INSTRUCTIONS AND RECOMMENDED PARTS FOR MAINTENANCE

GEK 39671C
Supersedes GEK-39671B

POWER/VAC* VACUUM CIRCUIT BREAKER WITH ML-17 MECHANISM

Types: □

VB-4.16-250-1200A-58-1
VB-4.16-250-1200A-78-1 Δ
VB-4.16-250-2000A-58-1
VB-4.16-250-2000A-78-1 Δ

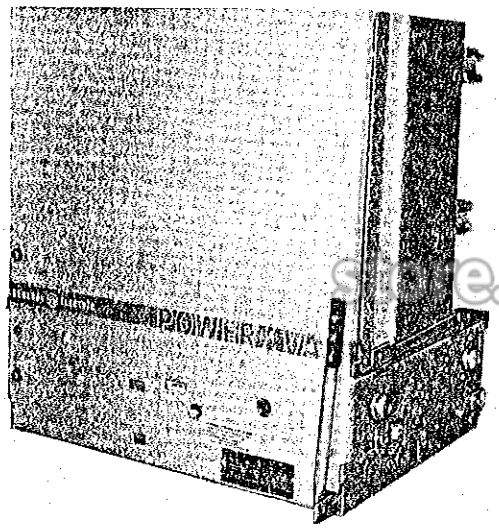
VB-4.16-350-1200A-78-1
VB-4.16-350-2000A-78-1
VB-4.16-350-3000A-78-1

VB-7.2-500-1200A-66-1
VB-7.2-500-1200A-78-1
VB-7.2-500-2000A-66-1
VB-7.2-500-2000A-78-1

VB-13.8-500-1200A-37-1
VB-13.8-500-1200A-58-1 Δ
VB-13.8-500-2000A-37-1
VB-13.8-500-2000A-58-1 Δ

VB-13.8-750-1200A-58-1
VB-13.8-750-1200A-77-1 Δ
VB-13.8-750-2000A-58-1
VB-13.8-750-2000A-77-1 Δ

VB-13.8-1000-1200A-77-1
VB-13.8-1000-2000A-77-1
VB-13.8-1000-3000A-77-1



Type Designation Means

□ Vacuum Breaker – Nominal Voltage – Nominal MVA – Continuous Current – Close and Latch Kiloamperes

Δ Non Standard High Close and Latch Ratings.

GENERAL ELECTRIC

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Cover (8918431J)

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POWER/VAC* VACUUM CIRCUIT BREAKER WITH ML-17 MECHANISM

TYPES VB-4.16-250, -350
VB-7.2-500
VB-13.8-500, -750, -1000

INTRODUCTION

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

SAFETY

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

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

GENERAL

1. All personnel associated with installation, operation and maintenance of power circuit breakers should be thoroughly instructed and supervised regarding power equipment in general and, also, the particular model of equipment with which they are working. Instruction books and service advices should be closely studied and followed.

2. Maintenance programs must be well planned and carried out consistent with both customer experience and manufacturer's recommendations including service advices and instruction books. Good maintenance is essential to breaker reliability and safety.

Local environment and breaker application must be considered in such programs, including such variables as ambient temperatures, actual continuous current, number of operations, type of interrupting duty, and any unusual local condition such as corrosive atmosphere or major insect problems.

SPECIFIC

1. DO NOT work on an energized breaker. If work has to be performed on the breaker, take it out of service and remove it from the metal clad.

2. DO NOT work on any part of the breaker with the test coupler engaged.

3. All spring-charged mechanisms related to a breaker must be serviced only by skilled and knowledgeable personnel capable of releasing each spring load in a controlled manner. Particular care must be exercised to keep personnel clear of mechanisms which are to be operated or released. Information on construction of such mechanisms is provided in this instruction book.

4. Operational tests and checks should be made on a breaker after maintenance, before it is returned to service, to ensure that it is capable of operating properly. The extent of such tests and checks should be consistent with the level of maintenance performed.

DESCRIPTION

The Power/Vac* vacuum circuit breaker is a horizontal drawout removable and interchangeable interrupting element for use in metal-clad switchgear to provide protection and control of electrical apparatus and power systems.

The Power/Vac* circuit breakers are available in continuous current ratings of 1200, 2000 and 3000 amperes in accordance with industry standards. A combination 1200/2000 ampere breaker is also available. Refer to the breaker nameplate for complete rating information of any particular breaker.

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

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

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The nameplate also describes the control power requirements for that breaker. The application of a breaker must be such that its voltage, current, and interrupting ratings are never exceeded. Since this book is written to include all ratings of the breaker as well as several design variations, the instructions will be of a general character and all illustrations will be typical unless otherwise specified.

PROPER INSTALLATION AND MAINTENANCE ARE NECESSARY TO INSURE CONTINUED SATISFACTORY OPERATION OF THE BREAKER. The following instructions will provide complete information for placing Power/Vac* breakers in service and for maintaining satisfactory operation.

RECEIVING, HANDLING AND STORAGE

RECEIVING

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

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

HANDLING

When lifting the breaker use of the specially designed lift truck is recommended. It is necessary to use the truck when placing a breaker into or removing it from the metal-clad equipment. If it is necessary to lift the breaker with a hoist use four 1/2 inch diameter hooks rated at least 500 pounds each. Lifting locations are provided in the side frame members. Use a spreader at least 12 inches wider than the breaker to prevent slings from contacting the interrupter supporting insulating material parts.

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

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 assure the proper storage of the breaker:

1. The breaker should be carefully protected against condensation, preferably by storing it in a warm dry room of moderate temperature such as 40°–100°F since water absorption has an adverse effect on the insulation parts. 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. Unplated surfaces of rollers, latches, etc., of the operating mechanism should be coated with D6A15A1 grease to prevent rusting.

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

INSTALLATION

SAFETY PRECAUTIONS

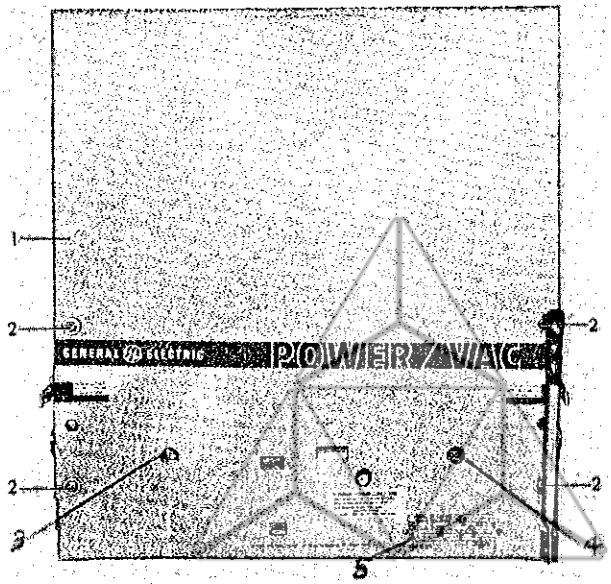
This circuit breaker uses powerful springs for energy storage. Do not work on the interrupters or mechanism unless both the closing springs and opening springs are either discharged or blocked and all electrical power is removed. These precautions are required to prevent accidental operation. Anyone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

SHIPPING POSITION

The circuit breaker has been shipped in a closed position with the mechanism trip latch blocked by a bolt through the left side frame. A yellow tag identifies this bolt. (This bolt is not installed on breakers shipped inside the equipment.) Before operation or insertion into the metal clad equipment, this bolt must be removed and the mechanism tripped open with the manual trip push button. The close spring is shipped discharged.

After removing packing material, locate, and remove (if installed) the trip latch blocking bolt indicated with a yellow tag

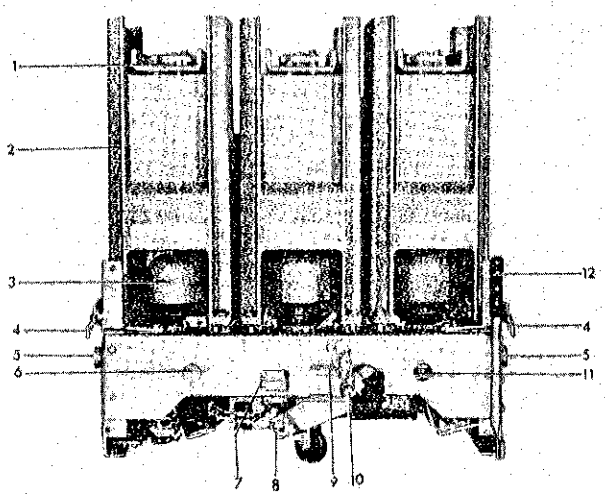
Fig. 1 (8918438M) (Rev.)



1 – Front Cover
2 – Cover Mounting Bolts
3 – Manual Trip Button
4 – Manual Close Button
5 – Name Plate

Fig. 1 Front View of Power/Vac* Breaker with Front Cover

Fig. 2 (8918438K)



1 – Upper Interrupter Connection
2 – Interrupter Support
3 – Operating Rod Insulator
4 – Racking Engagement Lever
5 – Rollers for Track
6 – Manual Trip Button
7 – Open-Close Indicator
8 – Counter
9 – Spring Charge Indicator
10 – Manual Wind Shaft
11 – Manual Close Button
12 – Handle to Connect Secondary Disconnects in Test Position

Fig. 2 Front View of Power/Vac* Breaker Without Cover

on the left side sheet of the mechanism. Press in on the manual trip push button (Fig. 1) to trip the mechanism open, keeping hands away from moving parts.

Close and open springs are now in their discharged positions. Check this by first pressing the manual close button, then the manual trip push buttons.

MECHANICAL CHECKING AND SLOW CLOSING

(1) Visually inspect the circuit breaker for any signs of damage or loose hardware.

(2) Manually charge the breaker closing spring using a 5/8 inch hex socket-ratchet-type wrench for safety, and turn in the direction of the arrow as indicated on or near the end of the manual wind shaft (Fig. 2). Several rotations with no apparent load are necessary until the winding mechanism engages the spring-charging pawl.

As the manual charging shaft is rotated the trip latch will reset first with a small "click". Continued rotation will fully charge the closing spring and a louder sound will be heard. At this time the indicator (Fig. 2) will change from "Discharged" to "Charged" Stop cranking when this occurs.

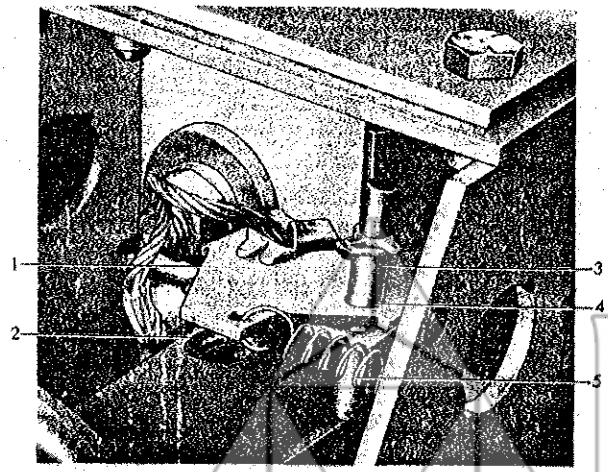
(3) Insert the close spring blocking pin (Fig. 3) by carefully removing it from its storage hole, rotating the interlock lever and reinserting it in the blocking hole. CAUTION: If the manual close button is not pressed prior to performing step (4), the breaker will be damaged. Press the manual close button to partially discharge the closing spring against the blocking pin.

(4) Pull the slow close pin on the flywheel (Fig. 4) and resume ratchet wrench operation of the manual wind shaft. After several rotations at no apparent load, the winding mechanism will engage the slow close pawl and begin the closing operation of the mechanism.

Continue rotating the manual wind shaft, checking for smooth operation with lack of sticking or sudden load increases. Be sure the close toggle (Fig. 5b) goes overcenter against the frame. After the one-half flywheel rotation necessary for closing, the slow close pawl is automatically disengaged and the flywheel is held by the brake.

(5) In the closed position, check and record the erosion indicator dimensions (Fig. 6b) and the wipe indicator dimensions (Fig. 6). Check that the position indicator shows "Closed". See section on PRIMARY CONTACT WIPE AND EROSION INDICATOR.

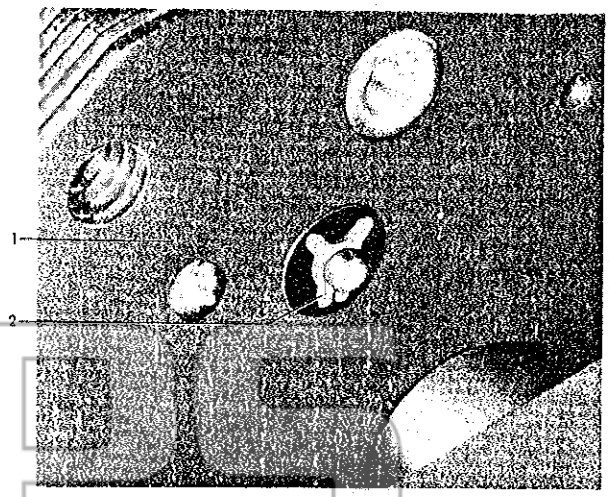
(6) Keep clear and push the manual trip push button to trip the breaker open. Check that the position indicator shows "Open" and the operation counter advances one count.



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

Fig. 3 Closing Spring Blocking Pin
(Shown in Unblocked Position)

Fig. 3 (891842)



1 – Flywheel
2 – Slow Close Pin

Fig. 4 Slow Close Pin on Flywheel

Fig. 4 (8918438P)

(7) Repeat (2) to charge closing spring, then press the manual close push button to partially discharge the close spring against the blocking pin.

(8) Repeat (4), (6), (7) in sequence to slow close and trip the breaker several times to insure proper operation.

(9) Repeat (2), then carefully remove the close spring blocking pin from its blocking hole, rotate the interlock coupling, and reinsert the pin in its storage hole as shown in Fig. 3.

(10) Close the breaker by pressing the manual close push button, then check that the close toggle is over-center onto the frame (Fig. 5b). Trip the breaker by pressing the manual trip push button. Close and open springs are now in their discharged positions.

ELECTRICAL CHECKING

Electrical checking consists of electrical breaker operation, secondary wiring high-potential testing (if required), primary current path resistance (if required) and Power/Vac* interrupter high-potential testing.

(1) To check the electrical operation attach a secondary test coupler to the circuit breaker connector. Check the control voltage on the nameplate and close and open the breaker several times to check electrical operation.

(2) Perform a vacuum interrupter integrity test to verify the condition of the interrupters. Perform the test as described under MAINTENANCE.

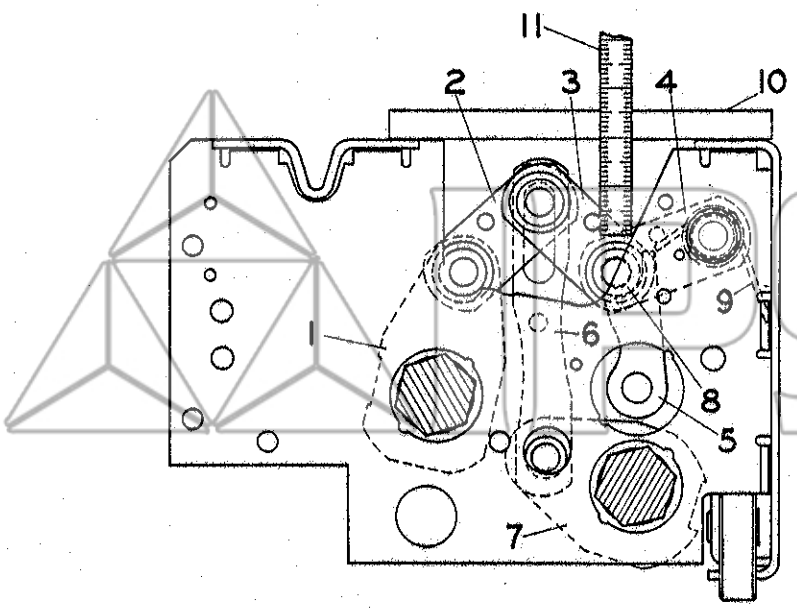
(3) Leave the circuit breaker in an open and spring-discharged condition after checks are complete and refer to metal-clad instruction book GEK 39672 before inserting the circuit breaker into a metal-clad unit. Reinstall the front cover if it has been removed.

OPERATION

GENERAL

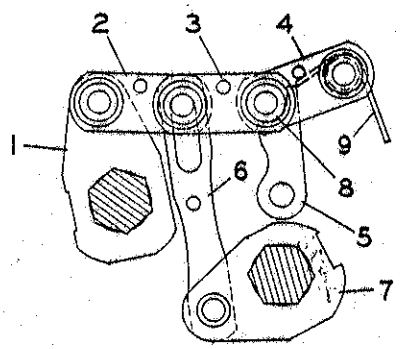
The Power/Vac* vacuum circuit breaker uses sealed vacuum power interrupters to establish and interrupt a primary circuit. Primary connections to the associated metal-clad switchgear are made by horizontal bars and disconnect fingers, electrically and mechanically connected to the vacuum interrupters. Molded supports, one per pole on a three-pole circuit breaker, provide interchangeable mountings for the primary bars, interrupters, current transfer fingers, and heat dissipation fins (where used). The operating mechanism provides vertical motion at each pole location in order to move the lower contact of the vacuum interrupters from an open position to a spring-loaded closed position and then back to the open position on command.

The ML-17 (Fig. 7) mechanism is of the stored-energy type and uses a gearmotor to charge a closing spring. During a closing operation, the energy stored in the closing spring is used to close the vacuum interrupter contacts, charge the wipe springs which load the contacts, charge the opening springs, and overcome bearing and other friction forces. The energy then stored in the wipe and opening springs will open the contacts during an opening operation.

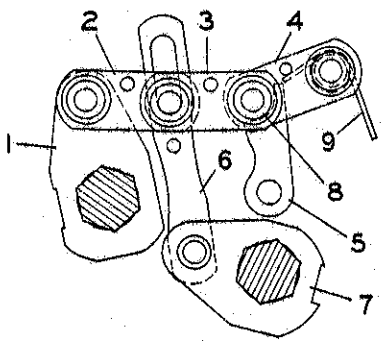


(a) Breaker Open-Close Spring Charged

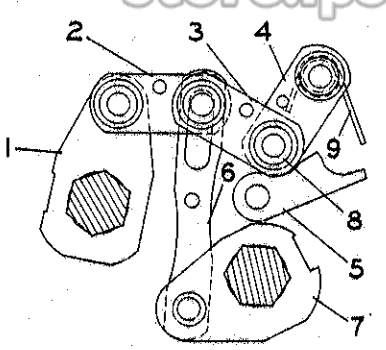
Fig. 5 (44D1405) 209B4202



(b) Breaker Closed-
Close Spring Discharged



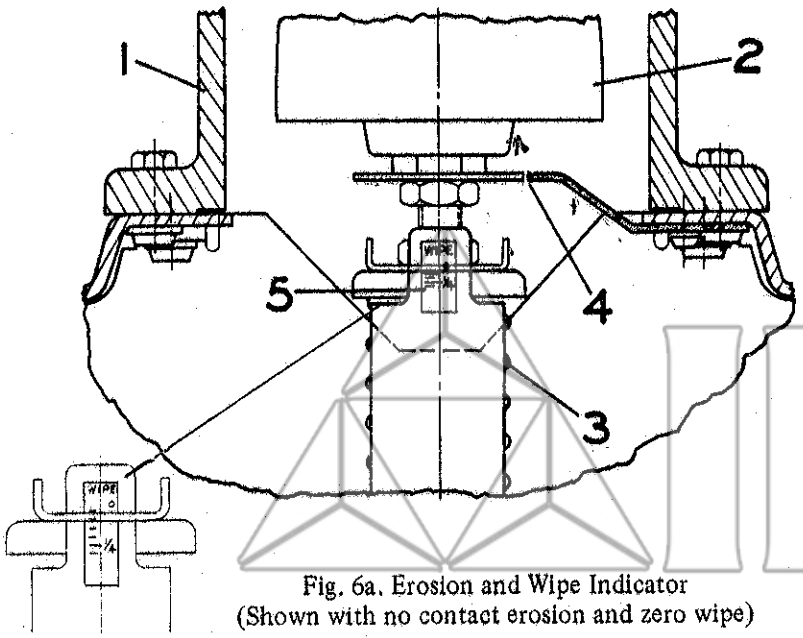
(c) Breaker Closed-
Close Spring Charged



(d) Breaker Open-
Close Spring Discharged

1 – Output Crank
2 – Link-Output Crank to Close Toggle
3 – Link-Close Toggle to Trip Toggle
4 – Link Trip Toggle to Frame
5 – Trip Latch
6 – Slotted Link
7 – Transfer Crank
8 – Trip Roller
9 – Linkage Return Spring
10 – Straight Edge
11 – Measuring Scale for Trip Latch Clearance

Fig. 5 Toggle Linkage Positions of ML 17 Mechanism
View From Rear



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

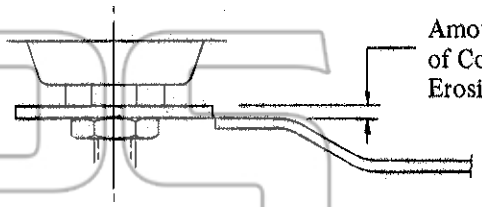


Fig. 6b

Fig. 6. 144D1403

Fig. 6a. Erosion and Wipe Indicator
(Shown with no contact erosion and zero wipe)

Closing and opening operations are controlled electrically by the metal clad or remote relaying. Mechanical control is provided by manual close and trip buttons on the circuit breaker. The closing spring may be manually charged, and a method for slow-closing the primary contacts is available. See MECHANICAL CHECKING AND SLOW CLOSING. The mechanism will operate at the a-c or d-c voltage indicated on the circuit breaker nameplate.

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

CLOSE SPRING CHARGING

Figure 7 rear view shows the mechanism expanded schematically with the contact open, closing spring in the charged condition. When the closing spring is discharged, the AA flywheel eccentric will be about 180 degrees from where it is shown with respect to center pivot CC. The transfer crank (14) will be rotated counterclockwise, the slotted link (17) will be holding the close toggle (20, 21) against the frame through link (19), and the trip latch (18) will be held out of latch clockwise by the trip toggle roller (8) per Fig. 5. When the closing spring is discharged, switch operator (44), Fig. 7, operates the motor limit switch (43). If the close-latch-checking switch (5) is made and power is available, the gearmotor (45) will drive the wind hub (11) counterclockwise. Slow-close pawl (10) will be held out of possible engagement with the wind hub notch by the action of the slow-close pin (48).

After some rotation of the wind hub (11) at no load, its notch engages the wind pawl (9) and rotates the flywheel counterclockwise, compressing the close spring assembly (6), and rotating the transfer crank (BB) shaft clockwise by pushing on rod (13). As the line of action of the close spring shifts over-center on the flywheel and attempts to discharge, the close roller (3) is blocked by the close latch (4) and held until a closing operation is required. Additionally, as the close spring goes over-center, the switch operator (44) is spring biased into a notch on the front flywheel (2). Arm (40) moves clockwise which, through the action of the rod (41) causes a flag (42) to indicate "CHARGE". A cam (12) engages the wind pawl (9), moving it from contact with the hub (11) notch, thereby allowing the gearmotor to coast to a stop when power is removed by limit switch (43).

As the close spring is compressed, the slotted link (17) rises, and the close toggle (20,21) forms a more acute angle until, about when the closing spring is going over-center, the trip latch (18) is spring biased into place under the trip roller. When the trip latch is in place, the latch-checking limit switch (47) closes.

CAUTION: With the bus energized manual operation is not recommended in the connect position.

If control power is lost, or manual operation desired, the close spring may be manually charged by using a 5/8 inch hex socket ratchet-type wrench to rotate the manual charging wind shaft in the direction indicated by the arrow until the yellow indicator shows "CHARGED". Manual charging must then be discontinued to avoid mechanism damage.

CLOSING OPERATION (REFER TO FIG. 7)

By either energizing the close solenoid or depressing the manual close button, the close latch (4) is rotated counterclockwise and releases the close roller (3) permitting the flywheel (1,2) to rotate counterclockwise by the force of the close spring. This action, transmitted to the slotted link (17) by means of the pull rod (13), transfer crank (14,16), pulls the close toggle (20,21) through the center against link (19) which is tied to the frame. This action rotates the output crank (22) counterclockwise. The Pole 1 bell cranks (23), on the same shaft as the output crank, also rotate counterclockwise, and by means of the horizontal connecting bar (28), rotate Pole 2 and 3 bell cranks. This rotation compresses the opening spring (29), closes the vacuum interrupters connected with each operating rod (25), and compresses the wipe spring (26) on each pole when the trunnion (24) continues moving after the operating rod (25) stops. Rotation

of an arm (34) coupled to the output shaft (DD) changes the auxiliary switch (37) position, and the position flag (38) indicates "CLOSED". The lever (44) is moved out of the notch in the flywheel (2) and, with the close latch (4) in position to catch the close roller, the limit switch (43) energizes the gearmotor as described under CLOSE SPRING CHARGING. With the circuit breaker in the closed position, the links (17) can move up past the close toggle without disturbing it as they are slotted to accommodate a close spring charging in the breaker-closed position.

OPENING OPERATION (REFER TO FIG. 7)

By either energizing the trip solenoid or depressing the manual trip button, the trip latch (18) is rotated clockwise permitting the trip toggle (19,20) to collapse and the vacuum interrupter contacts to open under the force of the wipe springs (26) and opening spring (29). At the end of the opening stroke, a stop block (30) on the bottom of the trunnion (24) strikes set screws in the horizontal connecting bar (28) which limits the over-travel. At the same time an opening stop is provided by a plate and buffer assembly (50). An opening dashpot (31) controls opening velocity and prevents excessive rebound of the interrupter contacts. Rotation of the output shaft (DD) from a closed to an open position operates the auxiliary switch (37) as described under CLOSING OPERATION and interrupts the trip coil circuit. If the closing spring is charged, the close toggle (20, 21) can rise to the top of the slotted link (17), thereby permitting the trip toggle to reset and the trip latch to fall in place under its roller preparatory to a closing operation. If the closing spring is not charged, the trip latch is held rotated clockwise until the close spring is compressed as described in CLOSE SPRING CHARGING. Electrically initiated closing is blocked by the latch checking switch (47) when the trip latch is not reset.

TRIP-FREE OPERATION (REFER TO FIG. 7)

The linkage (19,20,21) is mechanically trip free in any location on the closing stroke, this means that energization of the trip coil while closing after the auxiliary switch contacts change position will rotate the trip latch (18) clockwise and permit the circuit breaker to open without fully completing a closing stroke. The linkage will reset as in a normal open operation, the flywheel will complete its rotation, and the closing spring will recharge as described under SPRING CHARGING. The opening speed will be slightly less than with a normal open operation due to the wipe springs not having been fully compressed, but the speed will be within the acceptable range for rated interruption.

CONTROL CIRCUIT

A typical Power/Vac* circuit breaker ML-17 mechanism wiring diagram is shown in Fig. 8. Check the wiring diagram supplied with the actual circuit breaker for its wiring.

The close spring-charging-motor circuit is established through the CL/MS switch if the close latch is reset and the SM/LS if the closing spring is discharged. When the closing spring is charged, the SM/LS interrupts the circuit.

The close circuit is established through two normally closed Y relay contacts, 52Y and the latch-checking switch LC, if the trip latch is reset. An auxiliary switch contact 52 is also in series with the close coil and that closes when the breaker is open and opens when it is closed. During a close operation, flywheel rotation closes the SM/LS contact, picking up the Y relay coil thereby opening its contacts to interrupt the close coil current and sealing it in through a normally open contact to the close signal. The sealing prevents reclosing on a sustained close command as the close signal must be removed to drop out the Y relay, and reestablish the close circuit, thereby providing an anti-pump feature.

Circuit breaker mounted auxiliary switch contacts not used in the control circuit are brought out for control and indication functions. The metal-clad equipment may provide a breaker operated stationary auxiliary switch for additional contacts.

INTERLOCKS

Each Power/Vac* vacuum circuit breaker is provided with the following interlocks.

(1) Rating interference plate (Fig. 9) permits only a breaker of the matching continuous current, voltage and interrupting mva rating to be inserted into a metal-clad breaker compartment.

The combination 1200/2000 ampere breaker can be used in either a 1200 amp or a 2000 amp compartment. The rating interference plate must be adjusted to match the current rating of the compartment. This is done by positioning the outer interference plate so that the edge of the plate lines up with the current indicated on the label attached to the breaker just above the rating interference plate.

(2) The function of the closing spring discharge interlock is to prevent racking into the metal clad a breaker that has the closing spring charged. This is accomplished by a roller on the right-hand side of the mechanism (Fig. 10) which contacts the racking mechanism and discharges the closing spring unless the breaker is in the "Disconnect/Test" position or the "Connect" position in the metal clad. This interlock also opens the CL/MS switch in the motor charging circuit to prevent charging the closing springs when the breaker is between the Disconnect/Test" or "Connect" position in the metal clad. The function of the NEGATIVE TRIP INTERLOCK (5) Fig. 11 is to remove the trip latch from the trip latch roller thereby preventing a closing operation. The interlock also opens the latch checking switch in the closing circuit thereby removing the close circuit power. The negative interlock is in operation while the breaker is moving between the "Disconnect/Test" position and the "Connect" position.

(4) The positive interlock (Fig. 11) operates to prevent the racking of a breaker that is closed. A linkage connected to the horizontal connecting bar extends a detent bar (3) out from the side of the mechanism frame when it is in the closed position. If the breaker

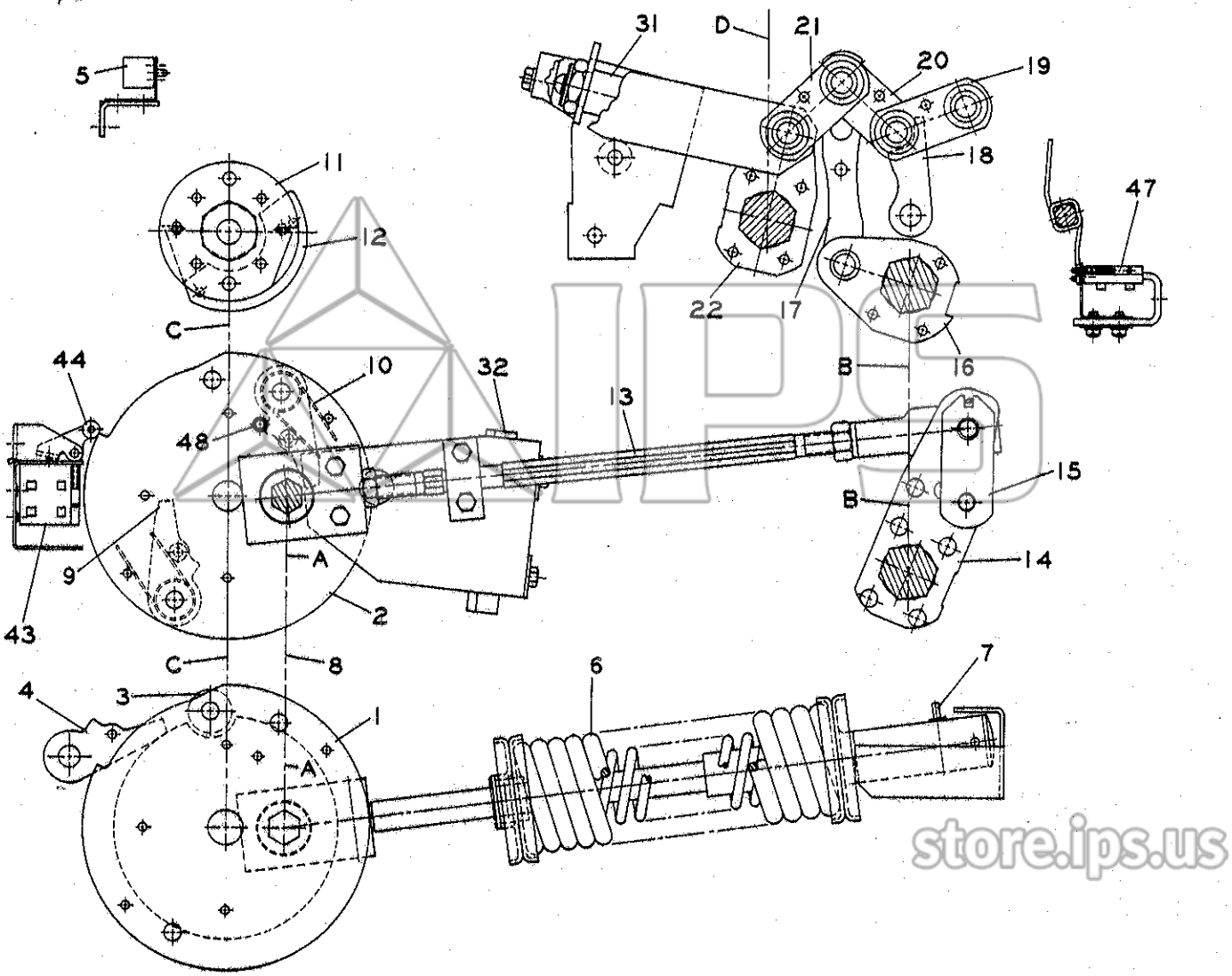


Fig. 7. (0144D1406 Sh. 1 Rev. 1)

AA Eccentric shaft connecting flywheel halves
BB Hex shaft connecting Transfer cranks
CC Flywheel rotation axis
DD Hex shaft connecting Output cranks

1 Rear Flywheel Section
2 Front Flywheel Section
3 Close Roller
4 Close Latch
5 Close Latch Checking Switch
6 Closing Spring Assembly
7 Blocking Pin in Closing Spring Assembly
8 Hex Shaft with Connection Blocks on Flywheel
9 Wind Pawl
10 Slow Close Pawl
11 Wind Hub
12 Pawl Disengagement Cam Surface – on Frame
13 Pull Rod
14 Adjustable Throw Transfer Crank
15 Adjustment Link
16 Short Transfer Crank

Fig. 7 Exploded Schematic – Rear View ML-17 Mechanism

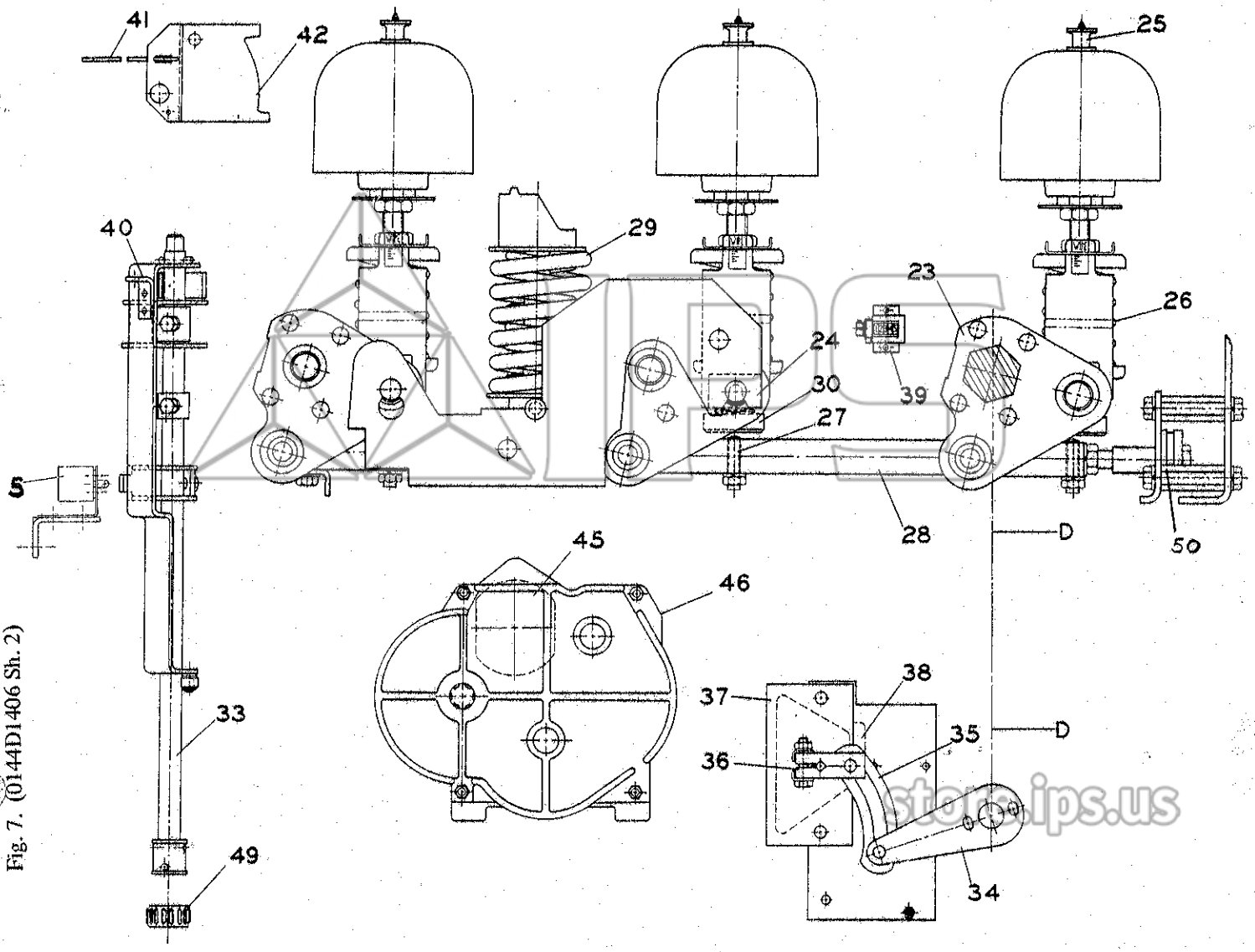
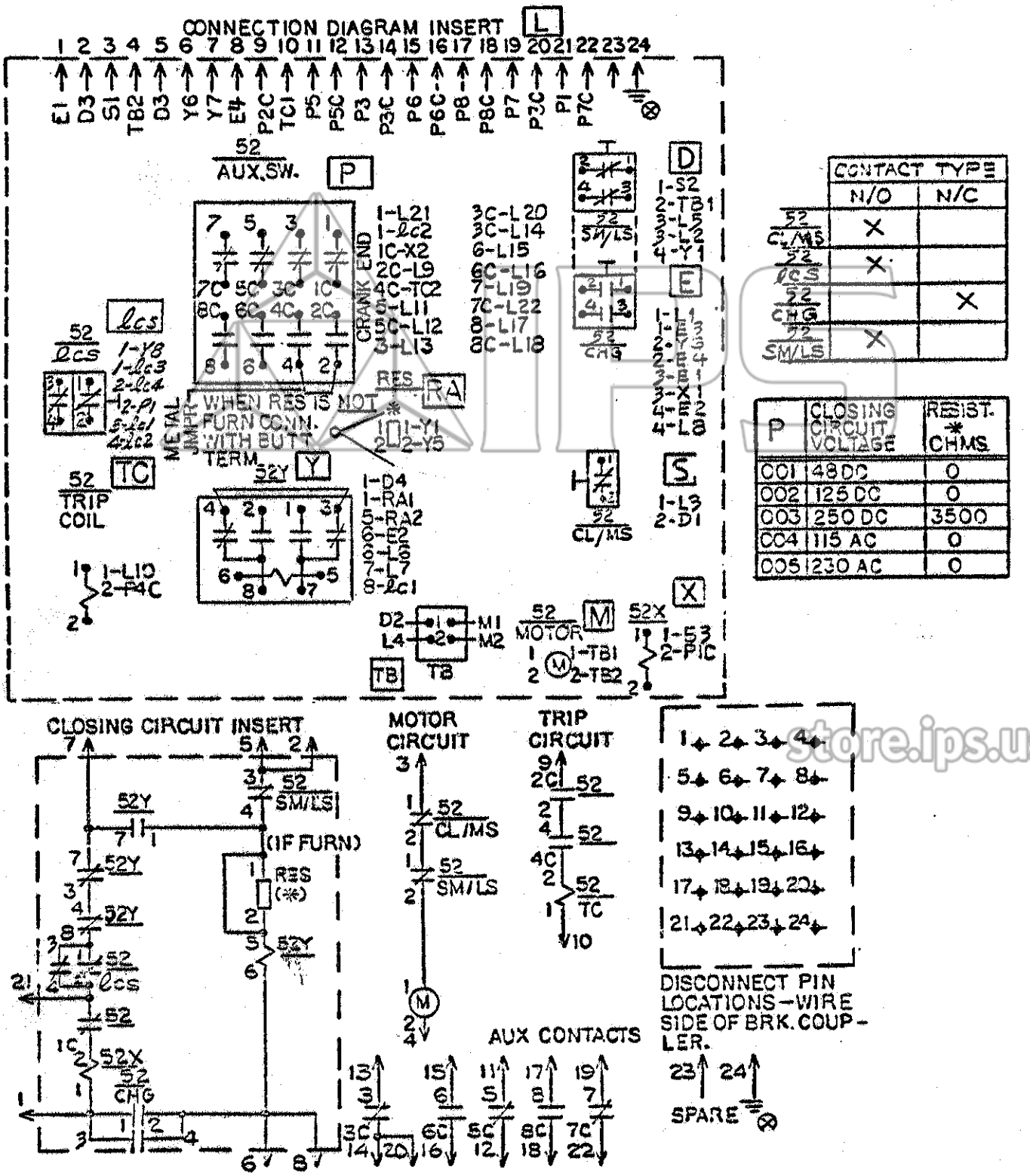


Fig. 7. (0144D1406 Sh. 2)

17	Slotted Link	34	Auxiliary Switch Drive Arm
18	Trip Latch	35	Idler Link
19	Link – Trip Toggle to Frame	36	Switch Drive Arm
20	Link from Close Toggle to Trip Toggle	37	Auxiliary Switch – SB-12 – Four Stage
21	Link from Output Crank to Close Toggle	38	Position Indicator Flag – on Switch Shaft
22	Output Crank	39	Operation Counter
23	Pole 1 Bell Cranks	40	Spring Charge Indicator Arm
24	Wipe Spring Trunnion Block	41	Rod
25	Interrupter Operating Rod Connection	42	Spring Charge-Discharge Indicator Flag
26	Wipe Spring	43	Gear Motor Limit Switch
27	Overtravel Stop Adjustment – on Each Pole	44	Gear Motor Limit Switch Operator
28	Horizontal Connecting Bar	45	Gearmotor
29	Opening Spring Assembly	46	Gearmotor Housing
30	Opening Stop Block	47	Trip Latch Checking Switch
31	Dashpot	48	Slow Close Pin
32	Brake	49	Retaining Clamp
33	Closing Latch Shaft	50	Opening Stop

Fig. 7 Exploded Schematic – Rear View ML-17 Mechanism



NOTES:

52 C/MS — Closing latch monitoring switch is closed when latch is capable of blocking fully charged closing spring. Held open between disc. & connect positions.

52 SM/LS — Limit switch for spring charging motor-contacts (1-2) (3-4) open when springs are fully charged.

52 CHG — Contact closed when closing springs are fully charged.

52X — Spring release coil operates latch which releases closing spring to close 52.

⊗ — Ground pin used for inspection box only.

* — See table for res. value.

52 PCS — Triplatch checking switch closed when latch is reset.

Type wire - SIS*14.

Fig. 8 Typical Wiring Diagram for ML-17 Mechanism

Fig. 8 (0209B3602 Rev. 3)

is in the "Connect" or "Disconnect/Test" position in the metal clad the detent bar locks into the racking mechanism to prevent access to the hex section of the jack screw.

(5) The closing spring gag interlock is provided on the breaker to prevent a breaker that has a gagged closing spring from entering the metal-clad unit. This is accomplished by projecting a lever (1) out of the left side of the mechanism when the closing spring is gagged. See Fig. 11.

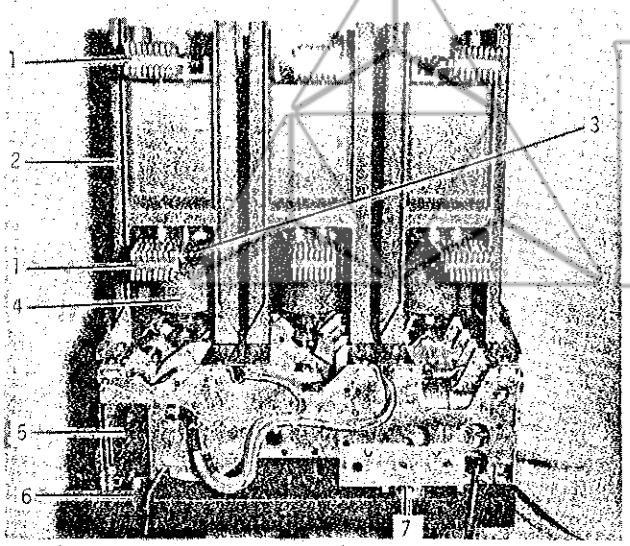


Fig. 9 (8043A)

1 – Primary Disconnect Fingers
2 – Interrupter Support
3 – Coupling Clamp
4 – Operating Rod Insulator
5 – Secondary Disconnect Coupler
6 – Ground Shoe
7 – Rating Interference Plate

Fig. 9 Rear View of Power/Vac* Breaker Showing Rating Interference Plate

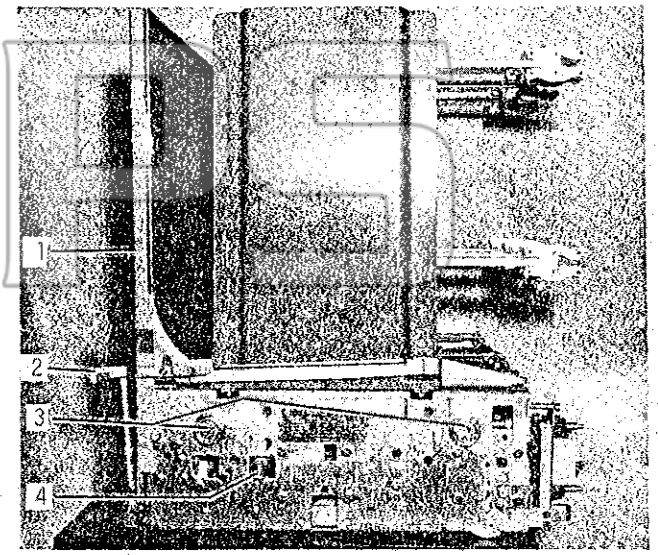


Fig. 10 (8043A)

1 – Front Cover
2 – Racking Engagement Lever
3 – Rollers for Track
4 – Closing Spring Discharge Roller

Fig. 10 Closing Spring Discharge Interlock on ML-17 Mechanism

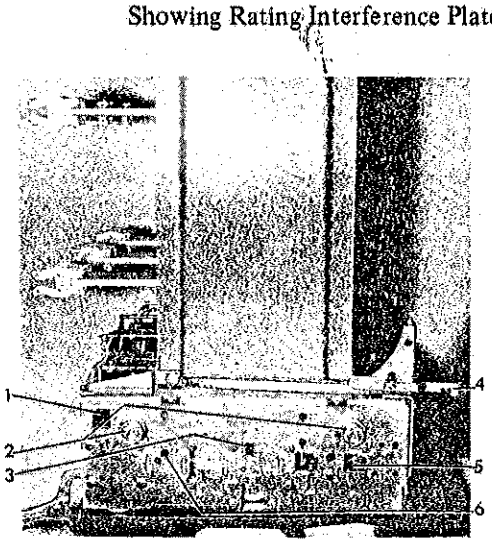


Fig. 11. (8043A)

1 – Closing Spring Gag Interlock
2 – Rollers for Track
3 – Positive Interlock Bar
4 – Racking Engagement Lever
5 – Negative Interlock Roller
6 – Trip Latch Blocking Hole

Fig. 11 Positive, Negative and Closing Spring Gag Interlocks on ML-17 Mechanism

MECHANICAL ADJUSTMENTS

GENERAL

Checking the mechanical adjustment and adjusting the mechanism if required must be performed in the sequence given below. If any readjustment is required the entire sequence must be completed. If any adjustment (except wipe) is required, back out the overtravel adjusting bolts (Fig. 12 – part 8) until they are flush with the top of the horizontal connecting bar before any adjustment is made.

PULL ROD

Refer to Fig. 7. The pull rod (13) is a turnbuckle, with a right-hand thread at the crank and a left-hand thread at the flywheel connection. Insert the close spring blocking pin (Fig. 3) and slow close the mechanism as described in MECHANICAL CHECKING and SLOW CLOSING. As the flywheel turns and spring compresses, the slotted link pulls the closing toggle pin over center so that the rollers on the end of the pin are resting on the mechanism frame. In this position, the slotted link should be in contact with the closing toggle pin.

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

In this position the slotted links (17) should have no clearance to the pin in the close toggle (20, 21) but should be capable of being moved axially along the pin by firm finger pressure. Tighten the pull rod lock nuts to 20-25 foot pounds of torque.

If the pull rod is too short, i.e., slotted link (17) is too tight against the pin in the closed toggle, the pin may be bent and require replacement.

TRIP LATCH CLEARANCE

Refer to Items 8 and 11, Fig. 5, with the close spring still gagged, wind manual charge shaft until flywheel roller is against closing prop. Stop manual charging at once. Determine the trip latch clearance by depressing the trip roller against the latch face from its spring-reset position. If no apparent motion exists, depress the manual trip push button and see if the trip roller rotates.

The acceptable range of initial latch clearance is 0.005 to 0.040 inch. The trip roller must not rotate when the latch is moved by the manual push button. The clearance may be estimated by pressing the roller down against the latch.

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

HORIZONTAL CONNECTING BAR STROKE

The setting of the horizontal connecting bar stroke is established by the position of the adjustment link (15) Fig. 7 which is set at the factory and must not be changed. Minor adjustments to the horizontal connecting bar stroke are made by changes to the trip latch clearance.

With the breaker in the closed position measure the distance from the right side (when facing the breaker) plate to the end of the horizontal connecting bar (7), Fig. 12. A scale may be inserted through an opening in the side plate to make this measurement. Remove the scale, open the breaker and repeat the measurement. The difference between the two measurements is the horizontal connecting bar stroke.

The required horizontal connecting bar stroke depends on the interrupter type. The interrupter type is shown on the breaker name plate.

INTERRUPTER TYPE	HORIZONTAL CONNECTING BAR STROKE (INCHES)
42A	0.600 – 0.680
40A	0.700 – 0.780
All others	0.820 – 0.900

Adjustments to the horizontal bar stroke may be made by adjusting the trip latch clearance. Increasing the trip latch clearance (0.040 inch maximum) decreases the horizontal connecting bar stroke while decreasing the trip latch clearance (0.005 minimum) increases the horizontal connecting bar stroke.

If sufficient horizontal connecting bar stroke can not be obtained, a problem in the mechanism is indicated. Recheck the pull rod adjustment and check for binding in the mechanism.

OVERTRAVEL STOPS

With the breaker in the open position refer to Fig. 12. Six adjustable bolts (8) are threaded into the horizontal connecting bar to provide stops for each pole to prevent overstroking the Power/Vac* interrupters. Each of these bolts should be

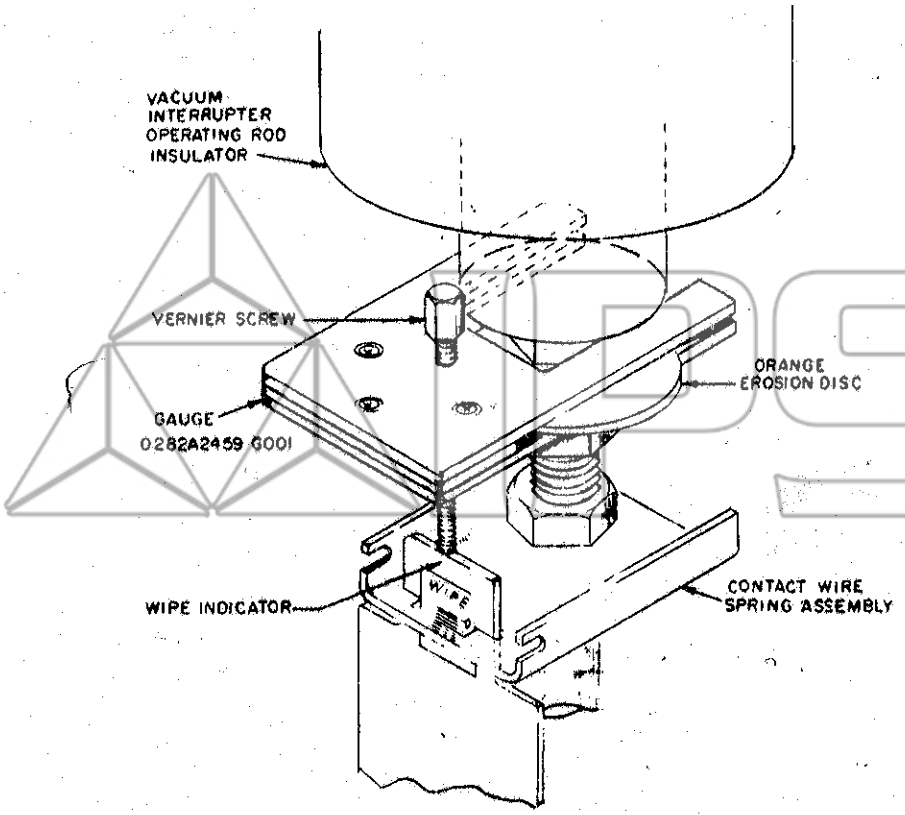


Fig. 11A (282A 3012)

Fig. 11A. Wipe Gauge

backed out of the horizontal connecting bar two turns prior to performing any mechanical adjustment. After all adjustments are complete (except wipe), turn each of the six bolts (8) in toward the opening stop block (14) until the bolt touches the stop ring. Back off 1/4 to 1/2 turn and tighten locking nut (11) to 20-25 foot-pounds.

WIPE ADJUSTMENT

Wipe is the additional compression of a preloaded spring, used to apply force to the vacuum interrupter contacts and to provide opening kick-off force.

An indicator is provided on the wipe spring assembly with graduations given in fractions of an inch on which the wipe is indicated directly. See Fig. 6. However, to improve the accuracy of wipe measurements and settings it is recommended that the contact wipe guage tool which is furnished with the Power Vac* metal-clad be used. (See Fig. 11A)

The gauge consists of an assembly which can be slid into position on the erosion disk as shown in Fig. 6. The vernier screw should be positioned over the top edge of the wipe indicator. With the breaker open, slide the gauge over the erosion disk. Turn the vernier screw until it contacts the top edge of the wipe indicator. Remove the indicator without disturbing the screw and measure the length of the screw which is protruding from the gauge as accurately as possible with a micrometer or vernier caliper. Record the readings for each pole. Close the breaker and repeat the readings. The difference between the two readings is the contact wipe.

The wipe should be set as follows:

Breaker Rating	Wipe (inches)
13.8 – 500	0.155 – 0.180
Readjust when reduced to 0.140	
All others	0.155 – 0.180
Readjust when reduced to 0.125	

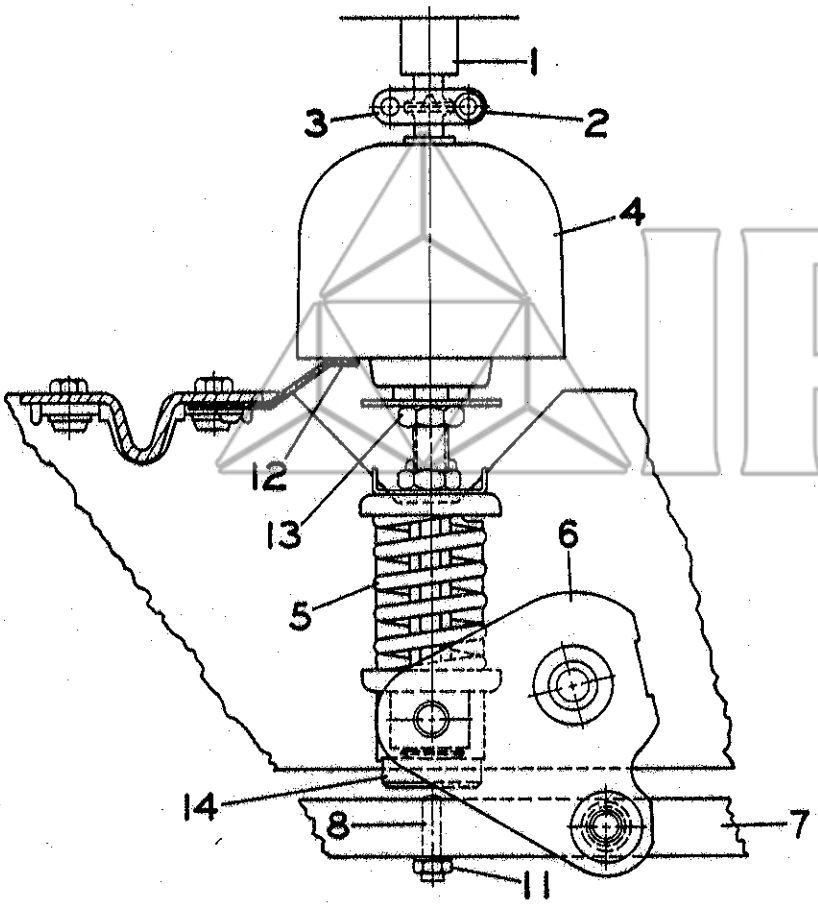
*Do not readjust unless over 0.187

To adjust primary contact wipe, close the breaker and block the trip latch against the frame to prevent accidental opening. Use a 3/8 – 16 (with 2 5/8 minimum thread length) bolt in trip latch blocking hole (6) Fig. 11.

(1) Loosen but do not remove the screws (3/16 hex key) holding the operating rod interrupter clamp (3), Fig. 12.

(2) Check that the clamp is loose. A light prying at the clamp half junction may be required to loosen the wedging action of the clamp.

(3) Hold the hexagon projection at the bottom of the operating rod insulator (1 1/8 inch wrench) and loosen the adjacent locknut (15/16 inch wrench). Refer to (13), Fig. 12. Adjust by rotating the operating rod insulator. The thread is 5/8-11 and each



1 – Power/Vac*
2 – Coupling Clamp
3 – Clamp Screws
4 – Operating Rod Insulator
5 – Wipe Spring
6 – Bell Crank
7 – Horizontal Connecting Bar
8 – Overtravel Adjusting Bolt
9 – Not Used
10 – Not Used
11 – Locknut
12 – Reference Arm
13 – Locknut
14 – Opening Stop Block
15 – Indicator Disk

Fig. 12. (0144D3403 Rev. 1)

Fig. 12 Primary Contact Gap and Erosion Indication

1/4 turn will give about 0.023 inch change in primary wipe. Screw the operating rod insulator toward the interrupter to increase wipe.

(4) After setting the contact wipes on each phase torque the operating rod locknut (13) to 40-50 foot pounds while preventing the operating rod insulator (4) from turning. Tighten the clamp screws (3) to 10-12 foot-pounds. Remove the trip shaft block and trip the breaker open. This procedure prevents accidental twisting of the operating rod of the interrupter by loading the contacts with the wipe springs and forcing relative rotation to occur at the clamp interface.

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

PRIMARY CONTACT EROSION INDICATION

In the closed position, the indicator disk (15) below the operating rod insulator is aligned with a reference arm (12) on new interrupters. With the breaker in the closed position, the indicator disk (15), Fig. 12, will move upward from alignment with the reference point due to contact erosion. Contact erosion will decrease the wipe which may be brought back to normal by performing wipe adjustment. When erosion reaches 1/8 inch, the Power/Vac* interrupters should be replaced. Do not readjust the alignment of the erosion indicator except when installing a new vacuum interrupter.

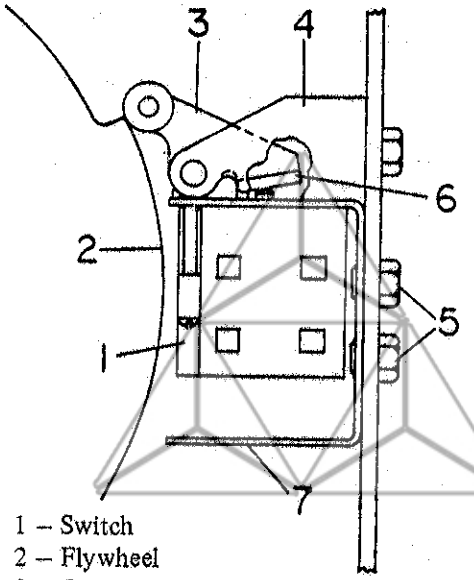
CONTROL COIL PLUNGER TRAVEL

TRIP COIL

With the breaker in the open position and the closing springs in the charged position, make certain that the trip linkage and trip shaft move freely over the full plunger travel.

CLOSE COIL

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



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

Fig. 13 Spring Motor Limit Switch (SM/LS) and Closing Spring Charge Switch $\left(\frac{52}{CHG}\right)$

Fig. 14. (209B4204) (Rev. 1)

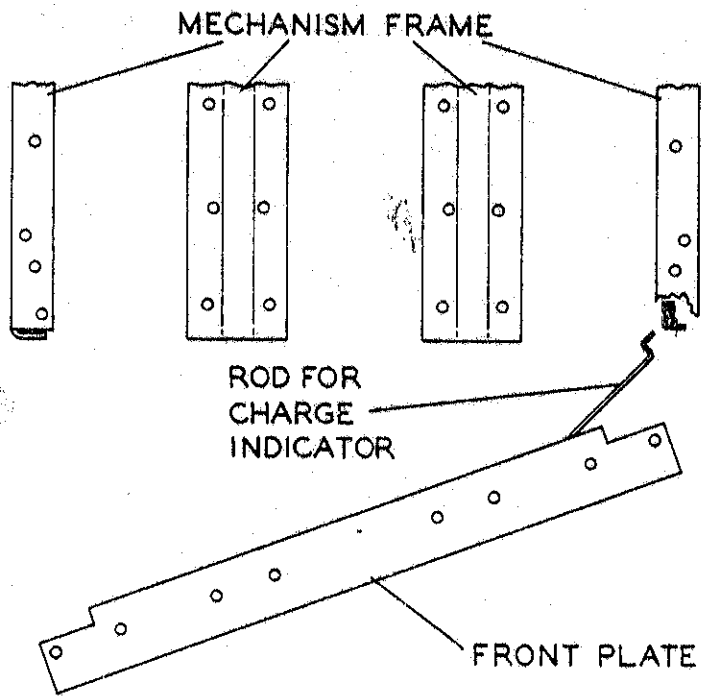


Fig. 14 Front Angle Plate

CONTROL SWITCHES

There are two switch locations on the right-hand side of the mechanism (when viewed as shown in Fig. 2) and one on the left. The single switch on the right-hand side (CL/MS) is toward the front of the mechanism and monitors the closing latch position. To the rear of this switch are two switches mounted together (SM/LS) which control the spring-charging motor and anti-pump relay. Also the 52 charge switch which can be used for remote indication of the charged condition of the spring. On the left side is the (LC) latch-checking switch which monitors the position of the trip latch. Fig. 13 shows the SM/LS switches but the adjustment on the other two is similar. The switches should be adjusted in their operated positions so that there is 0.015 to 0.032 inch clearance between the operator (6) and support (7). Bolts (5) can be loosened to make this adjustment.

SUMMARY OF MECHANICAL ADJUSTMENTS

(1) Pull Rod – Contact between slotted links and close toggle pin (see text).

(2) Trip latch clearance 0.005 – 0.040 inch. Readjust if more than 0.060.

(3) Horizontal Connecting Bar Stroke

Interrupter Type	Stroke (Inches)
42A	0.600 – 0.680
40A	0.700 – 0.780
All others	0.820 – 0.900

(4) Overtravel stops – 1/4 to 1/2 turn from touching.

(5) Primary contact wipe –

Breaker Rating	Wipe (Inches)
13.8 – 500	0.155 – 0.180
Readjust when reduced to 0.140	
All Others	0.155 – 0.180
Readjust when reduced to 0.125	

(6) Control coil plunger travel – free action. (Trip and close)

(7) Control switches – 0.015 – 0.032 inch.

ELECTRICAL CHECKS

CONTROL POWER

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

Rated Nominal Voltage	Close or Motor Circuit Min.	Max.	Trip Circuit Min.	Max.
48 DC	36	52	28	60
125 DC	90	130	70	140
250 DC	180	260	140	280
115 AC	95	125	Not available in Power/Vac*	
230 AC	190	250		

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

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

TIMING

Timing may be checked by monitoring control circuit voltage and using no more than six volts DC and one ampere through the vacuum interrupter contact to indicate closed or open condition. Typical time ranges vary with coil voltage but nominals are:

Trip coil to contact part	35–50 milliseconds
Close coil to contact close	60–90 milliseconds

Trip-free operation may be checked by applying a trip signal through one of the vacuum interrupters and a minimum reclose operation may be checked by tripping a charged breaker open while maintaining a close signal.

Trip-free-contact, close to open	50-65 milliseconds
Reclose contact, open to close	150-165 milliseconds

MAINTENANCE

GENERAL

Safe and dependable service from electrical apparatus and power systems is contingent upon reliable performance of power circuit breakers. To obtain maximum reliability the breaker should be inspected and maintained on a regular schedule. The breakers are designed in accordance with applicable standards which require that they be capable of performing 5000 – 10,000 operations (depending on rating) before any replacement of parts should be necessary. This requirement is based on the breakers being serviced, or maintained, at least every 1000 to 2000 operations (depending on rating), or once per year, whichever comes first. If the breaker is also required to interrupt fault currents during this period of time additional maintenance and replacement of parts may be necessary.

BEFORE ANY MAINTENANCE WORK IS PERFORMED, MAKE CERTAIN THAT ALL CONTROL CIRCUITS ARE DE-ENERGIZED AND THAT THE BREAKER IS REMOVED FROM THE METAL-CLAD UNIT. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE IN THE CLOSED POSITION WITHOUT TAKING PRECAUTIONS TO PREVENT ACCIDENTAL TRIPPING. THIS CAN BE DONE BY REPLACING THE LONG BOLT (3/8–16–2-5/8 MINIMUM LENGTH) USED FOR SHIPPING TO BLOCK THE TRIP SHAFT AND SECURE THE INTERRUPTER CONTACTS IN THE CLOSED POSITION. DO NOT WORK ON THE BREAKER WHILE THE CLOSING SPRINGS ARE CHARGED UNLESS THEY ARE SECURED IN THAT POSITION BY THE CLOSE-SPRING-BLOCKING PIN.

PERIODIC INSPECTION

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

POWER/VAC* INTERRUPTER

The Power/Vac* interrupter used in this breaker is a reliable, clean interrupting element. Since the contacts are contained in a vacuum chamber, they remain clean and require no maintenance at any time. The metallic vapors eroded from the contact surfaces during high current interruption remain in the chamber and are deposited on metal shields

thus insuring a high dielectric value of the vacuum and the walls of the glass container.

CONTACT EROSION

Check in the breaker-closed position per PRIMARY CONTACT EROSION INDICATION. When erosion reaches 1/8 inch, the interrupter should be replaced.

TRANSFER FINGER WEAR

Examine the moving contact rod projecting below the transfer fingers with the breaker open, wiping off the lubricant in order to see the metal surface condition. The finger locations should present a burnished silver contact without copper appearance at more than one location. If copper is visible at more than one location per pole or the silver plating is torn, the interrupter assembly should be replaced.

INSULATION TESTS

MEGGER

Since definite limits cannot be given for satisfactory insulation values, a record should be kept of the megohmeter readings as well as temperature and humidity readings. This record should be used to detect any weakening of the insulation from one check period to the next.

The primary circuit insulation on the breaker may be checked phase to phase and phase to ground using a 2500V megohmeter.

Prior to measuring the breaker secondary circuit insulation resistance, remove the motor leads, thread a wire connecting all secondary disconnect pins together except pin #24 (ground pin). The measurement may be made by connecting a 500V megohmeter from the wire to ground.

HIGH-POTENTIAL TEST

If high potential tests to check the integrity of the insulation are required, the AC high potential test described is strongly recommended. DC high potential testing is not recommended except for the VACUUM INTERRUPTER INTEGRITY TEST. The following procedure must be adhered to.

CAUTION: IF DC HIGH POTENTIAL TESTING IS REQUIRED, THE DC HIGH POTENTIAL MACHINE MUST NOT PRODUCE PEAK VOLTAGES EXCEEDING 50KV.

(1) Primary Circuit – The breaker should be hipotted in the closed breaker mode. An AC hipot machine capable of producing the test voltages shown below may be used to hipot the breaker phase to phase and phase to ground.

Breaker Voltage Rating	Test Voltage 60 HZ (RMS)
4.16 KV	14 KV
7.2 KV	27 KV
13.8 KV	27 KV

The machine should be connected with its output potential at zero and the voltage increased to the test voltage and that voltage maintained for 60 seconds. The voltage should then be returned to zero and the hipot machine removed from the circuit. NOTE – Do not exceed the test voltage indicated for the applicable breaker voltage rating.

(2) Secondary Circuit – Prior to hipotting the breaker secondary circuit, remove the motor leads, thread a wire connecting all secondary disconnect pins together except pin #24 (ground pin). Connect the hipot machine from this wire to ground. Increase the voltage to 1125 volts (rms) 60 Hz and maintain for 60 seconds. Reduce the voltage to zero and remove the hipot machine from the circuit. Remove the wire connecting the secondary disconnect pins and reinstall the motor leads.

VACUUM INTERRUPTER INTEGRITY TEST

This test of the vacuum interrupter will determine its internal dielectric condition and vacuum integrity. With the breaker open, individually check each interrupter by connecting the hipot machine across the primary studs (bars) on the breaker side of the disconnect fingers. Ground the other two interrupters line and load side of the primary studs, the frame, and the secondary wiring. Increase the hipot machine voltage to 36 kV (rms) 60 Hz or 50 kV DC and maintain for 60 seconds. If no breakdowns occur during any of the three hipot tests, the interrupters have passed and the breaker can be put into service. If a breakdown occurs in an interrupter, it must be replaced.

No attempt should be made to try to compare the condition of one vacuum interrupter with another nor to correlate the condition of any interrupter to low values of DC leakage current. There is no significant correlation.

After the high potential voltage is removed, discharge any electrical charge that may be retained.

CAUTION: MANY DC HIGH POTENTIAL MACHINES ARE HALFWAVE RECTIFIERS. THIS TYPE OF HIPOT TESTER MUST NOT BE USED TO TEST VACUUM INTERRUPTERS. THE CAPACITANCE OF THE POWER/VAC* BOTTLES IS VERY LOW AND THE LEAKAGE IN THE RECTIFIER AND ITS DC VOLTAGE MEASURING EQUIPMENT IS SUCH THAT THE PULSE FROM THE HALF-WAVE RECTIFIER MAY BE IN THE NEIGHBORHOOD OF 120KV WHEN THE METER IS ACTUALLY READING 40KV. IN THIS CASE, SOME PERFECTLY GOOD BOTTLES CAN SHOW A RELATIVELY HIGH LEAKAGE CURRENT SINCE IT IS THE PEAK VOLTAGE OF 120KV THAT IS PRODUCING ERRONEOUS BOTTLE LEAKAGE CURRENT. IN ADDITION, THE X-RADIATION WILL BE OF CONCERN.

An acceptable high potential machine is available from the Switchgear Business Department, Burlington, Iowa, catalog number 282A2610 P001. The machine has been designed by Switchgear so that the peak DC voltage is almost the same as the average DC voltage.

The Hypotronics Company also produces portable insulation testers which may be used to test vacuum interrupters. They are models number 860PL and 880PL.

PRIMARY CIRCUIT RESISTANCE

A resistance check of the primary circuit may be made with the breaker closed. Use a low resistance measuring instrument which measures microhms. The 100 ampere reading should not exceed 100 microhms when connected across the primary bars on the breaker side of the disconnect fingers.

MECHANISM

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

PRIMARY INSULATION PARTS

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

LUBRICATION

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

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

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

(1) Metal contact surfaces such as the movable contact rod of the interrupter should be lubricated with D6A15A1. This grease is available packaged in 4-ounce collapsible tubes to provide cleanliness and prevent oxidation.

(2) Silvered primary contact surfaces. Wipe clean and apply a light coat of D50H47 on primary disconnect fingers. General Electric lubricant D50H47 is also available packaged in 4-ounce collapsible tubes.

(3) Pins of the secondary disconnect coupler should be lightly coated with D6A15A1.

RECOMMENDED MAINTENANCE

A Power/Vac* breaker applied to normal operations should be serviced and maintained according to the following schedule:

For all ratings other than VB 4.16-350 and VB 13.8-1000 the following should be performed every 2000 operations or every year which ever comes first.

For VB 4.16-350 and VB 13.8-1000 the following should be performed every 1,000 operations or every year which ever comes first.

1. Make a visual inspection of the breaker and remove dust and contaminants from the vacuum interrupters, and insulation.

2. A high potential test should be applied to the vacuum interrupters as outlined under VACUUM INTERRUPTER INTEGRITY TEST.

3. Check the Power/Vac* contact erosion indicator as described.

4. Check the interrupter and mechanism adjustments as summarized under MECHANICAL ADJUSTMENTS. The necessary readjustments should be made as described under MECHANICAL ADJUSTMENTS.

5. The interrupters and operating mechanism should be carefully inspected for loose nuts, bolts, damaged parts, etc. All cam latch and roller surfaces should be inspected for damage or excessive wear.

6. Lubricate the breaker operating mechanism in accordance with instructions under LUBRICATION.

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

8. After the breaker has been serviced, it should be slowly closed and opened, as described in INSTALLATION, to be sure there is no binding or friction and that the movable contact of the interrupter can move to the fully opened and fully closed positions. Its electrical operation should then be checked using either the test cabinet or the test couplers.

For all ratings other than VB 4.16-350 and VB 13.8-1000 the following should be performed every 10,000 operations or every five years whichever comes first.

For VB 4.16-350 and VB 13.8-1000 the following should be performed every 5,000 operations or every five years whichever comes first.

1. At this time the breaker should be given a general overhaul and all excessively worn parts in both the mechanism and on the interrupters replaced. Such wear will usually be indicated when the breaker can not be adjusted to instruction book tolerances. This overhaul and inspection is more detailed and will require disassembly of mechanism and interrupter operating parts.
2. The interrupters and operating mechanism should also be serviced as described for 2,000 operation intervals and properly adjusted before being put back into service.

REPAIR AND REPLACEMENT

GENERAL

The following information covers in detail the proper method of removing various parts of the 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 KIND OF REPAIR WORK, ALL INTERRUPTER AND MECHANISM ADJUSTMENTS MUST BE CHECKED.

Refer to the sections on MECHANICAL AND ELECTRICAL ADJUSTMENTS.

REPLACEMENT OF INTERRUPTER

Interrupters are supplied as a complete pole unit. Four bolts holding the interrupter housing and split clamp connecting the interrupter to the operating insulator need to be removed to replace the interrupter assembly.

After the new assembly is installed reconnect the operating rod coupling clamp after slow closing the mechanism as described in MECHANICAL CHECKING AND SLOW CLOSING. Perform adjustments as described in MECHANICAL ADJUSTMENTS.

PRIMARY DISCONNECT FINGERS

Primary disconnect fingers can be removed by removing pins. Finger contact surfaces should be coated with D50H47 lubricant.

MECHANISM

Pin Retaining Rings – These rings are widely used in the ML 17 mechanism to retain pins. They can be installed and removed with a pair of standard pliers. Reuse is not recommended after removal. To remove, slowly squeeze the removal ears while pulling. To install, position on the pin groove and squeeze the installation ears closed to no more than 1/16 inch gap between ears.

Front Angle Plate – Most mechanism repairs require removal of the mechanism front angle plate for access. It is secured by ten bolts to the frame. Disconnect the counter spring and remove the indicator rod end at the close shaft crank Fig. 14 when taking the plate off. To reinstall the plate, reconnect the rod end and be sure it passes over the close manual push-button lever. Secure the bolts to 20-25 foot-pounds and reconnect the counter spring.

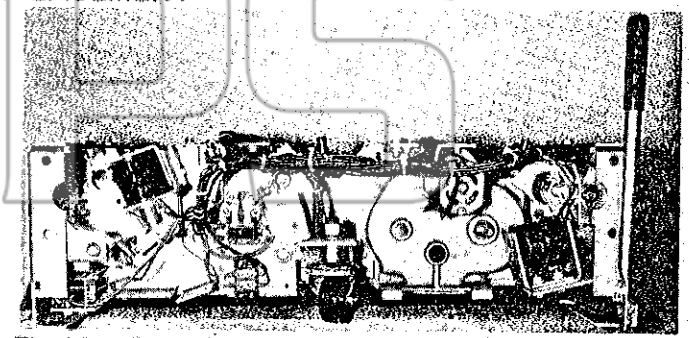


Fig. 15 ML-17 Mechanism with Front Angle Plate Removed

The front angle plate was a bearing for the manual wind shaft. Great care must be exercised if the shaft is operated without this bearing. A side thrust will break the shaft.

WIND SHAFT SHEAR PIN

A flywheel wind shaft shear pin is provided to minimize the chance of gearmotor damage if a jammed flywheel should occur. After locating and correcting the jamming condition, remove the gearmotor. Remove all pieces of the old pin, align the spline coupling and shaft holes, install a new pin, and remount the gearmotor.

CONTROL SWITCHES

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

TRIP OR CLOSE COILS

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

RENEWAL PARTS

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

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

The renewal parts list covers all breakers listed on the cover.

ORDERING INSTRUCTIONS

1. Always specify the complete nameplate data of both the breaker and the mechanism.

2. Specify the quantity, catalog number (if listed), reference number (if listed), and description of each part ordered, and this bulletin number.

3. Standard hardware, such as screws, bolts, nuts, washers, etc. is not listed in this bulletin. Such items should be purchased locally.

4. For prices or information on parts not listed in the Renewal Parts List, refer to the nearest office of the General Electric Company.

RECOMMENDED RENEWAL PARTS FOR POWER/VAC* BREAKERS WITH ML-17 MECHANISM

No. Req'd	Description	Catalog
	Spring - Charging Motor	
1	48 V-DC	0282A2034P003
1	125 V-DC & 115 V-AC, 60 Hz	0282A2034P001
1	250 V-DC & 230 V-AC, 60 Hz	0282A2034P002
	Relay	
1	48 V-DC	0282A2008P001
1	125 V-DC	0282A2008P002
1	250 V-DC	0282A2008G001
1	115 V-AC, 60 Hz	0282A2008P003
1	230 V-AC, 60 Hz	0282A2008P004
	Potential Trip Coil	
1	48 V-DC	0282A2009P007
1	125 V-DC	0282A2009P008
1	250 V-DC	0282A2009P009
	Closing Coil	
1	48 V-DC	0282A2009P001
1	125 V-DC	0282A2009P002
1	250 V-DC	0282A2009P003
1	115 V-AC	0282A2009P004
1	230 V-AC	0282A2009P005
2	Control Switch, Normally Open	0282A2097P003
1	Control Switch, Normally Closed	0282A2097P002
1	Auxiliary Switch(Prior to "-1" Change)	0177C2114P001
1	Auxiliary Switch for "-1"	0209B3410P001

RECOMMENDED RENEWAL PARTS FOR POWER/VAC* BREAKERS
WITH ML-17 MECHANISM (Continued)

No. Req'd	Description	Catalog No.
	Power/Vac* Interrupter Assemblies	
3	VB-4.16-250-1200A-58	0282A2751G041
3	VB-4.16-250-1200A-78	0282A2751G042
3	VB-4.16-250-2000A-58	0282A2751G043
3	VB-4.16-250-2000A-78	0282A2751G044
3	VB-4.16-350-1200A-78	0282A2751G045
3	VB-4.16-350-2000A-78	0282A2751G046
3	VB-4.16-350-3000A-78	0282A2751G047
3	VB-7.2-500-1200A-66	0282A2751G048
3	VB-7.2-500-1200A-78	0282A2751G049
3	VB-7.2-500-2000A-66	0282A2751G050
3	VB-7.2-500-2000A-78	0282A2751G051
3	VB-13.8-500-1200A-37	0282A2751G052
3	VB-13.8-500-1200A-58	0282A2751G053
3	VB-13.8-500-2000A-37	0282A2751G054
3	VB-13.8-500-2000A-58	0282A2751G055
3	VB-13.8-750-1200A-58	0282A2751G056
3	VB-13.8-750-1200A-77	0282A2751G057
3	VB-13.8-750-2000A-58	0282A2751G058
3	VB-13.8-750-2000A-77	0282A2751G059
3	VB-13.8-1000-1200A-77	0282A2751G060
3	VB-13.8-1000-2000A-77	0282A2751G061
3	VB-13.8-1000-3000A-77	0282A2751G062
	Primary Disconnects	
6	All 1200A Contact Assembly (Except 13.8-500)	0282A2700G001
6	2000 A Contact Assembly	0282A2700G002
6	1200 A Contact Assembly (13.8-500)	0282A2701G001
6	3000 A Contact Assembly	0282A2702G001
3	Operating Insulators	0209B3401G001

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