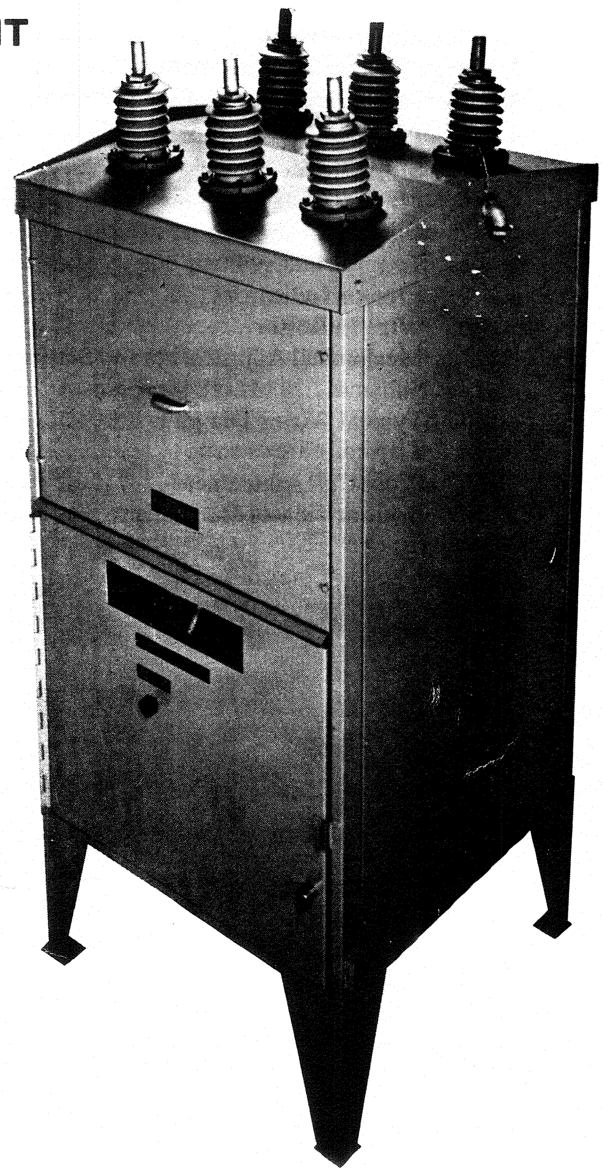
INSTRUCTIONS

Vacuum Circuit Breaker GEK 90211

POWER/VAC* VACUUM DISTRIBUTION CIRCUIT BREAKER WITH ML-18 MECHANISM



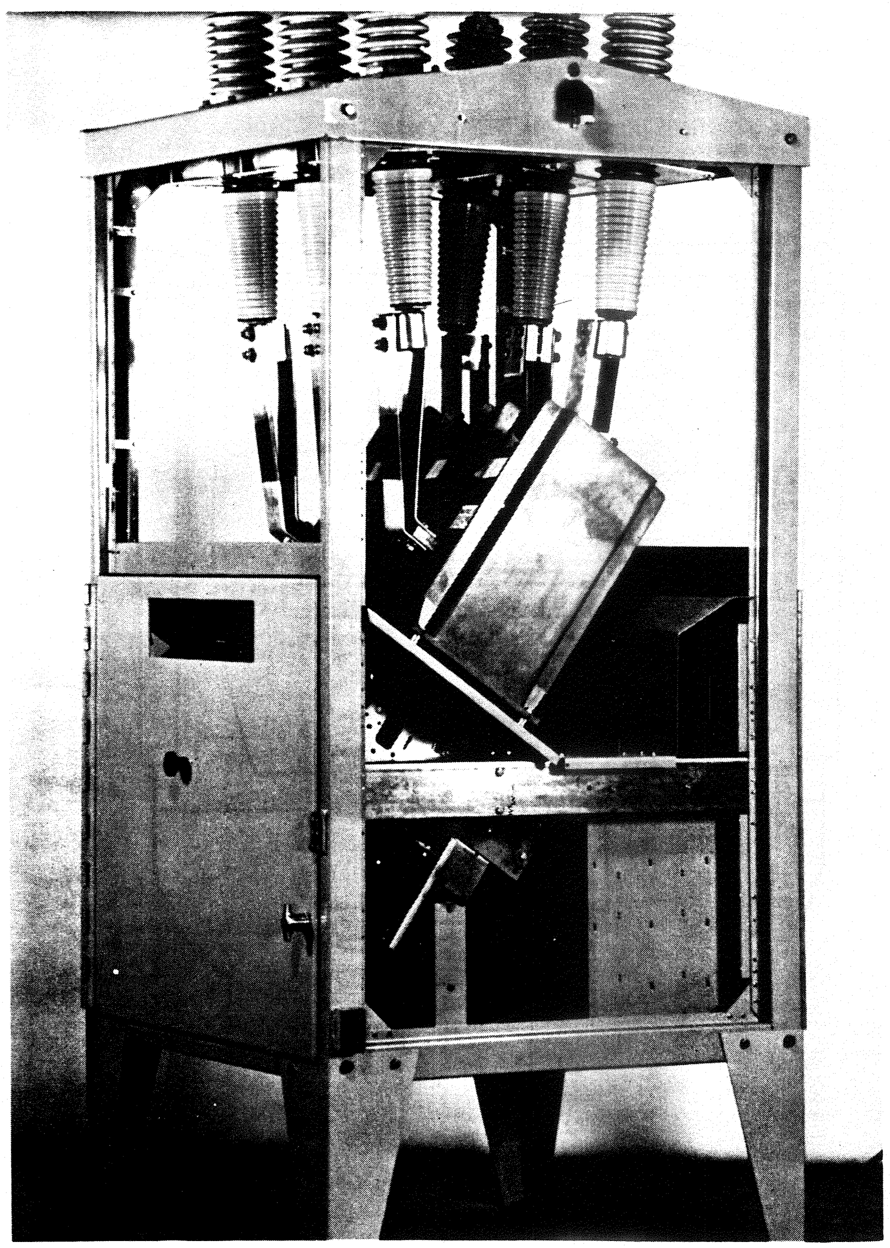
TYPES: □

PVDB1 15.5-12-600-0
PVDB1 15.5-16-800-0
PVDB1 15.5-16-1200-0
PVDB1 15.5-20-1200-0
PVDB1 15.5-20-2000-0
PVDB1 15.5-25-1200-0
PVDB1 15.5-25-2000-0

□ VACUUM BREAKER — MAX. VOLTAGE — RATED INTERRUPTING CURRENT — CONTINUOUS CURRENT — MODEL DESIGNATOR

GENERAL ELECTRIC

LIST OF ILLUSTRATIONS



TYPE PVDB1 DISTRIBUTION BREAKER

— COVERS REMOVED —

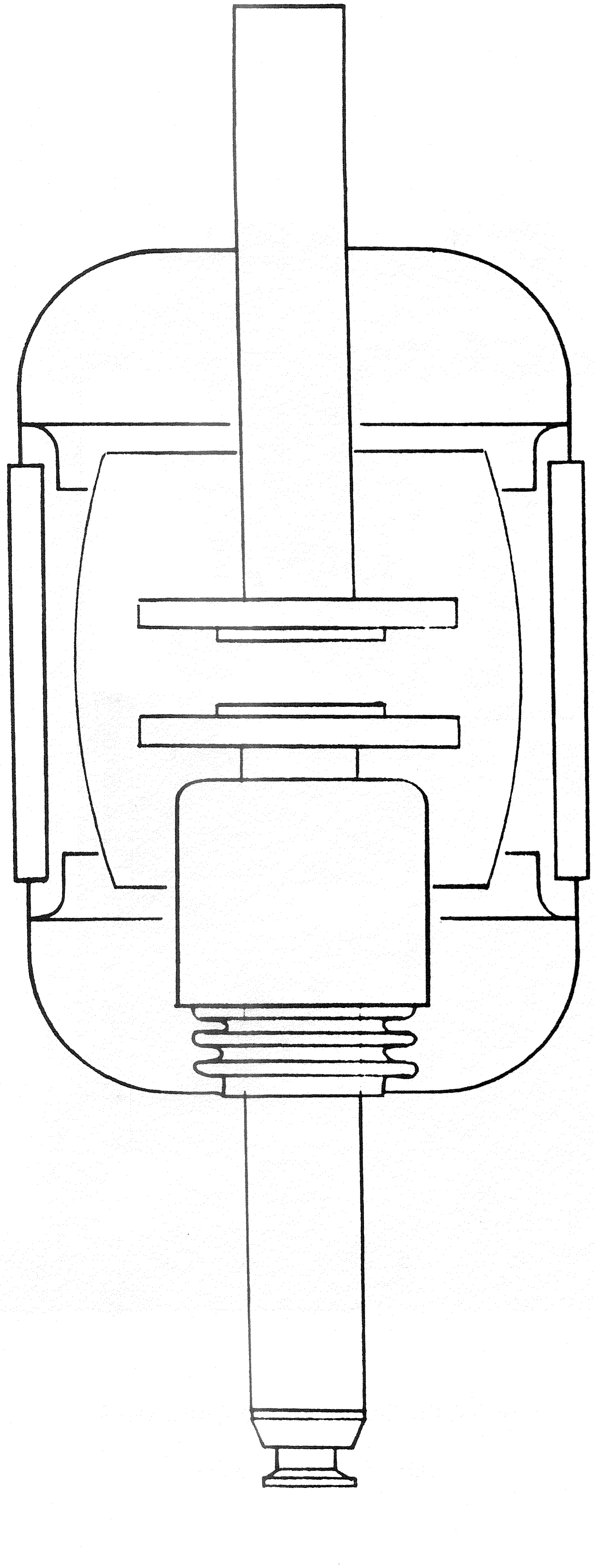


Fig. 1 Typical Vacuum Interrupter

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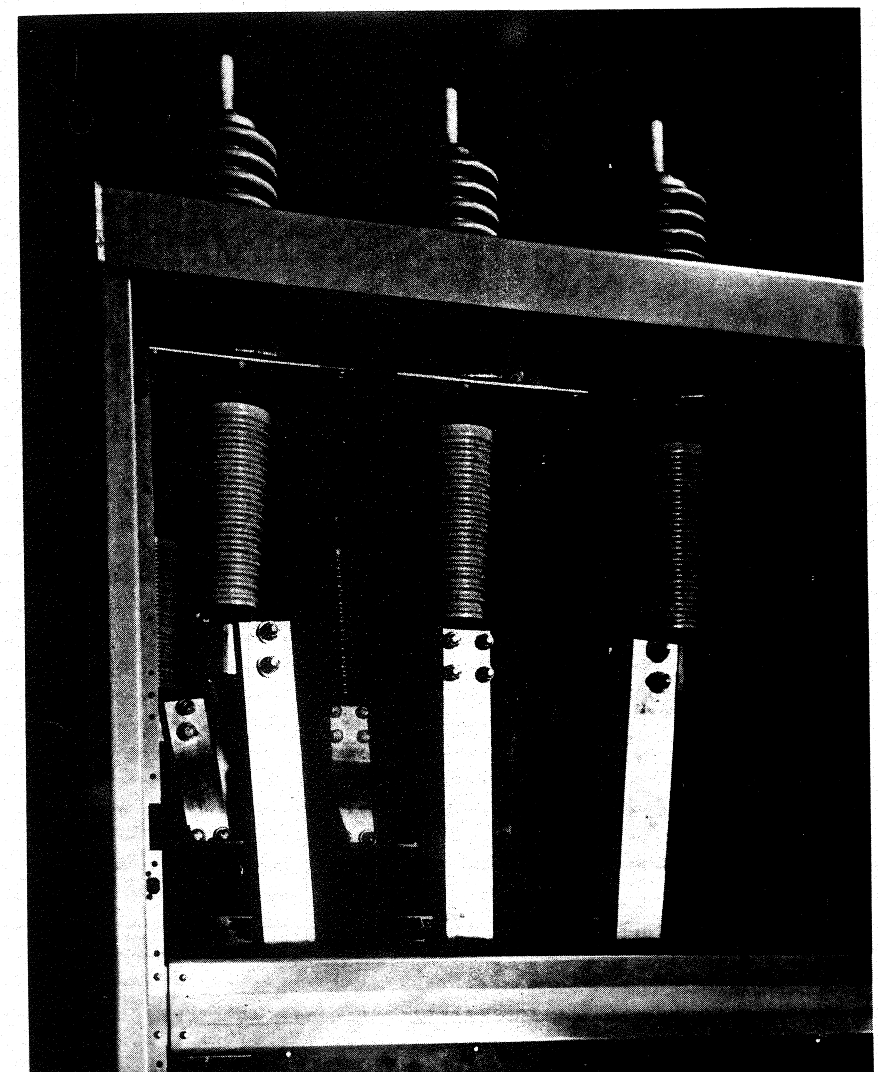


Fig. 2 High Voltage Compartment

POWER/VAC* VACUUM DISTRIBUTION CIRCUIT BREAKER WITH ML-18 MECHANISM

INTRODUCTION

The type PVDB1 breaker is a triple pole vacuum breaker designed for service up to rated voltage and rated continuous current. The interrupting current rating is symmetrical at any voltage to rated including any degree of asymmetry associated with these currents.

Vacuum interrupters, Fig. 1, display many of the features of an ideal interrupter including long life, low maintenance and rapid, quiet interruption. The standard rated interrupting time of the breaker is 5 cycles, (.083 seconds).

The vacuum breaker should be installed only in circuits where it will operate within the voltages or currents given on the nameplate. The short circuit conditions to be imposed on the breaker must not exceed the breaker rating.

"CAUTION: CIRCUIT BREAKERS ARE NOT TO BE CONSIDERED AS ISOLATING MEANS FOR PROVIDING SAFETY TO PERSONNEL WHEN WORKING ON LINES OR OTHER ELECTRICALLY CONNECTED EQUIPMENT.

VISIBLE BREAK WITH SUITABLE GROUNDING PROVISIONS MUST BE USED TO PROVIDE VISIBLE ISOLATION."

SAFETY

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

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

GENERAL

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

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

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

3. The term "breaker" includes all equipment mounted on the circuit breaker foundation.

SPECIFIC

1. DO NOT work on an energized breaker. If work has to be performed on the breaker, take it out of service, open the disconnect switches at each side of the breaker, then close the breaker and ground each phase.

2. DO NOT work on any part of the de-energized breaker until all control and heater power has been disconnected.

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

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

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

4. If there is any evidence of or suspected deterioration of breaker dielectric capability, the yard and adjacent areas should be promptly cleared of personnel. The breaker should then be deenergized by "back-ups" and isolate by disconnect switches.

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

RECEIVING, HANDLING AND STORAGE

All breakers are assembled and tested at the factory. They are shipped assembled as complete units except for the legs. Each breaker is carefully inspected and prepared for shipment by workmen experienced in the proper handling of electrical equipment. Inmediately upon receipt of a breaker, an examination should be made for any damage sustained during shipment. If injury or rough handling is evident, a damaged claim should be filed at once with the transportation company and the nearest General Electric Sales Office notified.

The exposed portion of the bushings both outside and inside the top cover should be checked for chips or cracks especially near the clamps on the top frame.

When the unit can be set up immediately in its permanent location, it is desirable to do so, even though it will not be placed in service for some time. If stored outdoors, the space heaters should be energized as soon as possible to prevent corrosion due to moisture condensation inside the housings.

DESCRIPTION

HIGH VOLTAGE COMPARTMENT

The three phases in the high voltage compartment consist of porcelain bushings, bushing current transformers, vacuum interrupters, insulating supports, and connection bars.

The vacuum interrupters, their supports and the operating mechanism comprise an interrupting module which is essentially the same as the Power/Vac circuit breaker used in Metal-Clad Switchgear.

The current path is as follows in any phase: Through the terminal stud into the entrance bushing, through the bushing conductor, and connection bar to the vacuum interrupter. Through the vacuum interrupter to the moving contact, the lower interrupter bar, the connection bar, the bushing conductor and out through the terminal.

The bushings are clamped to the roof of the housing. The bushing core is centered in the air-filled porcelain and rubber gaskets seal each end. After the bushings have been clamped in place no further adjustment is necessary when installing the connection bars.

Each of the moving interrupter contacts is operated through its own insulated operating rod assembly. A contact wipe indicator and an erosion indicator is provided for each phase.

MECHANISM

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

Additional mechanism features are the open-close and charged-discharged indicators; operations counter; manual close and trip pushbuttons; auxiliary switch; and padlock on the trip function. An optional feature is the addition of a key interlock on the trip function.

The breaker may be closed without control power by manually charging the closing spring and then pressing the manual close button.

DEVICE AND TERMINAL BOARD PANELS

Panels are provided in the low voltage compartment for mounting terminal boards for C.T. and control wiring and control devices. A cut-out with a cover plate is provided in the floor to permit conduit connection for external circuits.

BUSHING CURRENT TRANSFORMERS

Bushing current transformers, type BPD, are used on these breakers to provide a source of current supply for operating protective relays. Relaying transformers are of the multiratio type having five leads which provide a wide range of ratios. Ratio accuracy classification for standard transformers are in accordance with ANSI C-57-13 and NEMA SG-4 table 3-5 specifications.

High accuracy, single-tap metering-type current transformers can also be furnished. Ratio and accuracy classification for standard transformers of this type are also in accordance with ANSI C-57-13 and NEMA SG-4 TABLE 3-5 specifications.

Performance data in the form of ratio curves are available for all standard transformers of standard ratios. These are supplied in an instruction book or can be secured from the Switchgear Operation by giving the proper references.

Bushing current transformers are mounted inside the top frame. They are installed from underneath the top frame and t be slipped over the lower end of the bushing. A support- plate bolted to the top frame holds the transformer in place. It must be properly centered around the bushing when it is being installed.

ENTRANCE BUSHING REMOVAL

In the event that an entrance bushing must be removed, the current transformer on that bushing must first be removed to allow the removal of the grounding spring. The grounding spring is a long coil spring hooked together at the ends to form a garter which is passed up over the bushing ground sleeve. Within the coil spring is a bare conductor, the ends of which come out of the spring and are terminated in a single terminal. The terminal is anchored to the roof frame. The terminal must be disengaged and the garter removed before the bushing is removed. The procedure is reversed for reinserting a bushing. The ground sleeve referred to above is in the form of a conductive coating applied directly to a section of the lower end of the bushing.

The garter makes electrical contact with the ground sleeve and the conducting leads terminated in the terminal complete the connection to ground potential.

INSTALLATION

The installation of the breaker will be faciliated by a study of these instructions and a review of the approved drawings which supplement these instructions. The drawings show the general arrangement, dimensions, location of foundation bolts, provisions for conduit connections, electrical connections and other information necessary for the proper installation of the breaker. These drawings consist of the requisition summary, outline of the unit with its operating mechanism and housing, and the connection diagrams.

The breaker is shipped in the closed position with the trip latch blocked against its stop to prevent opening. This should be removed as stated in the section, INSPECTION BEFORE OPERATION.

LOCATION AND MOUNTING

The unit should be located so that it is readily accessible for manual operation and inspection. Care should be taken when lifting the unit not to allow the lifting device to come in contact with the bushing. Two lifting holes are provided on the top of the unit for lifting purposes. The total weight of the unit is given on the nameplate and should be taken into consideration when selecting a lifting device for the breaker.

Legs for the basic unit as indicated on the outline drawing come in 12 inch to 36 inch lengths and are shipped separately, ready for assembly. After assembly fasten the breaker in position on its foundation. The foundation should be firm and level; if it is not, shims should be used under the mounting pad of the leg to level the unit. The mounting bolts recommended are 0.625 inch diameter and their locations are shown on the breaker outline drawings.

CONNECTIONS

After the breaker has been located, electrical connections can be made. Before making these, every precaution must be taken to see that all leads to be connected to the unit are dead.

PRIMARY CONNECTIONS

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

Connections to the breaker are made by the bolted connectors fastened to the ends of the bushings and must be securely tightened to assure good contact. All joints must be clean and bright.

CONTROL AND SECONDARY WIRING

All control wires should be run in conduit insofar as it is practicable. Control wires must be run separately and remote from high tension leads unless the distance separating the two sets of wires is sufficient to prevent possible communication between them as a result of short circuits. Control wiring of adequate size should be used so that with full operating current flowing to the operating mechanism, the voltage across the terminals of the mechanism will be within the limits specified as standard for the control voltage as specified on the nameplate. It is recommended that all conduits entering the mechanism housing be sealed off at their entrances to the housing.

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

GROUND CONNECTIONS

The framework of each breaker should be permanently grounded. The usual practice is to connect a heavy cable to the framework and to the ground. Provisions for a bolted connector is provided on the framework to which the ground cable can be attached. The cable should be able to carry 25 per cent of the current rating of the breaker, but should not be smaller than #4/0.

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

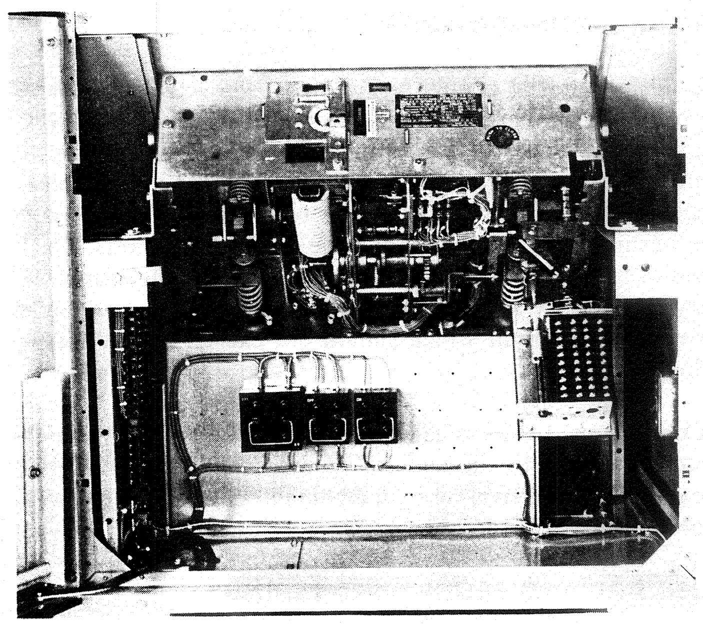


Fig. 3. Mechanism Side Low Voltage Compartment

INSPECTION BEFORE OPERATION

After the unit has been installed with all mechanical and electrical connections completed, the following inspections and test should be made before operation. If any question arises concerning the unit during the following inspection procedure, refer to the section, MAINTENANCE AND ADJUSTMENTS.

1. See that the unit is properly set up and leveled on its foundation.

2. See that all nuts, washers, bolts, snap rings, cotter pins and terminal connections are in place and tightened.

3. Inspect all insulated wiring to see that it has sustained no damage during installation and test it for possible grounds or short circuits.

4. See that all bearing surfaces of the operating and breaker mechanisms have been lubricated with 0282A2048P009 grease.

5. See that all covers and bolted connections are securely tightened.

6. See that all points where the surface of the paint has been damaged during installation are repainted immediately.

7. When all of the above items have been checked, the trip latch may be released. This is done by removing the blocking bolt which has prevented movement of the latch and subsequent opening of the unit during shipment.

The circuit breaker has been shipped in the closed position with the mechanism trip latch blocked by a bolt through the rear frame. A yellow tag identifies this bolt (see Figure 5). Before operation this bolt must be relocated to the storage position (1, Fig. 5) and the mechanism tripped open with the manual trip push button. The close spring is shipped discharged. DO NOT ATTEMPT TO TRIP THE BREAKER BEFORE RELOCATING THE BLOCKING BOLT. (Fig. 5)

SAFETY PRECAUTIONS

8. This circuit breaker uses powerful springs for energy storage. DO NOT WORK ON THE INTERRUPTERS OR MECAHNISM UNLESS BOTH THE CLOSING SPRINGS AND OPENING SPRINGS ARE EITHER DISCHARGED OR GAGGED AND *ALL ELECTRICAL POWER IS REMOVED*. These precautions are required to prevent accidential operation. Anyone working on the circuit breaker should be familiar with the contents of this instruction book.

9. Make a continuity check and a hipot test on each interrupter to make sure the vacuum within the unit has not been lost due to shipping damage. See HI-POT TESTING under MAINTENANCE AND ADJUSTMENTS for hipotting procedure and important precautionary measures.

10. When a capacitor trip device is supplied; make certain that the tripping circuit is not completed (all protective relay contacts open) when applying a-c voltage to a discharged unit.

11. The breaker should now be ready for mechanical checking and slow closing.

A. Visually inspect the circuit breaker for any signs of damage or loose hardware.

B. Manually charge the breaker closing spring using the charging handle provided (Fig. 6). The closing spring is charged by a ratcheting mechanism that advances by one ratchet tooth at a time. When the spring is fully charged and the spring load is held by the closing latch the

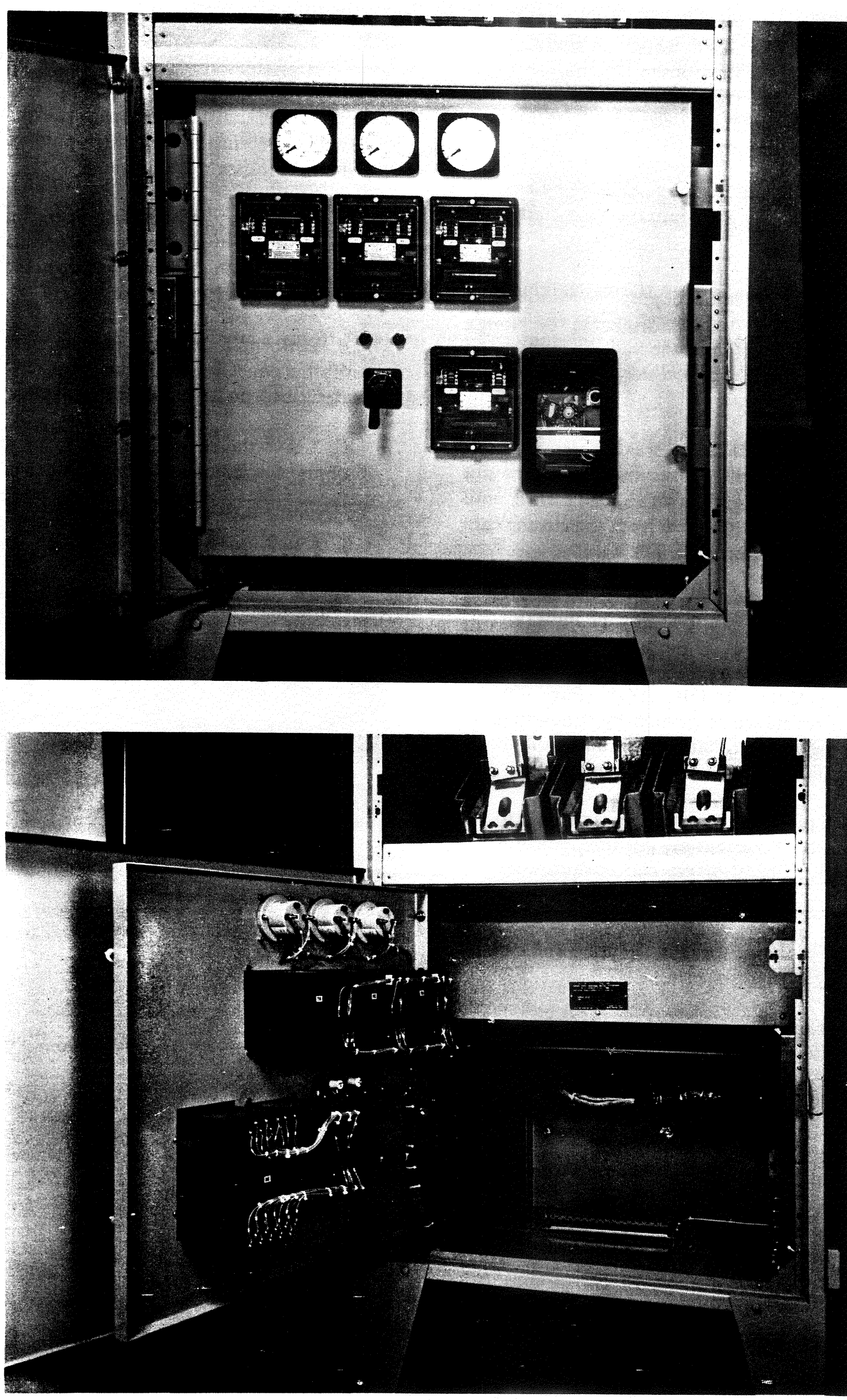


Fig. 4 Relay Side Low Voltage Compartment

spring indicator (Fig. 3) will change from "DIS-CHARGED" to "CHARGED", and a positive snap will be heard as the spring travels over center. After the spring is completely charged, as indicated above, *further forcing the charging handle may cause damage to the closing latch* and its associated parts.

C. Insert the closing spring gag plate (Fig. 7) by engaging the detents on the gag plate into the slots on the closing spring guide.

With the gag plate in position, depress the manual close button. This action will partially discharge the closing spring and also partially close the vacuum interrupter contacts. Do not energize the secondary control circuit at this time.

D. To manually slow-close the braker contacts, insert the manual charging handle in the manual charge slot and move the handle up and down about 12 times until the closing roller (5, Fig. 8) is free from the closing cam and resting on the close prop (8, Fig. 8).

E. In the closed position, check and record the erosion indicator dimensions (4, Fig. 9) and the wipe indicator dimensions (5, Fig. 10). Check that the position indicator shows "CLOSED". See PRIMARY CONTACT WIPE (Page 00) AND EROSION INDICATOR (Page 00). Check the insulation resistance to ground by connecting a megohmeter between the primary circuit and ground. The mimimum resistance should be 10,000 megohms.

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

G. Repeat (2) to charge the closing spring and then remove the closing spring gag plate.

H. Discharge any stored energy in the breaker by successively depressing the manual close and manual trip buttons. Performing these operations leaves the breaker open with the closing spring discharged.

12. Next, the following electrical checks should be made.

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

A. To check the electrical operation apply control voltage to the circuit breaker. Check the control voltage on the nameplate and close and open the breaker several times to check electrical operation.

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

C. Leave the circuit breaker in an open and spring-discharged condition after checks are complete.

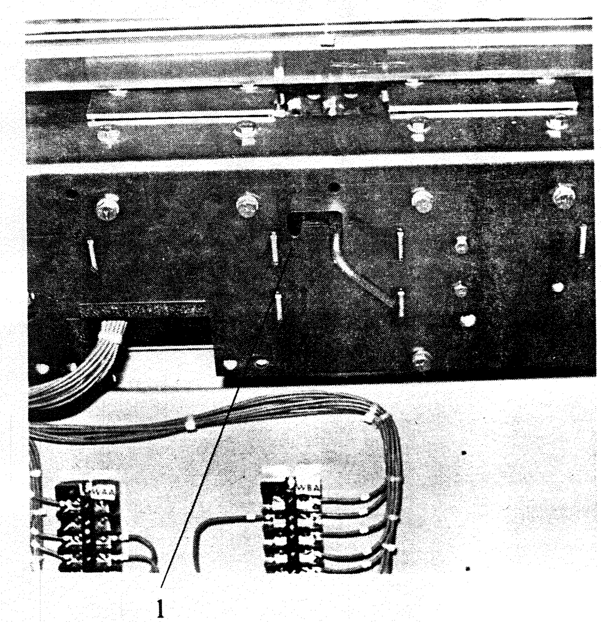


Fig. 5 Shipping Block

OPERATION

GENERAL

The Power/Vac* vacuum distribution circuit breaker uses a sealed vacuum interrupter to establish and interrupt a primary circuit. Molded supports, one per pole, provide interchangeable mountings for the primary bars, interrupters, and heat dissipation fins (where used). The operating mechanism provides motion at each pole location in order to move the lower contact of the vacuum interrupters from an open position to a spring-loaded closed position and then back to the open position on command.

The ML-18 mechanism (Fig. 12) is of the stored-energy type and uses a gearmotor to charge a closing spring. During a closing operation, the energy stored in the closing spring is used to close the vacuum interrupter contacts, charge the wipe springs which load the contacts, charge the opening springs, and overcome bearing and other friction forces. The energy then stored in the wipe and opening springs will open the contacts during an opening operation.

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

Figure 12 shows a front view of the ML-18 in a schematic form. The primary contacts are open and the closing springs charged. The closing spring charging system consists of a closing spring (1) mounted on the left side of the mechanism and electrical charging system mounted on the right side of the mechanism. Both components are fastened to the cam shaft (2). A manual charging system (3) is provided so that the mechanism can be slow-closed and the closing spring can be charged if there is a loss of electrical control power.

CLOSE SPRING CHARGING

Spring charging is accomplished electrically by a rotating eccentric on the output shaft of the gear motor driving pivoted charging arms (4, Fig. 12) that oscillate about the centerline of a ratchet wheel (5). A driving pawl (6), mounted within the charging arms, oscillates with the charging arms. Starting from its rear-most position, as the charging arms rotate forward, a spring forces engagement of the driving pawl with a tooth on the ratchet wheel. The ratchet wheel is advanced by the rotating charging arms and pawl assembly.

Advancment of one tooth spacing is provided for each oscillation of the system. The ratchet motion is restricted to one direction by a spring loaded holding pawl that prevents the ratchet wheel from going backwards as the charging arms oscillate back to pick up the next tooth. Thirteen (13) complete cycles of the charging arms are needed for a full charge of the closing spring. The efficient, compact gear motor accomplishes this action in just about one (1) second.

When the charging cycle is complete the ratchet wheel is positioned so that a missing tooth is adjacent to the driving pawl and any motor overspin will not drive the ratchet wheel, thus preventing damage to the system.

When the spring is completely charged, the assembly is retained in that position until it is desired to close the circuit breaker.

The closing coil cannot be electrically energized unless the closing spring is completely charged. This action is prevented by the 52/CHG switch in the closing circuit.

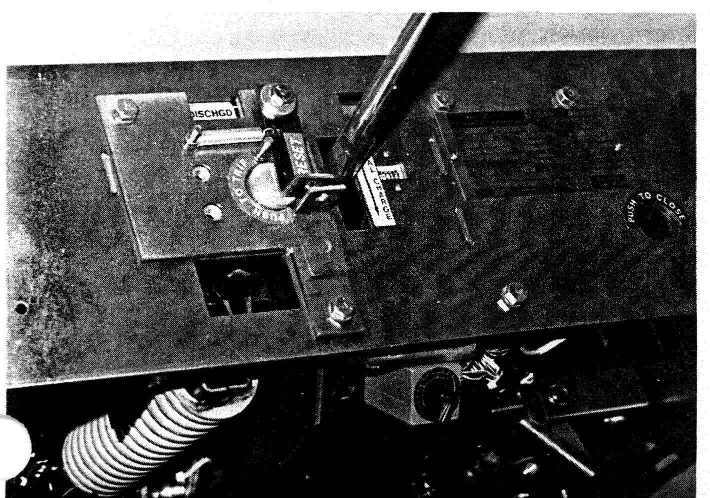


Fig. 6 Manual Charging

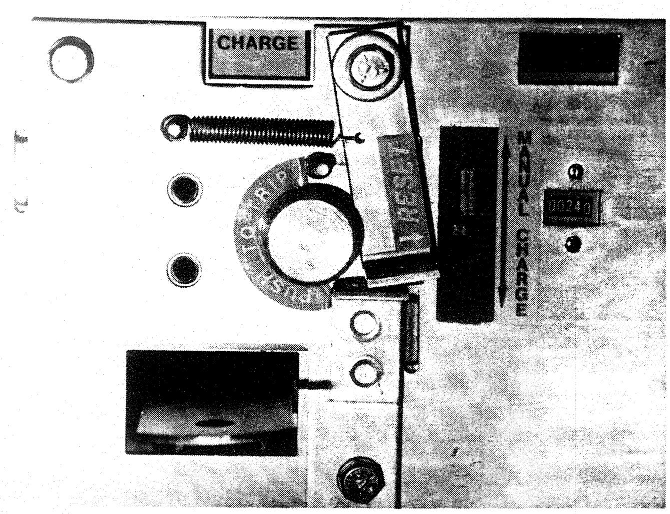
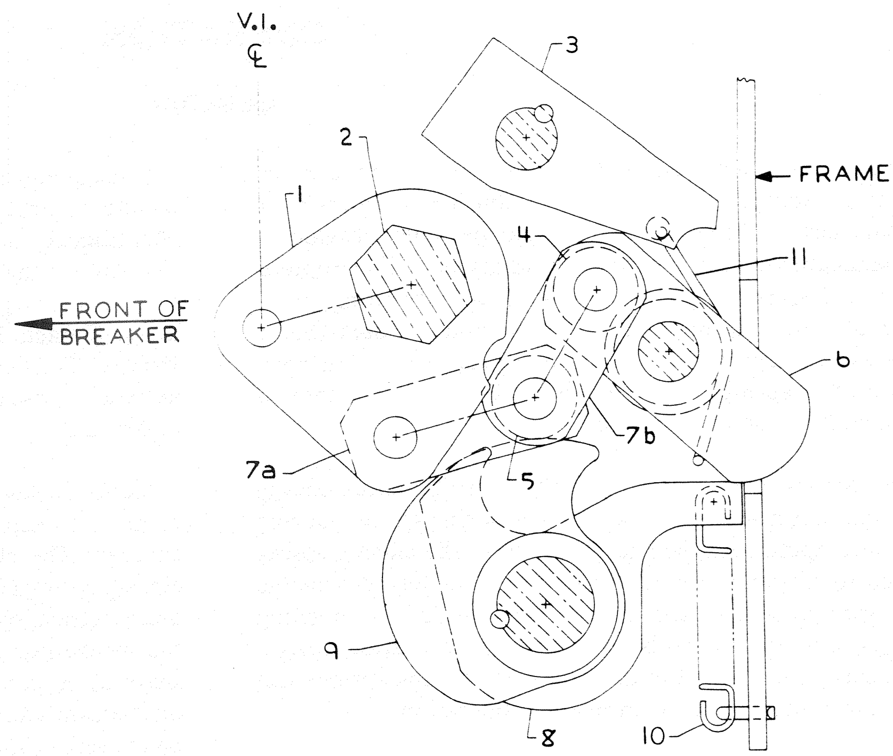
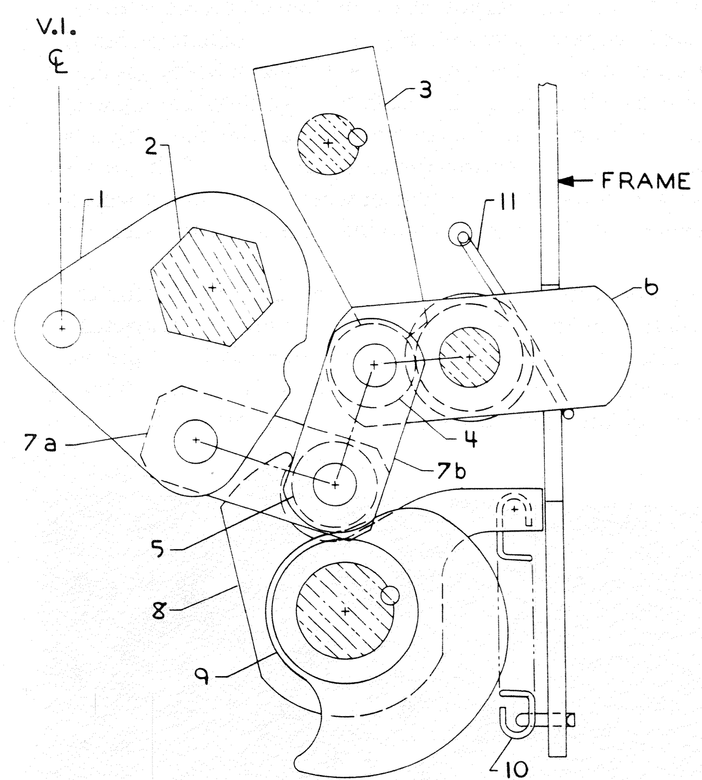


Fig. 7 Close Spring Gag



(A) BREAKER OPEN — SPRING DISCHARGED

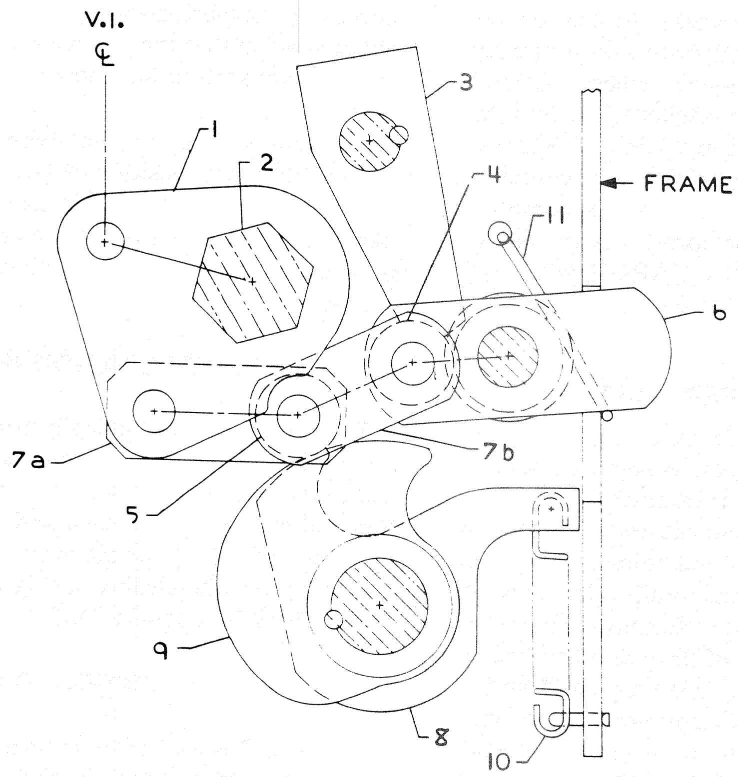


(B) BREAKER OPEN — SPRING CHARGED

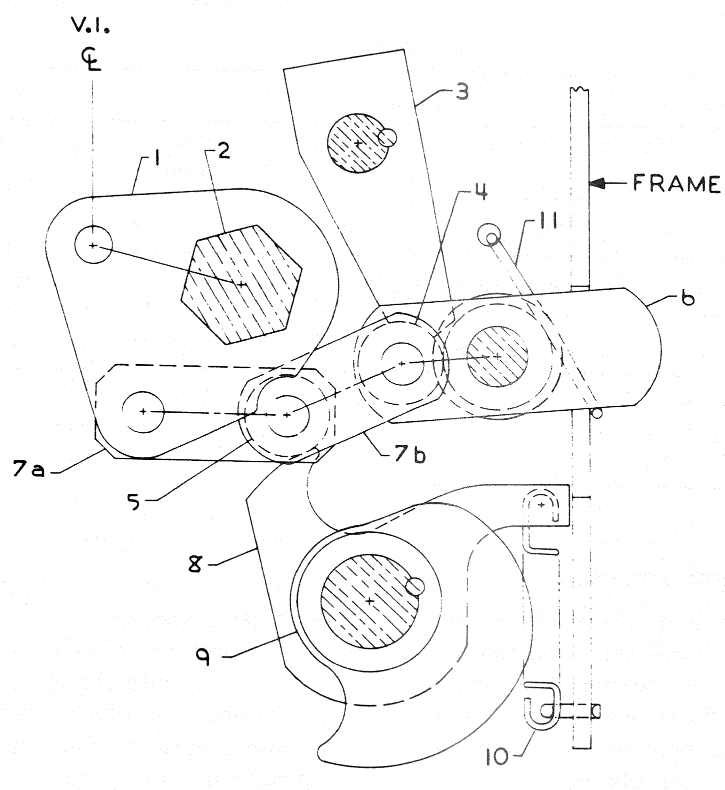
1 OUTPUT CRANK
2 JACKSHAFT
3 TRIP LATCH
4 TRIP ROLLER
5 CLOSING ROLLER
6 TRIP LINK
7a CLOSING TOGGLE
7b CLOSING TOGGLE
8 PROP
9 CLOSING CAM
10 PROP SPRING
11 LINKAGE RETURN SPRING

Note: Shading indicates fixed pivots.

Fig. 8 TOGGLE LINKAGE POSITIONS OF THE ML-18 MECHANISM
(VIEW FROM RIGHT HAND SIDE)



(C) BREAKER CLOSED — SPRING DISCHARGED



(D) BREAKER CLOSED — SPRING CHARGED

The manual charging system (3) works directly on the cam shaft where a one way clutch (7) driven by a manual handle provides rotation of the ratchet wheel. Manual pumping of the handle advances the ratchet wheel and the holding pawl prevents counter rotation while the handle is returning for another stroke. Six (6) to seven (7) complete strokes of the manual handle are required for one complete spring charging operation. When the spring charge indicator shows "CHARGED", MANUAL CHARGING MUST BE DISCONTINUED TO AVOID MECHANISM DAMAGE.

CLOSING OPERATION (REFER TO FIG. 12)

By either energizing the close solenoid or depressing the manual close button, the close latch (8) is rotated releasing the closing spring (1). This action is transmitted to the closing cam (9) and closing roller (10) and causes the linkage to rise until the prop (11) can slip under and hold the linkage in place. As the linkage moves the output crank (12) rotates the cross shaft (13) which in turn rotates the phase bell cranks (14) on all three poles. The rotation of the phase bell cranks compresses the two opening springs (15) on poles 1 and 3, closes the vacuum interrupters and compresses the wipe springs (16) on each interrupter. The rotation of the cross shaft (13) also changes the auxiliary switch (17) position and the position flag on the front panel will indicate "CLOSED". After the breaker is closed, the charging motor is again energized and the closing springs are charged as described under "CLOSE SPRING CHARGING". This is possible when the breaker is in the closed position because the linkage is held in position by the prop.

current. If the closing spring has been recharged the linkage will be reset so that the trip latch will fall in place on the trip roller in preparation for another closing operation.

If the closing spring has not been recharged, the trip latch will be held out of position. A latch checking switch (21) will not close unless the latch is in its normal position. The contacts of latch checking switch are in the closing circuit so that electrically initiated closing is blocked when the trip latch is not reset.

TRIP-FREE OPERATION (REFER TO FIG. 12)

The linkage is mechanically trip-free in any location on the closing stroke. This means that energizing the trip coil while closing after the auxiliary switch contacts change position will rotate the trip latch and permit the circuit breaker to open fully. The linkage will reset as in a normal open operation and the closing spring will recharge as described under SPRING CHARGING.

CONTROL CIRCUIT

A typical Power/Vac* circuit breaker ML-18 mechanism wiring diagram is shown in Fig. 13. Check the wiring diagram supplied with the actual circuit breaker for its wiring.

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

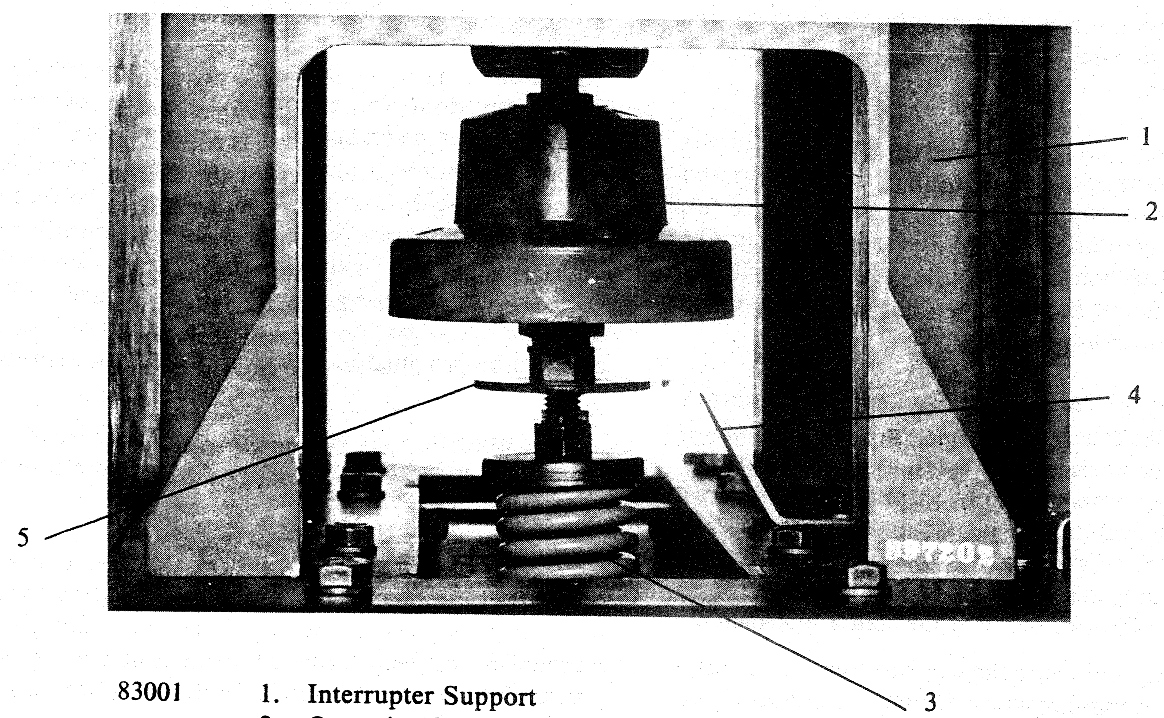
TABLE 1

NOMINAL CONTROL VOLTAGE	CHARGE MOTOR		CLOSE COIL		TRIP COIL		
	PART NO.	RANGE	PART NO.	RANGE	PART NO. (5 CYCLE)	PART NO. (3 CYCLE)	RANGE
48 VDC	0177C5050G003	36-56	0282A7015G001	36-56	0282A7015G004	0282A2009G007	28-56
125 VDC	0177C5050G001	90-140	0282A7015G002	90-140	0282A7015G006	0282A2009G008	70-140
250 VDC	0177C5050G002	180-280	0282A7015G003	180-280	0282A7015G007	0282A7015G010	140-280
120 VAC	0177C5050G001	104-127	0282A7015G008	104-127	N/A	N/A	—
240 VAC	0177C5050G002	208-254	0282A7015G005	208-254	N/A	N/A	—
340 VDC					0282A2009G009	0282A2009G010	(CAP. TRIP)

OPENING OPERATION (REFER TO FIG. 12)

By either energizing the trip solenoid (18) or depressing the manual trip button, the trip latch (19) is rotated permitting the linkage to collapse and the vacuum interrupter contacts to open under the force of the wipe springs (16) and opening springs. At the end of the opening stroke a stop hits the frame and limits overtravel and rebound. Rotation of the cross shaft from the closed to an open position operates the auxiliary switch (17) and interrupts the trip coil

The close circuit is established through two normally closed Y relay contacts, 52Y and the latch-checking switch LC, if the trip latch is reset. An auxiliary switch contact 52 is also in series with the close coil and it closes when the breaker is open and opens when the breaker is closed. During a close operation, cam rotation closes the SM/LS contact, picking up the Y relay coil thereby opening its contacts to interrupt the close, coil current and sealing it in through a normally open contact to the close signal. The sealing pre-



83001
1. Interrupter Support
2. Operating Rod Insulator
3. Wipe Spring
4. Erosion Indicator
5. Erosion Disk
(Shown in closed poistion with no contact erosion)

Fig. 9 EROSION INDICATOR

vents reclosing on a sustained close command as the close signal must be removed to drop out the Y relay, and re-establish the closing circuit, thereby providing an anti-pump feature.

The mechanism mounted auxiliary switch contacts not used in the control circuit are brought out for control and indication functions. An additional breaker operated, housing mounted auxiliary switch can be provided for additional contacts.

MECHANICAL ADJUSTMENTS

GENERAL

The ML-18 Mechanism has been designed for extended intervals between maintenance. In most cases only the wipe and gag adjustments will require re-setting throughout the life of the circuit breaker. In addition to the descriptions of the mechanical adjustments, Table 2 contains a summary of adjustment settings.

WIPE ADJUSTMENT

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

An indicator is provided on the wipe spring assembly with graduations given in 0.050 inch on which the wipe is indicated directly. See Figure 10.

Improvement in the accuracy of the wipe measurement may be obtained by using a feeler gauge between the wipe indicator and the erosion disc. The difference in readings recorded on each pole with the breaker closed and open will be the contact wipe.

The wipe should be set as follows:

Breaker Rating	Wipe (inches)
All	0.155-0.180

Readjust when reduced to 0.075

To adjust the primary contact wipe, close the breaker and block the trip latch with the trip latch blocking rod, Figure 5. This will prevent injury from accidential opening of the breaker.

(1) Loosen but do not remove the two screws (6), Figure 10, holding the interrupter clamp.

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

(3) Hold the hexagon projection (9), Figure 10, at the bottom of the operating rod insulator (1 inch wrench) and loosen the adjacent locknut (¾ inch wrench). Refer to (8), Figure 10. Adjust by rotating the operating rod insulator. The thread is ½-13 and each turn will give about 0.078 inch change in primary wipe. Screw the operating rod insulator toward the interrupter to increase wipe.

(4) After setting the contact wipes on each phase torque the operating rod locknut (8), Figure 10, to 40-50 foot pounds while preventing the operating rod insulator (2) from turning. Tighten the clamp screws (6) to 10-12 foot pounds. Remove the trip shaft block and trip the breaker open. This procedure prevents accidental twisting of the operating rod of the interrupter by loading the contacts with the wipe springs and forcing relative rotation to occur at the clamp interface.

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

1. Wipe Spring
2. Operating Rod Insulator
3. Lock Washer
4. Interrupter Clamp
5. Wipe Indicator
6. Clamp Screws
7. Erosion Disk
8. Lock Nut
9. Hexagon Projection

EMERGENCY TRIP

A "Pull to Trip" knob is provided on the outside of the mechanism door for emergency tripping of the circuit breaker. When the breaker is tripped by means of this knob, a small lever on the front of the mechanism frame is spring operated to hold the trip button depressed, so that the trip latch cannot reset, and the breaker is mechanically trip-free. The latch checking switch (lcs) is also held open so the closing coil cannot be energized. Provision is made for padlocking the lever in the operated position. As an option a key lock can also be provided to hold the trip button depressed.

After using the emergency trip, the mechanism door must be opened and the lever reset manually to release the trip button.

When properly adjusted, the lever will move across the face of the trip button just as the breaker trips. When it is holding the button depressed, the trip latch must not permit the mechanism to close. A fine adjustment of the trip latch adjusting nut may be required to insure this, See Table 2, adjustment #1 and Fig. 14.

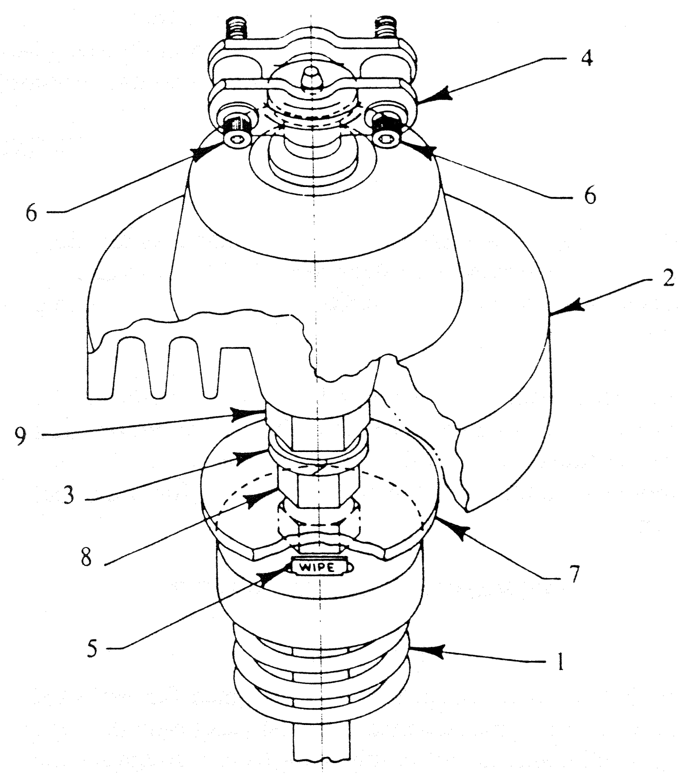
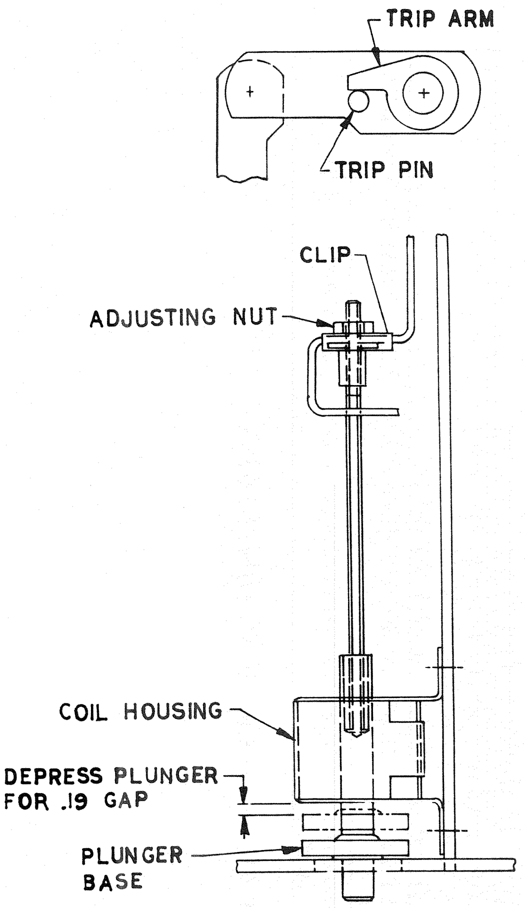


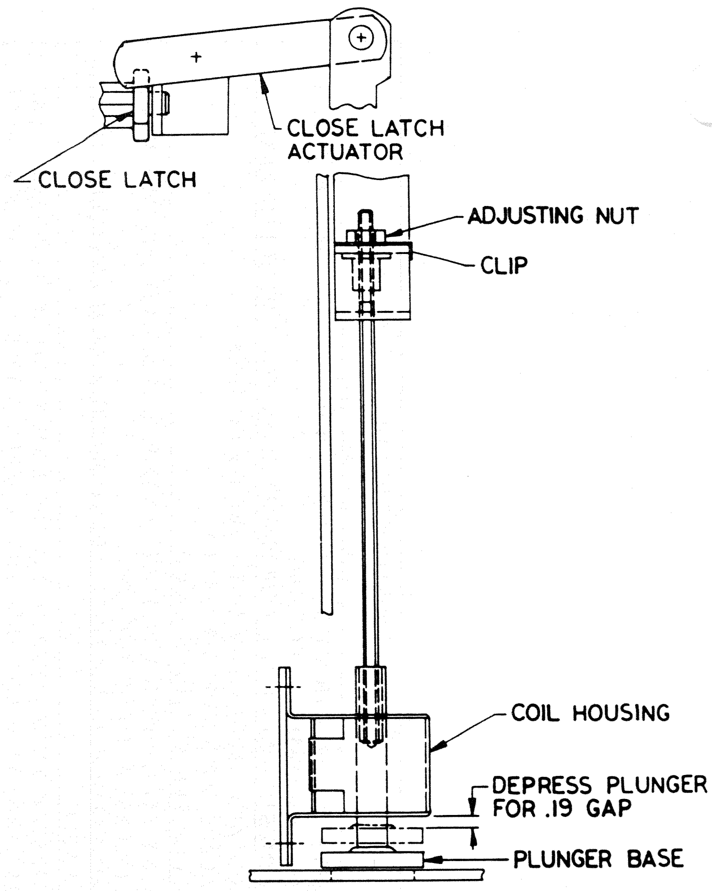
Fig. 10 Wipe Indicator

ITEM SEE FIG. 8A	BREAKER POSITION	CLOSING SPRING	OPENING SPRING	TRIP LATCH	ADJUSTMENT DETAIL
1. TRIP COIL	CLOSED	DISCHARGED	CHARGED	UNBLOCKED	1. DEPRESS PLUNGER WITH A .19 SPACER (EXAMPLE: .19 DRILL) PLACED BETWEEN PLUNGER BASE AND COIL HOUSING. 2. TURN ADJUSTING NUT UNTIL TRIP PIN MAKES CONTACT WITH TRIP ARM.
2. CLOSE LATCH	OPEN	CHARGED	DISCHARGED	UNBLOCKED	1. ADVANCE ADJUSTING SCREW UNTIL BREAKER CLOSES. 2. BACK ADJUSTING SCREW OFF ½ TURN. 3. CHECK ELECTRICAL CLOSE/CHARGE
3. CLOSE COIL	OPEN	CHARGED	DISCHARGED	UNBLOCKED	1. DEPRESS PLUNGER WITH A .19 SPACER EXAMPLE: .19 DRILL) PLACED BETWEEN PLUNGER BASE AND COIL HOUSING. 2. TURN ADJUSTMENT NUT UNTIL CLOSE **LATCH ACTUATOR MAKES CONTACT WITH** CLOSE LATCH.
4. OPENING SPRING	AS REQ'D.	AS REQ'D.	AS REQ'D.	UNBLOCKED	1. SET ADJUSTING NUT SO THAT OPENING SPEED IS APPROX. 5.0 FT/SEC. (MUST BE GREATER THAN 3.5 FT/SEC) AND CLOSING SPEED IS APPROX. 2.75 FT/SEC (MUST BE LESS THAN 4.0 FT/SEC).
5. WIPE	CLOSED	CHARGED & GAGGED	CHARGED	BLOCKED	1. CLOSE BREAKER. (LINKAGE MUST BE ON PROP LATCH). FIG. 8D 2. BACK OFF OPERATING ROD UNTIL CONTACTS ARE SEPARATED. 3. WITH BUZZER ACROSS CONTACTS, ADVANCE OP. ROD UNTIL CONTACTS TOUCH. 4. ADVANCE OP. ROD 2½ ADDITIONAL TURNS. 5. LOCK LOCK NUT. 6. CHECK WIPE — MUST BE .155 - .180 (SET ALL 3 PHASES BEFORE MEASURING). 7. IF REQUIRED, ADJUST TO FINE TUNE.
6. GAP	OPEN	CHARGED OR DISCHARGED	DISCHARGED	UNBLOCKED	1. SET ADJUSTING NUT SO THAT GAP IS .545 - .600. 2. CHECK THAT TRIP LATCH WILL RESET. 3. ADJUST GAP IF TRIP LATCH WILL NOT REST.
7. N.O. SWITCHES	AS REQ'D.				1. ADJUST SWITCH FOR RECESS SHOWN WHEN PLUNGER IS DEPRESSED (CONTACTS CLOSED).
8. V.I. STOP	OPEN	DISCHARGED	DISCHARGED	UNBLOCKED	1. SET ADJUSTING SCREW FOR NO CLEARANCE BETWEEN STOP AND WIPE SPRING ROD STRIKER.

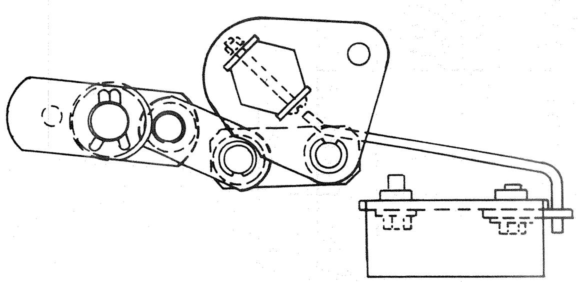
TABLE 2 SUMMARY OF ADJUSTMENTS AND CRITICAL DIMENSIONS



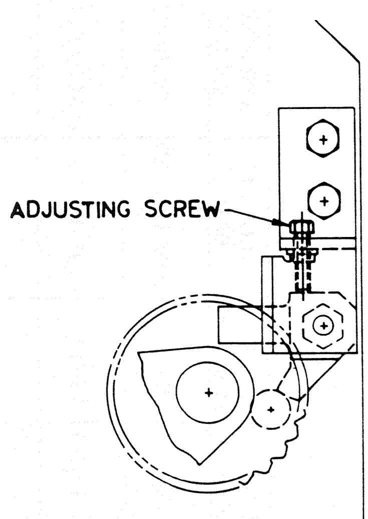
TRIP COIL
SEE TABLE 2 — ITEM 1



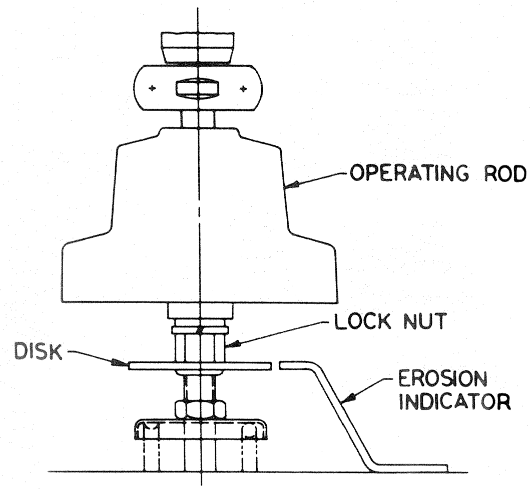
CLOSE COIL
SEE TABLE 2 — ITEM 3



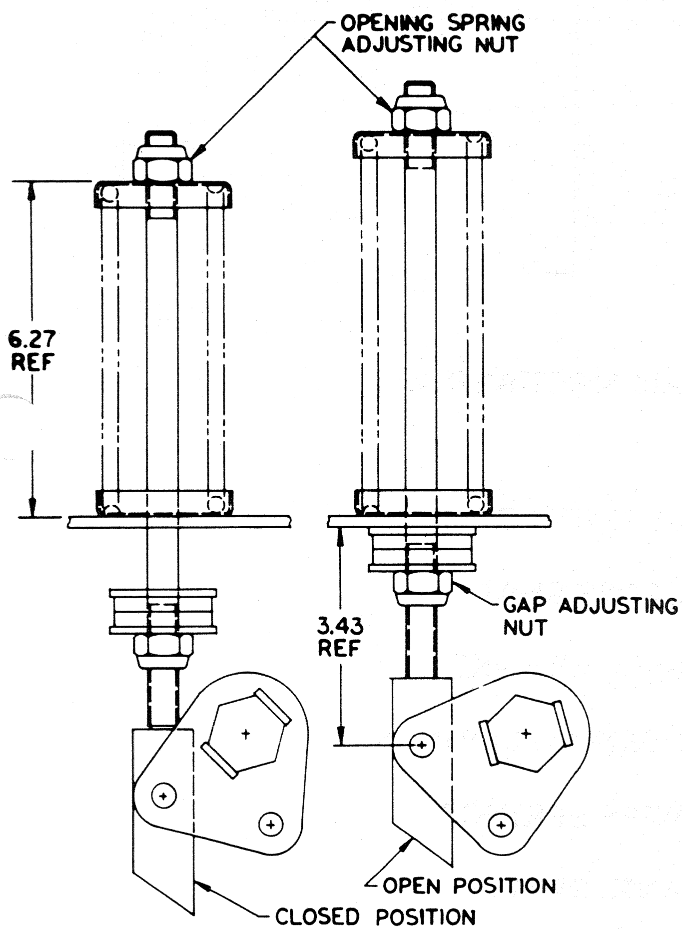
V.I. STOP (CENTER)
SEE TABLE 2 — ITEM 8



CLOSE LATCH
SEE TABLE 2 — ITEM 2

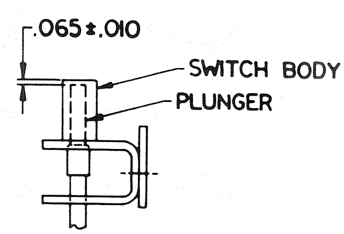


WIPE SEE TABLE 2 — ITEM 5



OPENING SPRING SEE TABLE 2 — ITEM 4

GAP SEE TABLE 2 — ITEM 6



N.O. SWITCHES
SEE TABLE 2 — ITEM 7

FIG. 8A

MECHANICAL
ADJUSTMENTS
AND
SETTINGS

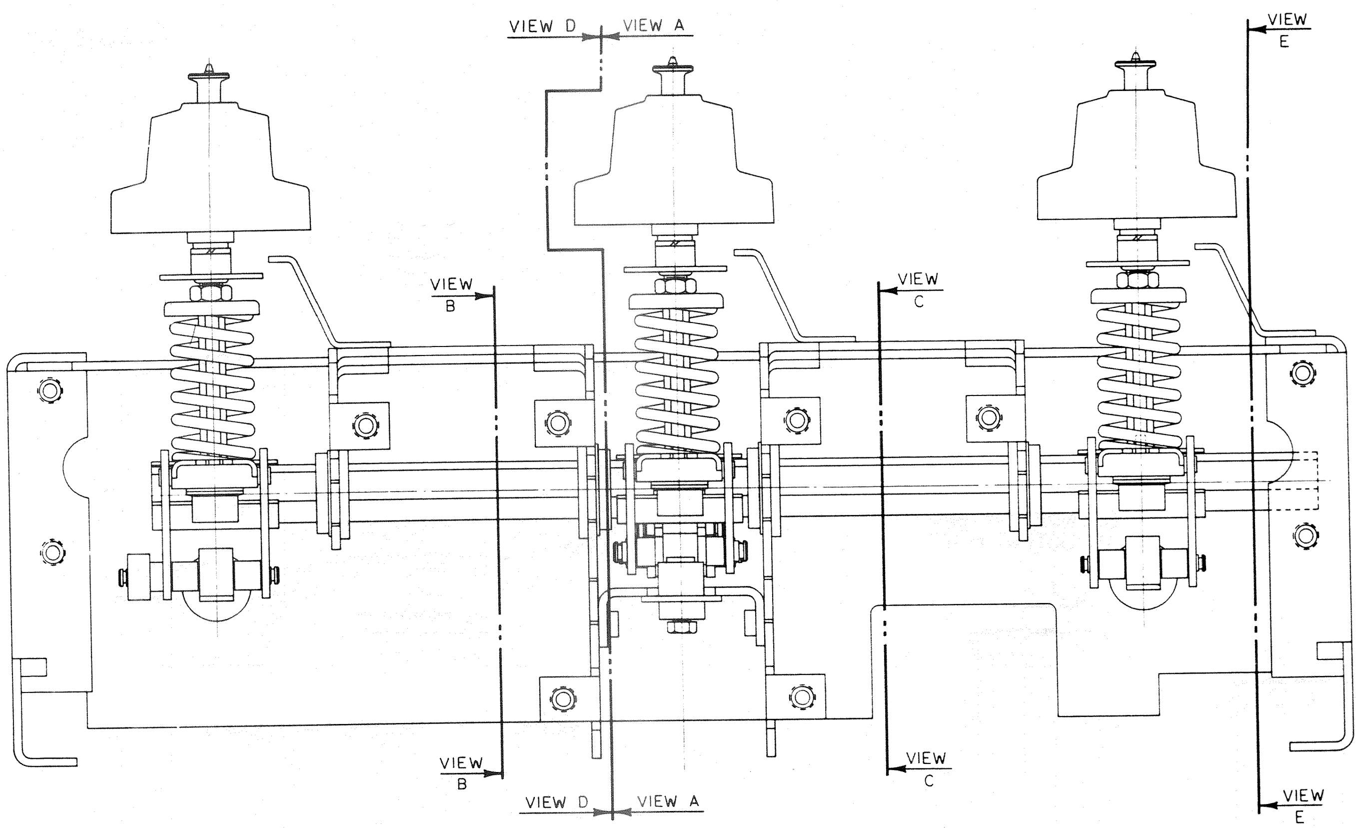
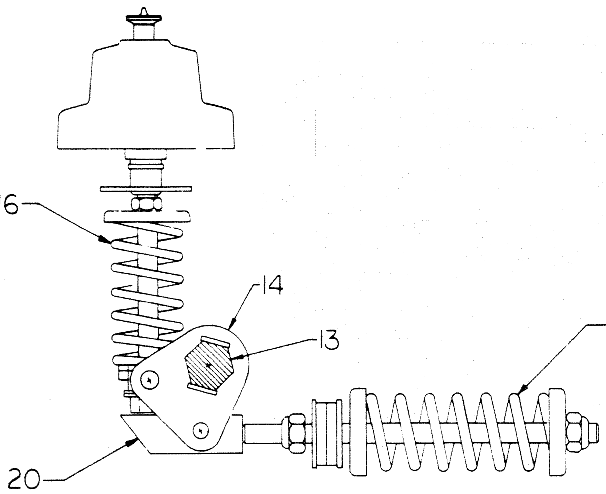
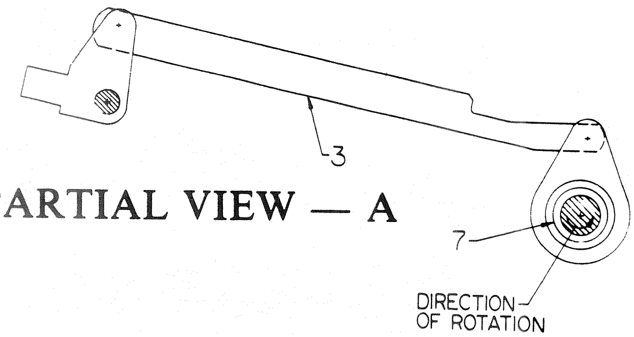


FIG. 12 SCHEMATIC OF ML-18 MECHANISM

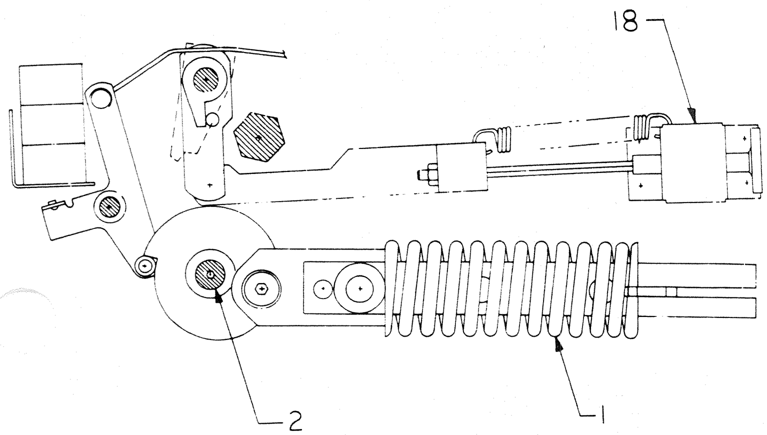
1. CLOSE SPRING
2. CAM SHAFT
3. MANUAL CHARGE
4. CHARGING ARMS
5. RATCHET WHEEL
6. DRIVING PAWL
7. ONE-WAY CLUTCH
8. CLOSE LATCH
9. CLOSE CAM
10. CLOSE ROLLER
11. PROP
12. OUTPUT CRANK
13. CROSS SHAFT
14. BELL CRANKS
15. OPENING SPRINGS
16. WIPE SPRINGS
17. AUX. SWITCH
18. TRIP SOLENOID
19. TRIP LATCH
20. OVER-TRAVEL STOP
21. LATCH CHECK SWITCH
22. GEAR MOTOR



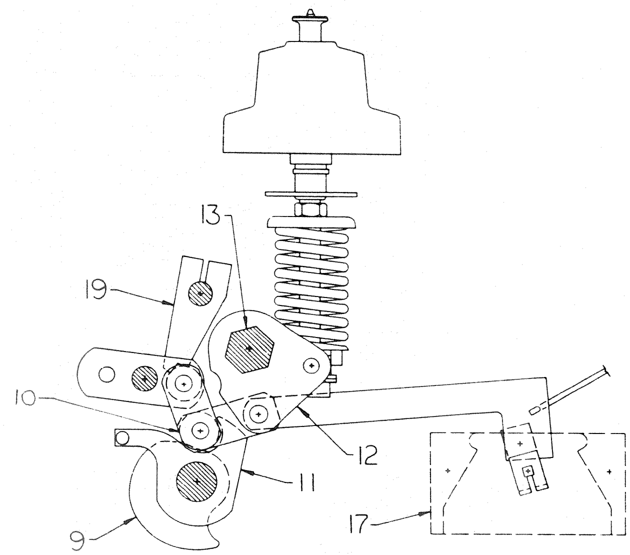
PARTIAL VIEW — E



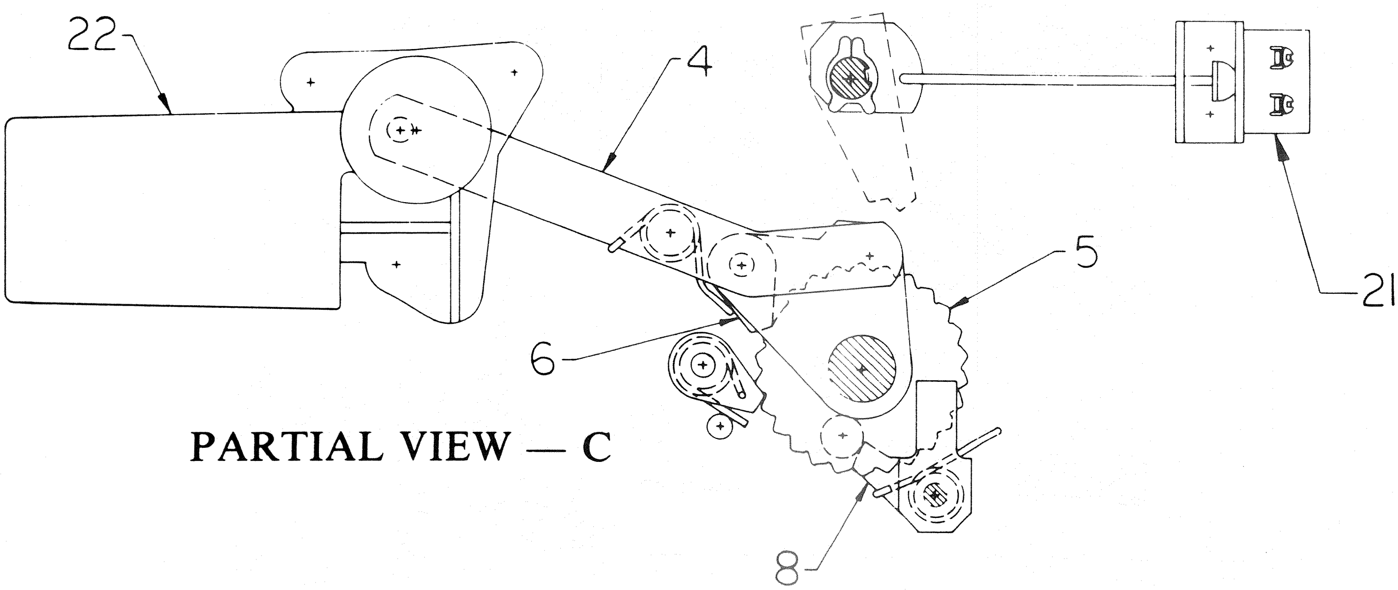
PARTIAL VIEW — A



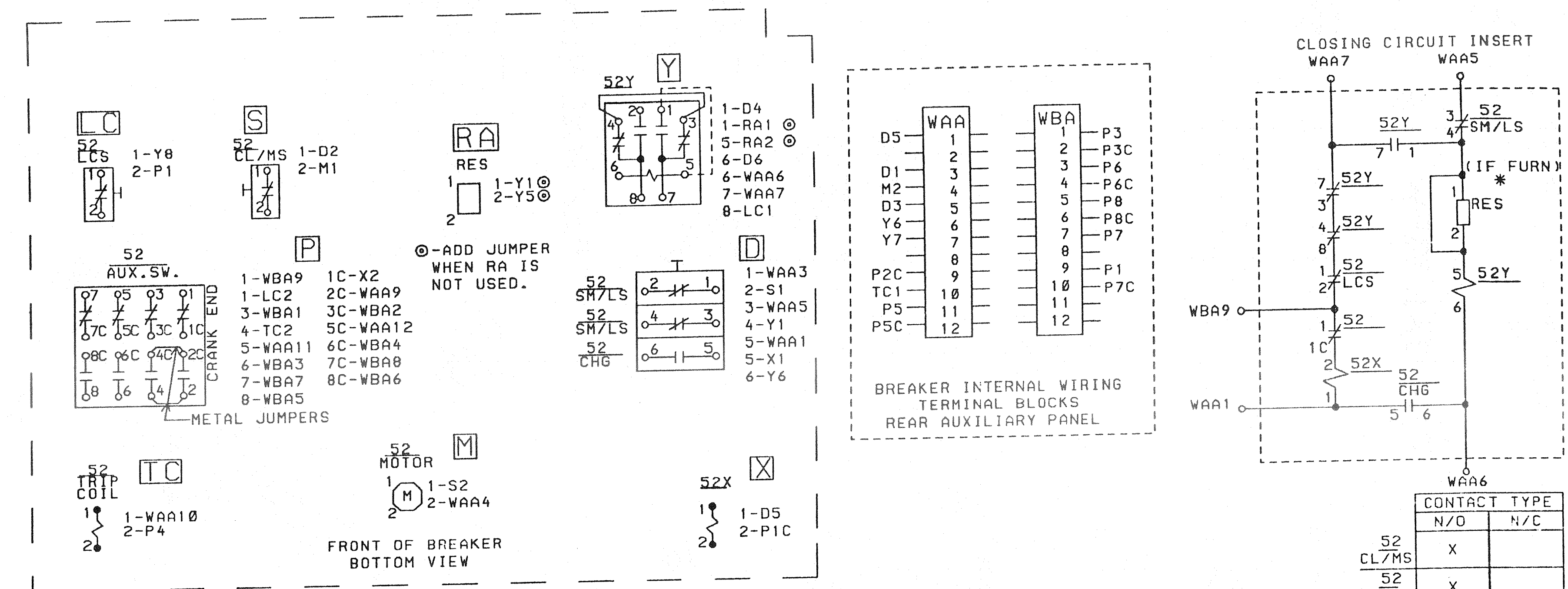
PARTIAL VIEW — B



PARTIAL VIEW — D



PARTIAL VIEW — C



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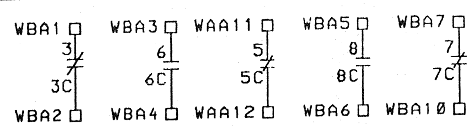

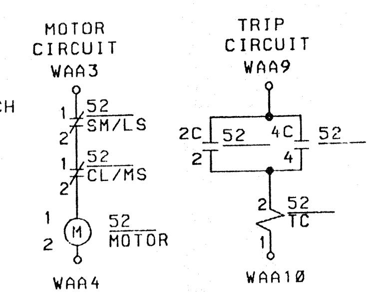

	CONTACT TYPE	
	N/O	N/C
52 CL/MS	X	
52 LCS	X	
52 CHG		X
52 SM/LS	X	

P	CLOSING CIRCUIT VOLTAGE	RESIST (*) OHMS
001	48VDC	0
002	125VDC	0
003	250VDC	3500
004	115VAC	0
005	230VAC	0

NOTES

BREAKER SHOWN "OPEN" AND WITH CLOSING SPRING "DISCHARGED"

52 CL/MS — CLOSING LATCH MONITORING SWITCH IS CLOSED WHEN LATCH IS CAPABLE OF BLOCKING FULLY CHARGED CLOSING SPRING.

52 SM/LS — LIMIT SWITCH FOR SPRING CHARGING MOTOR-CONTACTS (1-2)(3-4) OPEN WHEN SPRINGS ARE FULLY CHARGED.

52 CHG — CONTACTS CLOSED WHEN CLOSING SPRINGS ARE FULLY CHARGED.

52X — SPRING RELEASE COIL OPERATES LATCH WHICH RELEASES CLOSING SPRING TO CLOSE 52.

52 LCS — TRIP LATCH CHECKING SWITCH CLOSED WHEN LATCH IS RESET.

* — SEE TABLE FOR RES. VALUE

FIG. 13 TYPICAL WIRING DIAGRAM ML-18 MECHANISM

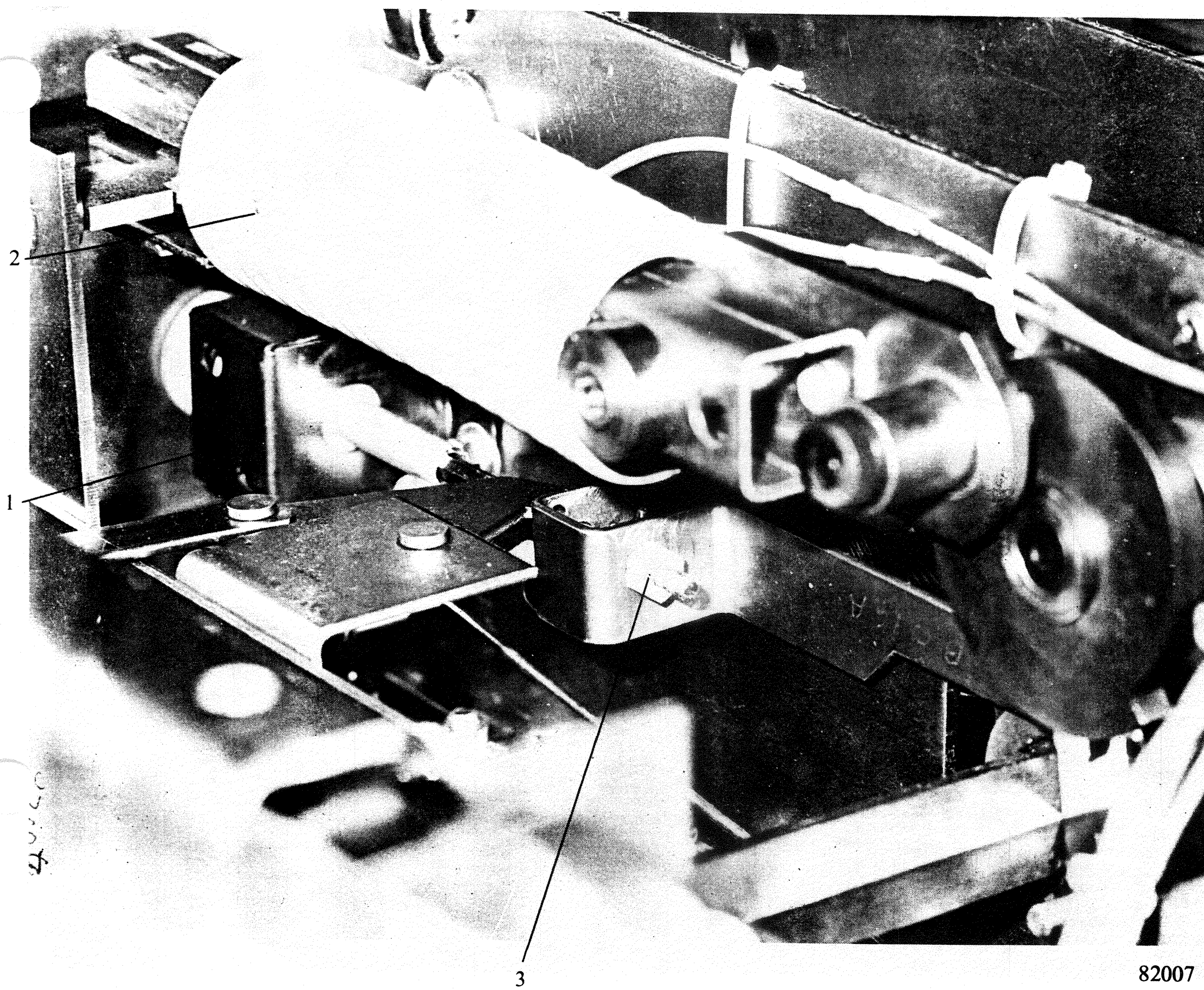

FIG. 14 TRIP COIL ADJUSTMENT

1. TRIP COIL
2. CLOSING SPRING
3. TRIP COIL ADJUSTING SCREW AND NUT

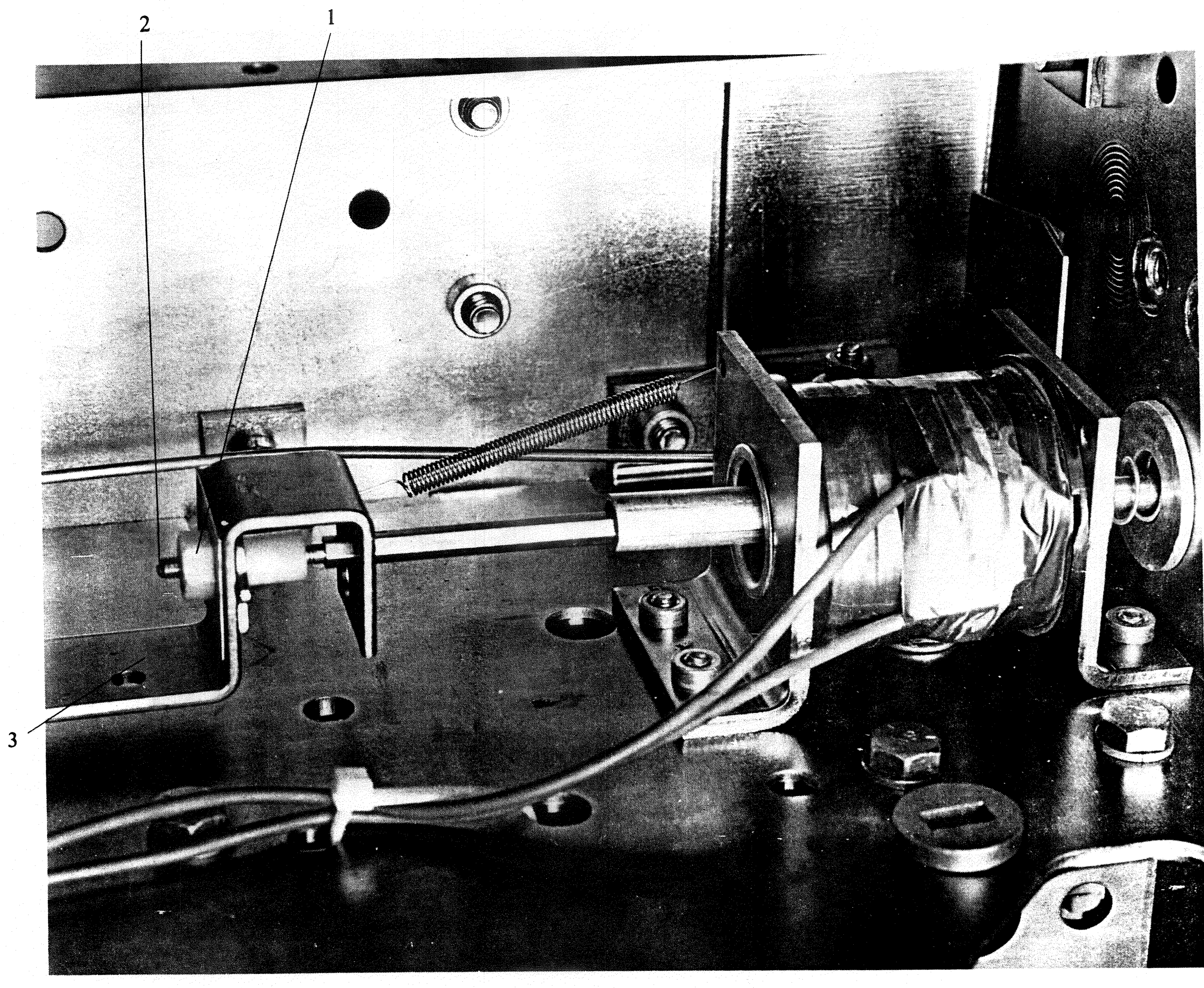

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FIG. 15 CLOSING COIL ADJUSTMENT

1. CLOSING COIL ADJUSTMENT NUT
2. CLOSING COIL ADJUSTING SCREW
3. LINK TO CLOSING LATCH

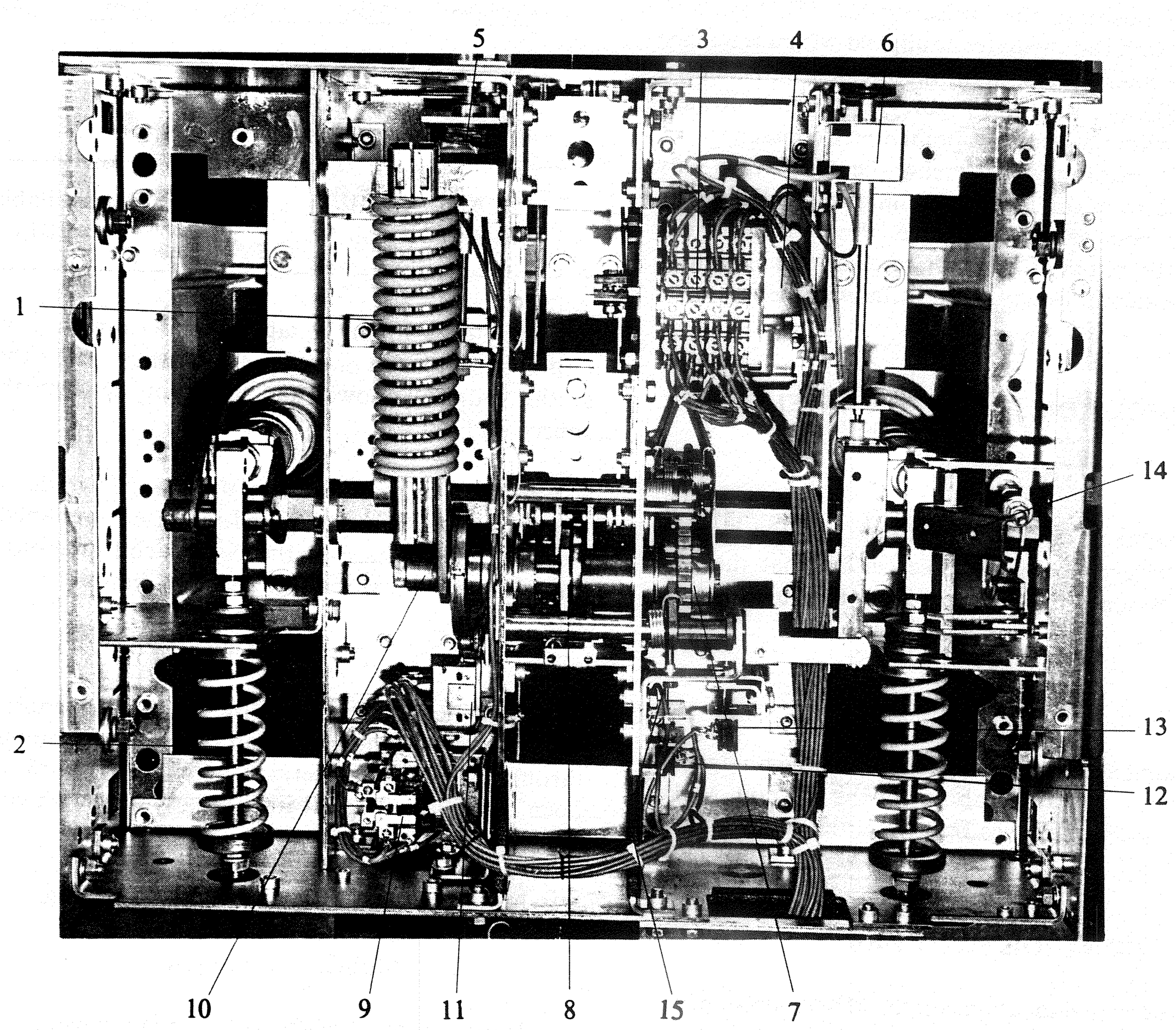


FIG. 16 BOTTOM VIEW OF ML-18 SPRING CHARGED MECHANISM

1. CLOSING SPRING
2. OPENING SPRING
3. AUXILIARY SWITCH
4. SPRING CHARGING MOTOR
5. TRIP COIL
6. CLOSING COIL
7. RATCHET WHEEL
8. CLOSING CAM
9. 52Y RELAY
10. PIVOT BOLT
11. SM/LS MOTOR CONTROL SWITCH
12. L/C LATCH CHECKING SWITCH
13. CL/MS CLOSING LATCH MONITORING SWITCH
14. HOUSING AUXILIARY SWITCH OPERATOR
15. CLOSE LATCH ADJUSTING SCREW

PRIMARY CONTACT EROSION INDICATION

In the closed position, the indicator disk (5), Figure 9, below the operating rod insulator is aligned with a reference arm (4) on new interrupters. With the breaker in the closed position, the indicator disk (5), Figure 9, will move upward from alignment with the reference point due to contact erosion. Contact erosion will decrease the wipe which may be brought back to normal by performing wipe adjustment. When erosion reaches ⅛ inch, the Power/Vac* interrupters should be replaced. Do not readjust the alignment of the erosion indicator except when installing a new vacuum interrupter.

CONTROL COIL PLUNGER TRAVEL

TRIP COIL

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

CLOSE COIL

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

CONTROL SWITCHES

There are three switch locations on the ML-18 mechanism. The CL/MS closing latch monitoring switch (13), Figure 16, is to the rear of the ratchet wheel and is operated from the closing latch linkage. The SM/LS spring motor limit switches (11), Figure 16, control the spring charging motor and the anti-pump relay. The 52 charge switch, which is in the same location, can be used for remote indication of the charged condition of the spring. L/C latch checking switch 12, Figure 16, monitors the position of the trip latch.

The switches are adjusted as described in Table 2 Item 7.

ELECTRICAL CHECKS

CONTROL POWER

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

Rated Nominal Voltage	Close or Motor Circuit Min.	Close or Motor Circuit Max.	Trip Circuit Min.	Trip Circuit Max.
48 DC	38	56	28	56
125 DC	90	140	70	140
250 DC	180	280	140	280
120 AC	104	127	Not available in ML-18	
240 AC	208	254		

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

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

TIMING

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

Initiation of trip signal to contact parting
35-45 Milliseconds (5 cycle)
25-30 Milliseconds (3 cycle)

Initiation of close signal to contact closing
60-90 Milliseconds

Trip-free operation may be checked by applying a simultaneous close and trip signal and a minimum reclose operation may be checked by tripping a charged breaker open while maintaining a close signal.

Instantaneous reclose time* 100-150 Milliseconds

*Time from application of trip signal and close signal until breaker opens and recloses.

MAINTENANCE

GENERAL

Power/Vac* circuit breakers have been designed to be as maintenance free as practicable. They include features such as sealed vacuum interrupters and long life synthetic greases which contribute to many years of trouble free performance with a minimum amount of maintenance attention.

SERVICE CONDITIONS

The frequency of required maintenance depends on the severity of the service conditions of the circuit breaker application. If the service conditions are mild the interval between maintenance operations may be extended to 10 years or 10,000 no load or normal load switching operations.

Mild service conditions are defined as an environment in which the circuit breaker is protected from the deleterious effects of conditions such as:

Salt atmosphere
Changes in temperature that produce condensation
Conductive and/or abrasive dust
Damaging chemicals and fumes
Vibration or mechanical shock
High relative humidity (90%)
Temperature extremes (-30°C, 40°C)

BEFORE ANY MAINTENANCE WORK IS PERFORMED, MAKE CERTAIN THAT ALL CONTROL CIRCUITS ARE DE-ENERGIZED. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE IN THE CLOSED POSITION WITHOUT TAKING PRECAUTIONS TO PREVENT ACCIDENTAL TRIPPING. THIS CAN BE DONE BY REPLACING THE TRIP LATCH BLOCKING BOLT USED FOR SHIPPING TO BLOCK THE TRIP SHAFT AND SECURE THE INTERRUPTER CONTACTS IN THE CLOSED POSITION. DO NOT WORK ON THE BREAKER WHILE THE CLOSING SPRING IS CHARGED UNLESS IT IS SECURED IN THAT POSITION BY THE CLOSE-SPRING GAG.

FAULT INTERRUPTIONS

The erosion rate of the primary contacts in the vacuum interrupters is very low for no load and normal load switching operations. However, fault current interruptions at or near the breaker rating may result in appreciable contact erosion. With frequent fault interruptions it is necessary to perform maintenance based on the number of interruptions. After each 15 fault interruptions the following should be performed.

1. Contact erosion per this page.

2. Wipe and gap per Table 2 Item 5 & 6

3. Vacuum interrupter integrity test per page 30

POWER/VAC* INTERRUPTER

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

CONTACT EROSION

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

TRANSFER BAND WEAR

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

INSULATION TESTS

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

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

To measure the breaker secondary circuit insulation resistance, remove the motor leads, and thread a wire connecting all secondary terminals together. The measurement may be made by connecting a 500V megohmeter from the wire to ground.

HIGH-POTENTIAL TEST

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

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

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

BREAKER VOLTAGE Rating	TEST VOLTAGE 60 HZ (RMS)
15.5 KV	37.5 KV

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

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

VACUUM INTERRUPTER INTEGRITY TEST

CAUTION: X-RADIATION MAY BE PRODUCED IF AN ABNORMALLY HIGH VOLTAGE IS APPLIED ACROSS A PAIR OF ELECTRODES IN A VACUUM. X-RADIATION MAY INCREASE WITH AN INCREASE IN VOLTAGE AND/OR A DECREASE IN CONTACT SEPARATION.

DURING A HIGH POTENTIAL OR A VACUUM INTEGRITY TEST ANY X-RADIATION WHICH MAY BE PRODUCED WILL NOT BE HAZARDOUS AT A DISTANCE SAFE FOR HIGH POTENTIAL TESTING, IF THE TEST IS CONDUCTED AT THE RECOMMENDED VOLTAGE AND WITH THE NORMAL OPEN CIRCUIT BREAKER CONTACT SEPARATION.

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 BREAKER CONTACTS.

This test of the vacuum interrupter will determine its internal dielectric condition and vacuum integrity. With the breaker open individually check each interrupter by connecting the hipot machine "hot" lead to the upper stud and the ground lead to the lower stud. If the machine has a center point ground, the connections may be made either way. Apply 36kV (rms) 60 Hz or 50 KV DC and hold a minimum of five (5) seconds. If no breakdown occurs the interrupter is in acceptable condition. If a breakdown occurs, the interrupter should be replaced.

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

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

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

An acceptable high potential machine is available from the Switchgear Operation, Burlington, Iowa, Catalog Number 282A2610P001. The following machines are also acceptable.

Hipotronics	Model 860PL
Hipotronics	Model 880PL
Hipotronics	Model 7BT 60A
James G. Biddle	Catalog 222060

PRIMARY CIRCUIT RESISTANCE

A resistance check of the primary circuit may be made with the breaker closed. Use a low resistance measuring instrument which measures microhms. The 100 ampere reading should not exceed 90 mircohms when connected across the primary bars on the breaker.

MECHANISM

Check all items on Table 2, Summary of Adjustments and Critical Dimensions, readjusting or tightening as required. Lubricate as recommended under LUBRICATION.

PRIMARY INSULATION PARTS

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

LUBRICATION

Proper lubrication is important for maintaining reliable circuit breaker performance. The ML-18 mechanism uses bearings which have a synthetic lining in some locations. These bearings do not require lubrication to maintain low friction, but lubrication does not harm them and oiling lightly is recommended. Sleeve bearings are used in some linkage locations and needle or roller bearings are used for low friction on trip shaft and close shaft.

Bearings are lubricated during factory assembly with grease and oil but, all lubricants have a tendency to deteriorate by oxidation or contamination with age. Providing a fresh lubricant supply at periodic intervals is essential to proper breaker operation, especially where frequent operation may have forced lubricant out of the bearing surfaces. Apply a few drops of light synthetic machine oil such as Mobil 1 at each bearing. Apply a coat of 0282A2048 P009 on the four corners of the closing spring guide where it enters inside the spring.

Electrical primary contact surfaces also require periodic lubrication to inhibit oxidation and minimize friction. At each inspection and maintenance interval, the metal contact surfaces of the movable contact rod of the interrupter should be lubricated with 0282A2048 P009. This grease is available packaged in a pint can to provide cleanliness and prevent oxidation.

RECOMMENDED MAINTENANCE

The following operations should be performed at each maintenance.

1. Perform a visual inspection of the breaker. Check for loose or damaged parts.

2. Perform the slow closing operation described on page 12.

3. Check the erosion indicator and the wipe and gap as described on pages 18 and 28.

4. Perform the vacuum interrupter integrity test as described on page 30.

5. Lubricate the breaker operating mechanism as described on this page.

6. Check the electrical operation.

7. Examine the movable contact rod of the vacuum interrupter. With the breaker open, wipe the lubricant off the rod and examine the silver surface. The rod should have a burnished appearance without copper appearing through the silver. If copper is visable at more than one location per pole, or if the silver plating is torn, the interrupter assembly should be replaced. Relubricate movable contact rod with 0282A-2048 P009 grease.

8. If desired, perform the additional electrical tests (Megger, primary and secondary high potential, and primary circuit resistance). See page 29.

REPAIR AND REPLACEMENT

GENERAL

The following information covers in detail the proper method of removing various parts of the breaker in order to make any necessary repairs. This section includes only those repairs that can be made at the installation on parts of the breaker that are most subject to damage or wear.

IMPORTANT: UPON COMPLETION OF ANY KIND OF REPAIR WORK, ALL INTERRUPTER AND MECHANISM ADJUSTMENTS MUST BE CHECKED.

Refer to the sections on MECHANICAL AND ELECTRICAL ADJUSTMENTS.

REPLACEMENT OF INTERRUPTER ASSEMBLIES

Interrupters are supplied as pole units which include the vacuum interrupter mounted in the interrupter support.

CAUTION

DO NOT ATTEMPT TO REMOVE OR REINSERT THE VACUUM INTERRUPTER IN THE INTERRUPTER SUPPORT ASSEMBLY. SPECIAL TOOLS AVAILABLE ONLY AT THE FACTORY ARE REQUIRED.

1. Close the breaker and remove the coupling clamp, (4) Fig. 10. Open the breaker and remove the four bolts holding the pole assembly to the mechanism and remove the old pole assembly.

2. Set the new pole assembly in place and install the four mounting bolts.

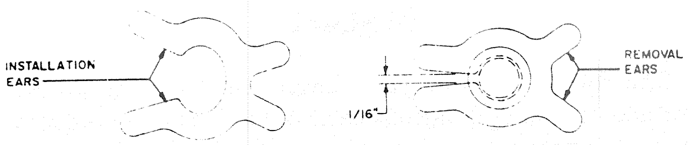
3. Close the breaker using the Slow Closing Operation. Perform the closing operation slowly while guiding the tip of the operating rod into the base of the movable contact rod on the vacuum interrupter. After the breaker is fully closed install the coupling clamp.

4. Check and adjust the erosion indicator (5) Fig. 9 (if new interrupter assembly is installed), and the Wipe and Gap as described in Table 2 Items 5 and 6.

5. Perform the Vacuum Interrupter Integrity test.

MECHANISM

Pin Retaining Rings — These rings are widely used in the ML 18 mechanism to retain pins. They can be installed and removed with a pair of standard pliers. Reuse is not recommended after removal. To remove, slowly squeeze the removal ears while pulling. To install, position on the pin groove and squeeze the installation ears closed to no more than 1/16 inch gap between ears.



CONTROL SWITCHES

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

TRIP COIL REPLACEMENT

TOOLS REQUIRED

—5/16" Allen wrench
—Needle nose pliers
—7/16" socket wrench
—7/16" box/combination wrench
—1/4" square drive ratchet
—1/4" square 3" extension
—Loctite #271 or equivalent

Perform the operation in the following sequence:

1. Charge closing spring and install gag plate.

2. Depress the close and then the trip buttons.

3. Pump the manual close handle 3 - 4 times.

4. With the 5/16" Allen wrench remove the pivot bolt (10), Figure 16, on the closing spring (1).

5. Remove the closing spring.

6. Remove the nuts from the coil bracket leaving the two bolts in place.

7. The trip coil can now be removed by cutting the coil leads.

To install the new coil connect leads with insulated butt connectors and reverse the above procedure. See Table 2 Item 1 for setting the stroke of the armature. Apply Loctite to the threads of the pivot bolt when it is replaced. Charge the breaker, remove the gag plate, then electrically close and trip it to make certain it has been reassembled correctly.

CLOSING COIL REPLACEMENT

Remove the closing coil housing (6), Figure 16. Disassemble the closing armature and closing coil adjustment screw (2), Figure 15. Cut the leads to the closing coil and remove the coil. Butt splice the new coil into the wiring harness and reassemble the coil and housing. Readjust the closing coil armature travel in accordance with instructions in Table 2 Item 3.

RENEWAL PARTS

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

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

ORDERING INSTRUCTIONS

1. Always specify the complete nameplate data of the breaker.

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

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

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

RECOMMENDED SPARE PARTS FOR POWER/VAC DISTRIBUTION BREAKERS WITH ML-18 MECHANISM

NO. REQ'D. PER BREAKER	MODEL	DESCRIPTION	CATALOG NO.
1	0	Charging Motor 48V-DC 125V-DC and 120V-AC 250V-DC and 240V-AC	 0177C5050G003 0177C5050G001 0177C5050G002
1	0	Relay 48V-DC 125V-DC 250V-DC 120V-60 Hz 240V-60 Hz 120V-50 Hz 240V-50 Hz	 0282A2008P001 0282A2008P002 0282A2008G001 0282A2008P003 0282A2008P004 0282A2008P005 0282A2008P006
1	0	Potential Trip Coil 48V-DC (5 Cycle) 125V-DC 250V-DC 340V-DC	 0282A7015G004 0282A7015G006 0282A7015G007 0282A7015G009
		48V-DC (3 Cycle) 125V-DC 250V-DC 340V-DC	0282A2009G007 0282A2009G008 0282A7015G010 0282A2009G010
1	0	Closing Coil (Standard) 48V-DC 125V-DC 250V-DC 120V-AC 240V-AC	 0282A7015G001 0282A7015G002 0282A7015G003 0282A7015G004 0282A7015G005
2	0	Control Swich, Normally Open	0282A7094P001
2	0	Control Switch, Normally Closed	0282A7094P002
1	0	Auxiliary Switch	0209B8064P001
3	0	Operating Rod	0282A6525G001
6	0	Bushing Assembly 1200 2000	 0177C6626G001 0117C6628G001
6	0	Bushing Gounding Spring 1200 2000	 0282A6496G001 0282A6496G002

INTERRUPTER ASSEMBLY
(POLE UNIT COMPLETE)

BREAKER TYPE	MODEL	CONTINUOUS CURRENT AMPERES	INTERRUPTING CURRENT RATING, KA	TYPE APPLICATION	QTY.	CATALOG NUMBER 0282A6524
PVDB1	0	600	12	STANDARD	3	G001
	0	800	16	&	3	G002
	0	1200	16	SEISMIC	3	G003
	0	1200	20	5 CYCLE	3	G004
	0	2000	20		3	G005
	0	1200	25		3	G006
	0	2000	25		3	G007
PVDB1	0	600	12	STANDARD	3	G008
	0	800	16	&	3	G009
	0	1200	16	SEISMIC	3	G010
	0	1200	20	3 CYCLE	3	G011
	0	2000	20		3	G012
	0	1200	25		3	G013
	0	2000	25		3	G014

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