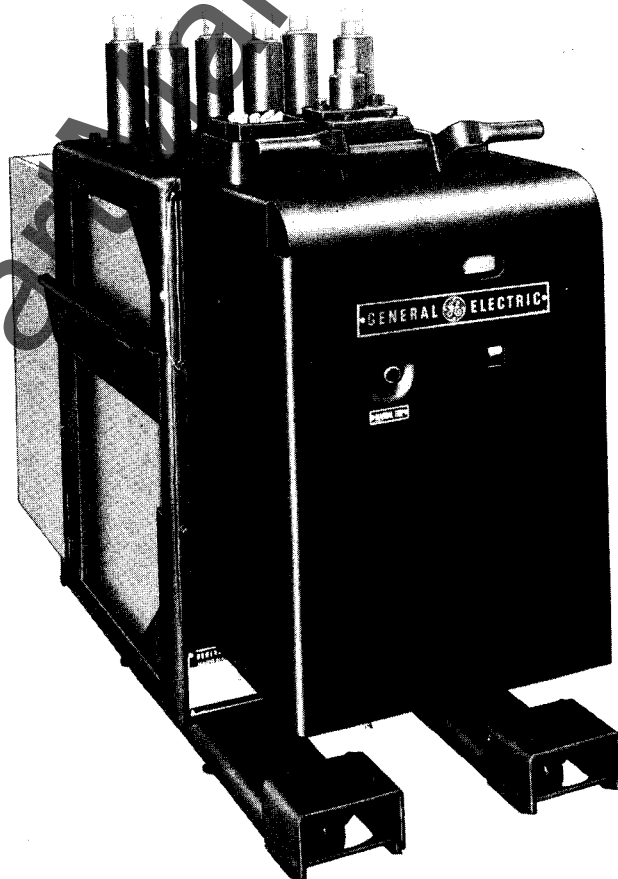


INSTRUCTIONS*Switchgear***POWER
CIRCUIT BREAKERS****Magne-blast Breakers
Types**

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



GENERAL  **ELECTRIC**

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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 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, 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 uncracking 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

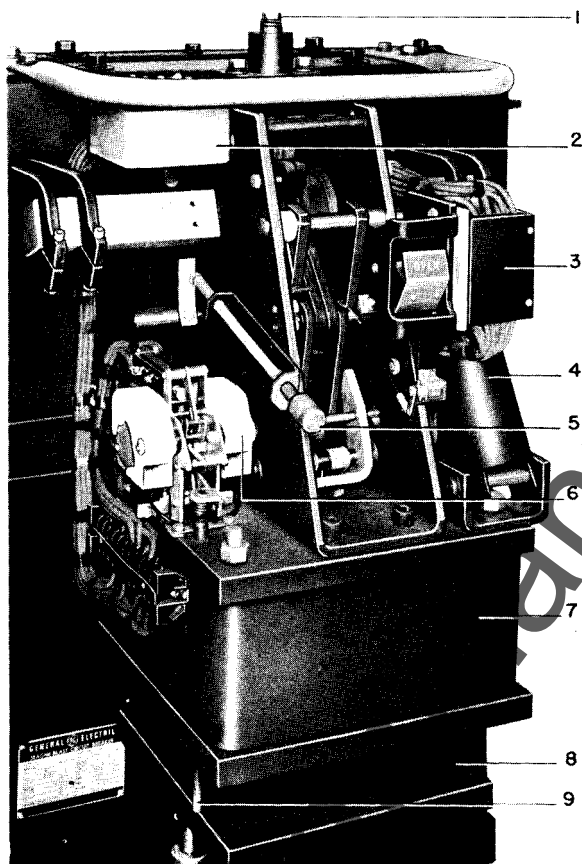


Fig. 1 Type MS-13C Operating Mechanism

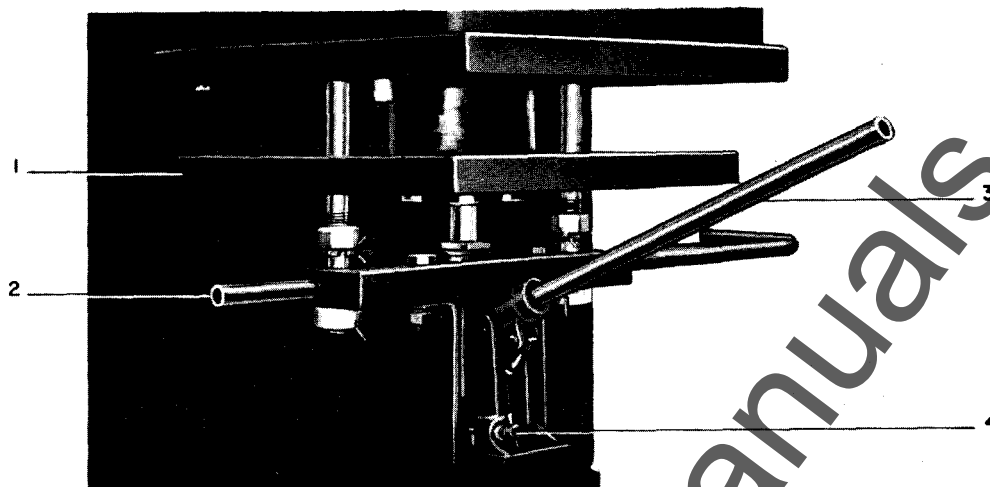
DESCRIPTION

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

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.

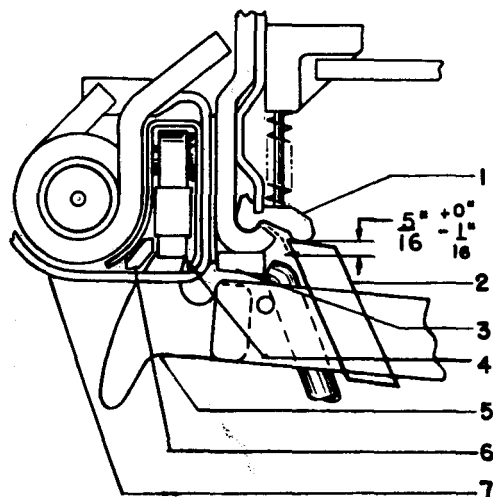
A maintenance operating device is provided for operation of the breaker during these adjustment checks. Mount the device as shown in Fig. 2, and turn the release valve (4) firmly to the right. To close the breaker, operate the handle (3) with a pumping motion. By turning the release valve (4)

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.

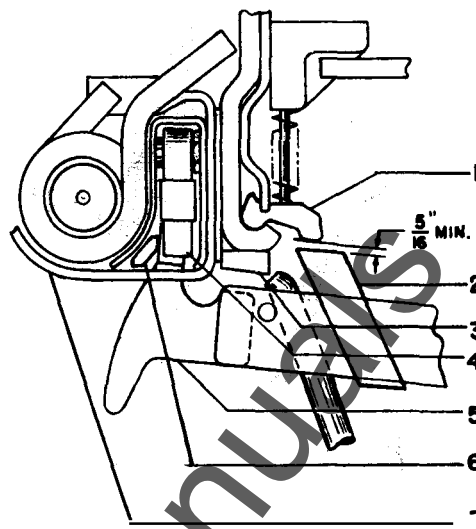
All adjustments should be checked not only during the initial installation of the breaker but also during periodic inspections and whenever it becomes necessary to repair or replace parts that have become worn or defective while in service. The following adjustments are listed in the order in which they 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 thumb nut (7). Screwing up on the thumb 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.



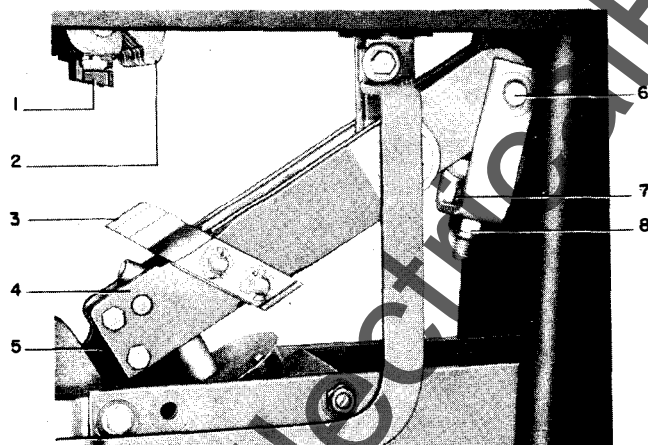
Primary Contact Wipe



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. Thumb Nut
8. Check Nut

Fig. 4 Adjustable Coupling For Making Primary Contact Wipe Adjustment

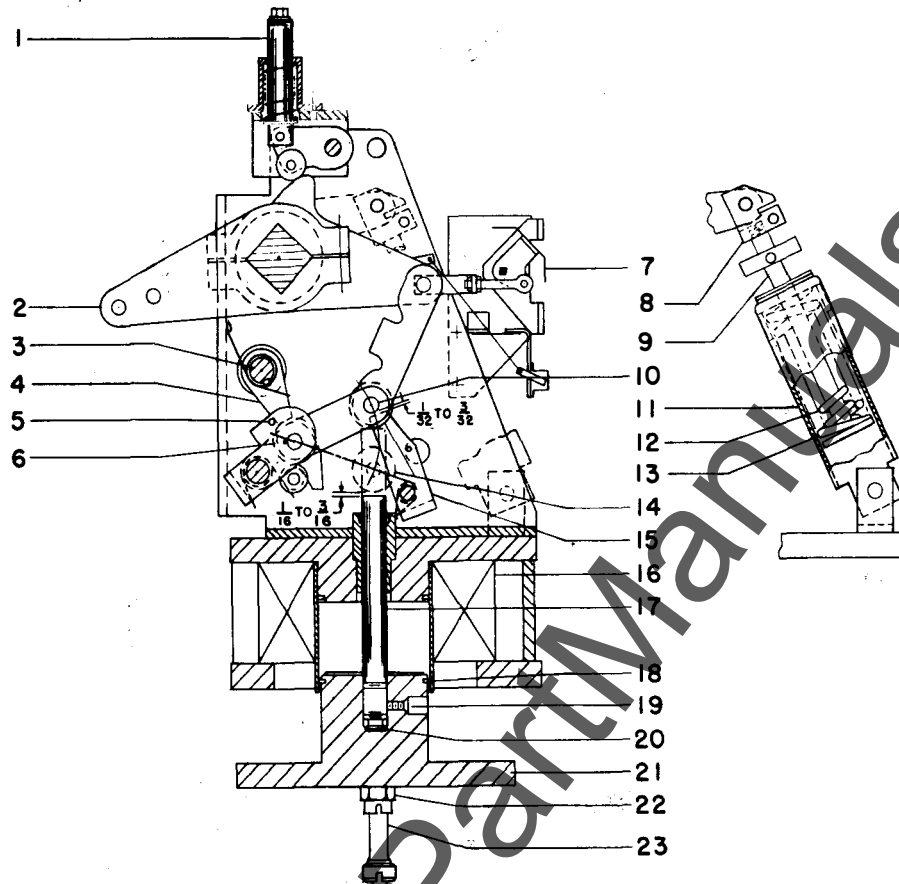
ARCING CONTACT WIPE

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. 3. 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 (1) and the movable primary contact (2) should be $3 \frac{13}{16}$ " \pm $1/8$ " - $1/16$ ". 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).

Fig. 5 (236C742)



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

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).

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

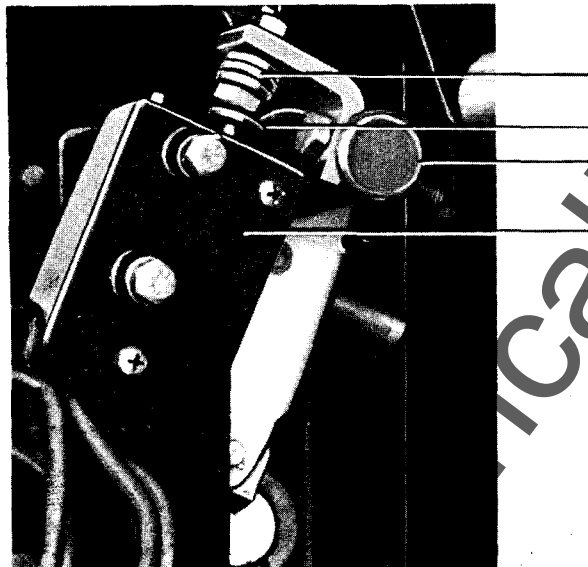
Refer to Fig. 5. With the breaker closed as far as possible with the maintenance device, the clearance between the closing pin (10) and the prop (15) should be $1/32"$ to $3/32"$. Measure the prop clearance with a feeler gage to determine whether or not an adjustment should be made, and if so, exactly 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

Magne-blast Circuit Breakers Type AM

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.



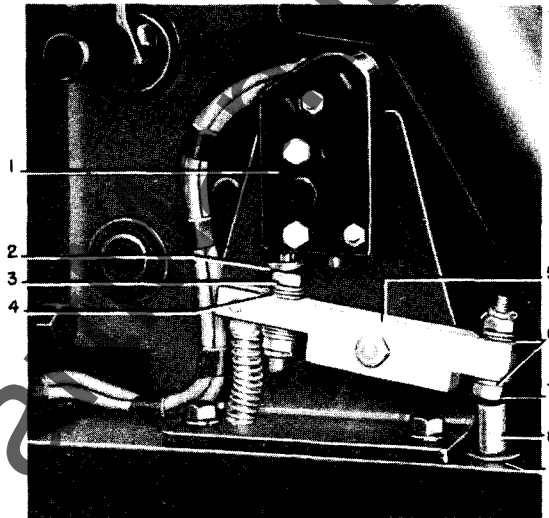
- 1. Washers
- 2. Switch Plunger
- 3. Trip Shaft
- 4. Latch Checking Switch

Fig. 6 Latch Checking Switch Wipe

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).

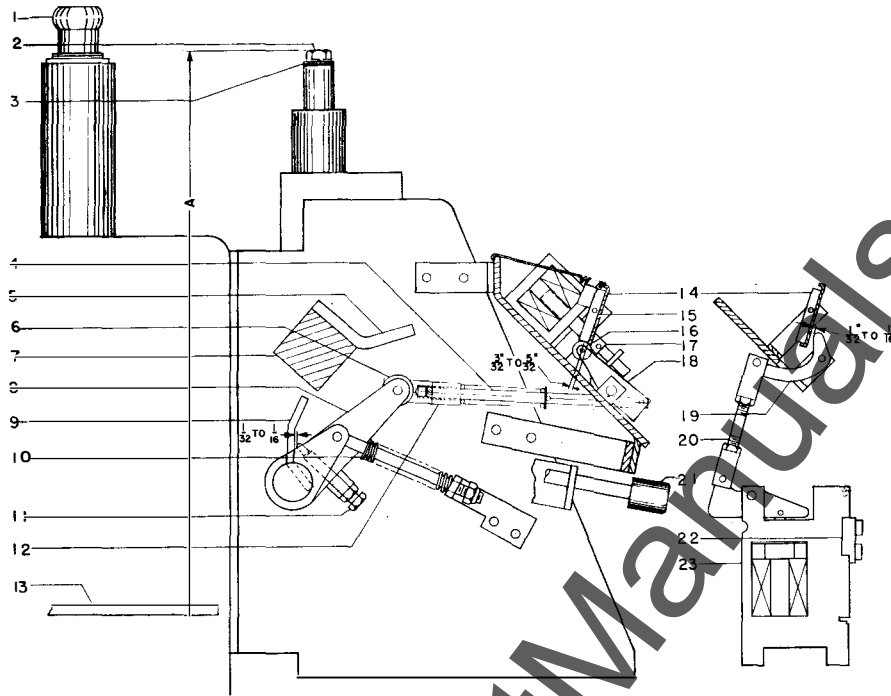


- 1. Cut-off Switch
- 2. Switch Plunger
- 3. Adjusting Bolt
- 4. Washers
- 5. Lever Arm
- 6. Washers
- 7. Adjustment Screw
- 8. Plunger Guide

Fig. 7 Cut-off Switch Adjustments

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).



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

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 $\frac{3}{32}$ " to $\frac{5}{32}$ ". 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 $\frac{1}{32}$ " to $\frac{1}{16}$ ". 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 $\frac{1}{32}$ " to $\frac{1}{16}$ ", 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 $15 \frac{19}{32}$ " $\pm \frac{1}{16}$ ". 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 $12 \frac{9}{32}$ ", 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: $3 \frac{13}{16}'' + 1/8'' - 3/16''$.
 - d. Trip latch wipe: $3/16''$ to $1/4''$ with trip latch resting against stop pin.
 - e. Prop clearance: $1/16'' \pm 1/32''$.
 - 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: $1/8'' \pm 1/32''$.
 - j. Impact trip bolt clearance: $3/64'' \pm 1/64''$.
 - k. Undervoltage trip hammer clearance: $3/64'' \pm 1/64''$.
 - l. Plunger interlock (100/150-1 and 150/250-1): $15 \frac{19}{32}'' \pm 1/16''$.
 - m. Auxiliary switch linkage (100/150A-1 and 150/250A-1. $12 \frac{9}{32}''$.
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.

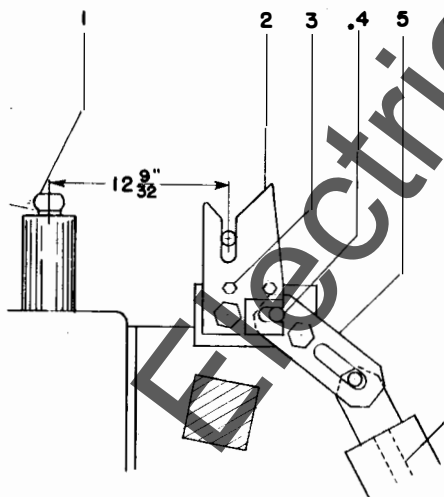


Fig. 9 Auxiliary Switch Linkage

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 115 to 120 volts DC. Where repetitive operation is required, the voltage should be set at 112 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 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.

* 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.

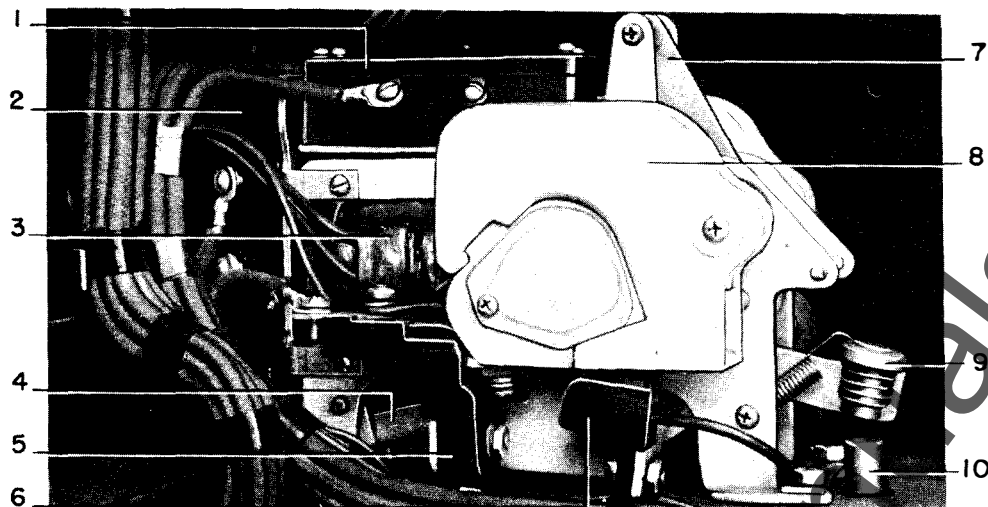
Take for example the AC control circuit shown in Fig. 12 (upper). Closing of the breaker is initiated by actuating the CLOSE control switch on the metal-clad unit. Referring to Fig. 10, the control device coil (3), is immediately energized, and as the control device linkage starts to move, the crank (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.

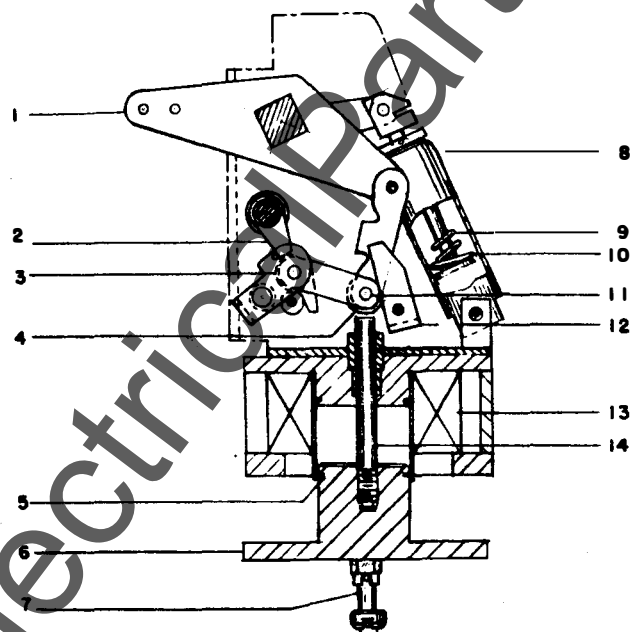
The plunger (9), Fig. 1, strikes the trip lever (9), Fig. 10, to trip open the control device contacts (5 and 6). This de-energizes the closing coil permitting the closing armature to return by gravity to its original position. The seal-in switch (2) opens but the anti-pump switch (1) will not open unless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

Magne-blast Circuit Breakers Type AM



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

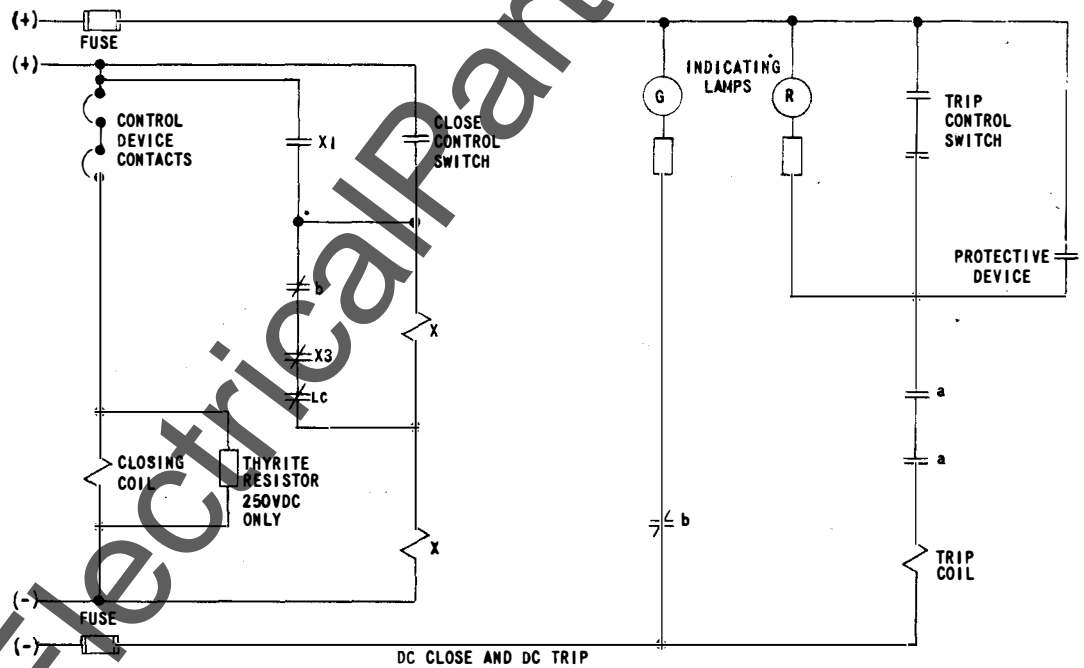
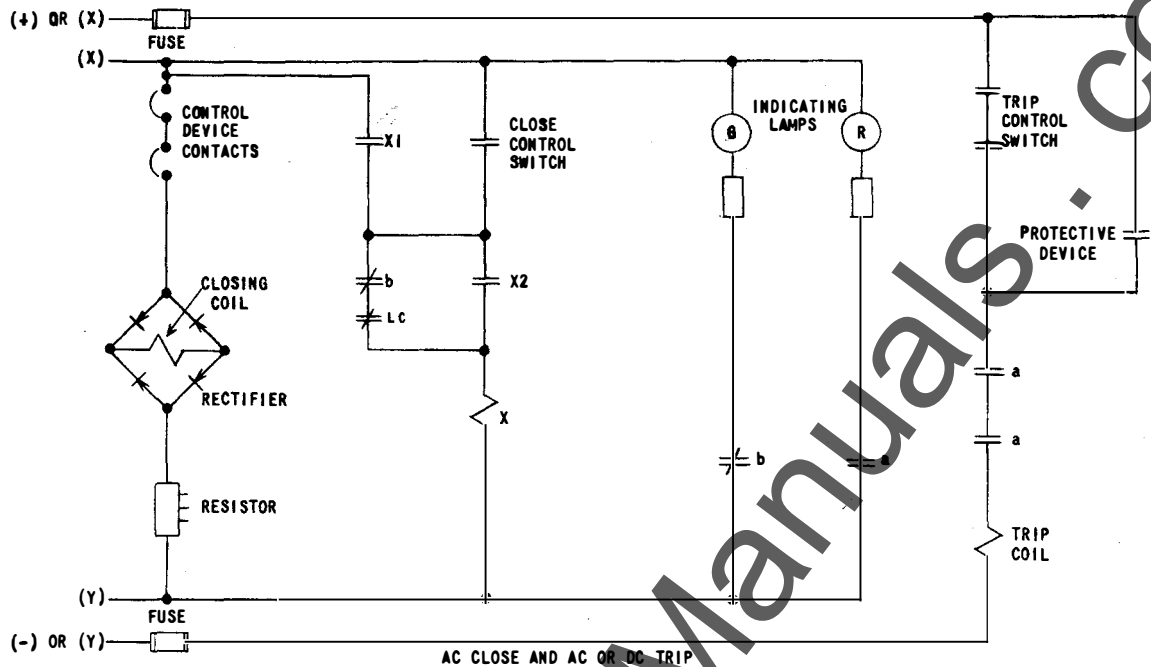
Fig. 10 Control Device



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

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

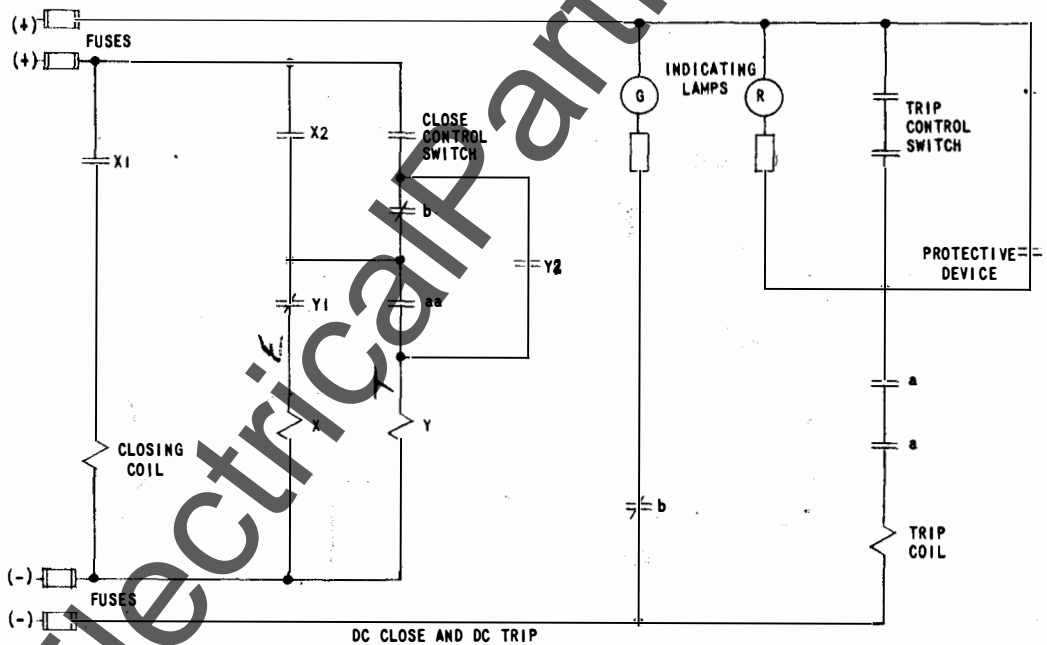
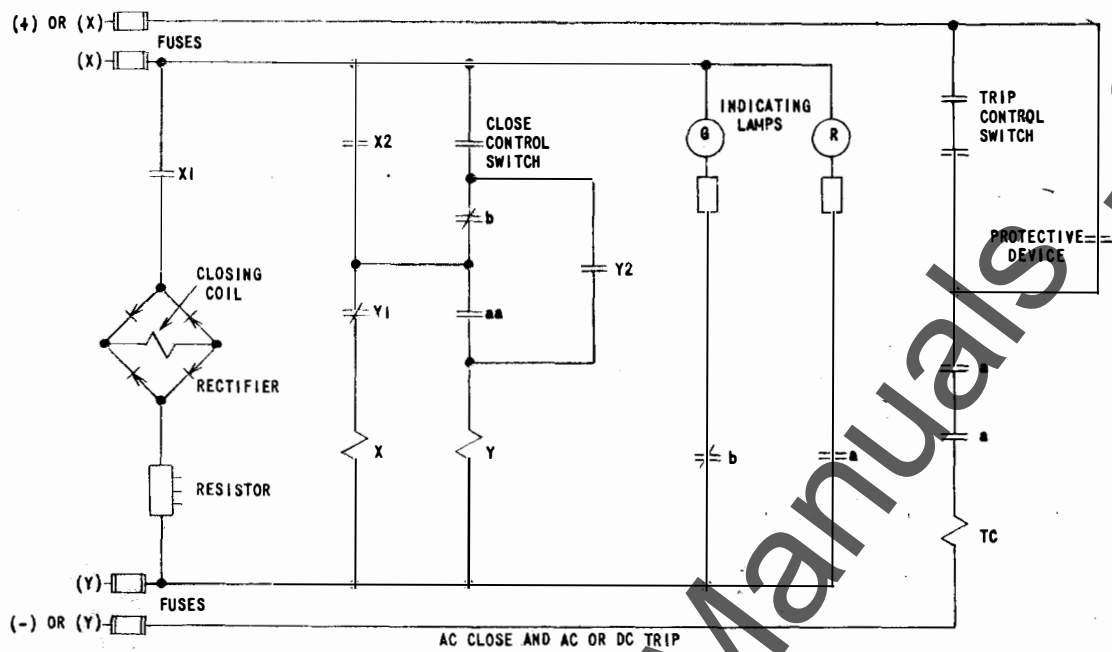
Magne-blast Circuit Breakers Type AM



- 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

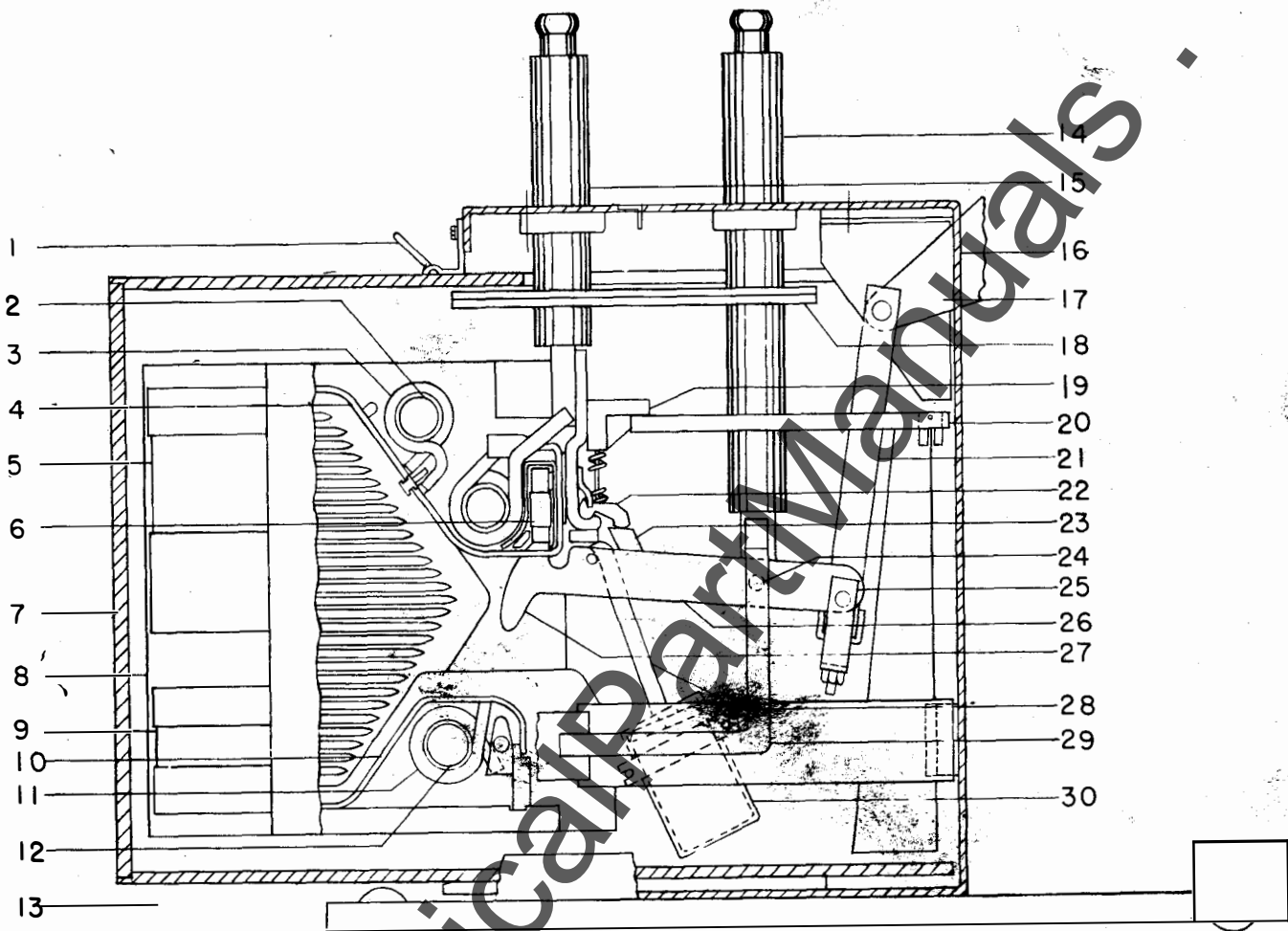
Magne-blast Circuit Breakers Type AM



- 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-I and -150/250A-I Magne-blast Circuit Breakers, Shown In The De-energized Position



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

Fig. 14 Cross Section Of Breaker Pole Unit

Magne-blast Circuit Breakers Type AM

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, 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 (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 com-

bination 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 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
Open 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
Sealed Bearings	Cannot be relubricated	Replace when they become sluggish.
Silver Plated Primary Disconnect Studs	Wipe clean and apply D50H28	Wipe clean and apply D50H28

Fig. 15 Lubrication Chart

* Registered in U. S. Patent Office.

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.

Open Ball, Roller, and Needle Bearings

After removing the bearings to be cleaned from the mechanism place them 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 conducive 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.

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.

Dust Sealed and Oil Sealed Bearings

Under ordinary circumstances, the life of these bearings should be five years or better. It will be necessary to replace them if oxidation of the lubricant is causing slower operation.

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.

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.

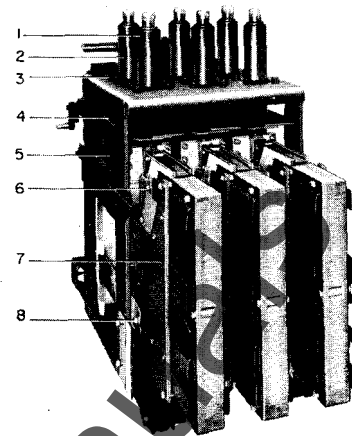
REPAIR AND REPLACEMENT

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.

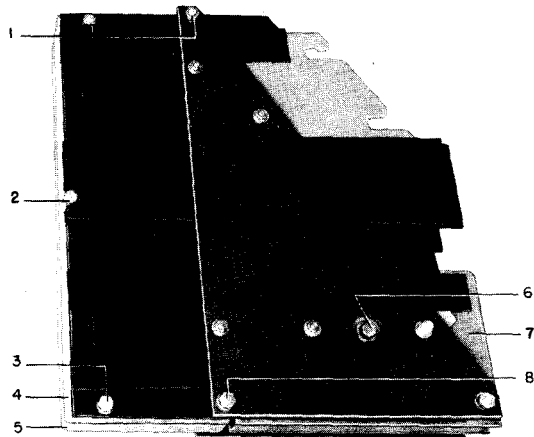
To disassemble the arc chute after it has been removed from the breaker, refer to Fig. 17 and proceed as follows:

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.

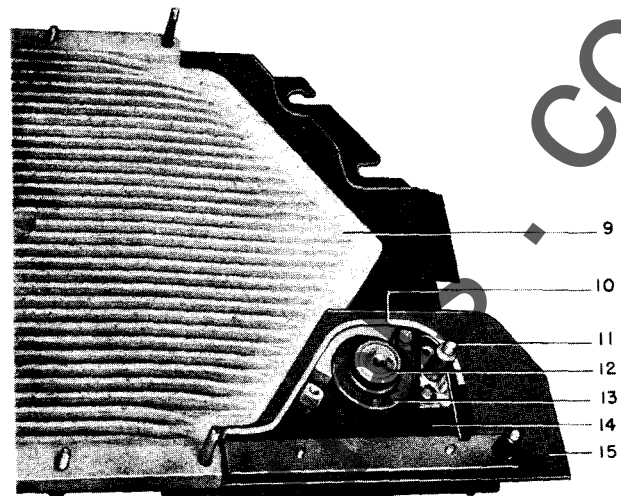
CONTACTS

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).

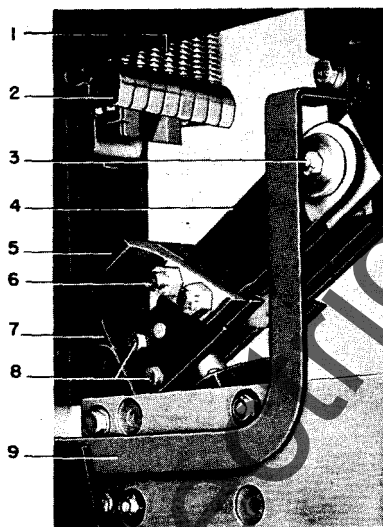


1. Assembly Bolts
2. Assembly Bolt
3. Assembly Bolt
4. Arc Chute Upper Half
5. Arc Chute Lower Half
6. Assembly Bolts
7. Glass Bonded Mica Side Piece
8. Assembly Bolts



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



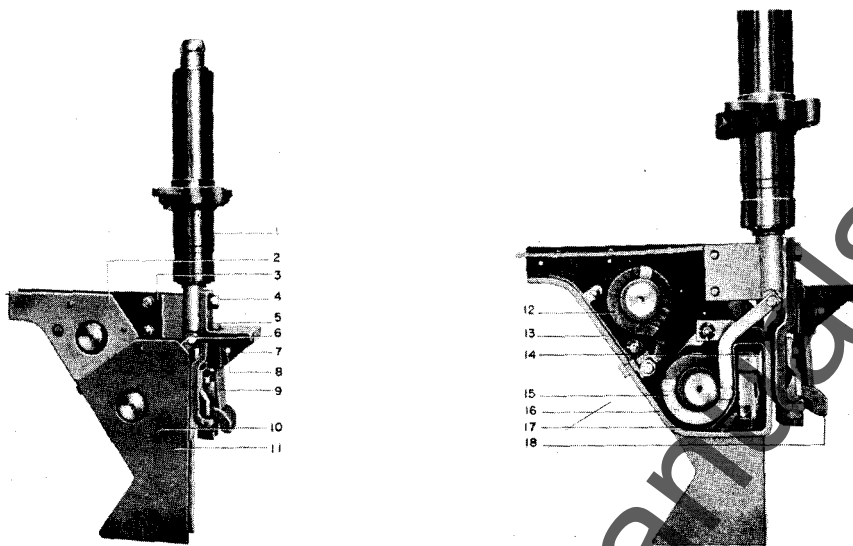
1. Contact Springs
2. Stationary Primary Contacts
3. Cup Bearing
4. Contact Arm
5. Movable Primary Contacts
6. Assembly Bolts
7. Movable Arcing Contact
8. Assembly Bolts
9. Connection Bar

Fig. 18 Removal Of Contacts

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 the contact spring (1) and raise the contact finger and slide it out. Remove one contact finger at a time.
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.



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

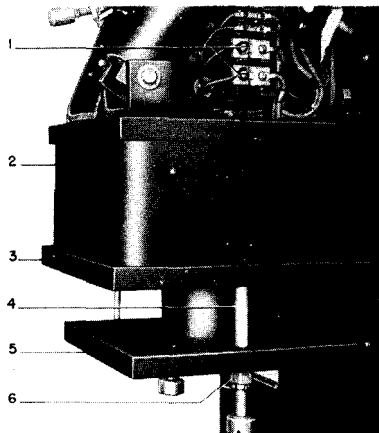
Front Bushings

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.
6. Remove the pin (6) Fig. 4, and check the minimum torque required to move the contact arm (4) from the fully open position. This should measure 130 to 150 inch-pounds.
7. 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

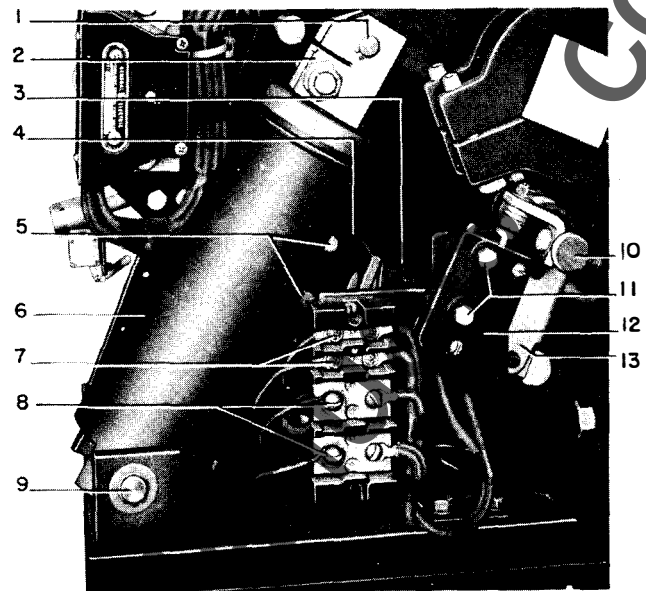
Fig. 20 Closing Solenoid Assembly

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



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

trip coil support (4).

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.

WHEN YOU NEED SERVICE

GEZ-85N

IF YOU NEED TO REPAIR, recondition, or rebuild any electric apparatus, a G-E service shop near you is available day and night, seven days a week, for work in the shops or on your premises. Latest factory methods and genuine G-E renewal parts are used to maintain the original performance of your electric equipment.

When you need parts only, to replenish those you stock as "production insurance," your General Electric representative will service your request. Plan to stock and order far enough in advance to assure an adequate supply to meet normal requirements.

The services of G-E factories and engineering divisions are always available to help you with your electrical problems. For full information about these services, contact the nearest service shop or sales office listed below:

APPARATUS SERVICE SHOPS

Atlanta—Chamblee, Ga. 4639 Peachtree Indus. Blvd.
Baltimore 30, Md. 920 E. Fort Ave.
Boston—Medford 55, Mass. Mystic Valley Pkwy.
Buffalo 11, N. Y. 318 Urban St.
Charleston 28, W. Va. 306 MacCorkle Ave., S.E.
Charlotte, N. C. 2328 Thrift Road
Chicago 80, Ill. 849 S. Clinton St.
Cincinnati 2, Ohio 444 W. Third St.
Cleveland 4, Ohio 4966 Woodland Ave.
Columbus 15, Ohio 213 Cozzens St.
Dallas 9, Texas 3202 Manor Way
Denver 5, Colo. 3353 Larimer St.
Detroit 2, Mich. 5950 Third Ave.
Houston 20, Texas 5534 Harvey Wilson Drive
Johnstown, Pa. 841 Oak St.
Kansas City 8, Mo. 819 E. 19th St.
Los Angeles 1, Calif. 6900 Stanford Ave.
Milwaukee 3, Wisc. 940 W. St. Paul Ave.
Minneapolis 12, Minn. 2025 49th Ave., N.
New York 14, N. Y. 416 W. 13th St.
Philadelphia 23, Pa. 429 N. Seventh St.
Pittsburgh 6, Pa. 6519 Penn Ave.
Portland 18, Oregon Swan Island
Richmond 24, Va. 1403 Ingram Ave.
St. Louis 10, Mo. 1115 East Road



San Francisco 3, Calif. 1098 Harrison St.
Salt Lake City 4, Utah 301 S. Seventh West St.
Seattle 4, Wash. 3422 First Ave., S.

Toledo 4, Ohio 1 So. St. Clair St.
York, Pa. 54 N. Harrison St.
Youngstown 5, Ohio 272 E. Indianola Ave.

APPARATUS SALES OFFICES

Akron 8, Ohio 335 S. Main St.
Albany 7, N. Y. 90 State St.
Albuquerque, N. Mex. 323 Third St., S.W.
Allentown, Pa. 1014 Hamilton St.
Amarillo, Texas 719 Amarillo Bldg.
Appleton, Wisc. 531 W. College Ave.
Atlanta 3, Ga. Peachtree Rd. at 28th St., N.W.
Augusta, Ga. Eighth & Broad Sts.
Bakersfield, Calif. 211 E. 18th St.
Baltimore 1, Md. 111 Park Avenue
Bangor, Maine 77 Central St.
Battle Creek, Mich. 25 W. Michigan Ave.
Beaumont, Texas 1385 Calder Ave.
Binghamton, N. Y. 19 Chenango St.
Birmingham 3, Ala. 1804 Seventh Ave., N.
Bluefield, W. Va. P.O. Box 447, Appalachian Bldg.
Boston 1, Mass. 140 Federal St.
Buffalo 3, N. Y. 535 Washington St.
Butte, Mont. P.O. Box 836, 103 N. Wyoming St.
Canton 2, Ohio 700 Tuscarawas St., W.
Cedar Rapids, Iowa 203 Second St., S.E.
Charleston 28, W. Va. 306 MacCorkle Ave., S.E.
Charlotte 1, N. C. 200 S. Tryon St.
Charlottesville, Va. 123 E. Main St.
Chattanooga 2, Tenn. 832 Georgia Ave.
Chicago 80, Ill. P.O. Box 5970A, 840 S. Canal St.
Cincinnati 2, Ohio 215 W. Third St.
Cleveland 4, Ohio 4966 Woodland Ave.
Columbia 1, S.C. P.O. Box 1434, 1420 Lady St.
Columbus 15, Ohio 40 S. Third St.
Corpus Christi, Texas 205 N. Chaparral Street
Dallas 2, Texas 1801 N. Lamar St.
Davenport, Iowa 511 Pershing Ave.
Dayton 2, Ohio 118 W. First St.
Denver 2, Colo. 650 Seventeenth St.
Des Moines 9, Iowa 505 W. Fifth St.
Detroit 2, Mich. 700 Antoinette St.
Duluth 2, Minn. 14 W. Superior St.
Elmira, N. Y. Main and Woodlawn Aves.
El Paso, Texas 109 N. Oregon St.
Erie 2, Pa. 1001 State St.
Eugene, Ore. 29 W. Eleventh St.
Evansville 19, Ind. 123 N.W. Fourth St.
Fairmont, W. Va. 310 Jacobs Bldg., P.O. Box 1626
Fergus Falls, Minn. 102 W. Lincoln St., P.O. Box 197
Flint, Mich. 653 S. Saginaw St.

Fort Wayne 2, Ind. 127 W. Berry St.
Fort Worth 2, Texas 408 W. Seventh St.
Fresno 1, Calif. Telere and Fulton St.
Grand Rapids 2, Mich. 148 Monroe Ave., N.W.
Greensboro, N. C. 301 S. Elm St.
Greenville, S. C. 108 W. Washington St.
Hagerstown, Md. Professional Arts Bldg.
Harrisburg, Pa. 300 N. Second St.
Hartford 3, Conn. 410 Asylum St.
Houston 1, Texas 1312 Live Oak St.
Indianapolis 4, Ind. 110 N. Illinois St.
Jackson, Mich. 120 W. Michigan Ave.
Jackson 1, Miss. 203 W. Capitol St.
Jacksonville 2, Fla. 700 E. Union St.
Jamestown, N. Y. P.O. Box 548, 2 Second St.
Johnson City, Tenn. 321-323 W. Walnut St.
Johnstown, Pa. 841 Oak St.
Kansas City 6, Mo. 106 W. Fourteenth St.
Knoxville 08, Tenn. 602 S. Gay St.
Lansing 8, Mich. 106 W. Allegan St.
Lincoln 8, Nebr. 1001 "O" St.
Little Rock, Ark. 103 W. Capitol Ave.
Los Angeles 54, Calif. 212 N. Vignes St.
Louisville 2, Ky. 455 S. Fourth St.
Madison 3, Wisc. 16 N. Carroll St.
Manchester, N. H. 875 Elm St.
Medford, Ore. P.O. Box 1349, 205 W. Main St.
Memphis 3, Tenn. 8 N. Third St.
Miami 32, Fla. 25 S.E. Second Ave.
Milwaukee 3, Wisc. 940 W. St. Paul Ave.
Minneapolis 3, Minn. 12 S. Sixth St.
Mobile 13, Ala. 54 St. Joseph St.
Montgomery 4, Ala. 121 Molton St.
Nashville 3, Tenn. 234 Third Ave., N.
Newark 2, N. J. 744 Broad St.
New Haven 6, Conn. 129 Church St.
New Orleans 12, La. 837 Gravier St.
New York 22, N. Y. 570 Lexington Ave.
Niagara Falls, N. Y. 253 Second St.
Norfolk 10, Va. 229 W. Butte St.
Oakland 12, Calif. 409 Thirteenth St.
Oklahoma City 2, Okla. 119 N. Robinson St.
Omaha 2, Nebr. 409 S. Seventeenth St.
Paducah, Ky. P.O. Box 1001, 231 S. Fourth St.
Pasco, Wash. 421 W. Clark St.
Peoria 2, Ill. 309 Jefferson Bldg.
Philadelphia 2, Pa. 1405 Locust St.
Phoenix, Ariz. P.O. Box 4037, 303 Luhrs Tower

Pittsburgh 22, Pa. 535 Smithfield St.
Portland 3, Maine 477 Congress St.
Portland 7, Ore. 920 S.W. Sixth Ave.
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. 38 1/2 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. 1513 Line Ave.
Sioux City, Iowa 572 Orpheum Electric Bldg.
Sioux Falls, S. D. 321 1/2 S. Phillips Ave.
South Bend 11, 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.
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.
Wheeling, W. Va. 40 Fourteenth St.
Wichita 2, Kan. 200 E. First St.
Williamston, N. C. City Hall
Wilmington 98, Del. 1326 N. Market St.
Worcester 8, Mass. 507 Main St.
York, Pa. 56 N. Harrison St.
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 COMPANY, SCHENECTADY, N. Y.

CURRENT-LIMITING FUSE UNITS

TYPES EJ-1 AND EJO-1

INTRODUCTION

A Type EJ-1 fuse unit--for indoor use--or a Type EJO-1 fuse unit--for indoor or outdoor use--consists of a Pyrex glass fuse tube having metal ferrules at each end and containing current-responsive elements surrounded by a quartz filler. When the fuse functions, the arc resulting from the melting of the current-responsive elements is cooled by the adjacent filler and extinguished without any expulsion of gases or material from the tube. The maximum current passing through the fuse before the arc is extinguished is limited to a value considerably lower than the maximum short-circuit current usually available in the circuit.

APPLICATION

Fuse units Types EJ-1 and EJO-1 conform with the 1943 NEMA Distribution Cutout and Power Fuse Standards, as denoted by letter "E" following the current rating. They will carry current up to their "E" ampere rating continuously; fuse units rated 100E amperes and below will melt at a current between 200% and 240% of the rating in five minutes, and fuse units rated 125E amperes and above will melt at a current between 220% and 264% of their rating in ten minutes.

For a given application the recommended voltage rating of the fuse unit is that nearest to, but greater than, the line-to-line circuit voltage. In no case should the line-to-line voltage be less than 70 per cent of the nominal voltage of the fuse unit nor greater than the maximum design voltage rating.

When the fuse units are rated 25/60 cycles, they may be used on systems from 25 to 60 cycle frequency. When rated for 60 cycles only, they may be used on frequencies of either 50 or 60 cycles.

The "E" current rating must be equal to or larger than the maximum load current in the circuit, and at the same time, the current-responsive element must also be of sufficient size so as not to be damaged by magnetizing inrush current of associated transformers. For detailed application data, and also for time-current and current-limiting curves, refer to the nearest General Electric Sales Office.

RATINGS

Fuse units are made in several different diameters of tube and ferrule assemblies. Each fer-

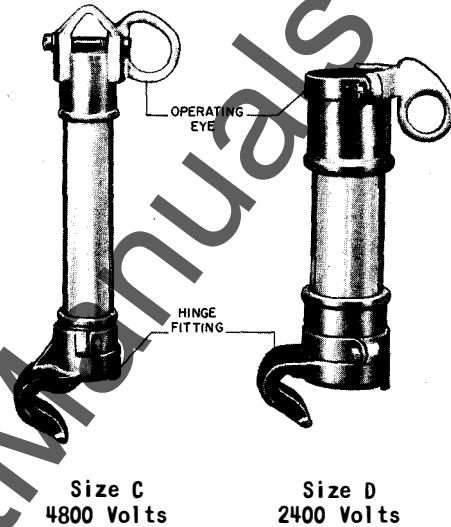


Fig. 1 Type EJ-1 Fuse Units Assembled With Fittings for Type EK-3C and EK-3D Fuse Disconnecting Switches

rule diameter is designated by a "size" letter, with the relation between size and letter being shown in Table 1. The tabulation also shows the voltage ratings for which each size is manufactured.

TABLE 1

Size	Ferrule Diameter	Maximum Design Rating
A	13/16"	600, 2750*
B	1 9/16"	2750, 5500, 8250, 15,500
C	2"	2750, 5500, 8250, 15,500
D	3"	25,800 2750, 5500, 8250, 15,500
DD	2-3" in Parallel	25,800, 38,000 2750, 5500, 8250, 15,500

* May also be used on 4300 volt solidly-grounded neutral circuits when mounted in porcelain housing on G-E Type JE-2 or JE-32 potential transformers.

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.

INSTALLATION

A suitable fuse support is required to use the fuse unit. With Type EK-3 and EKO-3 fuse disconnecting switches, fittings for the fuse unit are furnished to make it suitable for use as a disconnecting blade. To attach these fittings to a Size C or Size D fuse unit, slide them on the ferrules of the fuse unit and clamp in place in the position shown in Fig. 1. With a Size DD fuse unit, attach the hinge fitting to the bottom ferrule of one tube and the operating eye to the top ferrule of the other tube, as shown in Fig. 2. In all cases, the hinge fitting should be located at the

end of the fuse containing the indicating target, for ease of viewing from below. The target end of Size C, D, and DD fuse units has a concave appearance (see left side of Fig. 3 as distinguished from the flat cap closing the other end, or ends in the case of Size DD) of the fuse tube.

Unless special means are provided for disconnecting the entire fuse support or switch from all sources of power, the fuse unit should be removed and inserted only with insulated fuse tongs.

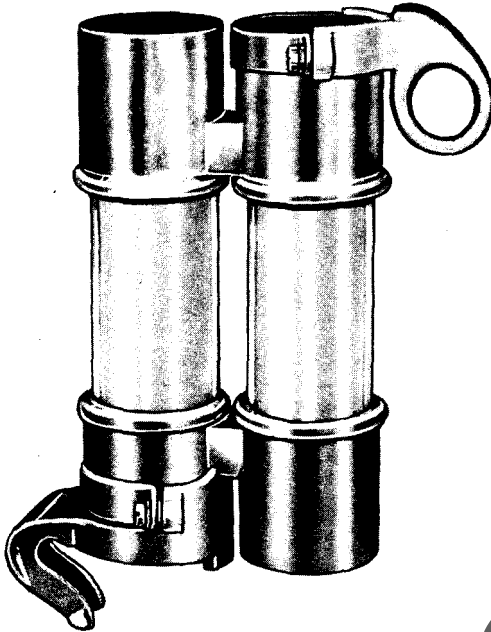


Fig. 2 Size DD Fuse Unit Assembled With Fittings for Type EK-3DD Fuse Disconnecting Switch



Fig. 3 Indicating Targets of Size C Fuse Units

OPERATION

When a fuse unit functions, it should be replaced by a complete new unit. Always use a fuse tongs for handling unless special means are provided for disconnecting the fuse support from all sources of power. If used in a fuse disconnecting switch, the fittings should be removed from the blown unit and transferred to a replacing unit. The time required to replace a blown fuse unit in a disconnecting switch may be considerably shortened if a spare fuse unit with fittings in place is kept on hand at each installation.

The indicating target provided at one end of the larger sizes of fuse units, operates when the fuse unit functions. Its operation is provided by a separate mechanism within the fuse tube, and is not due to any pressure developed by the main fuse elements in functioning. The appearance of the target for size C and larger fuse units is shown, before and after operation, in Fig. 3. Size B fuse units have an indicator consisting of a small plunger which projects from the end of the fuse unit after the fuse unit functions.

REPLACEMENTS

Do not dispose of blown fuse units until arrangements have been made through the nearest

General Electric Sales Office, to obtain duplicate units.

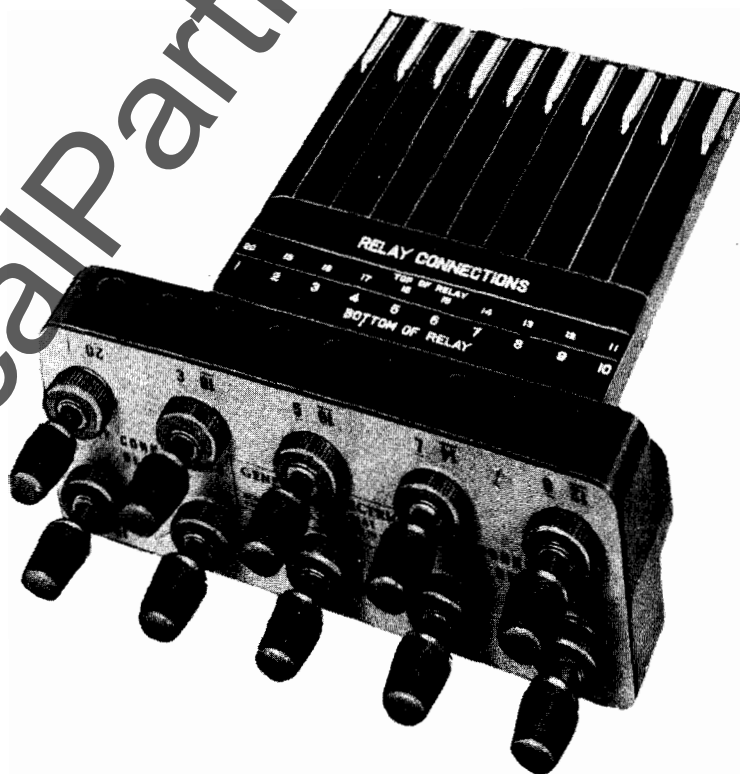
GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

INSTRUCTIONS

Switchgear

TEST PLUGS

FOR DRAWOUT RELAYS AND METERS



Type XLA

GENERAL  ELECTRIC

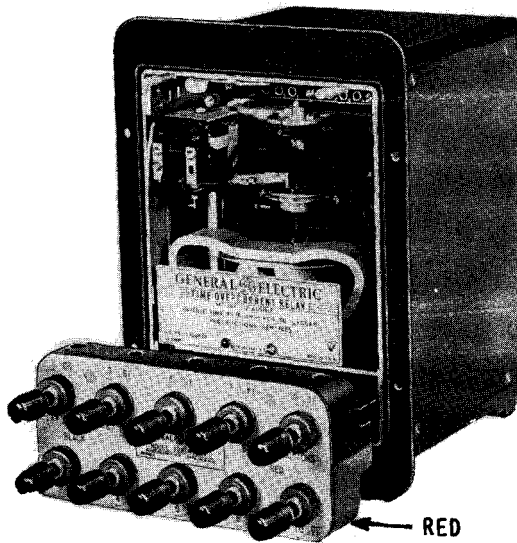


FIG. 1
TEST PLUG
IN RELAY

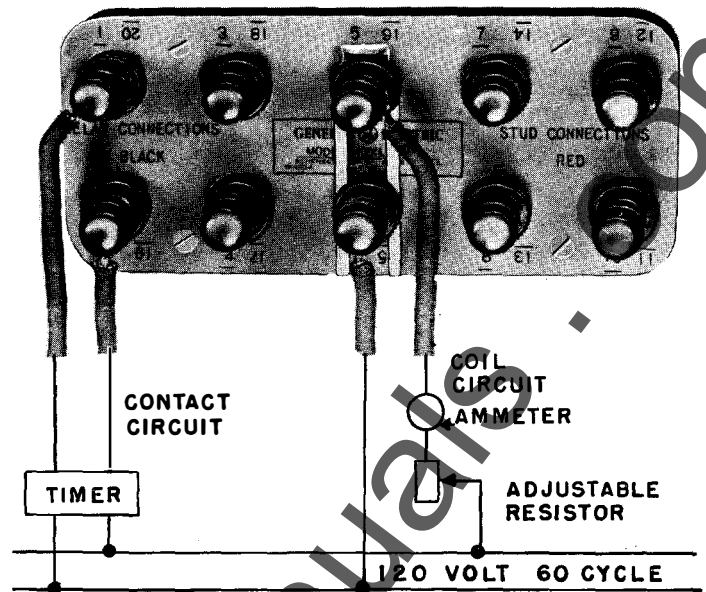


FIG. 2 - TEST CONNECTIONS FOR TYPE 1AC OVERCURRENT RELAY.

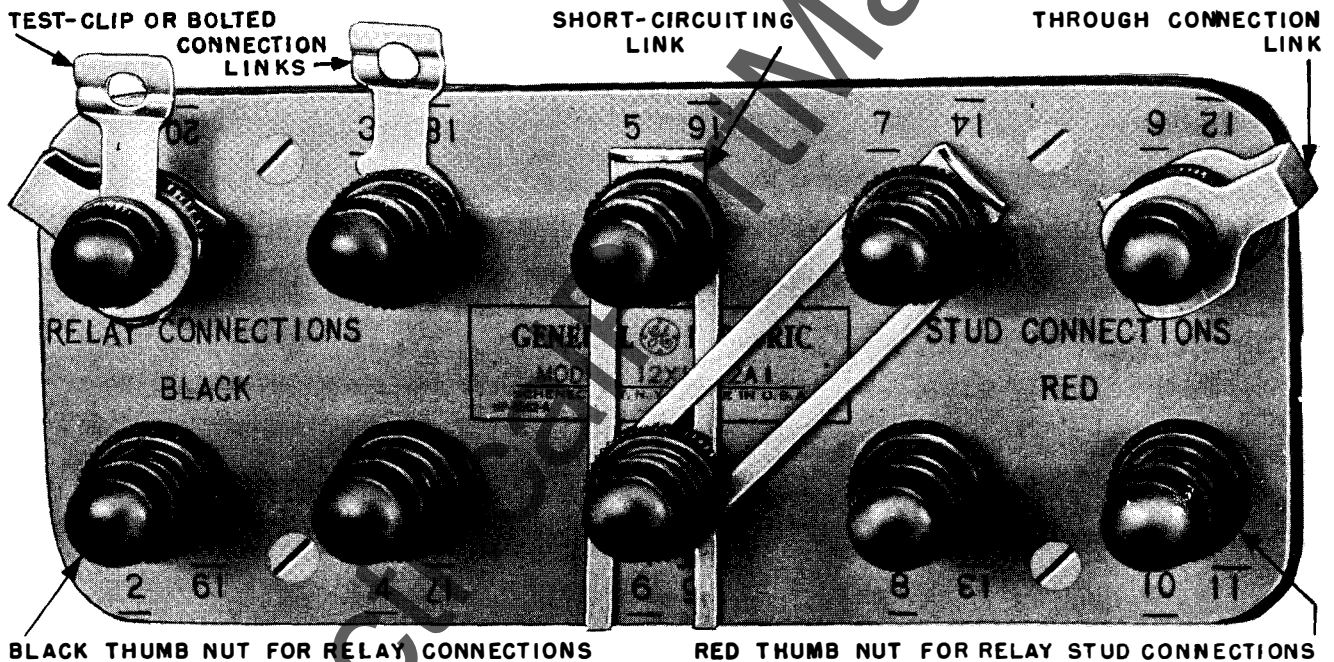


FIG. 3 - TEST LINKS IN USE ON TEST PLUG.

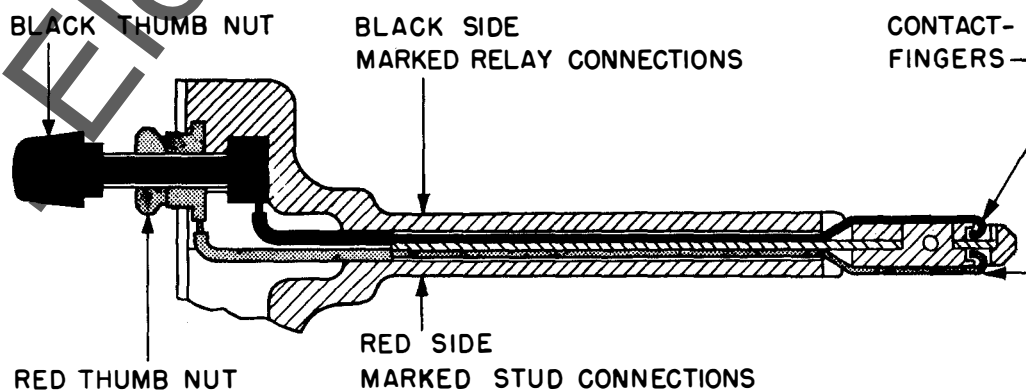


FIG. 4 - SECTIONAL VIEW OF TEST PLUG.

TEST PLUG

FOR DRAWOUT RELAYS AND METERS

DESCRIPTION

APPLICATION

The type XLA test plugs are used to test draw-out relays and meters from their own source of power or from other sources.

CONSTRUCTION

The XLA test plug consists of a black and red textolite molding with twenty electrical separate contact-fingers connected to ten concentric binding posts. The contact-fingers on the black side are connected to the inside binding posts with black thumb nuts and engage the relay internal connections. The contact-fingers on the red side are connected to the outer binding posts with the red thumb nuts and engage the relay case stud connections. See Fig. 4. The concentric binding posts are numbered on the front nameplate and the corresponding contact-fingers are numbered on each side of the test plug. Numbers from one to ten are used when the test plug is used in the bottom of the relay and eleven to twenty are used when the test plug is used in the top of the relay.

Removable test links for through connections, short-circuiting and test clips are furnished with each test plug. See Fig. 6.

TESTING

Routine testing can be made by removing the relay cover and substituting the test plug for the connection plug. The test plug must be inserted with the red side away from the relay unit. The relay may be tested either from its own source of current and potential or from other sources. See Fig. 1.

The U-shaped link is used to make through connections from stud to relay. The long opened end link is used to short circuit the current transformer. This must be inserted in the proper place under the red thumb nuts before the test plug is inserted in the relay. The two sizes of corrugated end links are used when standard test-clips or when bolted connections are preferred. See Fig. 3.

Typical test plug connections and wiring diagram for type IAC overcurrent relays are shown in Fig. 2.

Conventional representation of test plug connections that are used on wiring diagrams are shown in Fig. 5.

SHIPPING - UNPACKING

The Type XLA test plugs are shipped in individual cartons. In the carton with the test plug is a package containing the removable test links. The carton can be used for a storage case for the test plug.

Immediately upon receipt of the test plug 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 Sales Office should be notified.

RENEWAL PARTS

Orders for renewal parts should be addressed to the nearest Sales Office of the General Electric Company, giving name of part wanted, quantity required, and complete nameplate data.

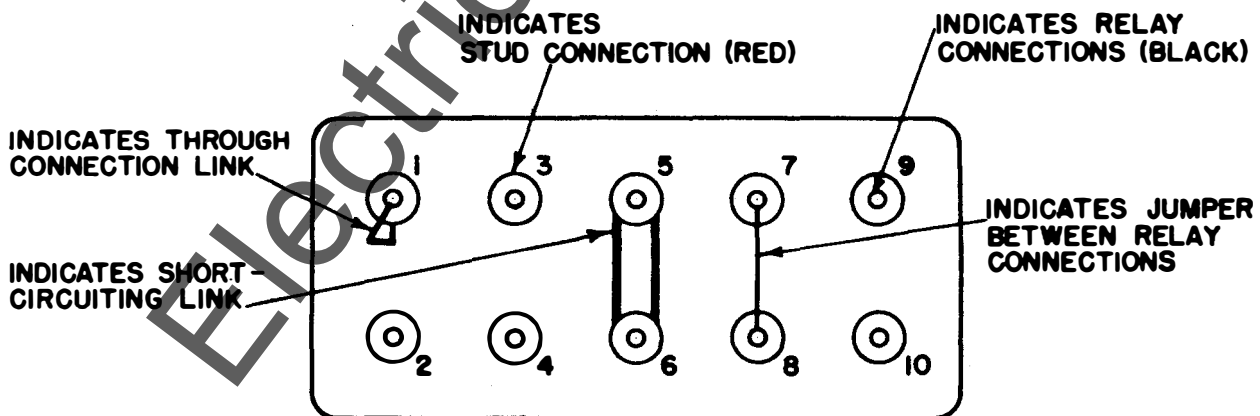


FIG. 5

CONVENTIONAL REPRESENTATION OF TEST PLUG CONNECTIONS

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.

