INSTRUCTIONS

GEI-78581C
SUPERSEDES GEI-78581B

OIL-BLAST CIRCUIT BREAKER

Types
FKD-14.4-100-3
FKD-14.4-250-3
FKD-14.4-500-3
with
ML-10-2 Mechanism

CONTENTS

HIGH VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

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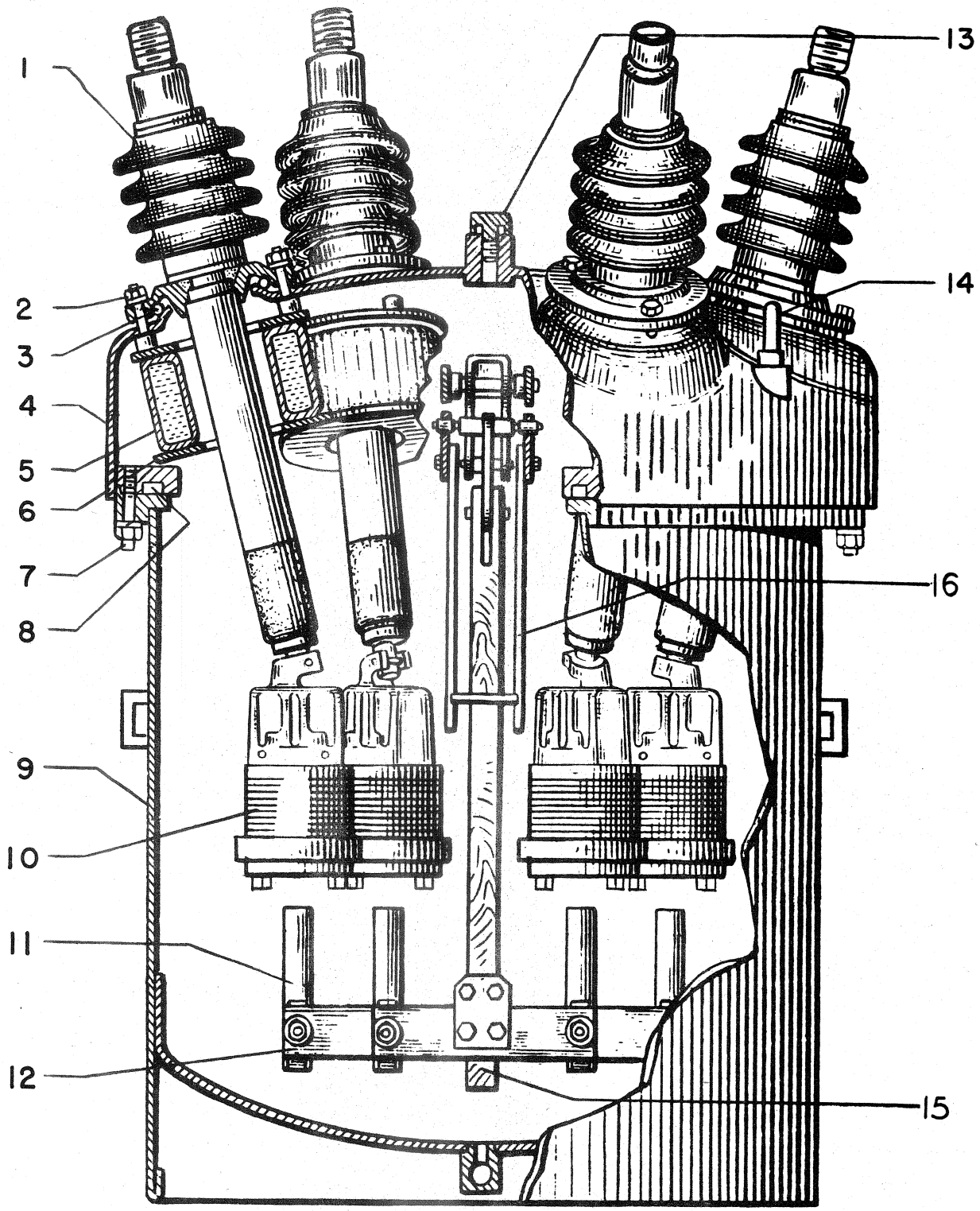

1. Bushing
2. Assembly Nut
3. "O" Ring Gasket
4. Dome
5. Bushing Current Transformer
6. B.C.T. Support Plate
7. Tank Nut
8. Tank Gasket
9. Tank
10. Interrupter
11. Contact Rod
12. Crossarm
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14. Oil Gage
15. Lift Rod
16. Lift Rod Guide

Fig. 1 Breaker Unit

Cover (8030346)

Fig. 1 (089T0232)

OIL-BLAST CIRCUIT BREAKER

TYPES FKD-14.4-100-3

FKD-14.4-250-3

AND FKD-14.4-500-3

The Type FKD-14.4 Oil-blast Circuit Breaker is a triple pole outdoor breaker designed for service at a normal circuit voltage of 14,400 volts, in current ratings of 600 or 1200 amperes and with interrupting ratings up to 500 mva as indicated on the breaker nameplate. It features the oil-blast principle of arc interruption which is designed for fast interruption. This means less system disturbance due to the shorter time required to clear the fault. Also, the short arc lengths mean lower maintenance because of reduced contact burning and oil deterioration.

An oil circuit breaker should not be installed in places where it will be called upon to operate at voltages or currents greater than those given on the nameplate. The short circuit conditions to be imposed on the breaker must not exceed the breaker rating. The oil-blast contacts are designed for the required interrupting rating at rated voltage. When used on circuits on lower than rated voltage the normal mva interrupting rating can only be retained down to the value of the circuit voltage where the amperes to be interrupted equal the maximum ampere rating of the breaker. For circuit voltages lower than this value the interrupting rating must be reduced proportionally.

RECEIVING, HANDLING AND STORAGE

All breakers are assembled and tested at the factory. They are shipped assembled as complete units. Each breaker is carefully inspected and packed by workmen experienced in the proper handling and packing of electrical equipment. Immediately upon receipt of a 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 Sales Office notified.

These breakers are shipped completely assembled on their framework. When unpacking, the crating or boxing must be removed carefully. The porcelains of the bushings and other parts are sometimes broken by driving a wrecking bar into crates or boxes carelessly.

When the breaker can be set up immediately in its permanent location and filled with oil it is advisable to do so, even though it will not be placed in service for some time. The oil tank should be cleaned and dried before it is filled with oil. The crating should not be taken from the bushings until after the breaker has reached its permanent location and all overhead work completed. If stored outdoors the tank should be filled with oil to protect the insulating parts. Although the operating mechanism housing is weatherproof, the space heater should be energized as soon as possible to prevent corrosion due to moisture condensation inside the housing.

Particular care should be taken to protect renewal parts, especially insulation parts which might absorb moisture. It is necessary that these parts be stored in a dry room.

DESCRIPTION

The FKD-14.4 oil-blast circuit breaker shown on the front cover consists of a three pole breaker unit and an operating mechanism. The three pole breaker unit consists of three single pole units mounted in a common dome and connected through an operating linkage to the mechanism.

Oil-blast interrupters are mounted on the lower ends of the oil-filled bushings and contain the stationary contacts. The breaker linkage carries insulated operating rods which carry the moving contacts. The contacts meet inside the interrupting chamber. The contacts open and close (essentially) simultaneously. When the contacts open inside the interrupters, which are under oil, circuit interruption occurs.

The trip-free operating mechanism is a motor-charged, spring-operated device. The action of a closing cam driven by a torsion spring causes closing of the breaker contacts. In closing, energy is stored in compression springs. Release of this energy by operation of the mechanism trip latch causes opening of the breaker contacts.

A float type oil gage is installed in the top of the dome. This indicates the oil level indirectly through the action of a float, the position of which corresponds to the true oil level. The float is fastened to a red pointer rod which is visible in a tube on the top of the breaker. The correct oil level at normal temperature (20°C), as indicated on the breaker outline drawing, is 1-3/16" above the bottom of the visible portion of the gage glass. This corresponds to the amount of oil necessary to keep the portion of the bushing below the ground sleeve immersed in oil.

The tank is held by eight studs against the top frame and a rubber gasket located in a groove on the underside of the top frame. The bolts must be tight to prevent oil leakage around the tank gasket during circuit interruption. This arrangement permits easy removal of the tank for maintenance of the contacts. A drain valve is attached to the drain pipe at the bottom of the tank so that all the oil may be drained. The valve should be plugged when not in use to prevent any possible leakage.

BUSHINGS

The bushings are of the oil-filled, center clamped design. The bushing is made with *Herkolite insulation around the bushing core. The ground sleeve and flange are pressed on to the *Herkolite. The bushings are completely sealed with gaskets under pressure of a spring washer at the top of the porcelain. This construction lends itself to easy assembly and disassembly. The porcelain at the top of the bushing is under an axial compressive load which is sufficient to allow some cantilever loading of the bushing. The construction of the bushing flange provides a swivel joint to aid in alignment. A rubber "O" ring seal is provided between the bushing mounting flange and the dome.

BUSHING CURRENT TRANSFORMERS

Bushing current transformers, Type BR-B, are used on these breakers to provide a source of current supply for operating breaker trip coils and protective relays. Relaying transformers are of the multi-ratio type having five leads which provide

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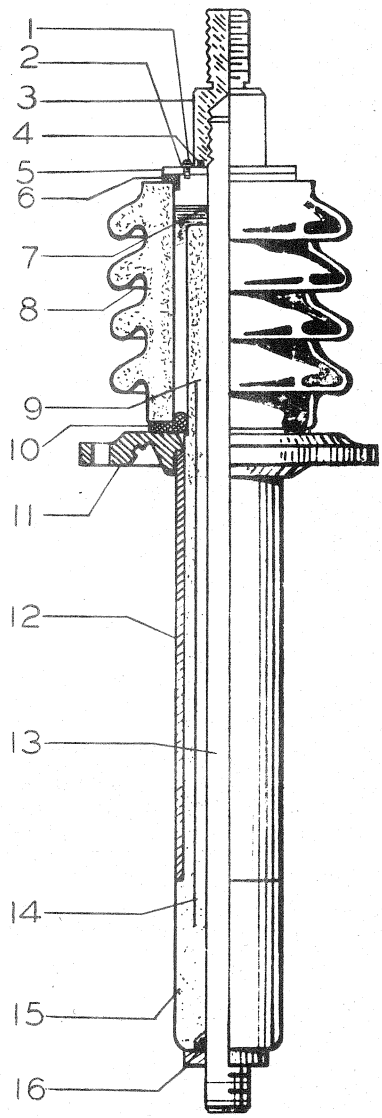
a wide range of ratios. Ratio and accuracy classification for standard transformers are in accordance with ASA C-57-13.017(C) and NEMA SG-6-250 specifications.

High accuracy single tap metering type current transformers can also be furnished. These have compensation applied for specified loadings and cannot be used on other loadings without affecting their accuracy. Ratio and accuracy classification for standard transformers of this type are also in accordance with ASA C-57-13.017 (C) and NEMA SG-6-250 specifications.

Performance data in the form of ratio curves is available for standard transformers of standard ratios. These are supplied with the order or can be secured from the Switchgear Department by giving the proper references.

Bushing current transformers are mounted inside the top frame. They are installed from underneath the top frame and they can be slipped over the lower end of the bushing, although the interrupters must be removed first. A supporting ring bolted to the top frame holds the transformer in place. Insulation washers above and below the transformer protect it from injury. It must be properly centered in the housing to prevent damage when the bushing is installed.

Leads from each transformer are carried on the inside of the top frame to the operating mechanism housing. These pass through a hole in the back plate of the housing and through an oil seal inside the housing. The seal assembly consists of a flexible compound seal held between two rigid compound plates. Bolts are screwed into tapped holes in the housing and compress the seal around the leads to prevent communication between the breaker top frame and the inside of the housing.



1. Oil Fill Screw
2. Gasket
3. Bushing Cap
4. Gasket
5. Belleville Washer
6. Gasket
7. Oil Level
8. Porcelain
9. Oil
10. Gasket
11. Support
12. Ground Sleeve
13. Stud
14. Equalizer
15. Herkolite* Insulation
16. Gasket

Fig. 2 Oil Filled Bushing

TANKLIFTER

The hand operated tanklifter for these breakers consists of two portable hoists of either the chain or cable type. They are hooked into eyebolts in opposite corners of the breaker frame. The elevation of the hoists can be changed to suit the installation by relocating the eyebolts in any convenient hole in the frame. The lead of the hoists passes over stationary sheaves at the top of the framework before hooking into the breaker tank. Operation of the tanklifters is shown in Fig. 3. The hoists being light and portable are easily carried by the maintenance crew.

SPECIAL TOOLS

A maintenance closing bolt which may be inserted in the front of the mechanism coupling, through the small access hole in the front sheet of the mechanism housing, is available.

A "T" wrench which may be used to manually wind the main spring is available.

These tools are normally furnished on the basis of one set for each five breakers in the same station or one per station if less than five breakers are ordered or if separate shipping locations are shown on the requisition.

The tools, when furnished, can be stored in the bottom of the mechanism house.

INSTALLATION

INSTALLATION

The installation of the breaker will be facilitated by a study of these instructions and a reveiw of the approved drawings which supplement these instructions. The drawings show the general arrangment, dimensions, location of foundation bolts, provisions for conduit connections, electrical connections and other information necessary for the proper installation of the breaker. The approved drawings include the requisition summary, outline of the breaker with its operating mechanism and housing, and the connection diagrams. The breakers are shipped in the closed position. The manual trip linkage and the manual closing release handle are wired to prevent accidental operation. These wires must be removed before operating the breaker.

This mechanism is designed only for electrical operation. Mechanical interlocks prevent closing the breaker if there is too little spring force available or inserting the maintenance bolt without tripping the latch. HOWEVER, NEVER ATTEMPT TO CLOSE THE BREAKER UNDER LOAD WITH THE MAINTENANCE CLOSING BOLT. UNDER EMERGENCY CONDITIONS THE BREAKER MAY BE CLOSED AGAINST LOAD BY MANUALLY OPERATING THE CLOSING RELEASE DEVICE AFTER THE SPRING HAS BEEN CHARGED.

LOCATION

The breaker should be located so that it will be readily accessible for cleaning and inspection. Sufficient space must be provided for the operation of the maintenance closing device and tanklifter and for easy removal of the oil tank. It will be necessary to unbolt the cross bracing on the side of the frame to allow the tank to be withdrawn from under the breaker. Where flood conditions exist, the mechanism housing should be above high water level.

MOUNTING

The total weight of the breaker with oil is given on the outline drawing and on the nameplate. This information will serve as a guide to the strength of the lifting means required for handling the breaker. It may be lifted by hooking into the holes in the ears at the top of the breaker framework. Do not allow cable slings to strike the bushings as any strain may cause them to crack or break.

As the breakers are shipped assembled on their frameworks, it is only necessary to correctly locate and fasten the frame in position on its foundation (after attaching the framework extension, if used). Bolts of 3/4" diameter are recommended for foundation bolts. The foundation bolts should be left loose to permit the frame to be properly plumbed and leveled by inserting shims under the feet of the frame where necessary. After this has been done, the foundation bolts should be tightened and the frame fastened securely to its foundation.

CONNECTIONS

After the breaker has been located, electrical connections can be made. Before making these, every precaution must be taken to see that all leads to be connected to the breaker are not energized.

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PRIMARY CONNECTIONS

Leads should be brought down from above if possible. Ample electrical clearance must be provided between these leads and parts of the station, such as walls, channels and framework. Leads should be properly supported so that the breaker bushings are not subjected to unnecessary strains. To avoid overheating, the connecting leads must be of a current carrying capacity at least equal to the maximum operating current of the circuit which should not exceed the breaker rating.

Connections to the breaker are made by bolted connectors fastened to the ends of the bushings. The bolts on the terminal connectors must be securely tightened to obtain good contact. All joints must be clean, bright and free from dents or burrs.

CONTROL AND SECONDARY WIRING

All control wires should be run in conduit insofar as it is practicable. Control wires must be run separately and remote from high tension leads. Control wiring of adequate size should be used so that with full operating current flowing to the operating mechanism, the voltage across the terminals of the mechanism will be within the limits specified as standard for the range of control voltage. It is recommended that all conduits entering the mechanism housing be sealed off at their entrance to the housing.

Control and bushing current transformer connections are made inside the operating mechanism housing where suitable terminal boards are provided. Connection diagrams are supplied for each breaker showing the proper connections for the operating mechanism and the bushing current transformers. All bushing current transformer terminal boards are shipped shorted and grounded. These connections should be changed upon setting the bushing current transformer ratio.

GROUND CONNECTIONS

The framework of each breaker should be permanently grounded. The usual practice is to connect a heavy cable between the framework and the station ground. A bolted connector is provided on a leg of the framework to which this cable can be attached. The cable should be able to carry 25% of the current rating of the breaker but should not be smaller than #4/0.

A good, permanent, low resistance ground is essential for adequate protection. A poor ground may be worse than no ground at all, since it gives a false feeling of safety to those working around the equipment and may result in ultimate loss of life or damage to the apparatus.

ADJUSTMENTS

BREAKER

Although the breaker has been set up, adjusted and tested at the factory, it is advisable to review all adjustments to see that no change has occurred during shipment and installation. Manual operation should be used for all preliminary inspections. The breaker should be slowly operated by hand (maintenance bolt) to see that it moves smoothly throughout the closing and opening of the breaker, that no binding occurs, and that no excessive play is noticeable between parts. The opening dashpot in the mechanism is self-contained so that the breaker may be operated electrically in air. Electrical operation should only be attempted after it is certain that all adjustments are made correctly. Details of these adjustments are given in the following paragraphs.

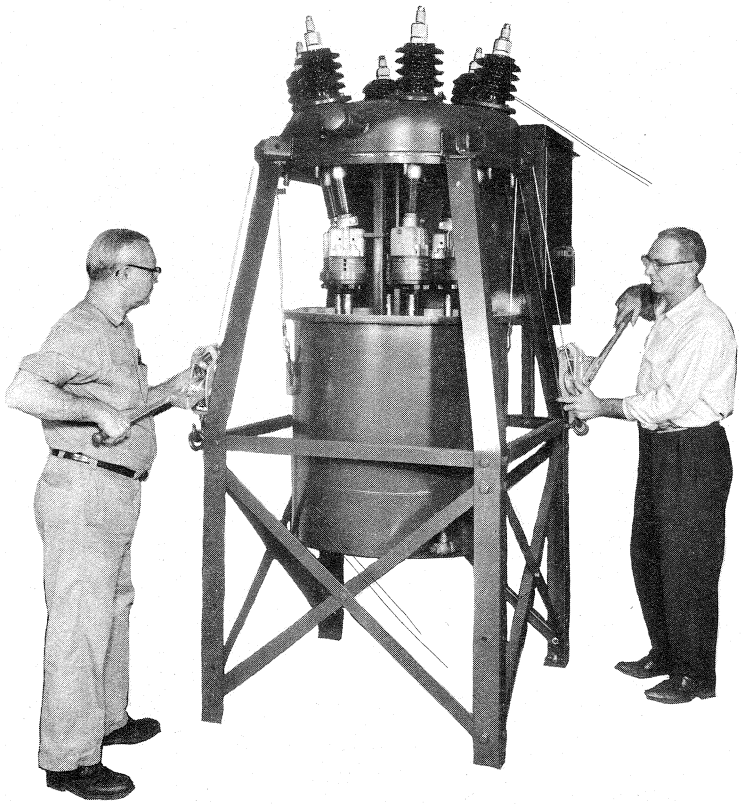


Fig. 3 Left Rear View of Circuit Breaker Showing Tank Lowered

The breaker is shipped in the closed position with the main spring partly discharged. Any maintenance closing may be done with the maintenance closing bolt which is described below.

The breaker may be closed slowly by means of the maintenance device. This is a jacking bolt which screws into the front of the breaker operating rod coupling (3) Fig. 4 and pulls the operating rod forward toward the closed position. The bolt should be well greased to reduce its resistance to turning. Since the bolt pulls directly on the operating rod the trip latch is ineffective to trip the breaker.

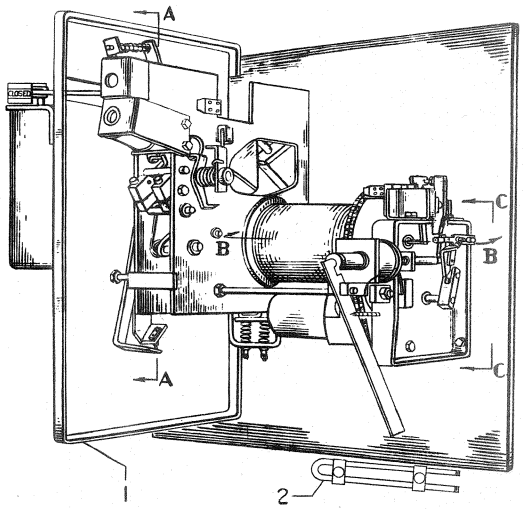
In jacking from the open to the closed position the cam follower roller (14), Fig. 4, must pass around the nose to the top of the cam. Normally this action is blocked by the trip latch. However, introduction of the maintenance bolt with the breaker open causes rotation of the trip latch during most of the closing stroke. Near the closed position the trip latch is released by the interlock, but held by the mechanism linkage until the closed position is reached. The breaker may be left in the closed position and the maintenance bolt withdrawn and conversely, the maintenance bolt may be inserted with the breaker in the closed position without tripping the breaker.

The closed position is established by proceeding forward until the trip latch drops in place and then backing-off until the load of the interrupters is taken by the mechanism linkage. The maintenance bolt has a 3/4-10 thread. The torque required to raise the contacts to the point of meeting is small but the torque required to complete closing is about 50 ft-lbs.

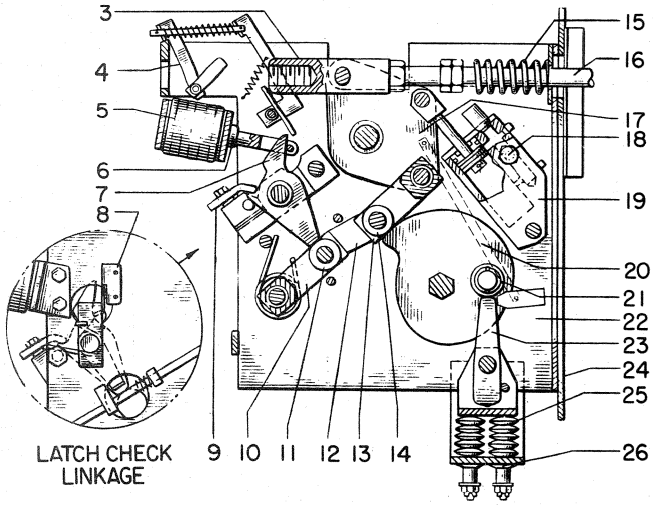
The breaker may be checked for correct adjustment by first establishing that the linkage is in the correct relation to the other parts. The linkage reference dimension, breaker closed, is 3-5/16" $\pm$ 1/8" measured from the top of the coupling in the center phase to the top of the lip of the boss in the center of the dome. This measurement is not of a critical dimension.

The stroke of the breaker contacts is 5" $\pm$ 1/8" no load. The open position is determined by equalling the weight of the contacts and the force of the slightly compressed opening springs with a relatively high gradient balancing spring (15), Fig. 4, located around the breaker operating rod in the mechanism. In the open position the balancing spring is compressed approximately 1/4" and the opening springs are compressed to 5-1/4". This corresponds

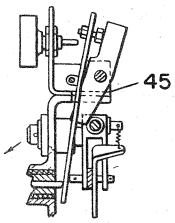
Fig. 3 (8030347)

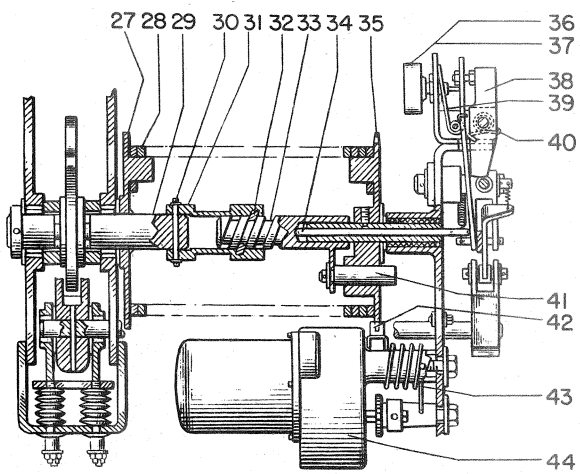


FRONT OBLIQUE VIEW

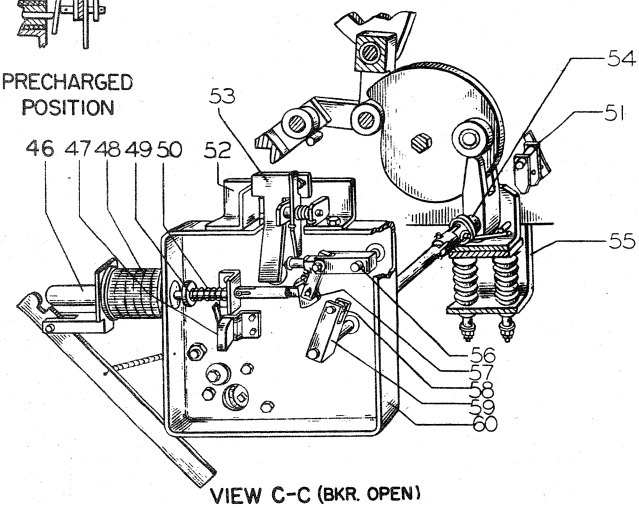


SECTION A-A (BKR. CLOSED)





SECTION B-B



VIEW C-C (BKR. OPEN)

1. Control Panel
2. Heater
3. Coupling
4. Maintenance Bolt Interlock
5. Trip Coil
6. Trip Coil Armature
7. Trip Latch
8. Latch Checking Switch
9. Latch Stop Plate
10. Trip-free Link
11. Trip Latch Roller
12. Intermediate Link
13. Toggle Link
14. Cam Follower Roller
15. Balancing Spring
16. Breaker Operating Rod
17. Output Crank
18. Dashpot Fill Plug
19. Dashpot
20. Cam
21. Cam Prop Roller
22. Mechanism Frame
23. Cam Prop
24. Back Plate
25. Spring Washers
26. Belleville Washers
27. Spring Plate
28. Spring
29. Shaft
30. Pin
31. Coupling
32. Key
33. Jack Screw
34. Control Plunger
35. Sprocket Wheel
36. Spring Cut-out Switch-Front
37. Motor Governor Switch-Rear
38. Latch
39. Paddle Spring
40. Latch Spring
41. Stop Pin
42. Ratchet Pawl
43. Ratchet Spring
44. Motor
45. Manual Spring Cut-out Interlock
46. Closing Release Coil Armature
47. CCX Switch
48. Closing Release Coil
49. Closing Release Coil Plunger
50. Return Spring
51. Prop Interlock
52. Switch Bracket
53. Paddle
54. Cam Prop Return Spring
55. Buffer
56. Lever
57. Closing Release Pawl
58. Roller
59. Cam Prop Lever
60. Motor Support Bracket

Fig. 4 Type ML-10-2 Mechanism

Fig. 4 (0131F0901)

to 1-/8" from the outside of the spring washer to the end of the housing. Adjustment of either the balancing spring or the opening spring will affect the stroke and the other spring, the balancing spring moving about 1/3 of the change of the opening spring.

The alignment of the interrupters and contact rods is made by rocking the bushings and interrupter about the ball joint under the bushing flange. The contact rod should enter the interrupter centrally and should not bind throughout its stroke. Be sure that the bushing flange nuts are equally tight after adjustment has been made.

A slight horizontal adjustment has been provided at the lower end of the contact rod by using a larger hole in the rod at the point where it attaches to the crossarm.

The wipe of the contacts is 3/8"+ 0", - 1/16". This may be adjusted by raising or lowering the contact rods with respect to the crossarm. The lower part of the contact rod and the inner surface of the end of the crossarm is serrated horizontally. This allows vertical adjustment in 1/16" steps.

The six contact rods may be adjusted to produce the same contact wipe. In addition to this they should touch the contact fingers at the same time. Practically, some differences will exist between phases but it should be possible to adjust them to touch within 1/8" of each other.

MECHANISM

The cam prop (23), Fig. 4, is supported by a spring buffer. The buffer consists of forty spring washers inside the "U" bracket and sixteen Belleville washers outside the "U" bracket. The forty washers are arranged in four stacks. Each stack contains five series sets of two washers in parallel. The individual washer is saddle shaped and when it is properly paired to obtain minimum height, the distance between the inner surfaces at the hole is 3/32". The normal stack height under compression is 15/16".

The Belleville washers outside the "U" bracket are stacked as saucers are stacked and thus are in parallel. The castellated nuts are adjusted so that the cam prop roller (21), Fig. 4, bears on the cam prop (23) with central bearing (front view) and with a wipe on the centerline of the prop of ± 1/16" (side view). A small hole in the side mechanism frame permits a view of the prop wipe. The castellated nuts are wired in pairs to prevent loosening during operation. The buffer adjustment is made at the factory and normally need not be changed.

The bolts holding the buffer bracket to the mechanism frame are equipped with locking plates and the bolt threads are coated with #1201 red * Glyptal.

The cam prop interlock (51) which is actuated by the output crank (17) locks the cam prop (23) in position. The clearance between the cam prop and the cam prop interlock should be 1/32" + 1/32" -0".

The wipe of the trip latch (7), Fig. 4, is adjustable by moving the position of the latch plate (9). The wipe should be 1/4" ± 1/16".

The trip latch clearance should be .008" to .020" in the open position. This is adjustable by a change in the shims which hold the yoke in turn holding the trip latch.

There should be about 1/16" clearance between the trip latch plunger extension pin and the face of the latch arm with the trip coil de-energized.

The latch checking switch should operate when the latch resets in order to indicate latch position. The latch checking switch should have 1/16" to 1/8" wipe when the latch is reset.

The 69 Switch is located behind the control panel. This should operate to open its circuit when the manual trip device is operated. It is reset by reaching in the right-hand door of the mechanism house. Slotted holes in the mounting bracket provide adjustment for this switch.

CHARGING AND DISCHARGING THE SPRING

The "T" wrench may be used to charge and discharge the closing spring. It is stored in the bottom of the mechanism house.

The torsion closing spring is suspended between two plates. On the mechanism frame end of the spring, the spring plate (27) supports it and on the motor support end it is supported by the sprocket wheel. The spring is fastened to the two plates as shown in Fig. 6. The sprocket wheel also acts as a ratchet wheel through the action of its ratchet. The "T" wrench fits the square end of the motor shaft which is accessible through a hole in the motor support bracket (60). Clockwise rotation of the wrench charges the spring. Overwinding of the spring is prevented by a stop pin (41) which extends through the sprocket wheel and engages a bolt extension of the motor support bracket. This stop pin is driven by the differential indicator device which acts as a jacking screw to extend the stop pin a distance proportional to the number of turns of the spring. With the spring slightly past the fully wound position, the stop pin should interfere axially approximately 1/4" with the stop bolt. The fully wound position is indicated by a stop clearance of 3/4" ± 1/4" manually. Electrically, the motor drift will close the stop clearance to about 1/2" ± 1/4".

In order to discharge the spring from any wound position it is necessary to gradually relieve the force of the spring. Turn the "T" wrench slightly clockwise and raise the ratchet (42) by depressing the small handle. Allow spring to unwind gradually until its force is completely relieved.

PRECAUTIONS:

1. BE SURE THAT THE MOTOR CIRCUIT IS DE-ENERGIZED BEFORE ATTEMPTING MANUAL WINDING.

2. DO NOT ALLOW THE SPRING TO REVERSE WIND WITHOUT RESTRAINING ITS MOTION WITH THE "T" WRENCH SINCE DAMAGE TO THE DIFFERENTIAL INDICATOR MAY RESULT.

The motor governor switch (37), the spring cut-out switch (36) and the latch for the manual spring cut-out switch (38) are attached to a bracket mounted on the motor support bracket (60). They are all actuated by the differential indicator parts (31) and (33) through the plunger and paddle. The motor of the plunger is parallel and equal to that of the stop pin advancing to the right with rising spring pressure.

The motor governor switch which is normally closed and the spring cut-out switch which is normally open are individually adjustable by means of the small jam nuts holding them in place. The motor governor switch should be adjusted to open its contacts on rising spring pressure when the main torsion spring is wound 2.07 turns or 747°.

This position as given above is indicated by a stop clearance of 3/4" ± 1/4" manually. For convenience the line painted on the spring is parallel to the axis of the spring when the spring is fully wound to its 2.07 turns. This spring when it is completely discharged as it would be laying on a bench would have the ends opposite each other--see Fig. 5. When it is put in the mechanism with the cam rollers (21) on the prop (23) and still completely discharged, it will continue to look like Fig. 5 with the ends in line and 30° below the horizontal. When the spring is fully charged for the first time, the sprocket wheel (35) will turn two complete revolutions plus approximately 4 teeth. Since there are 54 teeth in the sprocket wheel, the spring will have turned 747° approximately and will stop in position (A) as shown in Fig. 7.

When the spring is discharged, the spring plate (27) at the mechanism end rotates 360° and returns to position (B) shown in Fig. 7. From now on when the spring is charged, it will rotate only 360° on the sprocket wheel (35) end and always stop in position (A), Fig. 7. In other words, the spring discharges one turn on the spring plate (27) end and charges one turn on the sprocket wheel (35) end each time the breaker is closed.

The setting of the various control switches are all referenced on the closing spring (28). Fig. 8 shows the sequence in which they operate during a 360° charging operation. First, the stop pin (41) shown in position (D) is withdrawn when the breaker is closed to set up the mechanism for the spring-charging operation. The spring is charged by turning the sprocket wheel one turn clockwise starting at point (A). When the end of the spring reaches point (F) the manual spring cutout interlock (45) engages and when it reaches point (E), the contacts make (36). When the spring end reaches point (C) the power supply to the motor is disconnected by the motor governor switch (37) and the mechanism drifts about 18° to stop at point (A) having traveled 360°. If the sprocket wheel should travel beyond this point for any reason, it would be stopped after moving about 20° by the stop pin (41) at point (D).

The closing release coil auxiliary contact switch (CCX) is located on the motor support bracket. This switch should be set to open its contacts when the gap between the closing release coil armature and its pole piece is .075" for d-c and .100" for a-c.

The auxiliary switch mounted on the mechanism panel provides non-overlapping

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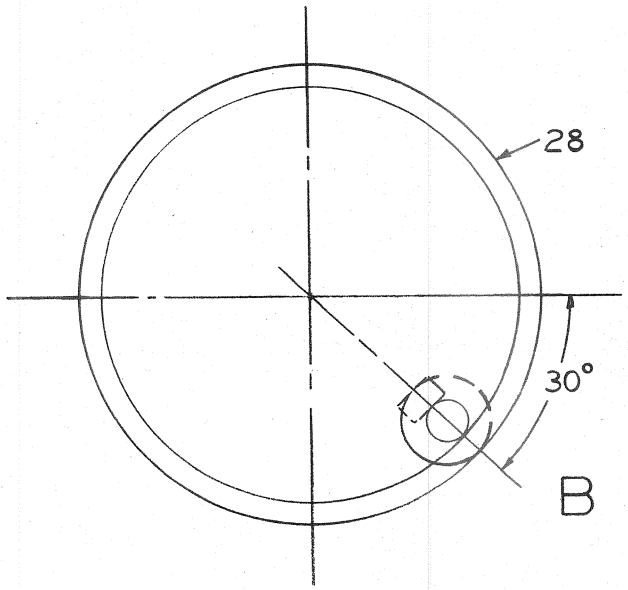


Fig. 5 Spring Completely Discharged (Looking at the End of the Closing Spring from the Motor Support Bracket End)

"a" and "b" switches. The trip circuit contains two "a" switches which break the trip coil current. (Refer to the wiring diagram furnished with the instruction book.) For electrical trip-free operation these switches should make before the main breaker contacts make and are set to close their contacts approximately 1" before the fully closed position.

The opening dashpot located in the rear of the mechanism house is filled with D50H27 oil (Univis #J-43). The fill plug is located in the right side of the dashpot, being exposed by a hole in the right side of the mechanism frame when facing the mechanism. The proper oil level is even with the bottom of the fill hole with the breaker in the closed position.

An adjusting coupling is provided at the top of the dashpot rod. The dashpot is adjusted at the factory for proper operation and should not normally require field adjustment. Changing the engagement of the dashpot rod in the adjusting coupling will change the point on the opening curve at which the dashpotting is effective.

OIL

The specified high-speed performance of the modern oil-blast breaker is dependent upon the use in the breaker of oil having the proper characteristics. It is recommended that G-E #10-C oil be used in these breakers since its characteristics, particularly at low temperatures, make it especially suited for use in oil-blast breakers.

Before final adjustments are made, the oil tank should be filled with G-E #10-C oil. Precautions must be taken to be sure of absolute dryness and cleanliness of the apparatus before filling and to prevent the entrance of water and dirt during the transfer of oil to the apparatus. For more detailed information on equipment and procedure for filtering G-E #10-C oil obtain Bulletin GEH-1180A from the nearest General Electric Sales Office.

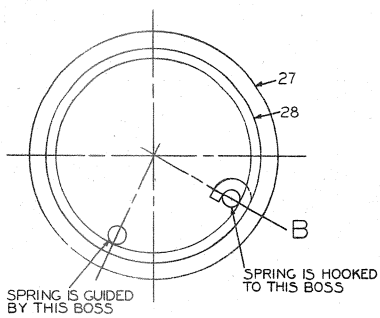
FILLING THE TANK

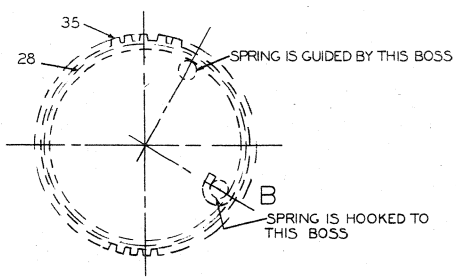
Before filling with oil, all accessories such as the drain valve and oil gage must be oil-tight. The threads should be filled with *Glyptal or equivalent. A plug is furnished for the outlet side of the drain valve and should be used to prevent any leakage if the valve seat becomes damaged from used.

The top of the gage rod for normal oil level at 20°C is 1-3/16" above the lowest portion of the oil gage glass. The range between minimum and maximum is represented by the visible portion of the gage glass and covers a temperature range of 70°C or from +40°C to -30°C. The oil level at any intermediate temperature is represented by a proportionate part of the gage range. It is important that the oil level never falls below the minimum level so that the lower end of the bushing is always immersed in oil above the end of the ground sleeve.

In filling, care must be taken so that moisture will not be absorbed by the oil

Fig. 5 (0138A7637)





The "Spring Plate" end of the Spring

The "Sprocket Wheel" end of the Spring

Fig. 6 (Looking at the End of the Closing Spring from the Motor Support Bracket End)

Fig. 6 (0104B3706)

* Registered Trade-Mark of General Electric Co.

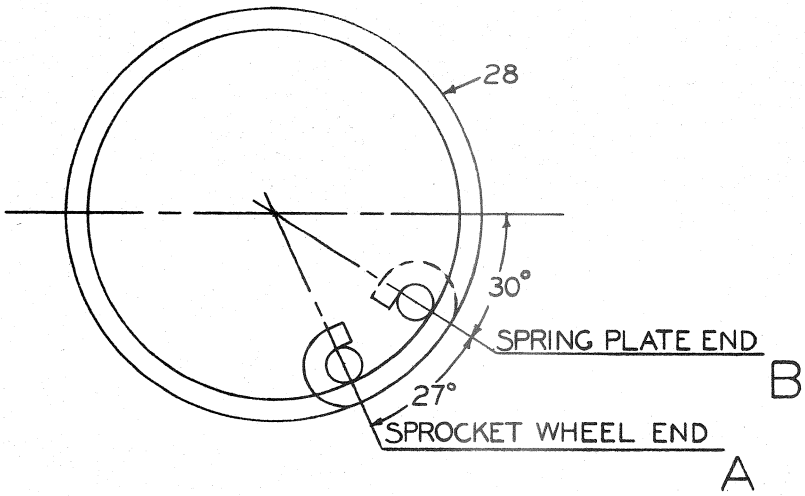


Fig. 7 (0138A7838)

Fig. 7 Looking at the End of the Closing Spring from the Motor Support Bracket End

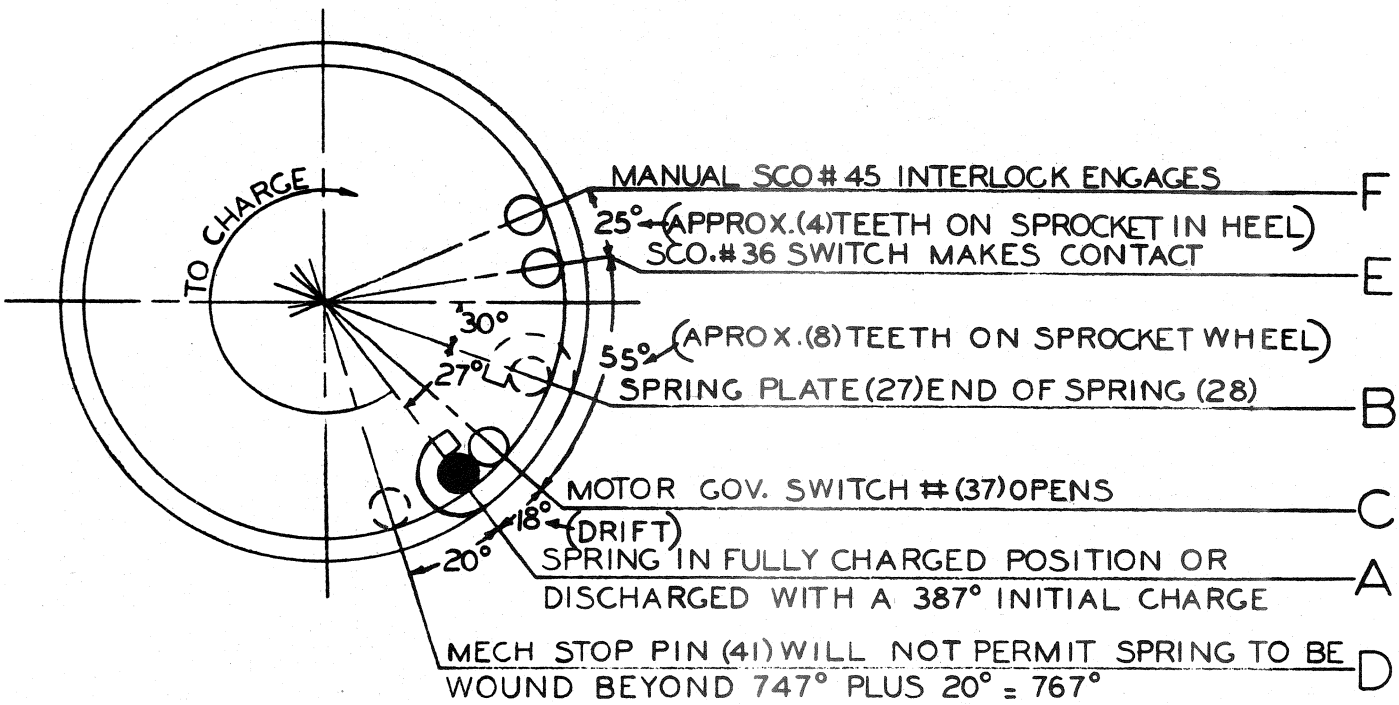


Fig. 8 (0104B3707)

Fig. 8 Looking at the End of the Closing Spring from the Motor Support Bracket End

during the filling process. When cold drums of oil are brought into a warm place they should be allowed to stand before opening until there is no condensation on the outside and until they are thoroughly dry. The preparation and filling should be done on a clear, dry day or adequate protection of some kind provided against moisture being absorbed. Metal or oil-proof rubber hose must be used because oil dissolves the sulphur in ordinary rubber hose. This may cause trouble, as sulphur attacks copper.

TESTING THE OIL

All new oil should be tested before being placed in the breaker. The dielectric strength of the oil when shipped is at least 26,000 volts when tested in a standard gap, with 1" disk terminals 0.1" apart. New oil of less than standard dielectric strength (26,000 volts) should not be placed in the breaker oil tanks until its insulating value has been brought up to the above standard (by filtering, drying, etc.).

SUMMARY OF ADJUSTMENTS

The following summary of adjustments is listed against breaker position and spring position as an aid to checking. Refer to Fig. 9.

Breaker Open	Spring any position, no control power,
BKR. -	Mark the breaker open position.

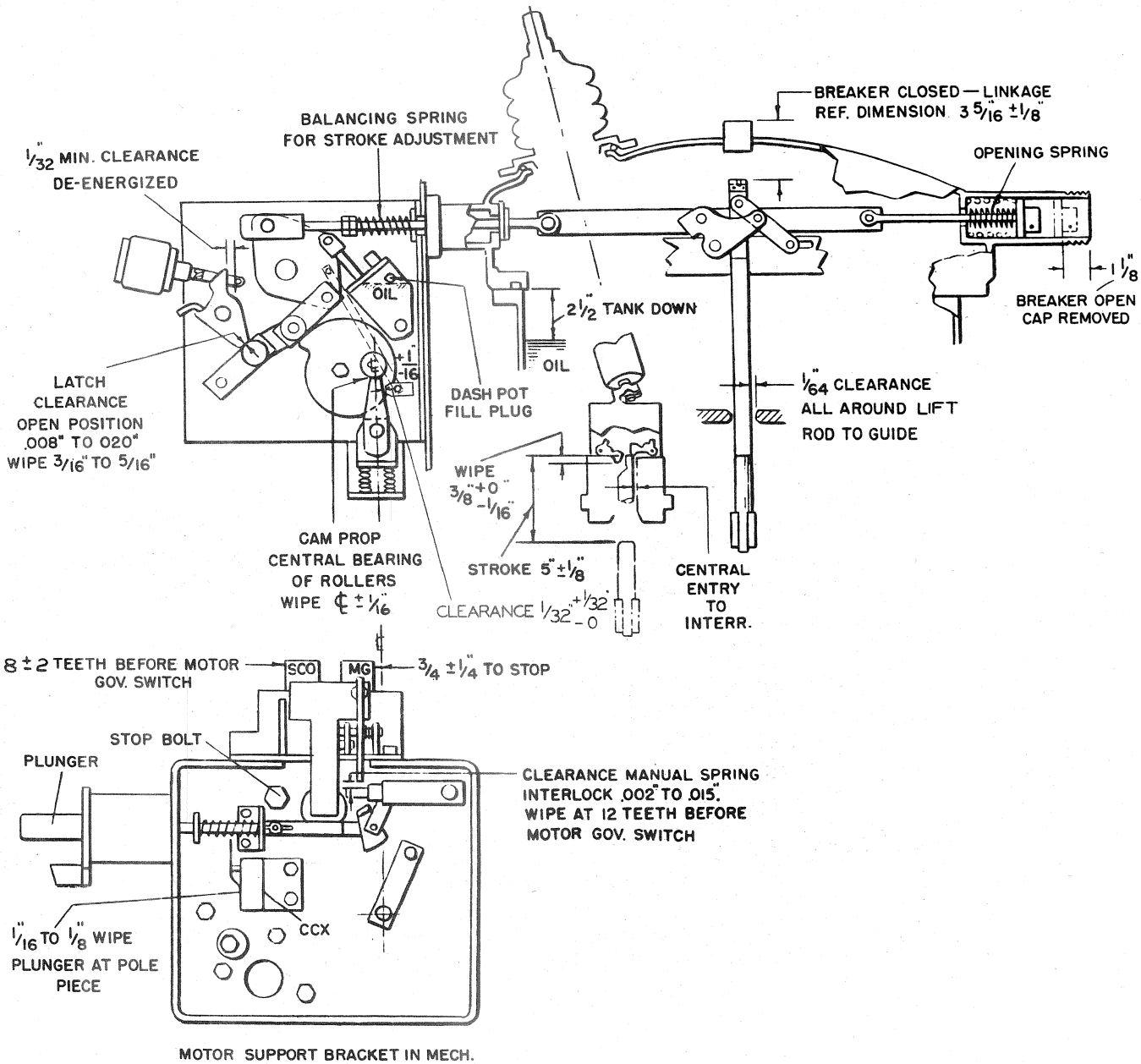


Fig. 9 (0897C0234)

Fig. 9 Adjustments for Type FKD-14.4-100/250/500 Oil-blast Circuit Breaker, 600 and 1200 Amperes

MECH. - The trip latch clearance should be .008" to .020". The trip latch wipe should be 3/16" to 5/16".

MECH. - The latch checking switch should have 1/16" to 1/8" wipe with latch reset.

Breaker Closing (Using maintenance closing bolt)
Spring any position, no control power.

BKR. - The breaker should operate smoothly throughout its stroke.

BKR. - Mark the contact make point.

BKR. - The lift rods should hang in a vertical position with approximately 1/64" clearance between the guide and the rod.

BKR. - The contacts should be centrally aligned with the interrupter.

MECH. - The trip circuit "a" auxiliary switch contacts should make approximately 1" from fully closed position.

Breaker Closed, Spring any position, no control power.

BKR. - The linkage reference dimension should be 3-5/16" ± 1/8".

BKR. - Mark the closed position. From above, the stroke should be 5" ± 1/8" and the wipe should be 3/8" + 0, - 1/16" (Note that the latch is holding the force of the breaker parts, not the maintenance bolt.)

MECH. - The dashpot oil level should be even with the bottom of the fill hole.

Rising spring pressure, spring partially discharged, no control power.

MECH. - The manual spring interlock latch should engage 12 teeth before the motor governor switch opens. Latch clearance .002" to .015".

MECH. - The spring cut-out switch should make its contact eight teeth before the motor governor switch opens.

MECH. - The motor governor switch should open its contacts when the stop clearance is 3/4" ± 1/4" between the stop pin and the manual stop located on the motor support brackets.

Additional adjustments not dependent on breaker or spring position.

MECH. - The CCX switch should have 1/16" to 1/8" wipe with the closing release coil armature against the pole piece.

MECH. - The 69 switch should open its contacts when the manual trip linkage is operated.

MECH. - The maintenance bolt interlock should clear the trip latch in its normal position.

MECH. - The trip coil plunger should clear the trip latch by 1/32" minimum with the latch reset.

MECH. - The cam prop rollers should have central bearing and rest on the centerline of the cam prop with ± 1/16" tolerance.

MECH. - The cam prop interlock should clear the cam prop by 1/32" + 1/32" -0.

Operation Adjustments. (Discussed under OPERATION.)

a. The no-load opening speed should be 6 feet to 8 feet per second.
b. The closing time should be a maximum of fifteen cycles.
c. The reclosing time should be approximately 16 to 20 cycles.
d. The contact parting time should be less than 2.5 cycles except where current tripping devices are used. In this case, the contact parting time will be delayed by the time required by the operation of the current tripping device.

BUSHINGS

The bushings are installed from above the top frame. The gasket is installed between the support flange and the top frame. The interrupters are aligned by adjustment of the bushing on a spherical seat. After this adjustment has been made be sure that the bushing nuts are tightened evenly.

A bushing can be removed without disturbing the bushing current transformer. To remove the bushing, first remove the four bolts holding the lift rod guide, and drop the guide down on top of the crossarm. The interrupter can now be removed by loosening the clamping bolt and unscrewing it from the bushing. Remove the three bushing nuts and the bushing will be free to be removed.

The bushing can be disassembled after pouring out the oil, by unscrewing the bushing cap with a Stillson wrench. See Fig. 2. To reassemble the bushing, the following procedure should be followed:

1. Put the new gaskets on each side of the porcelain before placing it in position on the support casting. The porcelain gasket surfaces and the gaskets (6) and (10) should be dry.
2. Position the tapped hole in the Belleville washer in line with the cutout in the upper gasket (6).
3. Be sure the "O" ring gasket (4) is in place in the cap (1) and apply grease to the gasket.
4. Screw the cap down on the Belleville washer making sure parts are centered as well as possible. Tighten the cap with a strap wrench or Stillson wrench until the Belleville washer is flat and the gasket is compressed.
5. Fill the bushing with 10C oil through the fill hole to approximately 3/8" above the top of the *Herkolite. (This assumes the bushing is in a vertical position.)
6. Replace the 1/4 - 20 x 1/4" long round-head screw and the sealing washer in the oil filling hole.
7. If the bushing is assembled on an angle in the breaker, the fill hole will normally appear on the lowest side. The oil level at this point may be slightly more than 3/8" above the *Herkolite due to the tilting angle.

BUSHING CURRENT TRANSFORMERS

The bushing current transformers are mounted on the inside of the top frame and are installed from underneath the top frame. The bushing current transformer leads are brought through an oil seal into the mechanism house. In order to remove a bushing current transformer it is necessary to remove the interrupter from the bushing. With the leads disconnected and the interrupter removed, the bushing current transformer support plate can be removed and the transformer slipped down over the lower end of the bushing.

FINAL INSPECTION

After the breaker has been installed with all mechanical and electrical connections completed, the following inspections and tests should be made:

1. See that the breaker is properly set up and leveled on its foundation.
2. See that all nuts, washers, bolts, cotter pins and terminal connections are in place and tightened. The gland nuts on all valves and oil gages should be checked to see that they are sufficiently tight to prevent leakage. In tightening the gland nuts, precautions should be taken to prevent damaging the packing through excessive pressure.
3. Inspect all insulated wiring to see that it has sustained no damage during installation and test it for possible grounds or short circuits.
4. See that all bearing surfaces of the operating and breaker mechanisms have been lubricated.
5. See that the tank is filled with oil to the proper level.
6. Make certain that the dashpot is filled to the proper level.
7. Make certain that the installation adjustments and operating adjustments have been thoroughly checked.
8. See that all covers and bolted connections are securely tightened and that all pipe plugs are properly installed and tightened to prevent the entrance of moisture.
9. Operate the breaker manually to check for binding, excessive play, etc. and electrically for performance.
10. Recheck the dielectric strength of the oil after no-load operations are complete.
11. See that all points where the surface of the paint has been damaged during installation are repainted immediately.

* Registered Trade-Mark of General Electric Co.

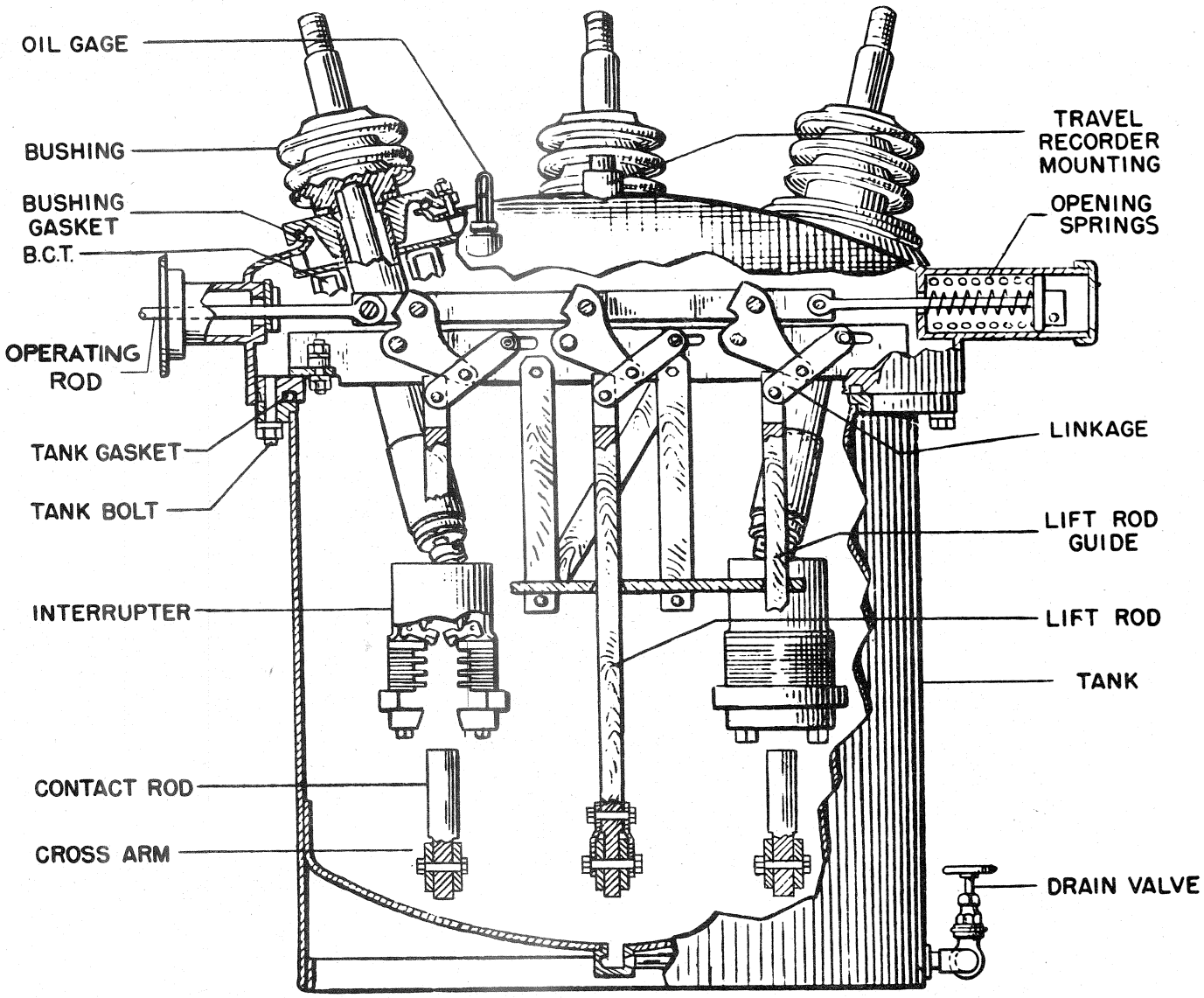


Fig. 10 (0697C0236)

Fig. 10 Linkage and Contacts

OPERATION

SPRING OPERATED MECHANISM

CLOSING

Consider the mechanism with the main spring fully wound and the control power available. See Fig. 4.

When the closing release coil (48) is energized through the closing control switch, the closing release armature and plunger (46) and (49) push the closing release pawl (57) against a roller extension on the cam prop lever (59). The pawl escapes beyond the cam prop lever after giving it a small angular displacement.

The main torsion spring (28) is retained at the right end by the sprocket wheel (35) and at the left end by the spring plate (27). The spring plate is coupled directly to the cam (20) so that the force of the spring is taken by the cam prop rollers on the cam prop. The cam prop is supported by a spring buffer (55).

The cam prop lever is coupled to the cam prop (23) through a universal type coupling. As the cam prop lever (59), and hence the cam prop, receives the

momentary angular displacement, the cam prop rollers (21) escape from the cam prop (23) under force of the torsion spring (28), rotate with the cam (20) and return to their normal position on top of the cam prop, which has returned to its normal vertical position through the action of the cam prop return spring. The rotation of the main cam is 360°. During this rotation the cam follower roller is lifted away from the cam center and forces the bottom of the output crank (17) backward, since the trip latch roller (11) is held in position by the trip latch (7). When the bottom of the output crank is forced backward it pulls forward on the coupling which attaches to the breaker operating rod. This motion is transmitted through the breaker linkage to close the contacts inside the interrupters. The pin attaching the output crank (17) to the coupling (3) carries the levers to operate the SB-1 auxiliary switch, the position indicator, and the operation counter. Another pin in the output crank operates the cam prop interlock (51) which prevents the cam prop (23) from moving unless the breaker is in the open position.

The closed position of the breaker is reached when the cam prop rollers rest on top of the cam prop. The additional energy supplied by the spring over and above that required by the breaker is absorbed by the spring buffer. No overtravel of the breaker contacts is required by the mechanism to close since the cam in the closed position serves as a prop.

RECHARGING THE SPRING

Inside the spring (28) is a differential indicating device which relates the angular relation of the main torsion spring. The spring is wound 2.07 turns or 747° when fully wound. In closing, the spring discharges 360° down to 387° or 1.07 turns. This is the precharged position. The action of the differential indicator device and the motor governor switch is to restore the spring to its fully wound position. In this fully wound position the mechanical stop (41) projects through the sprocket wheel (35) and prevents overwinding of the main torsion spring.

In parallel with the stop pin (41), the control plunger (34) extends through the sprocket shaft and actuates the motor governor switch (37) and the spring cut-out switch (36). When the main cam rotates to close the breaker, the coupling (31) turns with it withdrawing the jack screw (33) which withdraws the stop pin and allows the control plunger to be withdrawn through the action of the intermediate lever return spring. When the control plunger (34) is withdrawn, the motor switch contacts close and the motor winds the sprocket (and spring) in the same direction in which the cam turned. As the sprocket turns, the coupling is held and the jack screw extends itself until the control plunger actuates the motor governor switch at which point the spring is again fully wound.

This control feature allows the spring to be fully wound from its completely discharged position by applying the proper motor voltage.

TRIPPING

The energy stored in the contact finger springs and the opening springs during each closing operation is used to accelerate the parts on opening. When the trip coil is energized through a protective device, the trip latch rotates counterclockwise and allows the linkage to collapse. The cam follower roller slips around the front of the cam and the holding force on the breaker operating rod is released. This allows movement toward the open position and tripping is accomplished.

TRIP-FREE OPERATION

The spring-charged mechanism linkage is both mechanically and electrically trip-free.

RECLOSING

A breaker is normally operated in the closed position. From this position one high speed reclosing operation is possible since the spring contains sufficient energy for one closing operation. Subsequent reclosing operations depend upon the spring winding time which is 3 to 5 seconds, depending upon the available control voltage at the time. Following tripping, the latch checking switch indicates that the linkage is recoupled and thus controls the release of the closing mechanism. Normal high speed reclosing time is 15 to 20 cycles.

ANTI-PUMP

This mechanism is provided with anti-pump protection by the use of a seal-in resistor. The seal-in resistor is inserted by the operation of the closing release coil switch (CCX) which will remain in the operative position as long as an operator holds the control switch. Under this condition the closing release coil cannot be de-energized and, therefore, cannot be re-energized to cause pumping.

The seal-in circuit is not designed for continuous service. Operation of the seal-in circuit for periods in excess of five minutes may result in damage to the closing release coil and the seal-in resistor.

BREAKER LINKAGE AND INTERRUPTERS

CLOSING

The breaker contacts consist of a set of stationary fingers and a moving contact. The breaker linkage raises and lowers the moving contacts in a straight (vertical) line. The moving contacts are raised to the closed position by the operating mechanism and held there by the prop and latches in the mechanism. When the latch is released in the mechanism the contact finger springs accelerate the moving contact downward toward the open position. The amount of travel, 5" ± 1/8", is known as the stroke.

The motion of the parts is as follows:

Refer to Fig. 10. To close the breaker the operating rod is pulled to the left. This rotates the breaker linkage and lifts the operating rods. The insulated rod carries the crossarm which carries the moving contact rods. The moving contacts enter the interrupter chamber (the chamber is oriented with the vertical centerline of the breaker and the contacts are adjusted for central entry) and raise the contact fingers 3/8", stopping in this position which is referred to as the closed position. In raising the contact fingers the 3/8" (wipe) the contact finger springs are compressed. These springs decelerate the moving contacts at the end of the closing stroke.

TRIPPING

When the breaker opens under load, the contacts part drawing arcs between the tip of the contact fingers and the moving contact. The pressure generated by the arc forces oil through the port openings in the baffle stack. The flow of oil coupled with the configuration of the baffle stack, produces interruption. The opening dashpot in the operating mechanism limits the opening speed of the breaker contacts and absorbs the energy at the end of the breaker stroke.

The opening dashpot is so designed that additional opening distance is available to decelerate the higher speeds associated with interrupting high currents. This travel will be in excess of the 5" set dimension but the final open position should be 5". No-load operation will not produce more than 1/4" overtravel on opening.

CURRENT TRIP ATTACHMENT

The Type ML-10 operating mechanism may be equipped with a current trip attachment in addition to or in place of the potential trip. Refer to Instruction Book GEI-9340 on Impact Trip Mechanism.

SPEED MEASUREMENT

After completing the preceding installation, adjustments and inspection and after filling the tanks with oil, the breaker may be operated electrically to check the no-load performance. A travel analyzer may be used to obtain this information. A #10-32 tapped hole is located in the center of the block on top of the lift rod for phase #2. Access to the tapped hole is through the hole in the center of the dome.

The opening speed is determined by drawing a straight line through two points on the travel curve. See Fig. 12. One point is located on the opening curve 3/8" from fully closed. This is the point at which the contacts part. The second point is located on the opening curve 2-3/8" from the fully closed position (measured vertically). The slope of the line is an indication of the opening speed which should be 6 to 8 feet per second.

If it is found that the opening speed is not within the specified limits, recheck the contact wipe. The contact finger springs accelerate the contact rods on opening and a variation in the amount of wipe would affect the no-load speed.

The closing speed is determined by the mechanism and is not adjustable.

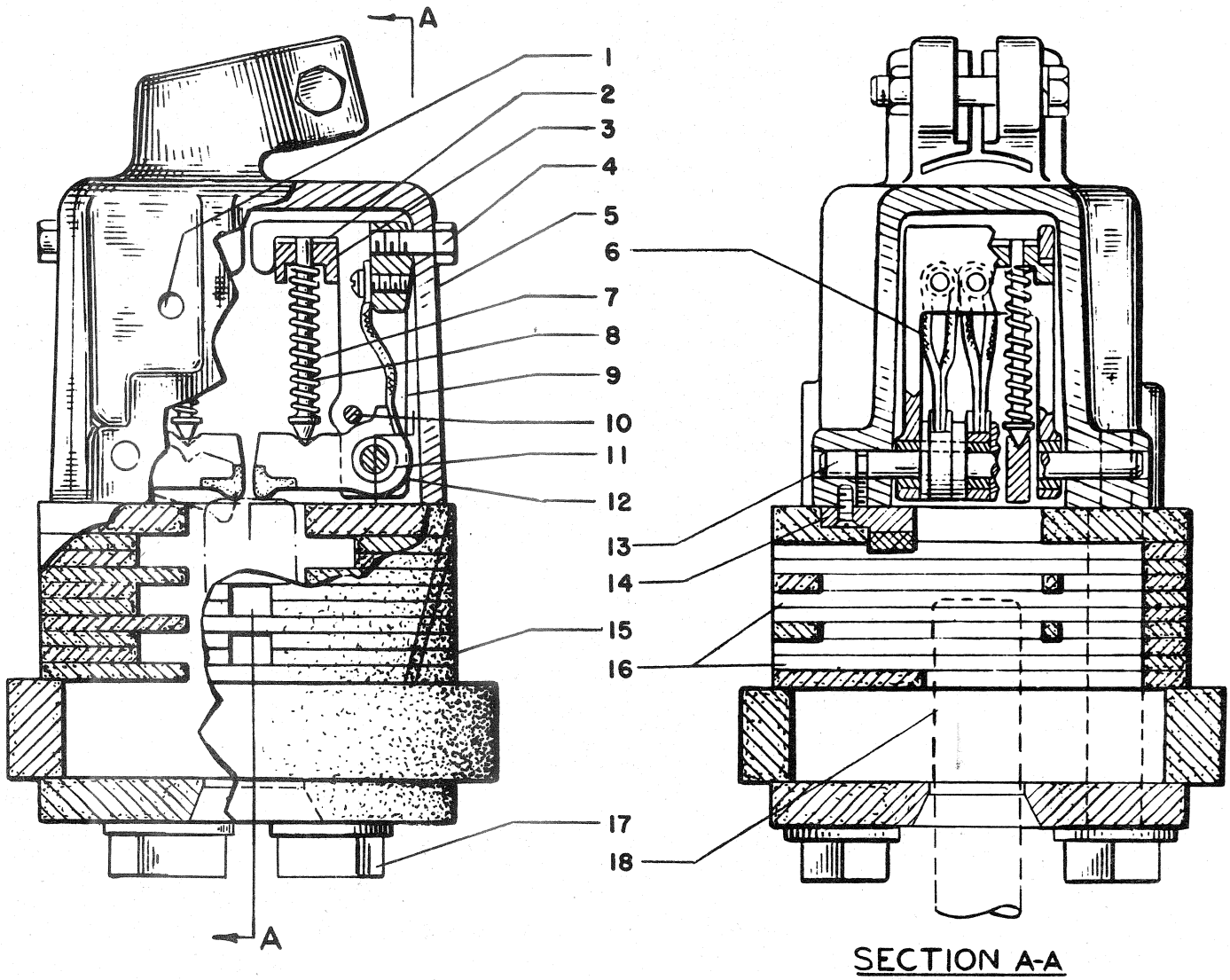
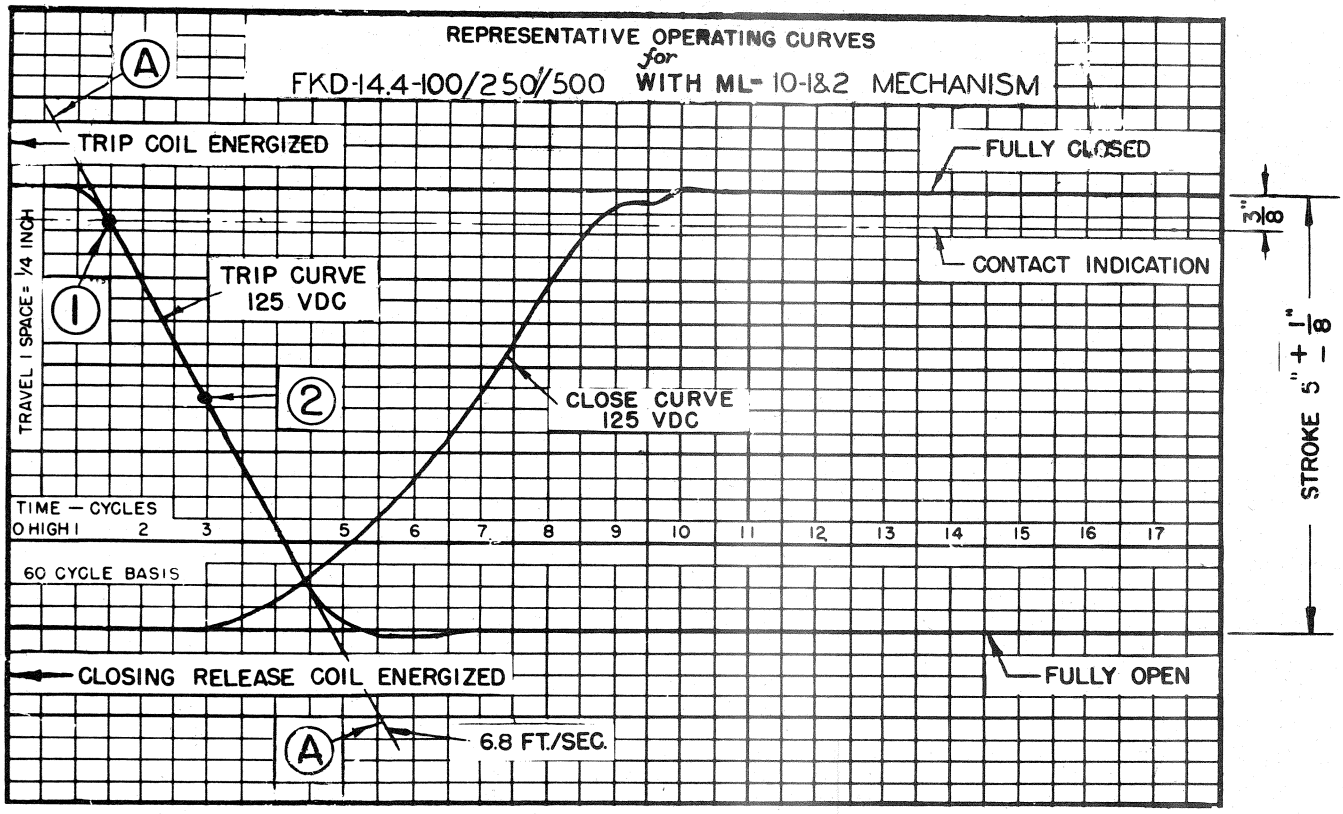


Fig. 11 (0897C0239)

1. Vent Hole
2. Insulation
3. Guide Block
4. Screw
5. Adapter
6. Contact Finger Braid
7. Spring
8. Spring Guide
9. Yoke
10. Stop Pin
11. Sleeve
12. Contact Finger
13. Hinge Pin
14. Arcing Plate
15. Baffle Stack
16. Port Baffles
17. Insulated Bolt
18. Contact Rod

Fig. 11 Oil-blast Interrupter



OPERATING SPEED RANGE
A - 6 TO 8 FT./SEC. (LINE DRAWN THROUGH POINTS 1 AND 2)
1 - ON CURVE 3/8" FROM FULLY CLOSED
2 - ON CURVE 2 3/8" " " "

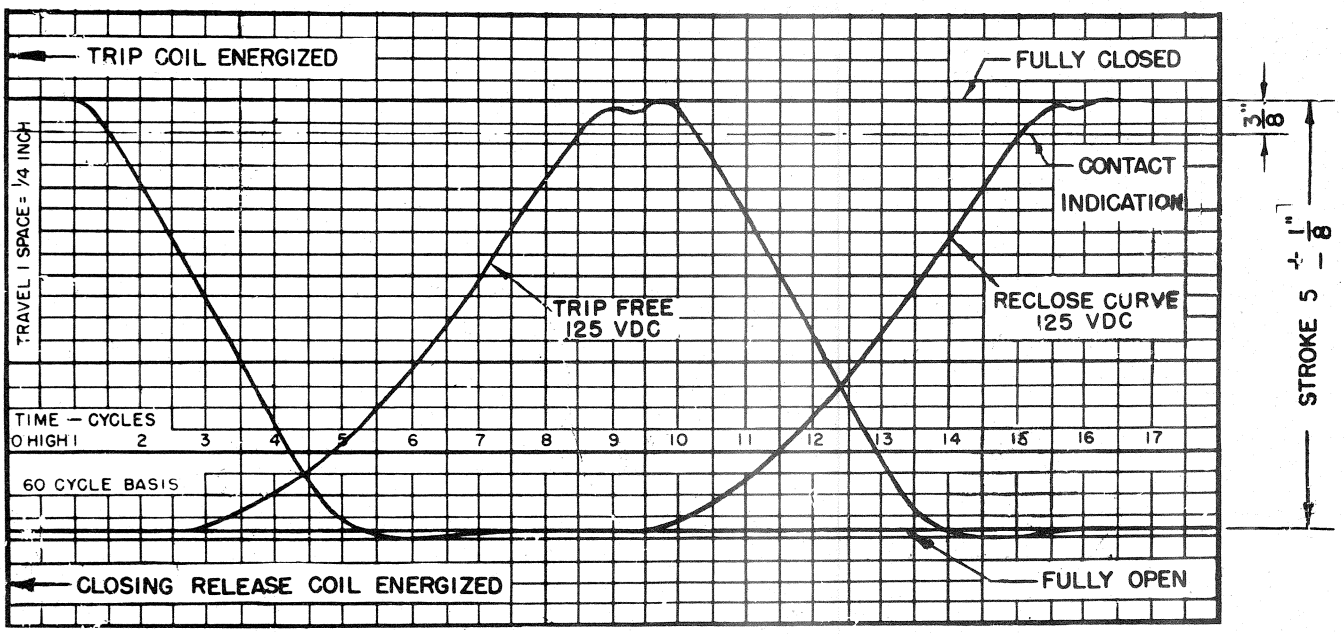


Fig. 12 (112HA752)

Fig. 12 Representative Travel Curves

MAINTENANCE

The safe and successful functioning of connected apparatus depends upon proper and reliable operation of the oil circuit breaker. For greater reliability the oil circuit breaker must have regular systematic inspections during which every part is looked over carefully. The frequency of the inspections should be determined by each operating company on the basis of the number of operations (including switching), the magnitude of the current interrupted and any unusual operations which might occur. Operating experience will establish a maintenance schedule which will give an assurance of proper breaker condition. The following paragraphs list the main points to be included in an inspection and a number of general recommendations.

PRECAUTIONS

1. Be sure the breaker and its mechanism are disconnected from all electric power, both high voltage and operating, before inspecting or repairing. After the breaker has been disconnected from power lines, grounding leads should be properly attached before coming in contact with any of the breaker parts.
2. Be sure the breaker framework is well grounded.
3. Use the maintenance closing device to assist in making adjustments. This is the primary purpose of the device because it permits slow closing and opening. It must not be used for closing the breaker on load.

PERIODIC INSPECTION

1. The contacts should be checked. See that they are aligned and that contact surfaces bear with firm uniform pressure. Replace badly pitted or burned contacts before they are burned away sufficiently to cause damage to other parts of the apparatus. If the silver alloy contact surfaces are only roughened they may be smoothed down with a fine file.
2. The oil should be checked. Oil in service should be tested at frequent intervals. Three month periods are recommended. If the dielectric strength of the oil tests less than 16,500 volts it should be filtered.

   When sampling oil the sample container should be a large-mouthed glass bottle. The bottle should be cleaned and dried with benzine and free from moisture before it is used. The sample of oil should be at least one pint. Test samples should be taken only after the oil has settled for some time. Samples should be taken from the valves at the bottom of the tank and sufficient oil drawn off to make sure the sample represents oil from the tank proper and not that stored in the drain pipe. A glass receptacle is desirable so that if water is present it may be readily observed. If water is found, an investigation of the cause should be made and a remedy applied. Excessive water is indicative of leakage somewhere in the breaker structure.
3. All insulating parts should be thoroughly cleaned to remove all traces of carbon which may remain after the oil has been drained from the tank. It is recommended that the oil be removed and the tank cleaned at regular intervals because filtering of the oil does not remove the carbon which adheres to the sides of the tank.
4. The operating and breaker mechanisms should be thoroughly checked. All bearing surfaces should be lubricated.
5. The dashpot piston should be examined to see that it works freely so that the dashpot functions properly.
6. All bolts, nuts, washers, cotter pins and terminal connections should be in place and properly tightened. The gland nuts on all valves and oil gages should be checked to see that they are sufficiently tight to prevent leakage. In tightening the gland nuts, precautions should be taken to prevent damaging the packing through excessive pressure.
7. Operate the breaker slowly by hand, (maintenance device) and check the points listed under SUMMARY OF ADJUSTMENTS.
8. Operate the breaker electrically and check the points listed under SUMMARY OF ADJUSTMENTS.
9. Inspect the bushing supports as the vibration due to the operation of the breaker may cause the bushing to move slightly and result in misalignment of contacts.
10. Clean the bushings at regular intervals where abnormal conditions prevail such as salt deposits, cement dust or acid fumes, to avoid flashover as a result of accumulation of foreign substances on their surfaces.
11. The oil in the bushings may be checked for level. Remove the plug in the oil fill hole on the bushing cap and stick a "dip stick" in the hole until it bottoms. It should now show approximately 3/8" of oil when the bushing is in a vertical position.
12. See that the oil is at the proper level in the tank.
13. After making any adjustments operate apparatus by hand before attempting electrical operation.
14. Installation and maintenance will generally result in damage to the surface of the paint and corrosion will result at these points. All such places should be repainted immediately.

REPAIR AND REPLACEMENT

If it should be necessary to replace a bushing current transformer, care must be taken to see that the end of the transformer carrying a white polarity mark is placed upwards. Performance data in the form of excitation and ratio curves are available for all transformers on the standard ratios. These are supplied with the order or can be secured from the Switchgear Department by giving the proper references. For more detailed information refer to Instruction Book, GEH-2020.

INTERRUPTERS

The surfaces of the moving contacts are plainly visible with the breaker open and the tank lowered. The condition of the moving contacts is a good indication of the condition of the contact fingers. Refer to Fig. 11. By removing the four insulated bolts and lowering the baffle stack, the contact fingers may be seen. Each baffle stack is marked by a painted "V" so that proper relation of the baffles may be maintained during assembly.

If it is found by inspection that the fingers are badly eroded, they should be replaced.

To disassemble the fingers:

1. Remove the baffle stack.
2. Remove the two 3/8" bolts in the ends of the adapter (attached to the bushing).
3. Remove one #8 set screw from below each hinge pin.
4. Remove hinge pin. The finger assembly is free to be removed.

To remove the fingers from the finger assembly:

5. Compress the fingers slightly in a vise and remove the 3/16" diameter stop pin.
6. Release the vise.
7. Snap out the springs and spring guide from the fingers.
8. Remove the sleeve. Note that the 1/8" washers are between the fingers and the 3/32" washers are beside the fingers.
9. Unscrew the fingers and replace. Be sure the braid is pulled down so that the screw is in the center of the eye.
10. Reassemble in the reverse order. Make sure the fingers work freely.
11. A torque of from 8 to 12 ft-lbs. should be applied to the insulating bolts to prevent cracking at assembly.
12. In replacing the two 3/8" bolts in the adapter tighten slightly more than snug. Avoid overtightening.

In addition to the fingers, each interrupter employs an arcing plate which aids in transferring the arc to the port opening. These arcing plates may be used until the arc resistant material is eroded about 75%. When replacing the arcing plate be sure to prick punch the material at the slot of the countersunk screw to prevent loosening.

GASKETS

Prepare gaskets and gasket surfaces (for cork, vellumoid and similar material) as follows:

All gasket surfaces shall be thoroughly cleaned to remove all oil, grease, or foreign material which will prevent proper adhesion of the gaskets, or sealing of the joints. They shall be allowed to become thoroughly dry before proceeding with treatment.

All surfaces to which gaskets are to be permanently assembled shall be given a full unbroken coat of G-E #1201 compound. All gaskets (except rubber gaskets) for such joints shall be given a similar coat. This shall be done at such time in the assembly cycle that the compound will be allowed to dry at least one half hour before final assembly. A longer time up to 24 hours is not detrimental. In making up permanent joints both the gaskets and gasket surfaces are again coated with G-E #1201 compound and the parts bolted before the compound sets.

For joints such as covers, manholes, or places where the joint has to be opened do not coat the gasket surface of the removable part or install this part until the compound on the gasket is perfectly dry. The side of the gasket to be assembled against the uncoated surfaces can be greased to prevent sticking.

RENEWAL PARTS

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

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

When ordering renewal parts, address the nearest Sales Office of the General Electric Company giving the complete data shown on the breaker nameplate, such as the serial number, type and rating of the breaker. The breaker namplate is mounted on the inside of the front door of the operating mechanism compartment. Also furnish a complete description of each part, the quantity required, and, if possible, the number of the requisition on which the breaker was originally furnished.

A recommended list of renewal parts follows.

FIG. NO.		REF. NO.	CATALOG NO. FOR MODEL FK-14.4-3	QUAN. PER BKR.	DESCRIPTION
*	1	1	See Fig. 2	6	Bushing Complete
*	1	3	182V292	6	Gasket for Bushing Support
	1	5	#	#	Bushing Current Transformer
*	1	8	182V835 P-5	1	Gasket for Oil Tank
	+		0103A6521 P-2	1	Tank Liner
	1	11, 12, 15	0809B0326 G-2	2	Moving Contact Asm. End Phase 600 & 1200 Amp 100/250
	1	11, 12, 15	0809B0326 G-1	1	Moving Contact Asm. Middle Phase 600 & 1200 Amp 100/250
	1	11, 12, 15	0809B0326 G-4	2	Moving Contact Asm. End Phase 600 & 1200 Amp 500
	1	11, 12, 15	0809B0326 G-3	1	Moving Contact Asm. Middle Phase 600 & 1200 Amp 500
*	1	+11	0103A3850 G-1	6	Contact Rod & Tip-600 Amp & 1200 Amp
*	1	15	0103A1180 P-1	3	Lift Rod-100/250
*	1	15	0103A1180 P-3	3	Lift Rod - 500
*	1	13	397A963 P-16	1	Gasket for Stop Bolt
	1	14	0109B1638 G-1	1	Oil Gage Complete
	1	14A	0103A6161 P-1	1	Glass for Oil Gage - Glass Top
	1	16	0109B1601 G-2	1	Lift Rod Guide Asm. 100/250
	1	16	0109B1601 G-1	1	Lift Rod Guide Asm. 500
+	1	18	6001070 P-1	1	Drain Valve
+	1	19	178V727	1	Glass for Indicator (Mech. House)
+	1	20	6508341 P-11	1	Maintenance Device Cover (Mech. House)
*	2		0991C0923 G-1	6	Bushing Complete 13-1/2" Creep
*	2		0991C0923 G-3	6	Bushing Complete 18" Creep
	2	4	6477428 P-84	6	Gasket for Bushing Cap
	2	6, 10	178V103 P-1	12	Gasket for Porcelain
	2	8	268B696 P-1	6	Porcelain Shell 13" Creep
	2	8	268B696 P-3	6	Porcelain Shell 18" Creep
	2	2	181V269 P-1	6	Gasket for Oil Fill Hole
*	4	2	0103A2049 P-2	1	Heater - 115v a-c
*	4	2	0103A2049 P-1	1	Heater - 230v a-c
*	4	5	See Table I, Pg. 18	1	Potential Trip Coil
*	4	8	179V585 P-1	1	Latch Checking Switch (LC)
*	4	11	183V714	1	Trip Latch Roller
	4	14	183V714	1	Cam Follower Roller
*	4	19B	6477428 P-1	1	Gasket for Dashpot Piston Rod
*	4	19B	6477428 P-10	1	Gasket for Dashpot Cylinder

\# Give Complete B.C.T. Nameplate Data

\+ Not Illustrated

* Recommended for Normal Maintenance

FIG. NO.	REF. NO.	CATALOG NO. FOR MODEL FK-14.4-3	QUAN. PER BKR.	DESCRIPTION
4	20	286B416 G-2	1	Cam
4	20A	0178L0789 G-1	1	Cam-Including Rollers (Ref. 21)
4	28	454A196	1	Spring
4	31	0178L0789 G-2	1	Coupling Incl. Ref. 32
4	33	428A866 G-1	1	Jack Screw
4	35	428A908 G-1	1	Sprocket Wheel
* 4	36	0103A6991 G-1	1	Spring Cut-out Switch (SCO)
* 4	37	0103A6828 P-2	1	Motor Governor Switch (44)
4	44	See Table 4	1	Motor
* 4	47	179V585 P-1	1	CCX Switch (Same as Ref. 8)
* 4	48	See Table 2	1	Closing Release Coil
4	+ 61	See Table 3	1	Seal-in Resistor for Closing Rel. Coil
4	55	286B816 G-2	1	Buffer & Prop. Asm. Comp. Incl. Refs. 23, 25, 26, 59
* 4	+62	6174599 G-2	3	Current Trip Coil - 3 Amp. (As Required)
* 4	+63	6174599 G-8	3	Current Trip Coil - 5 Amp. (As Required)
4	+64	0842C0571 G-2	1	Capacitor Trip Device
1, 11	10	0104B3705 G-1	6	Interrupter Complete - 600 Amp 100/250 MVA
1, 11	10	0104B3705 G-2	6	Interrupter Complete - 1200 Amp 100/250 MVA
1, 11	10	0104B3705 G-3	6	Interrupter Complete - 600 Amp 500 MVA
1, 11	10	0104B3705 G-4	6	Interrupter Complete - 1200 Amp 500 MVA
11	2	0103A3852 P-1	12	Insulation
11	3	0103A3853 P-1	12	Guide Block
11	7	454A589	36	Spring
11	8	183V314	36	Spring Guide
11	9	0808B0678 P-1	12	Yoke - 600 Amp
11	9	0808B0678 P-2	12	Yoke - 1200 Amp
11	10	183V318	12	Stop Pin
11	11	183V313	12	Sleeve
* 11	12	296B387 G-1	36	Contact Finger
11	13	0103A3855 P-1	12	Hinge Pin
* 11	14	428A926 G-1	6	Arcing Plate
11	15	0104B3705 G-7	6	Baffle Stack - 100/250 MVA (Incl. Ref. 17)
11	15	0104B3705 G-8	6	Baffle Stack - 500 MVA (Incl. Ref. 17)
11	17	399A447 G-1	24	Insulated Bolt
* 11	+ 19	0104B3705 G-10	12	Yoke & Contacts (Incl. Refs. 2, 3, 7, 8, 9, 10, 11, 12 - 600 Amp)
* 11	+ 19	0104B3705 G-11	12	Yoke & Contacts (Incl. Refs. 2, 3, 7, 8, 9, 10, 11, 12 - 1200 Amp)

\+ Not Illustrated

* Recommended for Normal Maintenance

Voltage Rating	TABLE #1 Potential Trip Coil Ref. #5	TABLE #2 Closing Release Coil Ref. #48	TABLE #3 Seal-in Resistor	TABLE #4 Motor Ref. #44
24 D-C	6174582 G-27	6174582 G-27	235L434 G-12	----------
48 D-C	6174582 G-32	6174582 G-39	235L434 G-11	268B673 P-3
125 D-C	6174582 G-22	6174582 G-22	235L434 G-15	268B673 P-2
250 D-C	6174582 G-2	6174582 G-2	235L434 G-10	268B673 P-1
115 A-C	6174582 G-27	366A764 G-1	0103A5114 P-2	268B673 P-2
230 A-C	6174582 G-32	6174582 G-10	0103A5114 P-1	268B673 P-1

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