INSTRUCTIONS

IB-65020

PowlVac® Type PV-PVAC 38-CDR Vacuum Circuit Breaker

Installation **Maintenance** **Renewal Parts**

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WARNING

THIS EQUIPMENT MAY CONTAIN HIGH VOLTAGES AND CURRENTS WHICH CAN CAUSE SERIOUS INJURY OR DEATH.

THE EQUIPMENT IS DESIGNED FOR USE, INSTALLATION, AND MAINTENANCE BY KNOWLEDGEABLE USERS OF SUCH EQUIPMENT HAVING EXPERIENCE AND TRAINING IN THE FIELD OF HIGH VOLTAGE ELECTRICITY. THIS DOCUMENT, AND ALL OTHER DOCUMENTATION SHALL BE FULLY READ, UNDERSTOOD, AND ALL WARNINGS AND CAUTIONS SHALL BE ABIDED BY. IF THERE ARE ANY DISCREPANCIES OR QUESTIONS, THE USER SHALL CONTACT POWELL ELECTRICAL MANUFACTURING COMPANY IMMEDIATELY AT 1-800-480-7273.

CAUTION

Before any adjustment, servicing, parts replacement, or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, the **POWER SUPPLY MUST BE DISCONNECTED**. Failure to follow this caution may result in injury or death.

IMPORTANT

These instructions are not intended to explain all details or variations of the circuit breakers, nor to provide for every possible contingency or hazard to be met in connection with usage, installation, testing, operation, and maintenance of the equipment. Should further information be desired or should particular problems arise which are not covered sufficiently for the user's purposes, the matter should be referred to Powell Electrical Manufacturing Company, 1-800-480-7273.

I. INTRODUCTION

A. SCOPE

This instruction bulletin describes the following PowlVac® Type PV Vacuum Circuit Breakers:

38PV40CDR

27PV25CDR

B. PURPOSE

The content of this document is intended to provide the information and procedures required to properly operate and maintain the circuit breakers described in Section A. SCOPE.

This instruction bulletin contains the following topics:

1. Guidelines for safety
2. General descriptions of the operation and maintenance of the circuit breakers
3. Instructions for installation and placing the circuit breakers into service
4. Instructions for part replacement
5. Renewal parts lists

Some of the illustrations contained in this document may not represent the exact construction details of each particular type of circuit breaker. Furthermore, the illustrations are provided as general information to aid in showing component locations.

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

C. INSTRUCTION BULLETINS AVAILABLE ELECTRONICALLY

Many Powell Electrical Manufacturing Company instruction bulletins are posted on the company Web site at www.powellservice.com. For more information contact Powell Apparatus Service Division (PASD) at 1-800-480-7273, 713-944-6900, or visit the Web site at info@powellservice.com.

II. SAFETY

Study this instruction bulletin and all other associated documentation before uncrating the circuit breakers.

Each user has the responsibility to design and implement thorough maintenance and safety procedures for each type of equipment used. The user shall train all personnel associated with the equipment on usage, installation, operation, maintenance and safety procedures. All safety procedures must be observed.

A. GENERAL

1. Only supervised and qualified personnel who are trained in the usage, installation, operation, and maintenance of power circuit breakers shall be allowed to work on this equipment. It is mandatory that this instruction bulletin, any supplements, and service advisories are studied, understood, and followed.
2. Maintenance programs must be consistent with the customer experience and the manufacturer's recommendations, including information available in service advisories and the instruction bulletin(s). A well-planned and executed routine maintenance program is essential for circuit breaker reliability and safety.
3. Service conditions and circuit breaker applications shall be considered in the development of maintenance programs. Service conditions include variables such as ambient temperature, humidity, actual continuous current, thermal cycling, the number of operations, interrupting duty, and any adverse local conditions such as excessive dust, ash, corrosive atmosphere, vermin, and insect problems.

B. SPECIFIC

1. **DO NOT WORK ON AN ENERGIZED CIRCUIT BREAKER.** If work must be performed on a circuit breaker, remove it from service and remove it from the metal-clad switchgear.

2. **DO NOT WORK ON A CIRCUIT BREAKER WITH THE CONTROL CIRCUIT ENERGIZED.**

3. **EXTREME CARE MUST BE EXERCISED TO KEEP ALL PERSONNEL, TOOLS, AND OTHER OBJECTS CLEAR OF MECHANISMS WHICH ARE TO BE OPERATED, DISCHARGED, OR RELEASED.** These circuit breakers utilize stored-energy mechanisms. These mechanisms must be serviced only by skilled and knowledgeable personnel who are capable of releasing each spring load in a controlled manner. Detailed information regarding these mechanisms is found in this instruction bulletin.

4. **DO NOT ATTEMPT TO CLOSE THE CIRCUIT BREAKER MANUALLY ON AN ENERGIZED CIRCUIT.**

5. **DO NOT USE AN OPEN CIRCUIT BREAKER AS THE ONLY MEANS OF ISOLATING A HIGH VOLTAGE CIRCUIT. FOR COMPLETE ISOLATION, THE CIRCUIT BREAKER SHALL BE IN THE DISCONNECTED POSITION OR SHALL BE WITHDRAWN COMPLETELY.**

6. **ALL COMPONENTS SHALL BE DISCONNECTED BY MEANS OF A VISIBLE BREAK AND** securely grounded for the safety of personnel performing maintenance procedures on the circuit breakers.

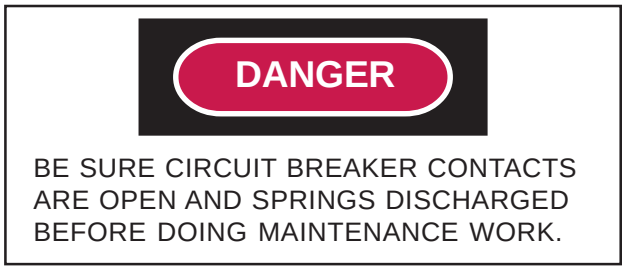
7. Interlocks are provided to ensure the proper operating sequences of the circuit breakers and for the safety of the user. **IF FOR ANY REASON AN INTERLOCK DOES NOT FUNCTION AS DESCRIBED, DO NOT MAKE ANY ADJUSTMENTS, MODIFICATIONS, OR DEFORM THE PARTS. DO NOT FORCE THE PARTS INTO POSITION. CONTACT POWELL ELECTRICAL MANUFACTURING COMPANY FOR INSTRUCTIONS.**

C. X-RAYS

When high voltage is applied across the contacts of a vacuum interrupter, there is the possibility of the generation of X-rays. The intensity of this radiation is dependent on the amount of the peak voltage and the distance of the contact gap. Radiation levels are negligible at the normal operating voltage for this type of equipment. At the voltages specified for testing, personnel must be located in front of the circuit breaker such that the two layers of steel used in the frame and front cover construction are between personnel and the vacuum interrupters. Personnel must be located no less than one meter from the front of the circuit breaker. **THE CIRCUIT BREAKER SHALL BE EITHER FULLY OPEN OR FULLY CLOSED DURING HIGH POTENTIAL TESTING. TEST SHALL NOT BE CONDUCED WITH THE CONTACTS PARTIALLY OPEN.**

D. SAFETY LABELS

Danger, warning, and caution labels are attached to the circuit breaker in various locations. Personnel must observe all **DANGER**, **WARNING**, and **CAUTION** labels while handling or maintaining the circuit breaker.



III. EQUIPMENT DESCRIPTION

A. GENERAL DESCRIPTION

The PowlVac® Type PV Vacuum Circuit Breakers consists of a Closed Door Racking Circuit Breaker (CDR). PowlVac® Circuit Beakers use sealed vacuum interrupters (Figure 1, ac) to control the primary circuit. The primary connections to the associated metal-clad switchgear are made by tubular copper bus bars that terminate in multiple contact fingers of the primary disconnecting devices. (See Figure 1, u and w.) The primary disconnecting devices, busbars, and vacuum interrupter assemblies are supported by high voltage insulators (Figure 1, ab) specifically designed for the user's application.

The primary current path side of the circuit breaker is considered the rear of the circuit breaker, while the side with the cover containing the various indicators and manual operators is considered the front of the circuit breaker. The operating mechanisms of the circuit breaker are exposed when the front cover is removed. The stored-energy mechanism assembly provides motion to each of the vacuum interrupter moving contact assemblies through operating pushrods (Figure 1, ae).

B. THE STORED-ENERGY MECHANISM

1) Mechanical Description

The stored-energy mechanism is located in the front of the circuit breaker behind the front cover. The front cover is held in place by twelve (12) cover bolts that may be removed to allow access to the stored-energy mechanism and its interlocks, auxiliary switches, and other control devices. Before removing the circuit breaker front cover, personnel shall ensure that the circuit breaker is in the "**OPEN**" position, as indicated on the open/closed indicator. (See Figure 1, m.) The main closing spring (Figure 2, h) must be fully discharged before the front cover is removed. **FAILURE TO DO THIS MAY RESULT IN PERSONAL INJURY.**

The escutcheon on the stored-energy mechanism, has two (2) indicators that display the various operation states of the mechanism, and two (2) manual operators that are used to open or close the stored-energy mechanism. The circuit breaker nameplate (Figure 1, e) is also located on the mechanism escutcheon. If, for any reason, the escutcheon is removed from the circuit breaker, personnel shall verify that the serial number that appears on the nameplate matches the engraved serial number plate permanently affixed to the rear of the circuit breaker frame, (Figure 1, af) before to reinstalling the escutcheon.

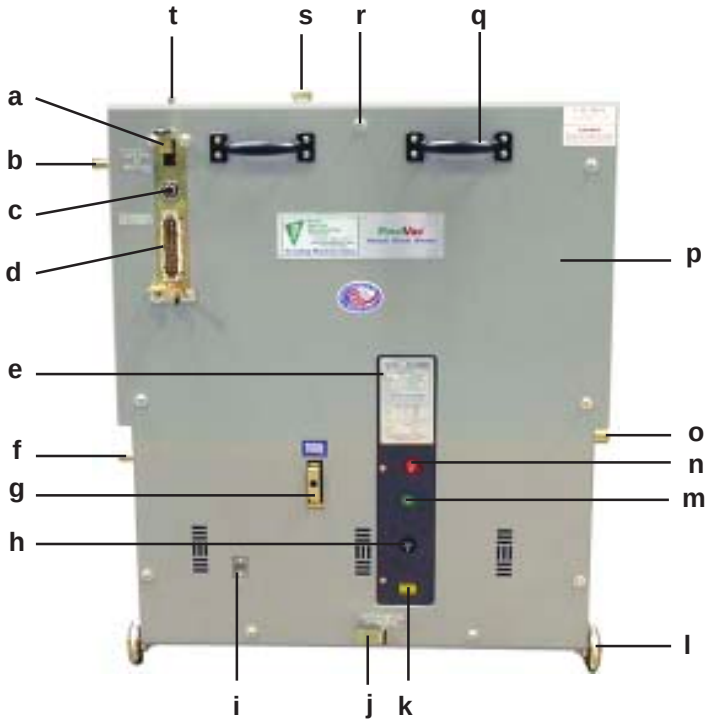
The mechanism employed in the circuit breaker is a stored-energy system that uses a charging motor to compress the main closing spring. During the closing operation the energy stored in the main closing spring is released. This allows the mechanism to close the vacuum interrupter contacts, compress the contact loading springs, charge the opening springs, and overcome frictional forces. When the circuit breaker is opened, the energy stored in the opening and contact loading springs is released, and the vacuum interrupter contacts are opened.

The charging motor (Figure 2, f), located on the bottom right of the base pan, is assembled to the circuit breaker by a bracket that is bolted to the base pan. The charging motor drive shaft inserts into the eccentric drive shaft. The eccentric drive shaft is supported by needle roller bearings in the mechanism frame side sheets. The eccentric drive shaft transmits the motor torque to the left side of the mechanism.

When the charging motor is energized, the eccentric drive shaft rotates and causes the pawl support arms to pivot about the camshaft (Figure 2, m). The drive pawl, which is supported by the arms, engages with the ratchet wheel and drives the ratchet wheel one tooth at a time. To prevent backwards motion of the ratchet wheel, a spring-loaded holding pawl is used to latch the ratchet wheel after each advance from the drive pawl.

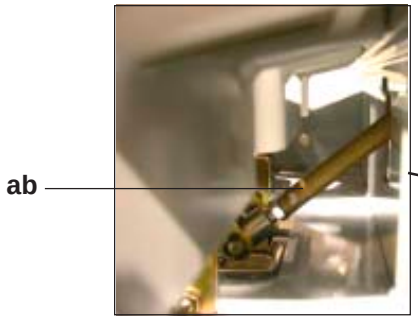
To ensure correct synchronization of the drive and holding pawl, the position of the holding pawl support arms are adjustable by the holding pawl adjusting eccentric (Figure 2, u) located at the left front of the mechanism. When the mechanism is operated manually, the top pawl becomes the drive pawl and the bottom pawl becomes the holding pawl.

The ratchet wheel (Figure 2,af) has projections from its side faces which engage the drive plates as it rotates. These drive plates, which are attached to the camshaft, cause the camshaft to rotate. Attached to the ends of the camshaft are crank arms (Figure 2, s). Crank pins (Figure 2, r) are assembled to the crank arms, which point outward. The crank arms engage the bottom ends of the connecting rods (Figure 2, h). The pins that project from the spring yoke, which straddles the main closing spring, engage the top ends of the connecting rods. As the camshaft rotates the connecting rods pulls the spring yoke downward, compressing the main closing spring.

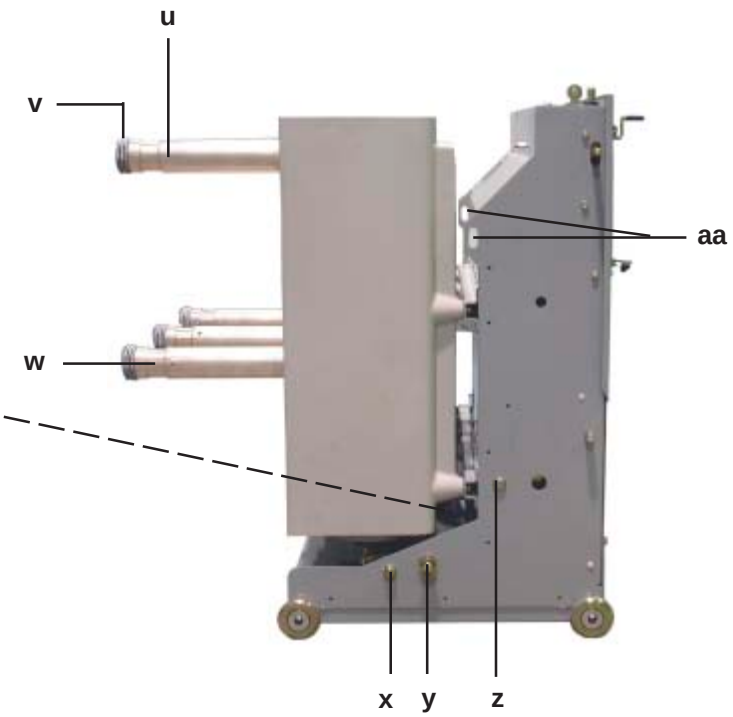


Front

a. *Secondary Disconnect Latch*
b. *Horizontal Secondary Disconnect Blocking Pin*
c. *Secondary Disconnect Blocking Pin Sleeve*
d. *Secondary Disconnect Receptacle*
e. *Nameplate*
f. *TOC Actuator*
g. *Manual Charging Crank*
h. *Manual Close Operator*
i. *Operations Counter*
j. *Anti-Rollout Latch*
k. *Spring Charge Indicator*
l. *Wheel*
m. *Circuit Breaker Open/Closed Indicator*
n. *Manual Trip Operator*
o. *MOC Actuator*
p. *Front Cover*
q. *Handle*
r. *Front Cover Bolts*
s. *Push to Trip Roller*
t. *Secondary Disconnect Blocking Pin*



Operating Arm Assembly (located between B phase and the mechanism)



Left Side

Figure 1. Standard Closed Door Racking Circuit Breaker (1 of 2)

u. *Upper Primary Disconnect Device*
v. *Primary Disconnect Device Spring*
w. *Lower Primary Disconnect Device*
x. *Main Shaft Pin*
y. *Shutter Operator*
z. *Jackshaft Pin*
aa. *Lifting Points*
ab. *Operating Arm Assembly*

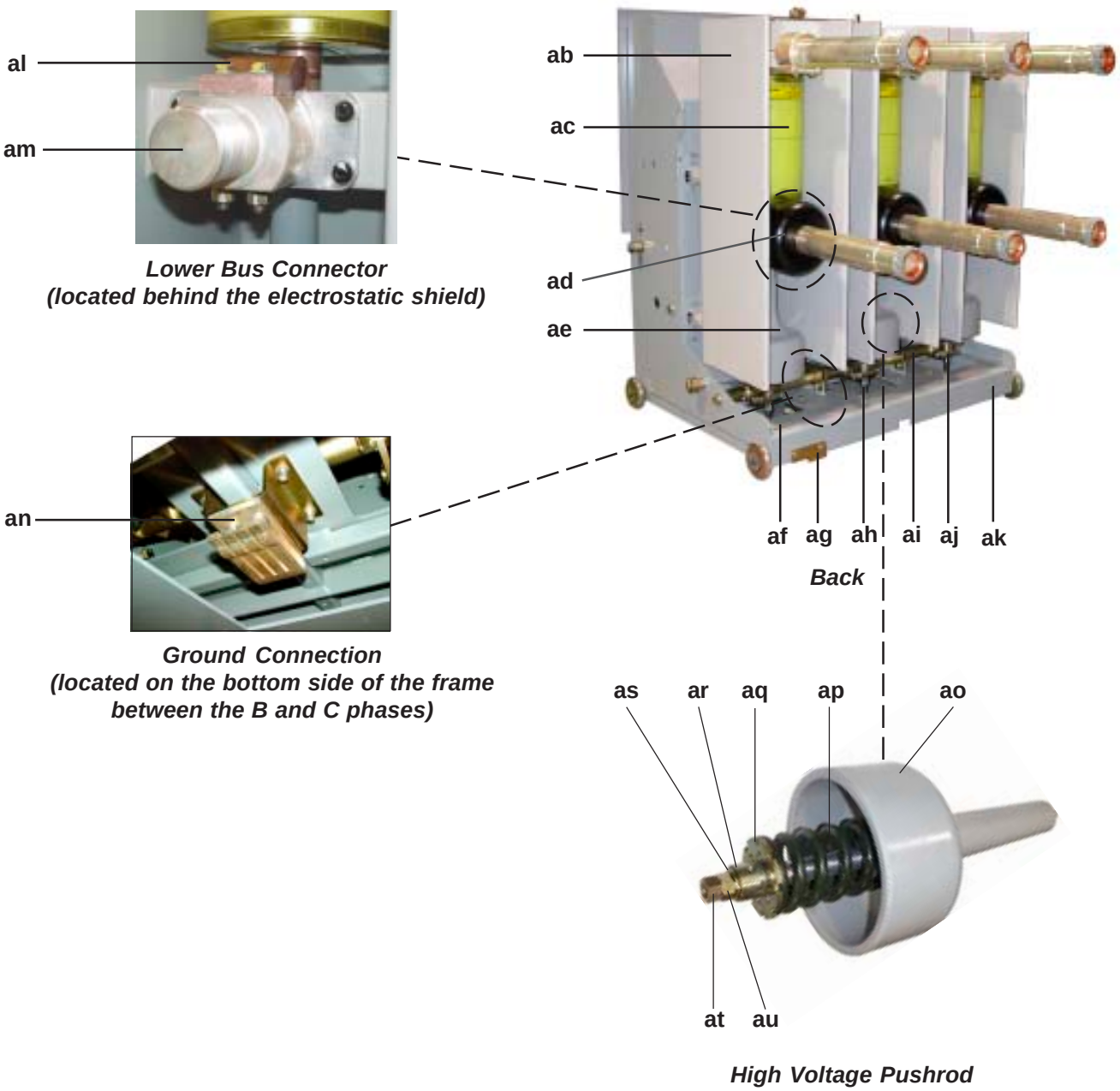


Figure 1. Standard Closed Door Racking Circuit Breaker (2 of 2)

ab. High Voltage Insulator
ac. Vacuum Interrupter
ad. Electrostatic Shield
ae. Operating Pushrod
af. Serial Number Plate
ag. Interference Plate
ah. Lock Nut
ai. Main Shaft
aj. High Voltage Pivot
ak. Frame
al. Shunt
am. Lower Bus Connector
an. Ground Connection
ao. High Voltage Pushrod
ap. Contact Loading Spring
aq. High Voltage Regulator Disk
ar. High Voltage Spacer
as. Flat washer
at. Jam Nut
au. Hex Head Nut

The ratchet wheel drives the camshaft so that the connecting rods go down to their lowest position, and then start to move upward. At a certain point, the spring force overcomes the friction and resistance and start to rotate the camshaft. At the same time, the pawls are uncoupled from the ratchet wheel by the pawl lift plate (Figure 2, aa) and the motor cutoff switch is operated. The motor cutoff switch (Figure 2, k), located at the right of the mechanism, is operated by the spring charge indicator and motor cutoff cam (Figure 2, i). The spring charge indicator (Figure 1, k) will display that the mechanism is charged.

The camshaft would continue to rotate, except that it is restrained by the close latch arm (Figure 2, ae) engaging against the close latch shaft (Figure 2, ad). The main closing cam, located between the mechanism side sheets, is now in a position where the fundamental linkage can move to the reset position.

The close latch, when released either by the closing coil or the manual close operator, allows the main closing spring to pull the crank arms upward thus rotating the main closing cam and driving the fundamental linkage into the closed position. This causes the main linkage to rotate the jackshaft such that the operating arm assembly (Figure 1, ab) is driven toward the current carrying side of the circuit breaker. This action then drives the pushrod upwards.

Each operating pushrod assembly has a recess at each end which encloses a contact loading spring (Figure 1, ao). The contact loading spring inside the pushrod has initial compression such that as soon as the vacuum interrupter contacts touch, the springs are preloaded to a value sufficient to resist vacuum interrupter contact separation under the highest electromagnetic forces exerted by the rated short-circuit current. Further movement of the operating pushrod assembly compresses the contact loading spring even more and produces a gap between the Flat Washer and the bottom of the Pivot. This “nut gap” is used to evaluate the erosion of the vacuum interrupter contacts.

In the cam and fundamental linkage positions shown in Figures 3b and 3d, the contact loading springs and the main opening springs are both acting to compress the three (3) main mechanism links. The jackshaft extends from the left to the right side of the circuit breaker frame and is supported at the main circuit breaker frame side sheets and by the mechanism side sheets. The outer operating levers on the jackshaft have connections to the circuit breaker opening springs (Figure 2, b and c).

The fundamental linkage is restrained from movement by the secondary trip prop acting on the primary trip prop roller. A component of force tends to make the primary trip prop rotate upward, but it is restrained by the secondary trip prop face acting on the primary trip prop roller. The clearance between the primary trip prop roller and the secondary trip prop is controlled by the primary trip prop adjusting screw. When the trip shaft is rotated by the action of the manual trip operator or the primary shunt trip coil, the secondary trip prop face moves downward and permits the primary trip prop to rotate upward, thus permitting the main linkage to move upward and the jackshaft to rotate, which opens the circuit breaker. The jackshaft levers engage shock absorbers (Figure 2, d), which control the rebound of the vacuum interrupter contacts on an opening operation.

With the standard electrical control scheme, as soon as the main closing spring is discharged on a closing operation, the charging motor is switched on to recharge the springs. This leaves the main closing cam in a position where a tripped linkage can reset under the action of the reset spring (Figure 2, w) and the primary and secondary trip props can fall into the reset position. The reset spring stretches between an extension of the main cam roller pin and a spring support pin located on the left mechanism side sheet. The latch check switch (Figure 2, o), operated by a lever on the trip shaft, closes as the secondary trip prop reaches the fully reset position.

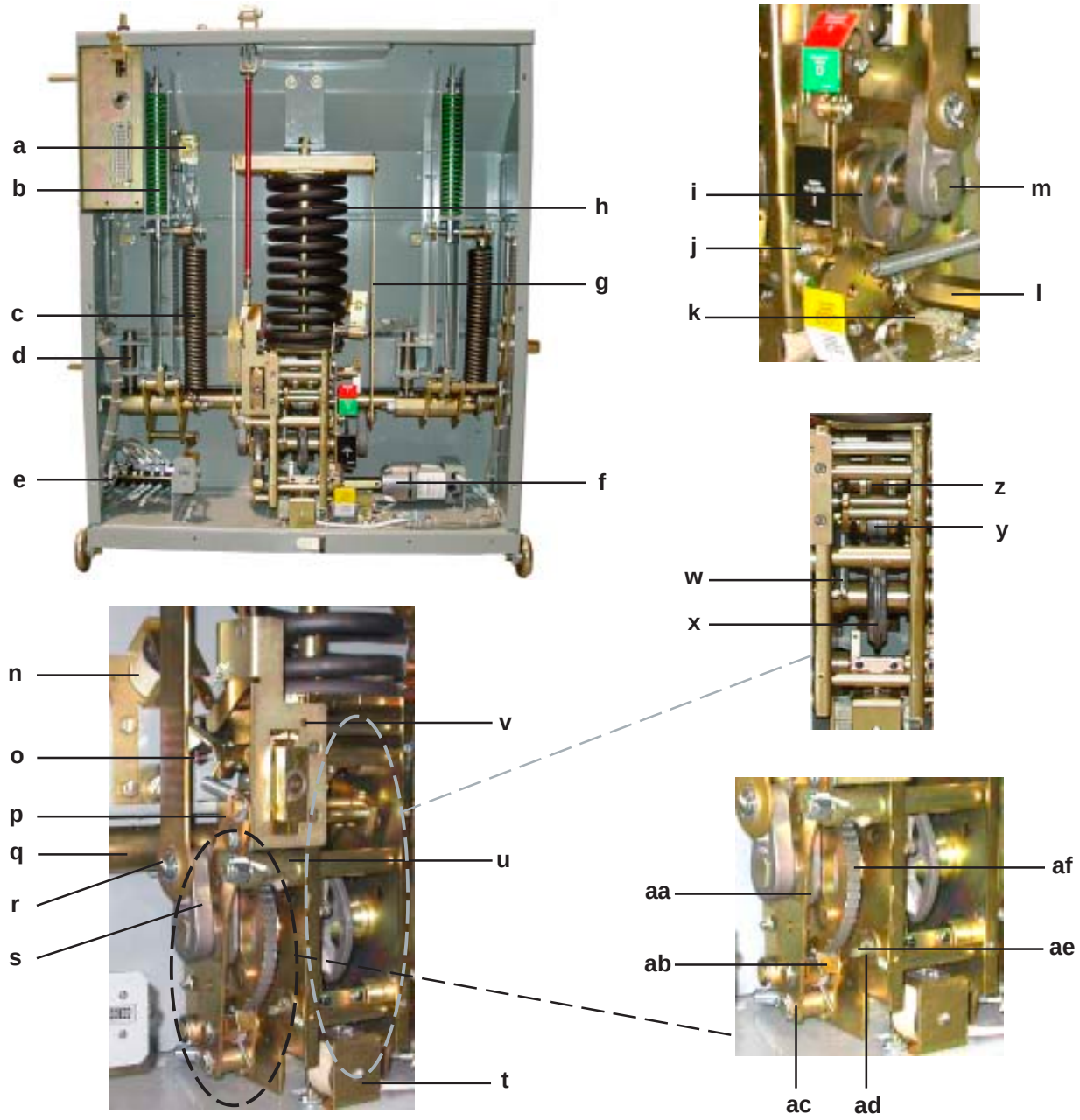


Figure 2. Closed Door Racking (CDR) - Interior View (Front Cover Removed)

a. *Anti-Pump Relay*
b. *Opening Kick-off Spring*
c. *Opening Anti-bellow Spring*
d. *Shock Absorber*
e. *Auxiliary Switch*
f. *Charging Motor*
g. *Connecting Rod*
h. *Main Closing Spring*
i. *Motor Cutoff Cam*
j. *Close Bar Adjusting Screw*
k. *Motor Cutoff Switch*
l. *Charging Motor Drive Shaft*
m. *Camshaft*
n. *Primary Shunt Trip Coil*
o. *Latch Check Switch*
p. *Holding Pawl Support Arm*
q. *Jackshaft*
r. *Crank Pin*
s. *Crank Arm*
t. *Closing Coil*
u. *Holding Pawl Adjusting Eccentric*
v. *Secondary Trip Prop Adjusting Screw (Located behind the plate. Access through the hole.)*
w. *Reset Spring*
x. *Main Closing Cam*
y. *Main Cam Roller*
z. *Secondary Trip Prop*
aa. *Pawl Lift Plate*
ab. *Drive Pawl*
ac. *Pawl Support Arm*
ad. *Close Latch Shaft*
ae. *Close Latch Arm*
af. *Ratchet Wheel*

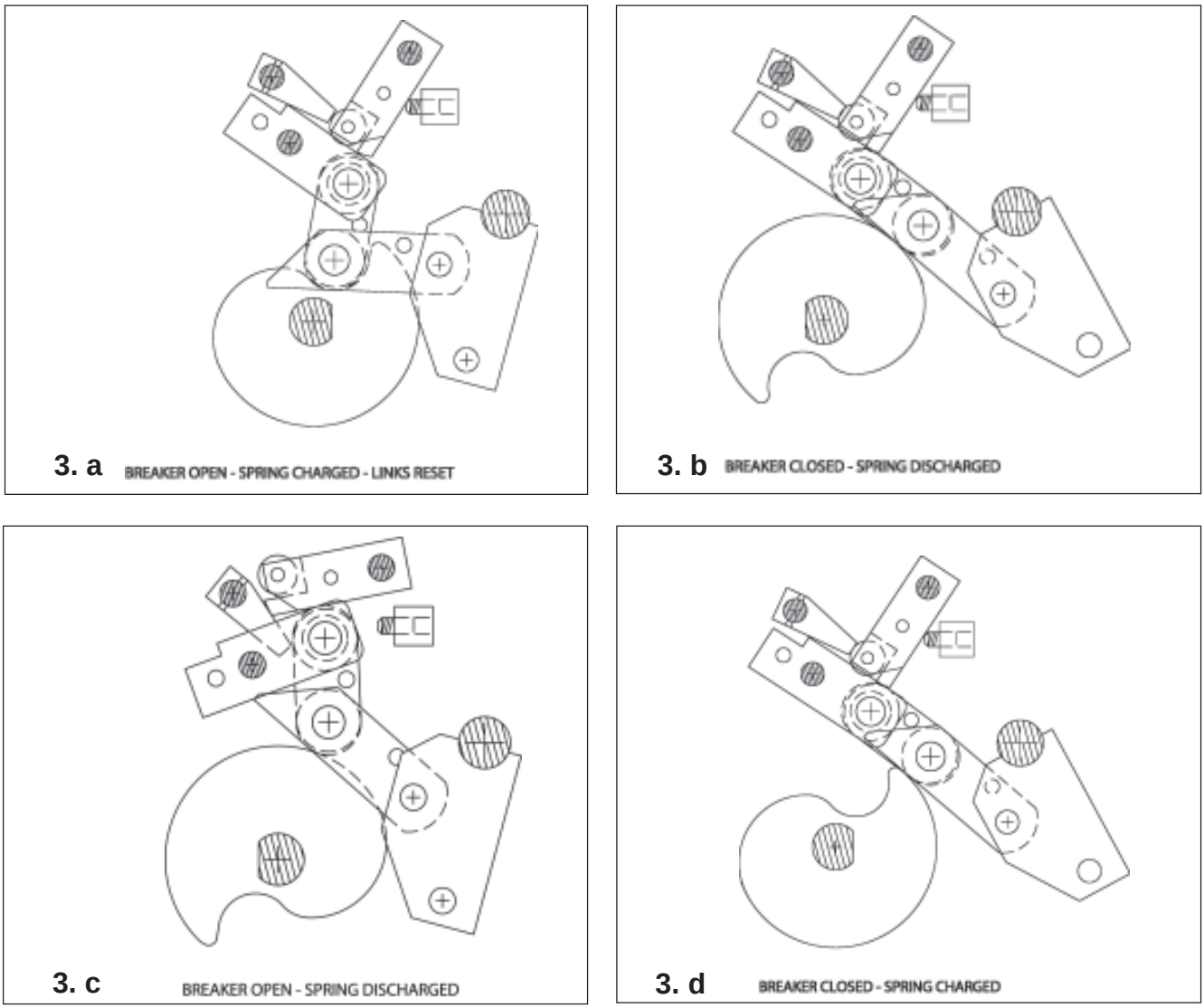
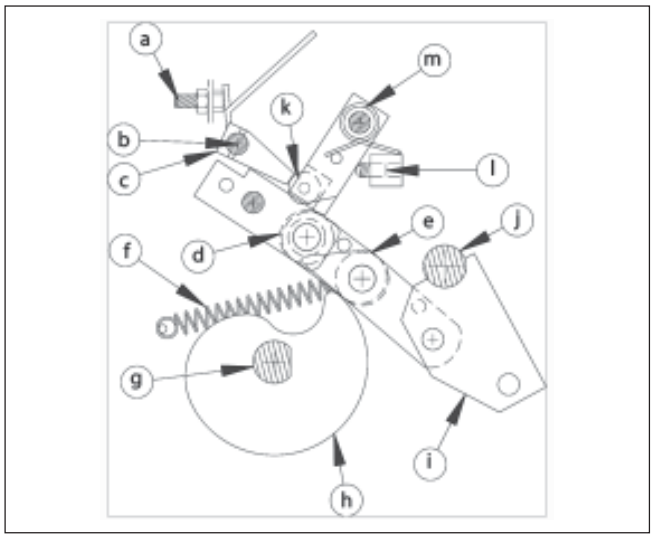


Figure 3. Cam and Fundamental Linkage Positions



a. Secondary Trip Prop Adjusting Screw
b. Secondary Trip Prop Shaft
c. Secondary Trip Prop
d. Secondary Linkage Roller
e. Main Cam Roller
f. Reset Spring
g. Camshaft
h. Main Closing Cam
i. Center Phase Operating Lever
j. Jackshaft
k. Primary Trip Prop Roller
l. Primary Trip Prop Adjusting Screw
m. Primary Trip Prop

Figure 4. Mechanism and Trip Linkages

2) Electrical Description

a) Charging Motor

The function of the charging motor (Figure 2, f) is to compress the main closing spring of the stored-energy mechanism, thus providing the necessary energy to close the circuit breaker. The charging motor, located at the bottom right of the base pan, is assembled to the circuit breaker by a bracket that is bolted to the base pan.

b) Motor Cutoff Switch

The motor cutoff switch (Figure 2, k) provides an electrical break in the control circuit that supplies the charging motor when the main closing spring is fully charged and the stored-energy mechanism is ready for a closing operation. The motor cutoff switch is located at the bottom right of the mechanism, and is supported by a bracket which is bolted to the circuit breaker base pan.

c) Anti-Pump Relay

The anti-pump relay (Figure 2, a) provides a logic function for the control circuit, which prevents a continuous electrical close signal from causing the circuit breaker to continuously re-close after a trip signal. The anti-pump relay is located on the circuit breaker frame, to the left of the connecting rod, and is supported by two screws.

d) Operating Solenoids

Electrical operation of the circuit breaker is accomplished using operating solenoids.

The closing coil (Figure 2, t) is an operating solenoid that is located at the bottom center of the mechanism, and is assembled to the circuit breaker base pan by bolts accessible from underneath the circuit breaker.

The primary shunt trip coil (Figure 2, n) is located at the top left side of the mechanism, and is assembled to the lower frame channel by two bolts.

Either a secondary shunt trip coil or an undervoltage device may be furnished as an option. When furnished, either of these devices will be located at the top right side of the mechanism, installed on the lower frame channel. Only one of these two operating solenoids may be furnished on any one circuit breaker, as both devices are located in the same space.

e) Control Circuit

Typical AC and DC electrical control schemes are shown in Figure 6 and Figure 7. The control scheme of any particular circuit breaker may differ from these typical schemes depending on the user's requirements, operating solenoids, and the control devices furnished with that circuit breaker.

The sequence of operation for all control schemes is shown in Figure 5. Circuit breaker mounted auxiliary contacts that are not used in the control circuit are brought out for control and indication functions. The metal-clad switchgear equipment may provide a circuit breaker MOC (Mechanism-Operated Contact) for additional contacts.

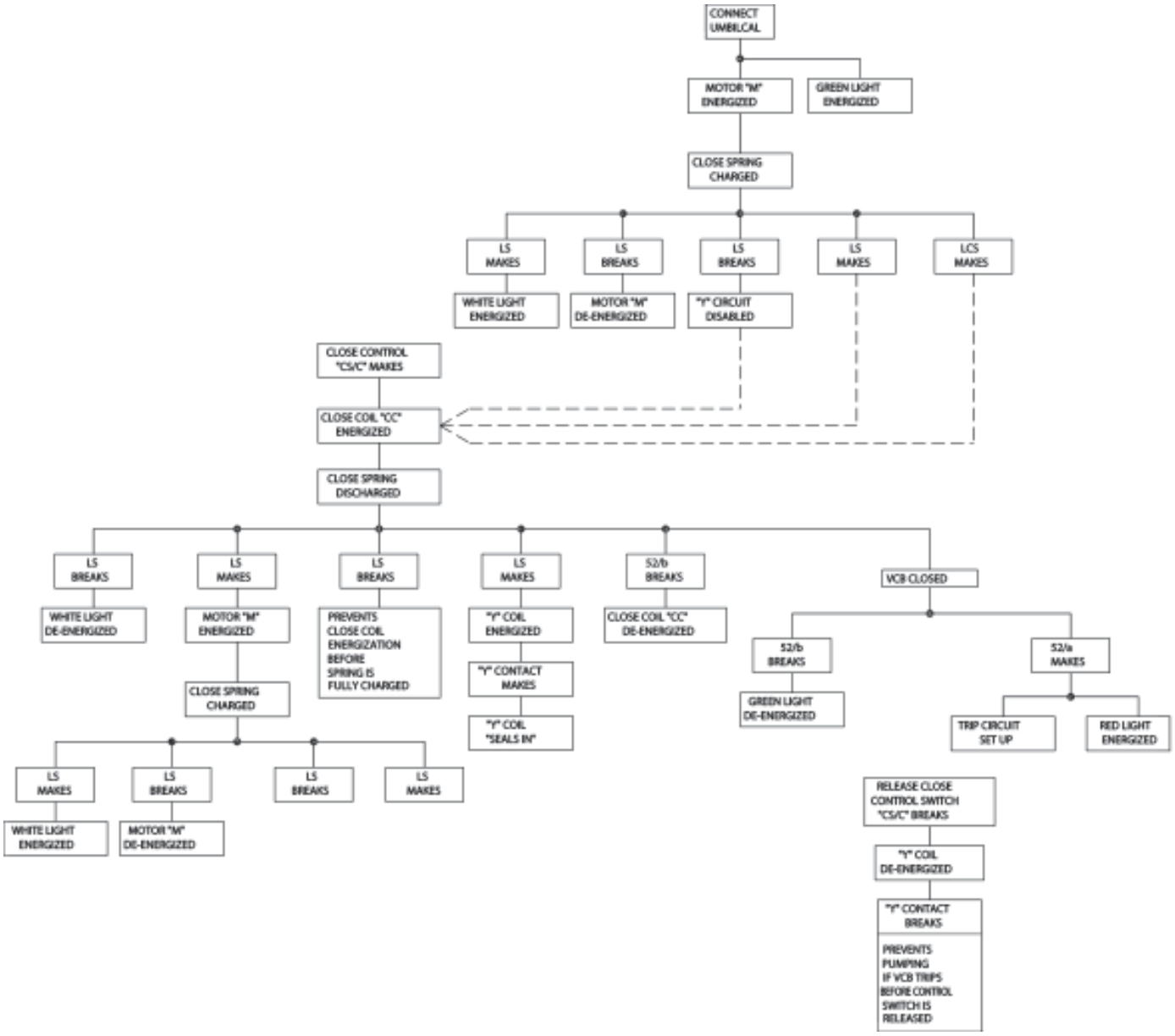
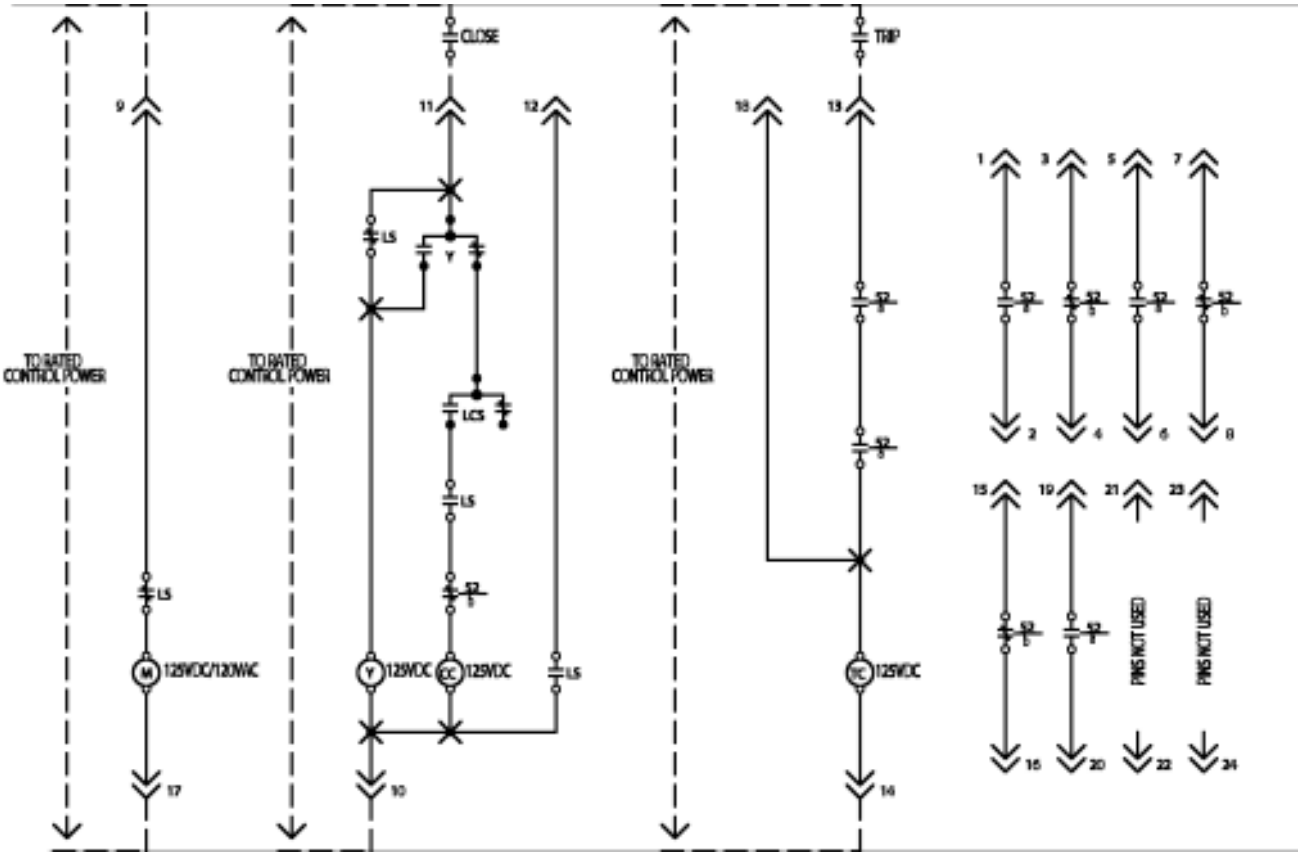


Figure 5. Operation Sequence



DEVICE IDENTIFICATION

LS = Spring Charge Limit Switch (shown with spring discharged)

LCS = Latch Check Switch (shown with spring discharged)

Y = Anti-Pump Relay

TC = Breaker Trip Coil

CC = Breaker Close Coil

M = Charging Motor

52/a = Breaker Auxiliary Contact (normally open)

52/b = Breaker Auxiliary Contact (normally closed)

SD = Breaker Secondary Disconnect ( ) ⩛

Figure 6. Typical Control Scheme

C. RACKING MECHANISM

The racking mechanism is the mechanical assembly that facilitates moving the circuit breaker between the breaker test/disconnected and the connected positions in the circuit breaker compartment. The main racking mechanism is located in the switchgear.

NOTE: *Refer to the information bulletin, IB-65000 Powell System PV38 - 38kV Switchgear for racking information. To access instruction bulletins, visit the Powell Web site at info@powellservice.com or to order instruction bulletins, call 1-800-480-7273.*

D. CIRCUIT BREAKER COMPARTMENT INTERFACES

1) Primary Disconnecting Devices

There are six primary disconnecting devices on the circuit breaker. The devices are arranged, two per phase, with the upper device connected to the stationary end of the vacuum interrupter, and the lower device connected to the moving end of the vacuum interrupter assembly. Each primary disconnecting device (Figure 1, u and w) has multiple contact fingers which will mate with the stationary primary disconnecting devices in the circuit breaker compartment. **DO NOT HANDLE OR MOVE THE CIRCUIT BREAKER BY THE PRIMARY DISCONNECTING DEVICES, AS DAMAGE MAY OCCUR.**

2) Secondary Disconnecting Devices

Control power is transferred from the metal-clad switchgear to the circuit breaker by means of the secondary disconnect device. The secondary disconnect receptacle (Figure 1, d) is located on the top left side of the circuit breaker. The secondary disconnect plug is attached to the switchgear and is located on the left side wall of the circuit breaker compartment. This arrangement allows the secondary connection to be visible in all positions of the circuit breaker.

3) MOC (Mechanism-Operated Contact) Actuator

The MOC, located in the switchgear, is operated by a lever which extends from the circuit breaker operating mechanism. Movement of the MOC actuator (Figure 1, o) is directly related to the movement of the circuit breaker mechanism and contacts.

4) TOC (Truck-Operated Contact) Actuator

The TOC, located in the switchgear, is operated by circuit breaker truck position. To accomplish this, a TOC actuator (Figure 1, f) is located on the middle, left side of the circuit breaker frame and it is designed to strike the TOC as the circuit breaker travels to the connected position.

5) Ground Connection

The ground connection is an assembly of spring-loaded fingers that effectively grounds the circuit breaker frame as it is inserted into the circuit breaker compartment. The ground connection (Figure 1, al) is located on the bottom side of the frame between the B and C phases. An extension of the metal-clad switchgear ground bus is secured to the circuit breaker compartment floor and engages the ground connection as the circuit breaker is placed into the disconnected position. The ground connection system remains engaged in all subsequent positions of the circuit breaker until the circuit breaker is removed from the compartment.

6) Shutter Rollers

The circuit breaker travels between the test/disconnected and connected positions as the racking mechanism is turned. This action also drives the compartment shutters to open/close which allows the primary disconnecting devices to connect or disconnect. (See Figure 1, y.)

7) Anti-Rollout Latch

The circuit breaker is equipped with an anti-rollout latch (Figure 1, j) which prevents inadvertent removal from the circuit breaker compartment by engaging a block in the circuit breaker compartment.

E. VACUUM INTERRUPTERS

PowlVac® circuit breakers utilize sealed vacuum interrupters to control the primary circuit. Some vacuum interrupters appear to be identical in size and shape externally, but types vary in ratings due to the differences in their internal construction. For a listing of the vacuum interrupters used in PowlVac® circuit breakers see Table E. VACUUM INTERRUPTERS MUST BE REPLACED ONLY WITH NEW VACUUM INTERRUPTERS OF THE SAME PART NUMBER.

F. VACUUM INTERRUPTER CONNECTION

Connection to the vacuum interrupter is made by means of copper pads. The top stem of the vacuum interrupter has a copper pad for attaching the bus. The pad contact block and the bars are bolted together and in turn are assembled to the upper

primary disconnecting devices of the circuit breaker. Another copper contact block is clamped to the bottom or moving stem of the vacuum interrupter. The shunt (Figure 1, al) is bolted to the copper contact block and lower primary disconnecting devices.

IV. INSTALLATION

A. RECEIVING

Inspect the circuit breaker for any signs of damage when it is received. If damage is found or suspected, immediately file applicable claims with the transportation company and notify the nearest representative of Powell Electrical Manufacturing Company.

The estimated size and weight of the PVAC 38-CDR Vacuum Circuit Breaker, when it is crated and placed on a pallet is:

Size: 42" width x 42" depth x 47" height
Weight: 750 lbs.

Figure 7 shows the circuit breaker enclosed in the carton and strapped to a shipping pallet. The carton, which contains the circuit breaker, is attached to the pallet by two metal bands. Remove the metal bands and lift the carton to remove it from the circuit breaker. With the carton removed, there are two more metal bands that attach the circuit breaker to the pallet. Remove the two metal bands from the circuit breaker and the pallet, and remove the circuit breaker from the shipping pallet. For more information on circuit breaker recommended moving and handling procedures, refer to Section B. HANDLING.

Figure 7. Circuit Breaker in Shipping Carton

B. HANDLING

To avoid personal injury while handling circuit breakers, personnel should not stand under the raised circuit breaker nor place hands or feet under the circuit breaker frame as it is being lowered.

After the circuit breaker has been removed from its shipping pallet, the preferred method for moving and handling a circuit breaker is to roll it on its own wheels on a level surface. When rolling the circuit breaker, it should be pushed and steered by the circuit breaker frame or by the handles on the front cover. **DO NOT HANDLE OR MOVE THE CIRCUIT BREAKER BY THE PRIMARY DISCONNECTING DEVICES, AS DAMAGE TO THE CIRCUIT BREAKER MAY OCCUR.**

A lift truck (Figure 8) or an overhead crane (Figure 9) can also be used to move the circuit breaker.

When using a lift truck, load the circuit breaker front first on the lift. Ensure the circuit breaker is secure after loading it on the lift truck.

Figure 8. Circuit Breaker Lift Truck

Figure 9. Circuit Breaker and Crane Hooks

When using an overhead crane to move the circuit breaker, insert the crane hooks into the two lifting holes located on the top sides of the circuit breaker frame (Figure 9). The circuit breaker will tilt backward when it is lifted by a crane. Therefore, when setting down the circuit breaker, it will be necessary to guide the circuit breaker to ensure that all four wheels are placed on a level surface. Use the front handles or top front frame to guide the circuit breaker to an upright position on a level surface.

C. STORAGE

It is recommended that the circuit breaker be placed into service immediately in its permanent location after completing the commissioning tests. If this is not possible, the following precautions must be taken to ensure the proper storage of the circuit breaker:

1. Since moisture has an adverse effect on the insulating parts, the circuit breaker should be carefully protected against condensation, preferably by storing it in a warm dry room of moderate temperature, such as 40°-100°F. Circuit breakers used in outdoor metal-clad switchgear should be stored in the equipment only when power is available and the anti-condensation heaters are in operation.

2. The circuit breaker should be stored in a clean location, which is free from corrosive gases and fumes. Particular care should be taken to protect the equipment from moisture and cement dust, as this combination has a corrosive effect on many circuit breaker parts.

3. Unplated surfaces, such as, rollers, latches, etc., should be coated with grease or oil to prevent rusting.

If the circuit breaker is stored for any length of time, it should be inspected periodically for rust and to ensure it is in good mechanical condition. Should the circuit breaker be stored under adverse atmospheric conditions, it should be cleaned and dried before performing the commissioning tests and before placing the circuit breaker into service.

D. PLACING THE CIRCUIT BREAKER INTO SERVICE

Before shipment from the factory, all circuit breaker functions are thoroughly checked. The user must verify functions after receipt. Powell Electrical Manufacturing Company recommends that the tests be performed in the sequence listed below:

1. High Voltage Insulation Integrity
2. Vacuum Integrity
3. Control Voltage Insulation Integrity
4. Mechanical Operation Check
5. Electrical Operation Check

1) High Voltage Insulation Integrity

CAUTION

HIGH VOLTAGES across the open gaps of the vacuum interrupter can produce RADIATION. Personnel should stand at least one meter away from the circuit breaker, with the covers in place, when conducting high voltage tests.

Test voltages SHOULD NOT exceed 40 kVAC (60 kVDC) for circuit a breaker with a rated maximum voltage of 27 kV, and 60 kVAC (60 kVDC) for a circuit breaker with a rated maximum voltage of 38 kV.

The primary circuit insulation on the circuit breaker may be checked phase-to-phase and phase-to-ground using a 2500V insulation resistance tester. Since definite limits cannot be given for satisfactory insulation values when testing with an insulation resistance tester, a record should be kept of the insulation resistance tester readings, as well as the temperature and humidity readings. The records should be used to detect any weakening of the insulation system from one check period to the next.

To check insulation integrity, the AC high potential test described below is strongly recommended. Performing DC testing is not the preferred method, however, values are provided due to the availability of DC test sets.

The circuit breaker insulation should be tested with the circuit breaker vacuum interrupter contacts in the

CAUTION

If DC high potential testing is performed, the DC high potential test machine must not produce instantaneous peak voltages exceeding 60kV.

closed position. Test each pole of the circuit breaker separately, with the other 2 poles and the frame grounded. Perform the field dielectric test described in ANSI Standard C37.20.2, at the voltage level appropriate for the equipment. This test should check all primary phase-to-ground and phase-to-phase insulation. (See Table A.)

Table A. Field Dielectric Test Values

Rated Maximum Voltage (kV rms)	Power Frequency Withstand (kV rms)
27.5	45
38	60

WARNING

After the high potential is removed, an electrical charge may be retained by the vacuum interrupters. Failure to discharge this residual electrostatic charge could result in an electrical shock. All six primary disconnecting devices of the circuit breaker and the metallic mid band ring, if present, should be grounded and remain grounded for at least one minute to reduce this electrical charge before coming into contact with the primary circuit.

CAUTION

Remove all grounding conductors applied for this test before placing the circuit breaker back into service.

The tests described in this section are the only tests required to determine the insulation integrity. Because of the design of the PowlVac® insulation system, no valid data can be obtained using other types of high-voltage insulation tests.

2) Vacuum Integrity

CAUTION

Applying abnormally high voltage across a pair of contacts in vacuum may produce X-radiation. The radiation may increase with increased voltage and/or decreased contact spacing.

X-radiation produced during this test with the voltage specified in Table A and normal contact spacing is extremely low and well below the maximum permitted by standards.

Do not apply voltage that is higher than the recommended value. Do not use contact separation that is less than the normal open position separation of the circuit breaker contacts.

Powell recommends AC testing for reliable verification of vacuum integrity. All PowlVac® 27kV and 38kV circuit breakers shall be tested with a minimum of 60 kVAC applied across fully open contacts for 10 seconds. No dielectric breakdown during the test period constitutes a successful test.

NOTE: *This test does not replace the AC high potential testing (HIPOT) used to determine "High voltage insulation integrity." See section IV. INSTALLATION, PLACING THE CIRCUIT BREAKER INTO SERVICE, 1) High Voltage Insulation Integrity.*

Powell offers a compact and lightweight PowlVac® Vacuum Integrity Tester designed specifically for PowlVac® circuit breakers. If the tester device is used, refer to the instruction bulletin provided with the vacuum integrity tester.

Powell recognizes the widespread use of DC hipot equipment to verify vacuum integrity. However, the capacitive component of the vacuum interrupter during DC testing may yield false negative test results, which are often misinterpreted as vacuum interrupter failure. When DC testing is performed, a test set providing a full wave rectified 60 kVDC hipot voltage can be applied for 5 seconds as a "go - no go" test.

It is not necessary to record the leakage readings because a dielectric breakdown will trip all portable DC hipot test sets. If a DC test breakdown occurs, the test must be repeated after reversing the DC high voltage test supply connection across the vacuum interrupter. Only when the vacuum interrupter has failed both tests should the operation condition be questioned.

CAUTION

When testing with DC, use a DC High potential test (HIPOT) set with FULL WAVE RECTIFICATION. DO NOT use these half-wave rectifiers. The capacitance of the vacuum interrupter, in combination with the leakage currents in the rectifiers and its DC voltage measuring equipment, may result in applying peak voltages as much as three times the measured voltage. These abnormally high voltages may give a false indication of a defective vacuum interrupter, and may produce abnormal X-radiation.

CAUTION

If DC high potential testing (HIPOT) is required, the DC high potential test machine must not produce instantaneous peak voltages exceeding 50 kV.

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

3) Control Voltage Insulation Integrity

If the user wants to check the insulation integrity of the control circuit, it may be done with a 500-volt or 1000-volt insulation resistance tester or with an AC high potential tester. The AC high potential test should be made at 1125 volts, 50 or 60 Hz for one minute. The charging motor must be disconnected prior to testing the control circuit. The charging motor itself may be similarly tested at a voltage not to exceed 675 volts, 50 or 60 Hz. Be sure to remove any test jumpers and reconnect the charging motor when the tests are complete.

4) Mechanical Operation Check

The user may check the mechanical operation of the circuit breaker by inserting the manual charging handle into the manual charging crank and pushing down until a metallic click is heard. (The click indicates that the holding pawl has dropped into place on the ratchet wheel.) Lift the handle until it is horizontal and then depress it. The procedure is repeated until the spring charge indicator indicates **"CLOSING SPRING CHARGED."** This requires about 60 operations of the handle. Remove the handle when the closing spring is charged.

CAUTION

Care must be exercised to keep personnel, tools, and other objects clear of the mechanism that are to be operated or released.

Push the manual close operator (Figure 1, h) inward and the circuit breaker will close. The circuit breaker open/closed indicator, located above the manual close operator, will now display **"BREAKER CLOSED."** Push the manual trip operator (Figure 1, n) inward, which is located at the top of the escutcheon and the circuit breaker open/closed indicator will now display **"BREAKER OPEN."**

5) Electrical Operation Check

To check the basic electrical operation of the circuit breaker, it must be placed in a circuit breaker test cabinet. Connect the secondary disconnect from the test cabinet to the circuit breaker to be tested. The test cabinet provides control voltage via a secondary disconnect plug to the circuit breaker and the appropriate control switches to verify the close and open functions of the circuit breaker. Specialized versions of the test cabinet may also contain circuits for circuit breakers equipped with dual shunt trip coils, undervoltage devices, or other options. With the secondary disconnect plug installed in the circuit breaker under test, operate the power switch on the test cabinet. The charging motor will automatically charge the stored-energy mechanism's main closing springs. Operation of the control switch on the front door of the test cabinet to the **"CLOSE"** position will cause the circuit breaker to close.

The circuitry is arranged to cause the charging motor to operate again and charge the main closing spring. Operating the control switch on the front door of the test cabinet to the **"OPEN"** position will cause the circuit breaker to open.

CAUTION

The MOC actuator is exposed when the circuit breaker is outside the metal-clad switchgear and can cause serious injury if the test personnel or any object is in the travel path during operation. Care should be taken to isolate the MOC side of the circuit breaker for these tests.

An alternate method for the electrical operation check is to use a test jumper cable to electrically operate the circuit breaker using the control circuitry of the circuit breaker compartment. If this method is used, ensure that the operation of the control circuitry of the compartment being used for testing does not cause undesirable effects or unintended operation of other interconnected equipment such as supervisory controls, SCADA, or automatic transfer schemes.

Remove the control fuses in the compartment. Connect the jumper cable to the secondary disconnect plug in the compartment and to the circuit breaker. Insert the fuses. The charging motor will automatically charge the stored-energy mechanism's main closing springs. Operation of the breaker control switch on the front door of the compartment will cause the circuit breaker to close. The circuitry is arranged to cause the charging motor to operate again and charge the main closing spring. Operating the breaker control switch on the front door will cause the circuit breaker to open.

E. INSERTING THE CIRCUIT BREAKER INTO THE METAL-CLAD SWITCHGEAR

The two methods for inserting the circuit breaker into the metal-clad switchgear are:

1. Closed Door Racking Circuit Breaker (CDR)
2. Power Racking

Before attempting to insert the circuit breakers into the metal-clad switchgear equipment, refer to the metal-clad switchgear instruction bulletin and drawings produced specifically for the installed equipment.

Each circuit breaker and metal-clad switchgear is provided with interference plates (Figure 1, ag), which are designed to ensure that no circuit breaker with less than the required voltage, continuous current, or interrupting current rating is placed in the incorrect circuit breaker compartment. If an attempt is made to insert an improperly rated circuit breaker into the circuit breaker compartment, the interference plates will deter further insertion. The interference will occur before the circuit breaker reaches the disconnected position. Do not attempt to force the circuit breaker past the compartment interference plate or remove the interference plates from either the compartment or the circuit breaker. If necessary, remove the incorrect rated circuit breaker and insert a properly rated circuit breaker into the metal-clad switchgear.

Circuit Breaker Inspection

1. Inspect the primary disconnecting devices for proper lubrication, damage, debris, or dirt. Ensure that disconnecting devices are in alignment and are not bent. If contamination is found, follow the instructions in sections, V. MAINTENANCE, A. GENERAL DESCRIPTION, 1) Inspection and Cleaning and B. MECHANISM AREA, 2) Lubrication, for cleaning and lubrication procedures.

   IMPORTANT: *If the primary disconnecting devices are damaged make no attempt to repair them. Contact Powell Electrical Manufacturing Company for further information.*

2. Inspect the circuit breaker compartment to ensure that it is clean and clear of debris that might interfere with circuit breaker travel.

Racking Methods

The racking methods described in this section apply only for indoor type and non arc-resistant constructions. For all other constructions, refer to the appropriate instruction bulletin(s) for the applicable racking procedures.

NOTE: *To access information bulletins online, visit the Powell Industries Web site at info@powellservice.com. To order instruction bulletins, call Powell Electrical Manufacturing Company at: 1-800-480-7273.*

The Closed Door Racking Circuit Breaker (CDR) may be racked manually or electrically by using the optional Power Racking device. The following sections describe each method of racking that is applicable to the specific type of circuit breaker.

1) Closed Door Racking Circuit Breaker (CDR)

The Closed Door Racking Circuit Breaker (CDR) is designed to be manually racked into the circuit breaker compartment with the compartment door closed. The optional Power Racking device may be fitted on the closed circuit breaker compartment door to eliminate manual operation.

2) Power Racking

Power racking enables the user to rack the circuit breaker with a motor-driven mechanism with an electric control. This enables the user to perform the racking function without being located in front of the circuit breaker compartment.

Power racking is applicable to the Closed Door Racking Circuit Breakers (CDR). The Power Racking Device mounts onto the compartment door when the closed door racking circuit breaker is used. Refer to the instruction bulletin provided with the Power Racking Device for the proper operation and use.

CAUTION

Before inserting a circuit breaker into a compartment, the user must verify that the circuit breaker rating MEETS or EXCEEDS the metal-clad switchgear rating.

CAUTION

Before inserting a circuit breaker into the circuit breaker compartment, be sure that the indicator flag on the front of the switchgear displays **"BREAKER TEST / DISCONNECTED."**

CAUTION

The illustrations shown for all racking procedures are provided to show device locations and are intended only as a guideline. These illustrations may not be representative of site-specific safety practices for performing the procedure. Before attempting any racking procedure, review Section II SAFETY.

V. MAINTENANCE

MAINTENANCE PROGRAM

Contact Powell Apparatus Service Division for assistance with performing maintenance or for setting up a maintenance program. Visit the Powell Web site at www.powellservice.com, or call 1-800-480-7273.

CAUTION

Prior to beginning any maintenance procedures, make certain that the control circuits are de-energized and the circuit breaker is resting securely outside the circuit breaker compartment **DO NOT** work on a closed circuit breaker or a circuit breaker with the main closing spring charged.

IMPORTANT

Before attempting any maintenance work, it is important to study and fully understand the safety practices outlined in section II of this Instruction Bulletin. If there is reason to believe there are any discrepancies in the descriptions contained in this instruction bulletin, or if they are deemed to be confusing and/or not fully understood, contact Powell Electrical Manufacturing Company immediately. Visit the Powell Web site at w**ww.powellservice.com**, or call **1-800-480-7273**.

A. GENERAL DESCRIPTION

1) Introduction

A regular maintenance schedule must be established to obtain the best service and reliability from the circuit breaker. PowlVac® circuit breakers are designed to comply with industry standards. Maintenance is required every 500 operations, depending upon the rating of the circuit breaker, or once a year. Maintenance and inspection records provide a basis for setting up a maintenance schedule, rational for subsequent maintenance work, and station operation conditions and history.

A permanent record should be established which includes details about maintenance work, inspections, and tests. The maintenance record should begin with tests performed at the time of installation and energizing.

NOTE: *Because of extensive quality control tests made at the factory, the operations counter on a new circuit breaker will normally register over one hundred operations. The operations counter reading should be recorded when the circuit breaker is placed into service and when any maintenance work is performed.*

All data should be graphed as a function of time to ensure a proper maintenance cycle is scheduled. The amount of record details depends on the equipment operating conditions. It is recommended that the record include the following information: date and time, operations counter amount, reports of tests performed, the condition of circuit breakers, and any repairs or adjustments that are performed.

An adequate maintenance scheduling depends on individual application conditions such as the number of operations, magnitude of currents switched, desired overall system reliability, and the operating environment. Any time the circuit breaker is known to have interrupted a fault current at or near its rating, it is recommended that the circuit breaker be inspected and the necessary maintenance be performed as soon as practical. When equipment is situated in adverse atmospheric conditions, such as extremes of dust, moisture, or corrosive gases, inspection and maintenance should be preformed more frequently.

Very clean and dry conditions combined with low switching duty will justify longer times between inspection and maintenance procedures. Each user can set an appropriate inspection and maintenance schedule based on equipment experience and established records.

If maintenance activities are performed at longer time intervals than one year, the vacuum integrity test should be performed each time the circuit breaker is removed from the metal-clad switchgear, for reasons other than scheduled circuit breaker maintenance.

WHEN ANY MAINTENANCE PROCEDURE REQUIRES OPENING OR CLOSING OF THE CIRCUIT BREAKER OR CHARGING OF ANY OF THE MECHANISM SPRINGS, EXERCISE EXTREME CARE TO MAKE SURE THAT ALL PERSONNEL, TOOLS, AND OTHER OBJECTS ARE KEPT WELL CLEAR OF ALL MOVING PARTS OR CHARGED SPRINGS.

CAUTION

When cleaning the circuit breaker insulating supports and bus insulation, use only denatured alcohol or isopropyl alcohol to remove foreign material. Failure to do so may damage the dielectric and/or the mechanical properties of the insulation.

2) Inspection and Cleaning

Visually inspect the circuit breaker for loose or damaged parts. Tighten loose hardware and replace any missing hardware. Replace any damaged parts that may interfere with the normal operation of the circuit breaker. The front cover may be removed for easier access for inspecting the circuit breaker.

Clean the circuit breaker by removing any loose dust and dirt. DO NOT use compressed air to clean the circuit breaker. This may result in loose dirt or grit being blown into bearings or other critical moving parts, thus causing excessive wear. To clean the circuit breaker, remove dust and dirt with a vacuum cleaner, wipe away dust and dirt with a dry, lint-free cloth, or use an industrial-type wiper. Do not use solvents, de-greasers, or any aerosol products to clean in the area of any mechanisms. For instructions on cleaning the lubricated areas for stored-energy mechanism and other specified parts, refer to the following sections: B. MECHANISM AREA, 2) Lubrication.

Primary insulation, including the operating pushrods, should be cleaned. Wipe clean with a dry lint-free cloth or an industrial type wiper. To remove dirt that adheres and cannot be removed by wiping, use distilled water or a mild solvent such as denatured alcohol. Ensure that the circuit breaker is dry before returning it to service. DO NOT use any type of detergent to wash the surface of the insulators because detergent may leave an electrically conducting residue on the surface as it dries.

B. MECHANISM AREA

1) Mechanical Operation

Remove the circuit breaker front cover to expose the stored-energy mechanism. Make a careful visual inspection of the mechanism for loose, damaged, or excessively worn parts.

NOTE: *If timing tests under Section D. OPTIONAL MAINTENANCE PROCEDURES are to be performed, DO NOT operate the circuit breaker until these tests are completed. Operation of the mechanism may alter the "As found" operating condition of the circuit breaker's stored-energy mechanism.*

CAUTION

Before applying any type of lubrication to the circuit breaker, the stored-energy mechanism should be in the open position, and all springs discharged.

2) Lubrication

Powell offers a complete lubrication kit (Powlube-102) which contains all the lubricants required for maintaining the circuit breakers. Powlube-102 contains Rheolube 368A grease, Anderol 456 oil, and Mobilgrease 28.

Earlier production models of PowlVac® circuit breakers used Anderol 757 lubricant grease, however, current production models use Rheolube 368A grease. Rheolube 368A grease is compatible with Anderol 757. Rheolube 368A grease should be lightly applied to bearing surfaces that are accessible. Inaccessible surfaces such as bearings may be lubricated with a light synthetic machine oil such as Anderol 456 oil. Mobilgrease 28 should be applied to the electrical contact surfaces.

Lubricate the stored-energy mechanism and other specified parts in accordance with Table D. Lubrication. Table D shows the location of all surfaces that should be lubricated, the type of lubricant to be applied, and the method of application. The lubrication guidelines are to lubricate regularly, use lubricant sparingly, and remove all excess lubricant. It is not necessity to disassemble the mechanism to apply lubrication. Tilting the circuit breaker enables the lubricant to enter the bearing surfaces.

3) Main Closing Spring Removal, Slow Closing of the Mechanism, and Latch Check Switch Adjustment

a) Main Closing Spring Removal

Disassembly of the stored-energy mechanism is not required for routine lubrication; however, for major overhaul, removal of the main closing spring is necessary. Removal of the spring permits slow closing of the mechanism and the vacuum interrupter contacts. Perform the following procedure for spring removal:

1. With the main closing spring discharged and the circuit breaker contacts open, remove the screw, flat washer, and lock washer at the top of the spring rod.
2. Remove the right-angled bracket, by unfastening the two attachment screws.
3. Remove the spacer from below the right angle bracket.
4. Turn the bracket 90°, and replace it on top of the spring yoke.
5. Place the spacer on top of the bracket with the flat washer above it.
6. Insert the screw and tighten it until the tension is taken off the connecting rods.
7. With a slight rocking motion of the main closing spring assembly, the connecting rods (Figure 10, e) can now be unhooked from the spring yoke pins and the main closing spring assembly can be removed.

   NOTE: *Care should be taken on reassembly to ensure correct location of the flat washer, lock washer, and spacer. (See Figure 11.)*

b) Slow Closing of the Mechanism

Although slow closing of the mechanism is not required for routine maintenance, it may be useful for troubleshooting circuit breaker misoperation. The following steps describe slow closing the mechanism.

1. With the main closing spring assembly removed, rotate the camshaft so that the crank arms are pointing downward.

   The fundamental linkage will now move into the reset position.

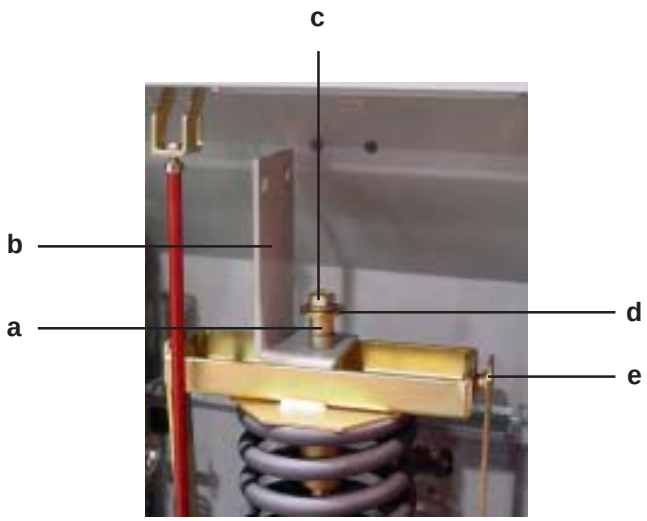


Figure 10. Main Closing Spring Assembly Compressed for Removal

a. Spacer
b. Bracket
c. Screw
d. Flat Washer
e. Connecting Rod

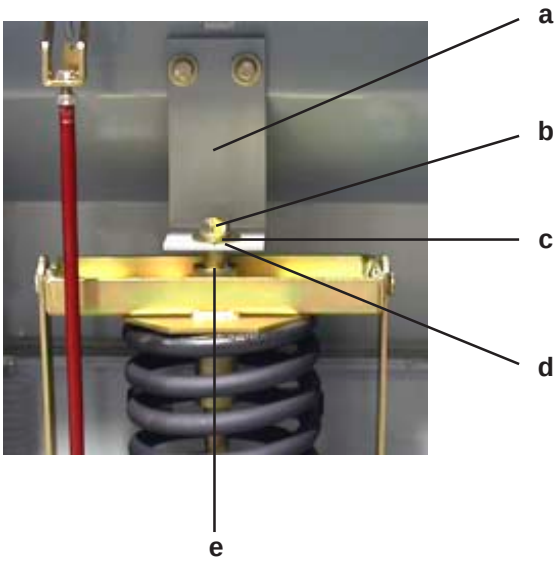


Figure 11. Main Closing Spring Assembly Installed

a. Bracket
b. Screw
c. Lock Washer
d. Flat Washer
e. Spacer

2. Push the manual close operator inward and hold it in while operating the manual charging handle to rotate the camshaft.

3. Once the close release latch arm is past the close shaft latch plate, the manual close operator may be released. As the main closing cam engages the main cam roller, the jackshaft will commence to rotate.

4. Continue to operate the manual charging handle until the crank arms point upward.

   The circuit breaker will now be closed and there will be a gap between the operating pushrod lock nuts and the contact spring yokes.

5. Return the circuit breaker to the open position by depressing the manual trip operator.

To install the main closing spring assembly reverse the preceding removal procedure.

c) Latch Check Switch Adjustment

The latch check switch adjustment described is not required for routine maintenance; however, the latch check switch may need to be adjusted after major overhaul or removal of the mechanism. (See Figure 12.)

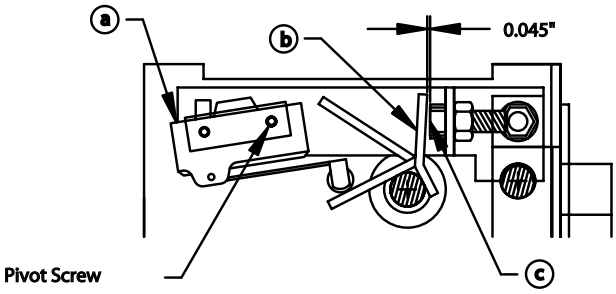


Figure 12. Latch Check Switch Adjustment

a. Latch Check Switch
b. Latch Check Operator
c. Secondary Trip Prop Adjusting Screw

Perform the following steps for latch check switch adjustment:

1. Remove the main closing spring as described in the following section: V. MAINTENANCE, B. MECHANISM AREA, 3), a) Main Closing Spring Removal.

2. Rotate the crank arms until the spring charge indicator displays, "**CLOSING SPRING CHARGED**."

3. Loosen the two screws that secure the latch check switch and rotate the latch check switch about the pivot screw downward to the lowest position allowed. The latch check switch contacts are now open.

4. Insert a 0.045 inch gauge between the secondary trip prop adjusting screw and latch check operator.

5. Rotate the latch check switch upwards until the contacts are closed. (An audible "click" of the contacts will be heard.) At the position where the "click" is heard hold the switch and retighten the two screws which secure the latch check switch.

6. Remove the gauge.

7. To confirm that the latch check switch is properly set, slowly depress and release the manual trip operator to verify that the latch check switch opens and closes properly. (An audible "click" of the contacts will be heard.

   The latch check switch contacts will open as the latch check operator is moved by the manual trip operator away from the secondary trip prop adjusting screw.

8. Slowly withdraw the manual trip operator.

   The latch check switch contacts will close as the latch check operator is a maximum of 0.045 inches away form the secondary trip prop adjusting screw.

9. Depress the manual close operator and rotate the crank arm until resistance is felt.

10. Depress and hold the manual trip operator inward and rotate the crank arms until the spring charge indicator displays, "**CLOSING SPRING DISCHARGED**."

11. Remove the secondary disconnect override device.

12. Reinstall the main closing spring.

4) Mechanism Adjustments

WARNING

When any maintenance procedure requires the opening or closing of the circuit breaker or the charging of any of the stored-energy mechanism springs, exercise extreme caution to make sure that all personnel, tools, and other objects are kept well clear of the moving parts or the charged springs. Failure to do this may cause serious damage or injury to the circuit breaker or personnel.

Several factory adjustments in the stored-energy mechanism are described below. **NO ADJUSTMENT OF THESE SETTINGS IS REQUIRED FOR ROUTINE MAINTENANCE** but they may need to be adjusted after major overhaul or removal of the mechanism.

DO NOT ADJUST THESE SETTINGS UNNECESSARILY, AS DAMAGE TO THE CIRCUIT BREAKER MAY OCCUR.

a) Ratchet Wheel Holding Pawl Adjustment

The holding pawl support arm (Figure 2, ac) is adjusted by the holding pawl adjusting eccentric (Figure 2, u). If the pawl is not properly adjusted, there will be a “Knocking” noise when the ratchet mechanism is operating or the stored-energy mechanism will not ratchet at all.

Perform the following steps to adjust the pawl:

1. Remove the escutcheon to Access to the head of the bolt holding the adjusting eccentric.
2. Loosen the bolt slightly.
3. Grip the eccentric with a pair of slip-joint pliers or a similar tool and rotate the stop slightly.
4. Tighten the holding bolt with the eccentric in the new position.
5. While charging the main closing spring, using the charging motor to drive the mechanism, observe the ratcheting operation for improvement.

   NOTE: *If necessary, repeat the ratchet wheel holding pawl procedure until the ratcheting operation is smooth. This may require several charging cycles.*

6. When the eccentric is properly set replace the escutcheon. Check the escutcheon nameplate circuit breaker’s rating and serial number information to ensure that the escutcheon is reinstalled on the proper circuit breaker. The serial number of the circuit breaker is also attached to the circuit breaker frame near the ground connection on a stamped metal plate. The serial number on the nameplate must match the serial number stamped on the frame.

b) Primary and Secondary Trip Prop Adjustment

Perform the following steps to adjust the Primary and Secondary Trip Prop:

1. Adjust the secondary trip prop adjusting screw (Figure 2, v) so that the secondary trip prop top edge is in the line of sight with the top of the rivet of the primary trip prop roller as shown in Figure 13, b.

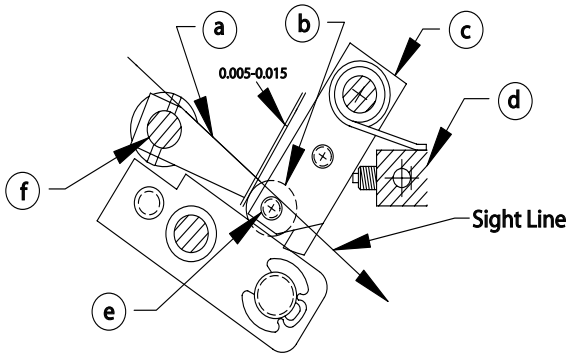


Figure 13. Primary and Secondary Trip Prop Adjustment

a. Secondary Trip Prop (Top Edge)
b. Primary Trip Prop Roller
c. Primary Trip Prop
d. Primary Trip Prop Adjusting Screw
e. Rivet
f. Trip Bar

2. Adjust the primary trip prop adjusting screw (Figure 4, l) so that with the fundamental linkage in the reset position, the clearance between the primary trip prop roller and the secondary trip prop is 0.005-0.015 inch.

Access the primary trip prop adjusting screw through a hole (Figure 14, a and b) in the metal plate around the Manual Charging Crank (Figure 1, g)

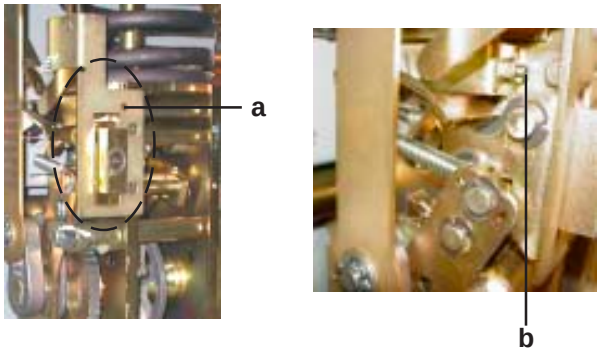


Figure 14. Secondary Trip Prop Adjusting Screw

a. Access to the Secondary Trip Prop Adjusting Screw
b. Secondary Trip Prop Adjusting Screw

c) Close Latch Shaft Adjustment

The close latch shaft (Figure 2, ad) passes through the side sheets of the stored-energy mechanism frame at the front of and below the camshaft. The left end of the shaft is shaped to make a latch face and interferes with the close latch arm (Figure 2, ae), which is attached to the camshaft. The other end of the close latch shaft is on the right side of the mechanism and a small lever attached to it is positioned by a close bar adjusting screw (Figure 2, j).

Perform the following steps to adjust the close latch shaft:

1. Remove the escutcheon.
2. Loosen the locking nut from the close bar adjusting screw while holding the position of the close bar adjusting screw with a screw driver.
3. Back out the close bar adjusting screw by turning the screw counterclockwise 2 full turns.
4. Manually charge the circuit breaker main closing spring with a manual charging handle until the spring charge indicator displays, “CLOSING SPRING CHARGED.”
5. Turn the close bar adjusting screw clockwise until the main closing spring discharges, then depress the manual trip operator to open the circuit breaker.
6. Turn the close bar adjusting screw 2-1/2 turns counterclockwise. Retighten the locking nut holding the screw with a screw driver.
7. Repeat step 5. Close and open the circuit breaker to ensure proper operation.
8. Replace the escutcheon and remove the secondary disconnect override device.

5) Electrical Operation

After performing any necessary mechanical and lubrication maintenance, operate the circuit breaker electrically several times to ensure that the electrical control system works properly. Refer to the following section: D. PLACING THE CIRCUIT BREAKER INTO SERVICE, 5. Electrical Operation Check.

C. VACUUM INTERRUPTER AND CONTACT AREA

1) Vacuum Interrupter and Contact Erosion

At each inspection, the vacuum interrupters should be checked for contact erosion. The circuit breaker must be closed for this check. Each new vacuum interrupter is set with a gap of about .150" to .188" between the contact loading spring pivot and the flat washer on the operating pushrod stud. As the contacts erode with use, this gap will decrease. (See Figure 19.)

2) Vacuum Integrity

For information on vacuum integrity and testing of vacuum interrupters, refer to the following section: D. PLACING THE CIRCUIT BREAKER INTO SERVICE, 5. Electrical Operation Check.

3) Vacuum Interrupters Mechanical Adjustment

No adjustments are required for routine maintenance of a vacuum interrupter assembly. Several factory adjustments will change over the operating life of the vacuum interrupter. **ADJUSTMENTS OF THESE SETTINGS IS ONLY NECESSARY WHEN THE VACUUM INTERRUPTER IS REMOVED TO PERFORM REPAIRS. DO NOT ADJUST SETTINGS UNNECESSARILY AS DAMAGE TO THE CIRCUIT BREAKER MAY RESULT.** When it is necessary to remove or replace the vacuum interrupter refer to the following section for details: VI. RECOMMENDED RENEWAL PARTS AND REPAIR PROCEDURES, C. REPLACEMENT PROCEDURES, 1) Vacuum Interrupter Assembly.

D. OPTIONAL MAINTENANCE PROCEDURES

1) High Potential Tests

High potential tests are not required for routine maintenance. However, it is recommended that high potential tests be conducted for the following situations: after a heavy fault interruption, after any major circuit breaker repair that involves the primary current path, and when the circuit breaker is stored for an extended time. When the circuit breaker has been stored in adverse or harsh atmospheric conditions, the following 2 tests should be performed: High Voltage Insulation Integrity and Control Voltage Insulation Integrity tests. For details of these procedures, refer to the following section: IV. INSTALLATION, D. PLACING THE CIRCUIT BREAKER INTO SERVICE, 1) High Voltage Insulation Integrity and 3) Control Voltage Insulation Integrity.

2) Close and Open Timing

The circuit breaker actual Close and Open (trip) times should not exceed the amounts listed in Table B. Timing.

Table B. Timing

	Close Timing	Open Timing
3 cycle	< 80 ms	< 35 ms
5 cycle	≤ 80 ms	< 55 ms

Close time is the amount of elapsed time from energizing the closing coil to vacuum interrupter contact touch.

1. To measure the close timing, at normal control voltage, operate the test source to the "**CLOSE**" position to close the circuit breaker. Record the close timing.

   Open (or *trip*) time is the amount of elapsed time from energizing the shunt trip coil to vacuum interrupter contact separation.

2. To measure the open time, at normal control voltage, operate the test source to the "**OPEN**" position to open (trip) the circuit breaker. Record the open timing.

3) Primary Resistance Check

The primary resistance check is not required for routine maintenance, but it is recommended after any major maintenance is performed that requires disassembly of any part of the primary current path.

To check the resistance, ensure the circuit breaker is closed, and pass a minimum of 100A DC through the circuit breaker pole. Measure the voltage drop across the primary contacts and calculate the resistance. The primary resistance should not exceed the values provided in this instruction bulletin for the specific type and rating of the circuit breaker being measured.

Connect the current source leads to the upper and lower primary disconnecting devices of the circuit breaker.

The micro-ohm values of resistance must not exceed the limits listed in Table C.

Table C. Primary Resistance

Breaker Type	Rated kV	Rated Continuous Current A	Resistance Micro-ohms
38PV40	38	1200	46
38PV40	38	2000	36
27PV25	27	1200	40
27PV25	27	2000	36

Table D. Lubrication

Location	Ref. Figure	Lubricant	Method
Electrical Parts			
Primary Disconnecting Device	Fig 15, a	Mobilgrease 28	Wipe clean. Apply lubricant only to actual contact surface.
Secondary Disconnect Receptacle	Fig 15, b	Mobilgrease 28	
Ground Connection	Fig 16, s	Mobilgrease 28	Wipe clean. Apply lubricant only to actual contact surface.
Mechanical Parts			
Spring Yoke Pin	Fig 15, c	Rheolube 368A Grease	
Jackshaft Support	Fig 15, d	Rheolube 368A Grease	
Trip Shaft Bearing	Fig 15, e	Anderol 456 Oil	
Crank Pin	Fig 15, f	Rheolube 368A Grease	
Jackshaft Lever Pins passing through Operating Pushrods	Fig 15, g	Rheolube 368A Grease	
Motor Drive Shaft Roller Needle Bearings	Fig 15, h	Anderol 456 Oil	
Pawls	Fig 15, i	Anderol 456 Oil	
Close Latch Shaft Face	Fig 15, j	Rheolube 368A Grease	Apply a light coating of grease and remove all excess.
Ratchet Wheel	Fig 15, k	Rheolube 368A Grease	
Pawl Support Arm	Fig 15, l	Anderol 456 Oil	
Fundamental Linkage Pin	Fig 15,m	Anderol 456 Oil	
Main Closing Spring Guide Rod	Fig 15, n	Rheolube 368A Grease	
Primary Trip Prop	Fig 16, o	Anderol 456 Oil	
Flag Support Pin	Fig 16, p	Anderol 456 Oil	
Open-Close Flag Drive Lever Pin at Jackshaft	Fig 16, q	Anderol 456 Oil	
Jackshaft Outer Bearings Support	Fig 16, r	Anderol 456 Oil	
Wheel	Fig 16, t	Rheolube 368A Grease	
Ground Connection	Fig 16, s	Mobilgrease 28	
Motor Drive Shaft Coupling	Fig 16, u	Rheolube 368A Grease	
Motor Drive Shaft Support Bearing	Fig 16, v	Anderol 456 Oil	
Camshaft Needle Bearing	Fig 16, w	Anderol 456 Oil	
Close Shaft Support Bearing	Fig 16, x	Anderol 456 Oil	
Motor Cutoff Cam	Fig 16, y	Rheolube 368A Grease	Apply to peripheral surface only.
Fundamental Linkage	Fig 16, z	Anderol 456 Oil	Apply to penetrate where pins pass through lines.

a. *Upper and Lower Primary Disconnect Devices*

b. *Secondary Disconnect Receptacle*

c. *Spring Yoke Pin*

d. *Jackshaft Supports (2) (located at the rear of the mechanism)*

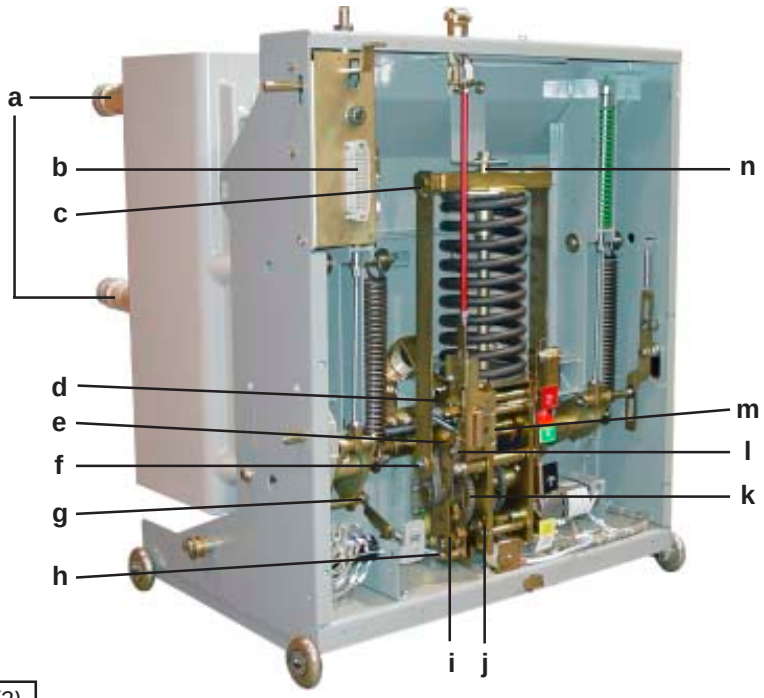


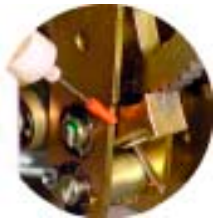
Figure 15. Lubrication (1 of 2)

e. *Trip Shaft Bearing*

f. *Crank Pin*

g. *Jackshaft Lever Pin passing through Operating Rods*

h. *Motor Drive Shaft Roller Needle Bearings*



i. *Pawls*

j. *Close Latch Shaft Face*

k. *Ratchet Wheel*

l. *Pawl Support Arm*

m. *Fundamental Linkage Pin*

n. *Main Closing Spring Guide Rod*

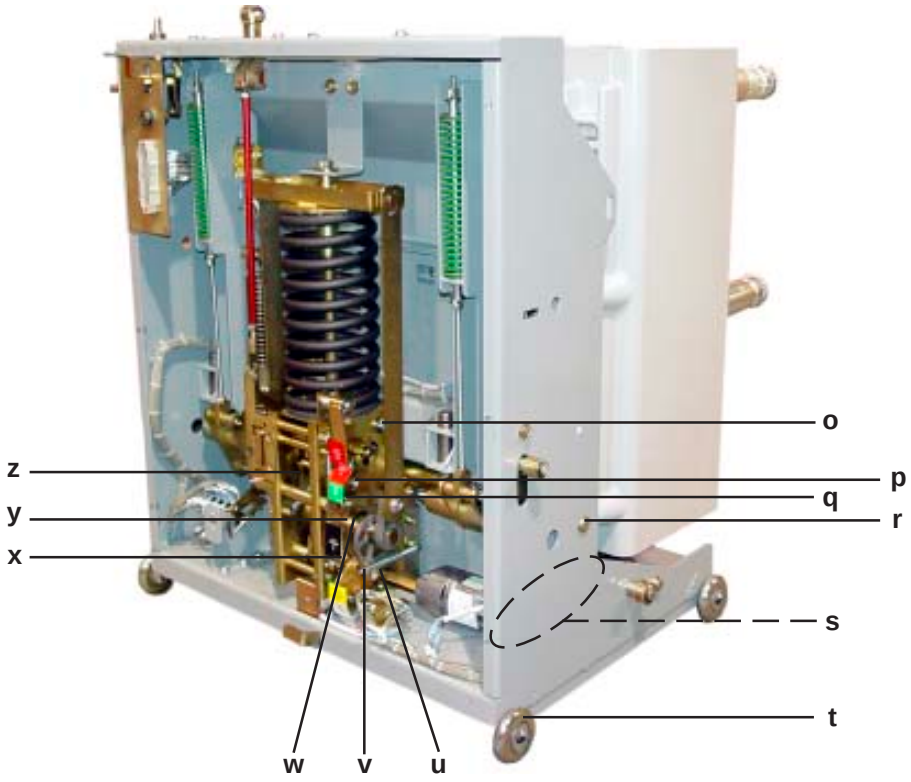


Figure 16. Lubrication (2 of 2)

o. *Primary Trip Prop*

p. *Flag Support Pin*

q. *Open-Closed Flag Drive Lever Pin at Jackshaft*

r. *Jackshaft Outer Bearings Support*

s. *Ground Connection (Mounted under frame)*

t. *Wheel*

u. *Motor Drive Shaft Coupling*

v. *Motor Drive Shaft Support Bearings*

y. *Camshaft Needle Bearings*

x. *Close Shaft Support Bearing*

w. *Motor Cutoff Cam*

z. *Fundamental Linkage*

VI. RECOMMENDED RENEWAL PARTS AND REPAIR PROCEDURES

A. ORDERING INSTRUCTIONS

1. To order **Renewal Parts** from Powell Apparatus Service Division (PASD), visit the Web site at www.powellservice.com or call 1-800-480-7273.
2. Always provide the following information from the circuit breaker nameplate:
   a. Circuit Breaker Type
   b. Serial Number
   c. Rated Voltage
   d. Rated Amps
   e. Impulse Withstand
   f. Control Voltage (for control devices and coils)
3. Specify the quantity and description of the part and the instruction bulletin number. If the part is in any of the information bulletin recommended renewal parts tables, specify the catalog number. If the part is not in any table, submit a description or the part with a illustration from this instruction bulletin, a photo, or a sketch showing the needed part.

B. RECOMMENDED RENEWAL PARTS

A sufficient amount of renewal parts should be stored to enable the prompt replacement of any worn, broken or damaged part. A sufficient amount of stocked parts minimizes service interruptions caused by breakdowns and saves time and expense. When continuous operation is a primary consideration, a greater amount of renewal parts should be stocked. The quantity of renewal parte needed depends on the severity of the service and the time required to secure replacements.

Since parts may be improved periodically, renewal parts may not be identical to the original parts. However, spare and replacement parts will be interchangeable with the original parts. Parts tables in this instruction bulletin list the recommended spare parts to be carried in stock by the user. The recommended quantity is not specified. The amount of spare parts needed must be determined by the user based on the application. As a minimum, it is recommended that one set of spare parts be stocked per ten circuit breakers or fraction thereof.

Powell Electrical Manufacturing Company recommends that only qualified technicians perform maintenance on these units. If these circuit breakers are installed in a location where they are not maintained by a qualified technician, a spare circuit breaker should be on site ready for circuit breaker replacement. The malfunctioning unit can then be returned to the factory for reconditioning.

Table E. Primary Current Path

Breaker Type k factor = 1	Rated kV	Rated Continuous Current A	Vacuum Interrupter Assembly	Shunt Contact	Primary Disconnecting Device	Operating Pushrod
38PV40	38	1200	43649G02P	40723P01	43315P01(6)	43645P01
38PV40	38	2000	43650G02P	43667P01	Upper 43651G01P Lower 433516P01	43645P01
27PV25	27	1200	43642G03P	40723P01	43315P01(6)	43645P01
27PV25	27	2000	43642G04P	43667P01	Upper 43651G01P Lower 43316P01	43645P01

Notes for Table E: The numbers in ( ) indicates the quantity of the part needed per each circuit breaker.

Figure 17. Primary Current Path

a. Primary Disconnecting Device
b. Vacuum Interrupter Assembly
c. Operating Pushrod

Table F. Special Tools

Special Tools	Catalog Number
Nut Gap Spanner	43309G01P
Primary Disconnect Removal Tool	43397H01P
Accessories	65003G01P
Lift Truck	65950G01P

Table G. Control Devices (1)*

Control Voltage	Primary Shunt Trip Coil Assembly (2)		Secondary Shunt Trip Coil Assembly (3)	Undervoltage Device Assembly (4)	Charging Motor Assembly	Anti-Pump Relay Assembly (5)	Closing Coil Assembly
	3-Cycle	2-Cycle					
24VDC	50027G05P	50041G08P	50042G06P	50028G04P	N/A	N/A	N/A
48VDC	50027G01P	50041G01P	50042G01P	50028G03P	50960G06P	RR2BA-US-DC48V	43684G05P
125VDC	50027G02P	50041G02P	50042G03P	50028G01P	50960G04P	RR2BA-US-DC110V	43684G03P
250VDC	50027G03P	50041G03P	50042G04P	50028G02P	50960G05P	RR2BA-US-DC110V	43684G04P
120VDC	50027G01P	50041G05P	50042G01P	N/A	50960G04P	RR2BA-US-AC120V	43684G01P
240VDC	50027G06P	50041G06P	50042G02P	N/A	50960G05P	RR2BA-US-AC240V	43684G02P
Capacitor Trip (6)	50027G04P	50041G04P	50042G05P	N/A	N/A	N/A	N/A

Notes for Table G: Numbers in parenthesis in the table refer to the following corresponding numbered notes.

1. One device is required per circuit breaker, if the circuit breaker was originally equipped with this item. All circuit breakers have a closing coil, primary shunt trip coil, charging motor, and an anti-pump relay assembly. Secondary shunt trip coils and undervoltage device assemblies are optional. For details on these devices, see notes, 2 through 6.
2. The primary shunt trip coil is available as a 3-cycle and a 5-cycle control device. **WARNING - A CIRCUIT BREAKER WITH AN ORIGINAL 5-CYCLE TRIP COIL MAY NOT BE REPLACED WITH A 3-CYCLE TRIP COIL AS DAMAGE TO THE CIRCUIT BREAKER MAY OCCUR.** A circuit breaker with an original 3-cycle trip coil may be replaced with a 5-cycle trip coil.
3. The Secondary Shunt Trip Coil cannot be furnished with an undervoltage device assembly.
4. Where furnished, The Undervoltage Device Assembly cannot be present with Secondary Shunt Trip Coil Assembly.
5. For 250VDC applications, a dropping resistor 50747G02P is required in series with the Anti-pump Relay.
6. Device is for use with a Capacitor Trip units with 240VAC input. Consult the manufacturer for other circuit breaker ratings.

NOTE: *All control Devices are available with push-on terminals. Consult the manufacturer for control devices with screw terminals.*

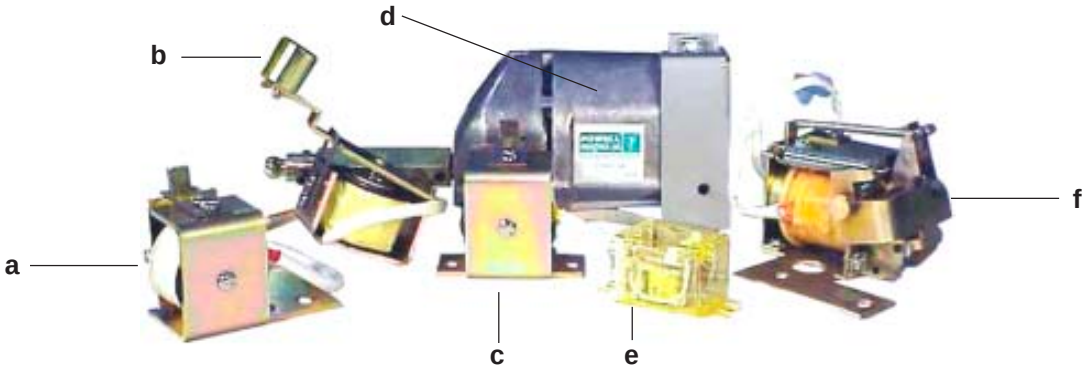
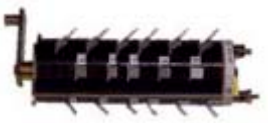
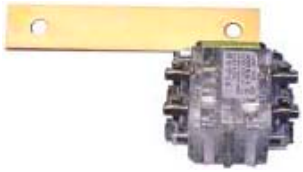


Figure 18. Control Devices

a. Secondary Shunt Trip Coil Assembly
b. Primary Shunt Trip Coil Assembly (3 cycle)
c. Closing Coil Assembly
d. Charging Motor Assembly
e. Anti-Pump Relay Assembly
f. Undervoltage Device Assembly

Table H. Miscellaneous Parts

Description	Catalog No.	Illustration
Auxiliary Switch Push-on Terminals Screw Terminals	 102108LN 102108LP	
Ground Connection 25kA 36kA 50kA	 50951G02P 50952G03P 50952G02P	
Latch Check Switch	BA-2RV2-A2	
Motor Cutoff Switch Assembly	50756G03P	
PowlVac® Hardware Kit	6050G24	
PowlVac® Lubrication Kit	Powlube-102	

C. REPLACEMENT PROCEDURES

This section includes instructions for replacing the parts recommended as renewal parts. Before attempting any maintenance repair work, take note of the safety practices outlined in Section II of this instruction bulletin.

MAKE CERTAIN THAT THE CONTROL CIRCUITS ARE DE-ENERGIZED AND THE CIRCUIT BREAKER IS RESTING SECURELY OUTSIDE THE METAL-CLAD SWITCHGEAR. DO NOT START TO WORK ON A CLOSED CIRCUIT BREAKER OR A CIRCUIT BREAKER WITH THE MAIN CLOSING SPRING CHARGED. WHEN ANY MAINTENANCE PROCEDURE REQUIRES THE OPENING OR CLOSING OF THE CIRCUIT BREAKER OR THE CHARGING OF ANY OF THE STORED-ENERGY MECHANISM SPRINGS, EXERCISE EXTREME CAUTION TO MAKE SURE THAT ALL PERSONNEL, TOOLS, AND OTHER OBJECTS ARE KEPT WELL CLEAR OF THE MOVING PARTS OR THE CHARGED SPRINGS.

CAUTION

The replacement of the vacuum interrupter assembly should only be replaced by a qualified technician or Powell PASD Service Technician. To contact Powell Electrical Manufacturing Company for further assistance, call 1-800-480-7273.

1) Vacuum Interrupter Assembly

This assembly is located in between the upper and lower primary disconnecting devices. (See Figure 19 and Figure 1, ac.)

Figure 19. Vacuum Interrupter Assembly

Refer to Figure 20, vacuum interrupter assembly, while performing the following instructions. The numbers in parenthesis after the part name, coordinate with part numbers on the vacuum interrupter assembly drawing.

a) Disassembly

1. Ensure all operating springs are discharged and the circuit breaker is open.
2.. With the circuit breaker (VCB) in the **OPEN** and **DISCHARGED** position, loosen both of the socket set screws (41) from the primary conductor (1) .
3. Using the primary disconnect removal tool (Catalog No. 43397H01) and at least a grade 8, 1/4 - 20 x 3-1/4" bolt, remove the primary conductor (1).
4. Remove the electrostatic shield (16).
5. Remove the single button head cap screw (36) that restricts access to one of the m12 hex head cap screws (32).
6. Remove both of the hex head screws (32), to allow the vacuum interrupter (3) to move to the **CLOSED POSITION**.
7. With a pencil, trace an outline of the bottom bus support (7) on the high voltage housing (11). During reassembly, the outline will enable proper alignment of these devices.

   NOTE: *It is important to document the location and size of the bottom bus support and the high voltage housing to enable proper reassembly.*
8. Remove both hex head cap screws (23) and loosen the hardware from the hex head cap screw (24).
9. Cautiously loosen and remove 3 of the 4 button head cap screws (20). Notice that small shims (approximately 5/8" OD, and 3/8" ID) may be located behind the bottom bus support (7). If shims are used, they are held in place by the button head cap screw (20).

   NOTE: *It is important to document the location and size of the shims to enable proper reassembly of the bottom bus support (7).*

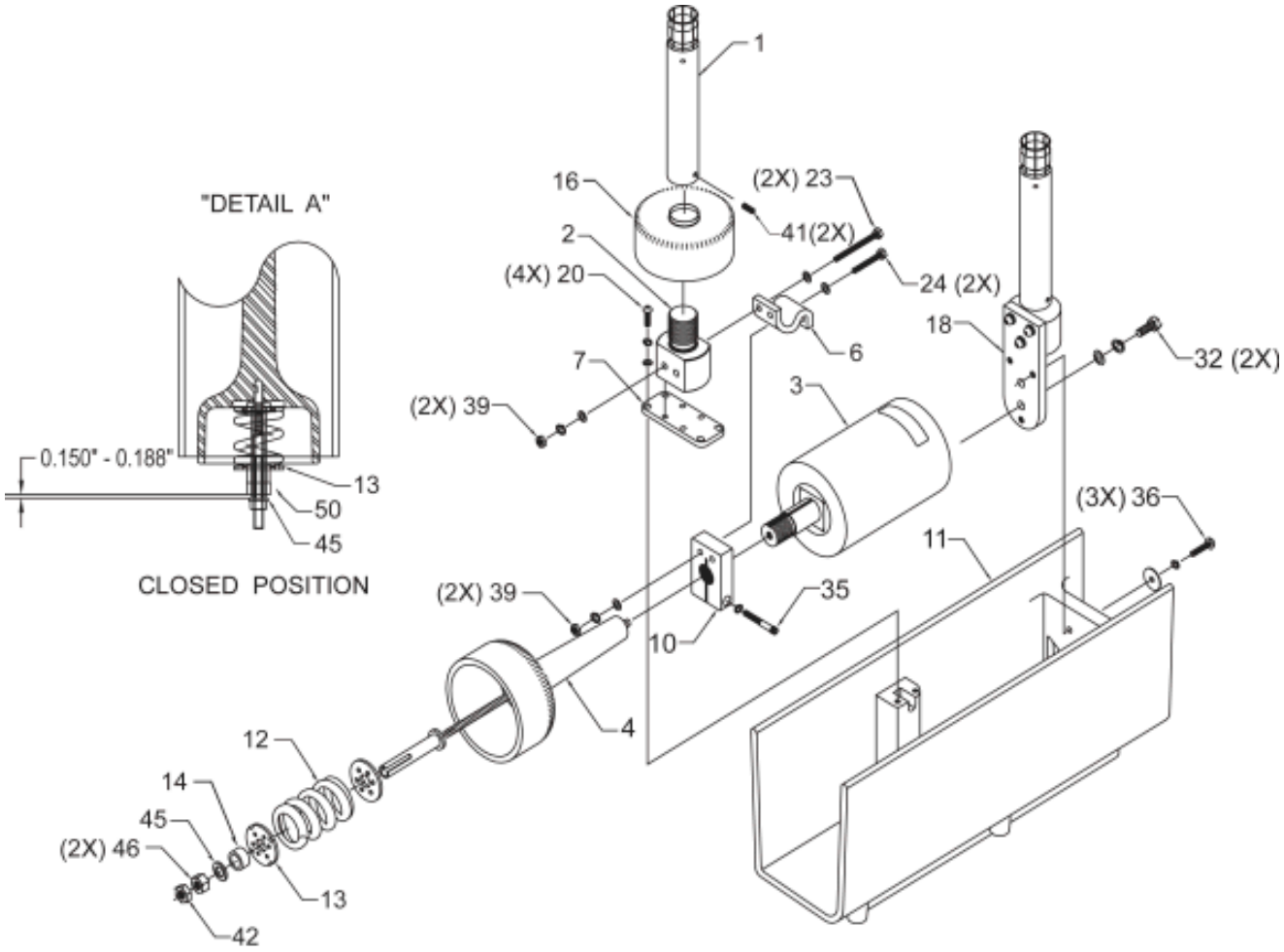


Figure 20. Vacuum Interrupter Assembly Drawing

10. Remove the last of the 4 button head cap screw (20) described in step 9, and remove the combined bottom bus support (7) and the lower bus connector (2). It is important to hold the vacuum interrupter (3) securely to avoid allowing the pushrod to tilt enough to strike the circuit breaker frame. The pushrod will break if it hits the frame with sufficient force.

11. While holding the front terminal clamp (10) to prevent it from tilting, loosen the socket head bolt (35). Unscrew the vacuum interrupter (3) and the assembly from the high voltage pushrod (4). Use care to avoid allowing the high voltage pushrod (4) to hit the circuit breaker frame. The pushrod will break if it hits the frame with sufficient force.

12. Place the vacuum interrupter (3) and the front terminal clamp (10) on a level surface such as a table, to remove the socket head bolt (35). Before unscrewing the front terminal clamp (10), observe and document the distance that the front terminal clamp (10) is screwed onto the threads of the vacuum interrupter (3). It is important to document the location of these devices to enable proper future reassembly.

    NOTE: *It is important to observe and document the location and orientation of the shunt (6) to enable future proper reassembly. Notice that the shunt points in the same direction as the label on the vacuum interrupter (3), as well as the two metric bolt holes on top of the vacuum interrupter (3).*

13. Unscrew the front terminal clamp (10) and the shunt (6). It may be necessary to wedge a screw driver blade into the slot of the front terminal clamp (10) only enough to easily remove the clamp.

b) Assembly

NOTE: *For easier and proper assembly procedures, it may be necessary to refer to documentation required in Section a) Disassembly, steps 7 and 9. The documentation should include part locations and conditions.*

1. Prior to assembly, clean all parts, including the high voltage housing (11), with denatured alcohol.

2. Screw the front terminal clamp (10) and the shunt (6) back on the new vacuum interrupter (3).

    Approximately 1 to 3 threads of the vacuum interrupter (3) should be visible beneath the lowest surface of the front terminal clamp (10). The label of the vacuum interrupter (3) should be pointed in the same direction as the shunt (6), as well as in the same direction as the two m12 holes in the top of the vacuum interrupter (3).

    NOTE: *The vacuum interrupter label should be visible from the back side of the circuit breaker.*

2. Hold the front terminal clamp (10) in place to prevent it from tilting, and torque the socket head bolt (10) to 30 ft.-lbs.

3. Screw the vacuum interrupter (3) and the assembly onto the high voltage pushrod (4) until it stops.

4. Tilt the vacuum interrupter (3) and the assembly back up to its original position and look down through the two holes of the upper primary assembly (18) to assure that they align with the bolt holes in the vacuum interrupter (3). If the device bolt holes do not align, follow these steps:

    a. Hold the high voltage regulator disk (13) with channel lock pliers and loosen the two hex head nuts (46) only enough (no more than 3 turns) to enable rotation of the whole assembly by hand with no resistance.

    b. Align the hex head cap screws (32) to the threads of the vacuum interrupter (3).

    c. Insert a m12 x 60mm temporary bolt through the upper primary assembly (18) and into the vacuum interrupter (3).

    d. Tighten the m12 x 60mm bolt enough to pull the vacuum interrupter (3) back up, which will start opening the contacts inside.

    e. Replace the original metric hardware when the vacuum interrupter (3) is pulled far enough to align the bolt holes.

    f. Remove the m12 x 60mm temporary bolt.

    g. Torque the original bolts to 50 ft.-lbs.

5. Grasp the bell portion of the high voltage pushrod (4) and tighten it by hand onto the vacuum interrupter (3). Hold the high voltage regulator disk (13) with channel lock pliers and tighten the hex head nuts (46).

6. Add one small drop of Lock-Tite 243 (Catalog No. 243) to the threads of the button head cap screws (36) that were removed, and install the screws.

7. Install the bottom bus support (7) onto the high voltage housing (11) and align the bus support and housing to the pencil marks. If shims are used, replace the shims in the original positions. Apply Lock-Tite (243) to the button head cap screws (20) and install and tighten them.

8. Apply Lock-Tite 243 to the hex head screws (39 and 23), and install and torque screws to 30 ft.-lbs.

9. Torque the hex nuts (39) and the hex head cap screw (24) to 30 ft.-lbs.

10. Install the primary conductor (1) onto the lower bus connector (2).

11. Screw the primary conductor (1) onto the bus connector (2). Torque the screw to 70 ft.-lbs. with the primary disconnect removal tool (Catalog No. 43397H01) and hex head.

12. Tighten the socket set screws (41).

***NOTE**: Make certain hardware is torqued correctly, and parts are installed in the same positions as before being removed.*

c) Verification

1. Charge and close the circuit breaker. There should be a gap between the flat washer (45) and the existing high voltage pivot (50) of Detail “A.”

2. The gap between the flat washer (45) and the high voltage pivot (50) should be set to between 0.150" and 0.188" on a vacuum interrupter with no operations. As the devices is operated, the gap may decrease over time due to erosion of the primary contacts (1).

3. If the gap needs to be increased, hold the high voltage regulator disk (13) with channel lock pliers, loosen the hex head nut (46), and turn the high voltage regulator disk (13) counterclockwise (loosening). Retighten the hex head nut (46) and measure the gap again. Do not allow the pushrod (4) to turn.

4. If the gap needs to be decreased, hold the high voltage regulator disk (13) with channel lock pliers, loosen the hex head nut (46) and turn the high voltage regulator disk (13) to the right (tightening). Retighten the hex head nut (46) and measure the gap again.

2) Closing Coil Assembly

The closing coil assembly is located in the center and beneath the circuit breaker mechanism. (See Figure 21 and Figure 2, ae.)

Figure 21. Closing Coil Assembly

Perform the following steps to replace the closing coil assembly:

1. Remove the circuit breaker front cover.

2. Elevate the circuit breaker so that there is at least 6 inches of clear space below the base pan of the breaker.

3. Disconnect the closing coil assembly from the wire harness.

4. Remove the two bolts which hold the assembly to the base pan, and drop the assembly out of the bottom of the circuit breaker.

5. Insert the new assembly into the circuit breaker from below and bolt it in place.

6. Reconnect the assembly to the wiring harness. No adjustment is required.

7. Close the circuit breaker several times electrically to ensure that the closing coil assembly is functioning properly.

8. Replace the circuit breaker front cover.

3) Primary Shunt Trip Coil Assembly

The primary shunt trip coil assembly is located at the top left side of the mechanism, just left of the main closing spring. (See Figure 22 and Figure 2, d.)

Figure 22. Primary Shunt Trip Coil Assembly

Perform the following steps to replace the primary shunt trip coil assembly:

1. Remove the circuit breaker front cover.
2. Disconnect the primary shunt trip coil assembly wiring from the wiring harness. Measure and record the distance between the assembly armature and the trip lever. (See Figure 23 a.)

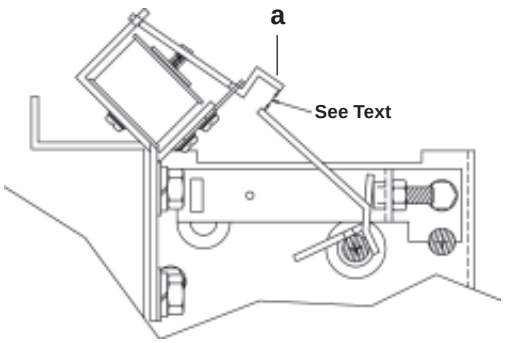


Figure 23. Trip Lever Gap Adjustment

a. Trip Lever

3. Remove the two bolts which holds the assembly to the circuit breaker frame and remove the assembly.
4. Bolt the new assembly in place and reconnect it to the wiring harness.
5. With the circuit breaker mechanism in the reset position, adjust the gap between the assembly armature and the trip lever to the dimension measured and recorded from step 2. To achieve this setting bend the trip lever slightly.
6. Trip the circuit breaker electrically several times to ensure that the primary shunt trip coil assembly is functioning properly.
7. Replace the circuit breaker front cover.

4) Secondary Shunt Trip Coil Assembly

The secondary shunt trip soil assembly is located at the top right side of the mechanism, just to the right of the main closing spring. The replacement procedure is identical to that of the primary shunt trip coil assembly, with the following additional information:

NOTE: *It will be easier to remove the secondary shunt trip coil assembly if the right connecting rod is removed. To remove the connecting rod refer to section, V. MAINTENANCE, B. MECHANISM AREA, 3) Main Closing Spring Removal, Slow Closing of Mechanism, and Latch Check Switch Adjustment in this information bulletin.*

Perform the following steps to replace the secondary shunt trip coil assembly:

1. Remove the circuit breaker front cover.
2. Disconnect the secondary shunt trip coil assembly wiring from the wiring harness.
3. Remove the two bolts which holds the assembly to the frame, and remove the assembly.
4. Bolt the new assembly in place and reconnect it to the wiring harness. No adjustment is required.
5. Reassemble the connecting rod and main closing spring, if previously removed.
6. Trip the circuit breaker several times electrically to ensure that secondary shunt trip coil assembly is functioning properly.
7. Replace the circuit breaker front cover.

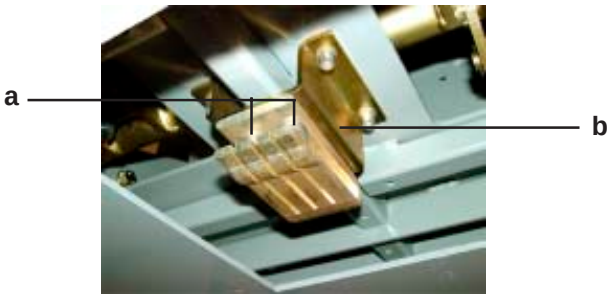
5) Undervoltage Device Assembly

Detailed instructions for replacing the undervoltage device assembly (Figure 24) are supplied with the replacement device.

Figure 24. Undervoltage Device Assembly

6) Ground Connection Assembly

This assembly is located at the rear edge of the floor pan of the circuit breaker, between the B and C poles of the circuit breaker. (See Figure 25 and Figure 1, al.)



a. Holding Bolts
b. Mounting Bracket

Figure 25. Ground Connection

Perform the following steps to replace the ground connection assembly:

1. Elevate the circuit breaker so that there is at least 6" of clear space below the bottom pan of the circuit breaker.
2. Remove the hardware holding the ground connection mounting bracket.
3. Pull down on the assembly and remove it from bottom of the circuit breaker.
4. Assemble the new ground connection assembly with the existing hardware. (Tighten bolts to 8 to 12 ft.-lbs. torque.)
5. Wipe the old lubricant off the ground connection on the circuit breaker, and apply a thin coat of contact lubricant Mobilgrease 28 to the new ground connection. (See Figure 16, s).
6. Insert the new assembly from below the circuit breaker floor pan and press it up into position.
7. Reinstall the hardware.

7) Charging Motor Assembly

The charging motor assembly is located at the bottom right of the floor pan of the mechanism. (See Figure 26 and Figure 2, f.)

Figure 26. Charging Motor Assembly

Perform the following steps to replace the charging motor assembly:

1. Remove the circuit breaker front cover.
2. Disconnect the charging motor assembly from the wiring harness.
3. Remove the two bolts which hold the charging motor mounting bracket to the base pan and slide the motor to the right, and disconnect the charging motor drive shaft from the mechanism's eccentric drive shaft. Remove the charging motor from the circuit breaker.
4. Lubricate the end of the shaft of the new charging motor liberally with Rheolube 368A grease.
5. Position the new assembly in the circuit breaker. Ensure that the pin on the end of the charging motor drive shaft engages the slot in the mechanism eccentric drive shaft.
6. Bolt the assembly to the base pan, and reconnect it to the wiring harness.
7. Operate the circuit breaker several times to ensure that the charging motor assembly operates smoothly.
8. Replace the circuit breaker front cover.

8) Anti-Pump Relay Assembly

The anti-pump relay assembly is located on the circuit breaker frame, left of the connecting rod, near the top of the mechanism. (See Figure 27 and Figure 2, a.)

Figure 27. Anti-Pump Relay

Perform the following steps to replace the anti-pump relay assembly:

1. Remove the circuit breaker front cover.
2. Loosen the lower mounting screw of the relay.
3. Remove the upper mounting screw and lift the relay off the lower screw.
4. Disconnect the leads from the anti-pump relay assembly, being careful to identify each wire by the terminal number from which it was removed.
5. Reconnect all wires to the proper terminals of the relay.
6. Place the new assembly over the lower screw, and reinstall the upper screw. Tighten the upper and lower screws.
7. Anti-pump relays that are in 250VDC closing circuits are provided with voltage dropping resistors. The resistor is mounted adjacent to the anti-pump relay. To replace the resistor, unscrew the mounting feet from the frame of the circuit breaker and remove the resistor. Insert a replacement resister and retighten the screws on the mounting feet.
9. Operate the circuit breaker several times to ensure the anti-pump relay assembly functions properly.
10. Replace the circuit breaker front cover.

9) Latch Check Switch

The latch check switch is located at the left side of the main mechanism frame, near the bottom of the main closing spring. (See Figure 28 and Figure 2, o.)

Figure 28. Latch Check Switch

Perform the following steps to replace the anti-pump relay assembly:

1. Review and the procedures in the following section: V. MAINTENANCE, b. MECHANISM AREA, 3) Main Closing Spring Removal, Slow Closing Mechanism, and Latch Check Switch Adjustment.

   NOTE: *In addition to the procedures in the above section, perform the following procedures to install a replacement Latch Check Switch:*

2. Remove the two screws that secure the latch check switch to the mechanism. Do not loose the nut plate into which these screws are threaded.
2. Disconnect the wires from the latch check switch.
3. Reconnect the wires to the new latch check switch and fasten the latch check switch in place with the screws and the nut plate which was previously removed.
4. Adjust the latch check switch according to the Main Closing Spring Removal, Slow Closing of Mechanism, and Latch Check Switch Adjustment section.
5. Operate the circuit breaker electrically several times to ensure that the latch check switch is working.

10) Motor Cutoff Switch Assembly

The motor cutoff switch assembly is located at the bottom right of the base pan of the mechanism, just to the right of the main mechanism. (See Figure 29 and Figure 2, j.)

Figure 29. Motor Cutoff Switch Assembly

Perform the following steps to replace the motor cutoff switch assembly:

1. Remove the circuit breaker front cover.
2. Remove the two bolts that hold the assembly to the floor pan and remove the assembly.
3. Disconnect the wires from the motor cutoff switch assembly, being careful to identify each wire by the terminal number from which it was removed.
4. Reconnect the wiring to the terminal from which it was removed.
5. Install the new motor cutoff assembly and bolt it to the base pan.
6. Operate the circuit breaker electrically several times to ensure that the motor cutoff switch assembly is working.
7. Replace the circuit breaker front cover.

11) Auxiliary Switch

The auxiliary switch is located at the bottom left of the base pan of the mechanism area. (See Figure 30 and Figure 2, e.)

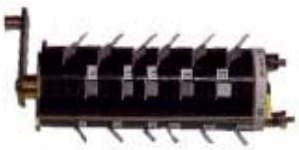


Figure 30. Auxiliary Switch

Perform the following steps to replace an auxiliary switch:

1. Remove the circuit breaker front cover.
2. Disconnect the wires from the auxiliary switch, being careful to identify each wire by the terminal number from which it was removed.
3. Remove the “E” ring securing the switch operating arm to the operations counter linkage.
4. Remove the two screws holding the auxiliary switch to its mounting bracket, and remove the switch. Note the orientation of the switch terminals prior to removing the switch.
5. Insert the new auxiliary switch and attach it to the mounting bracket with the two screws removed in step 4. Be certain to orient the auxiliary switch as noted in step 4.
6. Insert the operating arm of the auxiliary switch into the hole in the end of the operations counter linkage and secure it with the “E” ring removed in step 3.
7. Reconnect the wiring. Be sure that the wires are connected to the same terminal numbers from which they were removed.
8. Operate the circuit breaker electrically several times to ensure that the auxiliary switch is working.
9. Replace the circuit breaker front cover.

12) Primary Disconnecting Device Spring Assembly

The primary disconnecting device spring assembly is located at the outer end of the primary disconnecting device. (See Figure 31.)

Figure 31. Primary Disconnecting Device Spring Assembly

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