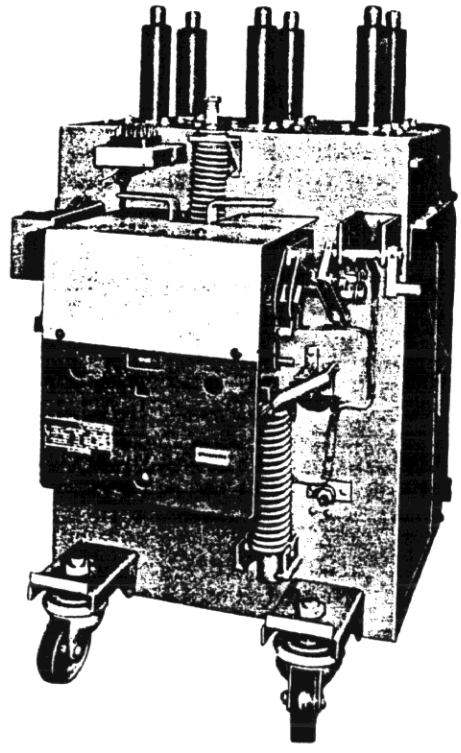
INSTRUCTIONS AND
RECOMMENDED PARTS
FOR MAINTENANCE

GEK-41900

# VACUUM CIRCUIT BREAKER

## VVB-13.8-500-1200 & 2000 Amp.

## With ML15E Mechanism



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SWITCHGEAR PRODUCTS DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

# VACUUM CIRCUIT BREAKER

## VVB-13.8-500-1200 & 2000 Amp.

## INTRODUCTION

The vacuum breaker is a removable and interchangeable interrupting element for use in vertical lift metal-clad switchgear to provide reliable control and protection of electrical apparatus and power systems.

The VVB-13.8-500 vacuum breaker is available with continuous current ratings of 1200 and 2000 amperes in accordance with applicable industry standards. Refer to the breaker nameplate for complete rating information. The nameplate also describes the control power requirements for the breaker. The application of a breaker must be such that its voltage, current and interrupting ratings are never exceeded.

Proper installation and maintenance are necessary to insure continued satisfactory operation of the breaker. The following instructions provide information normally required for placing the breaker in service and for maintaining satisfactory operation.

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

## RECEIVING, HANDLING AND STORAGE

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

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

STORAGE

It is recommended that the breaker be put into service immediately in its permanent location. If this is not possible, the following precautions must be taken to insure the proper storage of the breaker:

1. The breaker should be carefully protected against condensation, preferably by storing it in a warm dry room. Breakers for outdoor metal-clad switchgear should be stored in the equipment only when power is available and the heaters are in operation to prevent condensation.

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

3. Unplated surfaces of rollers, latches, etc., should be coated with grease to prevent rusting.

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

## INSTALLATION

1. The breaker has been shipped with the vacuum interrupter contacts secured in a closed position. Before inserting breaker into the metal-clad unit the securing wire must be removed from the operating mechanism trip latch, and the breaker tripped open.

   Remove the top mechanism cover and locate the trip latch securing wire as indicated by the yellow shipping tag. Cut the wire using wire cutting pliers or a similar tool and trip open the breaker by pushing the manual trip button (8) Figure 1. Keep your hands clear of the moving parts of the operating mechanism while cutting the wire and opening the breaker. At this time a complete visual inspection of the interrupters and mechanism should be made to ascertain their condition.

2. Charge the breaker closing spring using a 5/8" ratchet wrench to turn the manual charging shaft (5) Figure 1. Turning the shaft clock-

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wise will advance the ratchet wheel and compress the spring. When the spring has reached the fully charged position, the yellow indicator (4), Figure 1 will read "charged" and the ratchet handle will rotate freely.

Insert the spring blocking device (3) Figure 2 in the closing spring guide (2). Manually discharge the spring against the device by pushing the manual close button (2) Figure 1. The spring is now blocked and slow breaker closing can be accomplished by again turning the manual charging shaft with the 5/8" ratchet wrench.

During the slow closing operation, check to insure that the mechanism does not stick or bind during the entire stroke, that it latches securely in the closed position, and that it trips freely when the manually trip button is operated. The breaker should not be operated electrically until it has been operated several times manually to insure freedom of action. At this time, also check the following adjustments:

a. Primary contact gap (Refer to page 8 ).
b. Primary contact wipe (Refer to page 8 ).

DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRING IS BLOCKED AND THE OPENING SPRING HAS BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS PRECAUTION IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING.

After the adjustments have been checked, the closing spring can be unblocked. Rotate the manual charging shaft until the springs are charged and the ratchet wheel can no be advanced. The spring blocking can now be removed. The closing and g springs can now be discharged by g first the CLOSE button and then the button.

the test coupler to the breaker, and e electrically several times. Check the l voltage as described under "Control Check", page 10.

If the breaker secondary wiring is to en a hi-potential test at 1500 volts, both of the motor leads from the al connection. Failure to disconnect tor from the circuit may cause damage winding insulation.

the test coupler.

re interrupter reliability a 60 Hz. high l test should be applied to each Power errupter as described in Hipot Testing um Interrupter page 11 before energe breaker.

normal high voltage operation a charge red by the main shield of the interand may be retained after the breaker is removed from the housing. Therefore, the midband ring of the interrupter should be discharged to ground by a grounding stick or other similar device before touching the interrupter.

7. Refer to metal-clad instruction book GEH-1802 for final instructions, before inserting the breaker into the metal-clad unit.

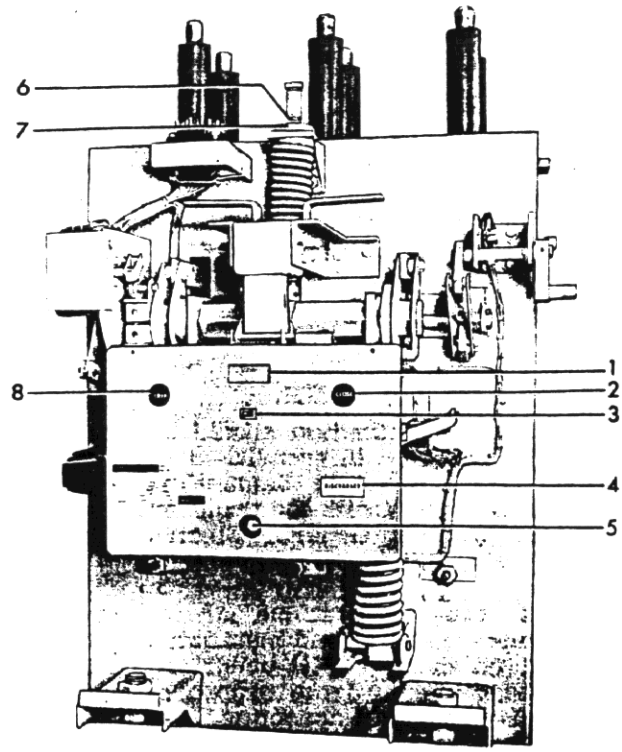



Figure 1. (8041551) Recloser (Front View)

1. Position Indicator
2. Manual Close Button
3. Operation Counter
4. Spring Charge Indicator
5. Manual Charging Shaft
6. Plunger Interlock
7. Stop
8. Manual Trip Button

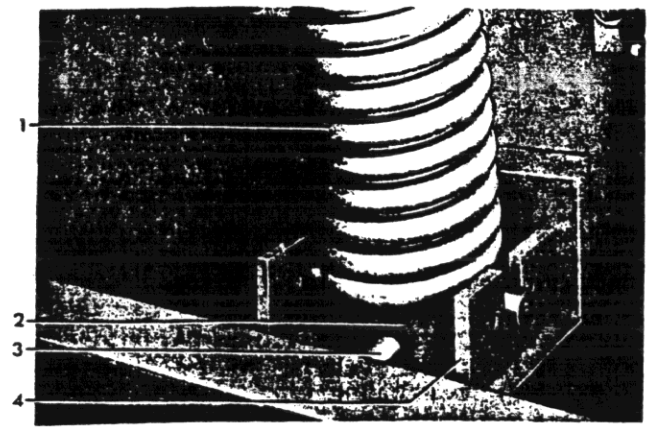



Figure 2. (8041869) Closing Spring Block

1. Closing Spring
2. Closing Spring Guide
3. Spring Blocking Device
4. Closing Spring Support

The vacuum breaker has two principal components, the interrupter element and the operating mechanism. The interrupter elements are three similar units, the main element being a vacuum power interrupter (8) Figure 3 whose main contacts are hermetically sealed in a high vacuum chamber. The primary connections to the associated metal-clad switchgear are made through the breaker bushings (1) Figure 4. The operating mechanism moves a horizontal square shaft (1) Figure 12 that closes the contacts of the interrupter through wipe springs (10) Figure 5.

The ML-15E operating mechanism is of the stored energy type designed to give low closing and opening speeds. The mechanism will operate on ac or dc voltage as indicated on the breaker nameplate. Closing and opening operations are controlled electrically by the metal-clad or remote relaying and mechanically by the manual close and trip buttons on the breaker. All secondary connections from the breaker to the metal-clad unit are made through the coupler (1) Figure 7.

A positive interlock (5) Figure 6 and interlock switch (4) Figure 6 are provided between the breaker and metal-clad unit to prevent raising or lowering of the breaker in the unit while in a closed position and to prevent a closing operation when the breaker is not in either the fully raised or lowered position. To insure that this interlock will function during manual, as well as during electrical operation of the equipment, both mechanical and electrical blocking is provided. If for any reason the closing springs should be discharged against the positive interlock the mechanism will be jammed and be inoperable. The mechanism can be released and returned to the reset position by pushing in on the trip lever (8) Figure 1. It may require more than normal force to release the interlock.

The spring release interlock (3) Figure 7 trips open the breaker and discharges the closing spring whenever the breaker is inserted or removed from the housing. Closing and opening springs are discharged automatically, as a safety precaution.

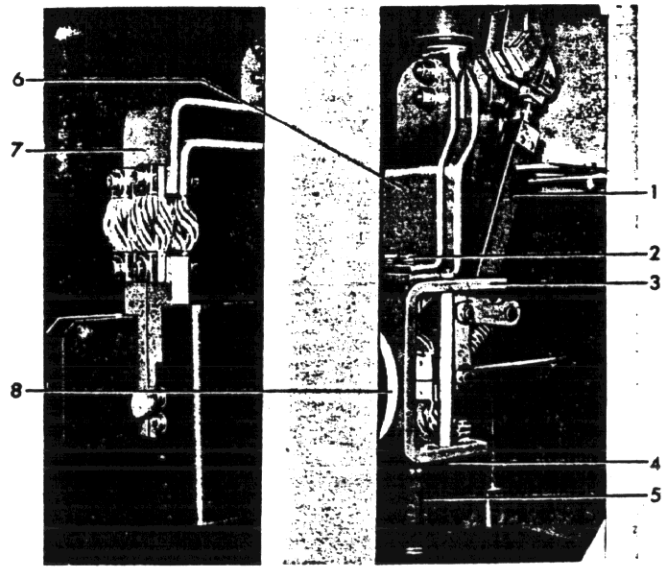



Figure 3. (8041778) Left Side View

1. Operating Rod
2. Mounting Bolts
3. Wipe Spring Cage Supt.
4. Mounting Bolts
5. Supt. Insulator
6. Front Connection Bar
7. Rear Connection Bar
8. Vacuum Interrupter

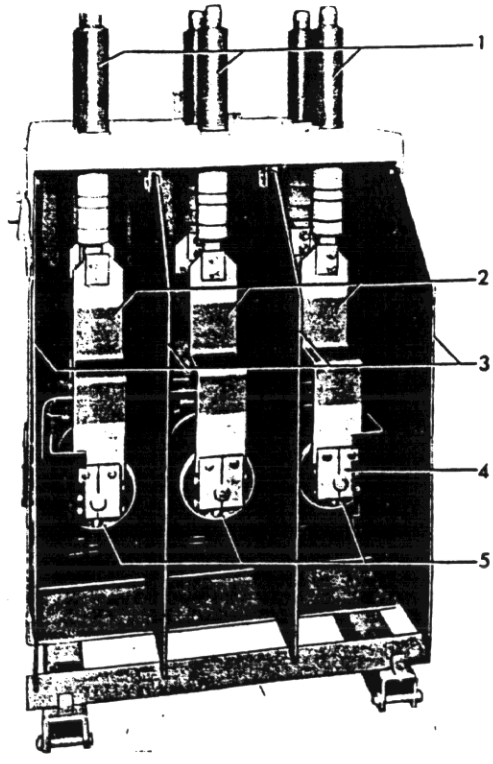



Figure 4. (8041554) Rear View

1. Bushings
2. Rear Conn. Bars
3. Interphase Barriers
4. Rear Interrupter Conn.
5. Vacuum Interrupters

## PLUNGER INTERLOCK

A plunger interlock, (6) Figure 1 can be provided when required to operate a stationary auxiliary switch and/or a rod interlock mounted in the metal-clad unit.

## SPRING CHARGING

The mechanism has a high speed gear motor that compresses a closing spring through the action of an eccentric, pawl and ratchet assembly. The rotary action of the motor (5) Figure 7 is converted to a straight stroke pumping action through the eccentric (4) Figure 8 that carries a spring loaded driving pawl (3). The pawl advances the ratchet wheel (1) Figure 8 only a few degrees each stroke where it is held in position by the latching pawl (2). When the ratchet wheel has been rotated approximately 180 degrees, the closing spring will be fully compressed. As the ratchet wheel continues to rotate, the spring load will shift over center and attempt to discharge. After only a few degrees of rotation, the closing latch (3) Figure 9 and the compressed spring will be held in repose until a closing operation is required. During the last few degrees of the ratchet wheel rotation, the motor and relay switches (6) Figure 6 are released and the driving pawl is on a smooth portion of the ratchet wheel. This allows the motor and driving mechanism to coast to a natural position expending all residual energy.

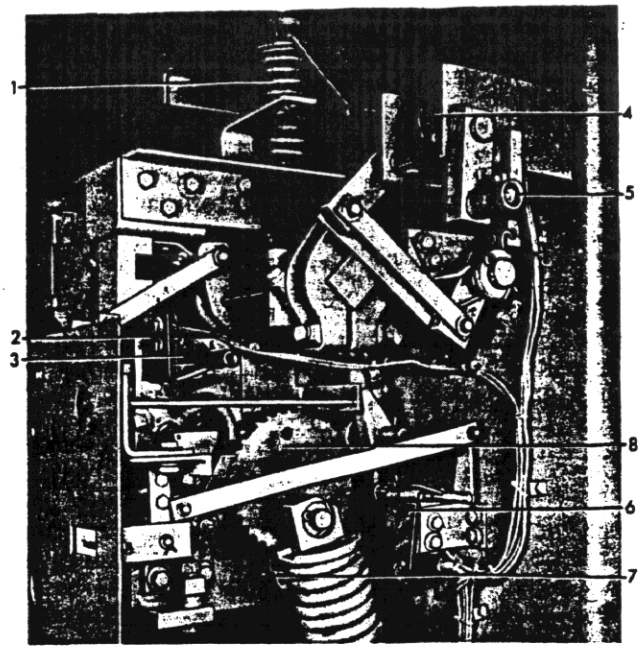
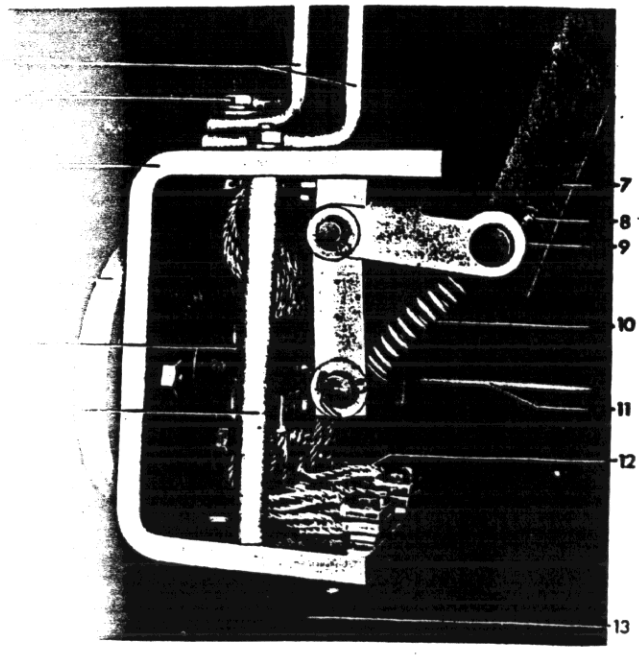



Figure 6. (8041780) Right Side ML-15E Operating Mechanism

1. Opening Spring
2. Trip Latch Checking Switch Support
3. Trip Latch Checking Switch
4. Interlock Switches
5. Positive Interlock Roller
6. Power Switches
7. Manual Charging Pawl
8. Ratchet Wheel




41779) Moving End of Vacuum Interrupter

n. Bar
n. Bolts
terrupter
ck
Rod

8. Wipe Adjusting Screw
9. Wipe Measurement Point
10. Wipe Springs
11. Contact Position Rod
12. Braid
13. Support Insulator

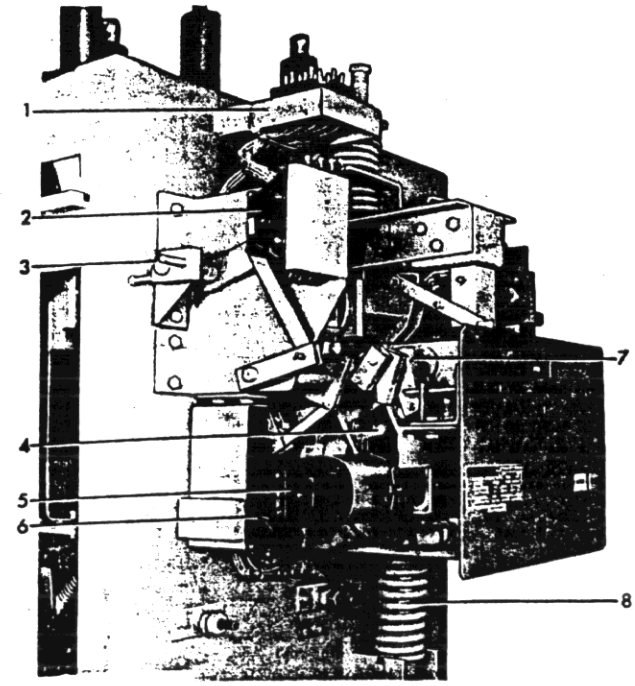



Figure 7. (8041549) Left Side ML-15E Operating Mechanism

1. Secondary Coupler
2. Auxiliary Switch
3. Spring Release Interlock
4. Trip Coil
5. Charging Motor
6. Control Relay
7. Trip Shaft

The closing spring may be charged manually if control voltage is lost. A 5/8" ratchet wrench can be used to rotate the manual charging shaft continuously in a clockwise direction until the yellow indicator reads "charged", and the ratchet handle is free. The use of the ratchet wrench provides for maximum safety in the event that control power is suddenly restored without warning. In this event, the motor will take over again and continues to charge the spring.

## CLOSING OPERATION

Closing the breaker is accomplished by energizing the closing solenoid or by manually pressing the close button. In either case, the closing latch is removed from the spring blocking location allowing the spring to discharge. The energy of the spring moves the cam (2) Figure 9 that closes the breaker through a simple linkage that remains trip-free at all times. A monitoring switch (3) Figure 10 on the closing latch will start the spring charging motor when it is fully reset after a closing operation.

## OPENING OPERATION

The breaker can be opened either electrically by energizing the trip coil (1) Figure 10 or manually by pushing the trip button (8) Figure 1. In each method the trip latch (5) Figure 9 is rotated permitting the operating mechanism to collapse. The energy stored in the opening spring is released opening the breaker. At the end of the opening operation the dashpot (8) Figure 10 will stop the contacts and linkage and absorb any excess energy from the system thereby limiting contact rebound. During this operation, the trip coil circuit is deenergized and upon completion of the opening operation, the operating mechanism is returned to its reset position, ready for closing.

## TRIP FREE OPERATION

If the trip coil circuit is energized while the breaker is closing, the trip plunger will move the trip latch (5) Figure 9 away from the trip roller (6) causing the mechanism linkage to collapse and the breaker to perform a close open operation. The closing cam (2) will complete its closing stroke and the springs will recharge as in a normal closing operation.

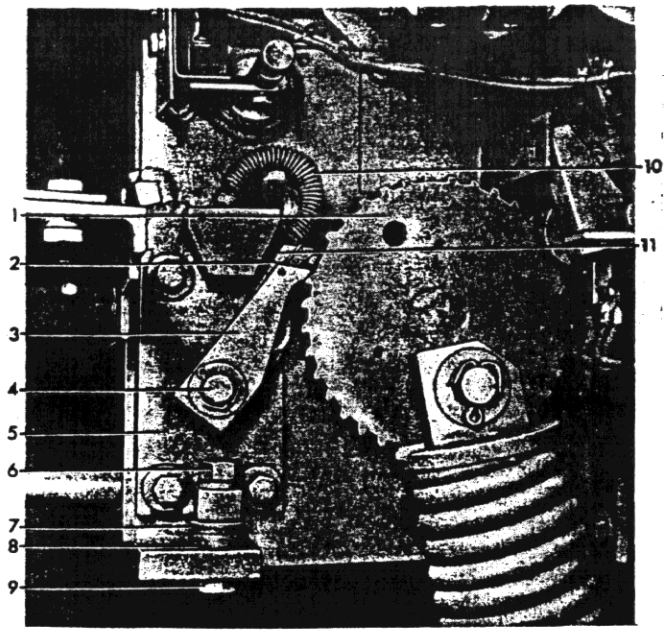



Figure 8. (8041559) Right Side ML-15E Operating Mechanism

1. Ratchet Wheel
2. Holding Pawl
3. Driving Pawl
4. Eccentric Pin
5. Motor Mount
6. Locking Nut
7. Buffer Spring Washers
8. Shim Washers
9. Mounting Bolt
10. Driving Pawl Spring

# ADJUSTMENTS

All adjustments should be checked during periodic inspections and whenever it becomes necessary to repair or replace parts that have become worn or defective while in service. First, remove the breaker from the metal-clad unit and remove the top mechanism cover. The following adjustments are listed in the order in which they are to be checked.

DO NOT WORK ON EITHER INTERRUPTERS OR MECHANISM UNLESS THE CLOSING SPRING IS BLOCKED AND THE OPENING SPRING HAS BEEN TRIPPED OPEN OR MECHANICALLY BLOCKED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING.

## THE TRIP LATCH CLEARANCE

Refer to Figure 9. With the breaker in the tripped position and the closing spring charged, check the clearance between the trip latch (5) and the trip roller (6). It should be ".030" to ".060". If adjustment is necessary, loosen check nut (8) and adjust stop pin (7).

## CLOSING LATCH WIPE

Refer to Figure 9. The closing latch (3) should strike the closing roller (4) approximately in the center. Apply a thin film of grease to the end of the closing latch and charge and block the closing

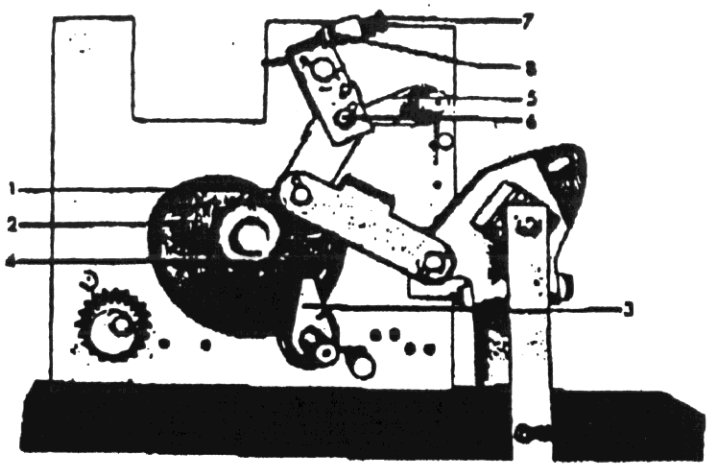



Figure 9. (8039445) Mechanism Linkage (Left Side of ML-15E Mechanism Frame are Removed)

1. Cam Follower Roller
2. Cam
3. Closing Latch
4. Closing Latch Roller
5. Trip Latch
6. Trip Latch Roller
7. Adjustment Bolt
8. Check Nut

springs. Release the closing latch by pushing the "close" button. Inspect the end of the latch for proper wipe.

If adjustment is necessary, loosen switch (3) ...ure 10 and move for clearance. Loosen nut and bolt (2) until the proper wipe is obtained. Secure the stop nut and reset switch (3) as listed under Switch Adjustment page 8.

## PRIMARY CONTACT GAP

Refer to Figure 11. With the breaker closed, press the manual trip button allowing the breaker to open normally. The gap between the primary contacts should be 5/8" + 0-1/32". Shaft (2) moves with the contact rod of the interrupter and can be used to measure the contact gap. Nut (1) is set at the factory so that shaft (2) projects 1/8" beyond the nut when the interrupter is closed. If the interrupter is in the open position the rod should project 3/4" + 0-1/32". To change the contact gap the operating rod adjustment screw (6) Figure 12 is used. Loosen nuts (5) and (7) and turn the hex center of the double ended adjustment screw to increase or decrease the gap. One full turn will close or open the contact gap approximately 1/8". Tighten the locking nuts and remeasure the gap after closing and tripping the breaker.

## PRIMARY CONTACT WIPE

When the breaker is closed, the primary contact springs (10) Figure 5 should be compressed 5 )" + 0-1/32". This dimension will vary with breaker use and can be used without readjustment down to 3/16". The measurement can be made on the spring guide at location (9) Figure 5.

To adjust the contact wipe loosen the operating rod bolt (3) Figure 12 and move the rod toward the square shaft to decrease wipe and away from the shaft to increase wipe. Be certain the serrated washers (4) are seated properly before tightening the bolt. Close the breaker and remeasure the gap at the spring guide.

WHEN WORKING ON THE MECHANISM IN THE CLOSED POSITION, KEEP FINGERS CLEAR OF THE LINKAGE, AS ACCIDENTAL TRIPPING CAN CAUSE SEVERE INJURY.

## SWITCHES

The strikers for operating the motor switches (6) Figure 6, positive interlock switches (4) Figure 6, closing latch monitoring switch (3) Figure 10 and trip latch checking switch (3) Figure 6 should be adjusted to a clearance of 1/64" to 1/32" from the switch support. The switch supports should be loosened and the switch moved to obtain this dimension.

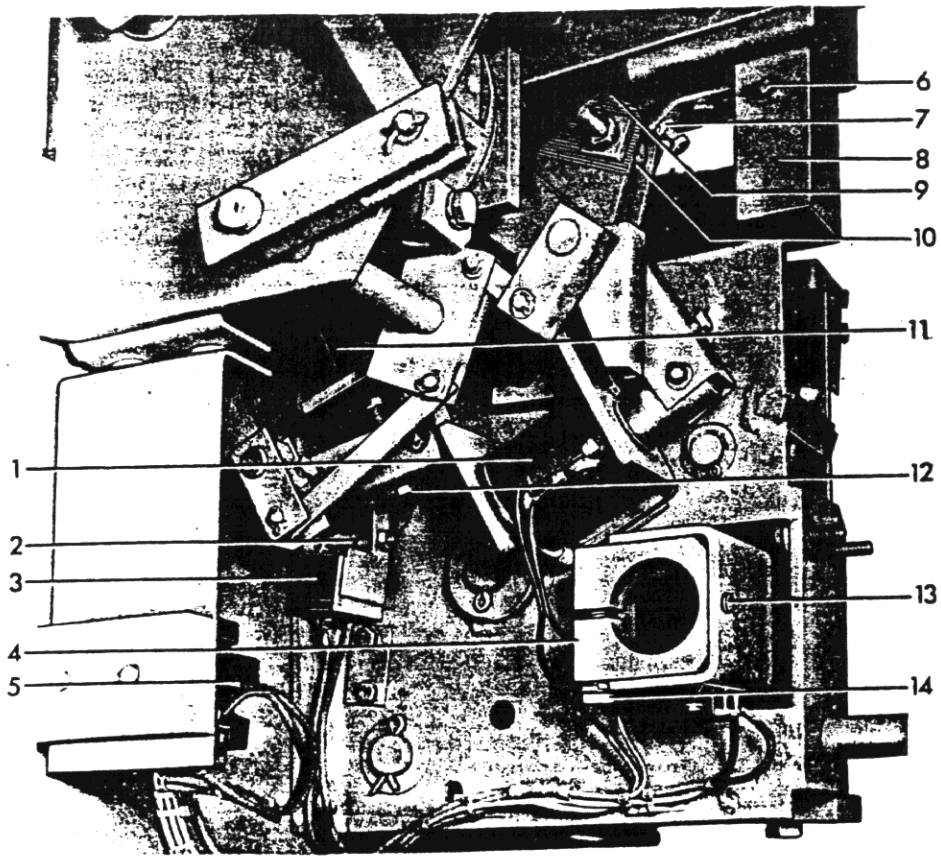
## DASHPOT

The dashpot (8) Figure 10 is adjusted to stop the contacts and linkage and limit overtravel to safe limits. The roller (10) contacts the dashpot actuating arm (9) before the end of its travel. A position stop (7) on the dashpot support can be adjusted to regulate the dashpot stroke to 1/2". This measurement can be made on the vertical shaft at the top of the dashpot.

The dashpot has been adjusted at the factory and should require no checking or adjusting unless it has been removed from the breaker and replaced. The oil level of the dashpot should be checked if there is any indication of an oil leakage. The pipe plug (6) Figure 10 should be removed and dashpot grade oil as recommended in the lubrication chart should be added to the lower level of the hole. A suitable thread sealer, such as plumber's pipe thread tape, should be applied to the plug before replacing.

## MANUAL CHARGING PAWL AND MOTOR MOUNT

The manual charging pawl (7) Figure 6 must advance the ratchet wheel (1) Figure 8 sufficiently to allow the holding pawl (2) Figure 8 to fall into the ratchet wheel teeth. Since the holding pawl is an integral part of the motor mount (5) Figure 8, the entire mounting must be moved to allow a clearance between the holding pawl and the ratchet wheel tooth of .020" to .040". This measurement should be made when the manual charging pawl is fully advanced and the maximum load of the closing spring is on the ratchet wheel. To move the motor mount the locking nut (6) and bolt (9) Figure 8 must be loosened. Shim washers (8) can be added or removed as required to set the holding pawl clearance. Do not alter the position or the number of buffer spring washers (7) Figure 8. Replace the mounting bolt (9) Figure 8 and tighten hand tight plus one half turn with a wrench. Manually charge the closing spring again and




1. Trip Coil
2. Adjusting Nut
3. Closing Latch Monitoring Switch
4. Motor Mount
5. Control Relay
6. Pipe Plug
7. Adjusting Screw
8. Dash Pot
9. Dash Pot Actuating Arm
10. Roller
11. Closing Coil
12. Stop Bolt
13. Position Screw
14. Clamping Bolt

Figure 10. (8041562) Left Side ML-15E Operating Mechanism

check the holding pawl clearance with the closing spring load applied. Secure bolt (9) by replacing the lock washer and nut (6) on the assembly.

LATCH CHECKING SWITCH (when present)

Refer to Figure 6. The latch checking switch (3) must make contact when the latch is within 1/16" of the latch stop. Rotate the trip latch away from the stop by pushing the trip button (8) Figure 1. Allow the latch to reset slowly until the switch contacts close. This can be checked by the use of an indicator light or a bell set. The dimension should be a maximum of 1/16" from the latch to the stop. If adjustment is necessary, move the switch support (2) Figure 6.

SPRING RELEASE INTERLOCK

A spring release interlock shown in (3) Figure 7, will assure that the breaker contacts are open and the closing springs are discharged when the breaker is being inserted or withdrawn from the metal-clad unit, the release interlock will trip the breaker open and hold the mechanism in a trip-free position while discharging the closing springs.

INSPECTION AND TEST

1. For ease in reviewing the adjustments, the following recapitulated:

   a. Cam follower roller clearance .030" to .060".

   b. Primary contact gap 5/8" + 0-1/32".

   c. Primary contact wipe 5/16" + 0-1/32".

   d. Switches - clearance from support 1/64" to 1/32".

   e. The trip latch clearance .030" to .060".

   f. The closing latch is centered

   g. Holding pawl clearance .020" to .040".

   h. Latch checking switch contacts make when the gap between the trip latch and the stop is 1/16" max.

2. Check all nuts, washers, bolts, cotter pins, and terminal connections for tightness.

3. Inspect all wiring to make sure that no damage has resulted during installation, and test for possible grounds or short circuits.

4. See that all bearing surfaces of the mechanism have been lubricated. Refer to the section on LUBRICATION.

5. Operate the breaker slowly with the manual charging wrench and note that there is no excessive binding or friction and that the breaker can be moved to the fully opened and fully closed positions.

6. See that any place where the surface of the paint has been damaged is repainted immediately.

7. Check the trip coil plunger and the release coil plunger to see that they move freely.

## CONTROL POWER CHECK

After the mechanism has been closed and opened slowly several times with the maintenance closing wrench and the mechanism adjustments are checked as described, the operating voltages should be checked at the release coil, trip coil, and motor terminals. For electrical operation of the mechanism, the control power may be either alternating or direct current. The operating voltages for the closing and tripping voltages are given on the breaker nameplate. The ranges, listed in the following table, are standard.

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

| Rated Normal Voltage | Close Min. | Close Max. | Trip Min. | Trip Max. |
|---|---|---|---|---|
| 24V dc | - | - | 14V | 30V |
| 48V dc | 34V | 50V | 28V | 60V |
| 125V dc | 90V | 130V | 70V | 140V |
| 250V dc | 180V | 260V | 140V | 280V |
| 115V ac | 95V | 125V | 95V | 125V |
| 230V ac | 190V | 250V | 190V | 250V |

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.

Electrical closing or opening is accomplished by merely energizing the closing or trip coil circuit. Control switches can be provided for this purpose on the metal-clad unit or control board. It is also possible to trip or close the breaker manually by pressing the manual trip button (8) Figure 1, or the manual close button (2). When the breaker is closed, the close button is interlocked to prevent release of the closing spring.

## OPENING AND CLOSING SPEEDS

OPEThe opening speed of the interrupter contacts should be from 6.5 to 7.5 ft./sec. and the closing speed from 2 to 3 ft./sec.

The opening speed is the average speed measured from contact parting to a 1/2" gap. The closing speed is the average speed measured over the last 1/4" before contact closing.

# MAINTENANCE

any maintenance work is performed, in that all control circuits are opened breaker is removed from the metal-
O NOT WORK ON THE INTERRUPTER
NISM WHILE IN THE CLOSED POSI-
ESS THE TRIP LATCH HAS BEEN
WIRED OR BLOCKED TO PREVENT
L TRIPPING, OR THE MECHANISM
D TO PREVENT OPENING. DO NOT
HE INTERRUPTERS OR MECHANISM
E SPRINGS ARE CHARGED UNLESS
SECURED IN THAT POSITION BY
ENANCE SPRING BLOCKING PIN.

## SPECTION.

uency of periodic inspection should be
y each operating company on the
e number of operations (including
e magnitude of currents interrupted,
ual operations which occur from time
erating experience will soon establish a maintenance schedule which will give assurance of proper breaker condition. On installations where a combination of fault duty and repetitive operation is encountered, an inspection is recommended after several severe fault operations or at 2000 operation intervals. The following instructions list the main points to be included in an inspection and a number of general recommendations.

## THE INTERRUPTER ELEMENT

The Power Vac interrupter used in this breaker is a reliable, safe, and 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.

Only two simple checks are required to assure reliable interruption:

1. A maximum contact erosion of 1/8" is allowed. This is easily determined by checking the indicator (2) Figure 11 when the breaker is in the closed position. When the shaft is flush with nut (1) the contacts have been eroded 1/8" and the Power Vac interrupter should be replaced.

2. A hipot test of the interrupter will determine the internal dielectric condition.

## HIPOT TESTING OF VACUUM INTERRUPTERS

High potential testing, in addition to careful visual inspection, provides the best means of verification of the condition of the interrupter. Each interrupter should be given 60 Hz ac high potential test of 36 kV rms for one minute across its open contacts before the breaker is put into service and the same test should be applied to the interrupters whenever the breaker is serviced.

Prior to applying voltage to the interrupter, the surface of its insulating envelop should be wiped clean of any surface contaminants. Normally wiping with methanol poured on a clean cloth or with an industrial wiper will be sufficient.

A high potential voltage source is then connected across the open interrupter contacts and the voltage slowly increased to the test voltage. A withstand of 36 kV rms ac for one minute is adequate to establish that the interrupter is in serviceable condition.

CAUTION: Although the procedure for hipotting a vacuum interrupter is similar to that used for any other electrical device, there are two areas that require the exercise of extra caution.

1. During any hipotting operation the main shield inside the interrupter can acquire an electrical charge that usually will be retained even after the hipot voltage is removed. This shield is attached to the midband ring of the insulating envelop and a grounding stick should always be used to discharge the ring as well as the other metal parts of the assembly before touching the interrupter, connections, or breaker studs.

2. High voltage applied across open gaps in a vacuum can produce X-radiation that may constitute a health hazard on prolonged exposure at close range unless the source is adequately shielded. The patented internal shield of the G.E. Vacuum interrupter contributes to X-radiation control by providing a measure of radiation shielding.

   During equipment operation in the normal current carrying mode there is no X-radiation because there are no open contacts. When the contacts are open in normal service on a maximum rated 15 kV system, the X-radiation at one meter (3 feet 3 inches) is well below the level of concern, and the metal-clad equipment enclosure provides additional shielding.

   As with any open contacts in a vacuum, hazardous X-radiation can be produced if the voltage across the contacts exceeds a certain level with a certain contact gap; therefore do not conduct hipot tests on the breaker at voltages higher than the recommended levels of 36 kV (rms) ac. During the hipot test, personnel should stand in front of the breaker to take advantage of the shielding afforded by the frame. If it is not practical to have operators located in front of the breaker during hipot testing, equivalent protection for such personnel can be obtained by limiting the number of tests to 12 per hour (4-3 phase breaker) with personnel no closer than 2 meters (6 feet 6 inches).

## MECHANISM

A careful inspection should be made to check for loose nuts or bolts and damaged parts. All cam, roller, and latch surfaces should be inspected for any evidence of damage or excessive wear. Lubricate the mechanism as outlined below, then using the manual charging wrench, open and close the breaker several times to make certain that the mechanism operates freely throughout its stroke. Check the mechanism adjustments as specified under ADJUSTMENTS. Check all terminal connections.

## INSULATING SURFACES

All insulating surfaces should be wiped clean with a dry cloth or industrial wipers.

## LUBRICATION

In order to maintain reliable operation, it is important that all circuit breakers be properly lubricated at all times. Some of the bearings and rolling surfaces utilize a new type of dry lubrication that will require no maintenance and will last the life of the equipment. Bearings and surfaces listed in Table I require lubrication. These have

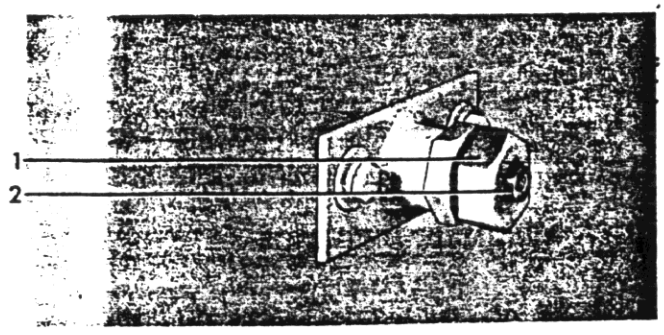



Figure 11. (8041552) Contact Erosion Indicator

1. Nut 2. Shaft

been properly lubricated during assembly at the factory, using the finest grades of lubricants available. However, even the finest oils and greases have a tendency to oxidize with age, as evidenced by hardening and darkening in color. Elimination of the hardened lubricant is essential for the proper operation of the breaker. Also frequent operation of the breaker causes the lubricant to be forced out from between the bearing surfaces. A simple lubrication will often clear up minor disturbances which might be mistaken for more serious trouble.

A definite lubrication schedule should be set up taking into consideration the frequency of operation of the breaker and local conditions. Until such a schedule is worked out, the breaker should be lubricated at each periodic inspection and also whenever it is overhauled, in accordance with the lubrication table. It is also recommended that all breakers be operated at regular intervals to insure the user that the equipment is operating freely.

The lubrication table is divided into two methods of lubrication. The first method outlines the maintenance lubrication which should be performed at the time of periodic maintenance, and requires no disassembly. The second method outlines a lubrication procedure similar to that performed on the breaker at the factory, but should be used only in cases of general overhaul or disassembly for other reasons.

General Electric Lubricant D50H15 is available in 1/4 pound collapsible tubes. It is so packaged to insure cleanliness and to prevent evaporation.

## METHOD OF CLEANING BEARINGS

Whenever cleaning is required, as indicated in lubrication table, the following procedure is recommended.

### SLEEVE BEARINGS

The breaker sleeve bearings located in the mechanism and the mechanism linkage and should be cleaned and relubricated with GE lubricant at general overhaul periods. Includes the bearings in the driving pawl (8), latching pawls (2), cranks, and the in the mechanism frame and interconnecting links. Bearings that are pressed into frame or other mechanism members should be removed. The main shaft bearings should be removed, cleaned, and lubricated with GE lubricant at general overhaul periods.

### NEEDLE BEARINGS

The cam follower roller (1) Figure 9 and needle bearings (4) and (6) should be first removed from the mechanism and the inner race removed. They should then be placed in a container of clean petroleum solvent or similar solvent. DO NOT USE CARBON TETRACHLORIDE.

If the grease in the bearings has become badly oxidized, it may be necessary to use alcohol (type used for thinning shellac) to remove it. Ordinarily, by agitating the bearings in the cleaning solution, and using a stiff brush to remove the solid particles, the bearings can be satisfactorily cleaned. Do not handle the bearings with bare hands as deposits from the skin onto the bearings are inducive to corrosion. If the bearings are touched, the contamination can be removed by washing in alcohol. After the bearings have been thoroughly cleaned, spin them in a clean new light machine oil until the cleaner or solvent is entirely removed. Allow this oil to drain off and then repack them immediately with GE lubricant D50H15 being sure all metal parts are greased. The removable seals should then be replaced.

NOTE: If it becomes necessary to clean the bearings in alcohol (shellac thinner), be sure the alcohol is perfectly clean, and do not allow the bearings to remain in the alcohol more than a few hours. If it is desirable to leave the bearings in the alcohol for a longer time, an inhibited alcohol such as is used for antifreeze should be used. Even then the bearings should be removed from the alcohol within twenty-four hours. Precautions against the toxic effects of the alcohol must be exercised by wearing rubber gloves and by using the alcohol in a well ventilated room; excessive exposure to the fumes is sometimes unpleasant to personnel. Washing the bearings in the light oil and draining should follow immediately, then apply the lubricant. Bearings that are pressed into the frame or other members such as the bearings for eccentric (4) Figure 8, cam shaft bearings and trip and close shaft bearings should not be removed. After removing the shaft and inner race the bearing can usually be cleaned satisfactorily with petroleum solvent or a similar cleaner and a stiff brush. Follow the procedure outlined above using a light machine oil and GE lubricant D50H15 before reassembling the inner race and shaft.

## ROLLING SURFACES

The surfaces of the ratchet wheel, cam, and pawls are lubricated with a baked-on, dry molybdenum disulfide coating. This requires no maintenance and should last the life of the breaker.

## RECOMMENDED MAINTENANCE OF BREAKER APPLIED TO NORMAL SWITCHING DUTY

A vacuum breaker applied to normal operations should be serviced and maintained according to the following schedule:

A. Every 2000 operations, or every year, whichever comes first, the following should be accomplished:

1. Make a visual inspection of the breaker

and remove dust and contaminants from the vacuum interrupters, and insulation.

2. A high potential test should be applied to the vacuum interrupters as outlined in Hipot Testing of Vacuum Interrupter, page 11.

3. Check the Power Vac contact erosion indicator as described on page

4. Check the interrupter and mechanism adjustments as summaryized under INSPECTION AND TEST. The necessary readjustments should be made as described under ADJUSTMENTS.

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

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

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

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

B. Every 10,000 operations or approximately every five years, whichever comes first, the following should be accomplished:

1. At this time the breaker should be given a general overhaul and all excessively worn parts in both the mechanism and on the interrupters replaced. Such wear will usually be indicated when the breaker can not be adjusted to instruction book tolerances. This overhaul and inspection is more detailed and will require disassembly of mechanism and interrupter operating parts.

2. All roller and needle bearings in the operating mechanism should be disassembled, cleaned, and repacked with G-E lubricant D50H15 as described under LUBRICATION.

3. The interrupters and operating mechanism should be serviced as described for every 2,000 operations and properly adjusted before being put back into service.

### RECOMMENDED MAINTENANCE OF BREAKER APPLIED TO REPETITIVE SWITCHING DUTY

A vacuum breaker applied to repetitive operation should be serviced and maintained according to the following schedule:

A. Every 2000 operations, or every six months, whichever comes first:

1. Maintain breakers per item "A" of Normal Switching Duty Above.

B. Every 10,000 operations, or every five years, whichever comes first:

1. Maintain breakers per Item "B" of Normal Switching Duty above.

## REPAIR AND REPLACEMENT

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

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

Refer to the section on INSTALLATION, paying particular attention to ADJUSTMENTS.

The listed terms "Right" and "Left" apply when facing the operating panel end of the breaker.

### INTERRUPTERS

Refer to Figure 3. To replace the interrupter, it is necessary to remove the interrupter (8), support (3), and operating rod (1) as a subassembly. It is not necessary or desirable to remove any of the primary studs. These have been accurately aligned at the factory, to assure proper contact with the metal-clad primary contact.

The following steps should be followed carefully.

1. Remove operating rod bolt (3) Figure 12.

2. Remove connection block (4) Figure 4, from the interrupter by removing mounting bolts.

3. Remove vertical bolts (2) Figure 3 holding the interrupter support to the front bushings.

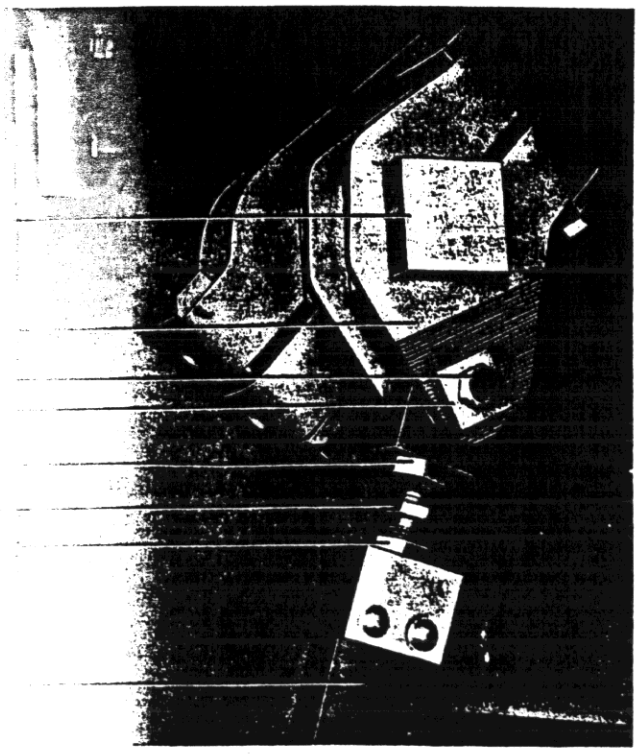
4. Remove two bolts fastening support in insulator (5) Figure 3 to support (3).

5. Loosen bolts holding top of front connecting bar (6) Figure 3. .

NOTE: THE COMPLETE ASSEMBLY SHOULD BE PROPERLY SUPPORTED BEFORE REMOVING THESE LAST BOLTS.

6. Move the interrupter assembly to the rear of the breaker and remove from frame. Reassemble the interrupter and support in the reverse order. A complete check of the primary gap and primary wipe should be made by closing the breaker slowly by the maintenance handle. Adjustments should be made as described under CONTACT GAP (page number 8 ) and CONTACT WIPE (page number 8 ).

7. Before putting breaker into service, operate approximately 100 times and check contact wipe and gap again. Some small changes sometimes occur during these first operations due to seating of contacts and bearings. Readjust if necessary.



12. (8041548) Operating Rod

Square Shaft
Washer
5. Nut
6. Adjusting Screw
7. Nut
8. Operating Rod

8. Readjust the erosion indicator nut (1) Figure 11 so that 1/8" of shaft (2) protrudes when the breaker is in the closed position.

## BUSHINGS

IMPORTANT: DO NOT REMOVE ALL SIX BUSHINGS AT ONCE. The bushings have been carefully aligned with breaker frame, during assembly at the factory, and it is important that this alignment be maintained to insure interchangeability of the breaker in the metal-clad units. It is, therefore, recommended that the bushings be removed and reassembled one at a time. Also, before removing any one bushing, measure the distance from that particular bushing to adjacent bushings in both directions, so that it may be reinstalled in the same location.

However, it is possible to remove and reassemble three bushings at one time. If this is preferred, alignment of the bushings may be accomplished by placing the breaker in a de-energized spare metal-clad unit before tightening the bushing mounting bolts. This must be done before the interrupters are reinstalled.

To replace the bushings, proceed as follows:

1. Open the breaker and disconnect the bus bars at the lower ends of the bushings.

2. Remove the four bolts at the mounting flange of the bushing being removed and lower the bushing assembly.

3. Reassemble in the reverse order.

## INTERLOCK SWITCH

To remove the two interlock switches (4) Figure 6, remove the two mounting screws and disconnect the wires. Reassemble in the reverse order and check the switch adjustment as explained under ADJUSTMENTS.

## CLOSING LATCH MONITORING SWITCH

To remove the closing latch monitoring switch (3) Figure 10 remove the bolts and disconnect the wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

## TRIPPING LATCH CHECKING SWITCH

To remove the tripping latch switch (3) Figure 6 remove the mounting screws and disconnect the wires. Reassemble in the reverse order and check the switch adjustment as explained under ADJUSTMENTS.

## MOTOR, RELAY AND LIGHT SWITCHES

To remove these switches (6) Figure 6, remove the mounting screws and disconnect the wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

## SPRING RELEASE AND TRIP COILS

The spring release coil (11) Figure 10 and the trip coil (1) can be replaced as follows:

1. Cut the wires close to the coil.
2. Remove stop bolt (12) and nut.
3. Remove two Coil Support Mounting Bolts.
4. When replacing the coil be sure to assemble the correct fiber spacers at the end before bolting supports in place.
5. Adjust stop bolt (12) and nut to allow approximately 1/8" of freedom for link.
6. Be certain armature is centered in the coil and is not binding.
7. Butt connect wires and check operation of solenoid electrically and mechanically.

## CHARGING MOTOR

Refer to Figure 10. To replace the spring charging motor loosen clamping bolt (14) and positioning screw (13) and remove from motor mount (4). Reassemble in the reverse order and be careful to tighten clamping bolt (14) so that the motor shaft is free to turn.

# 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 both the interrupter and the mechanism.
2. Specify the quantity, catalog number (if listed), reference number (if listed), and description of each part ordered, and this bulletin number.
3. Standard hardware such as screws, bolts, nuts, washers, etc. is not listed in this bulletin. Such items should be purchased locally.
4. For prices, refer to the nearest office of the General Electric Company.

TABLE I

| PARTS | LUBRICATION AT MAINTENANCE PERIOD | ALTERNATE LUBRICATION (REQUIRES DISASSEMBLY) |
|---|---|---|
| Sleeve Bearings - main crank shaft, Operating rod, opening spring connections, pawls, etc. (Bronze) | Light application of machine oil SAE 20 or SAE 30. | Remove bearings or links clean per instructions and apply D50H15 lubricant liberally. |
| Roller and Needle Bearings | Light application of machine oil SAE 20 or SAE 30. | Clean per instructions and repack with D50H15 lubricant. |
| Ground surfaces such as cams, ratchet teeth, etc. (Surfaces ocated with MOS2). | No lubrication required. | No lubrication required. |
| Ground surfaces such as latches, rollers, etc. | Wipe clean and apply D50H15 lubricant. | Wipe clean and apply D50H15 lubricant. |
| Silver Plated primary disconnect studs. | Wipe clean and apply D50H47. | Wipe clean and apply D50H47. |
| Dashpot | Check oil level add oil if necessary. | Check oil level add oil if necessary. |

G.E. D50H27

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TABLE II

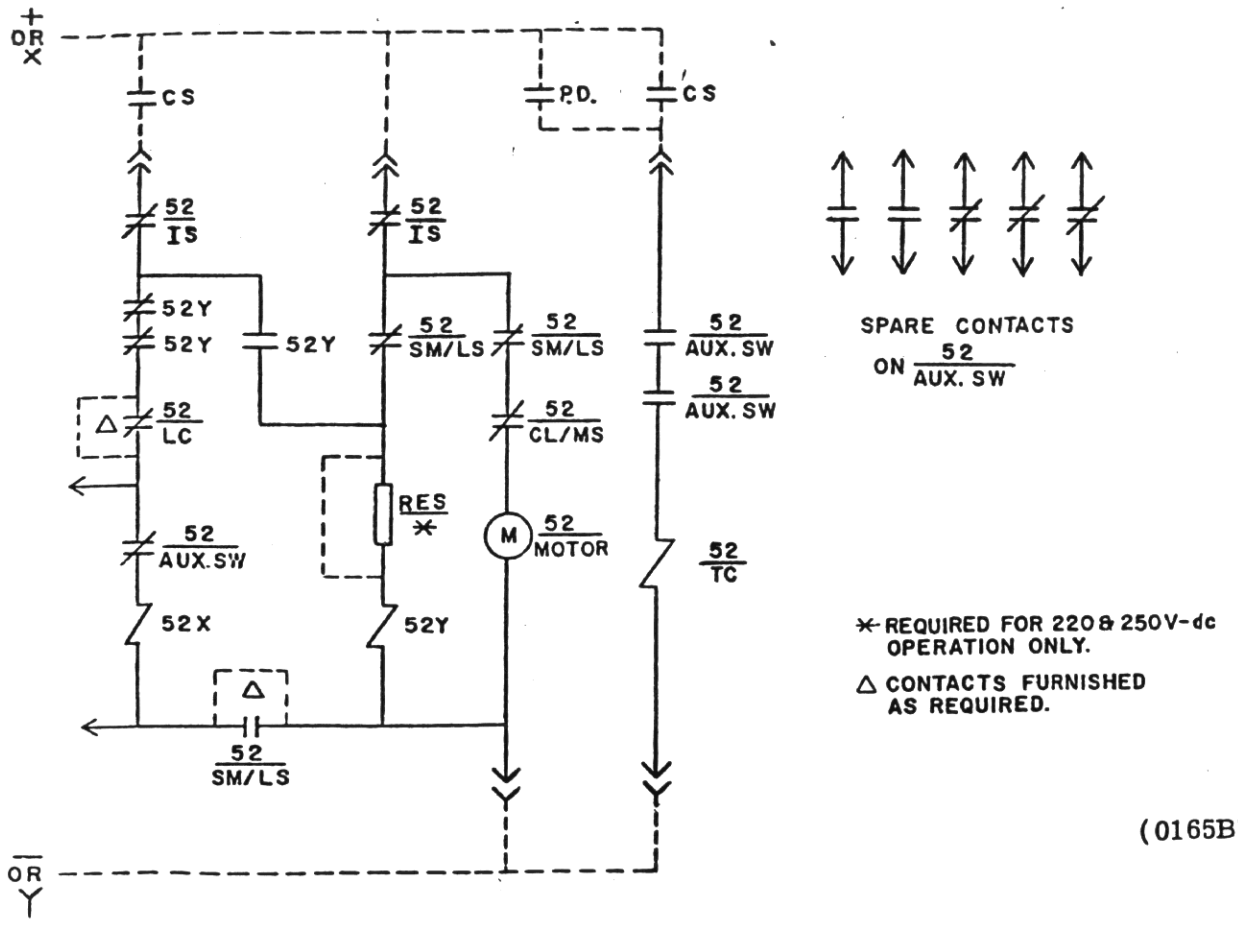
RECOMMENDED RENEWAL PARTS FOR VVB-13.8-500-1200 & 2000 AMP VACUUM BREAKER WITH ML-15E STORED ENERGY MECHANISM.

| Fig. No. | Ref. No. | No. Req'd | Description | Catalog No. |
|---|---|---|---|---|
| 7 | 5 | 1 | Spring Charging Motor - **<br>48 V-DC<br>110 & 125 V-DC & 115 V-AC, 60 Hz<br>220 & 250 V-DC & 230 V-AC, 60 Hz | <br>0121C8188-P001<br>0121C8188-P002<br>0121C8188-P003 |
| 7 | 6 | 1 | Relay - **<br>24 V-DC<br>48 V-DC<br>110 & 125 V-DC<br>220 & 250 V-DC<br>115 V-AC, 60 Hz<br>230 V-AC, 60 Hz | <br>0137A7575-P004<br>0137A7575-P006<br>0137A7575-P001<br>0108B1978-G003<br>0137A7575-P005<br>0137A7575-P002 |
| 7 | 4 | 1 | Potential Trip Coil - **<br>24 V-DC<br>48 V-DC<br>110 - 125 V-DC<br>220 - 250 V-DC<br>115 V-AC, 60 Hz<br>230 V-AC, 60 Hz | <br>006174582-G012<br>006174582-G034<br>006174582-G001<br>006174582-G002<br>006174582-G010<br>006174582-G014 |
| 10 | 11 | 1 | Closing Coil - **<br>48 V-DC<br>110 - 125 V-DC<br>220 - 250 V-DC<br>115 V-AC, 60 Hz<br>230 V-AC, 60 Hz | <br>006174582-G034<br>006174582-G001<br>006174582-G002<br>006174582-G010<br>006174582-G014 |
| 6 | 6 | 5 | Switch, Normally Open | 0456A0866-P005 |
| 6 | 6 | 1 | Switch, Normally Closed | 0456A0866-P006 |
| 7 | 2 | 1 | Auxiliary Switch | 0227A5340-P1 |
| 8 | 10 | 1 | Driving Pawl Spring | 0195A4000-P4 |
| 8 | 11 | 2 | Holding Pawl Spring | 0208A9458-P1 |
| 3 | 8 | 3 | Power Vac Interrupter Asm 1200 | 0213X0710-G2 |
| 3 | 8 | 3 | Power Vac Interrupter Asm 2000 | 0213X0710-G3 |

BOTTLE SAME BOTH Grips 0195A4040 P010 PV2

** Refer to breaker nameplate or summary for proper voltage rating.

# TYPICAL ELEMENTARY WIRING FOR VACUUM CIRCUIT BREAKER




(0165B7906)

| | FIG. NO. | REF. NO. | DESCRIPTION |
|---|---|---|---|
| 52/AUX SW | 7 | 2 | AUXILIARY SWITCH |
| 52X | 10 | 11 | CLOSING COIL (SPRG. REL. SOL'D) |
| 52Y | 7 | 6 | CONTROL RELAY |
| 52/TC | 7 | 4 | TRIP COIL |
| 52/IS | 6 | 4 | INTERLOCK SWITCHES |
| 52/CL/MS | 10 | 3 | CLOSING LATCH MONITORING SWITCH |
| 52/SM/LS | 6 | 6 | POWER SWITCHES |
| 52/LC | 6 | 3 | LATCH CHECKING SWITCH |
| 52/MOTOR | 7 | 5 | SPRING CHARGING MOTOR |