of insulation, blow-out coils, arc runners and assemblies which can become contaminated by arc products.

2. 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.

3. 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.

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

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

6. Any parts damaged or severely burned and/or eroded from arc action should be replaced.

NOTE: Fine cracks may develop on 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.

7. The cup bearing (23) Figure 21 and the contact ring at the hinge point of the contact blade should be disassembled, inspected, cleaned, and relubricated with G-E contact lubricant D50H47. The contact ring should be inspected for wear and replaced when reduced in thickness to less than 1/32". When reassembling the cup bearing, be sure the cotter pin is properly assembled in the castle nut on the hinge pin (24). This assures proper contact pressure at the hinge.

D. Every 20,000 Operations or Approximately Every Five Years - Whichever comes first:

1. The breaker should be given a general inspection and overhaul as required. All excessively worn parts in both the mechanism and breaker should be replaced. Such wear will usually be indicated when the breaker cannot be adjusted to indicated tolerances. This

overhaul and inspection is more detailed and will require disassembly of mechanism and breaker operating parts.

2. All roller and needle bearings in the operating mechanism should be disassembled, cleaned, and repacked with G. E. lubricant D50H15 as described under LUBRICATION.

3. The stationary primary contact fingers (19) Figure 21, should be disassembled and the silver-plated pivot area of the contact and contact support cleaned and lubricated with G-E. lubricant D50H47.

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

REPAIR AND REPLACEMENT

This section covers the proper method of removing and replacing those parts of the breaker subject to damage and wear that may require repair or replacement at the installation. 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.

In general, repair work can be accomplished with the removal of the top cover and box barrier only. However, when it is necessary to remove the side covers and front cover, they should be removed as an integral unit. When re-assembling, the dowel pins will reposition the covers to assure satisfactory alignement within the metal-clad unit.

ARC CHUTE (to inspect or replace blow-out coils and arc runners):

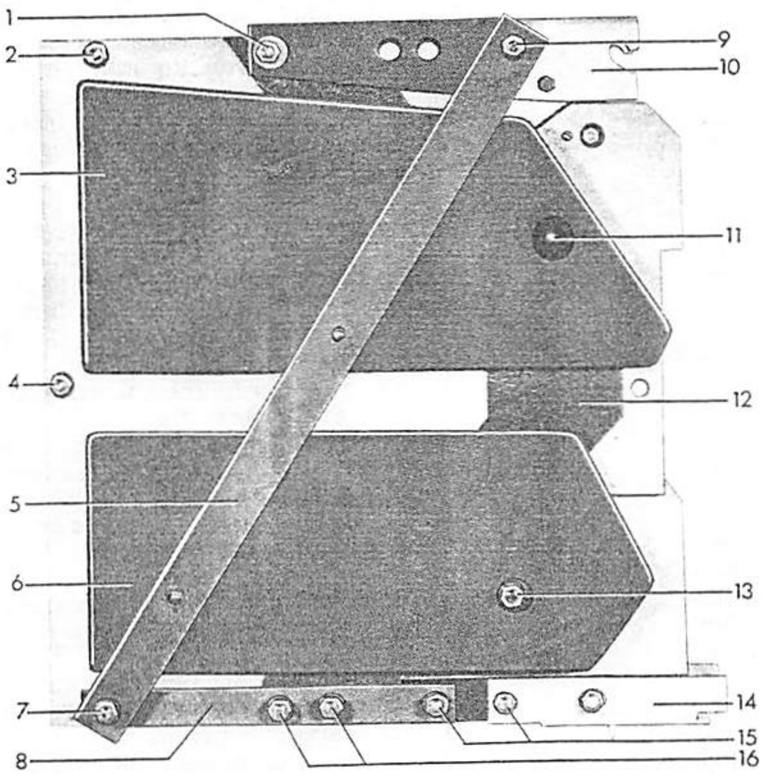
With the breaker open and the closing springs in the blocked position, remove the top cover and the box barrier (7), Figure 10. The interrupter can now be removed as described under REMOVAL AND REPLACEMENT page 17.

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

NOTE: When disassembling the arc chute and its components some small washers, spacers, etc., will be found that cannot be identified in these instructions. Care should be taken to collect and identify these items so they can be reassembled correctly.

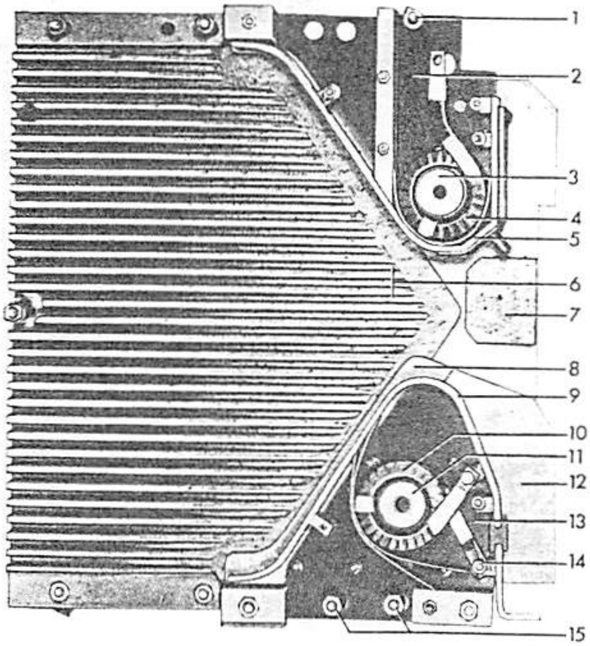
1. Remove the caps and assembly bolts (7, 9, 11, & 13), Figure 17.

2. Remove the side brace (5), and pole pieces (3 & 6).



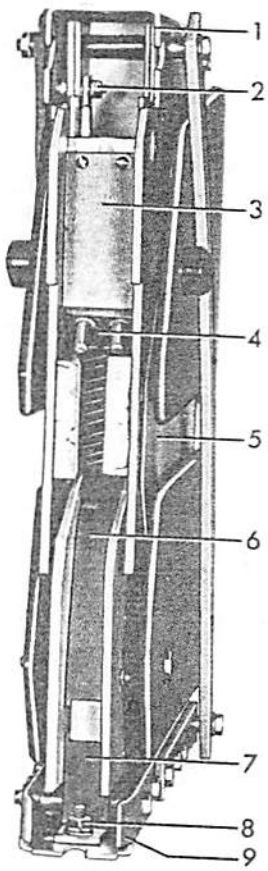
1. Assembly Bolts and Bushing
2. Assembly Bolts
3. Rear Pole Piece
4. Assembly Bolt
5. Side Brace
6. Front Pole Piece
7. Assembly Bolt
8. Front Brace
9. Assembly Bolt
10. Rear Interrupter Support
11. Insulating Cap
12. Side Shield
13. Assembly Bolt
14. Front Interrupter Support
15. Assembly Bolts
16. Assembly Bolts

Fig. 17 (8039601) Interrupter Assembly



1. Rear Arc Runner Spacer
2. Rear Arc Runner Assembly
3. Blowout Core
4. Blowout Coil
5. Rear Arc Runner
6. Arc Chute Side
7. Throat Insulation
8. Front Runner Shield
9. Front Arc Runner
10. Blowout Coil
11. Blowout Core
12. Front Insulation
13. Front Arc Runner Assembly
14. Front Coil Connection
15. Front Arc Runner Spacers

Fig. 18 (8039603) Interrupter Assembly with Side Removed



1. Rear Mounting Support
2. Connection Bolt
3. Insulation Plate
4. Rear Arc Runner Assembly
5. Side Shield
6. Front Arc Runner Assembly
7. Front Coil Connection
8. Connection Nut
9. Front Mounting Support

Fig. 19 (8039604) Interrupter Assembly

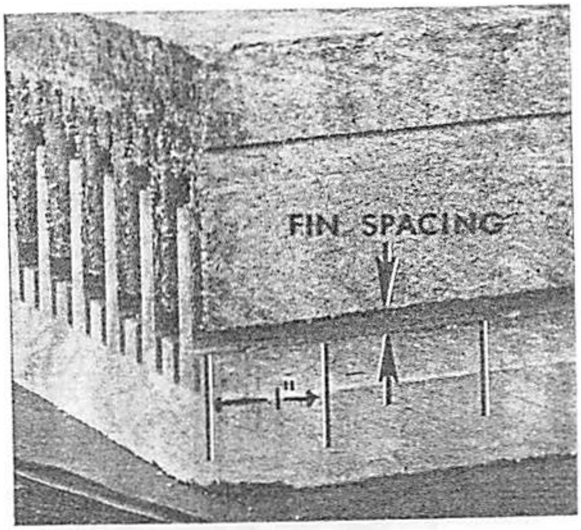


Fig. 20 (8029373) Arc Chute Fin Spacing

3. To remove the rear interrupter support (10) remove the assembly bolt (1), and the bolted connection (2) Figure 19 between the rear interrupter support and the blowout coil.

4. Remove the assembly bolt (16), Figure 17 to remove the front brace (8).

5. Remove the front interrupter support (14) by removing the assembly bolts (15) and the connection nut (8), Figure 19.

6. At this point, the side shields (12), Figure 17, and the arc runner assemblies (4 & 6), Figure 19 can be removed.

7. Further disassembly of both the rear and front arc runner assemblies can be done by removing the various screws and assembly bolts (not illustrated) as shown in Figure 18.

8. The arc chute sides (6) Figure 18, can also be separated for inspection after removing assembly bolts (2 & 4), Figure 17.

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

1. The fins of the arc chute sides should be equally spaced and aligned before bolting together. The front edge (along the runner) of the two arc chute sides should be parallel and in line.

2. The gap between the fins at the rear of the arc chute sides measured at least 1" in from the back end of the arc chute (See Figure 20) should be 1/64" to 3/32".

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

4. When reassembling the arc runner assemblies, check that the spacers are correctly installed.

5. Before bolting the rear supports in place, make certain that the rear arc runner assembly is tight against the arc chute side so that the gap between the throat insulation (7), Figure 18, and the arc chute sides (6) is a minimum.

6. Make certain that the electrical connections (2 & 8), Figure 19 are tight.

Reassemble the arc chute on the breaker as described under INTERRUPTER REMOVAL AND REPLACEMENT, page 17.

CONTACTS

Open the breaker and remove the top cover, box barrier, and interrupters as previously described. To remove the contacts, proceed as follows:

A. Stationary Arcing Contacts (2), Figure 21.

1. Disconnect the contact braids (4) from the contact fingers by removing two bolts and locking plates (14).

2. Grasp the front end of the contact fingers with pliers and pull contact assembly forward to remove from stud assembly.

3. To disassemble braids from stud plate remove one bolt (13).

4. To disassemble stud plate from contact support, remove two bolts (3).

5. Reassemble in the reverse order, make sure locking plates are properly reassembled with bolts (14).

B. Movable Arcing Contact (7) Figure 21.

1. Remove the assembly bolts (8) making note of quantity and location of shims and spacers used between contacts and contact arms.

2. Reassemble in reverse order, re-using the shims and spacers.

3. Close the breaker slowly to check that the movable arcing contact is approximately centered on the stationary arcing contact and that it does not rub on either side of the throat

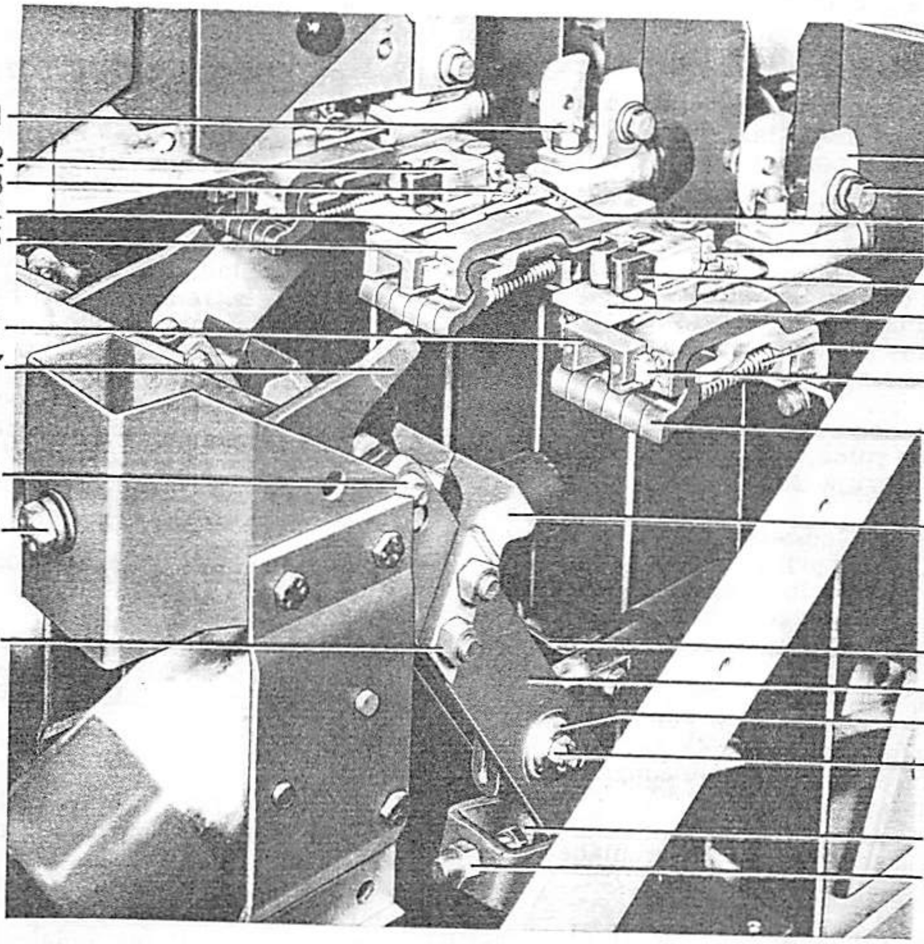


Fig. 21 (8037373) Contact Assembly

1. Bolts for Contact Support
2. Stationary Arcing Contact Asm.
3. Mounting Bolt
4. Flexible Braid
5. Contact Support
6. Buffer
7. Movable Arcing Contact
8. Assembly Bolts
9. Front Support Bolt
10. Assembly Bolts
11. Rear Interrupter Support
12. Rear Support Bolt
13. Bolt for Flexible Braids
14. Connection Bolt
15. Arcing Contact Finger
16. Insulation Plate
17. Contact Spring
18. Buffer Retainer
19. Stationary Primary Contact
20. Movable Primary Contact
21. Connection Bar
22. Contact Arm
23. Cup Bearing
24. Hinge Pin and Nut
25. Operating Rod
26. Adjusting Nut

barrier (7) Figure 11.

NOTE: Whenever it is found necessary to replace arcing contacts on any pole of a breaker it is recommended that both the stationary and movable contacts on that pole be replaced at the same time.

C. Stationary Primary Contacts (9), Figure 22.

1. Compress the contact spring (6) by use of the spring compressor.

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). Remove one contact finger at a time.

To replace the Stationary Primary Contacts:

1. Apply a thin coating of D50H47 grease on the hinged edge of the finger (9) then place it on the contact support (7) so that it is retained by stop plate (8).

2. Open spring compressor (3) and assemble spring guide, spring and spring compressor (Figure 22A).

3. Turn nut (2) in clockwise direction to compress contact spring (Figure 22B). Hold spring firmly in yoke on spring compressor to prevent 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 cutout in primary finger (Figure 22C).

5. Hold spring assembly, firmly in place and remove spring compressor.

D. Movable Primary Contacts (20), Figure 21.

To replace the movable primary contacts on a 1200 ampere breaker proceed as follows:

1. Disassemble nuts from assembly bolts (10) and remove the movable primary contacts (20).

2. Reassemble in reverse order.

To replace the movable primary contacts on a 2000 ampere breaker it is first necessary to disassemble the movable arcing contacts, then proceed as follows:

1. Disassemble operating rod pin, first noting quantity and location of washers in the assembly.

2. Pry contact arms (22) apart enough to disengage pivot pins of piston assembly (28), Figure 10, allowing piston to drop down into its booster cylinder.

3. Rotate the two parts of the contact arm assembly away from each other so accessible and movable primary contacts (20) can be removed.

4. Reassemble in reverse order.

E. Contact Arm Assembly (7, 20, 22, Figure 21).

1. Remove connection bar (21).

2. Disassemble hinge pin (24), cup bearing (23), and operating rod pin noting quantity and location of any washers and spacers used in assemblies.

3. The contact arm assembly including the piston assembly (28), Figure 10 can now be removed.

4. When reassembling, first insert piston tube assembly into the booster cylinder and reassemble the cup bearing, making sure the silvered contact washers between the bushing and contact arms (both sides) are in place.

5. Reassemble operating rod pin and connection bar (21).

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

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 insure interchangeability of the breakers in the metal-clad units. 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 reinstalled in the same location.

However, it is 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 deenergized spare metal-clad unit before tightening the bushing mounting bolts. This must be done before the interrupters are reinstalled.

To replace the bushing, proceed as follows:

Upper Bushing

1. Open the breaker and remove the top

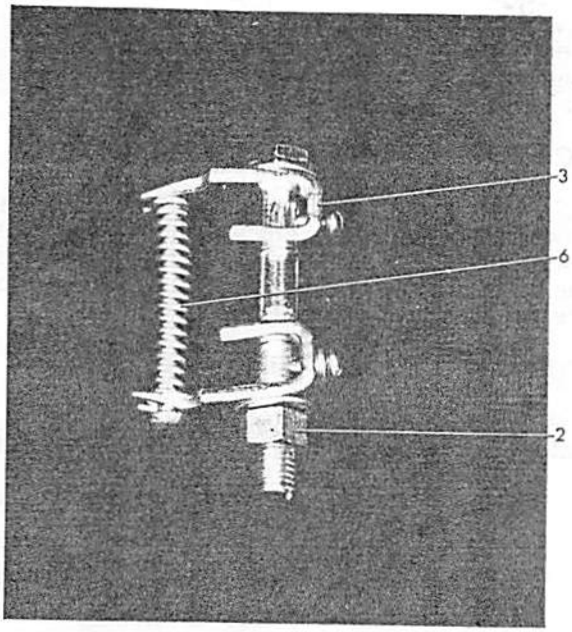


Figure 22A (8034466)

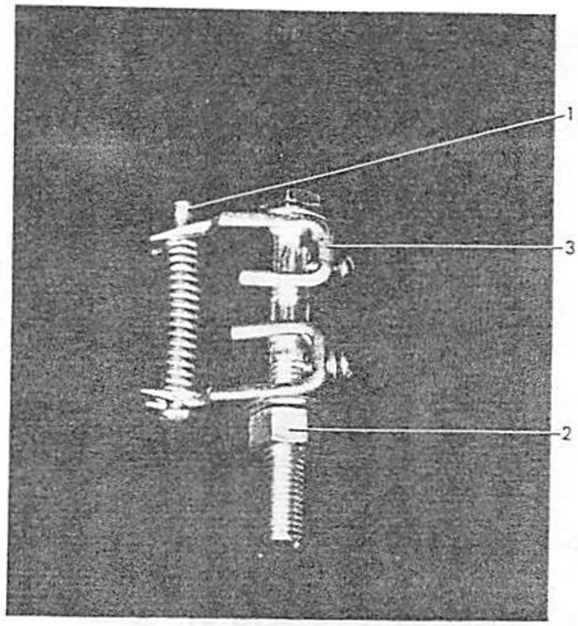


Figure 22B (8034465)

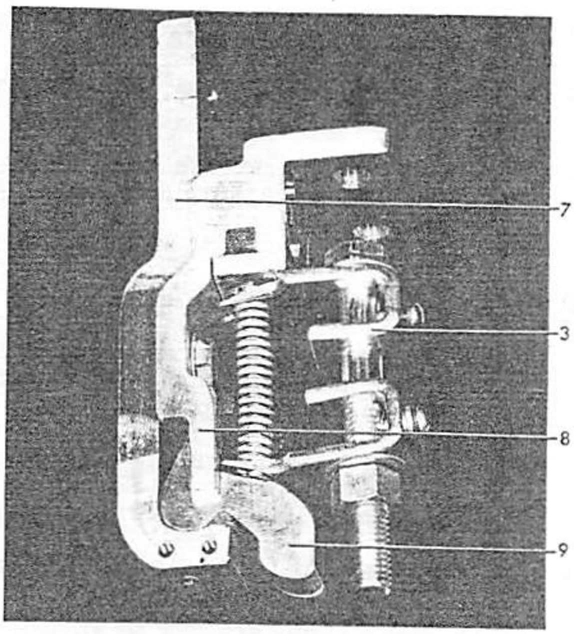


Figure 22C (8034469)

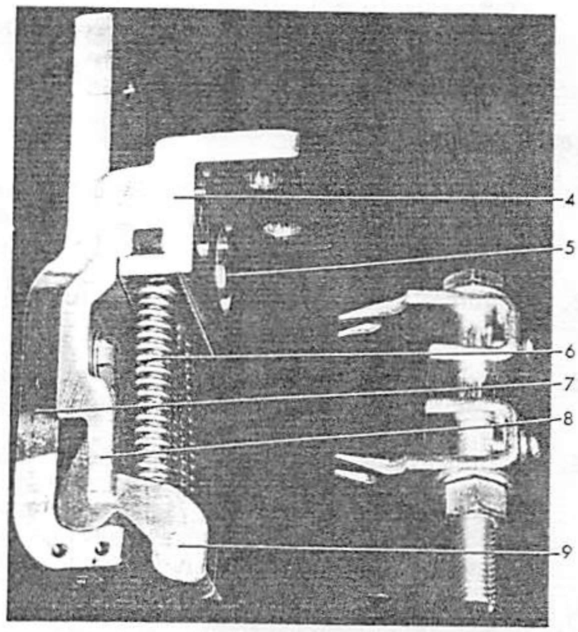


Figure 22D (8034468)

Figure 22. Method of Installing Primary Contact Springs Using a Spring Compressor

1. Spring Guide
2. Compressor Nut
3. Spring Compressor
4. Spring Retainer
5. Assembly Bolts
6. Spring
7. Contact Support
8. Stop Plate
9. Stationary Primary Finger

cover, box barrier, and interrupters as already described.

2. Remove the vertical barriers (5 and 13), Figure 15.

3. Remove the four bolts at the mounting flange of the top bushing being removed and move the bushing assembly toward the front of the breaker.

   NOTE: Shims may be found between the breaker mounting plate and the bushing mounting flange on some, or all bolts. These shims are for squaring up the bushing and may be required when new bushings are assembled.

4. Referring to Figure 22, disassemble the primary contact springs (6) as previously described.

5. Disassemble the spring retainer (4) by removing mounting bolts (5).

6. Referring to Figure 21, disassemble the contact support (5) and interrupter mounting bracket (11) removing two bolts (1).

7. Reassemble in the reverse order. The interrupter mounting bracket (11) is not symmetrical and must be assembled correctly to orient the interrupter properly on the breaker. The longest projection of the bracket should be toward the front end of the bushing.

Lower Bushing

1. Open the breaker and remove the top cover, box barrier, and interrupters as already described.

2. Remove the vertical barriers (5 and 13) Figure 15.

3. Remove the connection bar (21), Figure 21, cup bearing (23), and hinge pin (24).

4. Remove the four bolts at the mounting flange of the lower bushing being removed, and move the bushing assembly toward the front of the breaker. (See note under rear bushings concerning use of shims).

5. When reassembling, first mount the bushing and assemble the cup bearing (23), contact arm (22), and replace pin (24) being sure the silvered contact washers between the bushing and contact arms are in place. The contact surfaces at the hinge point of the contact blade and bushing should have a thin coating of D50H47 grease.

6. Check all contact adjustments as outlined under ADJUSTMENTS.

INTERLOCK SWITCH

To remove the interlock switch (5), Figure 13, remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

LATCH CHECKING SWITCH

To remove the latch checking switch (8), Figure 13, (when furnished), remove the two mounting screws and disconnect the lead wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

MOTOR, RELAY AND LIGHT SWITCHES

Two or three switches (13) Figure 4, are mounted in tandem as required by the application.

1. Remove the opening spring per instructions below.

2. Remove (2) mounting bolts (11 & !%) from switch bracket (12).

3. Remove the (2) mounting screws of the lower switch.

4. Remove the (2) mounting screws of the center switch.

5. Remove the (2) mounting screws of the upper switch.

6. Disconnect the lead wires of switch to be replaced.

7. Reassemble in the reverse order and check switch adjustment as explained under ADJUSTMENTS.

TRIP SHAFT AND LATCH (See Figure 9)

1. Remove manual trip lever (3) and if furnished, the latch checking switch operating arm (6) from the trip shaft.

2. Disengage trip latch spring (9).

3. Remove three (3) cotter pins from trip shaft.

4. Remove trip arm screw (14) and trip latch set screw (10).

5. Place a block between the trip latch (11) and the right side of the mechanism frame. Drive the trip shaft to the right until the latch is free of the key, then remove the key.

6. Check for and remove any burrs raised around the keyway on the shaft to avoid damaging the trip shaft bearings.

7. Shaft, latch, etc., may now be removed by driving it to the right through the notch

in the angle of the lower frame. Note quantity and location of washers used as spacers in the assembly.

8. Reassemble parts in reverse order. Be sure trip latch is aligned in center of trip latch roller and that the latch spring is properly installed. Check latch adjustment as described under ADJUSTMENTS.

TRIP LATCH ROLLER BEARING

1. Remove (2) cotter pins at ends of trip latch roller shaft (8) Figure 14.
2. Partially remove shaft out right side of frame until latch roller (6) is free.
3. Reassemble in reverse order with proper spacing of washers. Be sure latch roller rotates freely.

CLOSING LATCH

1. Remove cotter pins at both ends of closing latch shaft (17) Figure 4.
2. Remove spring and paddle (18).
3. Remove set screws from latch (14).
4. Move shaft (17) to right (away from frame) by tapping lightly on the inside end of shaft. Rotate shaft and continue tapping until shaft is free. Shaft will push outside needle bearing from housing.
5. Reassemble in reverse order putting bearing into frame last. Use a small piece of tubing or pipe when inserting bearing to assure proper alignment.
6. Check closing latch adjustments as described under ADJUSTMENTS.

MOTOR

1. To remove motor (11) Figure 3, first remove the cotter pin from the rear end of the treadle link (6), Figure 6. Rotate link up to clear motor.
2. Remove motor leads from the terminal board.
3. Remove four mounting bolts from motor (not shown).
4. Reassemble the motor in the reverse order and re-align it properly as described under DRIVING PAWL ADJUSTMENTS.

CAM

1. Remove 2 set screws from ratchet wheel (7) Figure 5 and remove wheel from main shaft (6).
2. Remove 2 set screws from switch cam (9) Figure 4 and remove cam from the main shaft.
3. Remove prop reset spring (7) Figure 9.
4. Remove 2 set screws from cam (16), Figure 8, and move cam to the right on the shaft as far as it will go. Slide the shaft to the left until key is fully exposed. Remove key and check shaft for burrs.
5. Remove shaft out left side of frame.
6. Reassemble in reverse order using the correct number of washers and spacers to properly locate the parts.
7. Rotate the mechanism through a closing operation using the manual charging wrench. Check the location of the cam follower (6), Figure 8, on the cam (16) If necessary, move the cam to correct the alignment. Complete the closing operation and check the location of the prop pin (13) on the prop (14). It should be approximately centered.

TRIP COIL

To replace the potential trip coil (13), Figure 9, proceed as follows:

1. With the breaker in the open position, remove the two mounting bolts (16).
2. Remove trip coil support (12) and spacers.
3. Cut wires at the butt connectors and remove coil.
4. When replacing the coil be sure to assemble the correct fiber spacers at the ends before bolting support (12).
5. Adjust coil location to allow approximately 1/4" of armature travel before latch starts to move.
6. Butt connect wires and check operation of solenoid electrically and mechanically.

SPRING RELEASE COIL

To remove the spring release coil (22) Figure 4, proceed as follows:

1. Block the closing springs as described in INSTALLATION.
2. Remove the right hand closing spring as described in CLOSING SPRINGS below.
3. Remove two mounting bolts, coil support (23), and spacers.
4. Cut wires at the butt connectors and remove coil.

5. Replace the coil and the correct number of fiber spacers before bolting support.

6. Butt connect wires and check that the armature is not binding. Check coil for electrical operation.

CLOSING SPRINGS

The closing springs (10) Figure 3, can be removed as follows:

1. Charge the springs with the manual charging wrench and apply the special short blocking pins (13) supplied in the tool kit. Insert pin so that it is centered in the spring support.

2. Discharge springs by pushing manual close button (6) Figure 2.

3. Rotate cam shaft (6) Figure 5, by using the manual charging wrench until the gap between the spring (11) and the bearing block (8) is a maximum (approximately 3").

4. Remove cotter pin and washer from spring guide pin and remove closing spring (11) and upper spring guide (8) as a unit.

5. Either discharge the opening springs by pushing the manual trip lever or block the opening springs with a suitable blocking device.

OPENING SPRINGS

To remove the opening springs (5) Figure 5, proceed as follows:

1. Charge and block the closing springs as described under INSTALLATION.

2. Push manual trip lever (1) Figure 2, to be sure the opening springs are fully discharged.

3. Remove rear pin (2) Figure 5, and front pin (9).

4. After reassembling springs check the open gap at the primary contacts as described under PRIMARY CONTACT GAP.

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 minimize service interruptions caused by breakdowns, and saves time and expense. When continuous operation is a primary consideration, more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

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

NOTE: The listed terms "Right" and "Left" apply when facing the front or panel 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., are not listed and should purchased locally.

4. For prices, refer to the nearest office of the General Electric Company.

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

In the following tabulations are listed those parts of the breaker and operating mechanism which are usually recommended for stock for normal maintenance. Other parts can be obtained by contacting the nearest office of the General Electric Company.

RECOMMENDED RENEWAL PARTS FOR

TYPE ML-13A STORED ENERGY MECHANISM

USED FOR AMH-4.76-250-0D & 1D, 1200 & 2000 AMPERE

Fig. No.	Ref. No.	No. Req'd.	Description	Catalog No.
3	11	1	Spring Charging Motor - **	
			48 V-DC	0105C9393P001
			110 & 125 V-DC & 115 V-AC, 60 Hz	0105C9393P002
			220 & 250 V-DC & 230 V-AC, 60 Hz	0105C9393P003
3	12	1	Relay - **, #	
			48 V-DC	0137A7575P004
			110 & 125 V-DC	0137A7575P001
			220 & 250 V-DC	0108B1978G001
			115 V-AC, 60 Hz	0137A7575P005
			230 V-AC, 60 Hz	0137A7575P002
9	13	1	Potential Trip Coil - **	
			110 & 125 V-DC	006174582G001
			220 V-DC	006174582G015
			250 V-DC	006174582G002
			115 V-AC, 60 Hz	006174582G013
			230 V-AC, 60 Hz	00 6174582G032
			24 V-DC	006275070G001
			48 V-DC	006275070G002
4	22	1	Spring Release Coil - **	
			110 & 125 V-DC	006174582G001
			220 V-DC	006174582G015
			250 V-DC	006174582G002
			115 V-AC, 60 Hz	006174582G010
			230 V-AC, 60 Hz	006174582G014
			48 V-DC	006275070G002
4	13	5	Switch, Normally Open	0456A0866P005
4	13	1	Switch, Normally Closed	0456A0866P006
9	4	1	Auxiliary Switch	0137A9192G003
4	18	1	Closing Latch Spring	0161A4231P001
9	7	1	Prop Spring	0137A9252P001
*		1	Driving Pawl Spring	0161A4241P001
5	3	2	Latching Pawl Spring	0161A5909P001

* Not Illustrated

** Refer to breaker nameplate or summary for proper voltage rating.

\# Quantity Two (2) relays required on special control circuits. Check breaker and connection diagram.

RECOMMENDED RENEWAL PARTS FOR MAGNEBLAST BREAKERS

TYPE AMH-4.76-250-0D & -1D, 1200 & 2000 AMPERES

Fig. No.	Ref. No.	Ampere Rating	Catalog No. For Type AMH-4.76-250 -0D	-1D	No. Req"d.	Description
10	13	1200	0195A4091G001	0195A4091G001	6	Primary Disconnect Fingers
10	13	2000	0195A4091G002	0195A4091G002	6	Primary Disconnect Fingers
10	21	ALL	0137B7902G001	0137B7902G001	3	Operating Rod Assembly
10	28	1200	0213X0343G043	0213X0343G090	3	Tube & Piston Assembly
10	28	2000	0213X0343G044	0213X0343G091	3	Tube & Piston Assembly
21	2	ALL	0236C0790G009	0236C0790G009	3	Arcing Contact Assembly
21	4	ALL	0236C0791G001	0236C0791G001	3	Flexible Connector (Left)
21	4	ALL	0236C0791G004	0236C0791G004	3	Flexible Connector (Right)
21	7	ALL	0802B0742G001	0108B5506G001	3	Movable Arcing Contact
21	16	ALL	0414A0116P004	-	3	Insulating Plate
21	17	ALL	0121A5964P001	0121A5964P001	18	Primary Contact Finger Spring
21	19	ALL	0114C5382P002	0114C5382P002	18	Primary Contact Finger
21	20	ALL	0114C5382P004	0114C5382P004	6	Movable Primary Contact
17	11	ALL	000421711P001	000421711P001	6	Insulating Cap
17	11	ALL	000407193P001	000407193P001	6	Threaded Washer (For Insul. Cap)
18	7	ALL	0108B1965G001	0195A7377G001	3	Throat Insulation (Left)
18	7	ALL	0108B1965G002	0195A7377G002	3	Throat Insulation (Right)
18	8	ALL	0161A5906P001	0161A5906P001	6	Front Runner Shield
18	12	ALL	0114C5381P001	0114C5381P010	6	Front Insulation
19	3	ALL	0114C5381P004	0414A0116P002	3	Insulating Plate
*		ALL	0836C0197P014	0836C0197P014	6	Rear Runner Insulation
11	7	ALL	–	0195A7388G002	3	Throat Barrier Assembly

* Not Illustrated

NOTES

NOTES

GENERAL ELECTRIC SALES OFFICES

READY TO ASSIST YOU ... When You Have Electrical Problems ... Need Further Information ... Require Ordering Instructions

KEY TO SALES OPERATIONS

A - Agency & Distributor
C - Components Sales
I - Industrial Sales
M - Marine & Defense Facilities Sales
U - Electric Utility Sales

ALABAMA
A C I U Birmingham 35205 ... 2151 Highland Ave.
I Huntsville 35801 .. 3322 Memorial Pkwy S.
A I Mobile 36606 ...... 1111 S. Beltline Hwy.
A Montgomery 36107 .... 513 Madison Ave.

ARIZONA
A C I U Phoenix 84012 ..... 3550 N. Central Ave.
A I U Tucson 85711 .... 40 No. Swan Rd.

ARKANSAS
A C I N. Little Rock 72119 .... 120 Main St.
U Pine Bluff 71602 .... P. O. Box 1033

CALIFORNIA
C Burlingame 94010 ..... 1815 Rollins Rd.
A I Emeryville 94608 .... 5000 Shellmound St.
A I Fresno 93728 .... 1532 N. West Ave.
C Los Angeles 90015 . 1543 W. Olympic Blvd.
A I M U Los Angeles 90054 .... 212 N. Vignes St.
A U Sacramento 95808 .... 2407 "J" St.
A M U San Diego 92103 .... 2560 First Ave.
A I M U San Francisco 94106 .. 235 Montgomery St.
A Santa Clara 95050 1400 Coleman Ave.

COLORADO
A C I U Denver 80206 ..... 201 University Blvd.

CONNECTICUT
I U Hamden 06518 .... 2905 Dixwell Ave.
A C U Hartford 06105 ...... 764 Asylum Ave.

DISTRICT OF COLUMBIA
I M U Washington 20005 .... 777-14th St., N. W.

FLORIDA
A M Cocoa Beach 32931 .. 1325 N. Atlantic Ave.
A I U Jacksonville 32207 ... 4040 Woodcock Dr.
A U Miami 33134 ...... 4100 W. Flagler St.
A Orlando 32803 ... 601 N. Fern Creek Ave.
U Pensacola 32502 .... P. O. Box 1027
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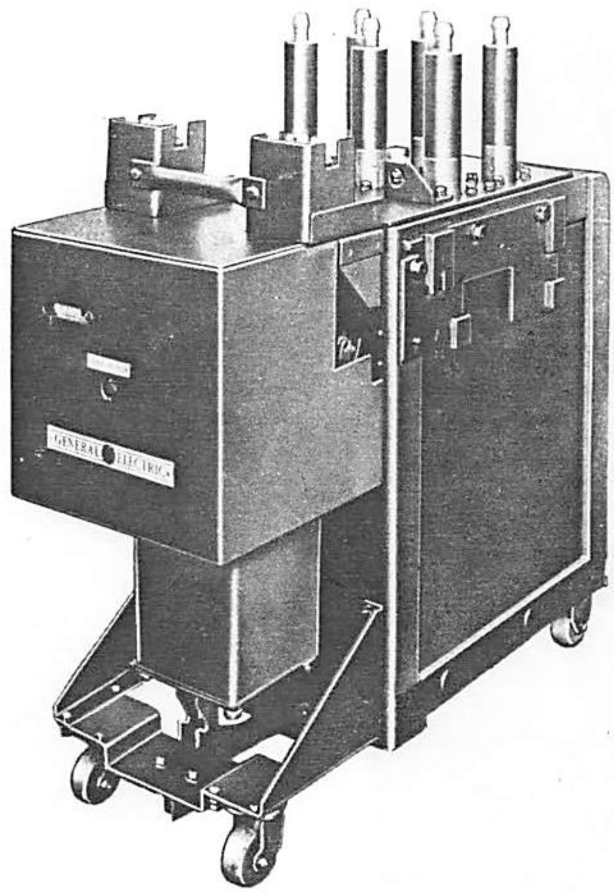
GEI-23903C

INSTRUCTIONS *Switchgear*

POWER CIRCUIT BREAKERS



Magne-blast Breaker Types AM-5-50-4 and AM-5-50-5 With MS-9 or MS-9-1 Mechanism

GENERAL ELECTRIC

CONTENTS

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.

MAGNE-BLAST AIR CIRCUIT BREAKER
TYPE AM-5-50-4 AND AM-5-50-5
WITH MS-9 MECHANISM

INTRODUCTION

The Magne-blast Air Circuit Breaker shown on the cover is a triple pole single throw breaker with integral operating mechanism and is arranged for application in Vertical Lift Metal-Clad Switchgear.

The Am-5-50-4 Breaker is available in 1200 ampere current rating only, the AM-5-50-5 breaker is available in 600 ampere current rating only. These breakers are designed for application at a maximum circuit voltage of 5000 volts. Within the published interrupting current range, these breakers have an interrupting capacity of 50,000 KVA on a duty cycle basis consisting of two closing-opening operations with a time interval of 15 seconds between them.

The Breaker-Mechanism combinations is designed only for electrical closing and the Maintenance Closing Lever is supplied only for use in making adjustments. NEVER ATTEMPT MANUAL CLOSING WITH THE BREAKER IN SERVICE, for under such conditions, sufficient closing force and speed cannot be applied.

RECEIVING, HANDLING AND STORAGE

RECEIVING

Each Circuit Breaker is carefully inspected and then is packed by workmen experienced in the proper handling of electrical switchgear.

Immediately on receipt of a Circuit Breaker, an examination should be made for any damage sustained during shipment. If injury or rough handling is evident, a damage claim should be filed at once with the Transportation Company, and the nearest General Electric Company's Sales Office should be notified promptly.

HANDLING

The breaker should be removed from the crating with sufficient care so that no damage will result from rough handling. It frequently happens that "loose parts" associated with the apparatus are included in the crate. Care should be taken to make certain that these parts are not overlooked.

After the Breaker has been removed from the crating, the brace and steel hooks, holding the Box Barrier in position, should be removed and discarded.

STORAGE

It is advisable that the Breaker be set up immediately, but if it must be stored, it should be kept in a clean dry place, free from corrosive gases or fumes. During construction work, particular care should be taken to protect this apparatus from moisture and cement dust as this combination has very corrosive effects on many parts. All machined parts except those on the contacts should be coated with heavy oil or grease to prevent rusting.

DESCRIPTION

The Magne-blast Air Circuit Breakers, listed on the cover with MS-9 or MS9-1 Mechanism may be seen in a cut-away view on Fig. 5.

It is composed of a solenoid operated mechanism bolted to a fabricated frame; six herkolite bushings with ball ends for good contact and easy installation in Vertical Lift Metal-Clad Switchgear; three operating rods of insulating material; three movable contact arms with primary and arcing contacts three stationary contact blocks and rear arc runner assemblies, containing the blow-out coils which are mounted on the back bushings; three front arc runners mounted on the arc chutes; three molded plastic "boosters" which supply air for aiding in the interruption of low currents; and three arc chutes of arc-resisting and insulating compound which segregate the three interrupting units.

INSTALLATION

Outline, wiring and all other drawings relating to dimensions electrical connections and control should be on hand so that points in question are readily settled as they arise. Before any installation work is done, consult these drawings and the Instruction Book for the "Metal-Clad Switchgear".

The complete Breaker Mechanism unit has already been assembled, adjusted, inspected, and tested at the factory in accordance with the detailed adjustments listed under the section OPERATION. It is possible, however, that unusually rough handling or transportation may have caused some loosening or disturbance of the apparatus to warrant a rechecking and in some cases, readjustment.

Before proceeding, the following precautions should be noted:

PRECAUTIONS

Make certain that all Control Circuits have been de-energized.

Make certain that the Primary Breaker Circuits are open and effectively grounded.

Never work on either the breaker or mechanism while in the closed position unless the Prop and Trip Latch have been wired or blocked to prevent accidental tripping.

INSPECTION

1. Check all nuts, bolts, screws, and cotter pins to make certain that they are properly tightened.
2. Inspect all wiring and make certain that no damage was done during installation. Check all terminals, screws, and connections and test the circuits for possible short circuits or grounds.
3. Engage the pin through the end of the maintenance closing lever in the notched bracket under the mechanism (see Fig. 5) and push down on the end of the lever closing the breaker. With a screw driver (CAUTION: Keep the fingers clear of the linkage as accidental tripping or fast movement could cause severe injury) rotate the prop from under the closing roller pin with the maintenance operating handle pushed all the way down and then raise the handle to open the breaker. Operate in this cycle of slow close and slow open operation several times making certain that all parts are working freely.
4. Check the operating voltage for both the closing coil and trip coil to determine, if with line drop it is within the limits specified on the nameplate. In the case of a rectifier operated mechanism, the D.C. voltage across the coil terminals with full closing coil current flowing should be 100 volts. Adjustment is possible by means of the tap resistor in the rectifier A.C. line. For detailed description of this adjustment refer to Instruction Book on Copper Oxide Rectifiers for Circuit Breaker Closing Service.

OPERATION

After the breaker has been closed and opened slowly with the maintenance closing lever and the voltage supply for both the closing and the trip coils checked as described under Installation, check the following items:

1. The wipe of the primary contact.
2. The gap between the primary contact fingers and the movable primary contact block with the arcing contacts just touching.
3. The gap between the primary contacts with the breaker in the open position.
4. The latch wipe.
5. The prop clearance.
6. The latch clearance.
7. The plunger clearance.

All these dimensions are given under Adjustments.

The MS-9 solenoid mechanism is trip free and will operate satisfactorily over the standard ranges for closing and tripping voltages as discussed below.

For electrical operation, control power may be from either an Alternating or Direct Current source. In the case of Alternating Current, it is necessary to use a Copper-Oxide Rectifier to supply the Direct Current required by the closing coil.

Operating ranges are given on the mechanism nameplate. Ordinarily, standard ranges apply and are as follows.

STANDARD CLOSING AND TRIPPING VOLTAGE RANGE

Nominal Voltage	Closing Range	Tripping Range
125 V. DC.	90-130 V. DC.	70-140 V. DC.
250 V. DC.	180-260 V. DC.	140-280 V. DC.
220 V. AC.	180-240 V. AC.	180-240 V. AC.

PRINCIPLES OF OPERATION

The Magne-blast Circuit Breaker utilizes magnetic forces produced by the load current through the blow-out coils to interrupt the arc. These magnetic forces together with an air stream from the "boosters" drives the arc from the contacts out along the diverging arc runners into the "interleaving" arc chutes. The tapered fins that project alternately from the two opposite inner surfaces of the chute deflect the arc into a gradually deepening serpentine path. This lengthening and consequent cooling action rapidly increases the resistance of the arc to cause interruption. Hot exhaust gases are cooled while passing through the muffler at the end of the arc chute. Easily removable box barriers encase each phase separately, segregating the interrupting units and providing insulation between phases and from each phase to the grounded frame.

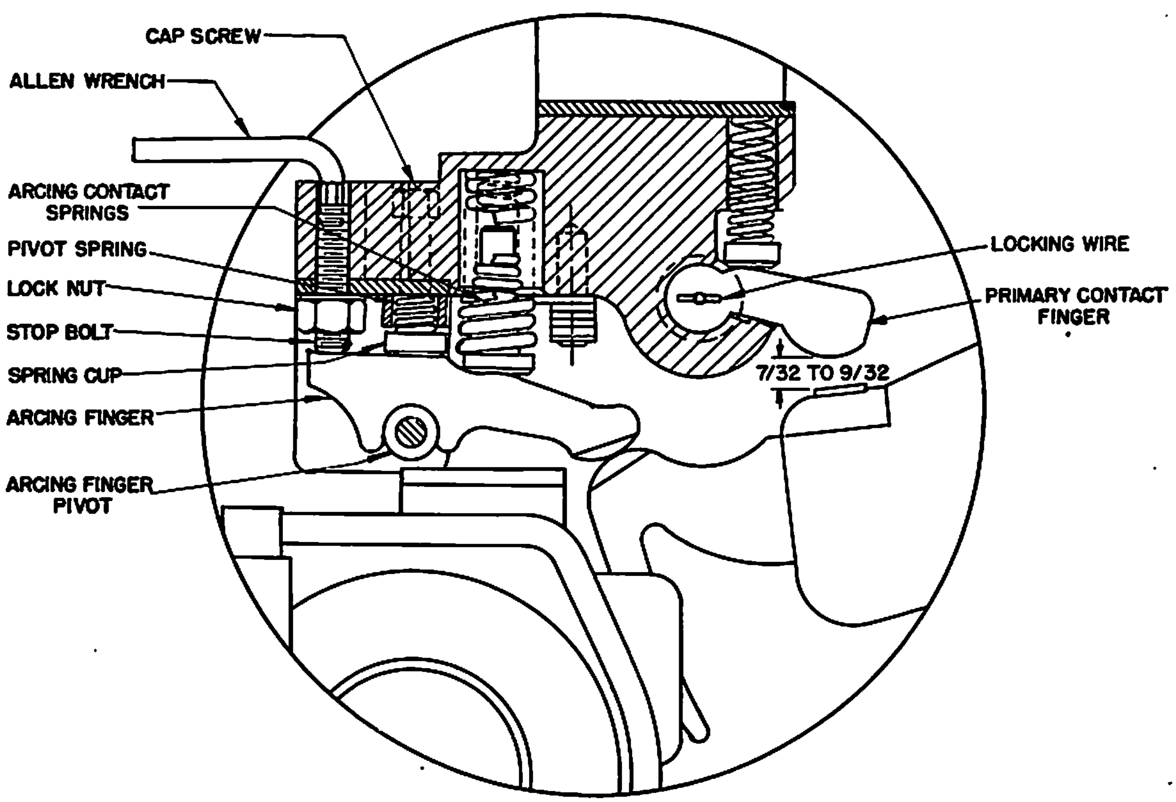
For the following closing, tripping and trip-free operations Fig. 5 may be consulted.

When the solenoid coil is energized, the armature is driven upwards and the plunger rod threaded into the armature raises the roller carried by the set of links fastened to the operating crank. This action rotates the crank and closes the breaker contacts. After the armature and linkage have reached the end of their travel, the prop rotates into position under each end of the pin through the roller and the mechanism is held in the closed position. The solenoid coil is de-energized by a relay which is actuated by the cut-off switch at the end of the armature stroke, and the armature is returned by gravity to its original position.

When the trip coil is energized, the plunger forces the latch off the roller causing the linkage to collapse which allows the opening spring to rotate the main crank and open the contacts. During the opening stroke, auxiliary switch contacts open to interrupt the trip coil circuit. After the breaker is open, the mechanism linkage returns to its normal position, and a spring resets the trip latch.

In case the trip coil is energized while the breaker is closing, the trip plunger forces the latch off the trip roller allowing the mechanism linkage to collapse and the breaker to reopen. The armature completes its closing stroke, however, and the coil is de-energized as in a normal closing operation.

When the breaker is tripped under load or short circuit conditions, the opening springs act to swing the contact arms downward, parting first the primary contacts, and then the arcing contacts. The arc is then transferred to the arc runners and, as described before, into the arc chutes where it is interrupted.



(K-6496371)

Fig. 1 Contact Assembly

ADJUSTMENTS

Adjustments described herein should be referred to not only during placement of breakers in service but also during periodic inspection of the breakers, and should be followed whenever it becomes necessary to repair or replace parts that have become worn or defective in service.

Instructions for the replacement of parts will be found under the later heading of Maintenance.

PRIMARY CONTACTS (Figs. 1 and 5)

With the breaker in the closed position, the top face of the primary contact fingers should be horizontal. This can be adjusted by means of the operating rod adjusting screw. To adjust, remove the pin fastening the adjusting screw to the mechanism crank and push the contact blade far enough closed so the adjusting screw can be turned. To increase the primary contact travel, turn the adjusting screw in the direction to lengthen the rod, and to decrease the primary contact travel, turn the screw to shorten the rod ($\frac{1}{2}$ turn gives approximately 1/32" change in contact travel). Reconnect the operating rod to the crank, and close the breaker manually to check the adjustment.

After the above adjustment has been made, the travel of the contact surface of the primary contact finger should be measured on a manual closing operation. This travel or wipe should be 1/8" or over. If enough material has been removed from the primary contacts, to reduce this travel below 3/32", the primary contacts should be replaced.

ARCING CONTACTS (Fig. 1)

Close the breaker until the arcing contacts just touch. The gap at the primary contacts should be 7/32" to 9/32". To adjust, the following procedure should be followed: -

(a) Remove the arc chute.

(b) Loosen the lock nut on the arcing contact stop bolt.

(c) With Allen wrench, turn the stop bolt until the arcing contacts just touch when the gap at the primary contacts is 7/32" to 9/32".

(d) Lock the stop bolt in position with the locknut, and close the breaker manually to check the adjustment.

(e) Replace the arc chute.

CONTACT GAP (Figs. 1 and 5)

With the breaker tripped from the closed position, the minimum distance from the primary contact fingers to the contact surface of the contact blade should be 4". At the same time, the clearance between the underside of the contact blade and the top of the booster cylinder should be at least 3/8" to 3/4". To adjust for these conditions, remove the cotter pin from the mechanism stop nut and turn the stop nut to increase or decrease the contact gap. If the old cotter pin hole cannot be used for the cotter pin to positively lock the stop nut, a new hole should be drilled. After the cotter pin has been replaced, the breaker should be closed and tripped and the adjustment checked. Note: A change in this adjustment may require a change in the adjustment of the plunger rod in the mechanism as described later.

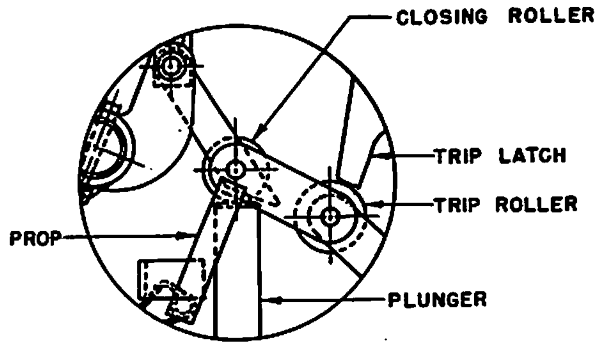


Fig. 2 Mechanism Linkage Closed Position

Latch Wipe (Fig. 2)

The wipe of the latch on the trip roller should be from 1/8" to 1/4". This can be determined easily by putting a film of grease on the latch, closing the breaker part way, and tripping. To adjust, add or remove washers under the head of the stop bolt located near the top of the latch on the trip coil frame.

Prop Clearance (Fig. 3)

With the breaker closed as far as possible with the manual handle, the clearance of the pin through the closing roller over the prop should be 1/32" to 3/32". This can be adjusted by dropping the closing coil and screwing the plunger rod into or out of the armature. Note: Two set screws are used to lock the plunger rod in position in the armature. If the rod adjustment is changed the rod must be spotted in the correct position and the set screws replaced.

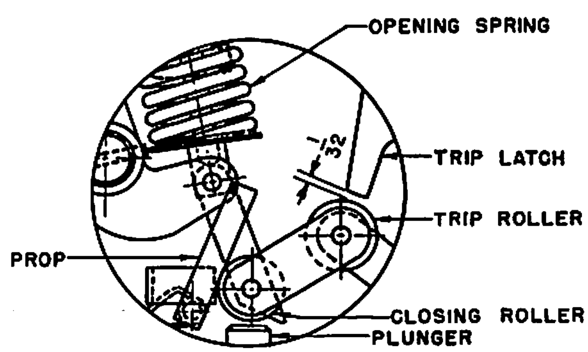


Fig. 3 Mechanism Linkage Open Position

Latch Clearance (Fig. 3)

The clearance between the trip latch and roller with the breaker open should be approximately 1/32". This can be adjusted by means of the stop bolt in the front of the mechanism frame near the bottom. The lock nut should be fastened securely if any adjustment has been made.

Plunger Clearance

With the breaker in the open position, there should be at least 1/8" clearance between the plunger and closing roller. To increase this clearance, the brackets to catch the armature in the open position should be lowered by placing a shim between them and the coil bottom plate.

After the foregoing items have been checked and any adjustments that may have been required are completed, the breaker may be placed in service.

MAINTENANCE

Dependable service and safety of power distribution equipment is based on the unfailing performance of the circuit breaker.

To maintain such service, it is recommended that a definite schedule be set up and adhered to for the purpose of properly lubricating the wearing parts. A dependable and observing attendant can be expected to forestall mishaps by reporting loosened nuts, scored surfaces, and other evidences of possible trouble.

In addition, but at less frequent intervals periodic inspection should be made at which time the apparatus should be given such servicing as may be found desirable or necessary. In case of highly repetitive operation it is recommended that the first Periodic Inspection be made after not more than 500 operations to determine whether there has been any loosening up of parts. The interval between later Periodic Inspections should depend on operating conditions and should be determined by experience.

PERIODIC INSPECTION

At this time a thorough inspection should be made of all parts of the breaker and mechanism.

Contacts

After removing the box barrier, the contacts on the two outside phases can readily be inspected. The contacts on the center phase can be seen with the aid of a mirror and flashlight. If the contacts are in good condition, there is no need of removing the arc chute. If, however, the surface of the contacts needs smoothing up with a fine file or sand paper, the arc chutes can be removed as described under the heading REPLACEMENT OF PARTS.

Arc Chute

If the arc chutes are removed for contact maintenance, and are for any reason disassembled for inspection, the following points should be noted:

1. Scale formed over the surface of the chute must not be removed but loose particles collected in the muffler 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 cracks do not interfere with the operation of the device in any way and should be disregarded. If the chute has had any mechanical injury due to dropping or accidental striking which has resulted in actual breaking off of fins, replacement of the chute is necessary.

Insulation Parts

The 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.

Bushings

The surface of the bushings should be smooth and unscratched. If the insulation surface should become damaged, it should be well cleaned and then re-touched with either 1170 clear varnish or 1202 (clear) or 1210 (brown) glyptal. Allow to dry smooth and hard.

Mechanism

Careful inspection should be made to check for loose nuts or bolts and broken cotter pins. The latch surface should be inspected for wear and the surfaces of the rollers should be inspected for chipping or other evidences of damage. Lubrication should be done in accordance with the instructions under the heading LUBRICATION.

LUBRICATION

During assembly at the factory, all wearing parts, bearing surfaces and all machined surfaces on both the breaker and mechanism have been coated with a film of medium soft lubricating and rust-resisting greases. At regular maintenance periods, apply a few drops of machine oil SAE-20 or 30 to bearings. Ground surfaces such as cams and rollers should be wiped clean and a thin coat of General Electric Lubricant D50H15 applied.

When the breaker is given a general overhaul or is disassembled, or when operation becomes sluggish, the following procedure should be followed: On bearings, the pins should be removed and all old oxidized grease cleaned off of parts by soaking in kerosene or similar cleaner. Do not use carbon-tetra-chloride. If the grease in the bearings has become badly oxidized, it may be necessary to use alcohol (the type used for thinning shellac) to remove it. Ordinarily, by swishing the bearing around and removing solid particles with a stiff brush, the bearings can be satisfactorily cleaned. After the bearings have been thoroughly cleaned, spin them in clean, light machine oil until the cleaner or solvent is entirely removed. Allow this oil to drain off and then repack immediately with General Electric Lubricant D50H15 being certain that all metal parts are greased.

General Electric Lubricant D50H15 is available only in cartons containing twelve collapsible tubes of grease. This is a total of three pounds of grease to the carton. It is so packaged to insure cleanliness and to prevent oxidation.

REPLACEMENT OF PARTS

Before maintenance or replacement of contacts, the arc chutes must be removed.

Arc Chute Removal (Fig. 5)

To remove the arc chutes, first loosen the two arc chute supporting bolts (one on each side of the chute) and remove the arc runner connection bolt. The arc chute is then free to be pulled away from the mechanism.

Primary Contacts (Fig. 5)

The primary contacts are designed to carry the normal load current with a minimum amount of heating and are provided with an inlaid block of silver to minimize the effects of wear. The stationary primary contacts consist of 4 fingers for the 1200 ampere breaker and are mounted along with the associated springs on the support casting carried by the rear bushing. The fingers may be replaced after removing the locking wire through the pivot end.

The movable primary contact is carried on the blade hinged at the front bushing. The arc chute must be removed (see section Arc Chute Removal) and the following steps should be followed for replacement of the contact blade: -

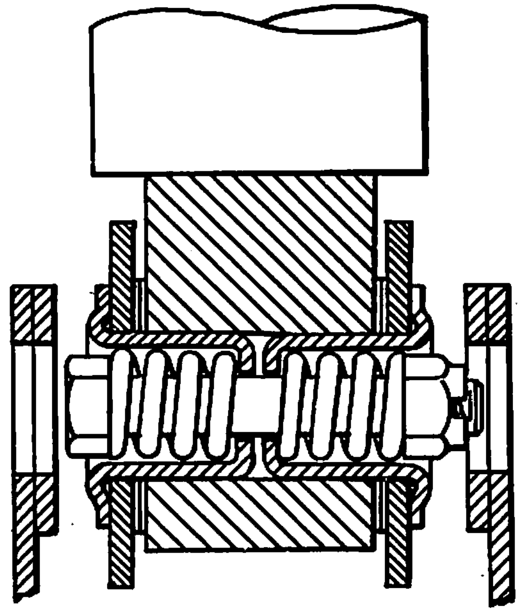
(a) Remove the bolt fastening the arc chute supporting bracket to the lower end of the front bushing, and remove the bracket.

(b) Disconnect the puffer tube and operating rod form the contact blade.

(c) At the blade hinge, remove the bolt, springs, spacers (only on 600 amp. breaker) and thimbles, see Fig. 4.

(d) Slip the contact blade off the end of the bushing and withdraw.

Reassemble the replacement parts making certain that all cotter pins are replaced. If a new hinge bolt has been used, or if it seems desirable for any other reason, the pressure at the hinge joint should be checked by measuring with a spring balance the force required to swing the contact arm. For both the 600 and 1200 ampere breakers, this force should be between 40 and 60 pound-inches.



(K-6496372)

Fig. 4 Contact Blade Hinge

Arcing Contacts

The movable arcing contact is bolted on the front of the contact block on the primary contact blade and is more convenient to replace with the contact blade removed.

The stationary arcing contact (see Fig. 1) is carried by the bracket fastened to the lower side of the rear bushing. To remove, take out the two Allen head cap screws from the top. To replace, the following steps should be followed:

(a) Remove lock nut and stop bolt.

(b) Place arcing finger on pivot pin.

(c) Place fibre spring cut on top of the arcing finger.

(d) Place pivot spring guide block in position on the underside of the top of the bracket.

(e) Insert spring through the top of the bracket, spring block and into the spring cup.

(f) Place the assembly on the underside of the bushing, and engage the cap screws one turn in the spring guide block.

(g) Insert the arcing contact springs and guide.

(h) Tighten the cap screws, and reassemble the stop bolt and lock nut.

The contacts should be adjusted as described previously under the section 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.

A complete list of renewal parts is contained in Renewal Parts Bulletin GEF-3391. Those parts subject to wear in ordinary operation and to damage or breakage due to abnormal conditions are marked as recommended renewal parts.

When ordering renewal parts, address the nearest General Electric Sales Office, specify the quantity required and give the catalog number from the Renewal Parts Bulletin.

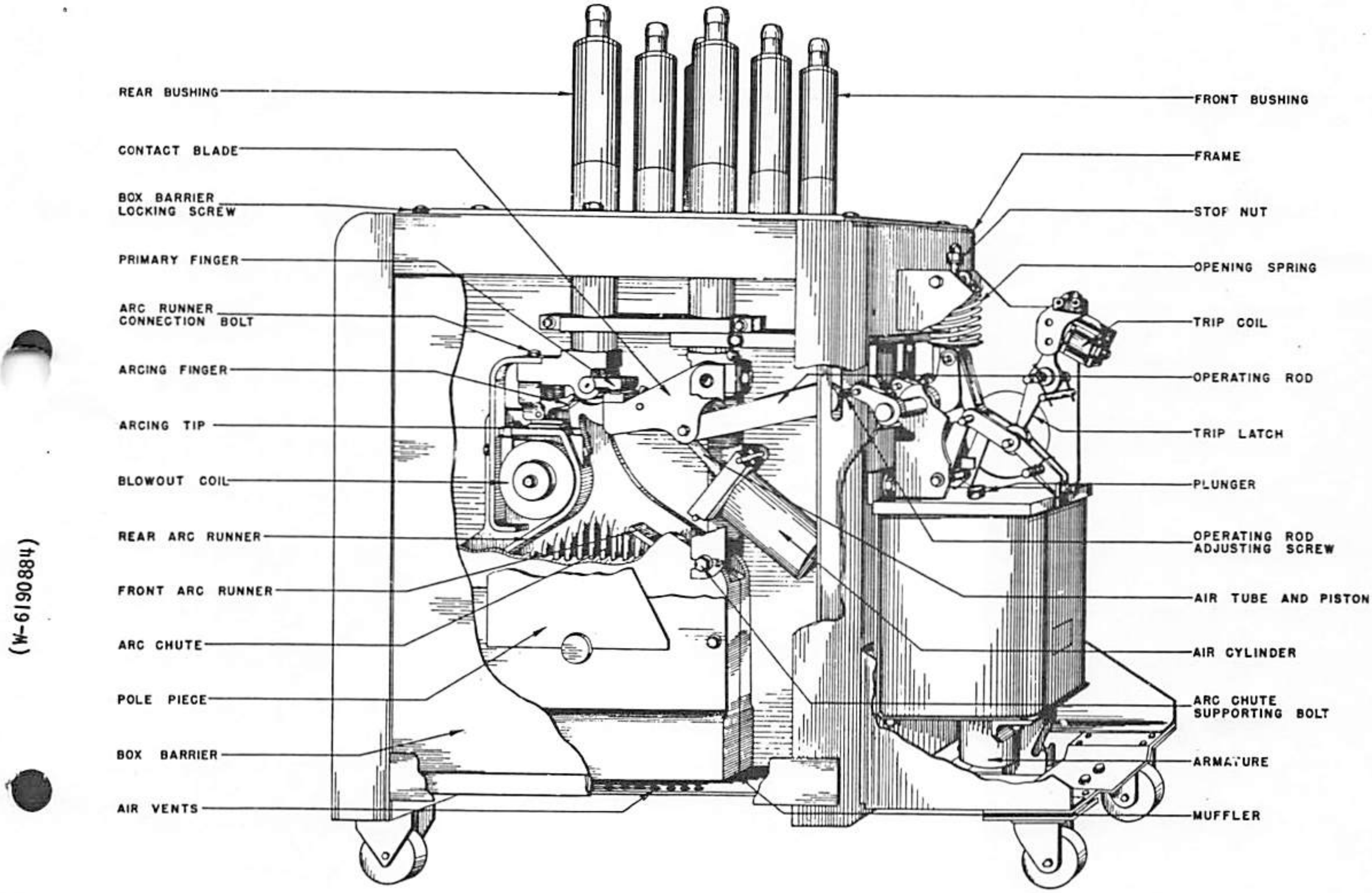


Fig. 5 Typical Magne-blast Air Circuit Breaker Type AM 5-50 With MS-9 or MS 9-1 Mechanism

INSTRUCTIONS

GEI-13532D
SUPERSEDES GEI-13532C

POWER CIRCUIT BREAKERS

MAGNE-BLAST AIR CIRCUIT BREAKERS

TYPES AM-5-100 AND AM-5-150

SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

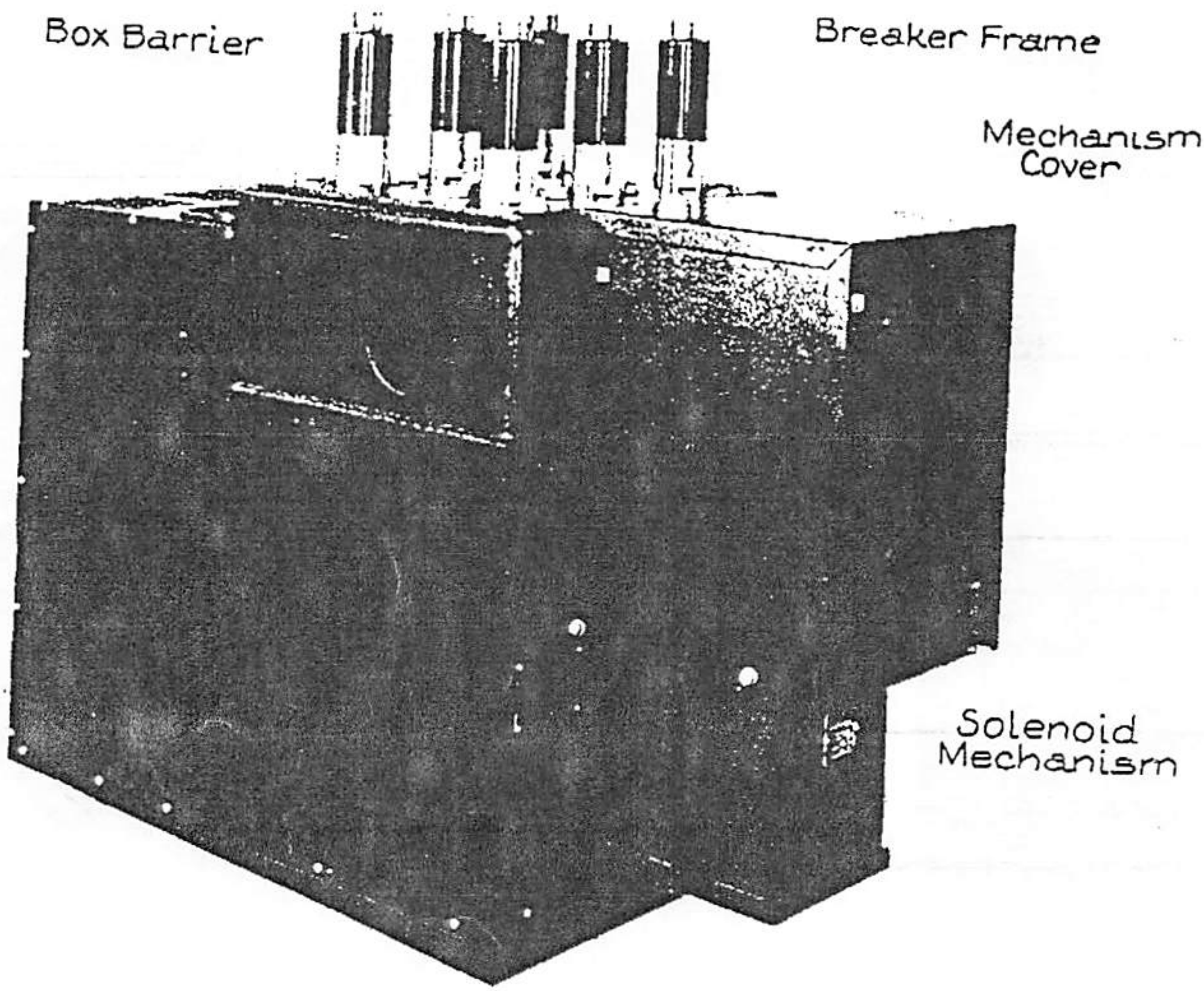


FIG. 1 MAGNE-BLAST BREAKER ARRANGED FOR USE IN AN MI-6 METAL CLAD EQUIPMENT UNIT.

MAGNE-BLAST AIR CIRCUIT BREAKERS

TYPE AM-5-100
AM-5-150

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.

GENERAL INFORMATION

The Magne-Blast Air Circuit Breaker shown in Fig. 1 is a triple pole single throw breaker with integral operating mechanism and is arranged for application in Vertical Lift Metal Clad Switchgear.

These breakers are available in 600, 1200, and 2000 ampere current ratings and are designed for application at a maximum circuit voltage of 5000 volts. Within the published interrupting current range, the AM-5-100 Breaker has an interrupting capacity of 100,000 KVA and the AM-5-150 Breaker has an interrupting capacity of 150,000 KVA on a duty cycle basis consisting of two closing-opening operations with a time interval of 15 seconds between them.

OPERATING CHARACTERISTICS

The Breaker-Mechanism combination is designed only for electrical closing and the Maintenance Closing Lever is supplied only for use in making adjustments. NEVER ATTEMPT MANUAL CLOSING WITH THE BREAKER IN SERVICE, for under such conditions sufficient closing force and speed cannot be applied.

The MS-7A solenoid mechanism is trip free and will operate satisfactorily over the standard ranges for closing and tripping voltages discussed later under CONTROL.

When the solenoid coil is energized, the armature (refer to Fig. 3), carrying the closing link is pulled down until it is stopped by the pole piece. A spring maintains engagement between the closing link and roller bearing of the operating crank which is rotated to close the breaker. The breaker is held in the fully closed position by the over center position of the compression toggle. The coil is de-energized by the relay actuated by the cut-off switch.

When the trip coil is energized, the trip armature is moved upwards rotating the trip shaft which releases the trip hammer. The trip hammer strikes the closing link forcing it off the roller bearing of the operating crank allowing the opening springs to rotate the crank and open the breaker contacts. The stud strikes the release spring to break the compression toggle allowing the resetting springs to raise the armature and reset the mechanism.

In case the trip coil is energized while the breaker is closing, the trip hammer strikes the closing link forcing it off of the roller bearing of the operating crank allowing the breaker to open. The mechanism immediately resets when the solenoid coil is de-energized by the control relay.

When the breaker is tripped under load or short circuit conditions, the opening springs act to swing the contact arms downward, parting first the primary contacts, then intermediate contacts, and then the arcing contacts. Magnetic forces of the Blowout Coils, together with an air stream from the "Booster" drives the arc from the contacts out along the diverging Arc Runners into the "Interleaving" arc chute. The tapered fins that project alternately from the two opposite inner surfaces of the chute deflect the arc into a gradually deepening serpentine path. This lengthening and consequent cooling action rapidly increases the electrical resistance of the arc to cause interruption. Hot exhaust gases are cooled while passing through the Muffler at the end of the arc chute. An easily removable Box Barrier encases the interrupting units, providing insulation between phases and from each phase to the grounded frame.

CONTROL

For electrical operation, control power may be from either an alternating or direct current source. In the case of alternating current, it is necessary to use a Copper Oxide Rectifier to supply the direct current required by the closing coil.

Operating ranges are given on the mechanism nameplate. Ordinarily, standard ranges apply and are as follows:

Nominal Voltage	Closing Range	Tripping Range
125 V.DC.	90-130 V.DC.	70-140 V.DC.
250 V.DC.	180-260 V.DC.	140-280 V.DC.
220 V.AC.	180-240 V.AC.	180-240 V.DC.

SHIPMENT

Each breaker is carefully inspected and packed by workmen experienced in the proper handling and packing of electrical equipment. Immediately upon receipt of a circuit breaker, an examination should be made for any damage sustained during shipment. If injury or rough handling is evident, a damage claim should be filed at once with the transportation company and the nearest General Electric Company's Sales Office should be notified promptly.

UNPACKING

The breaker should be removed from the crating with sufficient care so that no damage will result from rough handling. It frequently happens that "loose parts" associated with the apparatus are included in the crate. Care should be taken to make certain that these parts are not overlooked.

After the breaker has been removed from the crating, the brace and steel hooks holding the Box Barrier in position should be removed and discarded. The red painted hex-head shipping bolts holding the top of the box barrier to the frame should be replaced by the Thumb Screws as shown in Fig. 3.

STORAGE

It is advisable that the breaker be set up immediately, but if it must be stored, it should be kept in a clean dry place, free from corrosive gases or fumes. During construction work, particular care should be taken to protect this apparatus from moisture and cement dust as this combination has very corrosive effects on many parts. All machined parts except those on the contacts should be coated with heavy oil or grease to prevent rusting.

INSTALLATION

Outline, wiring and all other drawings relating to dimensions, electrical connections, and control should be on hand so that points in question are readily settled as they arise. Before any installation work is done, consult these drawings and the Instruction Book for the "Metal-Clad Switchgear" type MI-6, GEI-6256.

The complete Breaker unit has already been assembled, adjusted, inspected and tested at the factory in accordance with the detailed adjustments given later in this book. It is possible, however, that unusually rough handling or transportation may have caused some loosening or disturbance of the apparatus to warrant a rechecking and in some cases, re-adjustment.

Before proceeding, the following precautions should be noted.

PRECAUTIONS

Make certain that all control circuits have been de-energized.

Never work on a closed breaker without blocking to prevent tripping.

CONTACTS

With the breaker closed, the top surface of the primary contact fingers (Fig. 3) should be horizontal. This can be adjusted by the operating rod adjusting screw shown in Fig. 3. The travel of the primary contact fingers should be 3/16" ± 1/32" and can be adjusted by the primary finger screws which should be wired after adjustment. The distance between the primary block and fingers with the arcing tip just in contact should be 1/2" to 9/16" which can be adjusted by the contact adjusting screw which is shown in Fig. 3.

The contact blades should have 40 to 60 inch-pounds torque when the blade is in a horizontal position. This can be adjusted by tightening the blade pressure adjusting screw (Fig. 3) and locking it in place with a cotter key.

TRIP MECHANISM

To check the adjustment of the trip mechanism close the breaker part way and trip. Then reset the mechanism slowly with the operating handle until the trip hammer is directly under the center of the trip shaft with the trip plate extensions in the raised position. The clearance between the trip hammer and trip shaft should be 1/32" ± 1/64" which can be adjusted by shimming with washers between the trip frame and the solenoid frame.

With the breaker closed, adjust the lower stop screw so that the trip shaft has 1/32" to 1/16" lap on the catch of the trip hammer. Lock this screw tightly. If necessary, bend the plate extension over each firing pin so that it clears the firing pin by 1/16" to 1/8" when the trip plate rests on the lower stop screw. Then adjust the upper stop screw so that the end of the trip plate raises 1/8" to 1/4" above the firing pins when at the top of their strokes. Lock the upper stop screw tightly. Now raise each armature separately by hand to the limit of their stroke and be sure they will each rotate the trip shaft far enough to release the trip hammer catch. Do not remove the trip shaft when making adjustments.

With the breaker in the open position, there should be 1/16" to 1/8" clearance between the trip shaft and the trip hammer. This adjustment is obtained by turning the two set screws on the short arm of the trip hammer in or out as required. The lock nuts should be tightened after this adjustment is made.

CLOSING MECHANISM

With the armature in the fully closed position, the closing toggle (4--Fig. 4) (27--Fig. 4) should be free to snap over center 1/8" to 3/16". This can be adjusted by changing the position of the adjusting stop (5-Fig. 4) and by changing the number of shims (18-Fig. 4) between the armature and pole piece. With the armature in the open position, the operating crank (29-Fig. 4) should be against the buffer stop (30-Fig. 4). The buffer stop (32-Fig. 4) should be adjusted by adding or removing shims to permit unrestrained motion of closing link (25-Fig. 4) over roller bearing at end of operating crank.

A locking wire is provided to prevent the closing link from moving off of the roller bearing. In case of any excessive vibration causing the link to roll, the hook on the link engages the wire and the link is held in place.

On a normal operation of the solenoid the link operates without touching the wire, but if the mechanism overtravels, the closing link may strike the wire causing it to bend or break. A check should be made to see that the four bolts are tight and shims should be added or removed to allow the holding toggle to snap over center 1/8".

SUMMARY OF ADJUSTMENTS

1. Primary contact finger travel - 3/16" ±1/32".

2. Distance between primary block and fingers, arcing tips just in contact 1/2" to 9/16".

3. Contact blade torque - 40 to 60 inch-pounds.

4. Toggle distance - 1/8" to 3/16".

5. Tripping mechanism adjustments.

   a. Clearance between trip hammer and trip shaft raised and trip hammer under center of trip shaft - 1/32" ±1/64".

   b. Lap of trip shaft on trip hammer catch - 1/32" to 1/16".

   c. Clearance between firing pin and trip shaft extension, both in lowered position - 1/16" to 1/8".

   d. Clearance between firing pin and trip shaft extension, both in raised position - 1/8" to 1/4".

   e. Clearance between trip hammer and trip shaft with breaker open - 1/16" to 1/4".

ACCESSORIES

For information and instructions pertaining to accessories such as relays, rectifiers, undervoltage devices, and time delay trip coils refer to the instruction book of the device in question. The numbers of instruction books and renewal parts bulletins will be found on the nameplate of the device.

MAINTENANCE

These breakers should be inspected every six months or more often depending upon conditions. The arc chutes on all phases should be removed and the contacts, arc runners and arc chutes inspected for excessive erosion. Arcing contacts, arc runners and arc chutes need not be replaced unless more than 1/16" thickness of the material has been eroded from the surface. The chutes may be removed by removing the supporting bolts (Fig. 2), loosening the two upper coil bolts (Fig. 2), and loosening the lower bolt on the secondary coil connection (Fig. 3). The chute can then be removed, leaving the upper blowout coil assembly on the bushing. With the arc chutes off, the condition of the runners, contacts and arc chutes can be determined.

Scale formed over the surface of the chute must not be removed, but loose scale collected in the muffler should be removed. Cranks which have formed in the fins of the arc chute are to be expected in ceramic materials of this type which are subjected to severe heat. These cranks do not interfere with the operation of the device in any way and should be disregarded. If the chute has had any mechanical injury such as dropping or accidental striking of the fins which has resulted in actual breaking off of complete fins, replacement of the chute is necessary. The insulation parts on the breaker should be kept clean and dry. If the arc chutes show signs of moisture during any of these inspections, heaters should be installed to insure dryness.

The surface of the bushings should be smooth and unscratched. If the insulation surface of the bushing should become damaged (inside or outside the breaker) the surface should be well cleaned, then retouched with either 1170 clear varnish, or 1202 (clear) or 1210 (brown) Glyptal* Enamel. Allow to dry hard and smooth.

In the case of replacement of contact blade assembly, the silver rings on the contact blade and bushing should be lubricated with Socony Vacuum grease EF-323 or equivalent.

1. Keep the mechanism free of all "gritty" deposits, and reasonably clean of "linty" or dust-like substances.

2. Make regular inspections to see that the mechanism is adjusted properly and that no defects have developed.

3. In the case of time delay current trip mechanisms, remove old oil from dashpots, flush with some non-corrosive cleaning fluid, such as carbon-tetrachloride and refill with fresh dashpot oil. This should be done at intervals dependent upon the conditions of installation, but never less frequent than once in six months.

4. In the event that the mechanism fails to operate properly:

   A. Check applied voltage with that given on the mechanism nameplate.

   B. Check for burned out coils or loose connections.

   C. Look for binding in the mechanism which may be caused by broken, bent or dirty parts.

   D. Check the adjustments of all the mechanism parts against these given.

5. Lubrication:

The various parts of the mechanism are lubricated at the factory in the following manner.

   A. All main bearings such as operating crank, closing link, tripping hammer and manual closing crank, with G.E. Lubricant D50H1C (Lubriplate #110).

   B. Operating crank roller bearing with G.E. Lubricant D50H10 (#SC-518 from Standard Oil Co. of Pennsylvania).

   C. Finished surfaces and bearings of trip shaft, hardened end of tripping hammer and inside of closing link with Rust Ban 347 from Standard Oil Company of New Jersey.

It is recommended that these lubricants or their equivalent be used during maintenance at least once a year.

RENEWAL PARTS

For renewal parts refer to Renewal Parts Bulletin GEG-4422. When ordering, address the nearest sales office of the General Electric Company, specify the quantity, describe the parts and give all the information that appears on the nameplate. Also give the requisition number under which the breakers were purchased if it is available.

* Registered Trade-Mark of General Electric Company.

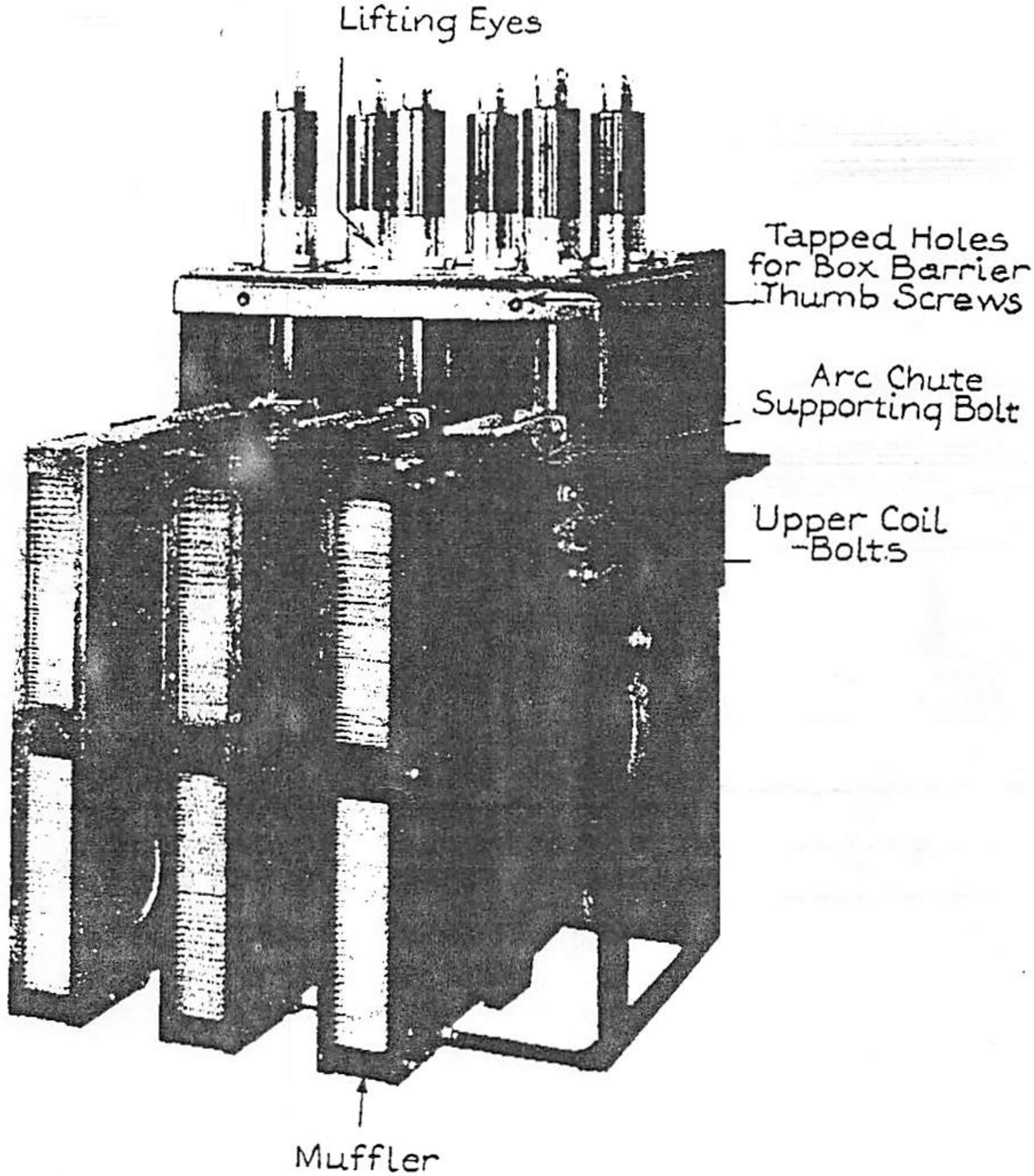


FIG. 2 ARC CHUTE END OF MAGNE-BLAST BREAKER WITH BOX BARRIER REMOVED.

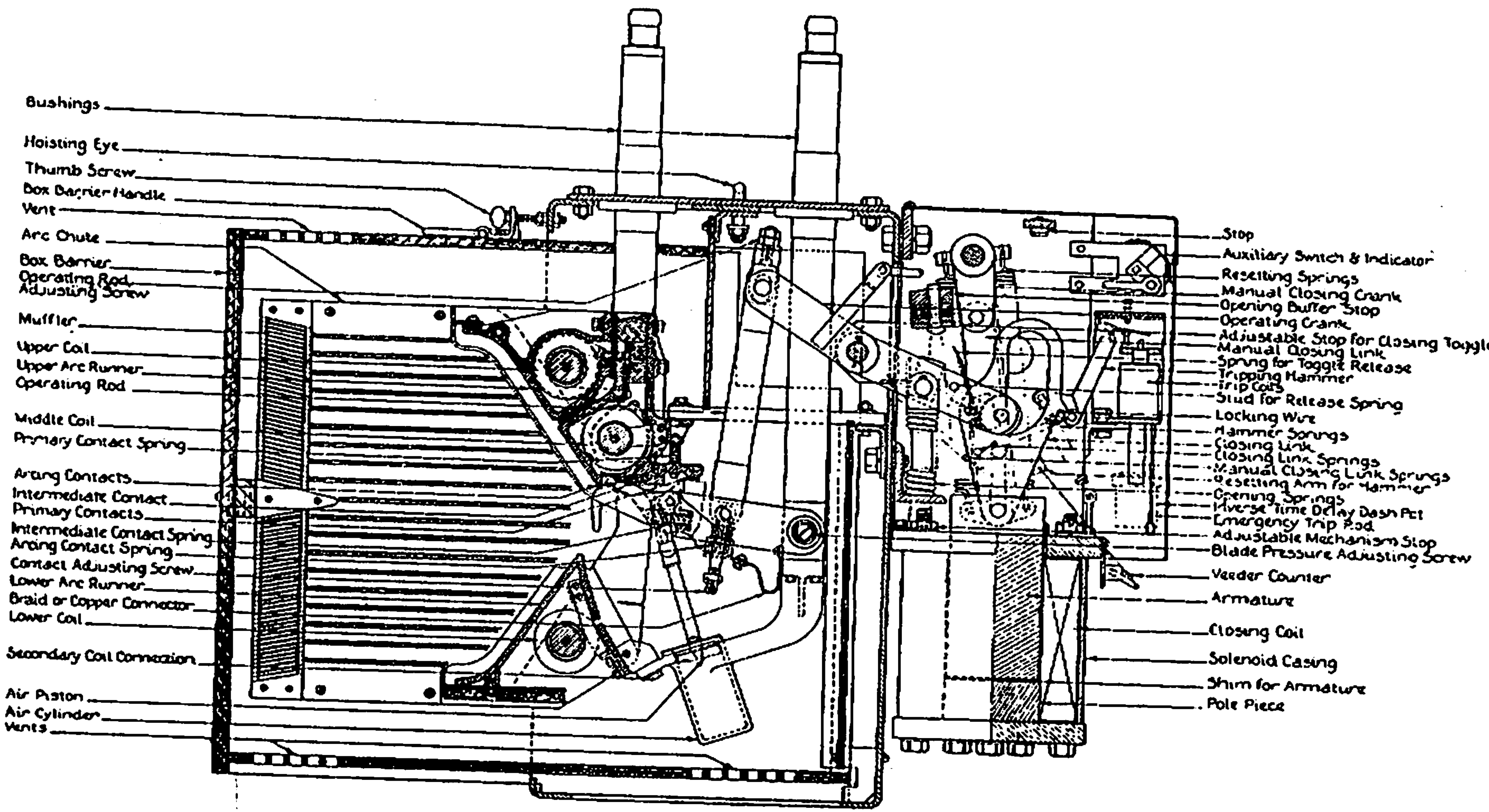


FIG. 3

MAGNE-BLAST AIR CIRCUIT BREAKER TYPE AM 5-100 & 5-150

SHOWN IN CLOSED POSITION

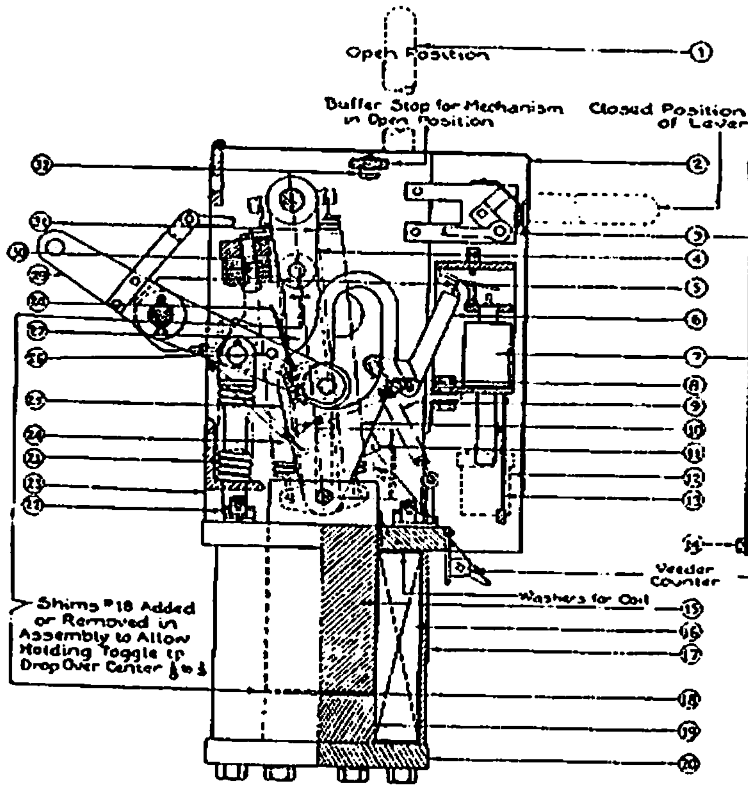


FIG. 4

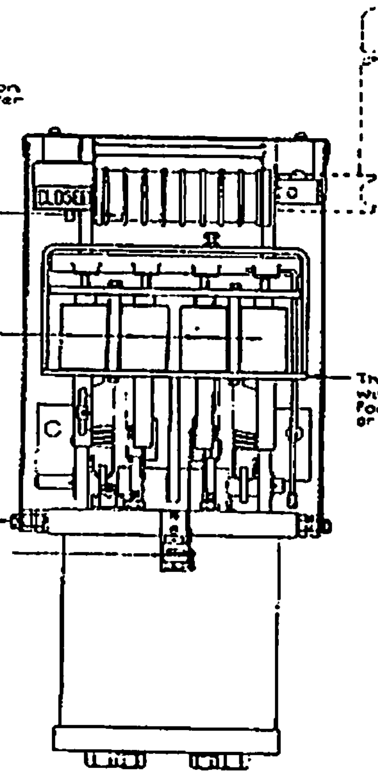
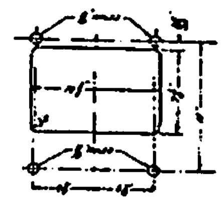


FIG. 5

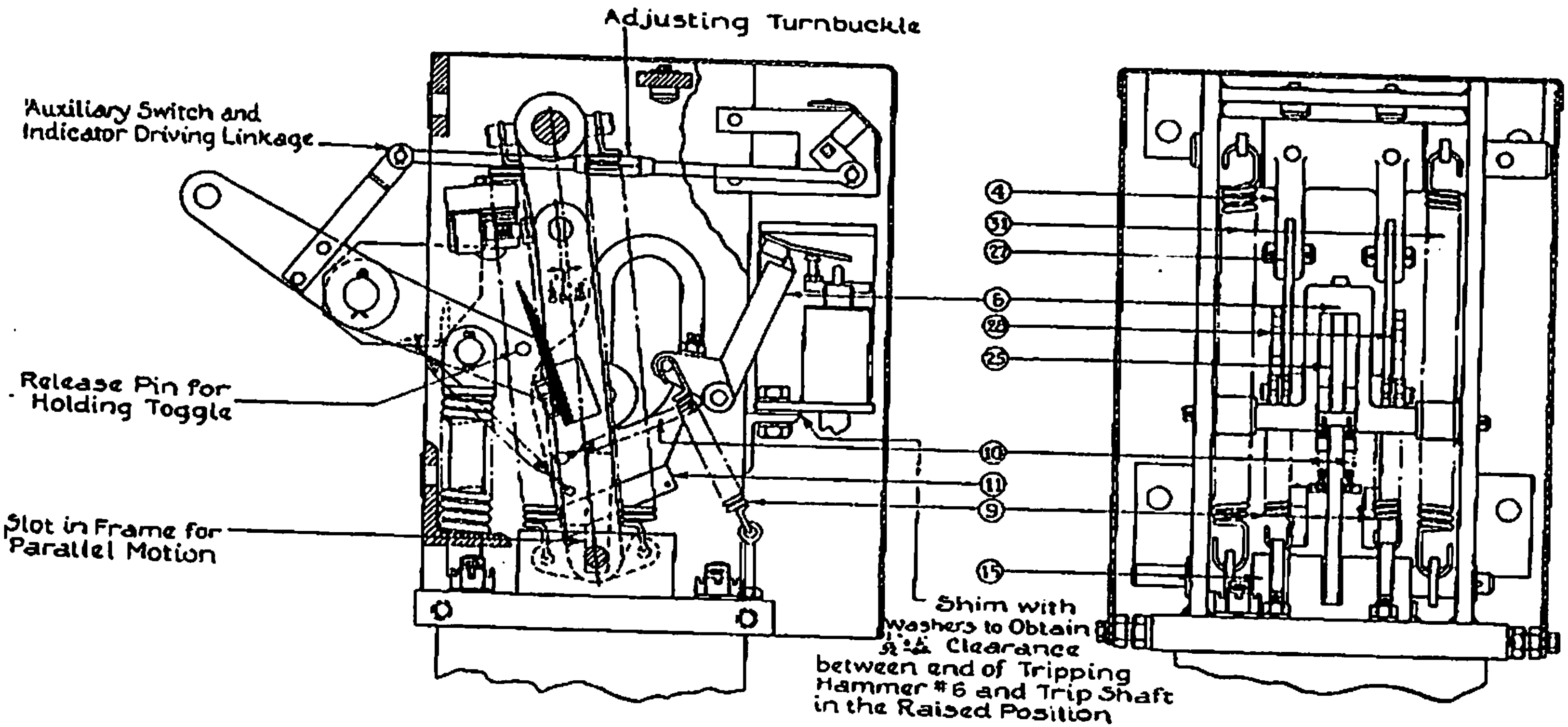


DRILLING PLAN

SOLENOID MECHANISM FOR MAGNE-BLAST AIR CIRCUIT BREAKER

AM 5-100 & AM 5-150 SHOWN IN CLOSED POSITION

1 Manual Operating Handle
2 Mechanism Cover
3 Auxiliary Switch (8 Stage) & Indicator
4 Manual Closing Crank
5 Adjustable Stop for Closing Toggle
6 Tripping Hammer
7 Trip Coils
8 Locking Wire
9 Hammer Springs
10 Closing Link Springs
11 Resetting Arm for Hammer
12 Dash Pot
13 Emergency Trip Rod
14 Cover Mounting Bolts
15 Armature
16 Closing Coil
17 Solenoid Casing
18 Shim for Armature
19 Pole Piece
20 Casing Bottom Plate
21 Opening Spring
22 Mounting Bolts for Solenoid Casing
23 Mechanism Frame
24 Manual Closing Link Spring
25 Closing Link
26 Stud for Release Spring
27 Manual Closing Link
28 Spring for Toggle Release
29 Operating Crank
30 Buffer
31 Resetting Springs
32 Stop



Note :- Part Numbers Refer to Those on Fig's. 4 & 5

FIG. 6

PROFILE OF MECHANISM
WITH COVER AND SIDE
OF FRAME REMOVED

FIG. 7

FRONT ELEVATION OF MECHANISM
WITH COVER, TRIP COILS AND
AUXILIARY SWITCH REMOVED

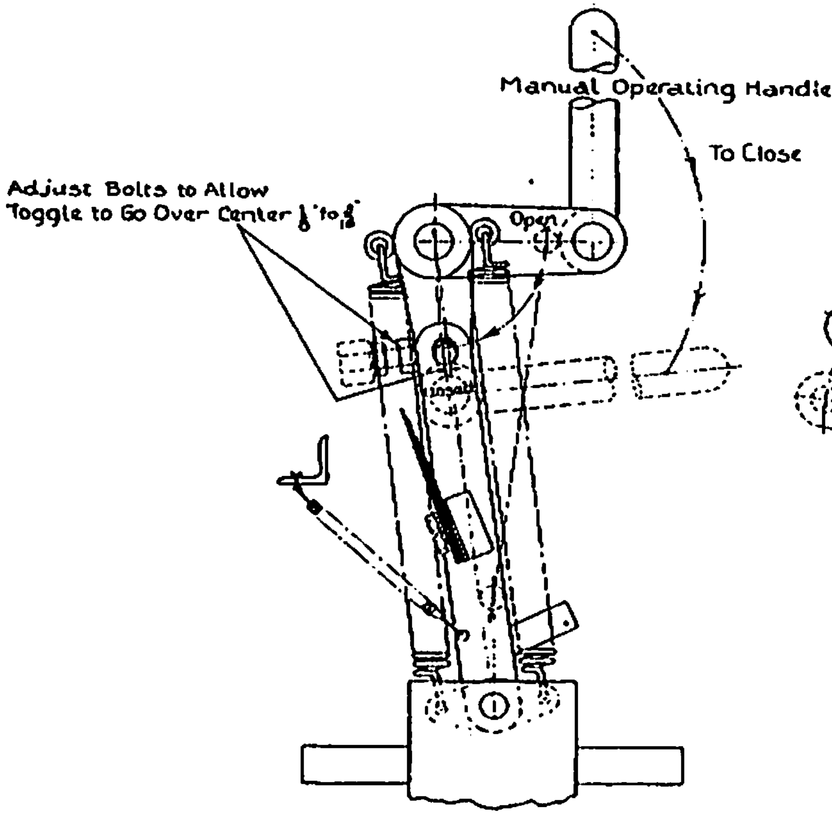


FIG. 8
MANUAL CLOSING MECHANISM

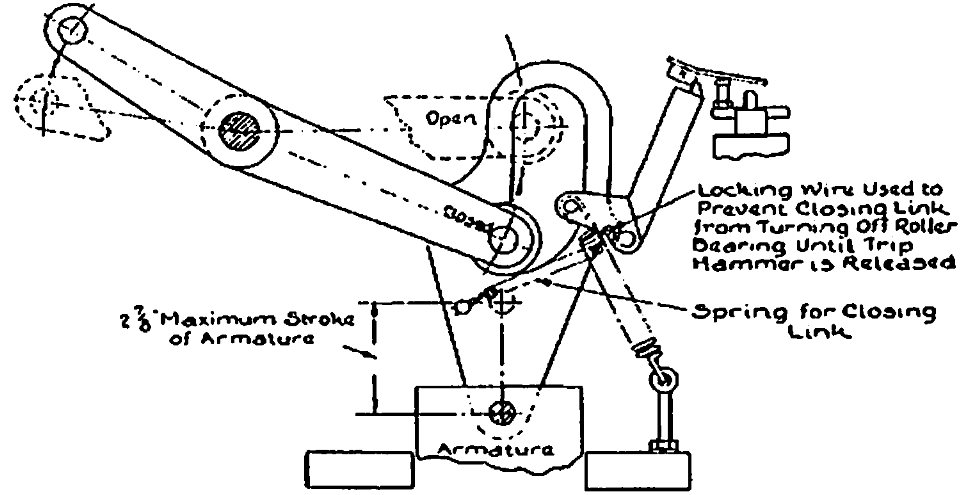


FIG. 9
SOLENOID CLOSING MECHANISM

GENERAL ELECTRIC SALES OFFICES

READY TO ASSIST YOU . . . When You Have Electrical Problems . . . Need Further Information . . . Require Ordering Instructions

SALES OFFICE CODE KEY
• Industrial Equipment (including Agent and Distributor) Sales
† Electric Utility Equipment Sales
§ Marine and Defense Equipment Sales
‡ Component Sales Operation

ALABAMA
• † ‡ Birmingham 35205 ... 2131 Highland Ave.
• Mobile 36602 ... 704 Government St.

ARIZONA
• † ‡ Phoenix 85012 ... 3550 N. Central Ave.
• † Tucson 85711 ... 151 S. Tucson Blvd.

ARKANSAS
• ‡ North Little Rock 72114 ... 1900 E. Washington
† Pine Bluff 71602 ... P. O. Box 1033

CALIFORNIA
• Fresno 93728 ... 1532 N. West Ave.
• † § Los Angeles 90054 ... 212 N. Vignes St.
‡ § Los Angeles 90005 ... 3325 Wilshire Blvd.
• Oakland 94612 ... 409 Thirteenth St.
• Redwood City 94063 ... 55 Veterans Blvd.
• † Sacramento 95816 ... 2407 "J" St.
• † § San Diego 92103 ... 2560 First Ave.
• † ‡ § San Francisco 94106 ... 235 Montgomery St.
• San Jose 95128 ... 2155 So. First St.

COLORADO
• † ‡ § Denver 80201 ... 201 University Blvd.

CONNECTICUT
• † Hamden 06518 ... 2905-2921 Dixwell Ave.
• † ‡ Hartford 06105 ... 764 Asylum Ave.

DISTRICT OF COLUMBIA
• † § Washington 20005 ... 777—14th St., N.W.

FLORIDA
§ Cocoa Beach (Cape Canaveral Office) ... 1325 N. Atlantic Ave.
• Coral Gables 33146 ... 230 Bird Road
• † Jacksonville 32202 ... 1901 Hill St.
† Miami 33134 ... 4100 West Flagler St.
† Pensacola 32503 ... First Bank Bldg.
• † ‡ Tampa 33609 Henderson Blvd. at Lois Ave.
• Tampa 33609 ... 2106 S. Lois Ave.

GEORGIA
• † ‡ Atlanta 30309 ... 1860 Peachtree Rd., N.W.
• Macon 31202 ... 682 Cherry St.
• † Savannah 31405 ... 5002 Paulsen St.

IDAHO
• † Boise 83706 ... 1524 Idaho St.

ILLINOIS
• † ‡ § Chicago 60680 ... 840 S. Canal St.
• † Peoria 61603 ... 2008 N.E. Perry Ave.
• Rockford 61105 ... 4223 East State St.
† Springfield 62701 ... 607 E. Adams St.

INDIANA
• † ‡ Evansville 47714 ... 2709 Washington Ave.
‡ Fort Wayne 46807 ... 1635 Broadway
• † Fort Wayne 46806 ... 3606 S. Calhoun St.
• † ‡ Indianapolis 46207 ... 3750 N. Meridian St.
• ‡ South Bend 46601 ... 430 N. Michigan St.

IOWA
• † Cedar Rapids 52401 ... 210 Second St., S.E.
• † ‡ Davenport 52803 ... 1039 State St., Bettendorf, Iowa
• † Des Moines 50310 ... 3839 Merle Hay Rd.
† Sioux City 51101 ... 520 Pierce St.

KANSAS
• † Wichita 67211 ... 820 E. Indianapolis Ave.

KENTUCKY
• † Lexington 40503 ... 465 E. High St.
• † ‡ Louisville 40218 ... 2300 Meadow Dr.

LOUISIANA
• † Alexandria 71302 ... 720 Murray St.
• Baton Rouge 70815 ... 633 Oak Villa Blvd.
• Lake Charles ... 1424 Ryan St.
• † § New Orleans 70112 ... 837 Gravier St.
• New Orleans 70125 ... 4747 Earhart Blvd.
• † Shreveport 71101 ... 400 Travis St.

MAINE
• † Augusta ... 152 State St.
• Bangor 04402 ... 77 Central St.

MARYLAND
• † ‡ Baltimore 21201 ... 1 North Charles
• † Hagerstown ... 49 East Franklin St.

MASSACHUSETTS
• † ‡ § Boston 02117 ... 31 St. James Ave.
• Springfield 01103 ... 120 Maple St.
• Worcester 01605 ... 288 Grove St.

MICHIGAN
• † ‡ Detroit 48202 ... 700 Antoinette St.
• Flint 48503 ... 316½ W. Court St.
• ‡ Grand Rapids 49508 2821 Madison Ave., S.E.
• † Jackson 49201 ... 210 W. Franklin St.
• Kalamazoo ... 927 S. Burdick St.
• † Lansing 48901 ... 301 Bank of Lansing Bldg.
• Saginaw 48607 Second National Bank Bldg.

MINNESOTA
• † Duluth 55802 ... 14 W. Superior St.
† Fergus Falls 56537 ... 106 E. Washington St.
• † ‡ Minneapolis 55402 ... 12 S. Sixth St.

MISSISSIPPI
† Gulfport 39502 ... P.O. Box 33
† Jackson 39201 ... 210 S. Lamar St.

MISSOURI
• Joplin 64802 ... 212½ W. Fifth St.
• † ‡ Kansas City 64105 ... 106 W. Fourteenth St.
• ‡ St. Louis 63101 ... 1015 Locust St.

MONTANA
• † Billings 59101 ... 303 N. Broadway
• † Butte 59701 ... 103 N. Wyoming St.

NEBRASKA
• † Omaha 68102 ... 409 S. Seventeenth St.

NEVADA
† Las Vegas 89106 ... 1711 S. 8th St.

NEW HAMPSHIRE
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• † ‡ East Orange 07017 ... 26 Washington St.

NEW MEXICO
• † Albuquerque 87108 120 Madeira Drive, N.E.

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• † Binghamton 13902 ... 19 Chenango St.
• † ‡ Buffalo 14202 ... 625 Delaware Ave.
• † § New York 10022 ... 570 Lexington Ave.
• † ‡ Rochester 14604 ... 89 East Ave.
• † ‡ Syracuse 13206 ... 3532 James St.
• Utica 13501 ... 1001 Broad St.
‡ Waverly 14892 ... P.O. Box 308

NORTH CAROLINA
• † ‡ Charlotte 28202 ... 129 W. Trade St.
• Greensboro 27405 ... 801 Summit Ave.
• † Raleigh 27602 ... 16 W. Martin St.

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† Bismarck 58501 ... 418 Rosser Ave.

OHIO
• † Akron 44313 ... 2858 W. Market St.
• † Canton 44701 ... 515 Third St., N.W.
• † ‡ Cincinnati 45206 ... 2621 Victory Pkwy.
• † ‡ § Cleveland 44104 ... 4966 Woodland Ave.
• † Columbus 43215 ... 395 E. Broad St.
‡ Columbus 43212 ... 937 Burrell Ave.
• ‡ Dayton 45402 ... 11 W. Monument Ave.
• † § Dayton 45402 ... 118 W. First St.
‡ Mansfield 44906 ... 564 Park Ave., West
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• Youngstown 44507 ... 272 E. Indianola Ave.

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• † Tulsa 74114 ... Columbia Bldg., 2651 E. 21st St.

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• † Medford 97501 ... 107 E. Main St.
• † ‡ Portland 97210 ... 2929 N.W. 29th Ave.

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• ‡ York 17403 ... 56 N. Harrison St.

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• † ‡ § Houston 77027 ... 4219 Richmond Ave.
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† Madison 53703 ... 340 W. Washington Ave.
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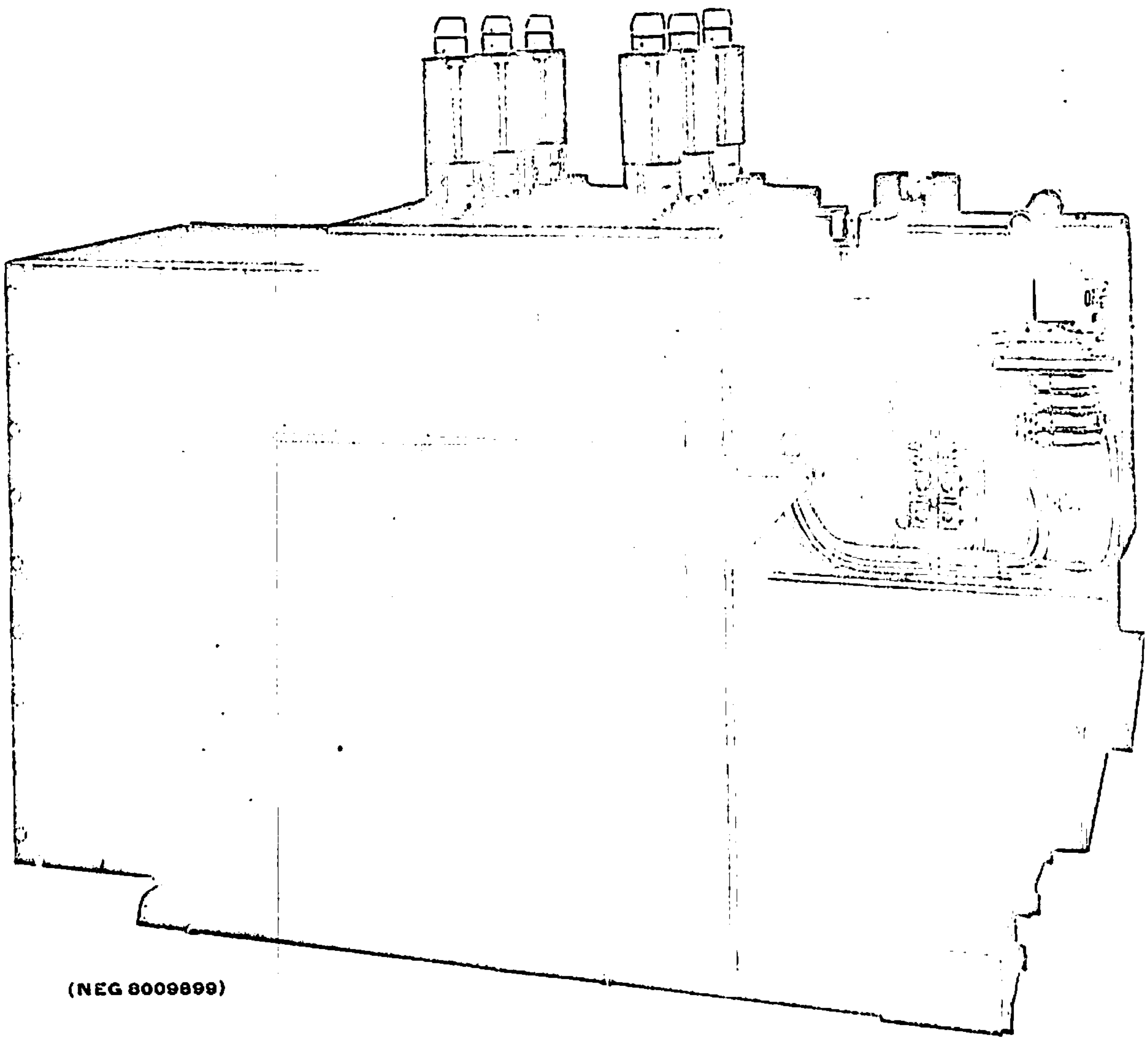
RENEWAL PARTS

TYPE AM-5-150 MAGNE-BLAST CIRCUIT BREAKER



(NEG 8009899)

Fig. 1. Type AM-5-150 magne-blast circuit breaker

GENERAL ELECTRIC

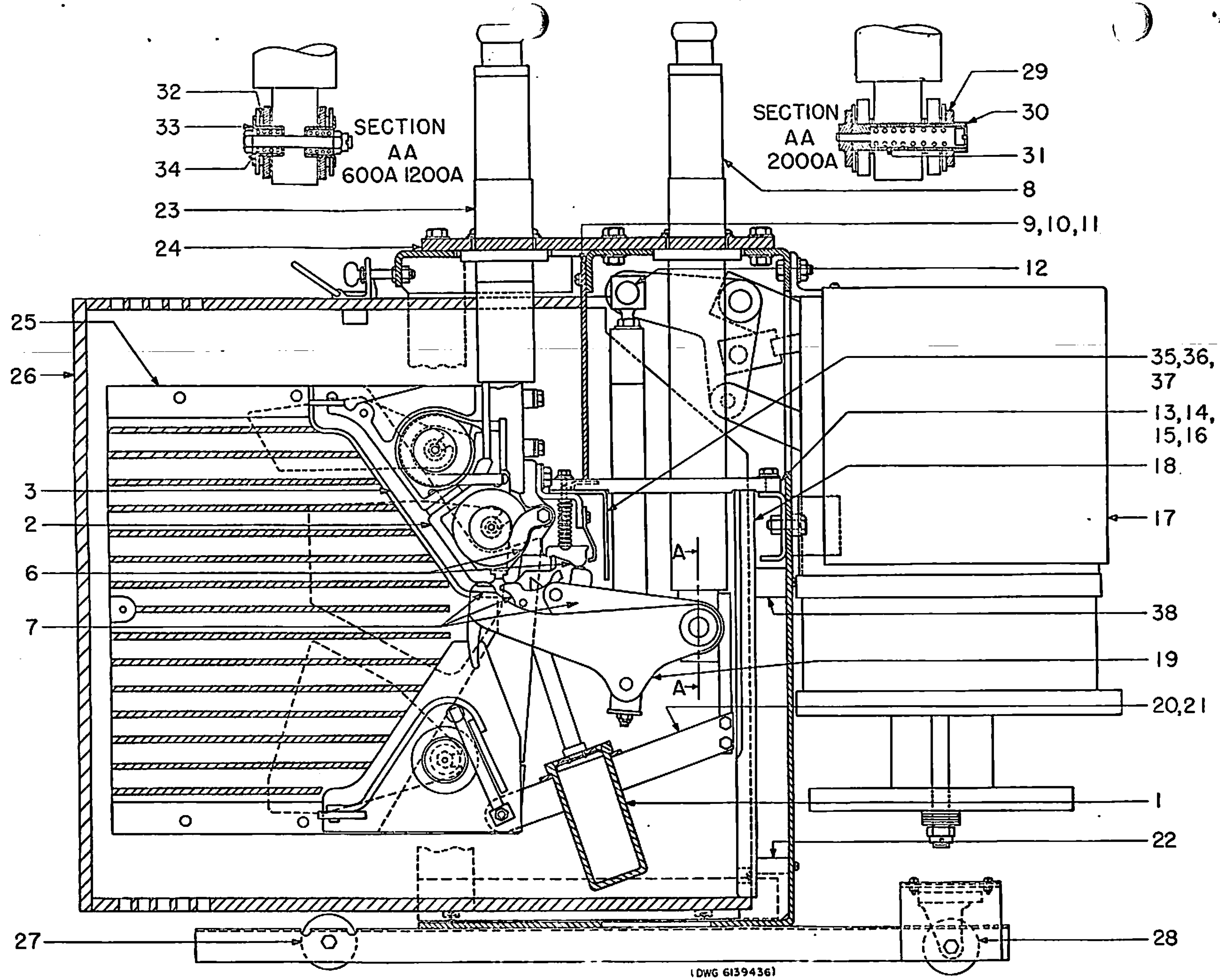


Fig. 2. Cross-section of breaker

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

Fig. No.	Ref. No.	Number Required for AM-5-150-																		Cat. No.	Description
		600 ampere							1200 ampere					2000 ampere							
		3	3Z	4	4Z	5	6	7	3	3Z	4	5	7	3	3Y	4	5	6	7		
2	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6315499P1	Booster cylinder
2	2	3		3		3	3		3		3	3		3		3	3	3		6229975G3	Stationary arcing contact and arc runner
2	2		3		3			3		3			3		3				3	6547728G1	Stationary arcing contact and arc runner
2	3	3	3						3	3										6193967G18	Upper insulation
2	3													3	3					6193967G17	Upper insulation
2	3			6	6	6	6	6			6	6	6			6	6	6	6	6412207G1	Upper insulation
2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	See page 11	Trip coil
2	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	See page 11	Closing coil
2	6	3		3		3			3		3	3								6316606G18	Stationary intermediate and primary contact assembly
2	6		3		3			3		3			3							6316613G23	Stationary intermediate and primary contact assembly
2	6						3					3								6316613G15	Stationary intermediate and primary contact assembly
2	6													3		3				6193967G19	Stationary intermediate and primary contact assembly
2	6														3				3	6316613G24	Stationary intermediate and primary contact assembly
2	6																3	3		6316606G12	Stationary intermediate and primary contact assembly
4	105	3		3		3	3		3		3	3								6318215P6	*Contact support
4	105		3		3			3		3			3							6551072G1	*Contact support
4	105													3		3				6217066G4	*Contact support
4	105																3	3		6217066G5	*Contact support
4	105														3				3	6217066G6	*Contact support
4	106	3	3	3	3	3	3	3	3	3	3	3	3							6440519	*Locking plate
4	107	12	12	12	12	12	12	12	12	12	12	12	12							6440517	*Spring guide
4	108	3		3		3			3		3									6318217P2	*Support for spring
4	108		3		3			3		3			3							6514168P1	*Support for spring
4	108						3					3								6318217P1	*Support for spring
4	109	12	12	12	12	12			12	12	12									6370616	*Spring
4	109						12	12				12	12							6509731	*Spring
4	109													21	21	21	21	21	21	6172977	*Spring
4	110	3	3	3	3	3	3	3	3	3	3	3	3							6440518	*Retainer
4	110													3						6440994	*Retainer
4	110															3				6243070	*Retainer
4	110														3		3	3	3	6508104P1	*Retainer
4	111	12	12	12	12	12	12	12	12	12	12	12	12							6476798G1	*Stationary primary contact
4	111													21	21	21	21			6440995	*Stationary primary contact
4	111																	21	21	6477100G1	*Stationary primary contact
4	112	3		3		3	3		3		3	3								6300108P1	*Shield
4	112		3		3			3		3			3							6441944	*Shield
4	112													3						6441104	*Shield
4	112															3	3	3		6300107P1	*Shield
4	112														3				3	6441943	*Shield
4	120													21	21	21	21	21	21	6243072	*Insulation
2	7	3	3	3	3	3	3	3	3	3	3	3	3							6316606G13	Movable primary, intermediate, and arcing contact assembly
2	7													3	3	3	3	3	3	6316606G15	Movable primary, intermediate, and arcing contact assembly
5	150	3	3	3	3	3	3	3	3	3	3	3	3							6217063G8	*Contact arm
5	150													3	3	3	3			6420220G4	*Contact arm
5	150																	3	3	6420220G8	*Contact arm
5	151													3	3	3	3	3	3	6076405P560	*Pin
5	152	3	3	3	3	3	3	3	3	3	3	3	3							6247780	*Pin
5	152													3	3	3	3	3	3	6440108	*Pin
5	153	3	3	3	3	3			3	3	3									6326299P2	*Movable intermediate contact
5	153						3	3				3	3							6275256G1	*Movable intermediate contact
5	153													3	3	3	3	3	3	6420221G2	*Movable intermediate contact
5	154	3	3	3	3	3	3	3	3	3	3	3	3							6420271G1	*Movable arcing contact
5	154													3	3	3	3	3	3	6420272G1	*Movable arcing contact
5	155	3	3	3	3	3	3	3	3	3	3	3	3							6245402P1	*Pin
5	155													3	3	3	3	3	3	6440115	*Pin
5	156	3	3	3	3	3	3	3	3	3	3	3	3							6440085	*Spring guide

* Seldom required. Assembly only recommended for normal maintenance.

Fig. No.	Ref. No.	Number Required for AM-5-150- 600 ampere							1200 ampere					2000 ampere						Cat. No.	Description
		3	3Z	4	4Z	5	6	7	3	3Z	4	5	7	3	3Y	4	5	6	7		
5	156													3	3	3	3	3	3	6440172	*Spring guide
5	157	3	3	3	3	3			3	3	3			3	3	3	3			6172869	*Outer spring
5	157						3	3				3	3					3	3	6509745	*Outer spring
5	158	3	3	3	3	3			3	3	3			3	3	3	3			6172949	*Intermediate spring
5	158						3	3				3	3					3	3	6509746	*Intermediate spring
5	159	3	3	3	3	3			3	3	3			3	3	3	3			6174948	*Inner spring
5	159						3	3				3	3					3	3	6509747	*Inner spring
5	160	3	3	3	3	3			3	3	3									6149967P1	*Insulation cup
5	160						3	3				3	3							6149967P2	*Insulation cup
5	161	3	3						3	3				3	3					6193967G23	*Tube and piston assembly
5	161			3	3	3	3	3			3	3	3			3	3	3	3	6316606G23	*Tube and piston assembly
2	8	3	3	3	3															6420344G1	Front bushing
2	8					3	3	3												6420344G7	Front bushing
2	8								3	3	3	3	3							6420344G3	Front bushing
2	8													3	3	3	3	3	3	6420344G5	Front bushing
2	9	3	3	3	3	3			3	3	3			3	3	3	3			6245722	Upper barrier (inner and outer)
2	10						1	1				1	1					1	1		Upper barrier (inner)
2	11						2	2				2	2					2	2		Upper barrier (outer)
2	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6440166	Pin for operating rod
2	13	3	3	3	3															6420266G1	Insulation, horizontal
2	13					3			3	3	3									6420266G2	Insulation, horizontal
2	14						1	1				1	1							6420266G4	Insulation, horizontal, left
2	15						1	1				1	1							6420266G8	Insulation, horizontal, center
2	16						1	1				1	1							6420266G5	Insulation, horizontal, right
2	13													3	3	3	3			6420266G3	Insulation, horizontal
2	14																	1	1	6420266G6	Insulation, horizontal, left
2	15																	1	1	6420266G9	Insulation, horizontal, center
2	16																	1	1	6420266G7	Insulation, horizontal, right
2	17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	See page 13	Solenoid mechanism
2	18	1	1						1	1				1	1					6193967G30	Front barrier assembly
2	18			1	1	1					1					1	1			6316606G30	Front barrier assembly
2	18						1	1				1	1					1	1	6547718G1	Front barrier assembly
2	19	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	See page 9	Contact arm assembly
2	20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6370753G1	Support, left
2	21	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6370753G2	Support, right
2	22	1	1						1	1				1	1					6247905	Spacer
2	22			1	1	1					1					1	1			6440983	Spacer
2	22						1	1				1	1					1	1	6551053P1	Spacer
2	23	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	See page 7	Rear bushing and arc runner assembly
2	24													1	1	1	1	1	1	6420316P2	Top plate
2	25	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	See page	Arc chute assembly
2	26	1	1						1	1										6193967G29	Box barrier
2	26			1	1	1					1									6316606G29	Box barrier
2	26						1	1				1	1							6316613G16	Box barrier
2	26													1	1					6193967G28	Box barrier
2	26															1	1			6316606G28	Box barrier
2	26																	1	1	6316613G17	Box barrier
2	27	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6316606P1112	Wheel
2	28	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6316606P1107	Wheel (swivel)
2	29													3	3	3	3	3	3	6245461P2	Bearing plate
2	30													3	3	3	3			6245814P1	Bearing
2	30																	3	3	6245814P2	Bearing
2	31													3	3	3	3	3	3	6172960	Spring
2	32	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6243996	Contact washer
2	33	6	6	6	6	6	6	6	6	6	6	6	6							2243035	Cup washer
2	34	6	6	6	6	6	6	6	6	6	6	6	6							6172976	Spring
2	35						1	1				1	1					1	1	6551054P1	Baffle, right-hand
2	36						1	1				1	1					1	1	6551054P2	Baffle, center
2	37						1	1				1	1					1	1	6551054P3	Baffle, left-hand
2	38						1	1				1	1					1	1	6508798P2	Spacer

* Seldom required. Assembly only recommended for normal maintenance.

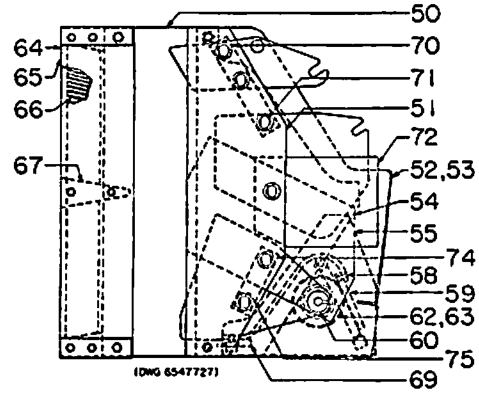


Fig. 3. Arc chute assembly

PARTS SELDOM REQUIRED

Fig. No.	Ref. No.	Number Required for AM-5-150-																		Cat. No.	Description
		600 ampere							1200 ampere					2000 ampere							
		3	3Z	4	4Z	5	6	7	3	3Z	4	5	7	3	3Y	4	5	6	7		
2	25	3	3						3	3										6193967G35	Arc chute assembly
2	25			3	3	3					3									6316606G35	Arc chute assembly
2	25						3	3				3	3							6316613G35	Arc chute assembly
2	25													3	3					6193967G36	Arc chute assembly
2	25															3	3			6316606G36	Arc chute assembly
2	25																	3	3	6316613G36	Arc chute assembly
3	50	3	3						3	3				3	3					6193967G39	Arc chute
3	50			3	3	3	3	3			3	3	3			3	3	3	3	6316606G39	Arc chute
3	51			6	6	6					6					6	6			6412203P1	Brace (right and left)
3	51	3	3						3	3				3	3					6318216P1	Brace, right
3	51	3	3						3	3				3	3					6318216P2	Brace, left
3	51						6	6				6	6					6	6	6412203P3	Brace (right and left)
3	52	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3			6420258P1	Left-side shield
3	52																	3	3	6420257P1	Left-side shield
3	53	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3			6420258P2	Right-side shield
3	53																	3	3	6420257P2	Right-side shield
3	54	12	12						12	12				12	12					6370587P1	Insulation
3	54			12	12	12	12	12			12	12	12			12	12	12	12	6476726P1	Insulation
3	55	6	6						6	6				6	6					6318166P1	Side shield (right and left)
3	56			3	3	3	3	3			3	3	3			3	3	3	3	6412204P1	Side shield (left)
3	57			3	3	3	3	3			3	3	3			3	3	3	3	6412204P2	Side shield (right)
3	58	3	3						3	3				3	3					6318159G1	Lower arc runner
3	58			3	3	3	3	3			3	3	3			3	3	3	3	6412205G1	Lower arc runner
3	59	3	3						3	3				3	3					6440528	Insulation
3	59			3	3	3	3	3			3	3	3			3	3	3	3	6440976P1	Insulation
3	60	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	421711	Molded cap
3	61	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	407193	Washer nut
3	62	3	3						3	3				3	3					6229976G1	Coil and terminal
3	63			3	3	3	3	3			3	3	3			3	3	3	3	6229977G1	Coil
3	64	3	3						3	3				3	3					6193967G26	Muffler assembly
3	65	6	6						6	6				6	6					6105830P1	Side plate
3	66	6	6						6	6				6	6					6193967G25	Filler for muffler
3	67	3	3						3	3				3	3					6149517	Divider
3	68			3	3	3	3	3			3	3	3			3	3	3	3	6316613P516	Spacer
3	69	3	3						3	3				3	3					6440155	Insulation
3	69			3	3	3					3					3	3			6440977P1	Insulation
3	69						3	3				3	3					3	3	6440977P2	Insulation
3	70						6	6				6	6					6	6	6551057P2	Spacer
3	71						30	30				30	30					30	30	6551056P1	Nut
3	72						3	3				3	3					3	3	6551022P2	Insulation (left)
3	73						3	3				3	3					3	3	6551022P1	Insulation (right)
3	74						6	6				6	6					6	6	6551057P1	Spacer
3	75						6	6				6	6					6	6	N402P11B	Spacer

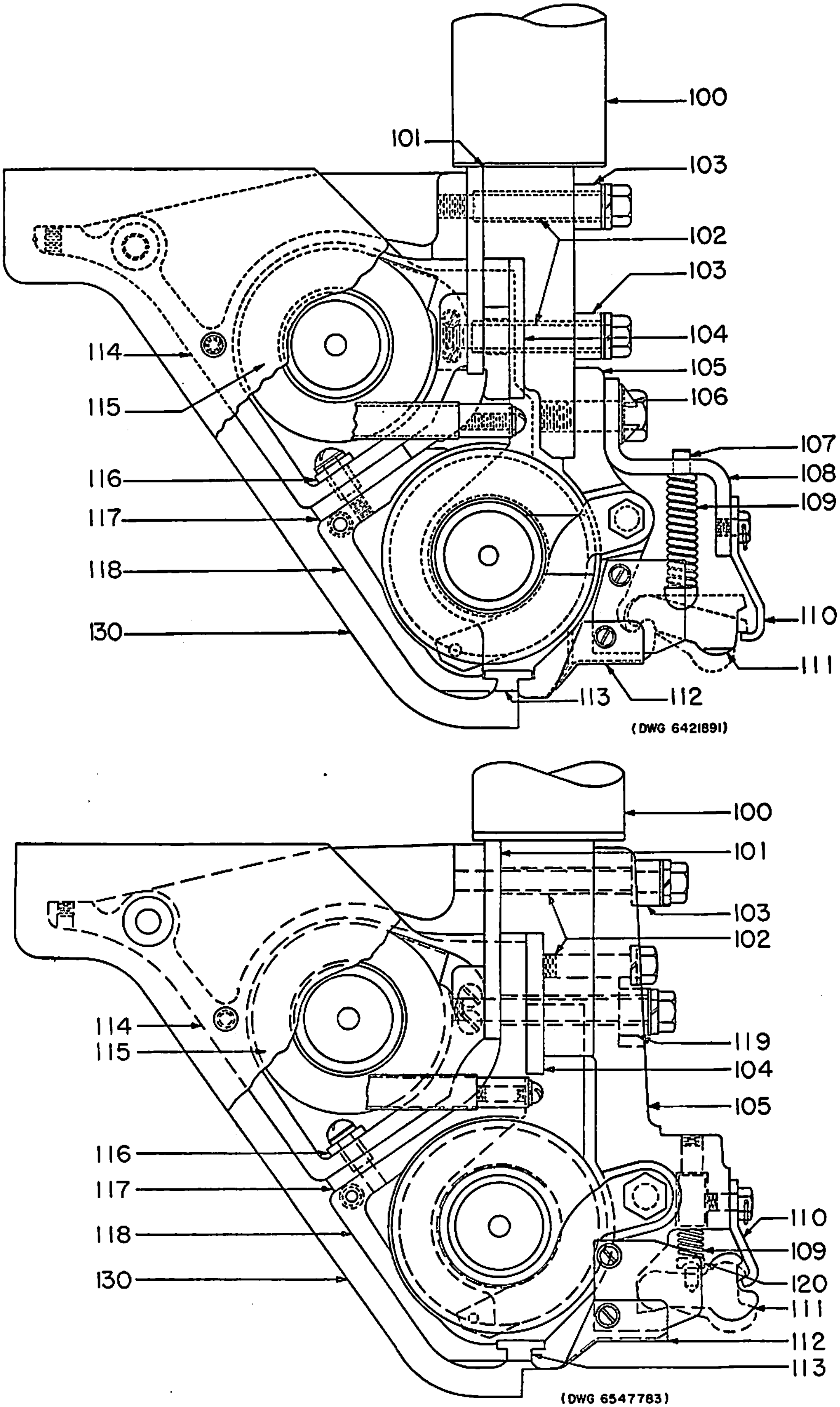


Fig. 4. Rear bushing and arc runner assembly

Fig. No.	Ref. No.	Number Required for AM-5-150-																		Cat. No.	Description
		600 ampere							1200 ampere					2000 ampere							
		3	3Z	4	4Z	5	6	7	3	3Z	4	5	7	3	3Y	4	5	6	7		
2	23	3																		6193967G22	Rear bushing and arc runner assembly
2	23		3		3															6316613G26	Rear bushing and arc runner assembly
2	23			3																6316606G22	Rear bushing and arc runner assembly
2	23					3														6316606G16	Rear bushing and arc runner assembly
2	23						3													6316613G13	Rear bushing and arc runner assembly
2	23							3												6316613G20	Rear bushing and arc runner assembly
2	23								3											6193967G21	Rear bushing and arc runner assembly
2	23									3			3							6316613G21	Rear bushing and arc runner assembly
2	23										3									6316606G21	Rear bushing and arc runner assembly
2	23											3								6316613G14	Rear bushing and arc runner assembly
2	23													3						6193967G31	Rear bushing and arc runner assembly
2	23														3				3	6316613G22	Rear bushing and arc runner assembly
2	23															3				6316606G31	Rear bushing and arc runner assembly
2	23																3	3		6316606G17	Rear bushing and arc runner assembly
4	100	3	3	3	3															6420344G2	Bushing, rear
4	100					3	3	3												6420344G8	Bushing, rear
4	100								3	3	3	3	3							6420344G4	Bushing, rear
4	100													3	3	3	3	3	3	6420344G6	Bushing, rear
4	101	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6187411P7	Insulation
4	102	9		9		9	9		9		9	9		9		9	9	9		6440159	Bushing
4	102		9		9			9		9			9		9				9	6316613P21	Bushing
4	103	9	6	9	6	9	9	6	9	6	9	9	6							6370595P6	Spacer for bushing
4	103													6	6	6	6	6	6	6370595P5	Spacer for bushing
4	103A		3		3			3		3			3							6316613P22	Spacer for bushing
4	104	3		3		3	3		3		3	3		3		3	3	3		6187411P4	Insulation
4	104		3		3			3		3			3		3				3	6441975	Insulation
4	105	3		3		3	3		3		3	3								6318215P6	Contact support
4	105		3		3			3		3			3							6551072G1	Contact support
4	105													3		3				6217066G4	Contact support
4	105														3				3	6217066G6	Contact support
4	105																3	3		6217066G5	Contact support
4	106	3	3	3	3	3	3	3	3	3	3	3	3							6440519	Locking plate
4	107	12	12	12	12	12	12	12	12	12	12	12	12							6440517	Spring guide
4	108	3		3		3			3		3									6318217P2	Support for spring
4	108		3		3			3		3			3							6514168P1	Support for spring
4	108						3					3								6318217P1	Support for spring
4	109	12	12	12	12	12			12	12	12									6370616	Spring
4	109						12	12				12	12							6509731	Spring
4	109													21	21	21	21	21	21	6172977	Spring
4	110	3	3	3	3	3	3	3	3	3	3	3	3							6440518	Retainer
4	110													3						6440994	Retainer
4	110														3		3	3	3	6508104P1	Retainer
4	110															3				6243070	Retainer
4	111	12	12	12	12	12	12	12	12	12	12	12	12							6476798G1	Stationary primary contact
4	111													21	21	21	21			6440995	Stationary primary contact
4	111																	21	21	6477100G1	Stationary primary contact
4	112	3		3		3	3		3		3	3								6300108P1	Shield
4	112		3		3			3		3			3							6441944	Shield
4	112													3						6441104	Shield
4	112														3				3	6441943	Shield
4	112															3	3	3		6300107P1	Shield
4	113	3		3		3			3		3			3		3	3			6187411P5	Insulation
4	113		3		3			3		3			3		3				3	6551070P1	Insulation
4	113						3					3						3		6551064G1	Insulation
4	114	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6187400P4	Arc runner, upper
4	115	3		3		3	3		3		3	3		3		3	3	3		6113702G2	Coil, upper
4	115		3		3			3		3			3		3				3	6547740G1	Coil, upper
4	116	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6148748	Bushing
4	117													3	3	3	3			6187411P8	Insulation
4	117	3	3	3	3	3	3	3	3	3	3	3	3					3	3	6551052P1	Insulation
4	118	3		3		3	3		3		3	3		3		3	3	3		6229975G3	Stationary arcing contact, arc runner, and coil
4	118		3		3			3		3			3		3				3	6547728G1	Stationary arcing contact, arc runner, and coil
4	119													3	3	3	3	3	3	6370595P4	Spacer for bushing
4	120													21	21	21	21	21	21	6243072	Insulation

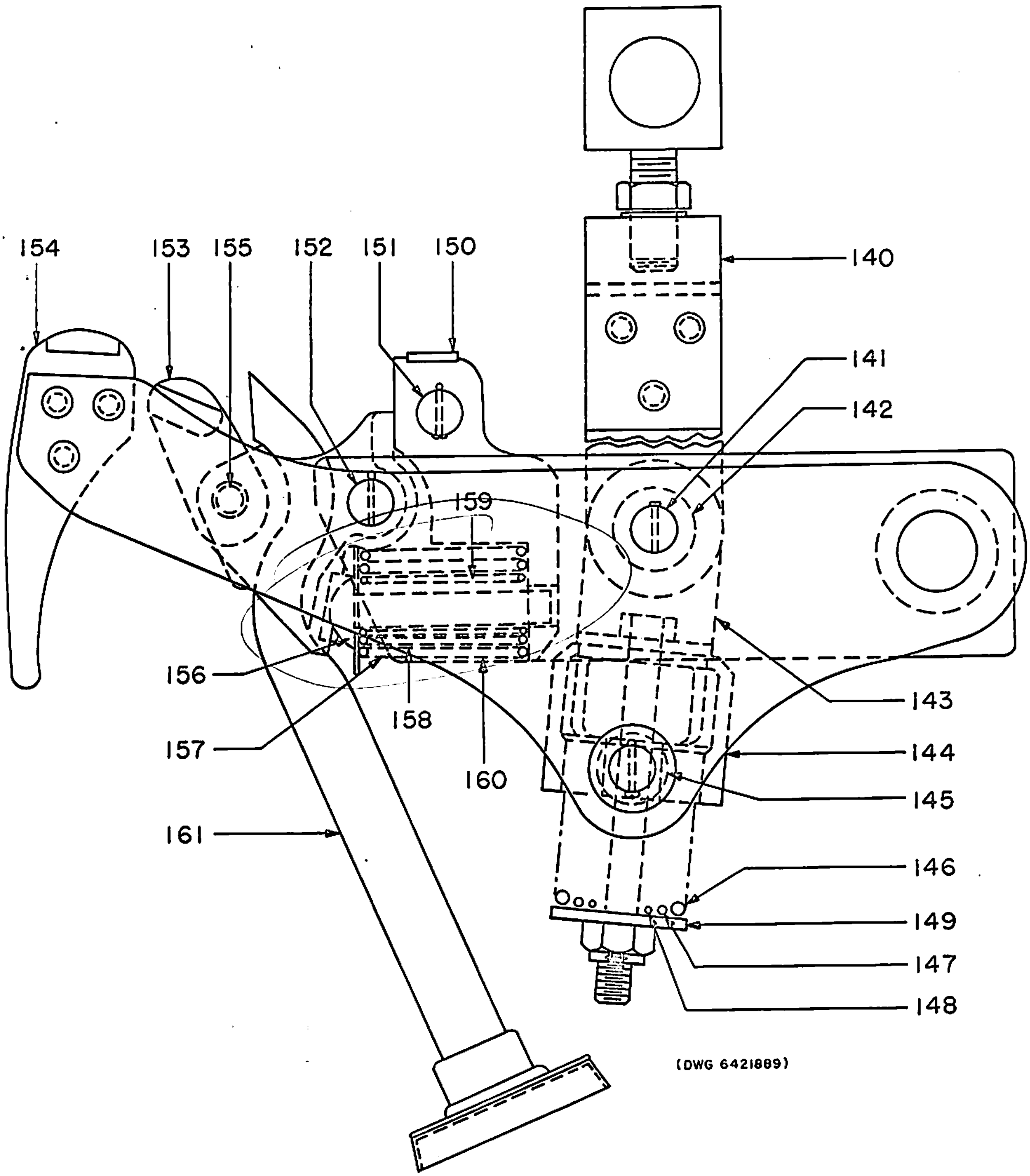


Fig. 5. Contact arm assembly

Fig. No.	Ref. No.	Number Required for AM-5-150-																		Cat. No.	Description
		600 ampere							1200 ampere					2000 ampere							
		3	3Z	4	4Z	5	6	7	3	3Z	4	5	7	3	3Y	4	5	6	7		
2	19	3	3						3	3										6193967G34	Contact arm assembly
2	19			3	3	3	3	3			3	3	3							6316606G34	Contact arm assembly
2	19													3	3					6193967G27	Contact arm assembly
2	19															3	3	3	3	6316606G27	Contact arm assembly
5	140	3	3						3	3				3	3					6193967G24	Operating rod and coupling
5	140			3	3	3	3	3			3	3	3			3	3	3	3	6316606G24	Operating rod and coupling
5	141	3	3	3	3	3	3	3	3	3	3	3	3							6247781	Pin
5	141													3	3	3	3	3	3	6245820	Pin
5	142													6	6	6	6	6	6	6440197	Bushing
5	143	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6247776P1	Clevis
5	144	3	3	3	3	3	3	3	3	3	3	3	3							6318226P1	Trunnion and spring container
5	144													3	3	3	3	3	3	6318226P2	Trunnion and spring container
5	145	6	6	6	6	6	6	6	6	6	6	6	6							6242806P1	Bushing
5	145													6	6	6	6	6	6	6242806P2	Bushing
5	146	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6172873	Outer spring
5	147	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6172874	Intermediate spring
5	148	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6172875	Inner spring
5	149	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6247777	Washer
5	150	3	3	3	3	3	3	3	3	3	3	3	3							6217063G8	Contact arm
5	150													3	3	3	3			6420220G4	Contact arm
5	150																	3	3	6420220G8	Contact arm
5	151													3	3	3	3	3	3	6076405P560	Pin
5	152	3	3	3	3	3	3	3	3	3	3	3	3							6247780	Pin
5	152													3	3	3	3	3	3	6440108	Pin
5	153	3	3	3	3	3			3	3	3									6275256G1	Movable intermediate contact
5	153						3	3				3	3							6275256G1	Movable intermediate contact
5	153													3	3	3	3	3	3	6420221G2	Movable intermediate contact
5	154	3	3	3	3	3	3	3	3	3	3	3	3							6420271G1	Movable arcing contact
5	154													3	3	3	3	3	3	6420272G1	Movable arcing contact
5	155	3	3	3	3	3	3	3	3	3	3	3	3							6245402P1	Pin
5	155													3	3	3	3	3	3	6440115	Pin
5	156	3	3	3	3	3	3	3	3	3	3	3	3							6149985	Spring guide
5	156													3	3	3	3	3	3	6440172	Spring guide
5	157	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6509745	Spring, outer
5	158	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6509746	Spring, intermediate
5	159	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6509747	Spring, inner
5	160	3	3	3	3	3			3	3	3									6149967P1	Insulation cup
5	160						3	3					3	3						6149967P2	Insulation cup
5	161	3	3						3	3				3	3					6193967G23	Tube and piston assembly
5	161			3	3	3	3	3			3	3	3			3	3	3	3	6316606G23	Tube and piston assembly

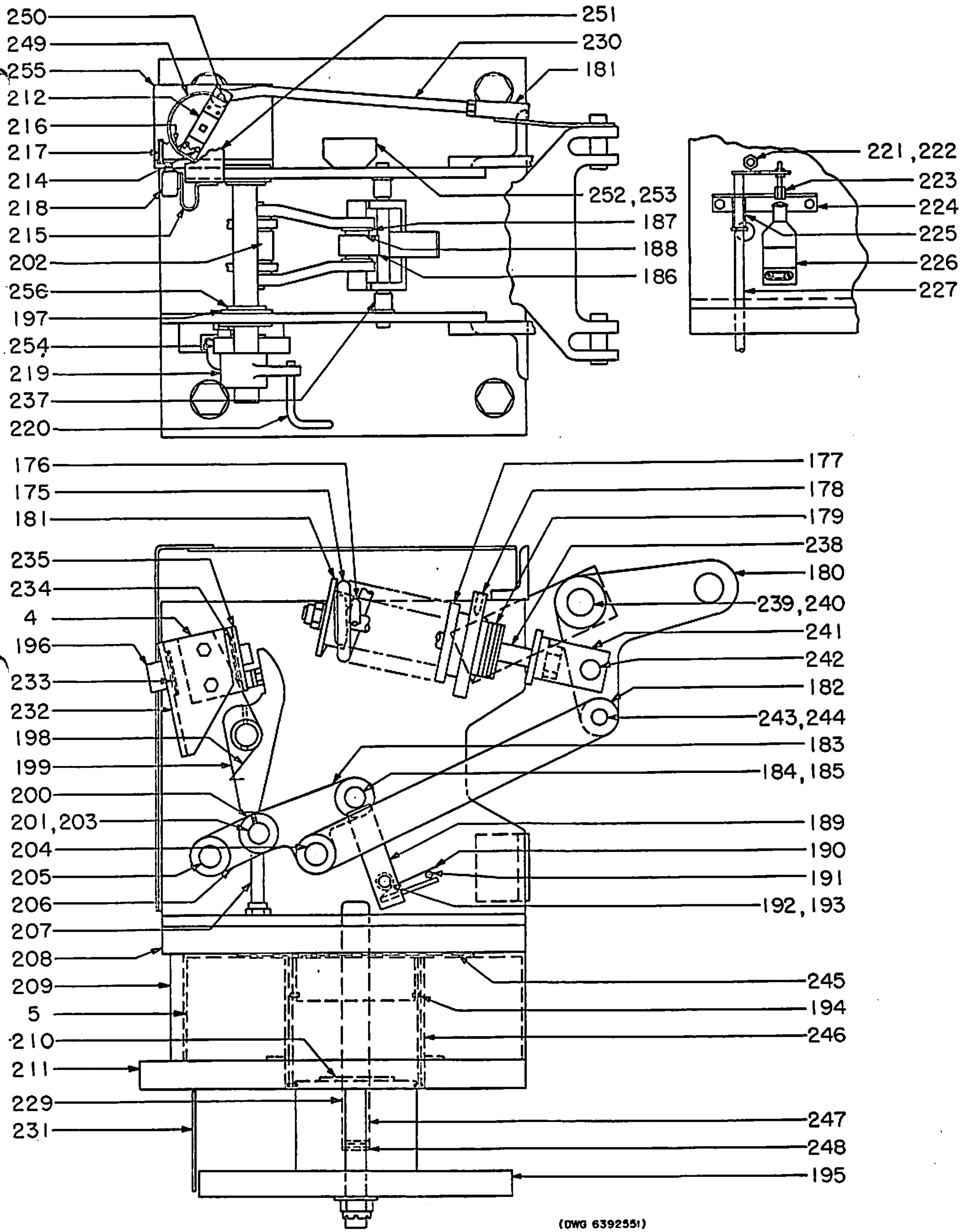


Fig. 6. Type MS solenoid mechanism

Fig. No.	Ref. No.	Number Required for MS- 10	10A	10B	10B-1	10BY	10BZ	Cat. No.	Description
									PARTS RECOMMENDED FOR NORMAL MAINTENANCE
2	4	1	1	1	1	1	1	6275070G1	Trip coil, 24-volt, d-c
2	4	1	1	1	1	1	1	6275070G2	Trip coil, 48-volt, d-c
2	4	1	1	1	1	1	1	6174582G1	Trip coil, 125-volt, d-c
2	4	1	1	1	1	1	1	6174582G2	Trip coil, 250-volt, d-c
2	4	1	1	1	1	1	1	6275070G1	Trip coil, 115-volt, a-c
2	4	1	1	1	1	1	1	6174582G14	Trip coil, 230-volt, a-c
2	5	1	1	1	1	1	1	6306764G3	Closing coil, 125-volt, d-c
2	5	1	1	1	1	1	1	6306764G4	Closing coil, 250-volt, d-c
									PARTS SELDOM REQUIRED
6	175	1	1		1	1	1	6301377	Outer spring
6	175			1				6301376	Outer spring
6	176	1	1		1	1	1	6370617	Inner spring
6	176			1				6301377	Inner spring
6	177	1						6370580P1	Guide for spring
6	177		1	1	1	1	1	6476714P1	Guide for spring
6	178	2	2	2	2	2	2	6193968P42	Set screw, hollow hd, cup pt., 1/4 in.-20, 1/4 in.
6	179	6	6	6	6	6	6	6370572P4	Buffer washer
6	180	1						6193968G40	Crank assembly
6	180		1	1	1	1	1	6193968G36	Crank assembly
6	181	1	1	1	1	1	1	6371478G1	Coupling
6	182	1	1	1	1	1	1	6420224P1	Link
6	183	1	1	1	1	1	1	6318160P1	Link
6	184	1	1	1	1	1	1	6371491P12	Pin
6	185	2	2	2	2	2	2	6477424P7	Retaining ring
6	186	1	1	1	1	1	1	6477418BAP15	Needle bearing
6	187	15	15	15	15	15	15	6477400P7	Washer
6	188	2	2	2	2	2	2	6002721P391	Spacer
6	189	1	1	1	1	1	1	6370577G1	Prop
6	190	1	1	1	1	1	1	6301380	Spring
6	191	1	1	1	1	1	1	6440990	Pin
6	192	1	1	1	1	1	1	6440987	Pin
6	193	2	2	2	2	2	2	6008491P10	Washer
6	194			2	2	2	2	6476710P1	Piston ring
6	195	1	1					6370589G1	Armature and plate
6	195			1	1	1	1	6476712G1	Armature and plate
6	196	1	1	1	1	1	1	6508713G1	Armature and plunger assembly
6	197	2				2		6477418AAP5	Ball bearing
6	197			2	2		2	6477418AAP2	Ball bearing
6	198	1		1	1	1	1	6172825P1	Spring
6	199	1		1	1	1	1	6193968G38	Latch assembly
6	200	2		2	2	2	2	6193968P102	Set screw, 8-36, 1/4 in., headless, cone pt, stl
6	201	1		1	1	1	1	6441148	Pin
6	202	1		1	1	1	1	6477418BAP10	Needle bearing
6	203	2		2	2	2	2	6177015P12	Washer
6	204	2		2	2	2	2	6440148	Pin
6	205	1		1	1	1	1	6440154	Pin
6	206	1		1	1	1	1	6370579G1	Yoke
6	207	1		1	1	1	1	6440137	Stud
6	208	1						6370586G1	Plate and pole piece
6	208			1	1	1	1	6476700G2	Plate and pole piece
6	209	1		1	1	1	1	6370581P1	Pot
6	210	1		1	1	1	1	6300924P13	Washer
6	211	1		1	1	1	1	6370582P1	Bottom plate
6	212	1		1		1	1	6117501G3	Support
6	213	1		1		1	1	6318131P2	Crank
6	213				1			6508728P1	Crank

Fig. No.	Ref. No.	Number Required for MS- 10	10A	10B	10B-1	10BY	10BZ	Cat. No.	Description
6	214	1		1		1	1	6147122	Pin
6	214				1			6442807	Pin
6	215	1		1	1	1	1	6243920	Support
6	216	1		1	1	1	1	6176838	Spring
6	217	1		1	1	1	1	6245825	Pin
6	218	1		1	1	1	1	6192382P5	Operation counter
6	219	1		1	1	1	1	6117509P1	Crank
6	220	1		1	1	1	1	6243020P2	Trip rod
6	221	1		1	1	1	1	6440905	Buffer
6	222	1		1	1	1	1	6440938	Stop stud
6	223	1		1	1	1	1	6440904	Adjusting stud
6	224	1		1	1	1	1	6370592P1	Bracket
6	225	1		1	1	1	1	6370610	Spring
6	226	1		1	1	1	1	6412114P2	Cut-off switch
6	227	1		1	1	1	1	6476341G1	Operating rod
6	228	1		1		1	1	6305650G2	Auxiliary switch
6	228				1			6577001G1	Auxiliary switch
6	229	1						6440134P1	Stud
6	229		1	1	1	1	1	6440143P2	Stud
6	230	1	1	1	1	1	1	6551045P2	Eye bolt
6	231	1	1	1	1	1	1	6318278P1	Cover
6	232	1	1	1	1	1	1	6055108	Support
6	233	1	1	1	1	1	1	6048842P2	Washer
6	234	2	2	2	2	2	2	6048842P1	Washer
6	235	1	1	1	1	1	1	6055109	Support
6	236	2	2	2	2	2	2	6370572P2	Washer
6	237	2	2	2	2	2	2	6076413P279	Spacer
6	238	1	1	1	1	1	1	6300046P13	Bolt
6	239	1	1	1	1	1	1	6076409P188	Pin
6	240	8	8	8	8	8	8	6008491P2	Washer
6	241	1	1	1	1	1	1	6440134	Yoke
6	242	1	1	1	1	1	1	6076407P180	Pin
6	243	1	1	1	1	1	1	6076406P118	Pin
6	244	4	4	4	4	4	4	6008491P3	Washer
6	245	4	4	4	4	4	4	6046816P1	Shim
6	246		1	1	1	1	1	6440951	Tube
6	247	1						6370509P1	Plunger
6	247		1	1	1	1	1	6370509P3	Plunger
6	248	8	8	8	8	8	8	6370572P2	Washer
6	249	1	1	1		1	1	---------	Semaphore
6	249				1			6557052G1	Semaphore and bracket
6	250	1	1	1	1	1	1	6056154	Pin
6	251	1	1	1	1	1	1	6440147	Cover for semaphore
6	252	1	1	1	1	1	1	6551084G1	Terminal board and hardware
6	253	1	1	1	1	1	1	6157223P2	Marking strip
6	254	1	1	1	1	1	1	6146194P2	Pin
6	255				1			6508688P1	Bracket
6	256	8	8	8	8	8	8	490072	Washer

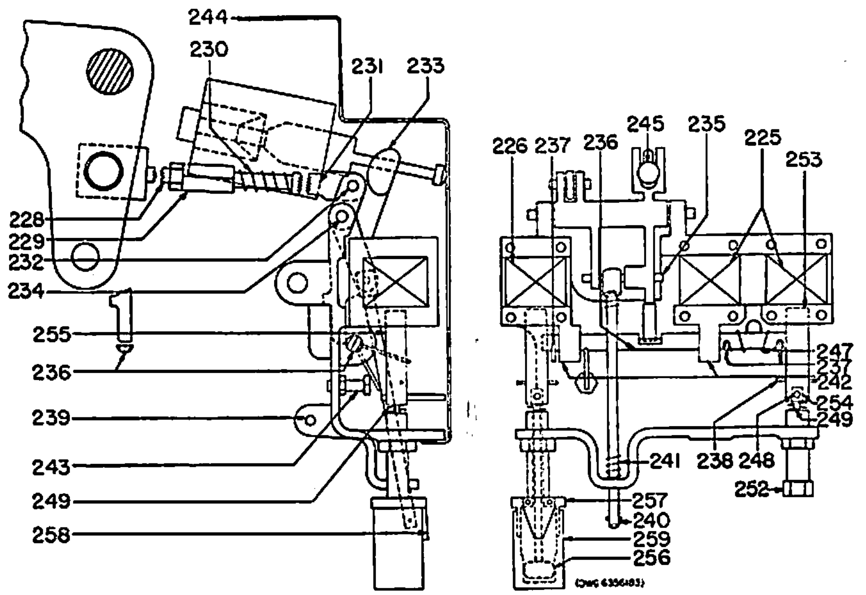


Fig. 7. Current trip mechanism for solenoid mechanism

Fig. No.	Ref. No:	Cat. No.	No. Required	Description
				PARTS RECOMMENDED FOR NORMAL MAINTENANCE
7	225	6174599G2	3	Trip coil, 3 amp for instantaneous only
7	226	22D3G226	3	Trip coil, 5 amp
7	227	6174599G6	1	Trip coil, capacitor trip for instantaneous only
				PARTS SELDOM REQUIRED
7	228	6371498G1	1	Connecting rod
7	229	6476300G1	1	Adjusting rod and coupling
7	230	6074238	1	Spring
7	231	6371499P1	1	Guide
7	232	6076402P3	1	Pin
7	233	6318259G1	1	Trip lever
7	234	6076402P49	1	Pin
7	235	6076401P17	1	Pin
7	236	6440860	1	Shaft
7	237	6193957P209	5	Dowel pin for spring
7	238	6193957P34	†	Groov-pin
7	239	6076402P72	1	Pin
7	240	6440885	1	Guide for spring
7	241	6370644	1	Spring
7	242	6193957P203	2	Needle bearing for trip shaft
7	243	6176575P3	1	Stop
7	244	6318258P1	1	Cover
7	245	6440865	1	Plunger
7	246	6074557P3	‡	Guide for armature
7	247	6370645	1	Torsion spring
7	248	6247927	†	Pin
7	249	6477094	†	Spring
7	250	6247919	3	Calibrating spring
7	251	6247927	†	Pin
7	252	6247924	†	Calibrating tube for instantaneous only
7	253	6247926	†	Armature for instantaneous only
7	254	6247925	†	Guide pin
7	255	6247923	†	Armature for time delay only
7	256	6301295G1	†	Piston for time delay only
7	257	6370204P1	†	Body for time delay only
7	258	6048813	†	Spring for time delay only
7	259	6247920	†	Well for time delay only

‡ Two for each trip coil furnished
† One for each trip coil furnished

GEI-23961E

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DO NOT DESTROY

INSTRUCTIONS *Switchgear*

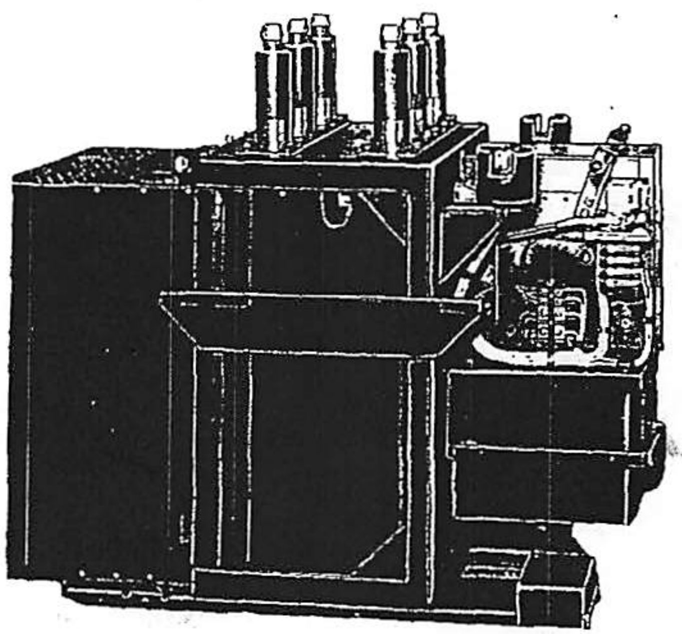
POWER CIRCUIT BREAKERS

Magne-blast Breakers

Types

AM-5-100-3, -3Y, -3Z
AM-5-100-4, -4Z
AM-5-100-5
AM-5-100-6
AM-5-150-3, -3Y, -3Z
AM-5-150-4, -4Z
AM-5-150-5
AM-5-150-6
AM-5-250-0, -0Y
AM-5-250-1
AM-5-250-2
AM-5-250-3

With MS-10, MS-10A, MS-10B, MS-10B-1 MS-10BY, and MS-10BZ Mechanisms



GENERAL ELECTRIC

CONTENTS

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.

LIST OF ILLUSTRATIONS

MAGNE-BLAST AIR CIRCUIT BREAKERS

TYPES AM-5-100, AM-5-150, AM-5-250, WITH MS-10, MS-10A, MS-10B, MS-10B-1, MS-10BY, & MS-10BZ MECHANISMS

INTRODUCTION

The Magne-blast Air Circuit Breaker shown on the cover is a triple pole breaker with an integral solenoid-operated mechanism and is arranged for application in Vertical Lift Metal-Clad Switchgear.

The AM-5-100 & 150 breakers are available in 600, 1200, or 2000 ampere ratings and the AM-5-250 breakers in 1200 and 2000 ampere ratings as indicated on the breaker nameplate, and all are designed for application at a maximum circuit voltage of 5000 volts. These instructions apply only to the breaker types listed on the front cover.

The breaker-mechanism combination is designed for electrical closing only. The maintenance operating device is supplied only for use in making adjustments. NEVER ATTEMPT MANUAL CLOSING WITH THE BREAKER IN SERVICE, for under such conditions, sufficient closing force and speed cannot be applied.

PROPER INSTALLATION AND MAINTENANCE ARE NECESSARY TO INSURE CONTINUED SATISFACTORY OPERATION OF THE BREAKER.

The various accessories that can be applied on the MS-10 Mechanisms are described in the appendix under "Accessories".

RECEIVING, HANDLING AND STORAGE

RECEIVING

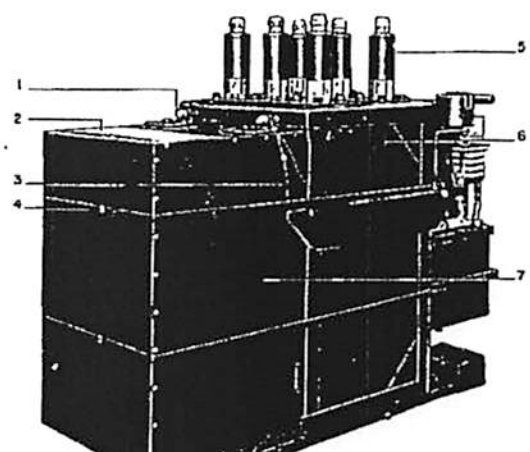
Each circuit breaker is carefully inspected and is then packed by workmen experienced in the proper handling of electrical switchgear.

Immediately on receipt of a circuit breaker, an examination should be made for any damage sustained during shipment. If injury or rough handling is evident, a damage claim should be filed at once with the Transportation Company, and the nearest General Electric Company's Sales Office should be notified promptly.

HANDLING

The crating must be removed carefully. Care must be taken not to damage the primary disconnects (5) Figure 1. Use a nail puller to open the crates and do not allow the primary disconnects to be struck by the tools while handling. Frequently, "loose parts" associated with the apparatus are included in the crate. Care should be taken to make certain that these parts are not overlooked.

After the breaker has been removed from the crating, wire bands (4) (or wood clamping bar) holding the box barrier (7) in position should be removed and discarded. Box barrier cover (2) seals the top holes during shipment. Seal (3) insures that only authorized personnel remove the box barrier when the breaker is unpacked. To lift the breaker with hooks, an opening at (6) is provided on each side of the breaker.



1. Thumb Screws
2. Box Barrier Cover
3. Seal
4. Wire Bands
5. Primary Disconnects
6. Lift Point
7. Box Barrier

Fig. 1 AM-5 Breaker After Removal From Packing Crate

Fig. 1 (8009906)

STORAGE

It is advisable that the breaker be set up immediately, but if it must be stored, it should be kept in a clean dry place, free from corrosive gases or fumes. During construction work, particular care should be taken to protect this apparatus from moisture and cement dust as this combination has a very corrosive effect on many parts. All machined parts except the contacts should be coated with heavy oil or grease to prevent rusting.

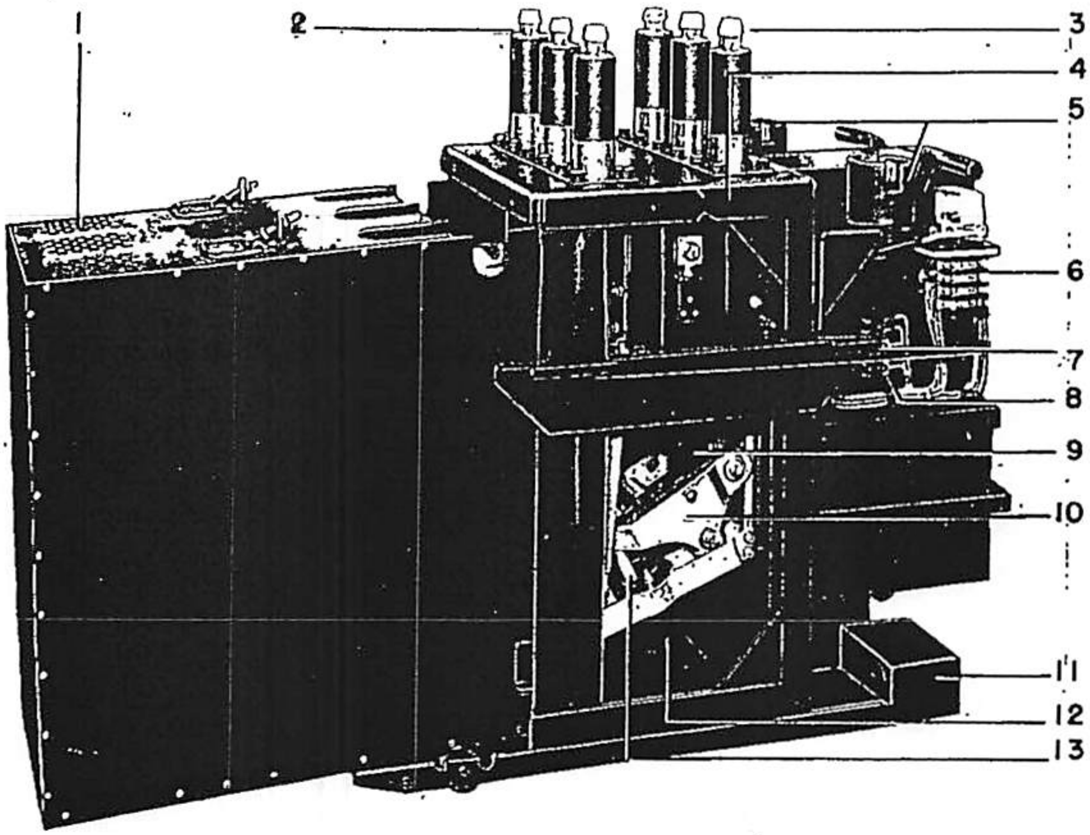


Fig. 2 (8010181)

1. Box Barrier
2. Rear Bushings
3. Front Bushings
4. Frame
5. Secondary Couplers
6. Auxiliary Switch
7. Lifting Lugs
8. Terminal Block
9. Operating Rod
10. Movable Contact Arm
11. Wheel Channels
12. Booster Cylinder
13. Booster

Fig. 2 Left Side View of AM-5-250 Breaker

DESCRIPTION

MECHANISM

Each magne-blast circuit breaker is furnished with an operating mechanism. This mechanism is capable of closing and latching the breaker on an energized circuit. A closing solenoid actuates an armature passing through its center, and the armature moves the linkage which closes the breaker contacts. When the trip coil is energized, its armature causes the linkage to collapse, allowing the opening springs of the mechanism to open the breaker contacts. This procedure is explained in detail under, "Principles of Operation".

BREAKER ELEMENT

The breaker element shown in Figure 2 consists of a fabricated frame (4) on which six bushings (2) & (3) are mounted. The bushings are made with ball ends for good contact and easy installation in the vertical metal-clad switchgear.

The arc chutes, primary, secondary, and arcing contacts, and the two upper blow-out coils are mounted on the rear bushings (2). The movable primary, secondary, and arcing contacts are pivoted about the lower end of the front bushings (3). The movable contact arms (10) are actuated by insulating operating rods (9) which fasten to the solenoid mechanism. The secondary contact casting holds the booster tube (13) which connects to the piston in the plastic booster cylinder (12). The booster cylinder supplies air for aiding the interruption of low currents.

The three arc chutes are made of an arc-resisting insulating material where the arc is interrupted. The box barrier is made of an insulating compound and segregates the three interrupting units.

INSTALLATION

Outline, wiring and all other drawings relating to dimensions, electrical connections, and control should be on hand so that points in question are readily settled as they arise. Before any installation work is done, consult these drawings and the Instruction Book for the "Metal-clad Switchgear" GEI-25390.

PRECAUTIONS

Before making any adjustments, the following precautions should be noted:

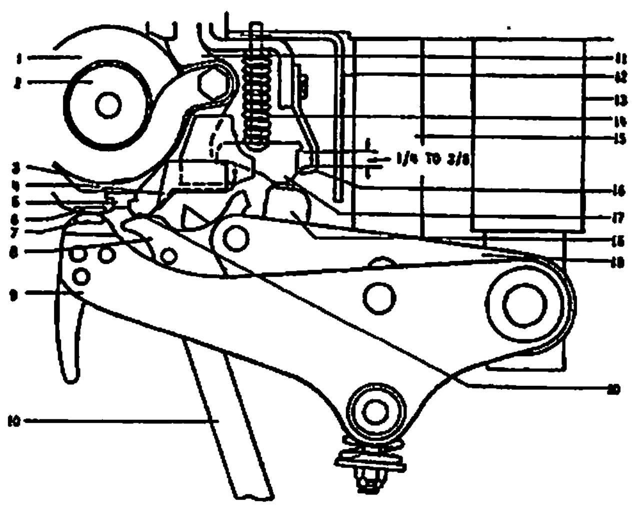
1. Make certain that all control circuits have been de-energized.
2. Make certain that the primary breaker circuits are open and effectively grounded.
3. Never work on either the breaker or the mechanism while in the closed position unless the prop and trip latch have been wired or blocked to prevent accidental tripping.

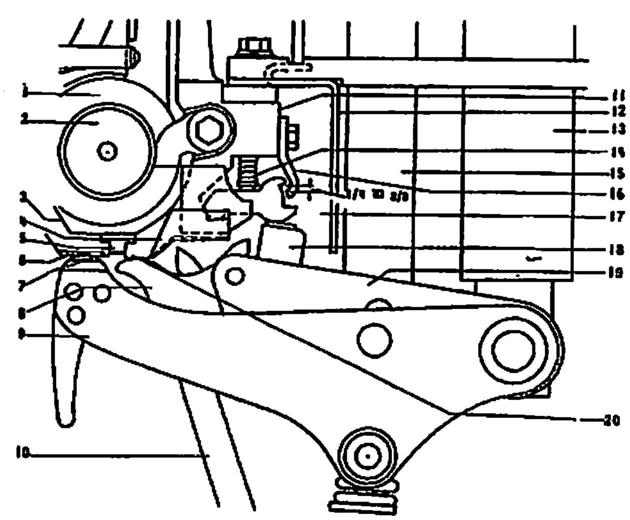
ADJUSTMENTS

Although the breaker has been completely assembled, adjusted, and thoroughly tested at the factory, it is advisable to review all adjustments before placing the breaker in service, as it is possible that some of the adjustments may have changed slightly during shipment and installation. A maintenance operating device is provided for operation of the breaker during these adjustment checks. Electrical operation should not be attempted until the breaker has been operated manually through its complete stroke and all adjustments checked.

PRIMARY CONTACTS (See Figures 3 & 4)

When the breaker is closed, the primary contacts (17) should raise 1/4" to 3/8" as shown in Figures 3 and 4. This wipe can be adjusted by means of the operating rod adjusting screw. To adjust, open the breaker, remove the box barrier and after removing the cotter pin in one end of the shaft through the top of the operating rods, slide the shaft free of the rod to be adjusted. Loosen the check nut on the operating rod adjusting screw and shorten the screw to increase the primary contact wipe or lengthen the screw to decrease the primary contact wipe (1/2 turn of the eyebolt gives approximately 5/64" change in the wipe). Replace the check nut, shaft, cotter pin, and close the breaker to check the adjustment.





1. Coil
2. Core
3. Arc Runner
4. Shield
5. Insulation
6. Arcing Contact
7. Arcing Contact
8. Secondary Contact
9. Arcing Blade
10. Booster Tube
11. Contact Support
12. Shield
13. Front Bushing
14. Contact Spring
15. Operating Rod
16. Retainer
17. Primary Contact Finger
18. Primary Contact Block
19. Primary Blade
20. Secondary Contact

Fig. 3 Primary Contact Wipe, 1200 Amp

Fig. 4 Primary Contact Wipe, 2000 Amp

Fig. 3 (K-6557234)

Fig. 4 (K-6557225)

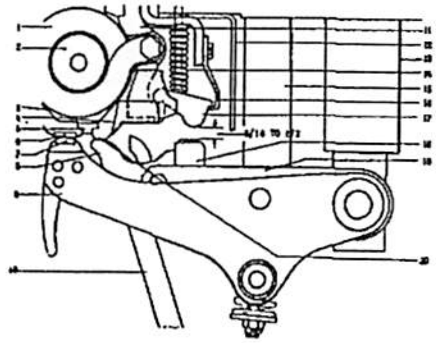


Fig. 5 Primary Contact Gap

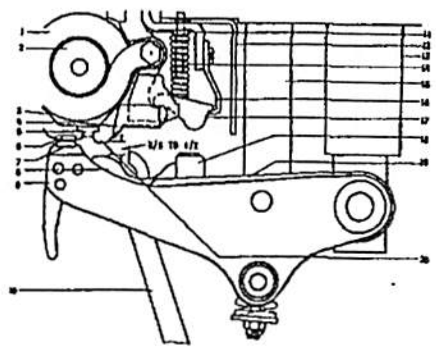
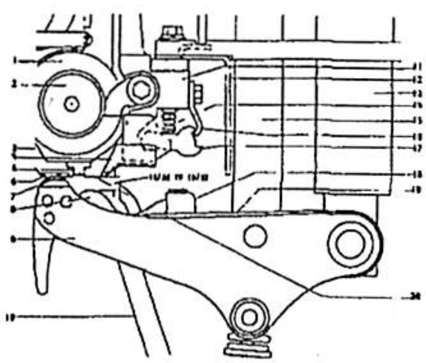


Fig. 6 Secondary Contact Gap, 1200 Amp



1. Coil
2. Core
3. Arc Runner
4. Shield
5. Insulation
6. Arcing Contact
7. Arcing Contact
8. Secondary Contact
9. Arcing Blade
10. Booster Tube
11. Contact Support
12. Shield
13. Front Bushing
14. Contact Spring
15. Operating Rod
16. Retainer
17. Primary Contact Finger
18. Primary Contact Block
19. Primary Blade
20. Secondary Contact

Fig. 7 Secondary Contact Gap, 2000 Amp

INTERMEDIATE CONTACTS (See Figure 5)

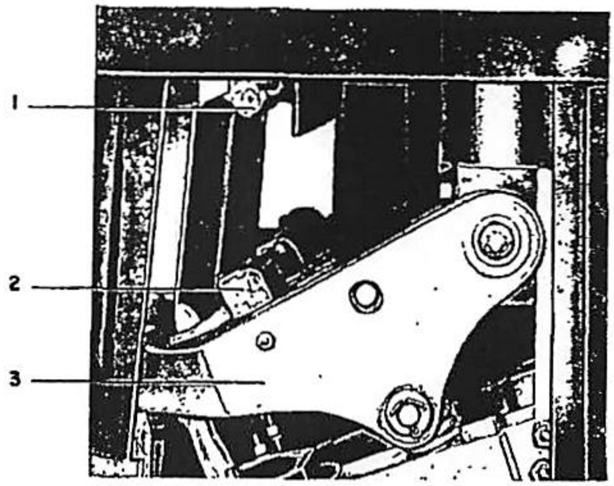
Close the breaker with the manual operating mechanism until the intermediate contacts (20) first touch. The gap between the primary contact fingers (17) and the movable primary contact block (18) should be 5/16" to 1/2" on the 600, 1200 and 2000 ampere sizes. This dimension has been set at the factory and no adjustment is provided. If enough material has been eroded away from the contacts to make this clearance too small, the contacts should be replaced.

ARCING CONTACTS (See Figures 6 & 7)

Close the breaker with the manual operating mechanism until the arcing contacts (6 & 7) just touch. The gap at the intermediate contacts (8 & 20) should be 3/8" to 1/2" on the 600 and 1200 ampere breakers, and 15/32" to 19/32" on the 2000 ampere breakers. The arcing contacts have been set in the factory, and no adjustment is provided. If enough material has been eroded from the contacts to make this clearance too small, the contacts should be replaced.

CONTACT GAP (See Figure 8)

With the breaker tripped from the closed position, the gap between the primary contacts (1 and 2)



1. Stationary Primary Contact
2. Movable Primary Contact
3. Arcing Blade

Fig. 8 Contact Gap, Breaker Tripped

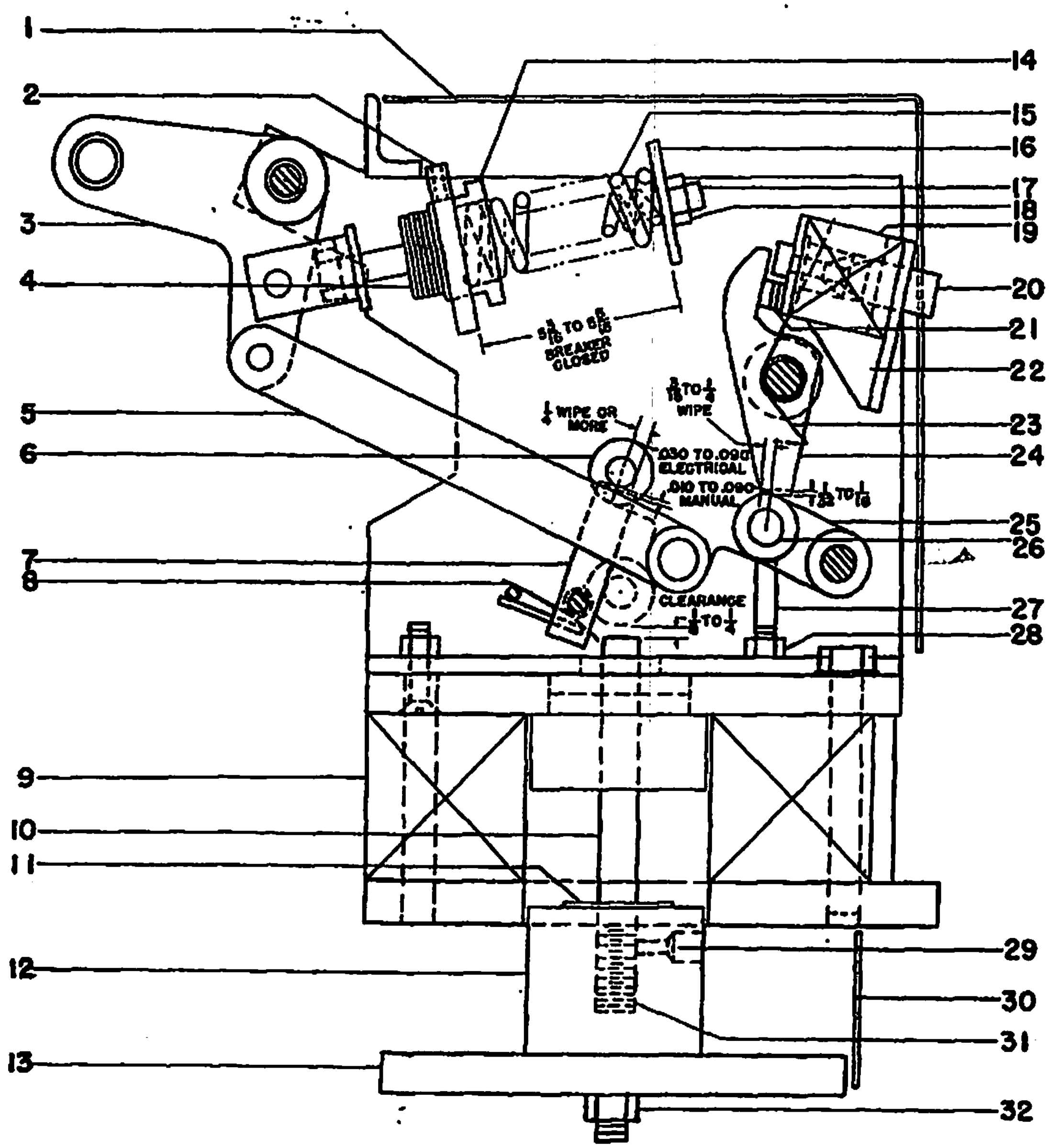
should be 3-3/8" + 1/8" -1/16". To change this gap, loosen set screws (Part 2) Fig. 9 holding the combination opening spring and guide-buffer stop (14), and then screw the guide-stop (14) into or out of the plate which holds it. Turning the stop out toward the front of the mechanism increases the primary gap. Note: A change in this adjustment may require a change in the "Plunger Clearance" described later.

Fig. 5 (K-6557232)

Fig. 6 (K-6557233)

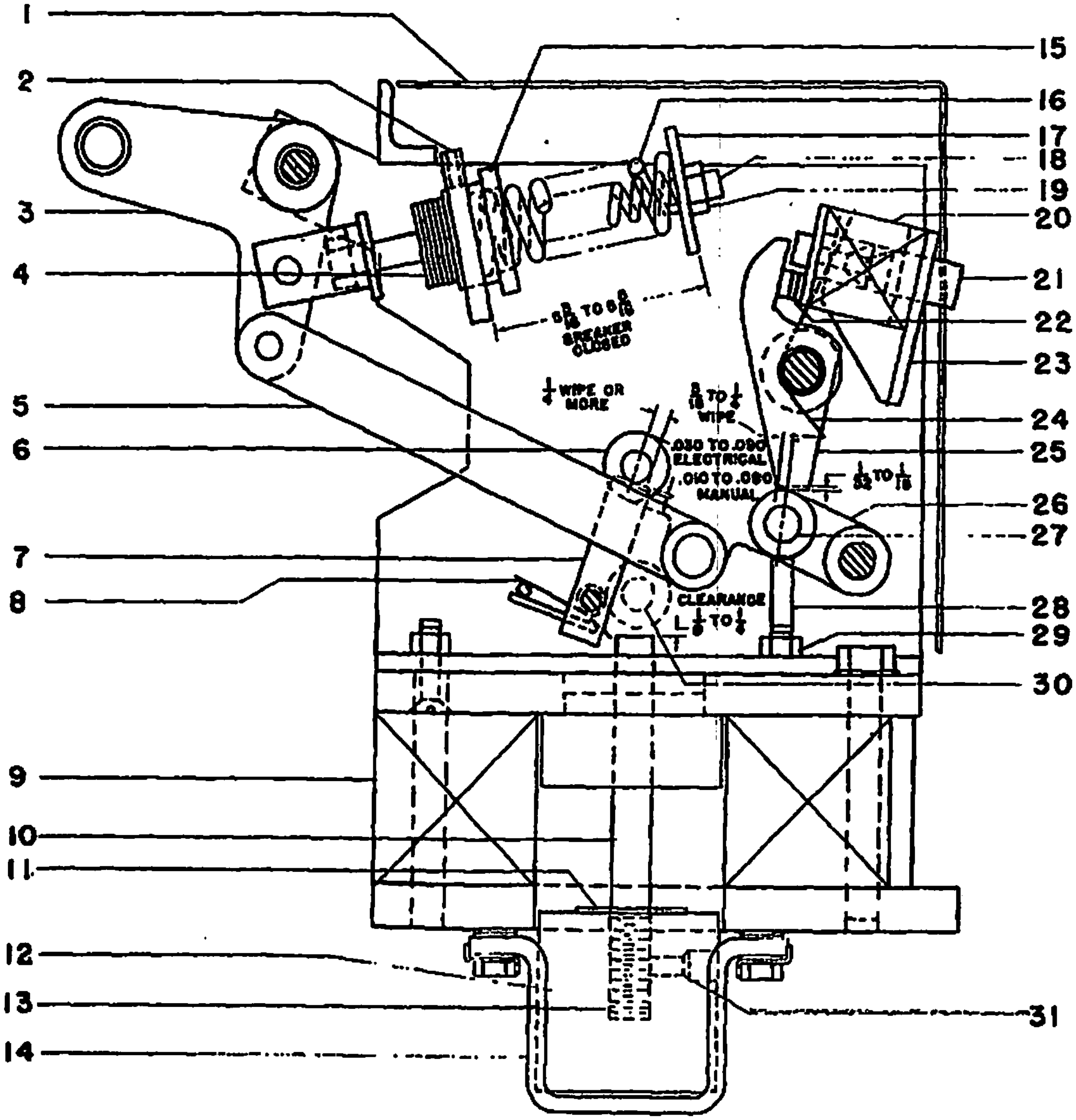
Fig. 7 (K-6557223)

Fig. 8 (8010184)



1. Cover
2. Set Screw
3. Crank
4. Buffer
5. Link
6. Closing Roller
7. Prop
8. Prop Spring
9. Closing Coil
10. Plunger
11. Washer
12. Armature
13. Bottom Plate
14. Guide Stop
15. Opening Springs
16. Washer
17. Stud
18. Crown Nut
19. Trip Coil
20. Trip Coil Armature
21. Stop
22. Trip Coil Support
23. Latch Spring
24. Latch
25. Yoke
26. Trip Roller
27. Stop Bolt
28. Nut
29. Set Screws
30. Shield
31. Spacers
32. Guide Stud and Nut

Fig. 9 Left View of MS-10 Mechanism



1. Cover	12. Armature	22. Stop
2. Set Screw	13. Spacers	23. Trip Coil Support
3. Crank	14. Support	24. Latch Spring
4. Buffer	15. Guide Stop	25. Latch
5. Link	16. Opening Springs	26. Yoke
6. Closing Roller	17. Washer	27. Trip Roller
7. Prop	18. Stud	28. Stop Bolt
8. Prop Spring	19. Crown Nut	29. Nut
9. Closing Coil	20. Trip Coil	30. Pin
10. Plunger	21. Trip Coil Armature	31. Set Screws
11. Washer		

Fig. 10 Left Side View of MS-10A Mechanism

Fig. 10 (P-8597763)

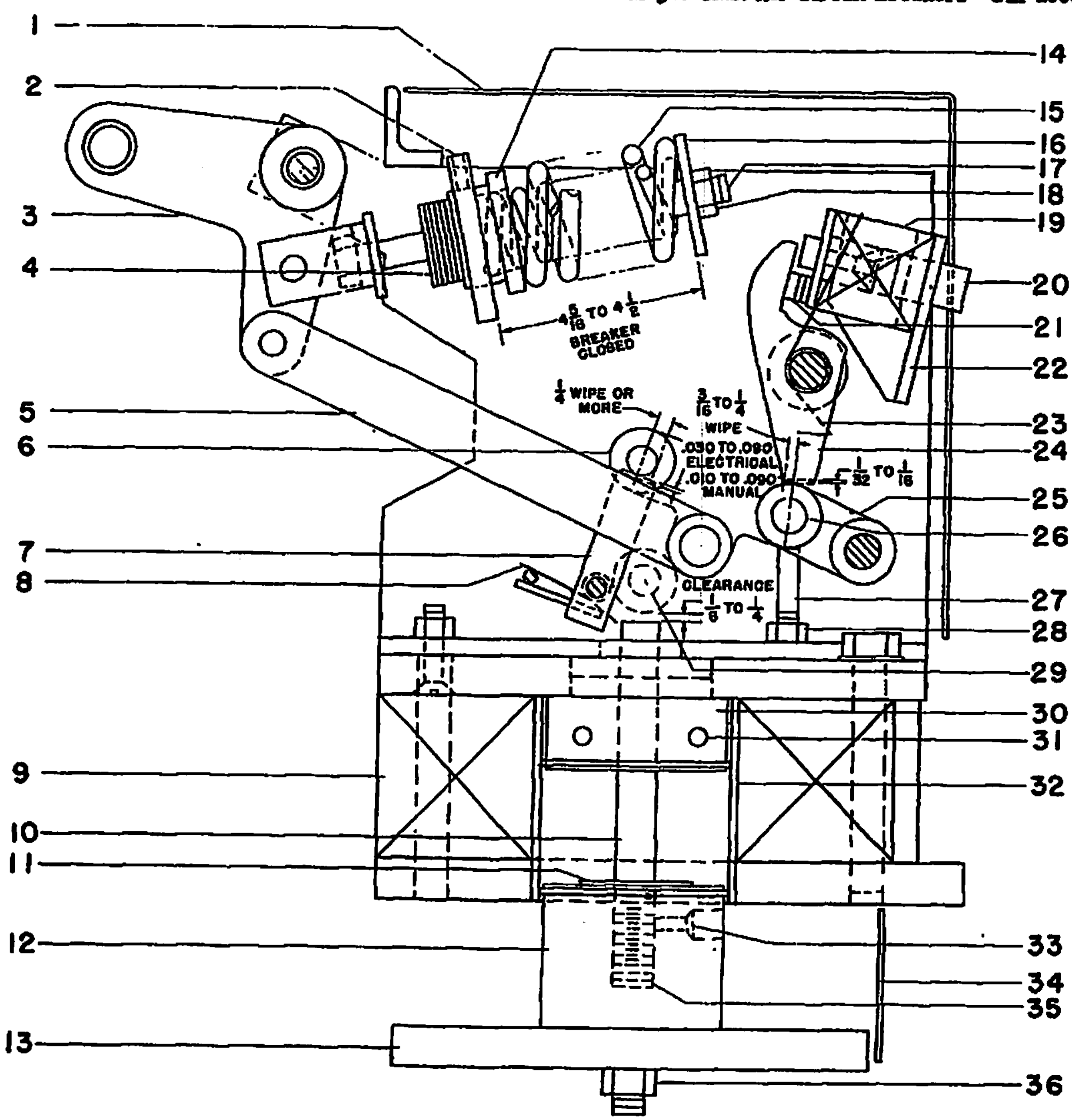
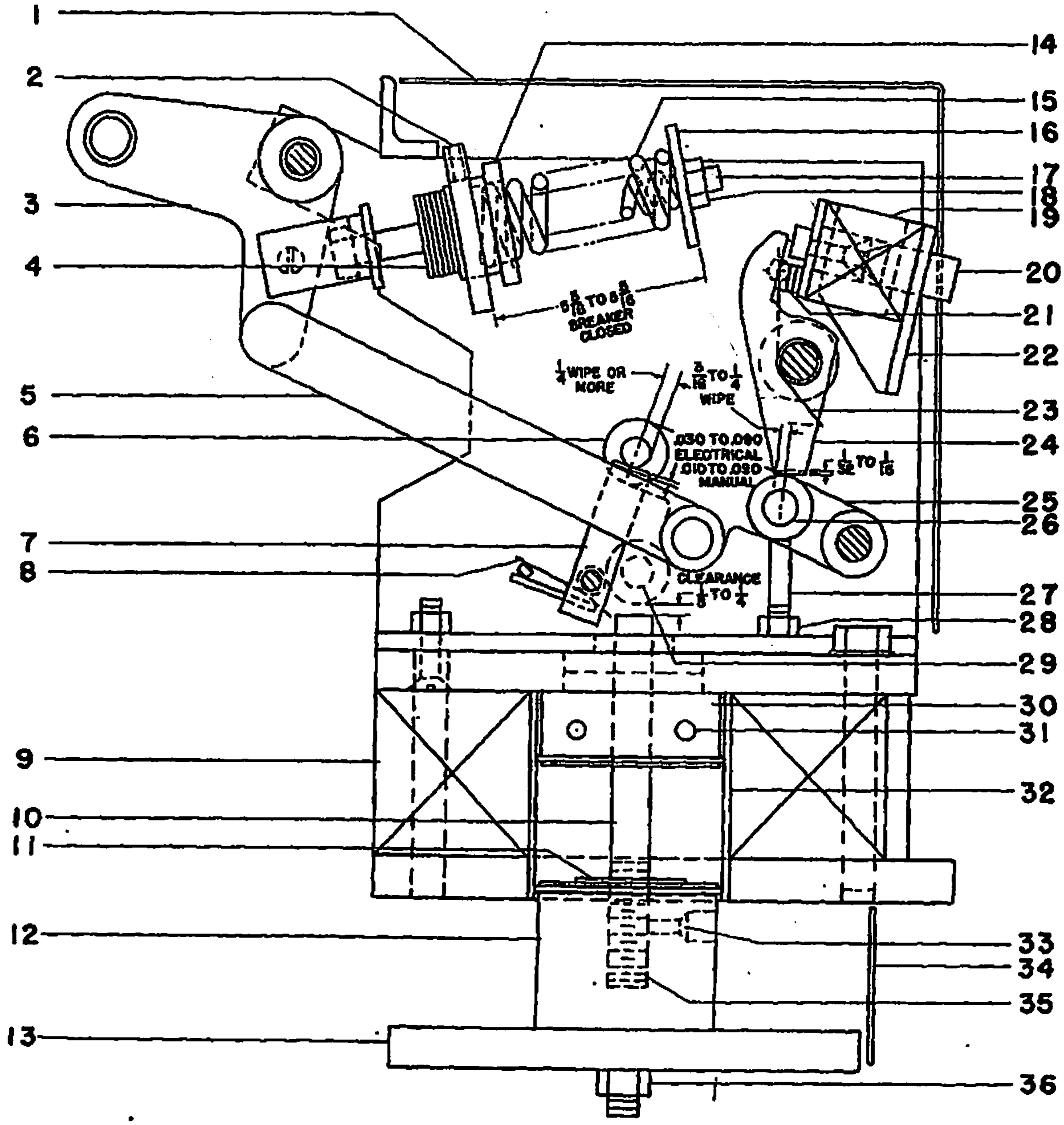


Fig. 11 (P-6547741)

1. Cover
2. Set Screw
3. Crank
4. Buffer
5. Link
6. Closing Roller
7. Prop
8. Prop Spring
9. Closing Coil
10. Plunger
11. Washer
12. Armature
13. Bottom Plate
14. Guide Stop
15. Opening Springs
16. Washer
17. Stud
18. Crown Nut
19. Trip Coil
20. Trip Coil Armature
21. Stop
22. Trip Coil Support
23. Latch Spring
24. Latch
25. Yoke
26. Trip Roller
27. Stop Bolt
28. Nut
29. Pin
30. Pole Piece
31. Groove Pins
32. Sleeve
33. Set Screws
34. Cover
35. Spacers
36. Guide Stud and Nut

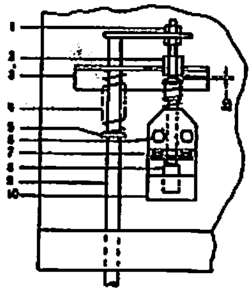
Fig. 11 Left Side View of MS-10B Mechanism



1. Cover
2. Set Screw
3. Crank
4. Buffer
5. Link
6. Closing Roller
7. Prop
8. Prop Spring
9. Closing Coil
10. Plunger
11. Washer
12. Armature
13. Bottom Plate
14. Guide Stop
15. Opening Springs
16. Washer
17. Stud
18. Crown Nut
19. Trip Coil
20. Trip Coil Armature
21. Stop
22. Trip Coil Support
23. Latch Spring
24. Latch
25. Yoke
26. Trip Roller
27. Stop Bolt
28. Nut
29. Pin
30. Pole Piece
31. Groove Pins
32. Sleeve
33. Set Screws
34. Cover
35. Spacers
36. Guide Stud and Nut

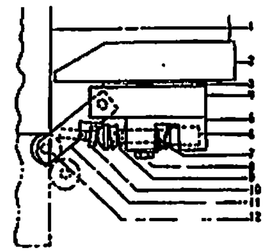
Fig. 12 Left Side View of MS-10B-1, MS-10BY and MS-10BZ Mechanisms

Fig. 12 (P-6547745)



1. Nut
2. Screw
3. Support
4. Springer
5. Retainer
6. Terminal
7. Contacts
8. Armature
9. Plunger Rod
10. Switch Base

Fig. 13 Cut-off Switch (MS-10B-1)



1. Armature
2. Frame
3. Shims
4. Base
5. Switch
6. Switch Armature
7. Contacts
8. Terminals
9. Spring
10. Screw
11. Arm
12. Roller

Fig. 14 Cut-off Switch (MS-10A)

Fig. 14 (K-6557235) (K-6557230) Fig. 13

LATCH WIPE (See Figures, 9, 10, 11,12)

The wipe of the latch (24) on the trip roller (26) (numbers refer to Fig. 9) should be from 3/16" to 1/4". This can be determined by putting a film of grease on the latch (24), closing the breaker part way, and tripping, to adjust, add, or remove washers under the head of the stop bolt (21) located near the top of the latch on the trip coil frame (22).

PROP CLEARANCE (See Figures, 9, 10, 11, 12)

When the breaker is closed as far as possible with the manual operating mechanism, the clearance of the pin through the closing roller (6) (numbers refer to Fig. 9) over the prop (7) should be .010 to .090". When the breaker is closed electrically, (cut-off switch blocked open to keep plunger in elevated position) the clearance over the prop should be .030-.090". This can be adjusted by dropping the closing coil (9) and screwing the plunger rod (10) into or out of the armature (12). Note: Two set screws (29) are used to lock the plunger rod in position in the armature. If the rod adjustment is changed, the rod must be spotted in the correct position and the set screws replaced. Spacers (31) should be added or removed to keep the space between the plunger (10) and armature (12) full.

LATCH CLEARANCE (See Figures 9, 10,11, 12)

The clearance between the trip latch (24) and roller (26) with the breaker open should be 1/32" to 1/16". This adjustment can be made by means of stop bolt (27) in the front of the mechanism frame near the bottom. The lock nut (28) should be fastened securely if any adjustment has been made.

PLUNGER CLEARANCE (See Figures 9, 10, 11, 12)

With the breaker in the open position, there should be 1/8" to 1/4" clearance between the plunger (10) and the closing roller (6). To change this clearance, the nuts (32) on the armature plate guide bolts can be run up or down to change the at-rest position of the MS-10 Mechanism.

CUT-OFF SWITCH (See Figure 13)

To adjust for the clearance of 1/32" shown in Figure 15, proceed as follows:

1. Close the breaker using the manual operating mechanism (leaving the manual operating mechanism in place).

2. Pin Figure 9 is resting on prop (7).

FINAL INSPECTION

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

   a. Wipe of primary contacts, 1/4" to 3/8".

   b. Gap between primary contact block and fingers, with the intermediate contacts just touching, 5/16" to 1/2".

   c. Intermediate contact gap, with the arcing contacts just touching, 3/8" to 1/2" (for 600 and 1200 Amps.), 15/32" to 19/32" (for 2000 Amps.).

   d. Primary contact gap, 3-3/8" + 1/8" -1/16".

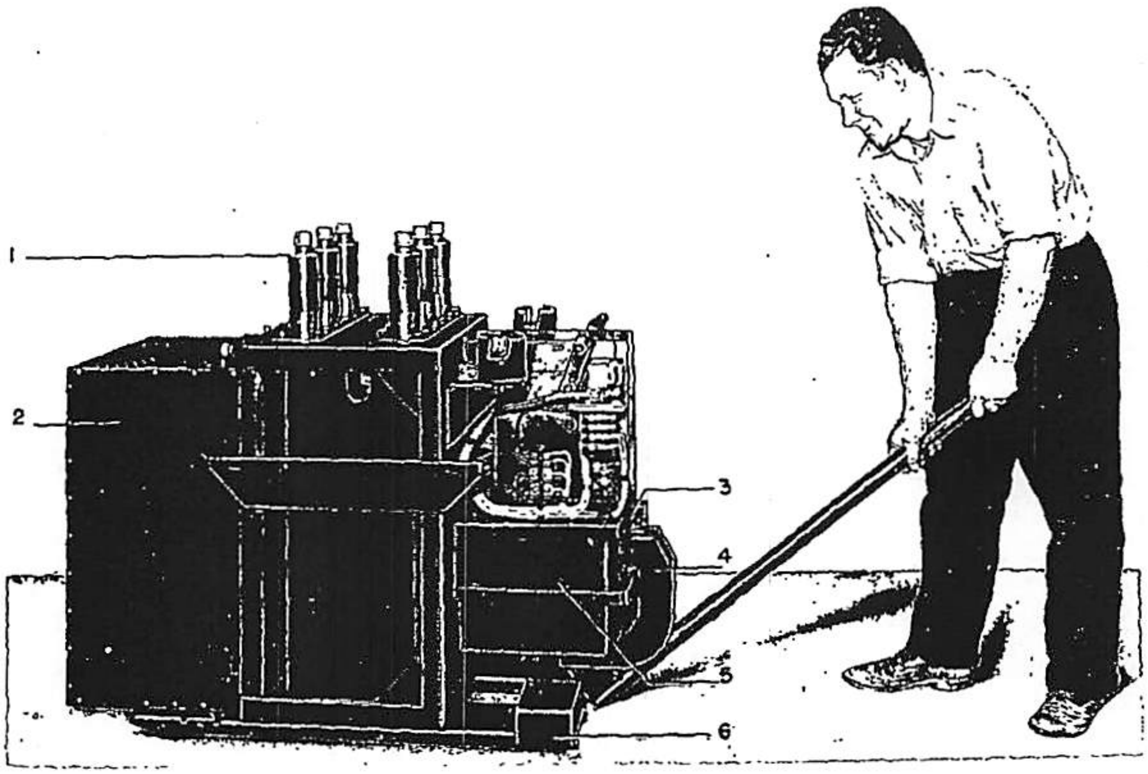
   e. Latch wipe, 3/16" to 1/4".

   f. Prop clearance, .010" to .090" for manual closing, .030" to .090" for electrical closing.

   g. Latch clearance, 1/32" to 1/16".

   h. Plunger clearance, 1/8" to 1/4".

   i. Cut-off switch, 1/32".



1. Primary Disconnects
2. Box Barrier
3. Adjusting Screw
4. Maintenance Operating Device
5. MS-10B-1 Mechanism
6. Wheel Channel

Fig. 15 Maintenance Operating Device

2. Check all nuts, bolts, screws, and cotter pins to make certain that they are properly tightened.

3. Inspect all wiring and make certain that no damage was done during installation. Check all terminals, screws, and connections and test the circuit for possible short circuits or grounds.

4. *Position the maintenance operating device* (4) Figure 15 under the solenoid armature and push down on the *handle to close* the breaker. *If* difficulty is experienced in closing the breaker, the clearance over the prop can be increased by moving the set screw (3) in toward the mechanism. With a screw driver, rotate the prop from under the closing roller pin with the maintenance operating device handle pushed all the way down, and then raise the handle to open the breaker. (CAUTION: Keep the fingers clear of the linkage because accidental tripping or fast movement could cause severe injury). Operate in this cycle of slow close and slow open operation several times, making certain that all parts are working freely.

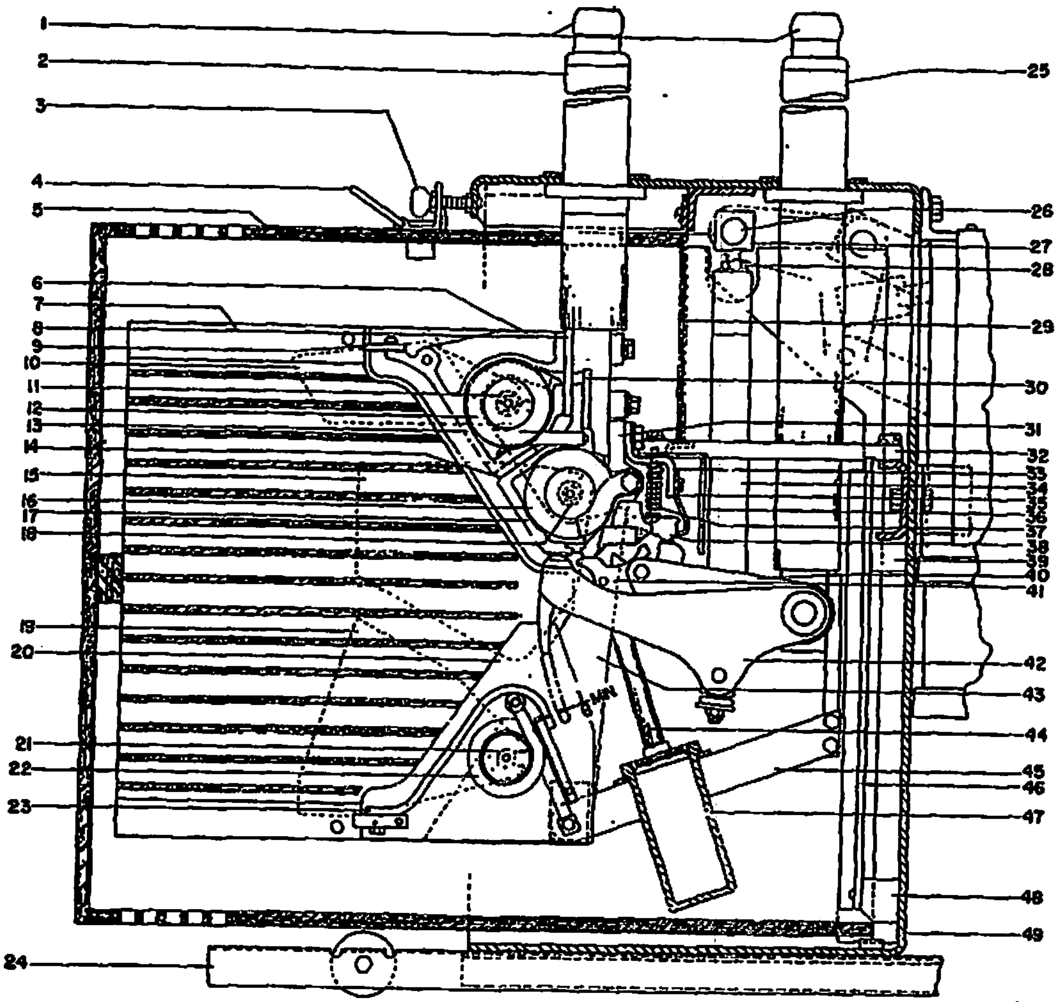
5. Check the closed circuit operating voltage for both closing and tripping range specified below.

STANDARD CLOSING & TRIPPING VOLTAGES

Nominal Voltages	Closing Range	Tripping Range
125 V.DC	90-130 V.DC	70-140 V.DC
250 V.DC	180-260 V.DC	140-280 V.DC
230 V.AC	190-250 V.AC	190-250 V.AC

Copper-oxide rectifiers are used to supply direct current to closing solenoid when the closing voltage source is 230 Volts AC.

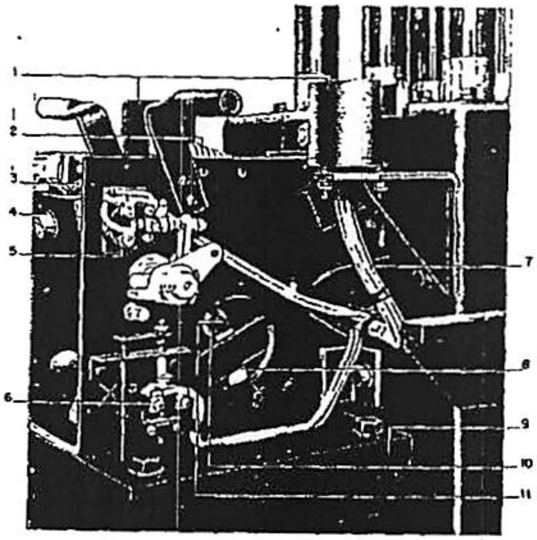
When all the foregoing inspection details have been checked, the breaker may be safely placed in service.



1. Ball Contacts
2. Rear Bushing
3. Thumb Screw
4. Handle
5. Box Barrier
6. Mycalex
7. Arc Chute
8. Insulation
9. Insulation
10. Pole Piece
11. Core
12. Upper Blow Out Coil
13. Upper Arc Runner
14. Insulation
15. Pole Piece
16. Lower Blow Out Coil
17. Lower Arc Runner
18. Core
19. Pole Piece
20. Mycalex
21. Core
22. Lower Blow Out Coil
23. Lower Arc Runner
24. Wheel Channel
25. Front Bushing
26. Shaft
27. Coupling
28. Nut
29. Vertical Barrier
30. Insulation
31. Contact Support
32. Horizontal Barrier
33. Support
34. Operating Rod
35. Retainer
36. Shield
37. Contact Spring
38. Primary Finger
39. Spacer
40. Primary Contact Arm
41. Secondary Contact
42. Arcing Contact Blade
43. Shield
44. Booster Tube
45. Support
46. Back Plate
47. Booster Cylinder
48. Spacer
49. Frame

Fig. 16 AM-5-150 Breaker Cross Section

Fig. 16 (T-6356184)



1. Secondary Couplers
2. Opening Spring
3. Trip Coil
4. Trip Coil Armature
5. Latch Checking Switch
6. Cut Off Switch
7. Links
8. Prop
9. Closing Coil Frame
10. Closing Roller
11. Pin

Fig. 17 Right Side View of MS-10B-1 Mechanism

Fig. 17 (8009901)

PRINCIPLES OF OPERATION

Referring to Figure 16, the magne-blast circuit breaker utilizes the magnetic forces produced by the load current through the blow-out coils (12, 16, 22) to interrupt the arc. These magnetic forces, together with the air stream supplied by the booster cylinder (47) and piston (44), drive the arc from the arcing contacts out along the diverging arc runners (13, 17, 23) into the interleaving arc chute (7). The tapered fins that project alternately from the two opposite inner surfaces of the chute deflect the arc into a gradually deepening serpentine path. This lengthening and consequent cooling action rapidly increases the electrical resistance of the arc to cause interruption. When the breaker is tripped under load or short circuit conditions, the opening springs act to swing the contact arms (40, 42) downward, parting first the primary contacts, the intermediate contacts and finally the arcing contacts. The arc is then transferred to the arc runners and into the chute where it is interrupted.

Easily removable box barrier (5) encases each phase segregating the interrupting units and providing insulation between phases and from each phase to ground.

On a closing operation, the solenoid mechanism shown in Figure 17 operates as follows: The solenoid coil in frame (9) is energized, the armature is driven upward and the plunger rod threaded into the armature raises the roller (10) carried by the set of links (7) fastened to the operating crank. This action rotates the crank and closes the breaker contacts.

After the armature and linkage have reached the end of their travel, the prop (8) rotates into position under each end of the pin (11) through the roller (10) and the mechanism is in the closed position. The solenoid coil is de-energized by a relay which is actuated by the cut-off switch (6) at the end of the armature stroke, and the armature is returned by gravity to its original position.

On an opening operation, the solenoid mechanism functions as follows. The trip coil (3) is energized, the trip armature (4) forces the latch off of the roller causing the linkage to collapse which allows the opening springs (2) to rotate the main cranks and open the contacts. During the opening stroke, the auxiliary switch contacts open and interrupt the trip coil current. After the breaker is open, the mechanism linkage returns to its normal position, and a spring resets the trip latch.

In case the trip coil is energized while the breaker is closing, the trip plunger forces the latch off the trip roller allowing the mechanism linkage to collapse and the breaker to reopen. The armature completes its closing stroke, however, and the coil is de-energized as in the normal closing operation.

MAINTENANCE

Dependable service and safety of power distribution equipment is based on unfailing performance of the circuit breaker. To maintain such service, it is recommended that a definite schedule be set up and adhered to for the purpose of properly lubricating the wearing parts. A dependable and observing attendant can be expected to forstall mishaps by reporting loosened nuts, scored surfaces, and other evidences of possible trouble.

In addition, but at less frequent intervals, periodic inspection should be made at which time the apparatus should be given such servicing as may be found desirable or necessary. In case of highly repetitive operation, it is recommended that the first periodic inspection be made after not more than 500 operations. (See "Periodic Inspection" for specific points to check.) The interval between periodic inspections should depend on operating conditions and should be determined by experience.

Replacement of parts may be necessary after 5000 operations on 600 and 1200 ampere breakers, and after 2500 operations on 2000 ampere breakers, when these breakers are employed for the following types of non-fault duty operations.

1. Motor starting service.
2. Capacitor switching duty.
3. Interrupting arc furnace currents.
4. Transformer magnetizing currents.
5. Interrupting up to a maximum of the breaker nameplate continuous current.

On non-fault duty, the frequency of repetitive operation should not exceed twenty interruptions in ten minutes.

On applications where a combination of fault duty and repetitive operation is encountered, an inspection of the breaker mechanism, contact parts, arc chutes and insulations should be made after each fault operation.

PERIODIC INSPECTION

At this time, a thorough inspection should be made of all parts of the breaker and mechanism.

CONTACTS

To inspect the contacts, proceed as follows: Trip the breaker and remove the box barrier. The removal of the box barrier is accomplished by loosing the thumbscrews at the top of the box barrier or the handles. Slide the barrier from the breaker frame to expose the breaker contacts. The silver primary contacts will normally show slight indentations due to the soft nature of the silver. Under normal conditions, little or no burning should have taken place on the primary contacts. Slightly burned primary, secondary, and arcing contact surfaces may be repaired by smoothing with a fine file or sand paper. If the clearance on the contacts stated under "Adjustments" are not within the limits specified, the burned contacts will have to be replaced. The changing of the contacts is explained under "Replacement of Parts".

ARC CHUTE

If the arc chutes are removed for inspection or contact maintenance, the following points should be noted: Scale formed over the surface of the chute must not be removed, but any loose particles collected in the chute or box barrier should be blown out. If the chute has had any mechanical injury due to dropping or accidental striking which has resulted in actual breaking off of fins, replacement of the chute is necessary.

INSULATION PARTS

The 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.

BUSHINGS

The surface of the bushings should be smooth and unscratched. If the insulation surfaces should become damaged, the damaged portion should be well cleaned and then re-touched with either 1170 clear varnish or 1202 (clear) or 1210 (brown) glyptal. Allow to dry smooth and hard.

MECHANISM

The clearances specified for the mechanism under "Adjustments" should be checked. Careful inspection should be made to check for loose nuts or bolts and broken cotter pins. The latch surfaces should be inspected for wear and the surfaces of the rollers should be inspected for chipping or other evidences of damage. Lubrication should be done in accordance with the instructions under "Lubrication".

LUBRICATION

During assembly at the factory, all wearing parts, bearing surfaces and all machined surfaces on both the breaker and the mechanism have been coated with a film of medium self-lubricating and rust-resisting greases. At regular maintenance periods, apply a few drops of machine oil SAE-20 or 30 to bearings. Ground surfaces such as cams and rollers should be wiped clean and a thin coat of General Electric Lubricant D50H15 applied.

When the breaker is given a general overhaul, or is disassembled, or when operation becomes sluggish, the following procedure should be followed: On bearings, the pins should be removed and all old oxidized grease cleaned off of parts by soaking in kerosene or similar cleaner. Do not use carbon-tetra-chloride. If the grease in the bearings has become badly oxidized, it may be necessary to use alcohol (the type used for thinning shellac) to remove it. Ordinarily, by swishing the bearing around and removing solid particles with a stiff brush, the bearing can be satisfactorily cleaned. After the bearings have been thoroughly cleaned, spin them in clean, light machine oil until the cleaner or solvent is entirely removed. Allow this oil to drain off and then repack immediately with General Electric Lubricant D50H15 being certain that all metal parts are greased. Lubricate pivots of the contact arms with D50H15.

General Electric Lubricant D50H15 is available only in cartons containing twelve collapsible tubes of grease. This is a total of three pounds of grease to the carton. It is so packaged to insure cleanliness and to prevent oxidation.

REPAIR AND REPLACEMENT

ARC CHUTE (See Figure 18)

To remove the arc chutes, proceed as follows:

1. Open the breaker.
2. Loosen thumbscrews at the top of the box barrier.
3. Remove the box barrier.
4. Remove the plastic covers (6 & 7) over bolt heads by turning them counterclockwise with gas pipe pliers. These covers are lightly spotted with glyptal to keep them tight. If the covers are broken or lost, they should be replaced before the breaker is put back in service.
5. Loosen the bolts (4 & 5) through the slots in the two upper pole pieces.
6. Remove the two capped screws (7) (one on each side of the arc chute) fastening the lower end of the chute to the booster cylinder support.
7. While supporting the weight of the arc chute, remove the two screws (3) at the top of the chute (through the upper pole pieces and into the top of the arc runner) which will allow the chute to slide out along the slots in the upper pole pieces.

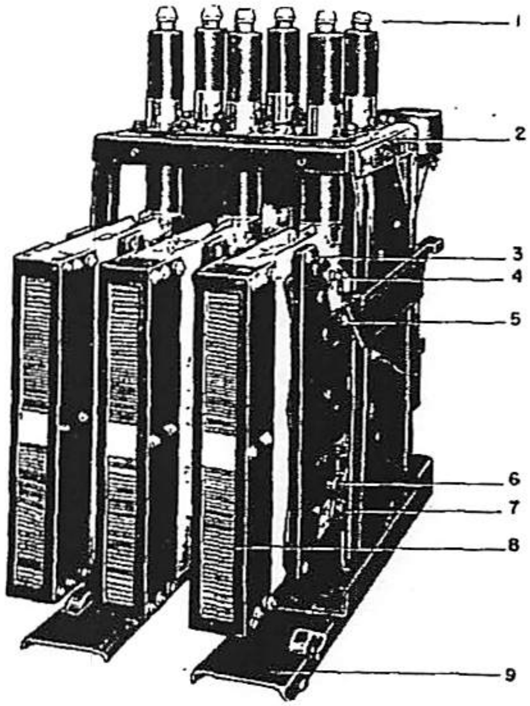
To replace the arc chutes, reverse the above procedure.

STATIONARY PRIMARY CONTACTS (See Figure 19)

Stationary primary fingers (18) are mounted on the rear bushing assembly as shown in Figure 19. These contacts are designed to carry full load current continuously. An inlaid block of silver on each finger reduces the contact voltage drop to a minimum. Under severe interrupting duty, and high momentary currents, these contacts may become pitted or worn enough to warrant replacement. To replace the contact fingers, proceed as follows:

1. Remove the arc chutes as explained under "Arc Chute Removal".
2. Remove the horizontal and vertical barriers.
3. Remove rear bushing assemblies by loosening the four bolts at the top of the frame holding each bushing in place. Measure the distance between front and rear bushings so that the front bushings may be used as a guide when the rear bushings are re-assembled.
4. Remove the mycalex side plates.
5. Use a heavy screw driver to compress each individual spring (16) by using the contact support (11) as a fulcrum. Put a small piece of wire into the hole in the top of spring guide (15) to hold springs (16) compressed.
6. Remove locking wire through screws holding retainer (17).
7. Remove retainer (17).
8. Remove insulation and plate (19 & 20).
9. Remove contact fingers.

To replace the contacts on the rear bushing assembly, reverse the above procedure. The metal clad unit can be used as a jig to make certain the bushings are aligned properly. Coat the ball contacts with a thin film of grease. Raise and lower the

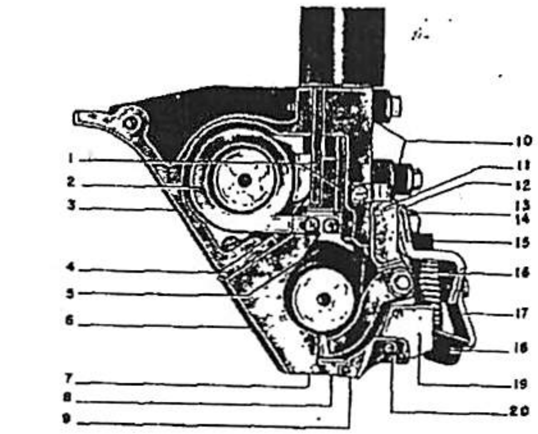


1. Primary Disconnects	5. Bolt
2. Frame	6. Cap
3. Bolt	7. Cap
4. Bolt	8. Arc Chutes
	9. Wheel Channels

Fig. 18 Rear View of AM-5-250 Breaker

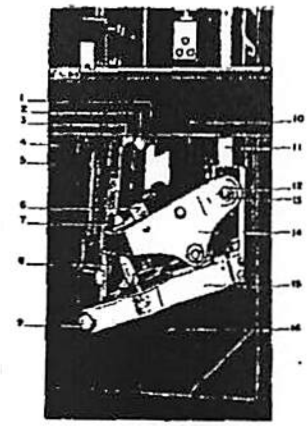
Fig. 20 (8010184)

Fig. 19 (8011295)



1. Insulation
2. Upper Blow Out Coil
3. Upper Arc Runner
4. Insulation
5. Lower Blow Out Coil
6. Lower Arc Runner
7. Arcing Contact
8. Insulation
9. Secondary Contact
10. Insulation
11. Contact Support
12. Support
13. Locking Plate
14. Bolt
15. Spring Guide
16. Spring
17. Retainer
18. Contact Finger
19. Plate
20. Shield

Fig. 19 Rear Bushing Assembly, 1200 Amp



1. Retainer
2. Contact Finger
3. Plate
4. Insulation
5. Frame
6. Main Contact
7. Secondary Contact
8. Puffer Tube
9. Cap
10. Operating Rod
11. Front Bushing
12. Nut and Cotter Pin
13. Thimble
14. Arcing Blade
15. Support
16. Booster Cylinder

Fig. 20 Moving Contact Assembly, 1200 Amp

breaker in the metal clad unit noting if the ball contacts are making contact around their periphery. Readjust the position of the bushings until full contact is made on the ball contacts.

STATIONARY ARCING & SECONDARY CONTACTS (See Figure 19)

Stationary arcing (7) and secondary (9) contacts are made of arc resisting material and little erosion can be expected on interruption of load currents. When high currents are interrupted, burning may be severe enough that replacement of these contacts is necessary. To remove secondary and arcing contacts, proceed as follows:

1. Remove primary fingers as explained under "Stationary Primary Contacts".

2. Remove springs (16), support (12), and locking plate (13).

3. Remove bolts holding lower arc runner section (6) and contact support (11) together.

4. Contact support (11) can now be removed. The contact support will have to be replaced if it is desired to replace the secondary contact (9).

5. Replacing arcing contact (7) necessitates the replacement of the lower blow-out coil and arc runner section (6).

To assemble the rear bushing assembly, reverse the above procedure making certain that insulation (18) is in its proper place, blow-out coil insulation has not been damaged, and all screws are tight.

MOVABLE PRIMARY, SECONDARY, AND ARCING CONTACTS (See Figure 20)

To replace primary, secondary, or arcing contacts on the movable contact arm, proceed as follows:

1. Open the breaker.

2. Remove the arc chutes as explained under "Arc Chute Removal".

3. Remove horizontal and vertical insulating barriers around bushings.

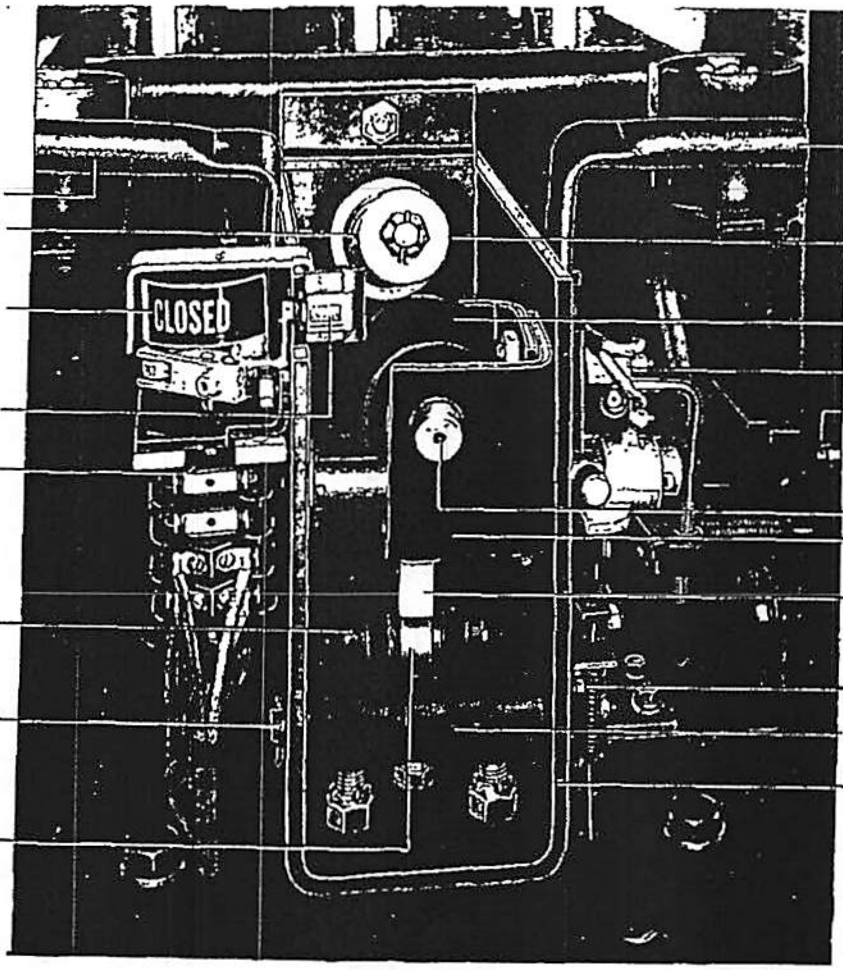
4. Remove cotter pin in one end of the shaft through the top end of the operating rods.

5. Slide the shaft free of the rod to be adjusted.

6. Remove cotter pin (12) at pivot.

7. Remove the bolt, springs and thimbles (13) at the pivot being careful not to lose the washers between the arcing contact blade and the primary contact arm.

8. Replacement of either arcing contact blade (14), or secondary contact casting (7) and booster tube (16) or primary contact arm (6) is now possible.



1. Handles
2. Opening Spring
3. Indicator
4. Counter
5. Auxiliary Switch
6. Link
7. Pin
8. Roller
9. Washer
10. Trip Coil
11. Latch Checking Switch
12. Trip Interlock
13. Trip Coil Armature
14. Trip Coil Support
15. Latch
16. Cut Off Switch
17. Link
18. Frame

Fig. 21 Front View of MS-10B-1 Mechanism

Fig. 21 (8009903)

Reassemble moving contact assembly in reverse order explained above. Make certain that all cotter pins are replaced. Pressure on the pivot joint should be checked by measuring with a spring balance the force required to move the contact arm. This torque should be between 40 and 60 pound inches.

TRIP AND CLOSING ROLLERS (See Figure 21)

For lubricating the solenoid mechanism, it is often necessary to remove the trip and closing rollers. Proceed as follows:

1. Make certain the breaker is open.
2. Remove pin (7) through yoke (17).
3. Pull links forward and extract pin through trip roller (8) by pushing it through hole in which pin (7) rested.
4. Trip roller (8) can now be removed.
5. Remove the pin through the closing roller and extract the closing roller.

Reassemble the linkage in the reverse order.

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 replacement.

A complete list of renewal parts is contained in the Renewal Parts Bulletins. Those parts subject to wear in ordinary operation, and to damage or breakage due to possible abnormal conditions, are marked as recommended renewal parts.

ORDERING INSTRUCTIONS

When ordering renewal parts, address the nearest General Electric Sales Office, specify the quantity required, the catalog number from the Renewal Parts Bulletin and the nameplate data.

APPENDIX

Accessories used on the AM-5-100, AM-5-150, and AM-5-250 Breakers are as follows:

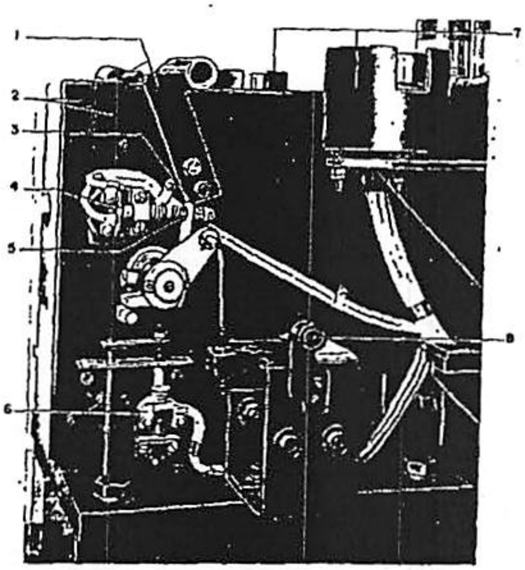
LATCH-CHECKING SWITCH (See Figure 22)

A latch-checking switch is used to insure that the mechanism latch has been reset after a tripping operation. The latch-checking switch contacts are connected in the control circuit in the metal clad unit to prevent the closing coil from being energized until the latch is reset. The wipe on the latch-checking switch contacts should be approximately 1/16". Washers (3 & 5) are used in adjusting the contact wipe. By placing washers at (5) from (3) will increase the contact wipe.

AUXILIARY SWITCH LINKAGE (See Figure 23)

The auxiliary switch linkage is used to actuate an auxiliary switch mounted on the metal clad unit. Link (3) is connected to a crank pin of the mechanism at the same point as the mechanism auxiliary switch link (5). The distance from the center of the front bushing to the inside edge of the fork should be 12" when the breaker is in the open position. Eyebolt (2) can be turned to give this adjustment.

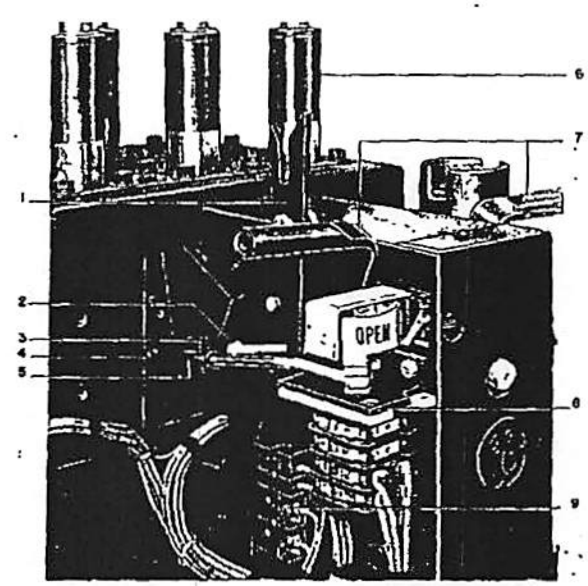
Fig. 22 (8009902)



1. Handles
2. Covers
3. Washers
4. Contacts
5. Washers
6. Cut-off Switch
7. Secondary Couplers
8. Trip Interlock

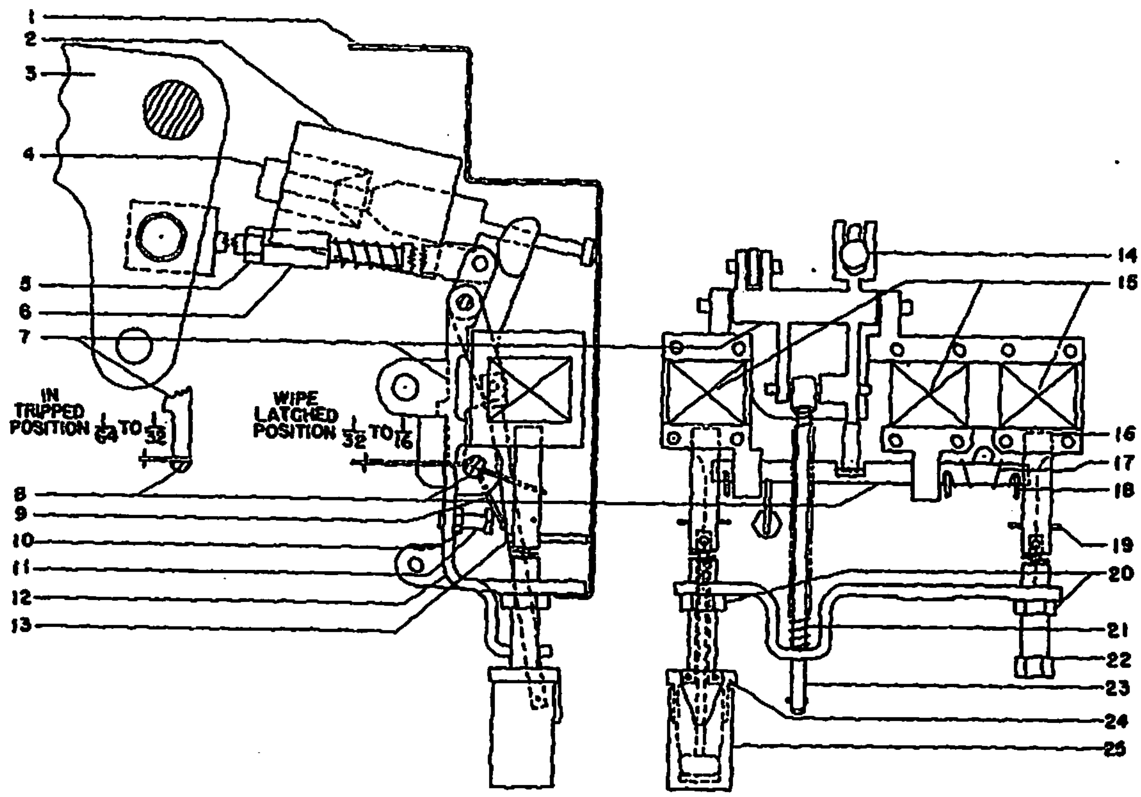
Fig. 22 Latch Checking Switch

Fig. 23 (8009918)



1. Fork
2. Adjusting Eyebolt
3. Link
4. Shaft
5. Auxiliary SW Link
6. Front Bushing
7. Handles
8. Auxiliary Switch
9. Terminal Board

Fig. 23 Auxiliary Switch Linkage

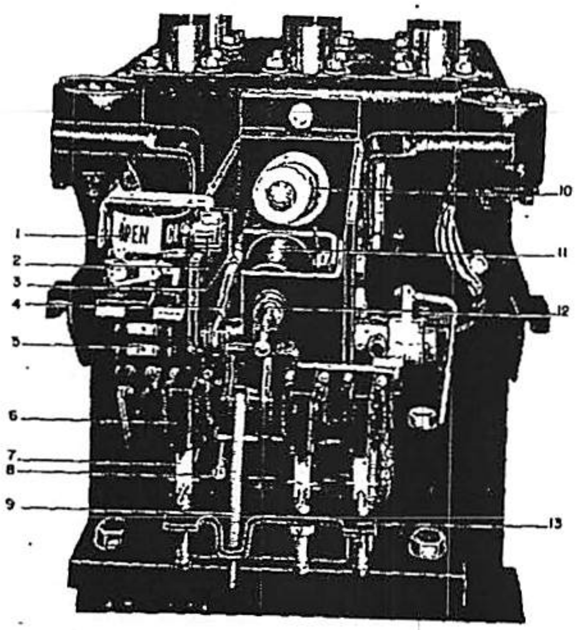


1. Cover
2. Potential Trip Coil
3. Crank
4. Trip Coil Armature
5. Nut
6. Coupling
7. Latch and Link
8. Trip Shaft
9. Pin
10. Nut
11. Stop Bolt
12. Frame
13. Pin
14. Trip Coil Armature Extension
15. Current Trip Coils
16. Armature
17. Spring
18. Pin
19. Pin
20. Nut
21. Spring
22. Bolt
23. Guide
24. Dashpot
25. Cup

Fig. 24 Current Trip Mechanism

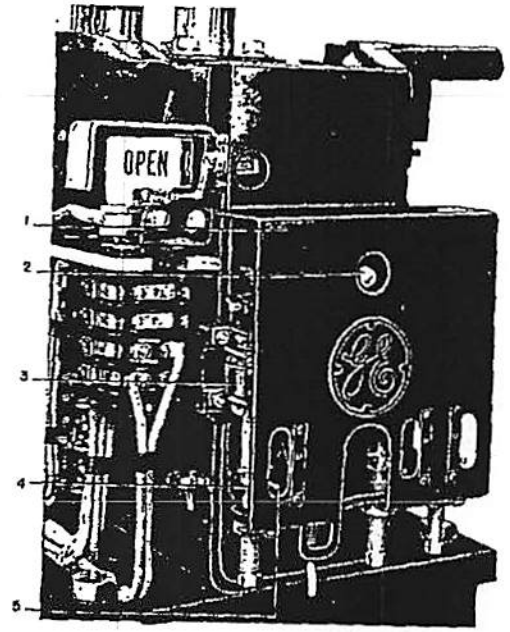
Fig. 24 (T-6356183)

Fig. 25 (8009946) Fig. 26 (8009953)



1. Indicator
2. Counter
3. Adjusting Nut
4. Link
5. Auxiliary Switch Current
6. Trip Coils
7. Armatures
8. Stop
9. Spring
10. Opening Spring
11. Trip Coil
12. Trip Coil Armature Current
13. Trip Frame

Fig. 25 Current Trip Mechanism



1. Cover
2. Trip Coil Armature
3. Current Trip Coil
4. Armature
5. Calibration Marks

Fig. 26 Current Trip Mechanism

CURRENT TRIP MECHANISM (See Figures 24, 25, & 26)

The current trip mechanism is used to trip the MS-10B-1 mechanism by current sensitive trip coils (6) Figure 25 which are energized directly from the current transformers in the metal clad unit.

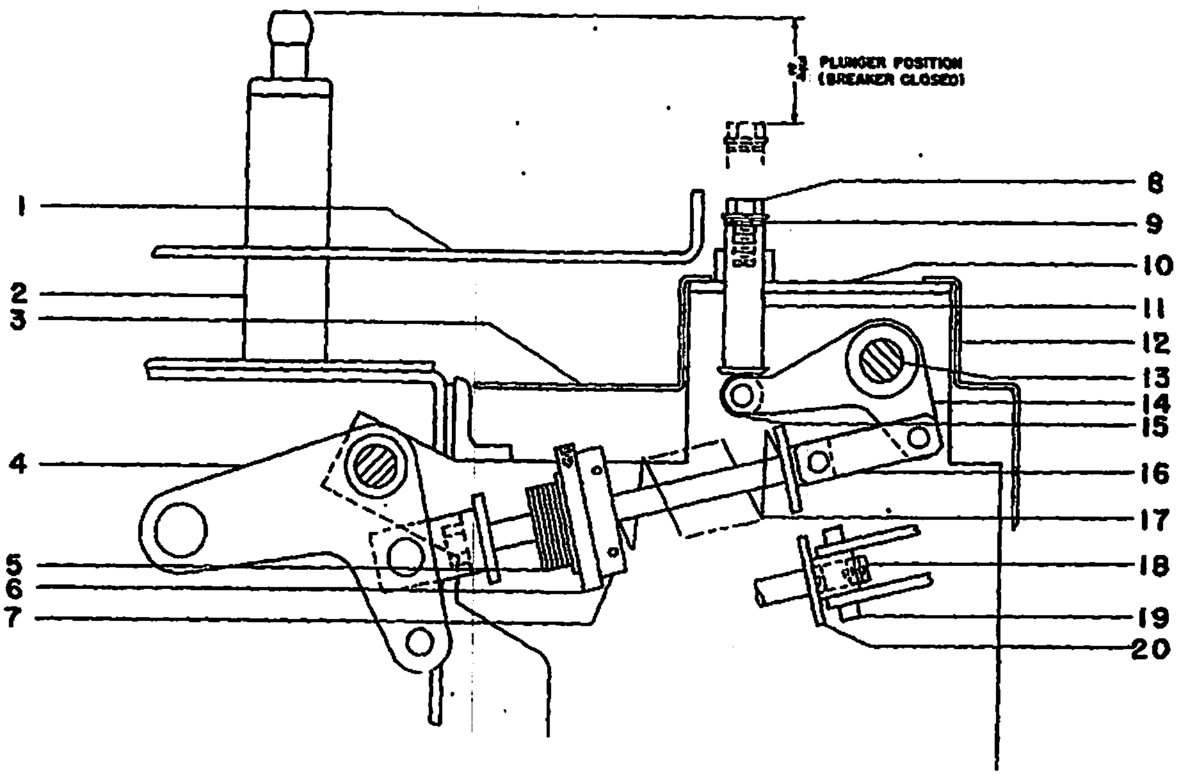
Figure 24 shows the two types of armatures provided on the mechanism. Instantaneous pick-up armatures are (9) Figure 25. These armatures pick-up instantaneously when the current through the coil or coils (6) Figure 25 reaches the calibrated value marked at (5) Figure 26 on cover (25). The scribe mark (5) is set at the factory and lines up with the bottom of the square section of the armature (4). Time delay dashpots (25) Figure 24 can be supplied to give a time delay before the armature is allowed to pick-up. These dashpots have been factory-adjusted and oil drained for shipment. A small bottle of oil is furnished to refill the dashpots when the initial installation is made.

Assuming the breaker is in the closed position and after either the instantaneous or time delay type armatures have picked up, pin (19) Figure 24 contacts pin (18) which rotates shaft (8) allowing the latch (7) to slide through the slot in the shaft (8). This allows latch (7) to rotate by force applied by spring (21). The rotation of latch (7) pushes the trip coil armature (14) forward knocking the mechanism latch off the roller tripping the breaker.

When the breaker is closed, the resetting linkage (5, 6) pushes the latch (7) out of the slot in the shaft (8). Shaft (8) is rotated by spring (17) until pin (9) stops against stop screw (11). The linkage is now reset and ready for another tripping operation.

Latch wipe shown on Figure 24 can be adjusted from 1/32" to 1/16" by stop screw (11). Latch clearance of 1/64" to 1/32" is measured by holding shaft (8) in the trip position and adjusting the clearance by using coupling (6).

The current trip mechanism is used in conjunction with the undervoltage device and capacitor trip unit.



(P-6547798) Fig. 27

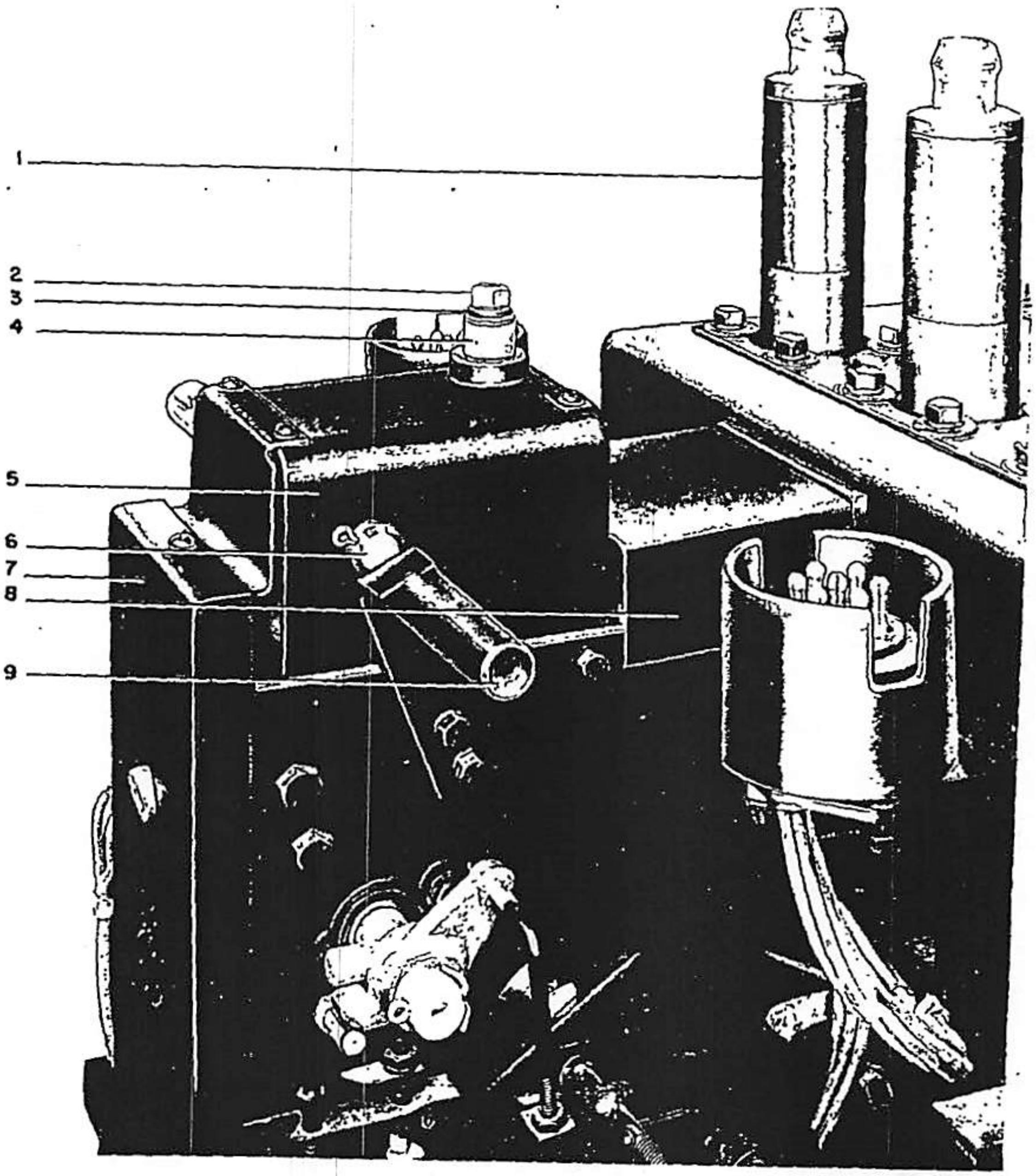
1. Metal Clad Frame	6. Frame	11. Plunger	16. Link
2. Front Breaker Bushing	7. Guide Stop	12. Cover	17. Opening Spring
3. Cover	8. Stud	13. Pin	18. Stud
4. Crank	9. Washers	14. Crank	19. Trunion
5. Buffers	10. Frame	15. Roller	20. Washer

Fig. 27 Plunger Interlock

PLUNGER INTERLOCK *(See Figures 27 & 28)*

The plunger interlock linkage can be used to operate an auxiliary switch mounted on the metal-clad unit or to serve as an interlock between two adjacent breakers allowing only one or the other to be closed at one time. When one of the two adjacent breakers is closed and a second breaker's closing coil is energized, the second breaker's mechanism is blocked by the plunger interlock of the first breaker. A special beam on the metal clad unit provides the link between the two plunger interlocks. If a breaker mechanism is blocked by using the plunger interlock, the fuses in the breaker's closing coil circuit will blow.

The plunger interlock linkage (16, 14, 11, 8) Figure 27 is an extension of stud (18) which passes through the opening springs (17) and translates the motion of the mechanism to plunger (11). Figures 27 and 28 show the plunger interlock linkage with the breaker in the closed position. When the breaker contacts are closed, crank (4) Figure 27 is rotated pulling stud (18) which compresses the opening springs (17) and raises plunger (11) through link (16) crank (14) to the upper position of plunger (11) shown. In the raised position, the distance from screw (8) to a point level with the top of the front bushing (2) should be 2-3/4" as shown in Figure 27. The adjusting washers (9) are provided for making this adjustment.



1. Front Bushings
2. Screw
3. Adjusting Washers
4. Plunger
5. Interlock Frame
6. Pin
7. Front Cover
8. Rear Cover
9. Handle

Fig. 28 Plunger Interlock

Fig. 28 (8009904)

NOTES

WHEN YOU NEED SERVICE

GEZ-85R

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Portsmouth, Ohio .P.O. Box 37, 721 Sixth St.
Providence 3, R. I......Industrial Trust Bldg.
Raleigh, N. C............336 Fayetteville St.
Reading, Pa.............. .31 N. Sixth St.
Richmond 17, Va...........700 E. Franklin St.
Riverside, Calif.... .... 3808 Main St.
Roanoke 16, Va....920-924 S. Jefferson St.
Rochester 4, N. Y............... 89 E. Ave.
Rockford, Ill.... . ...110 S. First St.
Rutland, Vt..................38½ Center St.
Sacramento 14, Calif.. ....626 Forum Bldg.
Saginaw, Mich.. . ... .501 Bearinger Bldg.
St Louis 2, Mo... . ...112 N. Fourth St.
Salt Lake City 9, Utah. .....200 S. Main St.
San Antonio 5, Texas....310 S. St. Mary's St.
San Diego 1, Calif...... .1240 Seventh Ave.
San Francisco 6, Calif.. .235 Montgomery St.
San Jose 10, Calif............460 Park Ave.
Savannah, Ga............. . 4 E. Bryan St.
Seattle 4, Wash..... .....710 Second Ave.
Shreveport, La.. . . ..910 Shelby Bldg.
Sioux City 13, Iowa 572 Orpheum Electric Bldg.
Sioux Falls, S. D. . ..306 South Phillips Ave.
South Bend 1, Ind.. .112 W. Jefferson Blvd.
Spokane 8, Wash. .... S. 162 Post St.
Springfield, Ill...............607 E. Adams St.
Springfield 3, Mass. .... 1387 Main St.
Stockton, Calif........11 So. San Joaquin St.
Syracuse 2, N. Y....... ...113 S. Salina St.
Tacoma 1, Wash.. ..1202 Washington Bldg.
Tampa 6, Fla...............1206 North A St.
Toledo 4, Ohio.... ......420 Madison Ave.
Trenton 8, N. J............214 E. Hanover St.
Tulsa 3, Okla...... . ...320 S. Boston Ave.
Tucson, Ariz.. .P.O. Box 710, 650 N. Sixth Ave.
Utica 2, N. Y...............258 Genesee St.
Washington 5, D.C.........777—14th St., N.W.
Waterbury 89, Conn.........111 W. Main St.
Waterloo, Iowa..............206 W. 4th St.
Wenatchee, Wash. .328 N. Wenatchee Ave.
Wheeling, W. Va..... . ..40 Fourteenth St.
Wichita 2, Kan........... . 200 E. First St.
Williamston, N. C.. ..... .115 E. Main St.
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Youngstown 5, Ohio....272 E. Indianola Ave.

Hawaii: American Factors, Ltd., P. O. Box 3230, Honolulu 1
Canada: Canadian General Electric Company, Ltd., Toronto

GENERAL ELECTRIC

2-51

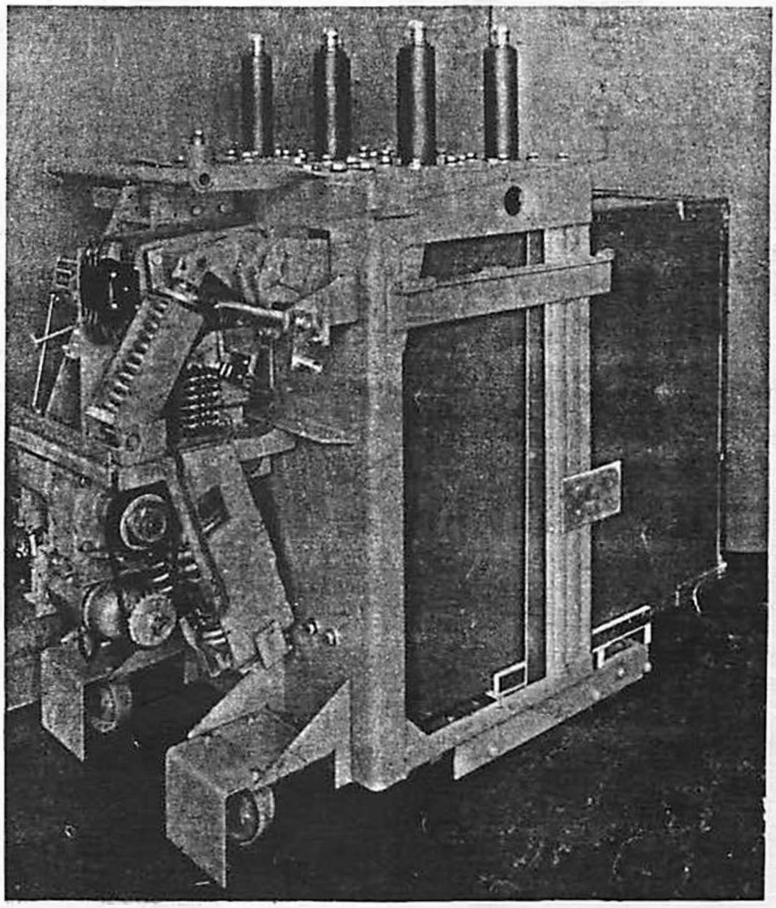
Supersedes GEI-23961D

INSTRUCTIONS
AND
RENEWAL PARTS

GEI-50143F
SUPERSEDES GEI-50143E

ACB'S FOR 4KV. CIRCUITS
403[illegible] - STA. TR. 4R. TO 4KV. BUS 4A.
4003 - " " " " 4KV. BUS 4B.

STORED ENERGY OPERATOR



Types

ML-11
ML-11A
ML-11B
ML-11C
ML-11D

CONTENTS

HIGH VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

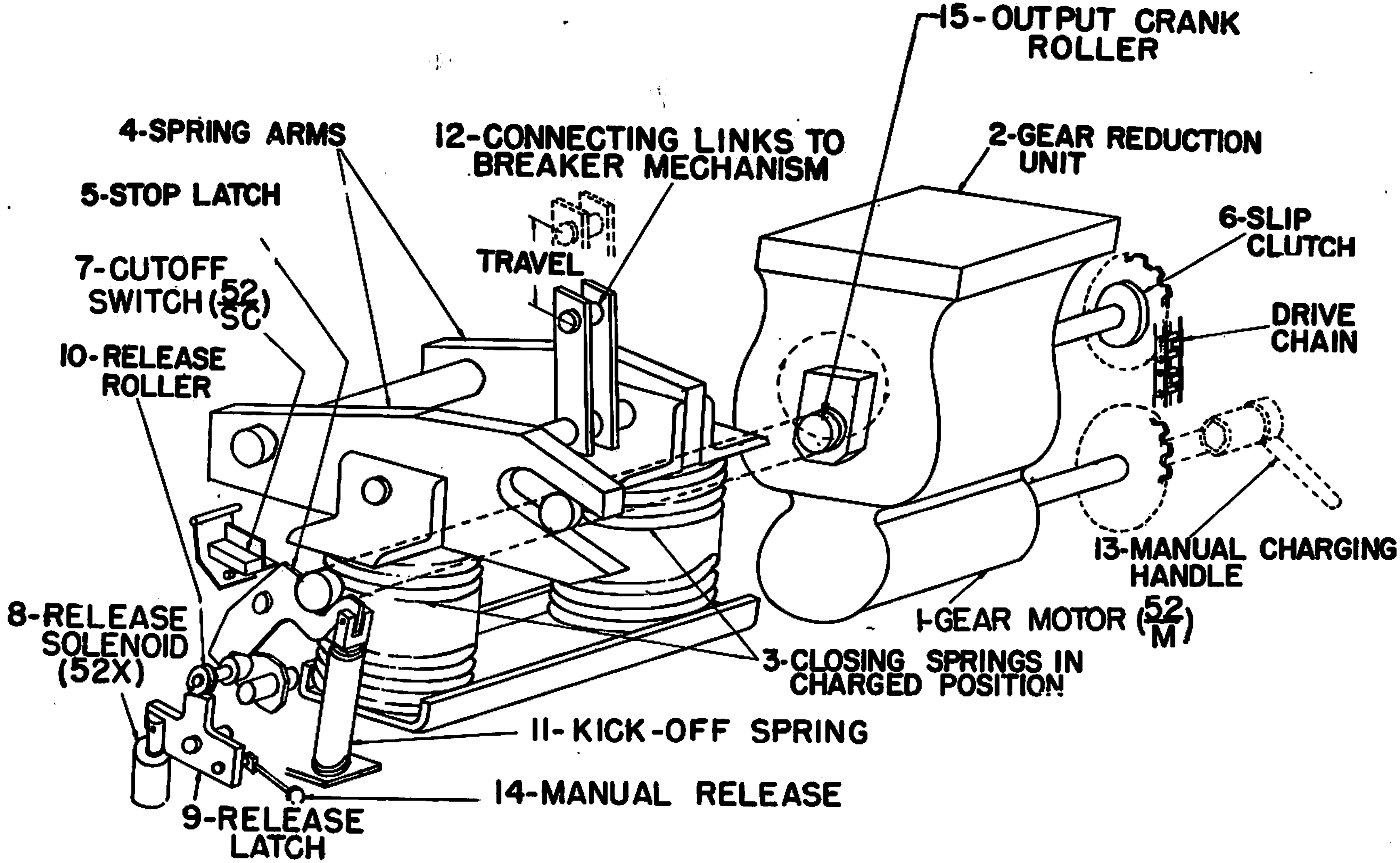


Fig. 1 Exploded Schematic of Stored Energy Operator

STORED-ENERGY OPERATOR FOR MAGNE-BLAST CIRCUIT BREAKER

INTRODUCTION

The new charged-spring stored-energy mechanism will close and latch magne-blast breakers with momentary current ratings up to and including 70,000 amperes in voltages from 4.16 kv to 13.8 kv and in interrupting ratings from 150 mva to 750 mva, inclusive. The operating force for the mechanism is supplied by a high speed 1/2 hp gear motor. See Fig. 1. The energy from the motor is stored in powerful springs which are capable of closing the circuit breaker at its required speed under all conditions. Only after the mechanism is fully charged can it be released to close the breaker. As soon as the circuit breaker has been closed by the mechanism, the motor immediately recharges the springs for another closing operation. The spring charging time of approximately seven seconds and the fast circuit breaker closing time provides ample time margin for all normal duty cycles.

INSTALLATION

The following instructions explain the necessary steps to be taken before the mechanism is placed in the metal-clad unit. Reference should also be made to the connection diagram as well as the magne-blast breaker instruction book that is furnished with each breaker.

"DO NOT WORK ON EITHER THE BREAKER OR THE MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING."

At installation of the equipment add a 10 amp fuse in the closing and charging circuit. When the equipment is finally installed, change the fuse to the size recommended on the connection diagram.

Charge the breaker closing springs manually using the manual charging handle as described under "MANUAL CHARGING". With springs fully charged, unloosen bolt (1), Fig. 3 used to retain the block plate (2), Fig. 3. Move blocking plate (2), Fig. 3 (approx. 1-1/2") from right to left (facing mechanism) until the right flange is against the spring frame upright (3), Fig. 2. Release the closing springs against this blocking plate by pushing the manual release button (3), Fig. 3. <u>THE SPRINGS ARE NOW BLOCKED.</u> The closing springs will now be confined in this position and the gear motor, reduction unit, mechanism linkage and breaker contacts are free to move, and the breaker contacts now may be cranked slowly closed and a check of the adjustments may be made.

Operate the mechanism manually several times and observe that the mechanism and breaker does not stick or bind during the entire stroke, that it latches securely in closed position, and that it trips freely when the manual trip plunger is operated. The breaker should not be operated electrically until it has been operated manually to insure this freedom of action. At this time check the following adjustments:

a. Primary contact wipe.

b. Primary contact gap. (Refer to Magne-Blast Circuit Breaker book for description.)

c. Prop clearance. (Page 4 this book)

After these adjustments have been checked the springs can be unblocked. To unblock the springs, manually charge the closing springs as described in "MANUAL CHARGING" operation. Move the <u>BLOCKING PLATE</u> (2), Fig. 3 from left to right (facing mechanism) approximately 1-1/2". Make gage plate secure by tightening bolt (1), Fig. 3. The mechanism is now free to operate both mechanically and electrically.

Attach test coupler to circuit breaker and operate electrically several times. Check the control voltage as described under "CONTROL POWER CHECK".

NOTE: If the breaker secondary wiring is to be given a hi-potential test at 1500 volts, remove both of the motor leads from the terminal board. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

DESCRIPTION OF OPERATION

ELECTRICAL CHARGING (Ref. Fig. 1)

When the high speed gear motor (1) is energized, power is transmitted through a chain to the gear reduction unit (2). The torque is then increased so that the output crank of the reduction unit will compress the closing springs (3) through action of the spring arms (4) to the fully charged position. When the closing springs (3) are fully compressed, a cut-off switch (7) de-energizes the motor (1). In this position the output crank roller (15) is mechanically stopped against stop latch (5), and the semaphore reads "CHARGED".

ELECTRICAL RELEASE (Ref. Fig. 1)

When the release solenoid (8) is energized, its action rotates release latch (9) and permits release roller (10) link assembly to be forced free of stop latch (5). The overrunning clutch in the reduction unit allows the output crank to rotate freely so that the closing springs (3) can discharge their energy to the breaker mechanism through the connecting links (12). Immediately upon its release the cut-off switch (7) starts the motor (13) and the springs are again charged.

MANUAL CHARGING (Ref. Fig. 1)

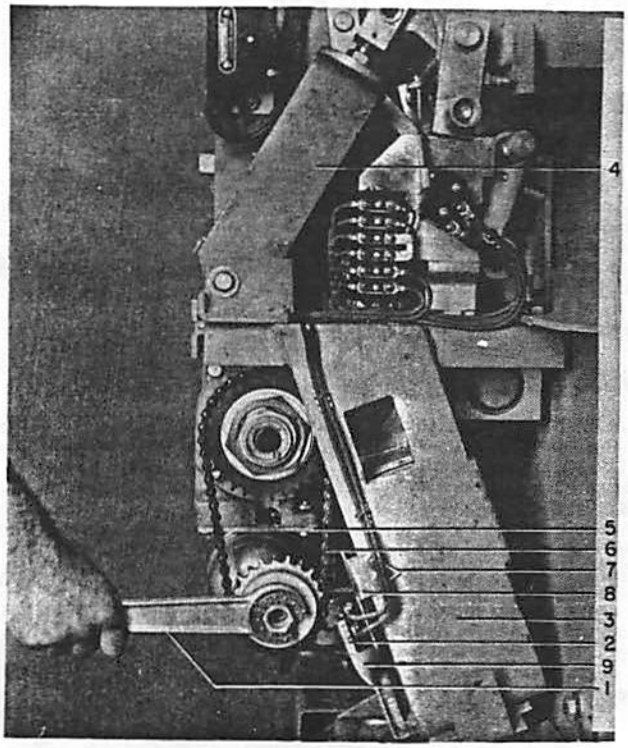
Closing the breaker may be accomplished by manual operation of the mechanism if control voltage is lost. The closing springs may be charged manually by using a standard 1" socket and a standard ratchet handle. Attach the handle (13) to the right side of the motor sprocket and using a pumping action rotate the handle counter-clockwise until the semaphore reads "CHARGED" and the <u>handle becomes snug.</u> The use of the ratchet wrench provides for maximum safety in the event that control power is suddenly restored without warning. In this event, the motor drive takes over again and continues to charge the mechanism.

MANUAL RELEASE (Ref. Fig. 1)

The closing speed of the breaker is independent of the method of charging the springs or release of the control mechanism, and the breaker closes at the same speed for a manual release as it does for an electrical release. To manually release the closing springs and close the breaker, press manual release plunger (14). This actuates release latch (9) and the linkage operation is the same as stated in the "Electrical Release" description.

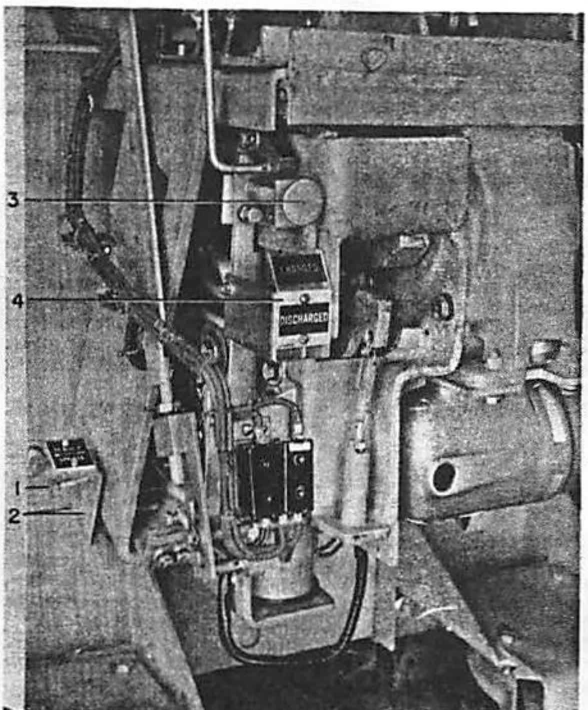
These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently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

ADJUSTMENTS



1. Charging Handle
2. Spring Blocking Plate Switch
3. Frame
4. Opening Spring
5. Motor Shims
6. Chain
7. Mounting Bolts
8. Switch Bracket
9. Switch Actuator Paddle

Fig. 2



1. Blocking Plate Retaining Bolt
2. Blocking Plate
3. Manual Release Button
4. Semaphore

Fig. 3

Adjustments should be checked during periodic inspections and whenever it becomes necessary to repair or replace parts that have become worn or defective while in service.

"DO NOT WORK ON EITHER THE BREAKER OR THE MECHANISM UNLESS THE CLOSING SPRINGS ARE BLOCKED AND THE OPENING SPRINGS HAVE BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING."

TRIP LATCH CLEARANCE (Ref. Fig. 4)

With the breaker in the tripped position, check the clearance between the trip latch (4) and trip roller (6). It should measure 1/32" to 1/16". This should be measured with the closing springs gagged, and after the breaker has been tripped out.

TRIP LATCH WIPE (Ref. Fig. 4)

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.

Fig. 2 (8028593)

PROP CLEARANCE (Ref. Fig. 4)

All Designs

Block the closing springs (Using the manual charging handle (1), Fig. 2 rotate the prop pin (8) to a position over the prop (10) as far as possible.

ML-11 Design

Measure this clearance with a feeler gage. The clearance should measure between .040" to .070" for the AM-4.16-150-250; AM-7.2-250; AM-13.8-250-500 breakers and .060" to .100" for the AM-7.2-500 and AM-13.8-750 breakers. In conjunction with this measurement, when the breaker is in the unblocked position, manually close the breaker and measure the distance the prop pin comes to rest over the prop. (NOTE: It is possible that in some breakers it will rest on the prop). Rotate the prop pin back over the props the distance measured + 1/16". At this point the breaker must trip both manually and electrically.

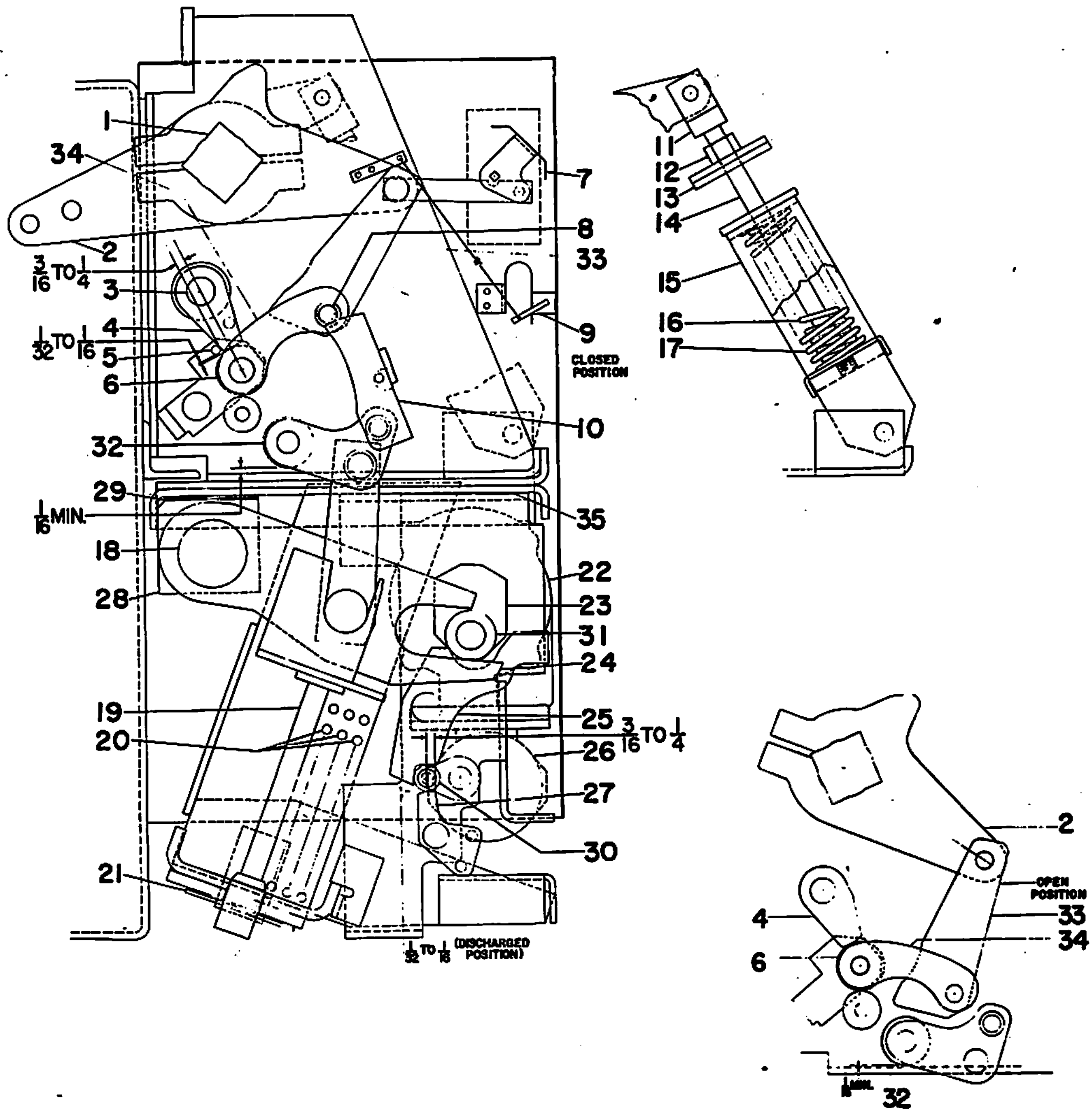
Fig. 3 (8028592)

ML-11A, 11B and 11C Design

The clearance for all rated breakers should be 1/16" minimum measured when the springs are blocked. (This clearance may measure 3/8" over the prop pin when the mechanism is unblocked and fully closed).

On All Designs

On all designs the allowable difference between sides of the prop pin (8) measured from the top of the prop (10) to the underside of the prop pin (8) is 1/16". If adjustment is required remove the bolts holding the bearing blocks (28) and add or remove shims (29) as required. Loosen



1. Main Operating Shaft
2. Main Crank
3. Trip Shaft
4. Trip Latch
5. Trip Latch Stop
6. Trip Roller
7. Position Indicator
8. Closing Pin
9. Counter
10. Prop
11. Clevis
12. Check Nut
13. Adjusting Nut
14. Adjusting Stud
15. Opening Spring Housing
16. Opening Spring, Inner
17. Opening Spring, Outer
18. Main Spring Shaft
19. Spring Yoke Assembly
20. Closing Springs
21. Maintenance Spring Blocking Plate
22. Gear Reduction Unit
23. Output Crank
24. Spring Compression Arm
25. Stop Latch
26. Gear Motor
27. Close Latch
28. Bearing Block
29. Pillar Block Shims
30. Latch Reset Roller
31. Output Roller
32. Roller
33. Canoe Link
34. Banana Link
35. Gear Box Shim

Fig. 4 Cross Section of ML-11 Mechanism

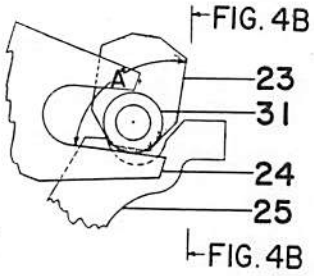


Fig. 4A

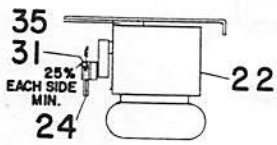
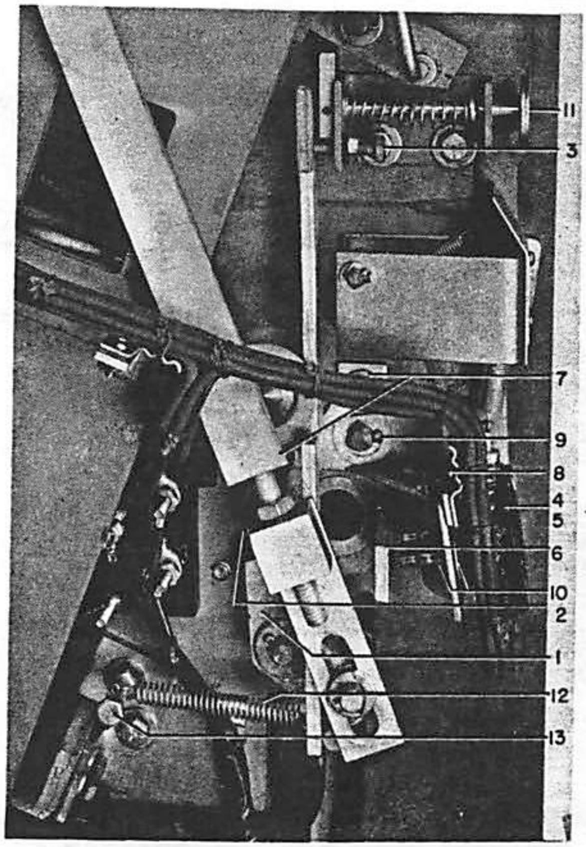


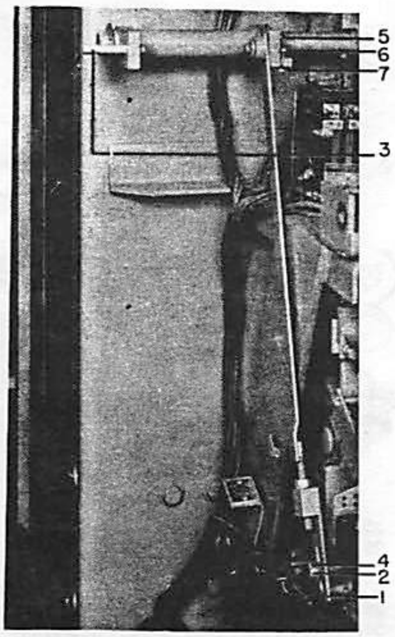
FIG. 4B

Fig. 4A and 4B



1. Release Latch
2. Release Latch Roller
3. Adjustment Bolt
4. Auxiliary Switch (Inboard)
5. Auxiliary Switch (Outboard)
6. Switch Actuator Paddle
7. Switch Bracket Bolts
8. Switch Bracket
9. Pin
10. Switch Lock Nut
11. Manual Release Button
12. Reset Spring
13. Bolt

Fig. 5



1. Spring Release Link
2. Release Latch Pin
3. Spring Release Pin
4. Cotter Pin
5. Latch Shaft Actuator Pin
6. Spring Release Link Bolt
7. Lock Nut

Fig. 6

Fig. 4A & B (542E742)

Fig. 5 (8028594)

Fig. 6 (8025980)

bolts and adjust only one bearing block (29) at a time. The addition of a 1/64" shim will decrease the clearance approximately .010". Conversely removing a 1/64" shim will increase the clearance approximately .010".

RELEASE LATCH CLEARANCE (Ref. Fig.5)

If the latch (1) fails to reset, check to see that the latch reset roller (2) has a clearance between the reset latch (1) top surface and the bottom of the roller (2) of 1/32" to 1/16". No adjustment is provided and a visual inspection is all that is required. To make latch (1) respond faster add tension to spring (12) by rotating bolt (13) counterclockwise.

RELEASE LATCH WIPE (Ref. Fig. 5)

The wipe between the right top latch surface edge and the center of the release latch rpller should be between 3/16" to 1/4". If the setting is incorrect adjust wipe by rotating adjustment bolt (3) clockwise or counterclockwise. Recheck above setting.

AUXILIARY SWITCHES (Ref. Fig. 5)

The auxiliary normally closed (4) inboard and normally open (5) outboard switches are set to have both switch buttons operated together initiated by the switch actuator paddle (6). They are operated by the action of paddle (6) and are indexed with the gear box crank (23) Fig. 4 to operate before the gear box crank roller (31) Fig. 4 comes to rest against stop latch (25) Fig. 4. They are adjusted and set at the factory by applying the minimum operating voltage to the motor and should require no additional adjustments. They are set properly when the crank roller (31) Fig. 4A is resting against stop latch (25) Fig. 4A and the "A" angle Fig. 4A as measured between the output crank (23) Fig. 4A and spring compression arm (24)

Fig. 4A cam surface measures 90° to 94° on the ML-11 design and 95° to 102° on the ML-11A, ML-11B and ML-11C design. However, if adjustment of the switches is required, first block the closing springs, unscrew bolts (7) Fig. 5 and rotate complete switch bracket (8) and both switches (4 & 5) about pin (9). When the bracket (8) and switches (4 & 5) are moved toward the switch actuator paddle the switches will operate earlier in the charging cycle. When the bracket and switches are moved away from the switch actuator paddle the switches will operate later in the closing spring charging cycle.

After the setting has been made check to see that the switches have a minimum of 1/16" overtravel on the switch buttons. If not, adjust switches (4 & 5) on bracket (8) either individually or together by loosening switch lock nuts (10) and moving switches out. Tighten switch lock nuts and recheck adjustment. Charge the closing springs manually and check the operation of the switches with a bell set. Remove block from the closing springs and close the mechanism manually by pressing manual release button (11). Wind up mechanism electrically by applying minimum control voltage (see control power range) to the motor. The switches should cut off and allow the output crank (23), Fig. 4 to coast against latch (24), Fig. 4. The mechanism should then close manually and electrically. When the above is finished and checked the switches are adjusted properly.

SPRING RELEASE (Ref. Fig. 6)

Check the clearance between the closing spring release link (1) and the pin on the release latch (2). This should be 1/2" to 5/8" measured from the bottom of the actuator slot to the bottom surface of the pin. To check this adjustment, charge the closing springs of the breaker and rotate the spring release pin (3) counterclockwise. The breaker should trip out before the closing springs discharge giving a "Trip-free" operation. If adjustment is necessary, remove one cotter pin (4) and disassemble link. Rotate link (1) clockwise or counterclockwise. Assemble and recheck. On ML-11 design check the clearance between the latch shaft actuator pin (5) and spring release link pin. The clearance should measure 1/32" ± 1/64". No adjustment is supplied and a visible check is all that is required. On the ML-11A and ML-11B design check the clearance between the latch shaft actuator pin (5) and spring release link bolt (6). It should measure 1/4" to 5/16". To adjust, rotate bolt (6). Tighten locknut (7) and remeasure.

FRICTION CLUTCH (Ref. Fig. 7)

The friction clutch should be tested with a torque-meter (1) to have a break away torque of 300 to 350 inch-pounds on the AM-4.16-100/150, 250, AM-7.2-250, AM-13.8-250/500 breakers and 350 to 400 inch pounds on the AM-7.2-500 & 13.8-750 breakers. Rest wrench (2) against frame (3) and apply torque to the torque meter (1) until the clutch breaks away and note the value on the torque meter dial. Do not continue to turn if the value exceeds that as stated above. If adjustment is required, refer to Fig. 8, loosen 2 set screws (1) in the hexagon head nut (2) and apply clutch adjustment wrench (3) to hexagon head nut (2) and wrench (4) to the square coupling (5). Tighten or loosen the hexagon head nut (2) and tighten the set screws (1) in the nut and recheck the torque.

INTERLOCK SWITCH WIPE (Ref. Fig. 7)

Rotate the interlock shaft manually clockwise to release the interlock switch arm (4). 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 (5), bend the interlock switch arm (4). The roller and crank on the interlock switch (5) should have 1/32" to 1/16" overtravel after final adjustment. No attempt should be made to interrupt the motor current with this switch as damage to the switch will result.

BLOCKING PLATE SWITCH (Ref. Fig. 2)

The blocking plate switch (2) is connected in the motor circuit and located such that when the closing springs are blocked the switch opens. When the closing springs are not blocked the switch is closed. When the switch is closed there should be an overtravel of 1/32" to 1/16" on the switch arm. If adjustment is necessary first check bolts (7) for tightness, then bend the switch actuator paddle slightly to give the required overtravel.

DRIVE CHAIN (Ref. Fig. 2)

The chain is set snug at the factory and should require no additional adjustment. However, as is common on chain drives after numerous operations the chain will set lower in the sprockets and show signs of looseness. To check the chain, measure the horizontal distance between the inside edges of the chain in the normal position. Pull both sides together and measure the distance. Rotate the sprocket 180° and measure both distances again. If the difference between dimensions on each set of dimensions is greater than 5/8" add shims (7) between the motor mounting base and the gear box base.

OUTPUT ROLLER (Fig. 4, 4A & 4B)

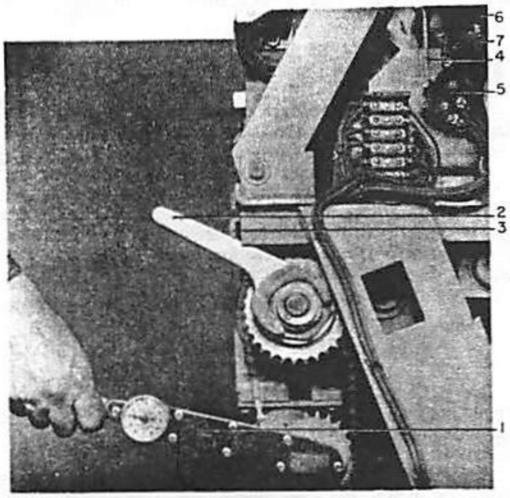
The output roller (31) and the spring compression arm (24) should have at least 50% minimum engagement. The 50% engagement should be taken from the center portion of the output roller (31) as shown in Fig. 4B. This engagement should be checked when the mechanism is in the charged position. To adjust to this condition add or remove shims (35) between the frame and gear reduction unit (22).

AUXILIARY DEVICES

Refer to the magne-blast circuit breaker instruction book for adjustment of all auxiliary devices.

CONTROL POWER CHECK (Ref. Fig. 2)

After the mechanism has been closed and opened slowly several times with the maintenance closing handle (1) Fig. 2 and the mechanism adjustments checked as described, the operating voltages should



1. Torque Meter
2. Wrench
3. Frame
4. Interlock Switch Arm
5. Interlock Switch
6. Latch Checking Switch Arm
7. Latch Checking Switch

Fig. 7

Fig. 7 (8025983)

1. Set Screws
2. Hex Head Nut
3. Clutch Adjustment Wrench
4. Wrench
5. Coupling

Fig. 8

Fig. 8 (8025986)

be checked at the release coil, trip coil, and motor terminals. For electrical operation of the mechanism 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	
	Min.	Max.	Min.	Max.
48v d-c	34 -	50v d-c	28 -	60v d-c
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

INSULATION TEST

If the breaker secondary wiring is to be given a hi-potential test at 1500 volts, remove both of the motor leads from the terminal board. Failure to disconnect the motor from the circuit may cause damage to the winding insulation.

INSPECTION AND TEST

1. For ease in reviewing the adjustments, the following are recapitulated.
   (a) Primary contact wipe, arcing contact wipe, primary contact gap, plunger interlock and auxiliary devices - refer to magne-blast circuit breaker instruction book.
   (b) Trip latch clearance - 1/32" to 1/16". (Fig. 4)
   (c) Trip latch wipe - 3/16" to 1/4". (Fig. 4)
   (d) Prop clearance - See prop clearance section. (Fig. 4)
   (e) Release latch clearance - 1/32" to 1/16". (Fig. 5)
   (f) Release latch wipe - 3/16" to 1/4" (Fig. 5)
   (g) Spring release lower adjustment 1/2" to 5/8".
   Upper ML-11 1/32" ± 1/64". ML-11A, ML-11B and ML-11C 1/4" to 5/16". (Fig. 6)
   (h) Auxiliary switches - 1/16" over travel - Angle. ML-11 92° to 94° ML-11A, ML-11B and ML-11C 95° to 102°. (Fig. 5)
   (i) Friction clutch - 300 to 350 inch-pounds torque. AM-7.2-500, AM-13.8-750, 350 to 400 inch-pounds torque. (Fig. 7 & 8)
   (j) Blocking plate switch - 1/16" overtravel. (Fig. 2)
   (k) Interlock switch - 1/16" overtravel. (Fig. 7)
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 section on LUBRICATION.
5. Operate the breaker slowly with the manual charging handle 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.
7. Check the trip coil plunger and release coil plunger to see that they move freely.

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. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE THE SPRINGS ARE CHARGED UNLESS THEY ARE SECURED IN THAT POSITION BY THE MAINTENANCE SPRING BLOCKING PLATE.

During maintenance of the mechanism substitute a 10 amp fuse in the closing and charging circuit. When the equipment is placed back in operation, change the fuse to the size recommended on the connection diagram.

PERIODIC INSPECTION

The frequency of periodic inspections should be determined by each operating company on the basis of the number of operations and any unusual operations which occur from time to time. Even with a limited number of operations, the breaker should be inspected regularly and cleaned and lubricated to insure trouble free operation. The following instructions list the main points to be included in an inspection, and a number of general recommendations.

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 manual charging handle, 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 ADJUSTMENTS. Check all terminal connections.

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

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 the following 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 the following cleaning instructions and repack with D50H15.
Gear Reduction Unit	Sealed unit does not normally require additional lubrication.	Clean as per the following instructions and lubricate with approximately 2 ounces of SAE 20 or SAE 30. NOTE: DO NOT FILL GEAR BOX WITH OIL. High internal pressures will cause the oil to leak at the seals and gaskets.

Fig. 9 Lubrication Chart

whenever it is overhauled, in accordance with the lubrication chart. 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 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 pound collapsible tubes. It is so packaged to insure cleanliness and to prevent oxidation.

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 face 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.

Gear Reduction Unit (Ref. Fig. 19)

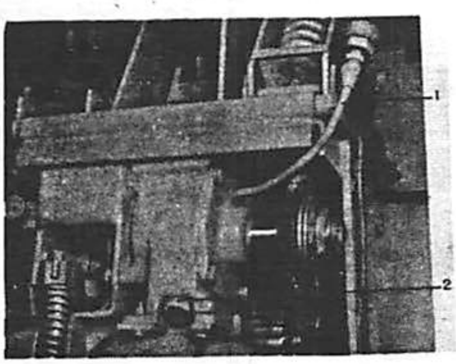
The gear reduction unit should be removed from the frame after disconnecting the chain drive and motor, and blocking the springs with the maintenance blocking plate.

Removal of the cotter pin and washers from the end of the shaft, and the four bolts holding the end bell (221) on the casting will allow enough of the unit to be disassembled for a thorough cleaning. Remove the pinion (211) ring gear (237) and eccentric (210) and place them in a container of clean petroleum solvent or similar cleaner. DO NOT USE CARBON-TETRACHLORIDE. The housing and remaining parts can usually be cleaned with a stiff brush and petroleum solvent. Inspect all gears, spacers and internal parts for cracks or any sign of unusual wear. Inspect the oil seal rings on the shafts and the gasket on the bell end cover to insure a tight fit.

In some cases, small metal chips may appear in the oil. This is not unusual and is to be expected from new gears.

Reassemble gears, spacers, etc. in the opposite order of their removal and add 2 ounces of SAE 20 or SAE 30 oil as shown in Fig. 10. Do not use more than 2 ounces of oil as high internal pressure caused by the rotating gears will force the oil past the gaskets and oil seal rings.

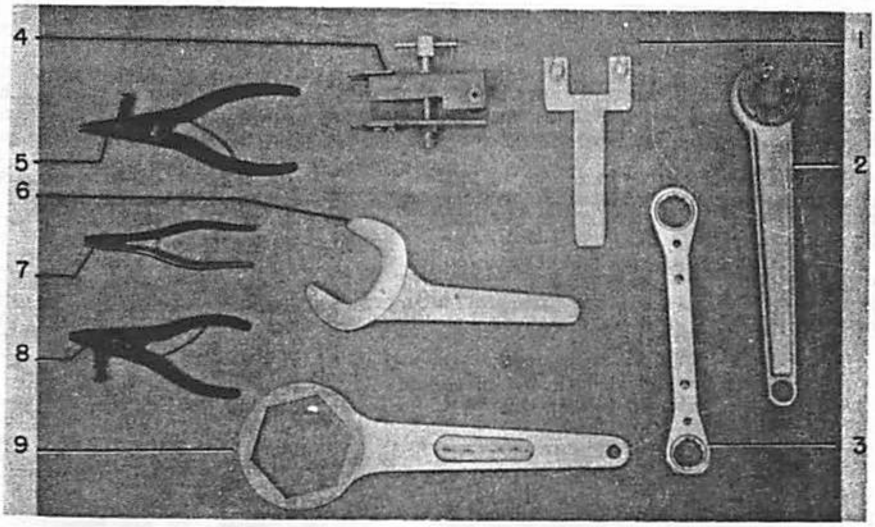
Reassemble gear reduction unit, motor and chain drive on mechanism. Before applying power to the motor, check all clearances as indicated in adjustments.



1. Oil Funnel 2. Oil Drain

Fig. 10

Fig. 10 (8025979)



1. Spanner Wrench
2. 1" Snap-on Wrench
3. 3/4" and 7/8" Snap-on Wrench (Supplied With 13.8kv Bkr. Only)
4. Spring Compressor
5. Retaining Ring Pliers
6. Square Nut Wrench
7. Retaining Ring Pliers
8. Retaining Ring Pliers
9. Hex Nut Wrench

Fig. 11 Tool Set for ML-11 Mechanism

Fig. 11 (8028557)

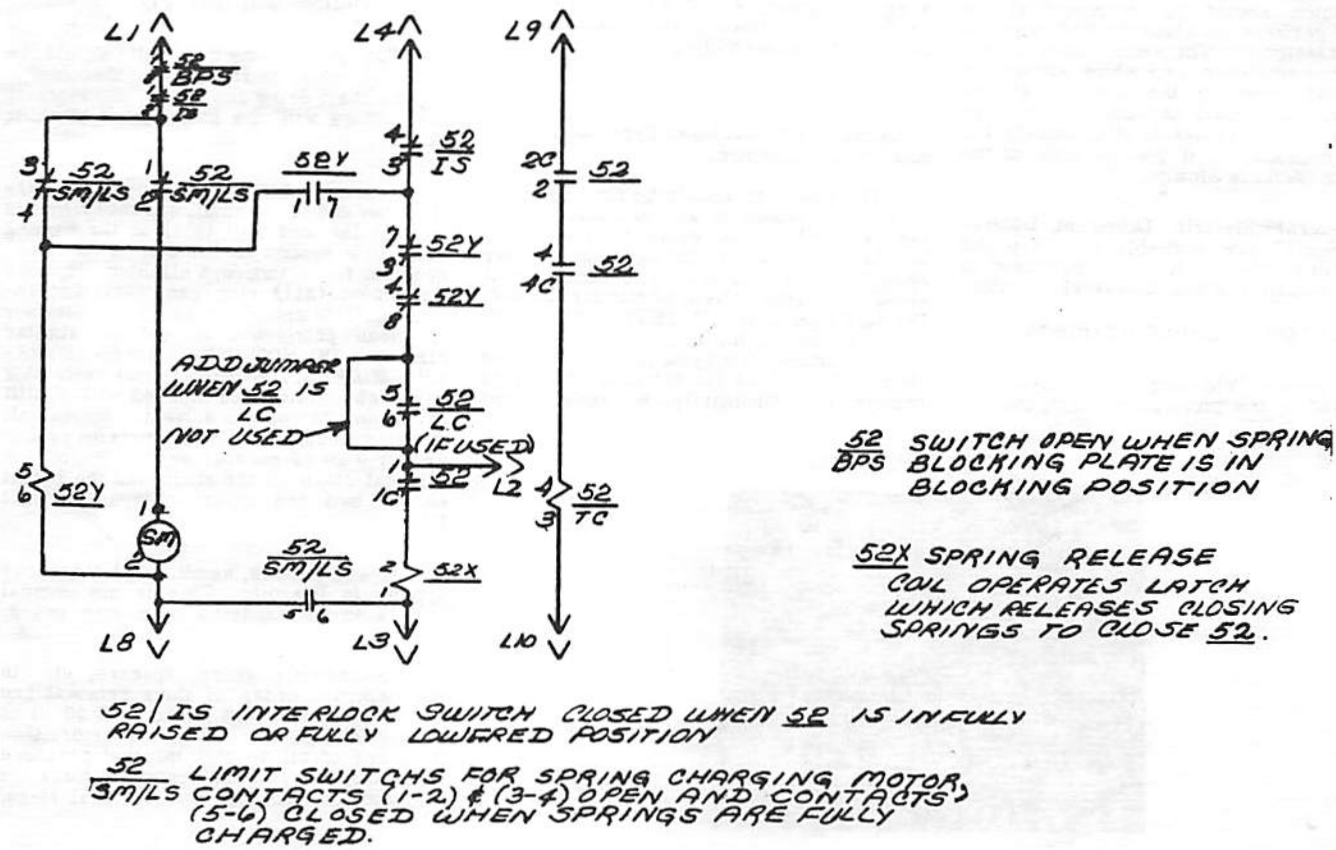


Fig. 12 Typical Breaker Wiring Diagram

Fig. 12 (121A5926)

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

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

FIG. NO.	REF. NO.	CAT. NO. FOR ML-11	NO. PER MECH.	DESCRIPTION
14	108	6517087 G-7	1	Motor (48v d-c)
14	108	6517087 G-5	1	Motor (125v d-c)
14	108	6517087 G-6	1	Motor (250v d-c) 270213
14	108	6517087 G-6	1	Motor (230v a-c)
16	109	12HGA11H54	1	Relay (48v d-c)
16	109	12HGA11H52	1	Relay (125v d-c)
16	109	12HGA11H51	1	Relay (250v d-c)
16	109	12HGA11H71	1	Relay (230v a-c)
13	119	254D738 P-64	1	Spring Blocking Plate Switch
18	204	104A2451 P-2	1	Clutch Spring Washer
18	207	265C189 P-6	2	Clutch Friction Washer
20	212	258C626 P-10	2	Gasket
20	216	215D472 P-12	1	Gear Box "O" Ring
20	217	215D472 P-11	1	Gear Box "O" Ring
20	218	215D472 P-38	1	Gear Box "O" Ring
20	225	258C626 P-12	2	Drain Plug Gasket
19	239	258C626 P-19	4	Motor Shims 1/64" Thk.
19	239	258C626 P-14	4	Motor Shims 1/32" Thk.
19	239	258C626 P-13	4	Motor Shims 1/16" Thk.
*	240	258C642 P-12	AR	Pillar Block Shims 1/64" Thk.
*	240	258C642 P-11	2	Pillar Block Shims 1/32" Thk.
*	240	258C642 P-10	2	Pillar Block Shims 1/16" Thk.
*	241	265C189 P-9	3	Gear Box Shims
23	257	104A2456	1	Release Latch Reset Spring (ML-11B)
23	257	414A135 P-1	1	Release Latch Reset Spring (ML-11 & ML-11A)
23	257	104A2456	1	Release Latch Reset Spring (ML-11 & ML-11A)
23	279	9921661 P-1	1	Motor Switch (Norm. Open)
24	280	104A2455	1	Release Roller Spring
23	281	9921661 P-2	1	Motor Switch (Norm. Closed)
23	292	6174582 G-1	2 △	Release & Trip Coils 125v d-c
23	292	6174582 G-2	2 △	Release & Trip Coils 250v d-c - 272433 ← SL
23	292	6174582 G-14	2 △	Release & Trip Coils 230v a-c
23	292	6275070 G-2	2 △	Release & Trip Coils 48v d-c
23	292	6275070 G-1	1	Trip Coil 24v d-c

△ Use one for Spring Release Circuit and one for Trip Circuit.
* Not Shown

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 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.

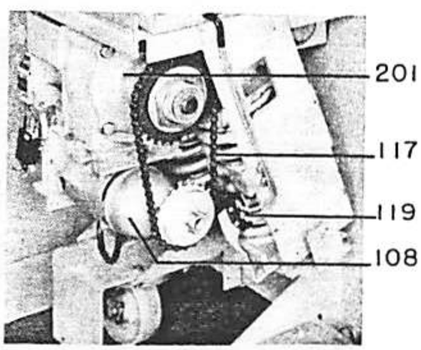


Fig. 13

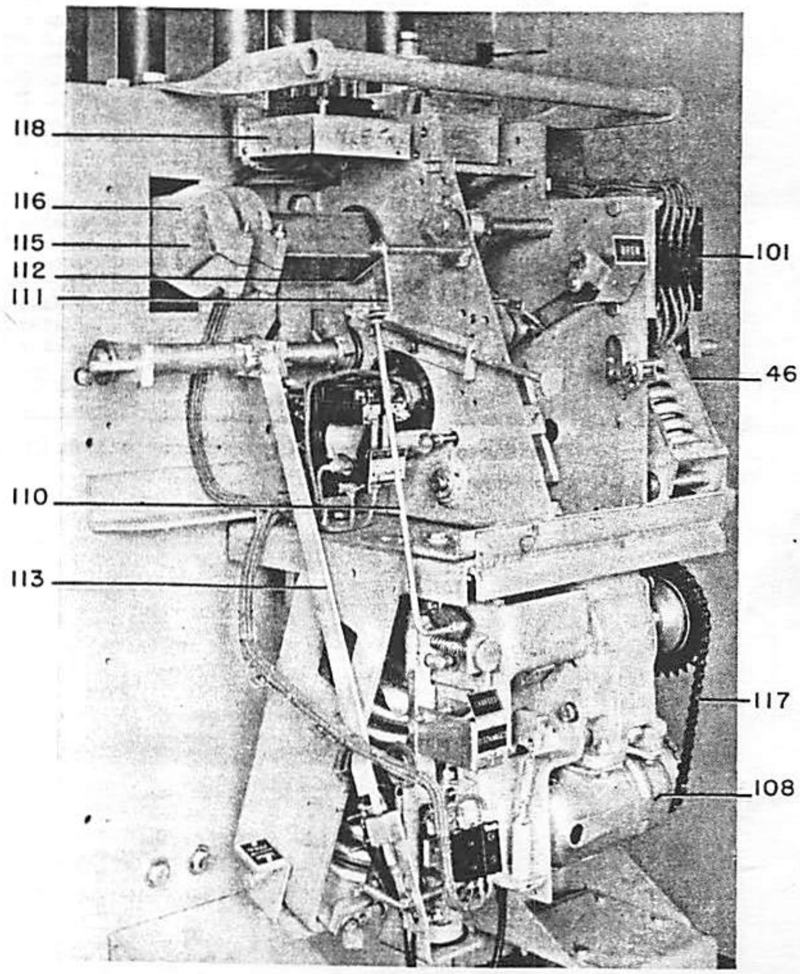


Fig. 14

Fig. 13 (8028590)

Fig. 14 (8028595)

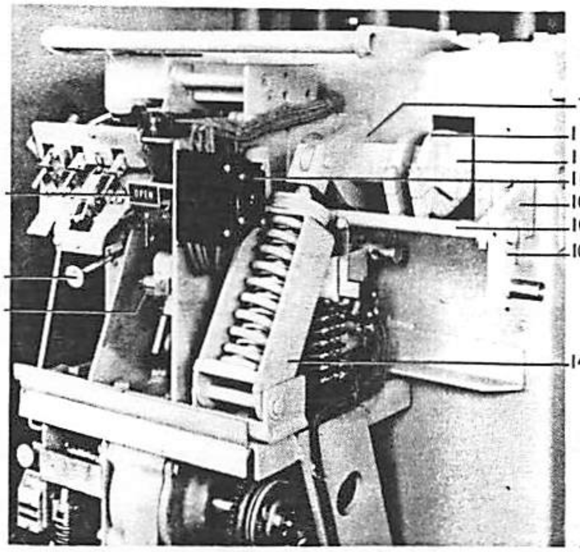


Fig. 15

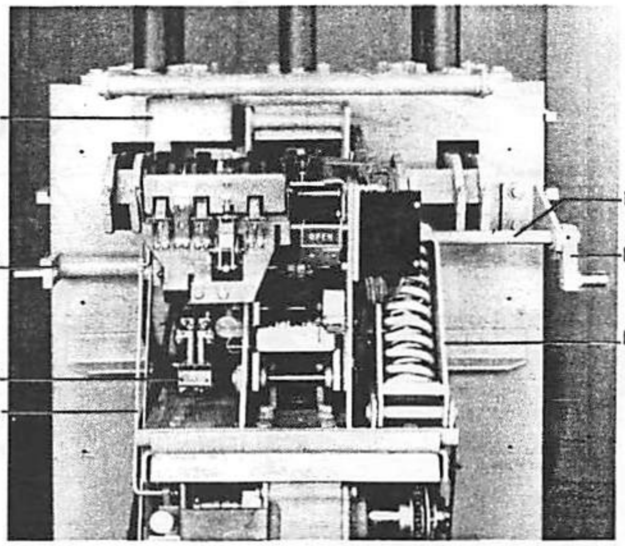
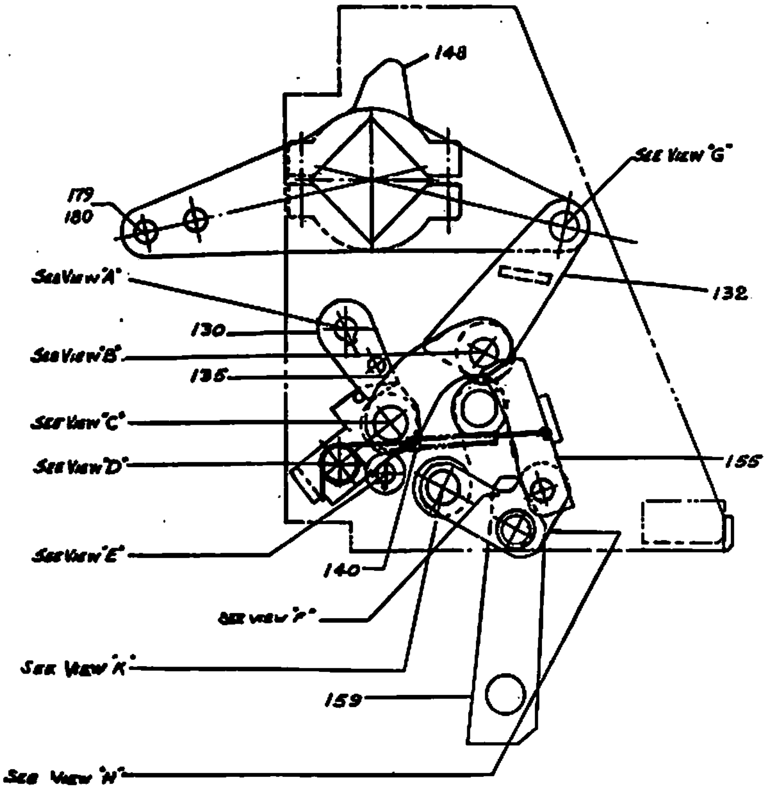


Fig. 16

Fig. 15 (8024971)

Fig. 16 (8024970)

REF. NO.	CAT. NO. FOR ML-11	NO. PER MECH.	DESCRIPTION
100	258C604 G-4	1	Manual Trip Assembly
101	415A489 G-1	1	Auxiliary Switch
103	6192382AB P-1	1	Operation Counter
104	281B711 G-1	1	Indicator Assembly
105	258C601 P-14	1	Shaft (4.16)
105	258C601 P-15	1	Shaft (13.8 & 7.2)
106	236C788 G-10	1	Crank Assembly
107	258C601 G-3	1	Bearing Bracket
108	6517087 G-5	1	Motor (125v d-c)
108	6517087 G-6	1	Motor (250v d-c & 230v a-c)
108	6517087 G-7	1	Motor (48v d-c)
109	12HGA11H54	1	Relay (48v d-c)
109	12HGA11H52	1	Relay (125v d-c)
109	12HGA11H51	1	Relay (250v d-c)
109	12HGA11H71	1	Relay (230v a-c)
109	12HGA11H56	1	Relay (24v d-c)
110	619C421 P-6	1	Trip Lock Rod
111	619C421 P-4	1	Trip Lock Link
112	619C421 G-3	1	Trip Lock Pin & Crank (4.16, 7.2 & 13.8-500)
112	619C421 G-4	1	Trip Lock Pin & Crank (13.8-750)
113	688C511 G-2	1	Trip Interlock Complete (4.16)
113	688C511 G-1	1	Trip Interlock Complete (13.8 & 7.2)
114	688C511 G-6	1	Trip Interlock Crank Only (4.16)
114	688C511 G-3	1	Trip Interlock Crank Only (13.8 & 7.2)
115	6443518 P-2	1	Shaft (4.16)
115	6443518 P-1	1	Shaft (13.8 & 7.2)
116	836C190 P-1	6	Crank
117	215D472 P-13	1	Chain 269630
118	802B795 G-3	1	Secondary Disconnect Device Complete (#14 Wire)
118	802B795 G-4	1	Secondary Disconnect Device Complete (#12 Wire)
119	254D738 P-64	1	Spring Blocking Plate Switch (N. O.)



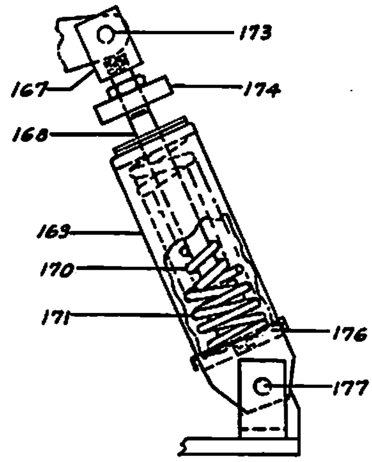


Fig. 17A Complete Opening Spring Assembly
Ref. 146

Fig. 17A (0105C9391)

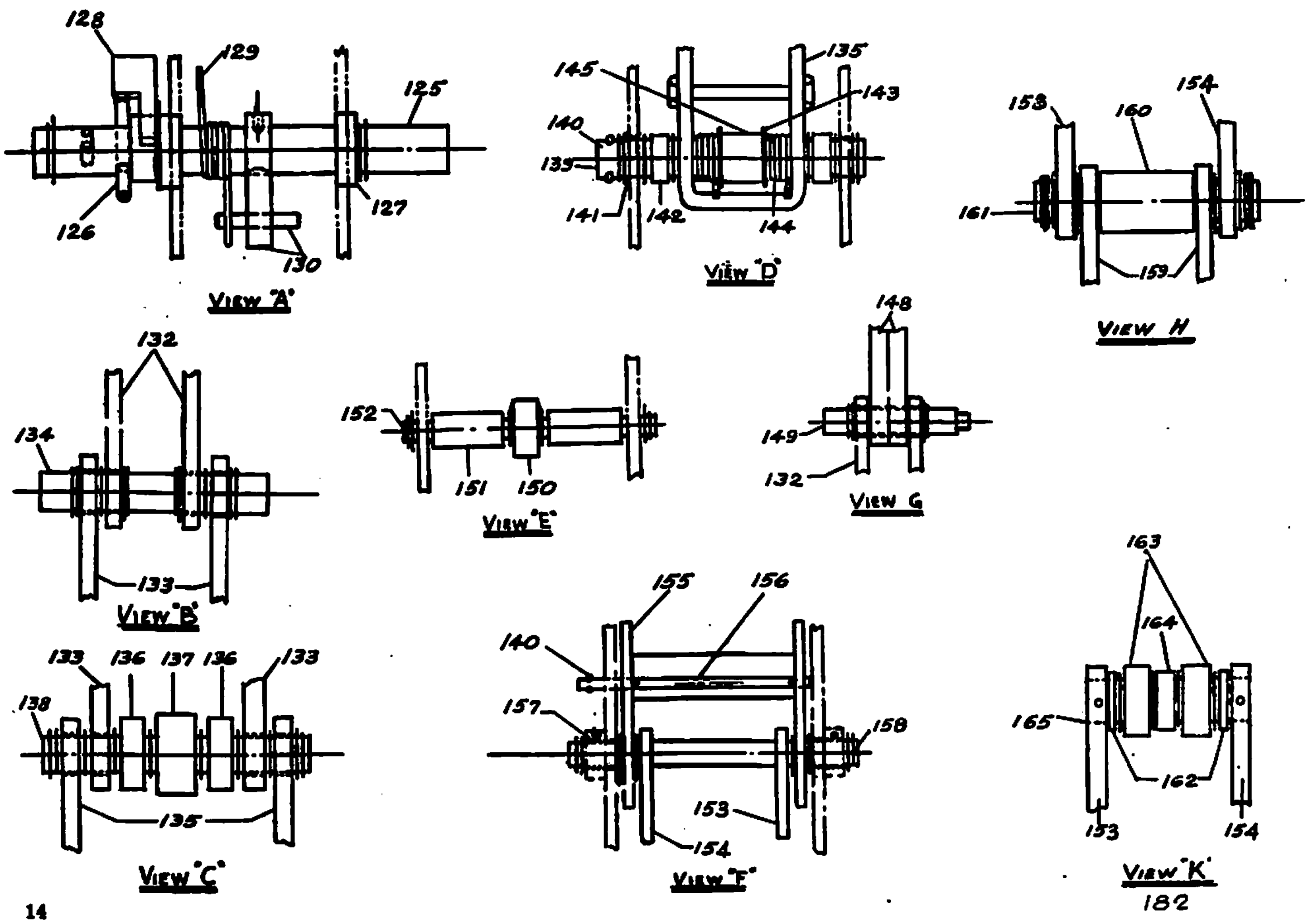


Fig. 17 (0105C9391)

Fig. 17 Cross Section

REF. NO.	CAT. NO. FOR ML-11	NO. PER MECH.	DESCRIPTION
125	215D465 P-34	1	Latch Shaft (4.16)
125	215D465 P-35	1	Latch Shaft (13.8 & 7.2)
126	258C635 P-11	1	Stop Bar
127	121A7436 G-1	2	Dry Bearing Assembly
128	104A2472 G-1	1	Stop Bar
129	421A244	1	Spring
130	828C758 G-1	1	Latch & Pin
132	215D473 G-53	1	Link & Bushing
133	215D473 G-52	2	Link & Bushing
134	258C627 P-10	1	Prop Pin
135	215D473 G-51	1	Link & Bushing
136	456A876 P-102	2	Spacer
137	414A112 P-1	1	Needle Bearing
138	414A110 P-5	1	Pin
139	258C628 P-4	1	Pin
140	456A820	1	Spring
141	6370567 P-51	2	Bushing
142	456A876 P-104	2	Spacer
143	414A105 P-10	4	Washer
144	6509799	2	Spring
145	456A876 P-105	1	Spacer
146	258C630 G-4	1	Spring Assembly Complete
146	258C630 G-6	2	Spring Assembly Complete (13.8 - 750)
148	215D473 G-54	2	Crank & Bushing
149	258C609 P-9	1	Pin
150	828C758 P-7	1	Roller
151	421A209 P-101	2	Spacer
152	383A926AE P-39	1	Pin
153	215D473 G-55	1	Crank & Bushing
154	215D473 G-56	1	Crank & Bushing
155	265C189 G-1	1	Prop
156	258C627 P-13	1	Pin
157	456A885 P-1	2	Bushing
158	688C553 P-10	1	Pin
159	258C627 P-4	2	Link
160	456A876 P-19	1	Spacer
161	258C627 P-11	1	Pin
162	6176109 P-168	2	Spacer
163	414A112 P-8	2	Needle Bearing
164	6176109 P-174	1	Spacer
165	258C627 P-12	1	Pin
167	258C630 P-7	*	Clevis
168	258C630 P-8	*	Rod
169	258C630 P-3	*	Spring Retainer
170	456A808	*	Inner Spring
171	456A807	*	Outer Spring
172	258C630 P-4	*	Spring Base
173	383A926AE P-1	*	Pin
174	258C630 G-3	*	Plate
175	414A109 P-8	*	Buffer
176	258C630 P-5	*	Retaining Plate
177	383A926AF P-20	*	Pin
178	258C609 P-4	*	Crank
179	619C478 P-19	2	Pin for End Pole
180	688C568 P-8	1	Pin for Center Pole
181△	0258C0611 P-15	1	Opening Spring Cover (Left Hand Spring Only)
182	215D473 G-57	1	Closing Crank & Roller Assembly Complete

* (1) For Std. (2) For 13.8-750
△ Not Shown

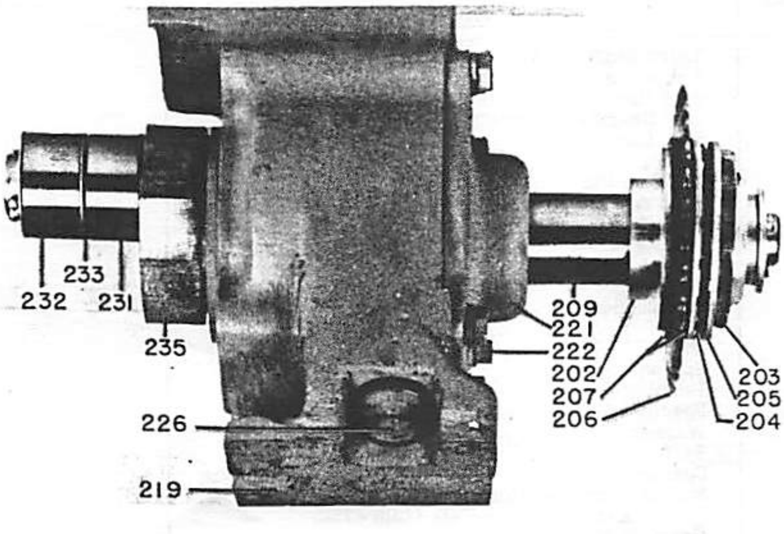


Fig. 18 Complete Gear Unit Ref. 201

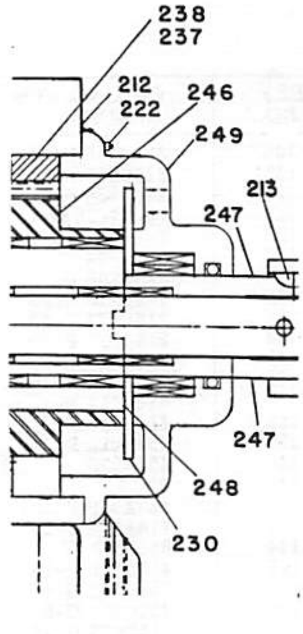


Fig. 19A Reduction Gear Unit ML-11D (Otherwise Same As Fig. 19)

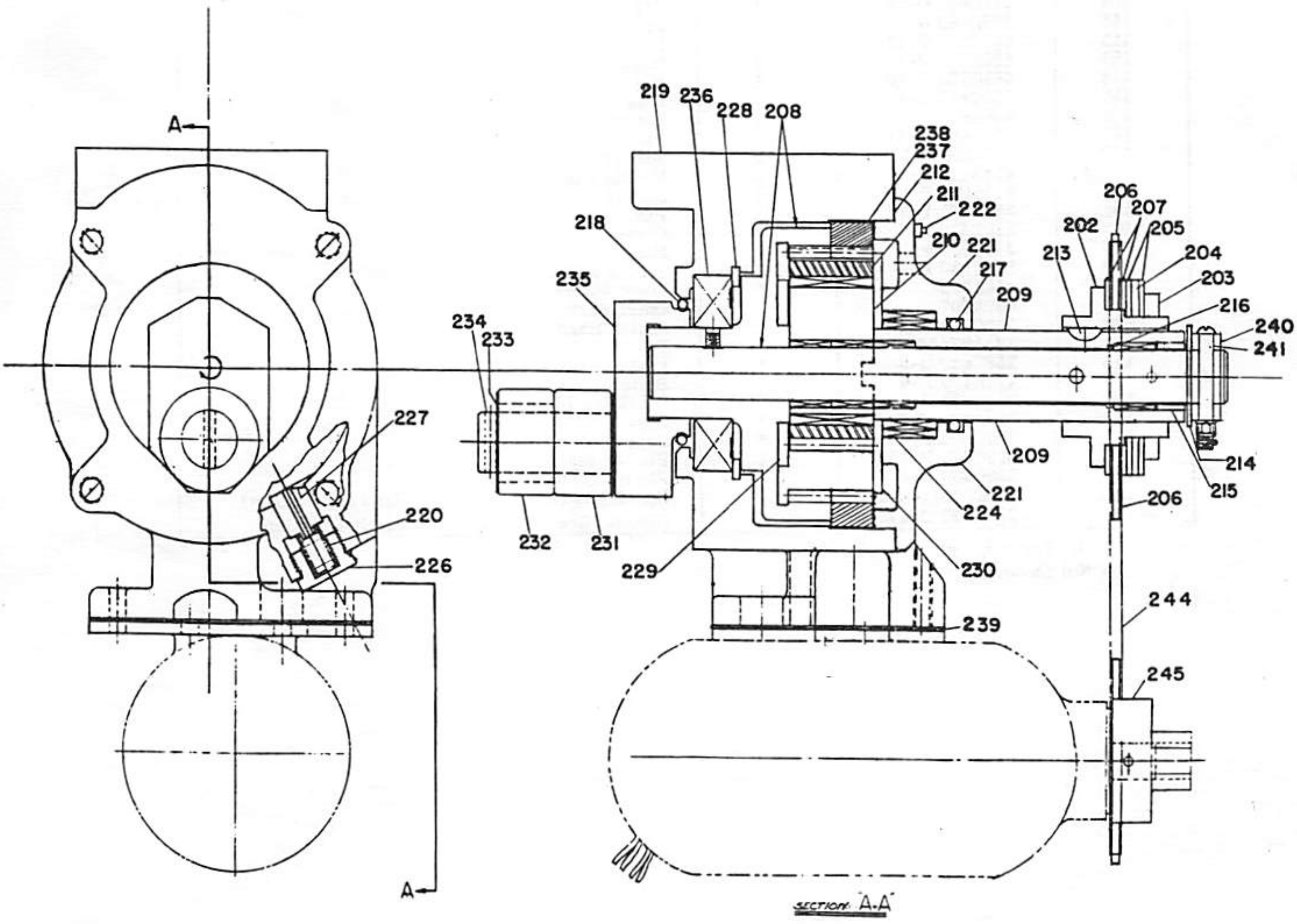
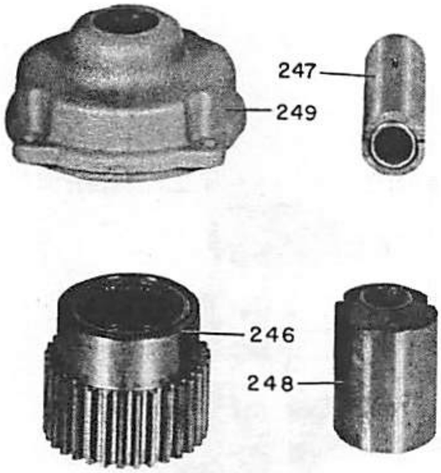


Fig. 19 Reduction Gear Unit

Fig. 18 (8024680)

Fig. 19 (634D322)

Fig. 19A (635D364)



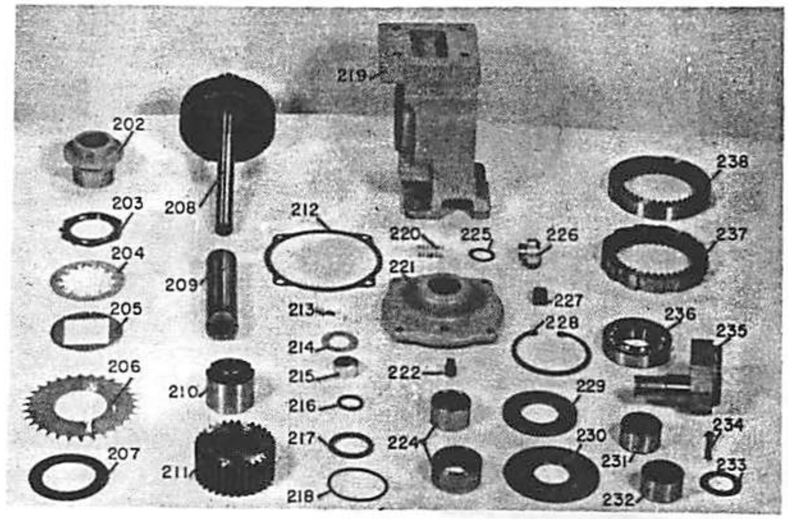
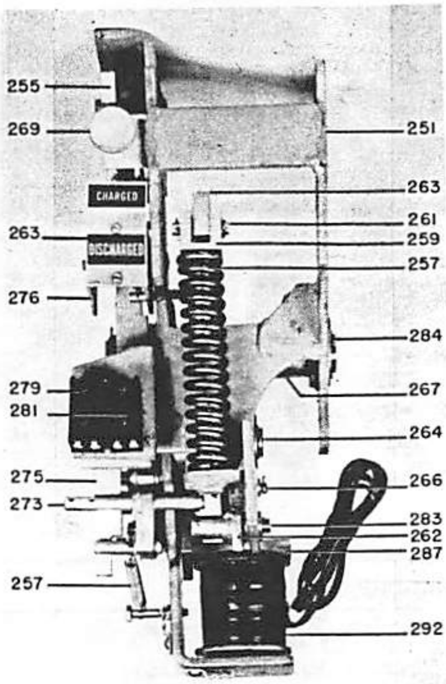


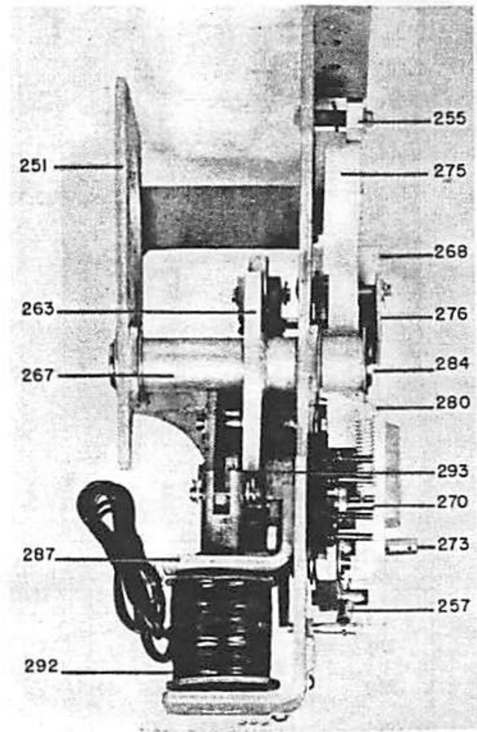
Fig. 20

Fig. 20 (8026378 and 80___0)

REF. NO.	CAT. NO. FOR ML-11	NO. PER MECH.	DESCRIPTION
201	215D472 G-1	1	Reduction Gear Unit Complete (ML-11A, ML-11B) 4.16-150, 250; 7.2-250; 13.8-150, 250, 500
201	215D472 G-2	1	Reduction Gear Unit Complete (ML-11A, ML-11B) 7.2-500, 13.8-750
201	215D472 G-3	1	Reduction Gear Unit Complete (ML-11C) 4.16-150, 250; 7.2-250; 13.8-150, 250, 500
201	215D472 G-5	1	Reduction Gear Unit Complete (ML-11D) 7.2-500; 13.8-750
202	265C189 P-4	1	Retainer
203	265C189 P-7	1	Nut
204	104A2451 P-2	1	Spring Washer
205	265C189 P-5	2	Washer
206	258C625 P-7	1	Sprocket
207	265C189 P-6	2	Clutch Washer
208	215D472 G-50	1	Gear Assembly
209	215D472 G-51	1	Shaft, Bearing & "O" Ring (ML-11, ML-11A, ML-11B, ML-11C)
210	215D472 G-53	1	Eccentric (ML-11, ML-11A, ML-11B, ML-11C)
211	215D472 G-52	1	Pinion Gear & Bearing (ML-11, ML-11A, ML-11B, ML-11C)
212	258C626 P-10	1	Gasket
213	215D472 P-37	1	Woodruff Key
214	414A105 P-10	2	Washer
215	258C625 P-10	1	Spacer
216	121A5998 P-4	1	"O" Ring
217	121A5998 P-5	1	"O" Ring
218	121A5998 P-6	1	"O" Ring
219	258C622 P-1	1	Gear Housing 4.16-150, 250; 7.2-250; 13.8-150, 250, 500
219	258C622 P-3	1	Gear Housing 7.2-500 & 13.8-750
220	104A2470	1	Spring
221	258C624 P-1	1	Cover (ML-11, ML-11A, ML-11B, ML-11C)
222	215D472 P-26	1	Plug
224	414A112 P-5	1	Bearing (Inner & Outer Race)
225	258C626 P-12	2	Gasket
226	688C553 P-8	1	Plug
227	258C626 P-20	1	Rachet Pin
228	N901P334	1	Retaining Ring
229	137A6028 P-1	1	Spacer
230	137A6028 P-2	1	Spacer
231	414A112 P-7	1	Bearing (ML-11, ML-11A, ML-11B)
231	414A112 P-44	1	Bearing (ML-11C, ML-11D)
232	215D472 G-54	1	Roller & Bearing
233	414A105 P-18	1	Washer
234	1/8 Dia X 1/2 Lg	1	Cotter Pin
235	258C625 P-1	1	Latch Prop
236	414A112 P-9	1	Bearing
237	6404419 P-1	1	Ring Gear (ML-11)
238	104A2407 P-2	1	Ring Gear (ML-11A, ML-11B, ML-11C, ML-11D)
239	258C626 P-19	4	Motor Shims 1/64" Thk.
239	258C626 P-14	4	Motor Shims 1/32" Thk.
239	258C626 P-13	4	Motor Shims 1/16" Thk.
240	258C626 P-21	1	Spacer
241	258C626 P-22	1	Screw
243 *	265C189 P-9	3	Gear Box Shims
244	456A864 P-50	1	Chain
245	258C626 G-2	1	Sprocket
246	215D472 G-56	1	Pinion Gear & Bearing (ML-11D)
247	215D472 G-55	1	Shaft, Bearing & "O" Ring (ML-11D)
248	215D472 G-57	1	Eccentric (ML-11D)
249	258C624 P-1	1	Cover (ML-11D)

* Not Shown

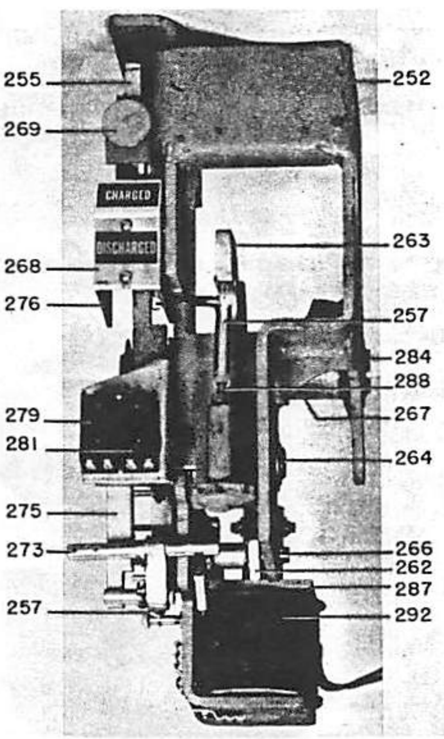


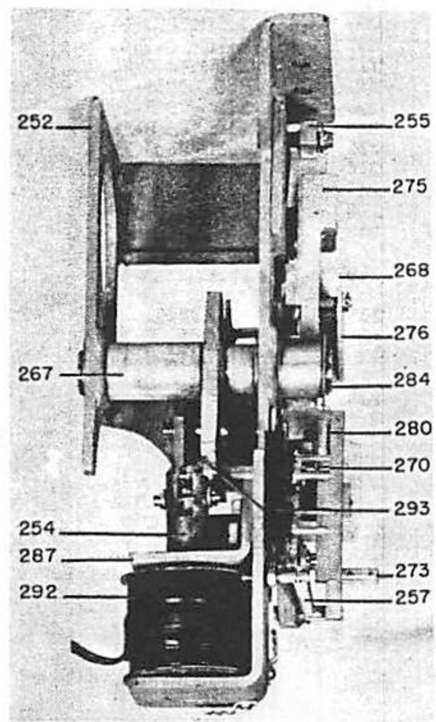


ML-11 and ML-11A

Fig. 21 Ref. 250

Fig. 22 Ref. 1





ML-11B

Fig. 23 Ref. 1

Fig. 24 Ref. 1

Fig. 21 (8024799)

Fig. 22 (8024797)

Fig. 23 (8026371)

Fig. 24 (8026372)

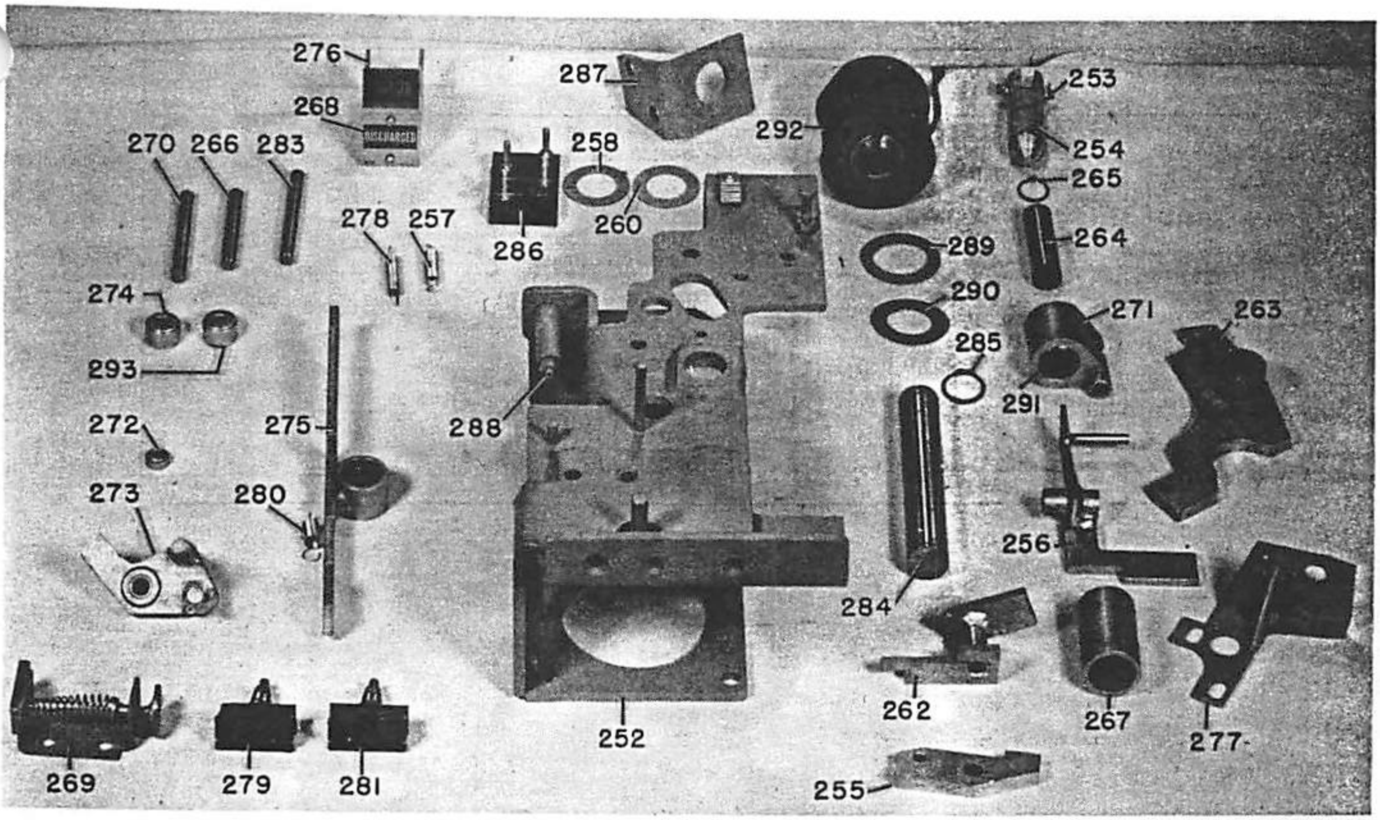


Fig. 25 (8026370)

Fig. 25 ML-11B

REF. NO.	CAT. NO. FOR ML-11	NO. PER MECH.	DESCRIPTION
250	215D466 G-1	1	Control Mechanism Complete (Less Coil) (4.16-150, 250)
250	215D466 G-1	1	Control Mechanism Complete (Less Coil) (7.2-250, 500; 13.8-150, 250, 500, 750)
251	688C592 G-1	1	Control Frame
253	215D465 P-32	1	Pin for Plunger
254	215D465 P-15	1	Plunger
255	619C421 P-3	1	Crank
256	215D464 G-3	1	Switch Trip Assembly
257	414A135 P-1	1	Spring (ML-11 & ML-11A)
257	104A2456	1	Spring (ML-11 & ML-11A)
257	104A2456	2	Spring (ML-11B)
*258	215D465 P-49	1	Spring Retaining Washer
259	215D464 P-13	1	Spring Rod (ML-11 & 11A)
260	414A105 P-10	3	Washer
261	215D465 P-38	1	Pin (ML-11 & 11A)
262	688C553 G-1	1	Crank Assembly
263	215D464 G-2	1	Prop
264	215D465 P-31	1	Pin
265	N900P-75	2	Retaining Ring
266	215D465 P-23	1	Pin
267	6176110 P-201	1	Spacer
268	NP 166999A	1	Nameplate (Indicator)
269	215D466 G-3	1	Rod Assembly
270	215D465 P-36	1	Pin
271	215D465 P-1	1	Trigger Assembly
272	6176109 P-77	1	Spacer
273	215D465 G-2	1	Prop Assembly
274	414A112 P-2	1	Bearing
275	688C592 G-2	1	Paddle Assembly
276	215D465 P-27	1	Support for NP
277	215D465 G-7	1	Support
278	104A2410	1	Spring
279	9921661 P-1	1	Switch (Open)

* Not Shown

(Continued on Next Page)

REF. NO.	CAT. NO. FOR ML-11	NO. PER MECH.	DESCRIPTION
280	104A2455	1	Release Roller Spring
281	9921661 P-2	1	Switch (Closed)
282	258C611 P-9	1	Pole Piece
283	215D464 P-21	1	Pin
284	215D465 P-33	1	Pin
285	N900P100P	2	Retaining Ring
286	1438640	1	Terminal Board
287	215D465 P-30	1	Coil Support
288	215D464 P-30	1	Pin (For ML 11-B)
289	414A109 P-3	2	Washer
290	414A109 P-5	5	Washer
291	414A112 P-3	2	Bearing
292	6174582 G-1	1	Release Coil (125v d-c)
292	6174582 G-2	1	Release Coil (250v d-c)
292	6275070 G-1	1	Release Coil (24v d-c)
292	6275070 G-2	1	Release Coil (48v d-c)
292	6174582 G-14	1	Release Coil (230v a-c)
293	121A7436 G-3	1	Dry Bearing

Fig. 26 (8025400)

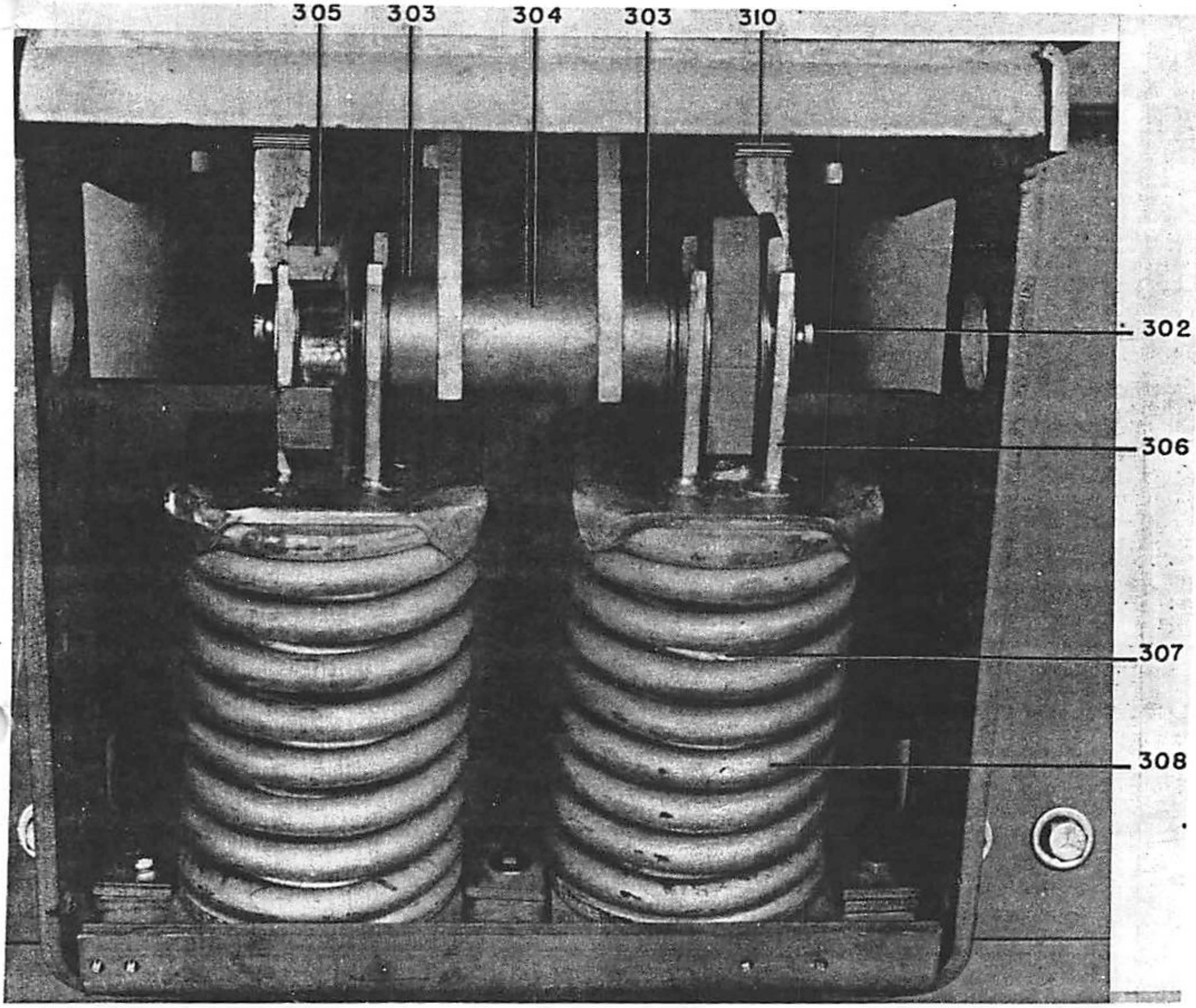


Fig. 26 Spring Assembly Ref. 301

REF. NO.	4.16 STD.	7.2 & 13.8 STD.	13.8 - 750 7.2 - 500	NO. REQ. PER. MECH.	DESCRIPTION
301	258C638 G-1	258C638 G-2	258C638 G-7	1	Spring Assembly Complete
302	258C628 P-3	258C628 P-3	258C628 P-3	1	Pin
303	6176109 P-285	6176109 P-285	6176109 P-285	2	Spacer
304	6176109 P-639	6176109 P-639	6176109 P-639	1	Spacer
305	254D738 G-50	254D738 G-50	254D738 G-50	1	Crank & Bushing Assembly (ML-11A, ML-11B)
305	254D738 G-51	254D738 G-51	254D738 G-51	1	Crank & Bushing Assembly (ML-11C)
306	258C638 G-3	258C638 G-3	258C638 G-3	2	Rod & Guide
307	383A982	383A982	383A982	2	Spring (Inner)
308	383A983	383A983	383A983	2	Spring (Outer)
* 309	△	△	456A809	2	Spring (Inner)
310	258C642 P-12	258C642 P-12	258C642 P-12	2	Pillar Block Shims 1/64"
310	258C642 P-11	258C642 P-11	258C642 P-11	2	Pillar Block Shims 1/32"
310	258C642 P-10	258C642 P-10	258C642 P-10	2	Pillar Block Shims 1/16"

△ Not Required
* Not Shown

Fig. 27 (8026035)

Fig. 28 (8020216)

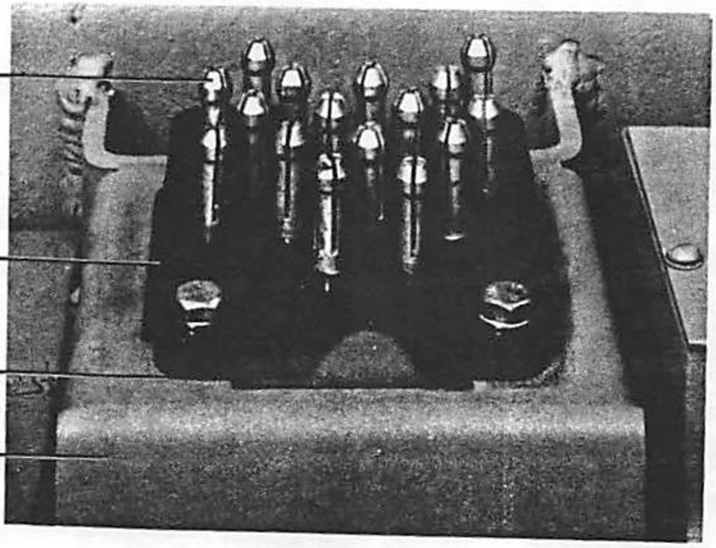


Fig. 27 Ref. 118

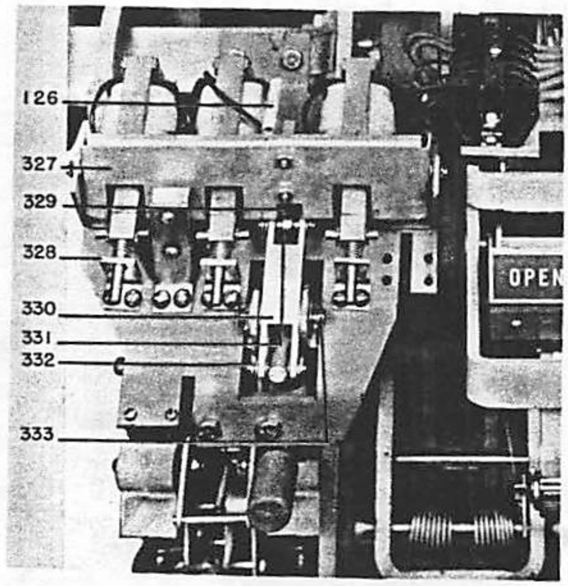


Fig. 28 Current Trip Mechanism Ref. 119

REF. NO.	CAT. NO. FOR ML-11	NO. PER MECH.	DESCRIPTION
118	802B795 G-3	1	Secondary Disconnect Device Complete (#14 Wire)
118	802B795 G-4	1	Secondary Disconnect Device Complete (#12 Wire)
319	6319964 P-2	16	Plug
320	848768 P-1	16	LK Washer for Plug
322	6505244 P-1	1	Socket
324	3663094 P-38	3	Spacer
325	366A234 P-1	2	Contact Nut
325	366A234 P-2	14	Contact Nut (#14 Wire)
325	366A234 P-3	14	Contact Nut (#12 Wire)
326	6551725	1	Spring
327	366A611 G-1	1	Trip Pan
328	6558748 P-1	3	Bracket
329	6558756 P-1	1	Trip Latch
330	366A600 P-1	1	Trip Arm
331	6477418AA P-10	1	Ball Bearing
332	6076401 P-307	1	Pin
333	6477427AA P-8	1	Pin

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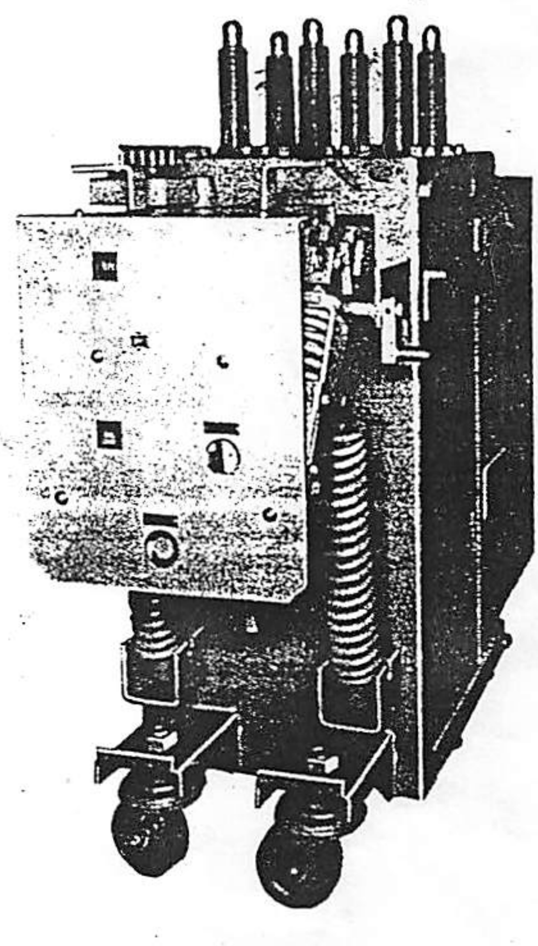
RENEWAL PARTS

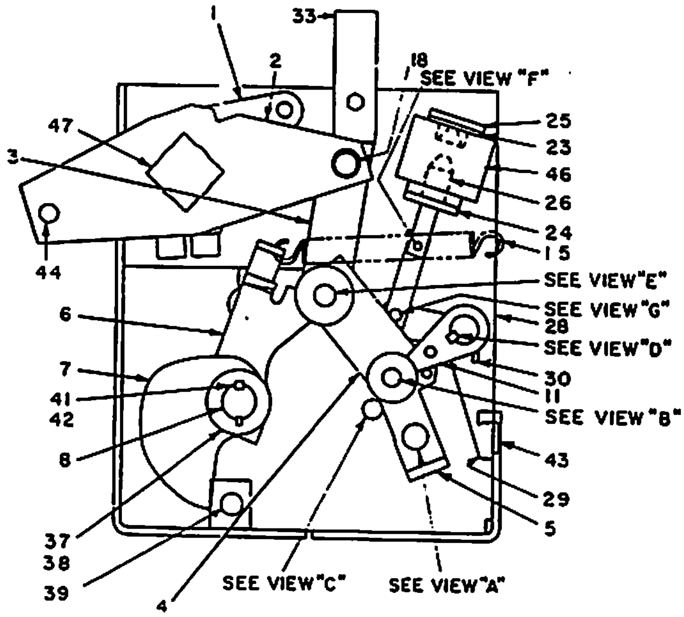
Type ML-13 Mechanisms

Ordering Instructions

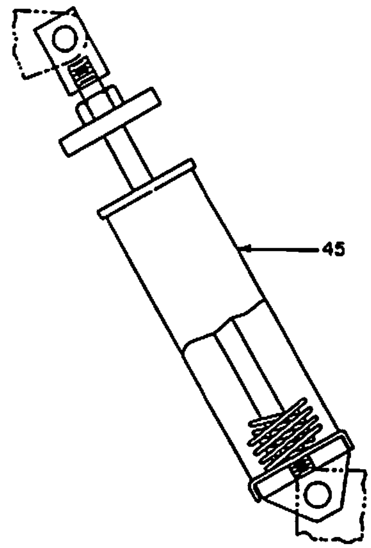
1. **Always specify the complete nameplate data of the mechanism.**
2. Specify the quantity, catalog number (if listed), reference number (if listed), description, and this bulletin number.
3. Standard hardware, such as screws, bolts, nuts, washers, etc., is not listed in this bulletin. Such items should be purchased locally.
4. Renewal parts for breakers qualified for use in 1E equipment will require different ordering information for certain parts.
5. For prices, refer to the nearest office of the General Electric Company.



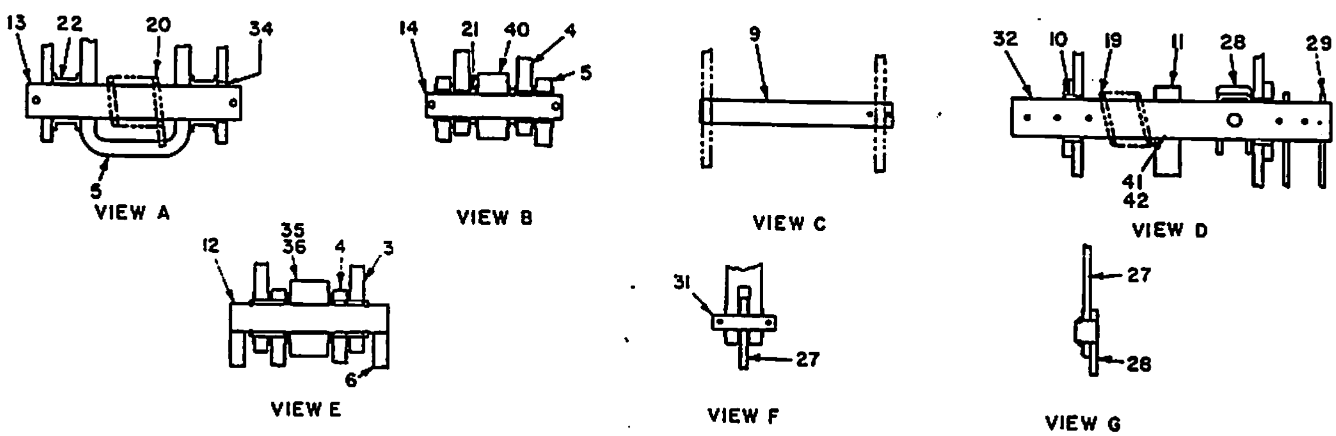
Data is subject to change without notice.



A. Sectional side view



B. Opening spring assembly



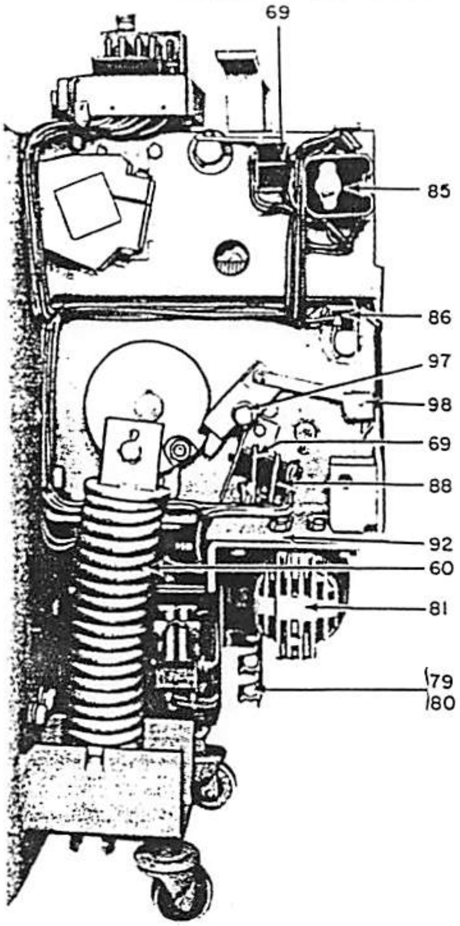
C. Detailed view

Fig. 1.

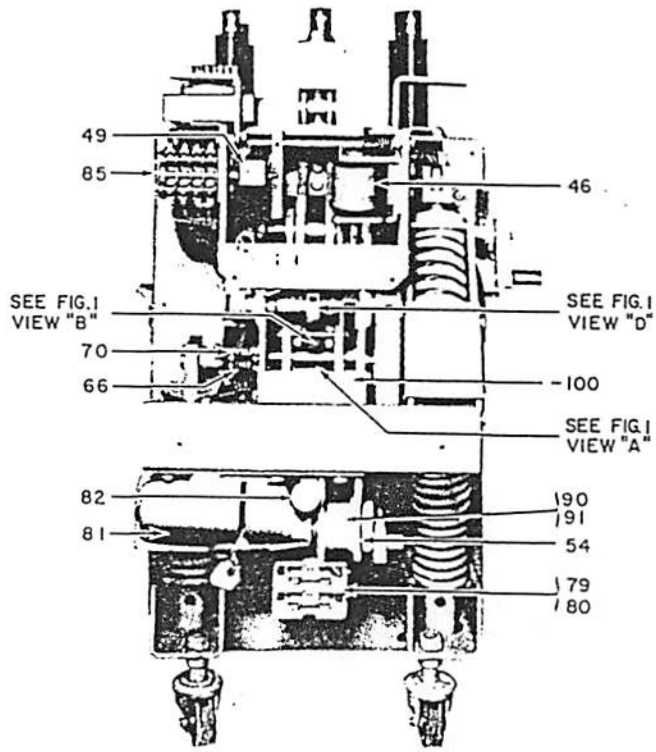
Book is misprint - See ML-13 mech book in Vol 3 of 3 under tab 4

Ref. No.	Number Required for Type AM-						Catalog Number	Description
	4.16 KV		7.2kV ~~7.2kV~~ 13.8kV		13.8 kV			
	250 MVA	350 MVA	500 MVA	500 MVA	750 MVA	1000 MVA		
1	4	4	4	4	4	4	134C3488P1	Crank
2	2	2	2	2	2	2	213X702G11	Crank
3	1	1	1	1	1	1	213X702G12	Link
4	2	2	2	2	2	—	213X702G20	Link
4	—	—	—	—	—	2	134C3585P3	Link
5	1	1	1	1	1	2	213X702G21	Link
5	—	—	—	—	—	1	213X702G19	Link
6	1	1	1	1	1	1	213X702G13	Prop
7	1	1	1	1	1	1	0105C9311G2	Cam
8	1	1	1	1	1	1	0105C9310P4	Cam shaft
9	1	1	1	1	1	1	105C9304P3	Stop pin
10	2	2	2	2	2	2	456A885P21	Bushing
11	1	1	1	1	1	1	105C9302G2	Latch (trip)
12	1	1	1	1	1	1	105C9302P4	Pin (prop)
13	1	1	1	1	1	1	105C9301P7	Pin
14	1	1	1	1	1	1	105C9301P8	Pin
14	—	—	—	—	—	1	134C3585P5	Pin
15	1	1	1	1	1	1	137A9252P1	Prop spring
ßß16	ß	1	1	—	1	1	6071231P1	Prop spring No. 2
ßß17	ß	1	1	—	1	1	108B5466G1	Support
18	1	1	1	1	1	1	105C9308P4	Shaft
19	1	1	1	1	1	1	137A9262P1	Latch spring
20	1	1	1	1	1	1	137A9261P1	Reset spring
21	2	2	2	2	2	—	456A876P134	Spacer
22	2	2	2	2	2	2	456A876P136	Spacer
23	1	1	1	1	1	1	114C5347P6	Pole piece
24	1	1	1	1	1	1	114C5347G1	Coil support (tripping)
25	1	1	1	1	1	1	105C9316P2	Coil support (tripping)
26	1	1	1	1	1	1	114C5347P4	Armature
27	1	1	1	1	1	1	105C9316P5	Link
28	1	1	1	1	1	1	105C9316G1	Crank
29	1	1	1	1	1	1	105C9316P8	Crank
30	1	1	1	1	1	1	105C9316P9	Paddle
31	1	1	1	1	1	1	6076402P5	Pin
32	1	1	1	1	1	1	114C5324P8	Trip shaft
33	1	1	1	1	1	1	161A4287G1	Handle
34	2	2	2	2	2	2	456A885P206	Bushing
35	1	1	1	1	1	1	414A112P52	Bearing (O.R.)
36	1	1	1	1	1	1	414A112P53	Bearing (I.R.)
37	2	2	2	2	2	2	414A112P94	Bearing (O.R.)
38	2	2	2	2	2	2	414A112P95	Bearing (I.R.)
39	2	2	2	2	2	2	414A112P61	Bearing (O.R.)
40	1	1	1	1	1	—	414A112P1	Bearing (O.R. & I.R.)
40	—	—	—	—	—	1	414A112P54	Bearing (O.R.)
41	3	3	3	3	3	3	N3401P808	Woodruff key
42	1	1	1	1	1	2	105C9310P7	Square key
ßß43	1	1	1	1	1	1	0105C9317G1	Mechanism cover
44	3	3	3	3	3	3	619C478P19	Pin
45	ø1	—	—	—	—	—	213X505G17	Opening spring
45	†1	—	—	—	—	—	213X341G7	Opening spring
45	—	1	1	1	—	—	213X341G23	Opening spring
45	—	—	—	—	1	•1	213X341G24	Opening spring
45	—	—	—	—	—	δ1	213X341G3	Opening spring
46	1	1	1	1	1	1	6275070G1	Trip coil, 24 Vdc
46	1	1	1	1	1	1	6275070G3	Trip coil, 32 Vdc
46	1	1	1	1	1	1	6174582G34	Trip coil, 48 Vdc
46	1	1	1	1	1	1	6174582G1	Trip coil, 110-125 Vdc
46	1	1	1	1	1	1	6174582G15	Trip coil, 220 Vdc
46	1	1	1	1	1	1	6174582G2	Trip coil, 250 Vdc
46	1	1	1	1	1	1	6174582G13	Trip coil, 115 Vac
46	1	1	1	1	1	1	6174582G3	Trip coil, 230 Vac
47	1	—	—	—	—	—	6443518P2	Square shaft
47	—	1	1	1	1	‡1	6443518P1	Square shaft
ßß48	1	††1	—	—	—	—	161A4283G1	Square shaft spacer
ßß48	—	—	1	1	1	1	161A4283G2	Square shaft spacer

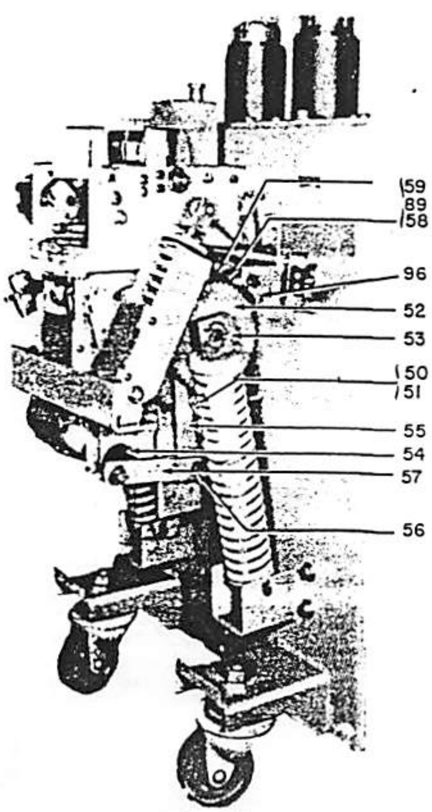
ß For Type "B" only
ßß Not illustrated
ø 1200 amp. only
† 2000 and 2500 amp. only
• 1200 and 2000 amp. only
δ 3000 and 3750 amp. only
‡ For 3000 and 3750 amp. order Cat. No. 6443518P3
†† For 3000 amp. order Cat. No. 161A4283G4



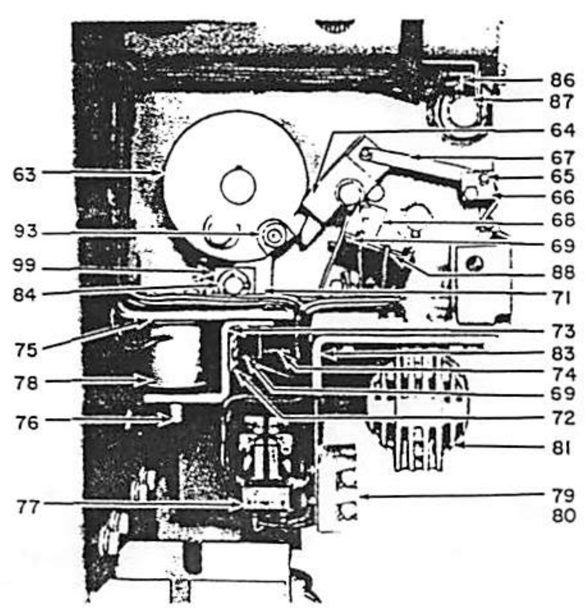
A. Left side view



B. Front view



C. Right side view



D. Left side (bottom) view

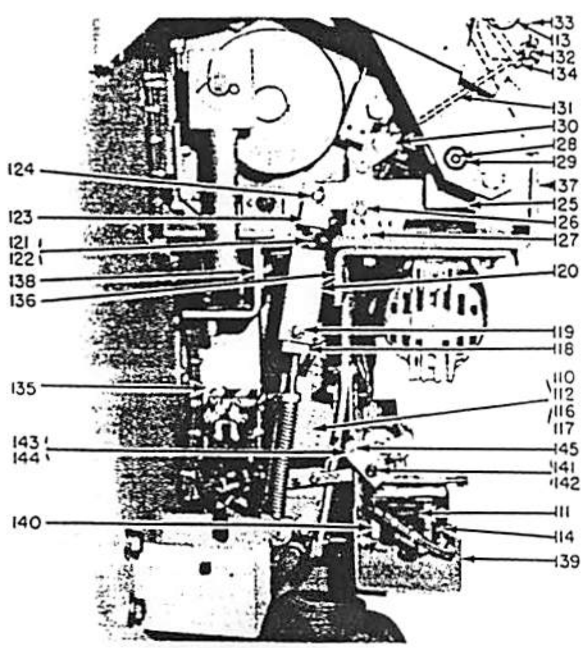
Fig. 2.

Ref. No.	Number Required for Type AM-						Catalog Number	Description
	4.16 KV		7.2 KV		13.8 kV			
	250 MVA	350 MVA	500 MVA	500 MVA	750 MVA	1000 MVA		
49	1	1	1	1	1	1	105C9308G2	Indicator (open-closed)
50	1	1	1	1	1	1	213X702G16	Pawl (Driving)
51	1	1	1	1	1	1	161A4241P1	Pawl spring
52	1	1	1	1	1	1	105C9310G1	Ratchet wheel
53	2	2	2	2	2	2	213X702G22	Bearing block
54	1	1	1	1	1	1	165B7926P1	Eccentric
55	1	1	1	1	1	1	0257A6975G1	Crank
56	1	1	1	1	1	1	105C9314P3	Pin
57	1	1	1	1	1	1	213X702G18	Link
58	1	1	1	1	1	1	213X702G14	Pawl (outside)
59	1	1	1	1	1	1	213X702G15	Pawl (inside)
60	2	—	—	2	—	—	114C5393G1	Closing spring[1]
60	2	—	—	—	—	—	114C5393G2	Closing spring[2]
60	—	—	2	2	2	—	114C5393G3	Closing spring[3]
60	—	—	—	—	2	2	114C5393G4	Closing spring[4] Refer to
60	—	—	—	—	—	2	114C5393G5	Closing spring[5] footnotes
60	—	—	—	—	—	2	114C5393G6	Closing spring[6] 1 thru 9
60	—	2	2	—	2	—	114C5393G7	Closing spring[7]
60	2	—	—	—	—	—	114C5393G9	Closing spring[8]
60	—	—	—	—	2	—	114C5393G11	Closing spring[9]
63	1	1	1	1	1	1	105C9311G2	Cam
64	1	1	1	1	1	1	105C9311G3	Striker
65	1	1	1	1	1	1	6076402P10	Pin
66	1	1	1	1	1	1	105C9306G2	Indicator (Chrdg/Dischrgd)
67	1	1	1	1	1	1	105C9306P7	Link
68	1	1	1	1	1	1	105C9306P5	Switch plate
69	3	3	3	3	3	3	456A866P5	Switch (N.O.)
70	1	1	1	1	1	1	161A4230P1	Indicator spring
71	1	1	1	1	1	1	114C5342G1	Latch (closing)
72	1	1	1	1	1	1	105C9309P5	Switch plate
73	1	1	1	1	1	1	114C5347G2	Coil support
74	1	1	1	1	1	1	161A4231P1	Closing latch spring
75	1	1	1	1	1	1	114C5347P7	Pole piece
76	1	1	1	1	1	1	114C5347G3	Armature
77	1	1	1	1	1	1	137A7575P4	Relay, 48 Vdc
77	1	1	1	1	1	1	137A7575P1	Relay, 110-125 Vdc
77	1	1	1	1	1	1	108B5565G1	Relay, 220-250 Vdc
77	1	1	1	1	1	1	137A7575P5	Relay, 115 Vac
77	1	1	1	1	1	1	137A7575P2	Relay, 230 Vac
78	1	1	1	1	1	1	6174582G34	Closing coil, 48 Vdc
78	1	1	1	1	1	1	6074582G1	Closing coil, 110-125 Vdc
78	1	1	1	1	1	1	6174582G15	Closing coil, 220 Vdc
78	1	1	1	1	1	1	6174582G2	Closing coil, 250 Vdc
78	1	1	1	1	1	1	6174582G10	Closing coil, 115 Vac
78	1	1	1	1	1	1	6174582G14	Closing coil, 230 Vac
79	1	1	1	1	1	1	456A864P121	Fuse block
80	2	2	2	2	2	2	456A864P111	Fuse, 48 Vdc
80	2	2	2	2	2	2	456A864P123	Fuse, 110-125 Vdc
80	2	2	2	2	2	2	456A864P124	Fuse, 220-250 Vdc
80	2	2	2	2	2	2	456A864P123	Fuse, 115 Vac
80	2	2	2	2	2	2	456A864P124	Fuse, 230 Vac
81	1	1	1	1	1	1	0184B7360G001	Motor, 48 Vdc
81	1	1	1	1	1	1	0184B7360G002	Motor, 110 Vdc
81	1	1	1	1	1	1	0184B7360G002	Motor, 125 Vdc
81	1	1	1	1	1	1	0184B7360G003	Motor, 220 Vdc
81	1	1	1	1	1	1	0184B7360G003	Motor, 250 Vdc
81	1	1	1	1	1	1	0184B7360G002	Motor, 115 Vac
81	1	1	1	1	1	1	0184B7360G003	Motor, 230 Vac
82	1	1	1	1	1	1	105C9306G1	Closing button
83	1	1	1	1	1	1	105C9313G1	Motor mount

[1] 4.16-250 STD. MOM., 2000-2500 amp., 13.8-250/500 STD. MOM.
[2] 4.16-150/250 STD. MOM., 1200 amp.
[3] 7.2-500 STD. MOM., 13.8-500 HI. MOM., 13.8-750-5 STD. MOM.
[4] 13.8-750-2, 3, 4, HI. MOM., 13.8-1000-4, 1200-2000 amp.
[5] 13.8-1000-3, 1200-2000 amp., 13.8-1000-4-300-3750 amp.
[6] 13.8-1000-3, 3000-3750 amp.
[7] 4.16-350, 7.2-500 HI. MOM., 13.8-750-2, 3, 4 STD. MOM.
[8] 4.16-250 HI. MOM.
[9] 13.8-750-5 HI. MOM.

Ref. No.	Number Required for Type AM-						Catalog Number	Description
	4.16 KV		7.2 KV		13.8 kV			
	250 MVA	350 MVA	500 MVA	500 MVA	750 MVA	1000 MVA		
84	1	1	1	1	1	1	105C9309P4	Shaft
85	1	1	1	1	1	1	137A9192G11	Auxiliary switch
86	1	1	1	1	1	1	161A4282G1	Latch checking switch
87	1	1	1	1	1	1	105C9311P2	Striker
88	1	1	1	1	1	1	456A866P6	Switch (N.C.)
89	2	2	2	2	2	2	161A5909P1	Pawl spring
90	2	2	2	2	2	2	414A112P59	Bearing
91	2	2	2	2	2	2	414A112P60	Bearing
92	1	1	1	1	1	1	456A864P138	Terminal board
93	1	1	1	1	1	1	414A112P58	Closing Latch Roller
ÆÆ94	1	1	1	1	1	1	161A4289P2	Thrust race
ÆÆ95	1	1	1	1	1	1	161A4289P3	Thrust race
96	1	1	1	1	1	1	105C9307P17	Spring support
97	1	1	1	1	1	1	456A876P141	Spacer
98	1	1	1	1	1	1	456A876P139	Spacer
99	1	1	1	1	1	1	456A876P140	Spacer
100	1	1	1	1	1	1	105C9304P13	Cover

ó 1200 amp only.
ÆÆ Not illustrated



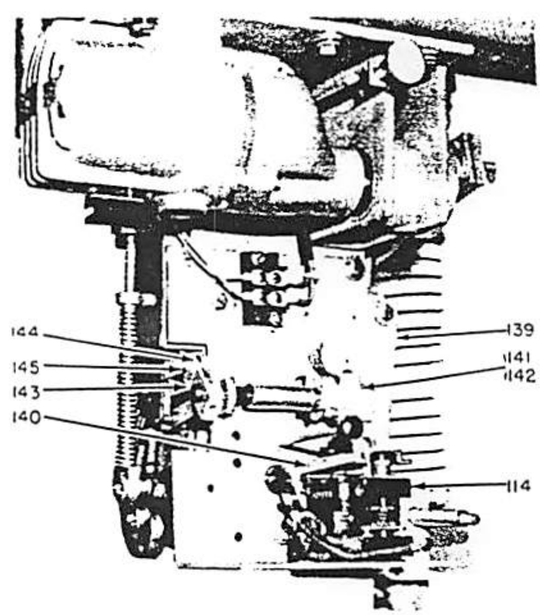


Fig. 3. Current trip and undervoltage device

CURRENT TRIP AND UNDERVOLTAGE DEVICE (See Fig. 3)

Ref. No.	Number Required for: Current Trip	Current Trip and U.D. (Time/Delay)	U.D. 48 Vdc (Inst.)	U.D. 125 Vdc (Inst.)	U.D. 250 Vdc (Inst.)	U.D. 230 Vac (Inst.)	U.D. 230 Vac (Time/Delay)	U.D. 115 Vac (Inst.)	Catalog Number	Description
110	3	3	—	—	—	—	—	—	6174599G2	Coil. 3A
111	—	—	1	—	—	—	—	—	6275017G45	Coil. 48 Vdc
111	—	—	—	1	—	—	—	—	6275017G15	Coil. 125 Vdc
111	—	—	—	—	1	—	—	—	WSF3241202	Coil. 250 Vdc
111	—	—	—	—	—	1	1	—	6275017G12	Coil. 230 Vac
111	—	—	—	—	—	—	—	1	6275017G16	Coil. 115 Vac
112	3	3	—	—	—	—	—	—	6116449G1	Instantaneous trip solenoid
113	1	1	1	1	1	1	1	1	114C5400P12	Shaft trip
114	—	—	1	1	1	—	—	—	6275259G2	Cutoff switch. dc
114	—	1	—	—	—	1	1	1	6275259G1	Cutoff switch. ac
ΔΔ115	—	—	1	—	—	—	—	—	161A5937G3	Resistor. 48 Vdc
ΔΔ115	—	—	—	1	—	—	—	—	161A5937G1	Resistor. 125 Vdc
ΔΔ115	—	—	—	—	1	—	—	—	161A5937G2	Resistor. 250 Vdc
116	1	—	—	—	—	—	—	—	114C5434G1	Current trip
116	—	1	1	1	1	1	1	1	114C5434G2	Current trip
117	1	1	1	1	1	1	1	1	6116526G2	Latch checking switch
118	1	1	1	1	1	1	1	1	134C3598P4	Head
119	1	1	1	1	1	1	1	1	6076403P17	Pin
120	1	1	1	1	1	1	1	1	134C3598P2	Yoke
121	1	1	1	1	1	1	1	1	134C3598P1	Piston
122	1	1	1	1	1	1	1	1	208A8097P1	Spring
123	1	1	1	1	1	1	1	1	114C5399P8	Clevis
124	1	1	1	1	1	1	1	1	114C5401P4	Pin
125	1	1	1	1	1	1	1	1	114C5399G4	Crank
126	1	1	1	1	1	1	1	1	6076404P9	Pin
127	1	1	1	1	1	1	1	1	114C5401P3	Bearing
128	1	1	1	1	1	1	1	1	114C5401P5	Pin
129	1	1	1	1	1	1	1	1	114C5400P10	Roller
130	1	1	1	1	1	1	1	1	114C5400P4	Clevis
131	1	1	1	1	1	1	1	1	114C5400G1	Rod
132	1	1	1	1	1	1	1	1	6076402P17	Pin
133	1	1	1	1	1	1	1	1	114C5400P7	Crank
134	1	1	1	1	1	1	1	1	114C5400P8	Paddle
135	1	1	1	1	1	1	1	1	108B5595G1	Plate relay mounting
136	1	1	1	1	1	1	1	1	114C5401G1	Motor mount
137	1	1	1	1	1	1	1	1	114C5399P1	Mechanism frame
138	1	1	1	1	1	1	1	1	114C5347G4	Coil support
139	—	—	1	1	1	1	—	1	114C5402P1	Undervoltage frame
139	—	1	—	—	—	—	1	—	114C5402P7	Undervoltage frame
140	—	—	1	1	1	1	—	1	6316605G23	Undervoltage device (dc instantaneous)
140	—	1	—	—	—	—	1	—	6316605G24	Undervoltage device (ac time delay)
141	—	—	1	1	1	1	—	1	114C5402G1	Crank and shaft
142	—	1	—	—	—	—	1	—	114C5402G2	Crank and shaft
143	—	1	1	1	1	1	1	1	114C5399P4	Clevis
144	—	1	1	1	1	1	1	1	414A112P40	Bearing
145	—	1	1	1	1	1	1	1	114C5399P5	Pin
ΔΔ146	—	1	—	—	—	—	1	—	114C5402G3	Cover

ΔΔ Not illustrated

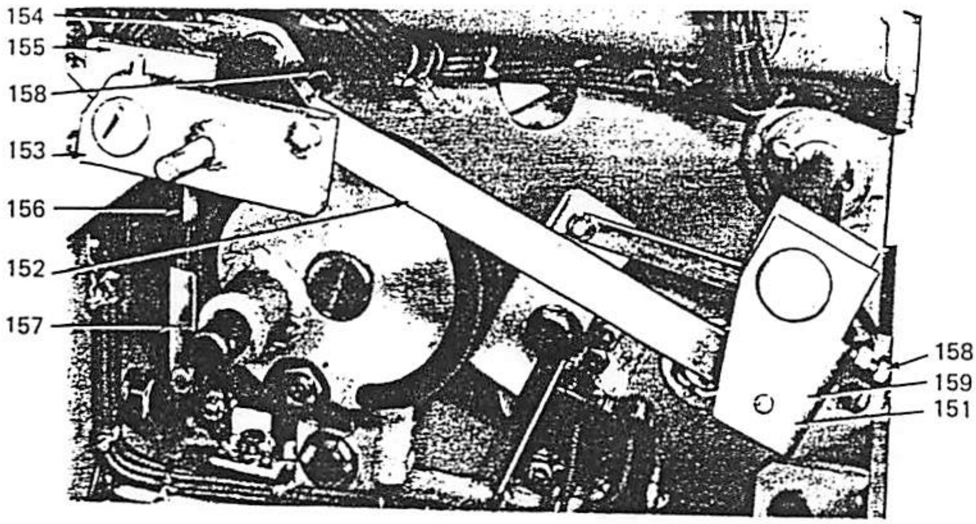


Fig. 4. Spring release

SPRING RELEASE (See Fig. 4)

Ref. No.	Ampere Rating	Number Required for Type AM- 4.16 KV 250 MVA	4.16 KV 350 MVA	7.2 KV 500 MVA	13.8 kV 500 MVA	13.8 kV 750 MVA	13.8 kV 1000 MVA	Catalog Number	Description
150	1200A 2000A	1	—	—	—	—	—	114C5413G1	Spring discharge assembly, complete
150	1200A 2000A	—	—	1	1	1	1	114C5413G2	Spring discharge assembly, complete
150	3000	—	—	—	—	—	1	114C5413G3	Spring discharge assembly, complete
150	1200	—	1	—	—	—	—	114C5413G4	Spring discharge assembly, complete
150	3000	—	1	—	—	—	—	114C5413G5	Spring discharge assembly, complete
151	All	1	1	1	1	1	1	114C5341P2	Crank
152	1200 2000	1	1	—	—	—	—	114C5341P11	Link
152	3000	—	—	—	1	—	—	114C5341P11	Link
152	1200 2000	—	—	1	1	1	1	114C5341P9	Link
152	3000	—	1	—	—	—	—	114C5341P10	Link
153	All	1	1	—	—	—	—	114C5343G2	Crank
153	All	—	—	1	1	1	1	114C5343G3	Crank
154	All	—	—	1	1	1	1	114C5343G2	Crank
155	All	1	1	1	1	1	1	114C5324P6	Clevis
156	All	1	1	1	1	1	1	114C5343P11	Rod
157	All	1	1	1	1	1	1	114C5342G4	Clevis
158	All	1	1	1	1	1	1	208A8068P1	Crank
•159	All	1	1	1	1	1	1	114C5341P8	Paddle

• Part not illustrated (position only indicated)

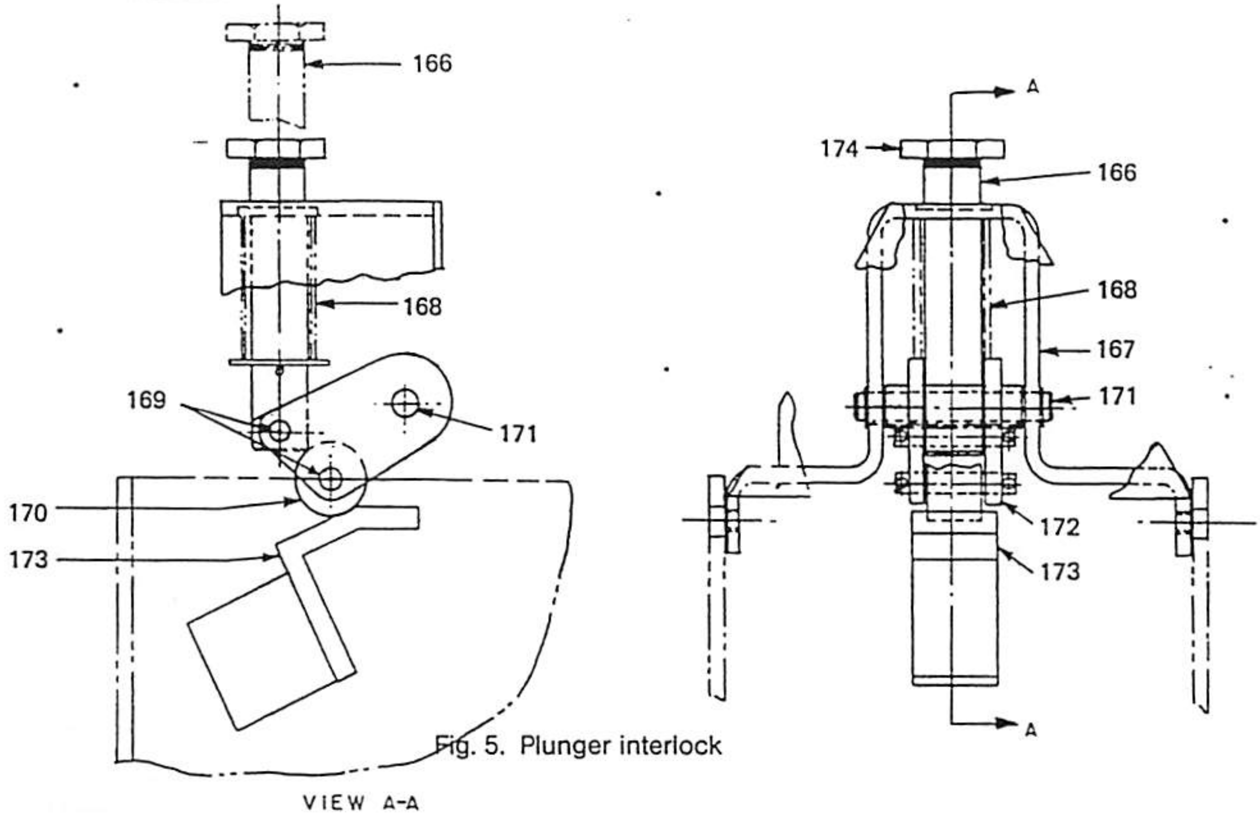


Fig. 5. Plunger interlock

Plunger Interlock for ML-13 Mechanism (See Fig. 5)

Ref. No.	Cat. No.	No. Reqd.	Description
165	0105C9305G001	1	Plunger interlock, complete
166	0236C0897P012	1	¶Plunger
167	0105C9305G002	1	Bracket assembly
168	006509728P001	1	Spring
169	0137A6085P023	2	Pin
170	0236C0787P014	1	Roller
171	0414A0110P006	1	Pin
172	0105C9305P006	2	Crank
173	0105C9305P007	1	Clip
174	0161A5948P001	1	Bolt

¶ For Type AM13.8-1000. 1200. and 2000 amps., order Cat. No. 0236C0787P27

Secondary Disconnect Device (See Fig. 6)

Ref. No.	Cat. No.	No. Reqd.	Description
180	0108B1931G005	1	Secondary disconnect device complete, 16 points
181	006319964P002	16	Contact plug
182	000848768P001	16	Lockwasher for contact plug
183	006505244P001	1	Contact socket, 16 point
184	0366A0234P001	†	Contact nut for No. 8 wire
184	0366A0234P002	†	Contact nut for No. 14 wire
148	0366A0234P003	†	Contact nut for No. 12 wire

† Total of 16 required. Order size and quantity to correspond with size and quantity of wires entering the secondary disconnect device.

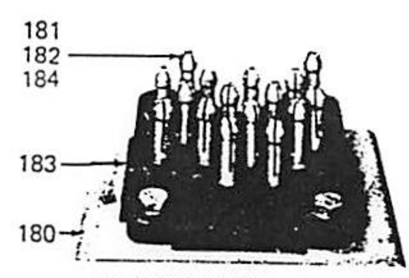


Fig. 6. Secondary disconnect device

PARTS RECOMMENDED FOR NORMAL MAINTENANCE

Ref. No.	Catalog Number	No. Req'd	Description
46	6275070G1	1	Trip coil, 24 Vdc
46	6275070G3	1	Trip coil, 32 Vdc
46	6174582G34	1	Trip coil, 48 Vdc
46	6174581G1	1	Trip coil, 110-125 Vdc
46	6174582G15	1	Trip coil, 220 Vdc
46	6174582G2	1	Trip coil, 250 Vdc
46	6174582G13	1	Trip coil, 115 Vac
46	6174582G3	1	Trip coil, 230 Vac
77	137A7575P4	1	Relay, 48 Vdc
77	137A7575P1	1	Relay, 110-125 Vdc
77	108B5565G1	1	Relay, 220-250 Vdc
77	137A7575P5	1	Relay, 115 Vac
77	137A7575P2	1	Relay, 230 Vac
78	6174582G34	1	Closing coil, 48 Vdc
78	6074582G1	1	Closing coil, 110-125 Vdc
78	6174582G15	1	Closing coil, 220 Vdc
78	6174582G2	1	Closing coil, 250 Vdc
78	6174582G10	1	Closing coil, 115 Vac
78	6174582G14	1	Closing coil, 230 Vac
81	0184B7360	1	G001—Motor, 48 Vdc
81	0184B7360	1	G002—Motor, 110 Vdc
81	0184B7360	1	G002—Motor, 125 Vdc
81	0184B7360	1	G003—Motor, 220 Vdc
81	0184B7360	1	G003—Motor, 250 Vdc
81	0184B7360	1	G002—Motor, 115 Vac
81	0184B7360	1	G003—Motor, 230 Vac
51	161A4241P1	1	Driving pawl spring
69	456A866P5	3	Switch (N.O.)
74	161A4231P1	1	Closing latch spring
85	137A9192G11	1	Auxiliary switch
88	456A866P6	1	Switch (N.C.)
89	161A5909P1	2	Latching pawl spring

MEMORANDUM