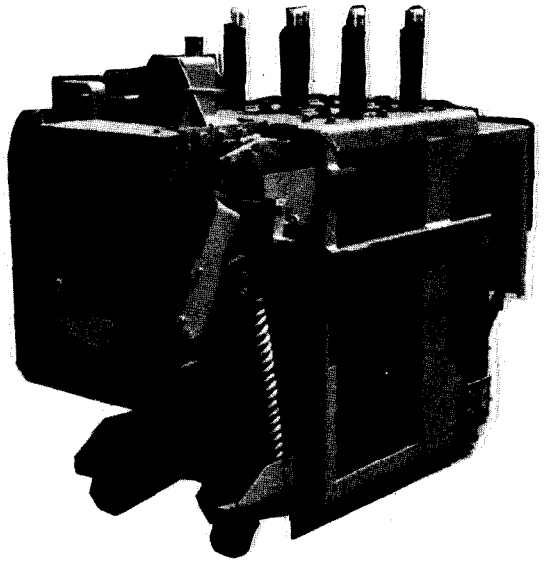
INSTRUCTIONS

GEK-89757

GE/Vac™ VACUUM CIRCUIT BREAKER

Types VVC- 4.16 -250 -1200 or 2000A -0H, -0C
VVC- 7.2 -500 -1200 or 2000A -1H, -1C
VVC-13.8 -500 -1200 or 2000A -1H, -1C
VVC-13.8 -500B-1200 or 2000A -1H, -1C
VVC-13.8 -750 -1200 or 2000A -1H, -1L
-1C, -1F

with ML13C mechanism



CONTENTS

GENERAL ELECTRIC

WARNING

DE-ENERGIZE BREAKER BEFORE PERFORMING ANY MAINTENANCE OR SERVICE ON THE EQUIPMENT.

WARNING

THIS CIRCUIT BREAKER CONTAINS CHARGED SPRINGS. BEFORE PERFORMING ANY SERVICE ON THIS EQUIPMENT, READ THE APPLICABLE SECTIONS OF THE INSTRUCTION BOOK ON WORKING ON THE MECHANISM.

GENERAL ELECTRIC VACUUM POWER CIRCUIT BREAKER							TYPE 4.16 - 250 - OH				
							SER. NO. 0288A2255-003				
RATED MAX. VOLTAGE	4.76	KV	RATED AMP.	1200	Hz 60	WITHSTAND IMPULSE	60	KV	INT TIME	5	CY
RATED SHORT CIRCUIT AMPS	29	KA	RATED VOLTAGE RANGE FACTOR	1.24		CLOSE & LATCH CAPABILITY	58				KA
CLOSING COIL	006174582G001	VOLTS	125	CLOSING AMPS.	6	DC	VOLT RANGE	90-130			
POTENTIAL TRIP COIL	006174582G001	VOLTS	125	TRIPPING AMPS.	6	DC	VOLT RANGE	70-140			
UV TRIP COIL		VOLTS		CURRENT TRIP COIL				AMP. AC			
CONNECTION DIAGRAM	0227A1000 P041	WT.	900	MECH TYPE	ML-13C		DATE MFG.	7/87			
CAUTION! BEFORE INSTALLING OR OPERATING READ INST.		GEK - 89757					MADE IN U.S.A. PHILADELPHIA, PA. NP0227A5336				

FIGURE 1 TYPICAL NAMEPLATE DATA

1. INTRODUCTION

1.1 SCOPE

This manual provides information needed by the user to properly check out, install and maintain the GE/Vac™ breaker.

The GE/Vac™ vacuum circuit breaker is a removable and interchangeable interrupting element for use in vertical lift metalclad switchgear and provides protection and control of electrical apparatus and power systems. To the extent required applicable ANSI, IEEE and NEMA Standards are met. No such assurances are given with respect to local codes and ordinances as they vary greatly.

1.2 SAFETY

Each user has the responsibility to instruct all personnel associated with this 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 most important aspects of personnel safety related to circuit breakers. GE neither condones nor assumes any responsibility for user practices which deviate from these recommendations.

1. All personnel associated with installation, operation, and maintenance of power circuit breakers should be thoroughly instructed and supervised regarding power equipment with which they are working. Instruction books 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. Good maintenance is essential to breaker reliability and safety.

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

4. **DO NOT WORK ON AN ENERGIZED BREAKER. IF WORK HAS TO BE PERFORMED ON THE BREAKER, TAKE IT OUT OF SERVICE AND REMOVE IT FROM THE METALCLAD.**

5. **DO NOT WORK ON ANY PART OF THE BREAKER WITH THE TEST COUPLER ENGAGED.**

6. All spring-charged mechanisms related to a breaker must be serviced only by skilled and knowledgeable personnel capable of gagging or releasing each spring load in a controlled manner. **PARTICULAR CARE MUST BE EXERCISED TO KEEP PERSONNEL CLEAR OF MECHANISMS WHICH ARE TO BE OPERATED OR RELEASED.** Information on construction of such mechanisms is provided in this instruction book.

7. 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.

8. If maintenance on the GE/Vac™ breaker is being performed to an extended schedule such as on a 5 year or 10 year basis, it is recommended that the vacuum interrupter integrity test of (para. 6.3) be performed each time the breaker is removed from the metalclad switchgear for reasons other than scheduled breaker maintenance if it has been more than one year since the last vacuum interrupter integrity test.

9. Refer to Instruction Book GEH-1802 for a description of the procedure to insert a GE/Vac™ breaker into the metalclad switchgear. All personnel associated with the installation and operation of the power

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

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

circuit breakers should be thoroughly instructed on the interlock systems which interface between circuit breaker and switchgear.

1.3 GENERAL

The VVC -4.16-250; 7.2-500; 13.8-500; and 13.8-750 type vacuum breakers are available with continuous current ratings of 1200 and 2000 amperes in accordance with applicable industry standards. The letter designation (H, C, L, or F) immediately following the breaker model or "Dash" number (e.g. -OH, 1L) on the breaker nameplate indicates basic design features as shown below in Table 1. The nameplate also describes the rating and control 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.

TABLE 1

DESCRIPTION OF LETTER DESIGNATIONS FOLLOWING "DASH" NUMBERS

COL (1) LETTER DESIGNATION FOLLOWING THE "DASH" NUMBER E.G. -OH (DASH ZERO H)	TYPE OF VVC BREAKER	FOR USE IN THIS TYPE OF SWITCHGEAR	LETTER (IN COL (1) INDICATES A STANDARD BREAKER WITH A ML-13C MECHANISM, INTERCHANGEABLE WITH BREAKERS HAVING THESE FEATURES:		
			TYPE MECH	TYPE INTERLOCK	TYPE SECONDARY COUPLER
OH 1H	4.16 - 250 7.2 - 500 13.8 - 500 13.8 - 750	M26 M36 M36 M36HN	ML-11 or ML-13	Positive	Single 16 Point
OC 1C	4.16 - 250 7.2 - 500 13.8 - 500 13.8 - 750	M26 M36 M36 M36HN	MS-13 Solenoid	Positive	Single 16 Point
1L	13.8 - 750	M36H	ML-11 or ML-13	Positive	Single 16 Point
1F	13.8 - 750	M36H	MS-13 Solenoid	Positive	Single 16 Point

2. RECEIVING, HANDLING AND STORAGE

2.1 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 damage or rough handling is evident, a 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.

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

3. INSTALLATION

3.1 PREINSTALLATION CHECKOUT

Before the initial installation of the GE/Vac™ Circuit Breaker in the metalclad inspect and check for proper operation and adjustments as follows:

1. Check the breaker nameplate to see that the breaker rating meets the intended application.

2. Remove the shipping wires and open the breaker as described in paragraph 3.2.

3. Check that both the closing spring and opening spring have been discharged.

4. Perform a slow closing operation and make mechanical checks per paragraph 3.3.

5. Perform electrical checks per paragraph 3.4.

6. Check position of erosion indicator per paragraph 5.8.

WARNING

DO NOT WORK ON EITHER THE BREAKER OR MECHANISM UNLESS THE CLOSING SPRING AND THE OPENING SPRING HAVE BEEN DISCHARGED. THIS PRECAUTION IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING. ANYONE WORKING ON THE CIRCUIT BREAKER SHOULD BE FAMILIAR WITH THE DEVICE AS DESCRIBED IN THIS INSTRUCTION BOOK AND SHOULD BE COGNIZANT OF ALL SAFETY PRECAUTIONS. DO NOT WORK ON ANY PART OF THE BREAKER WITH THE TEST COUPLER ENGAGED.

3.2 The breaker has been shipped with the vacuum interrupter contacts secured in the closed position by wiring the trip latch and spring release crank.

Remove the top mechanism cover and locate these two securing wires as indicated by the yellow shipping tags. Cut the wires using wire cutting pliers or a similar tool and trip open the breaker by pushing the manual trip button (5) Figure 1. Keep your hands clear of the moving parts of the operating mechanism while cutting the wire and opening the breaker. To assure all springs are discharged push the close button and then the trip button. At this time a complete visual inspection of the interrupters and mechanism should be made to ascertain their condition.

3.3 MECH. CHECKING AND SLOW CLOSING

1. Charge the breaker closing spring using a 5/8" ratchet wrench to turn the manual charging shaft (2) Figure 7. Turning the shaft ccw 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.

2. 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 (6) Figure 1. The spring is now blocked and slow breaker closing can now be accomplished by again turning the manual charging shaft with the 5/8" ratchet wrench.

3. 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 manual 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:

   Interrupter contact gap (Refer to page 13).

   Interrupter contact wipe (Refer to page 13).

4. After the mechanical checks and adjustments have been made, the closing spring can be unblocked. Rotate the manual charging shaft until the springs are fully charged and the ratchet wheel can no longer be advanced. The spring blocking device can now be removed. The closing and opening springs can now be discharged by pushing first the CLOSE button and then the TRIP button.

3.4 ELECTRICAL CHECKING

1. Attach the test coupler to the breaker, and operate electrically several times. Check the control voltage as described under "Control Power Check", Page 19.

2. Perform the vacuum interrupter integrity test described on page 20.

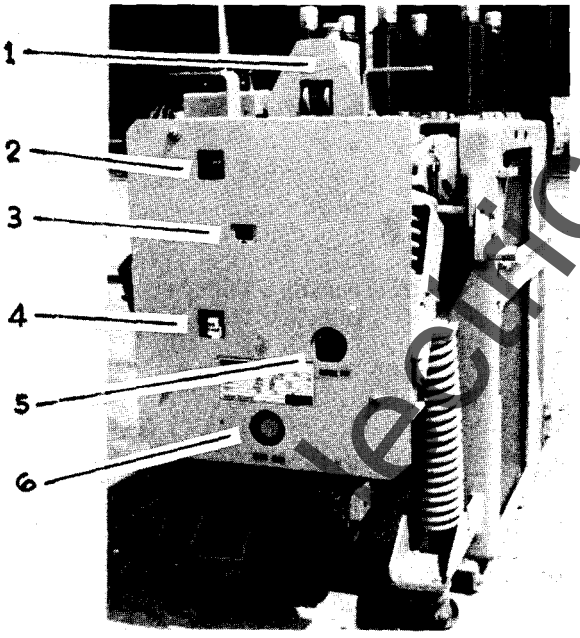


FIGURE 1 FRONT VIEW

1. PLUNGER INTERLOCK
2. OPEN/CLOSED INDICATOR
3. OPERATION COUNTER
4. CHARGED/DISCHARGED INDICATOR
5. MANUAL TRIP BUTTON
6. MANUAL CLOSE BUTTON

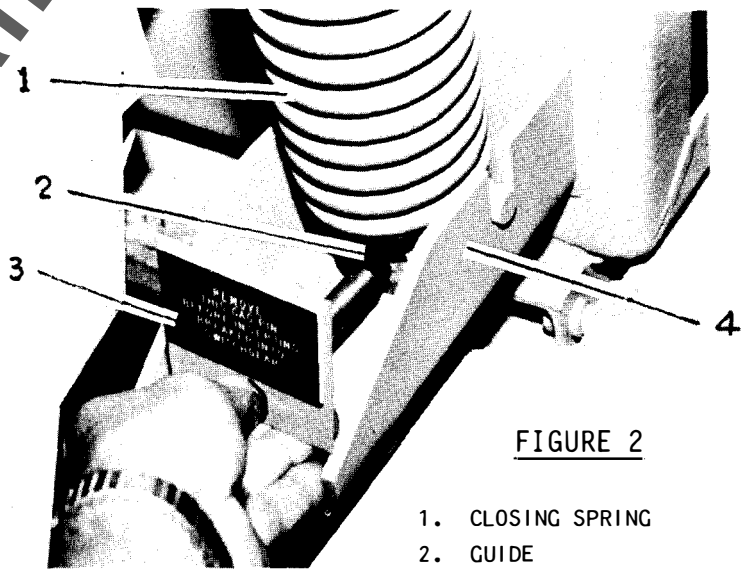


FIGURE 2

1. CLOSING SPRING
2. GUIDE
3. SPRING BLOCKING DEVICE
4. SPRING SUPPORT

4. OPERATING PRINCIPLES

4.1 The GE/Vac™ Vacuum Circuit Breaker has two principal components: the interrupter elements and the operating mechanism.

The interrupter element is three similar pole units, each of which includes the current carrying parts, a hermetically sealed vacuum interrupter, wipe springs to provide contact pressure and an enclosing barrier system that provides insulation between phases and to ground.

The primary conections to the associated metalcald switchgear are made through the ball contacts at the top of the breaker bushings.

The ML-13C operating mechanism is of the stored energy type. The mechanism will operate on AC or DC voltage as indicated on the breaker nameplate. Closing and opening operations are controlled electrically by the metalclad or remote relaying and mechanically by the manual close and trip buttons on the breaker. All secondary connections from the breaker to the metalclad unit are made through the coupler (1) Figure. 4.

A positive interlock (5) Figure 4 and interlock switch (2) Figure 4 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. It also prevents a closing operation unless the breaker is in the fully raised 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 (5) Figure 1. It may require more than normal force to release the interlock.

The spring release interlock (1) Figure 6 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.

4.2 PLUNGER INTERLOCK

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

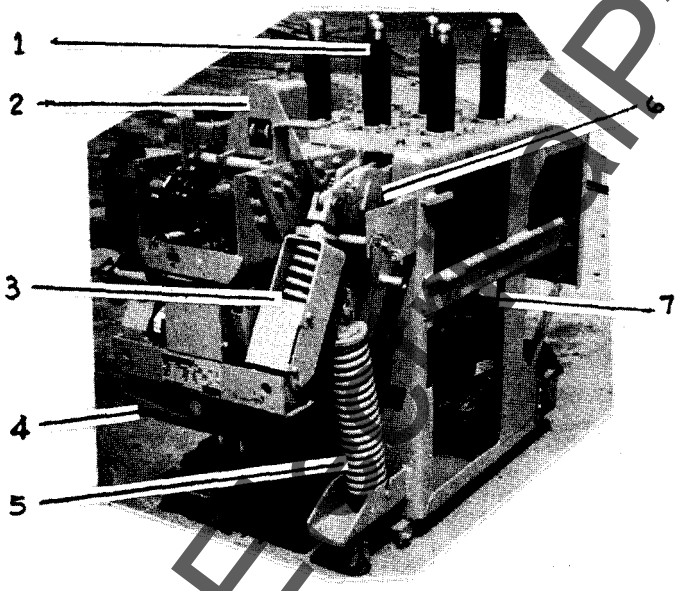


FIGURE 3 VACUUM BREAKER

1. BUSHINGS
2. PLUNGER INTERLOCK
3. OPENING SPRINGS
4. SPRING CHARGING MOTOR
5. CLOSING SPRING
6. SQUARE SHAFT
7. VACUUM INTERRUPTERS

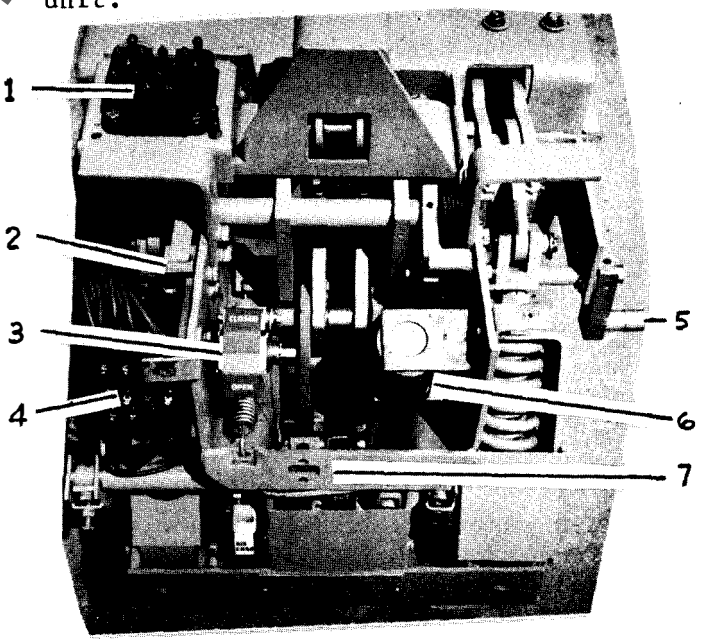


FIGURE 4 MECHANICAL TOP VIEW

1. SECONDARY COUPLER
2. INTERLOCK SWITCH
3. OPEN/CLOSE INDICATOR
4. AUXILIARY SWITCH
5. POSITIVE INTERLOCK ROLLER
6. TRIP COIL
7. OPER.COUNTER

4.3 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 (6) Figure 6 is converted to a straight stroke pumping action through the eccentric (4) Figure 5 that carries a spring loaded driving pawl (3). The pawl advances the ratchet wheel (1) Figure 5 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 roller (6) Figure 8 will engage the closing latch (8) 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 (7) Figure 8 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 stop expending all residual energy.

The closing spring may be charged manually if control voltage is not available. A 5/8" ratchet wrench must be used to rotate the manual charging shaft continuously in a ccw 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 continue to charge the spring. Do not use anything but a ratchet wrench if electrical control power can be restored.

4.4 CLOSING OPERATION

Closing the breaker is accomplished by energizing the closing coil or by pressing the manual close button. In either cae, the closing latch rotates to release the energy of the closing spring which powers the cam (7) Figure 9 that closes the breaker through a simple linkage that remains trip-free at all times. A monitoring switch (13) Figure 8 and power switch (7) control the operation of the spring charging motor.

4.5 OPENING OPERATION

The breaker can be opened either electrically by energizing the trip coil (6) Figure 4 or by pushing the manual trip button (5) Figure 1. In each method the trip latch (14) 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 (5) Figure 9 will stop the contacts and linkage and absorb any excess energy from the system thereby controlling 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.

4.6 TRIP FREE OPERATION

If the trip coil circuit is energized while the breaker is closing, the trip plunger will move the trip latch (14) Figure 9 away from the trip roller (16) causing the mechanism linkage to collapse and the breaker to perform a close open operation. The closing cam (7) will complete its closing stroke and the springs will recharge as in a normal closing operation.

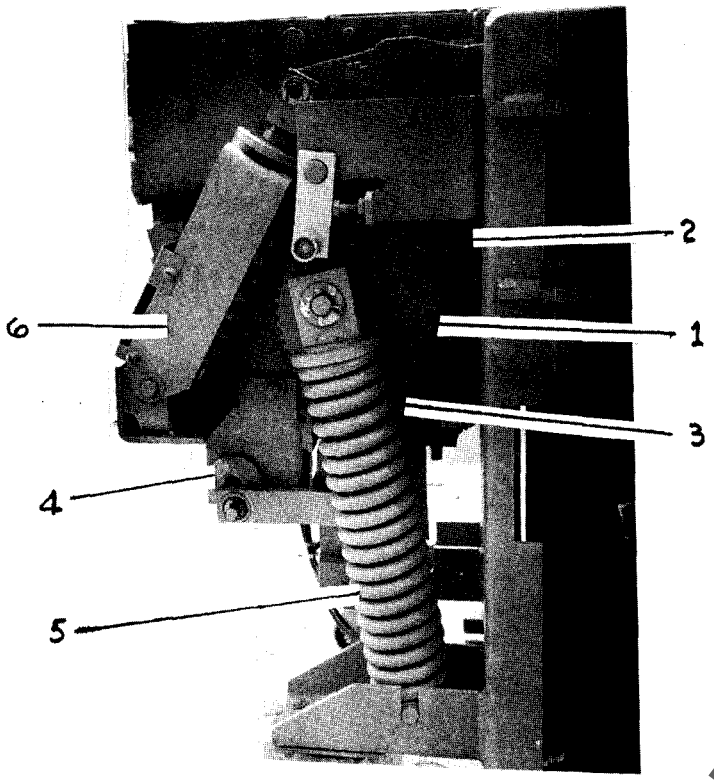


FIGURE 5 MECHANISM RIGHT SIDE

FIGURE 5

1. RATCHET WHEEL
2. HOLDING PAWL
3. DRIVING PAWL
4. ECCENTRIC
5. CLOSING SPRING
6. OPENING SPRING

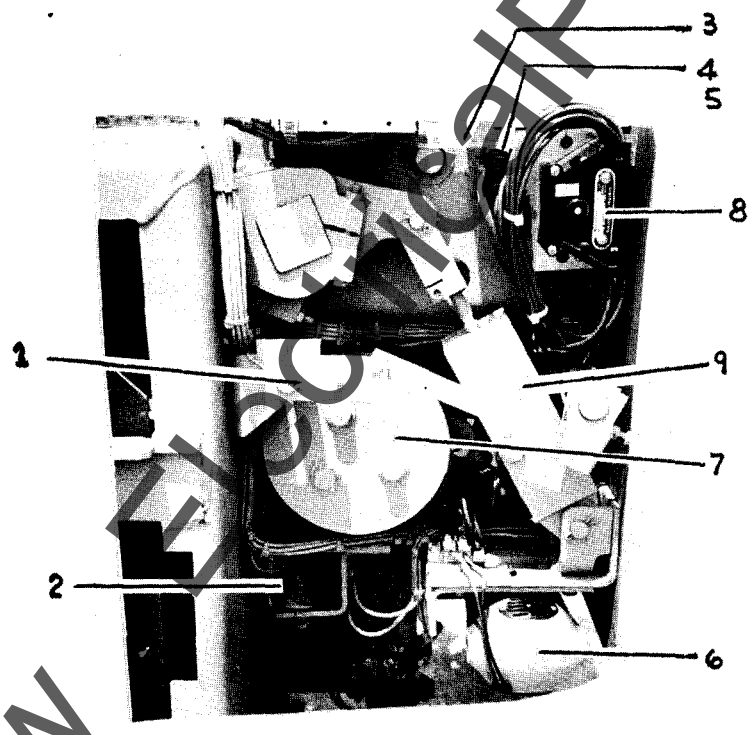


FIGURE 6 MECHANISM LEFT SIDE

FIGURE 6

1. SPRING RELEASE INTERLOCK
2. CLOSING COIL
3. SWITCH ARM
4. SUPPORT
5. SWITCH
6. CHARGING MOTOR
7. FLYWHEEL
8. AUXILIARY SWITCH
9. DASHPOT

5.0 MECHANICAL CHECKS AND ADJUSTMENTS

5.1 All adjustments should be checked during periodic inspection 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 front mechanism cover and insulated barriers.

WARNING

DO NOT WORK ON EITHER BREAKERS OR MECHANISM UNLESS THE CLOSING SPRING AND THE OPENING SPRING HAVE BEEN DISCHARGED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING. DO NOT WORK ON ANY PART OF THE BREAKER OR MECHANISM WITH THE TEST COUPLER ENGAGED.

5.2 TRIP LATCH WIPE

Refer to Figure 9. The wipe of the trip latch (14) on the trip roller (16) should be from .187" to .250". This can be measured by putting a film of grease on the latch (14), closing the breaker part way, and tripping. The mechanism has the proper trip latch wipe when the latch rests against the stop pin (15). No adjustment is provided and a visual inspection is usually all that is required. If this setting is not correct, look for insufficient travel of the trip shaft (13).

5.3 RELEASE LATCH WIPE

Refer to Figure 8. The wipe between the release latch (8) and roller (6) should be .187" to .250". If re-setting is required, loosen, set, and retighten adjustment nut and screw (10), and refer to paragraph 5.10

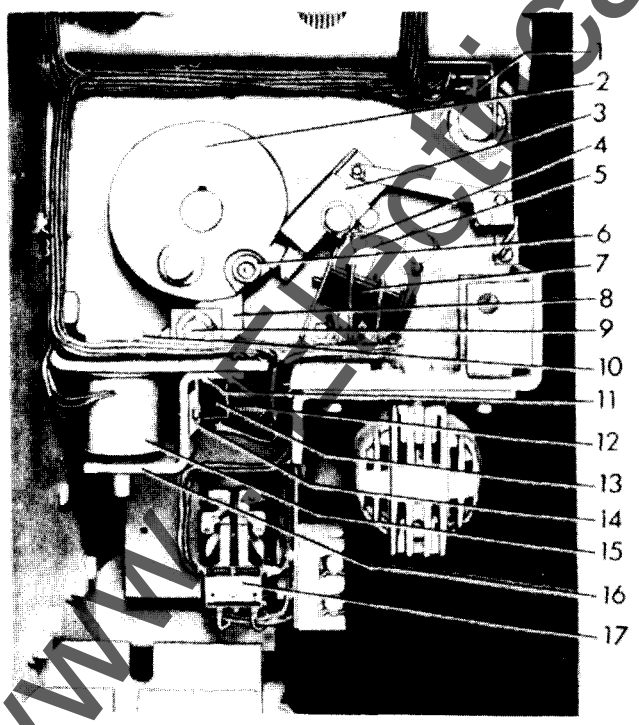


FIGURE 8 (8034467) MECHANISM

5.4 TRIP ARMATURE TRAVEL

Refer to Figure 9. The trip armature (10) should have 1/16" to 3/16" travel plus 1/32" minimum overtravel before the trip latch (18) starts to move. This can be adjusted by moving the trip coil support (8) and/or by adjusting the trip armature screw (3) Figure 7. A locking screw located behind the trip armature screw must first be loosened. Retighten locking screw after making adjustment.

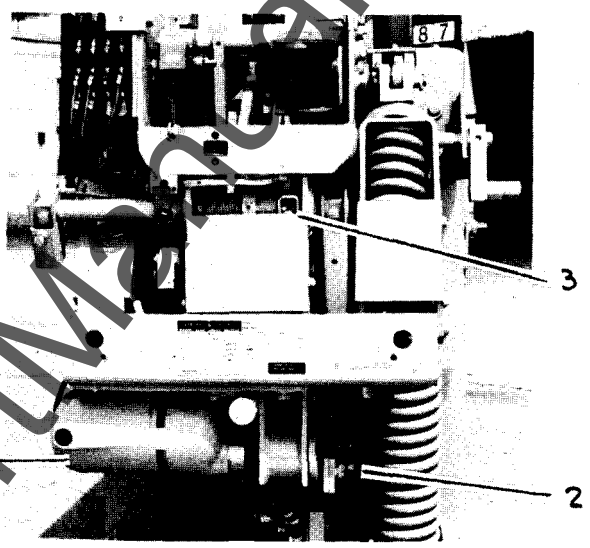


FIGURE 7. LOWER MECHANISM

1. Charging Motor
2. Manual Charging Shaft
3. Trip Arm Screw

1. Latch Checking Switch
2. Switch Cam
3. Switch Striker
4. Switch Support Bolts
5. Switch Support
6. Closing Latch Roller
7. Power Switches
8. Closing Latch
9. Closing Latch Shaft
10. Latch Adjusting Screw
11. Release Coil Bolts
12. Closing Latch Spring
13. Latch Monitoring Switch
14. Switch Mounting Bracket
15. Spring Release Solenoid
16. Release Coil Support
17. Control Relay

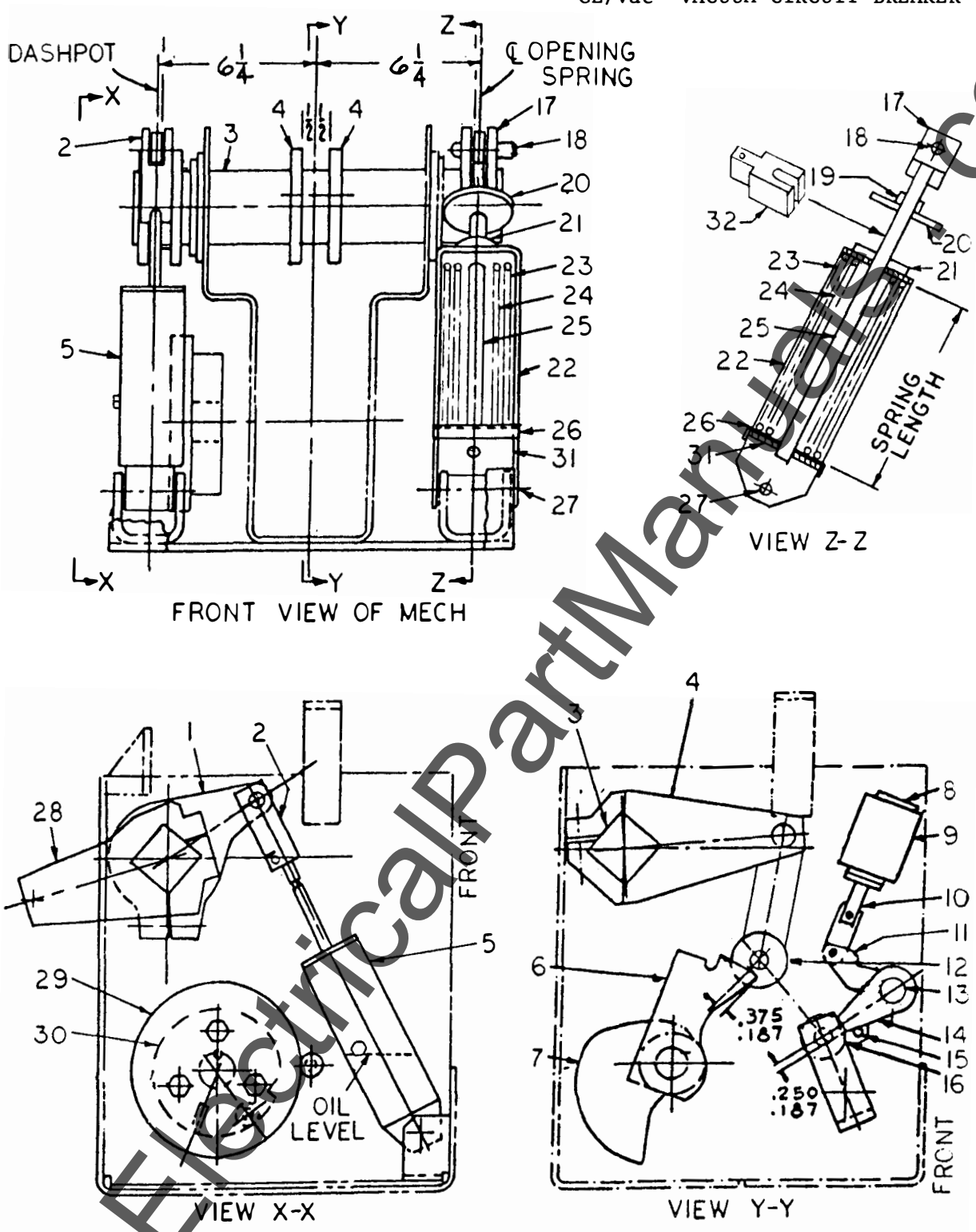


FIGURE 9 ML-13C OPERATING MECHANISM (SHOWN BREAKER CLOSED)

1. CRANK
2. DASHPOT COUPLING
3. SQUARE SHAFT
4. CENTER CRANK
5. DASHPOT
6. PROP
7. CAM
8. TRIP COIL SUPPORT
9. TRIP COIL
10. ARMATURE
11. TRIP CRANK
12. CLOSING ROLLER
13. TRIP SHAFT
14. TRIP LATCH
15. STOP PIN
16. TRIP ROLLER
17. CLEVIS
18. PIN
19. CHECK NUT
20. ADJUSTMENT PLATE
21. BUFFER
22. SPRING SUPPORT
23. OUTER SPRING
24. INNER SPRING
25. ROD
26. SLIDING PLATE
27. PIN
28. OPERATING CRANK
29. FLYWHEEL
30. CAM WHEEL
31. NUT PLATE
32. SPRING BLOCK

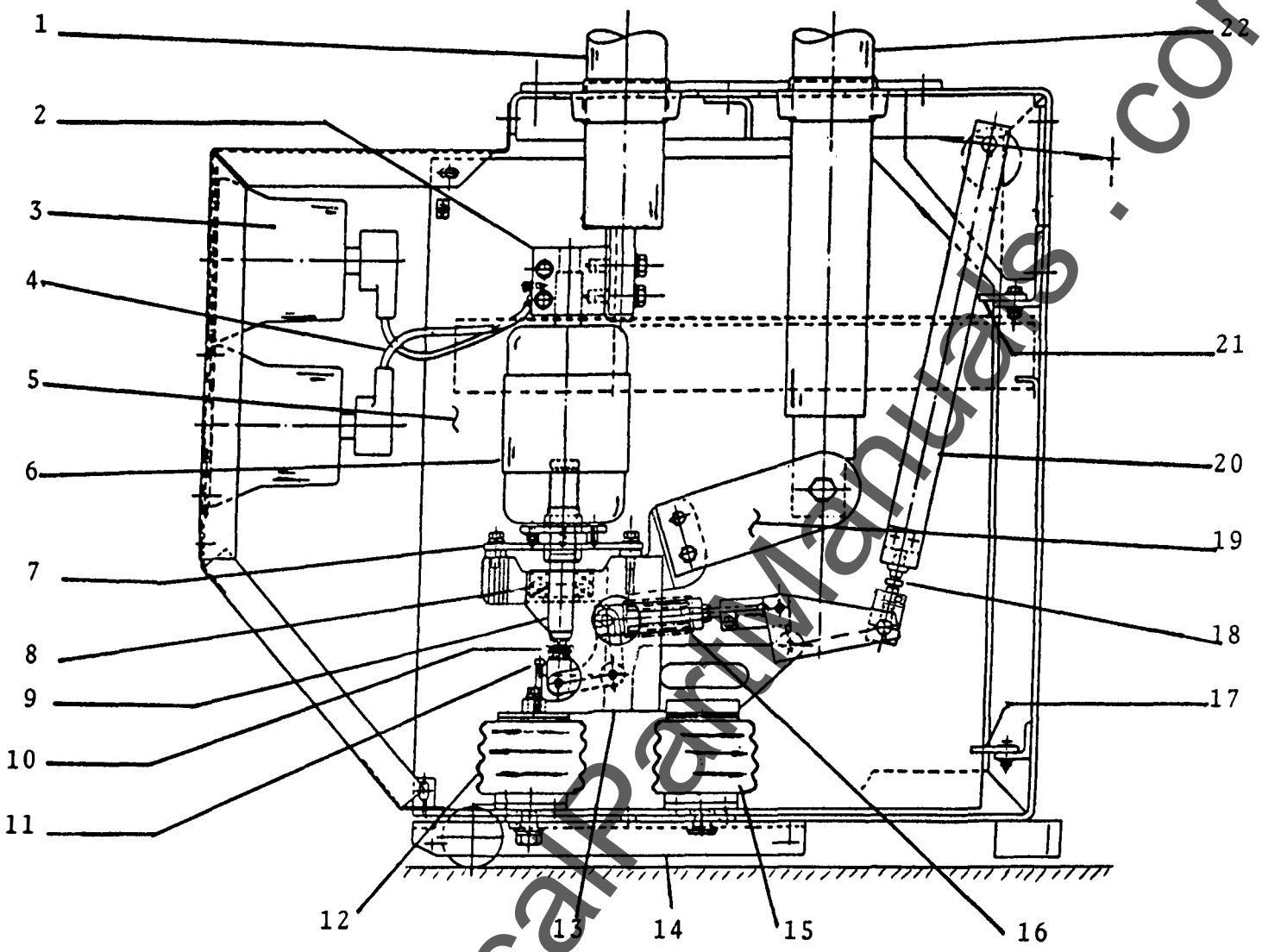
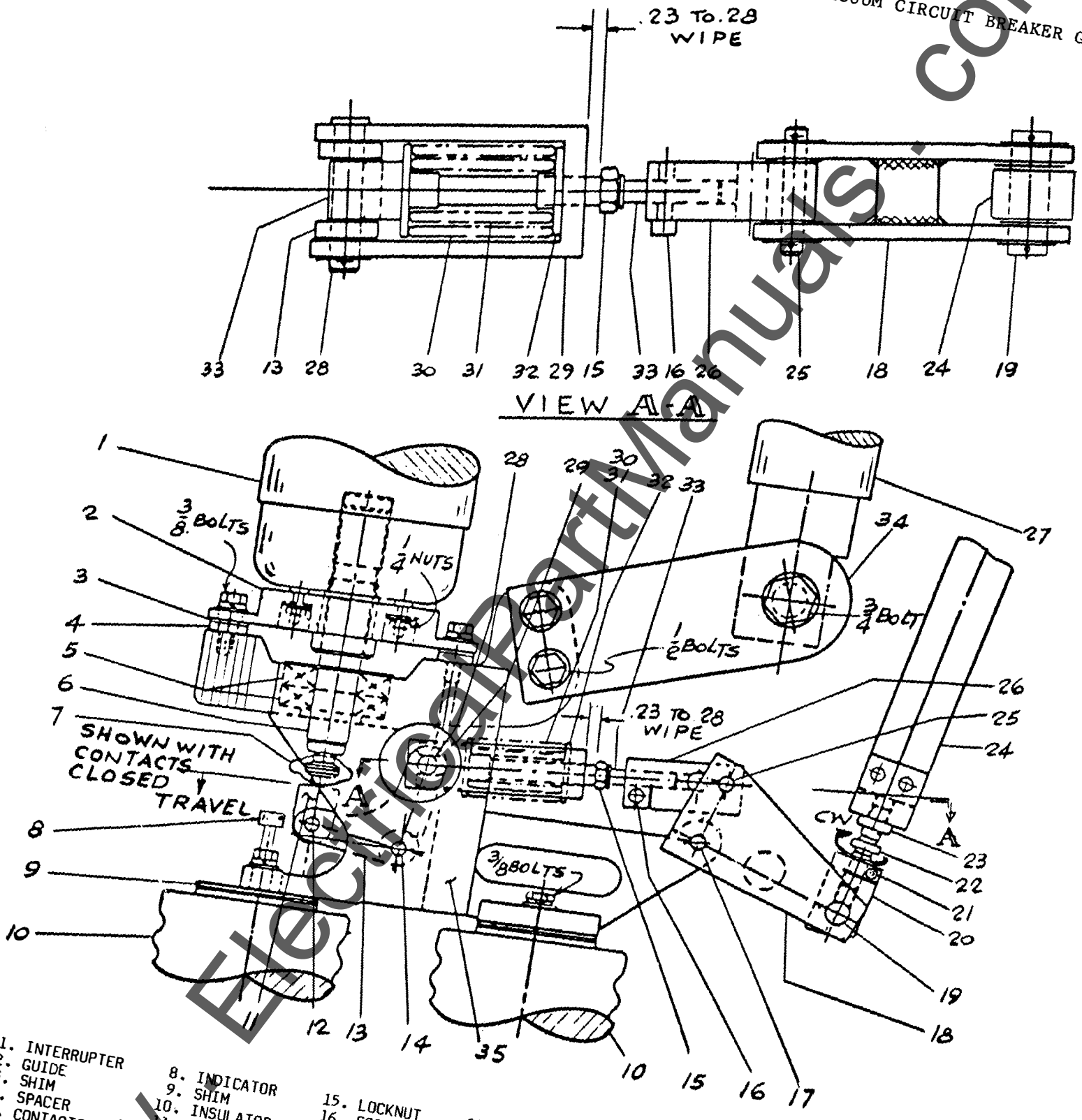


FIGURE 10 CROSS SECTION OF 4.16KV - 250MVA BREAKER (MECHANISM REMOVED)

1. REAR BUSHING
2. CONNECTION BLOCK
3. SURGE SUPPRESSOR
4. SURGE SUPPRESSOR CABLE
5. INTERPHASE BARRIER
6. VACUUM INTERRUPTER
7. GUIDE
8. CONTACT FINGER CLUSTERS
9. MOVABLE CONTACT ROD
10. CLAMP
11. WEAR INDICATOR BOLT
12. REAR INSULATOR
13. WIPE CAGE ASSEMBLY CASTING
14. WHEEL BASE ASSEMBLY
15. FRONT INSULATOR
16. WIPE SPRINGS
17. LOWER BARRIER GUIDE
18. WIPE/GAP ADJUSTMENT NUT
19. CONNECTION BAR
20. OPERATING ROD
21. UPPER BARRIER GUIDE
22. FRONT BUSHING



1. INTERRUPTER
2. GUIDE
3. SHIM
4. SPACER
5. CONTACTS
6. MOVABLE ROD
7. CLAMP
8. INDICATOR
9. SHIM
10. INSULATOR
11. COUPLING
12. PIN
13. CRANK
14. PIN
15. LOCKNUT
16. SCREW
17. PIN
18. CRANK
19. PIN
20. CLEVIS
21. LOCKSCREW
22. ADJUST NUT
23. LOCKNUT
24. OPERATING ROD
25. PIN
26. CLEVIS
27. BUSHING
28. PIN
29. YOKE
30. OUTER SPRING
31. INNER SPRING
32. GUIDE
33. PIN
34. BAR
35. CASTING

FIGURE 11 WIPE CAGE ASSEMBLY (4.16 KV - 250MVA PV-52A)

5.5 CONTACT WIPE AND GAP

Wipe is the additional compression of the pre-loaded wipe springs (30)(31) Figure 11, which is used to apply force to the closed vacuum interrupter contacts.

Gap is the distance between the two vacuum interrupter contacts when the breaker is open.

Wipe and gap are related in such a way that decreasing the wipe increases the gap and increasing the wipe decreases the gap. Therefore, these two adjustments must be coordinated to bring both to within the required settings simultaneously.

Refer to Figure 13. With the breaker open, mark the position of the top of the coupling (3) on an index card (6) while the edge of the card is resting on the surface of the casting (5). Mark and label a different card for each phase.

Close the breaker and block the opening spring with the opening spring blocking tool 0138D3329P023 to prevent accidental tripping and mark the position of the top of the coupling (3) on the index card (6). The distance between the two marks is the contact gap. Measure the contact gap in this manner on all three phases.

While the breaker is still closed and blocked from accidental tripping, measure the wipe distance between the base of the yoke (29) Figure 11 and the locknut (15). A wipe gage 0138D3329P007 (ref. 1 Figure 20) is a go-nogo gage and may be used to check the wipe, rather than taking individual measurements.

Compare the measured wipe and gap distances with those shown is Table II.

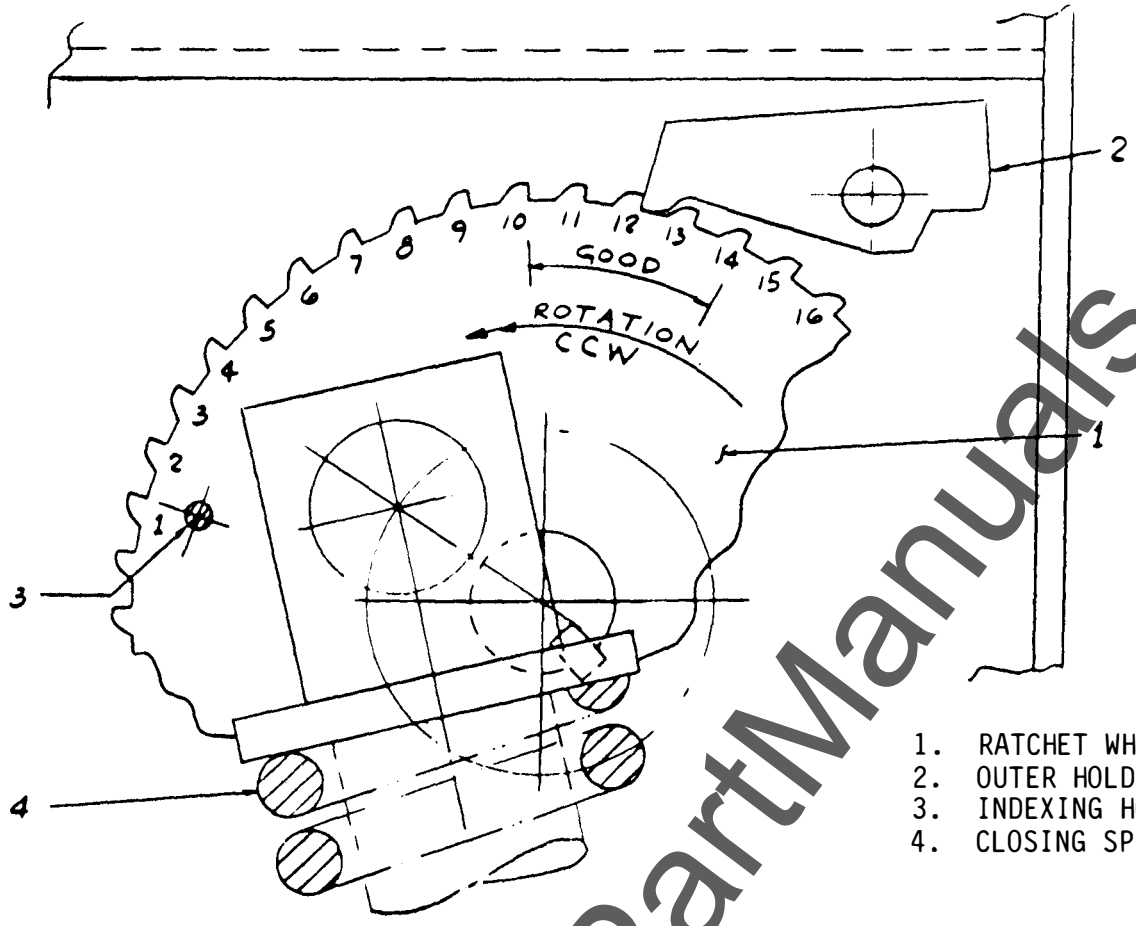
TABLE II

TYPE BREAKER	INTERRUPTER	WIPE	GAP
4.16KV-250-0	PV52A	.23 to .28	.56 to .62

If the wipe, or gap, or both are outside the limits given in TABLE II adjustment is required.

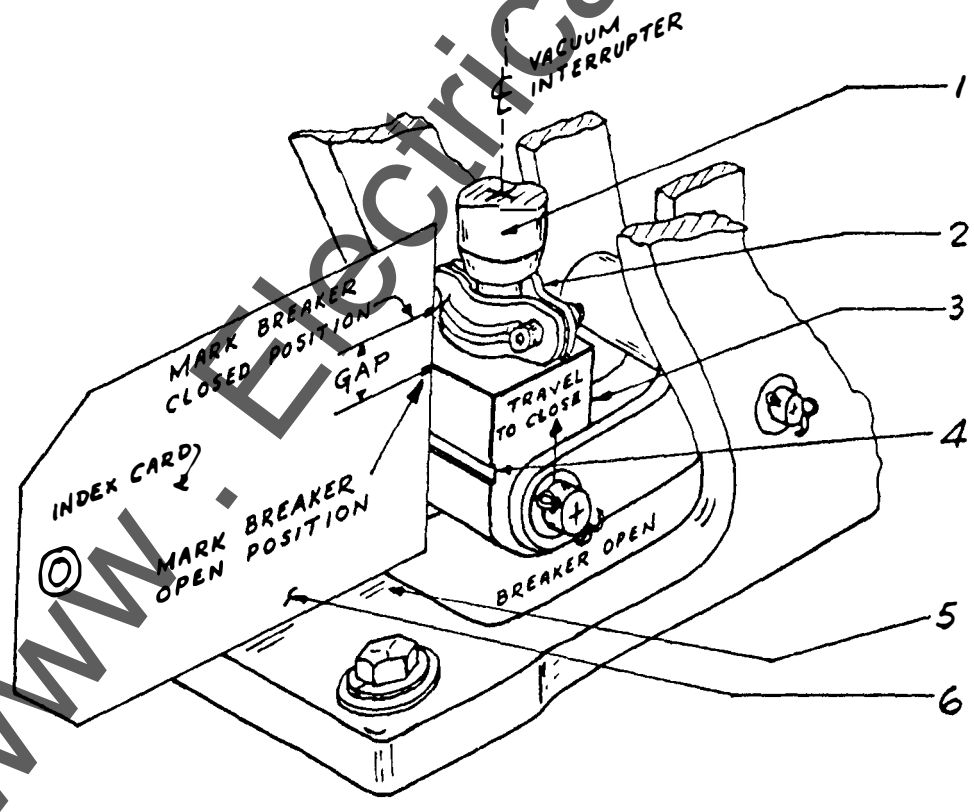
Determine the amount of adjustment required for each phase to bring the wipe and gap within limits. With the breaker still on the closed position refer to Figure 11. To adjust the gap or wipe, loosen lockscrew (21) and locknut (23). Turn adjusting hex (22) clockwise to increase wipe (and reduce gap) and counterclockwise to decrease the wipe (and increase gap). The adjusting hex is designed such that turning the hex 1/6 turn clockwise as shown in Figure 11, results in a .011 increase in wipe (and .011 decrease in gap).

If both the wipe and gap cannot be brought within the limits of TABLE II the total stroke can be adjusted by loosening check nut 19 Figure 9 and turning adjusting plate 20 to increase or decrease the total stoke. However, the clearance between the trip latch (14) Figure 9 and the trip roller (16) must not be reduced to less than .005.



1. RATCHET WHEEL
2. OUTER HOLDING PAWL
3. INDEXING HOLE
4. CLOSING SPRING

FIGURE 12 CLOSING SPRING CHECK AT RATCHET WHEEL



1. MOVABLE OPERATING ROD
2. CLAMP
3. COUPLING
4. EROSION INDICATOR GROOVE
5. CASTING
6. INDEX CARD

FIGURE 13 CONTACT GAP MEASUREMENT

5.6 CLOSING OPERATION CHECK

Refer to Figure 12. With the closing spring fully charged and control power disconnected, release the closing spring energy by pushing the manual close button (6) Figure 1.

The mechanism is closing properly when the number of teeth on the ratchet wheel (1) which pass by the outer holding pawl (2) in relation to an indexing hold (3) is between 10 and 14 teeth.

No adjustment should be necessary but changing the opening spring length could increase or decrease the tooth count. The maximum opening spring length is 7.38 inches.

5.7 OPENING SPRING LENGTH

Refer to Figure 9 View ZZ. The opening spring length is measured from the underside of the top of the spring support (22) to the top of the sliding plate when the breaker is in the open position. This length should be within the limits given in TABLE III.

TABLE III

TYPE BREAKER	OPENING SPRING LENGTH
4.16KV-250-0	7.31 to 7.44

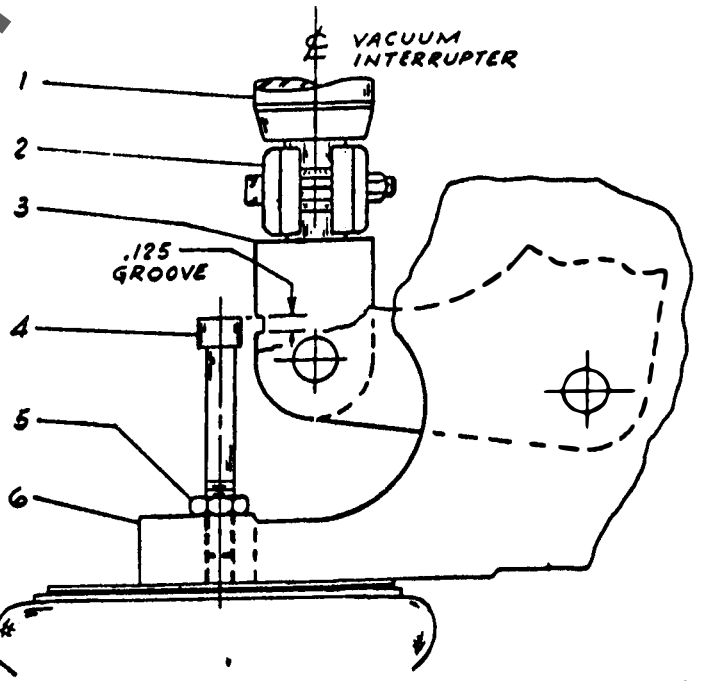
To adjust the spring length remove pin (18), pull spring assembly to a vertical position and turn clevis (17) 1/2 turn at a time to increase or decrease spring length.

5.8 CONTACT EROSION

Refer to Figure 14. In the closed position the top of the indicator bolt (4) will line up with the top of the .125" wide groove in the coupling (3).

Contact erosion will occur as the breaker performs its intended service. Contact erosion will decrease wipe which must be adjusted to within limits in TABLE II as described in Section 5.5. When the bottom of the groove reaches the top of the indicator bolt (4) the vacuum interrupter should be replaced.

Do not adjust the indicator bolt (4) except when installing a new vacuum interrupter, wipe cage assembly or operating rod.



1. MOVABLE CONTACT ROD
2. CLAMP
3. COUPLING
4. INDICATOR BOLT
5. LOCKNUT
6. CASTING

FIGURE 14 EROSION INDICATOR (BREAKER CLOSED)

5.9 DRIVING PAWL ADJUSTMENT

Refer to Figure 16. The driving pawl must advance the ratchet wheel sufficiently on each stroke to allow the latching pawls to fall into the ratchet teeth. This should be checked with the closing spring load against the driving members. With the mechanism unblocked, hand charge the closing springs with the manual charging wrench until they are slightly more than half charged. Slowly rotate the charging wrench until the driving pawl has traveled through its return stroke and check the maximum clearance between the pawl and the ratchet tooth. Rotate the charging wrench until the driving pawl has advanced the ratchet tooth to its maximum travel. Now check the clearance between the ratchet tooth and the latching pawl. The clearance should be approximately equal for both the driving and latching pawls and not less than .015" in either case.

If adjustment is required for either pawl, the springs must first be fully charged and blocked. Loosen seven motor support bolts and move entire motor assembly to the rear if the clearance is under the minimum at the latching pawls, and to the front if the clearance is under the minimum at the driving pawl. Move the motor assembly approximately twice the dimensional increase required at the pawl. Be certain the motor assembly is moved straight forward or rearward and tighten the one bolt on the right side of the mounting frame first to assure proper alignment. After tightening the remaining bolts, the springs should be released and the clearance again checked as described above.

5.10 RELEASE LATCH MONITORING SWITCH

Refer to Figure 8. The release latch must be fully reset and the latch monitoring switch (13) operated before the motor will start. When the latch is fully reset the clearance between the switch striker arm and the switch mounting bracket (14) is 1/32" or less, this can be adjusted by bending the striker arm.

5.11 MOTOR AND RELAY SWITCHES

Refer to Figure 8. With the closing springs blocked rotate the switch cam (2) until the switch striker (3) has traveled the maximum amount (about 180 degrees rotation of cam). At this point the clearance between the striker and the switch support (5) should be 1/32" or less. This can be adjusted by loosening the switch support mounting bolts (4) and rotating the support.

5.12 INTERLOCK SWITCH WIPE

Refer to Figure 6. With the positive interlock in the reset, or normal position the clearance between the interlock switch arm (3) and the switch mounting plate (4) should be 1/32" or less. This can be adjusted by bending the switch arm.

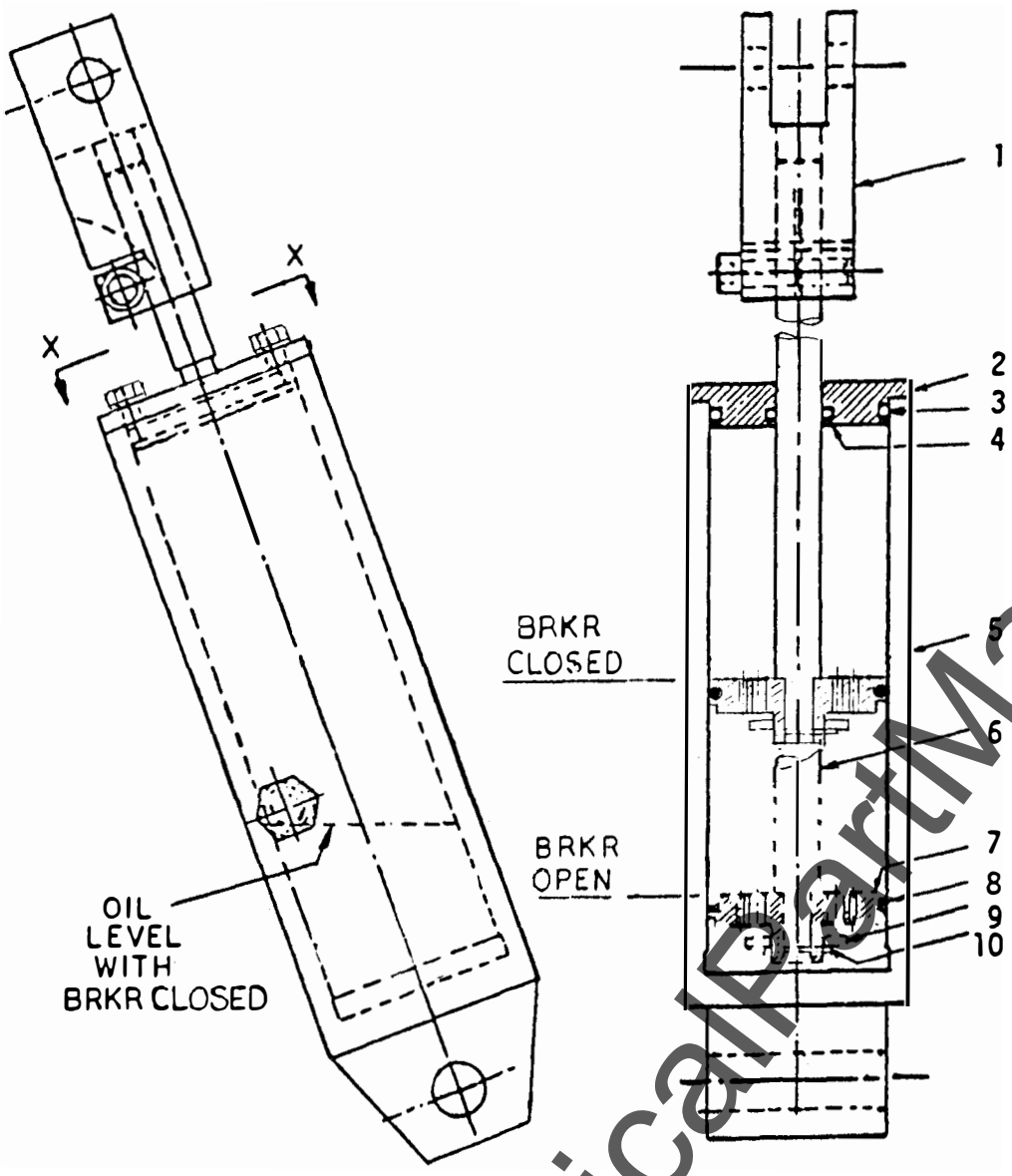


FIGURE 15 DASHPOT ASSEMBLY

5.13 DASHPOT

The dashpot Figure 15 is adjusted to stop the contacts and linkage and limit overtravel to safe limits.

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 oil level should be checked with the breaker in the closed position and the opening springs blocked. The fill plug (11) Figure 15 should be removed and dashpot grade oil as recommended in the lubrication chart should be added to the lower level of the hole. Dashpot action can be checked using a travel recorder such as a "Cincinnati Recorder". An adapter (0114C5314G001) is available for this purpose. To obtain less dashpotting, screw the piston shaft into the coupling. Adjust one-half turn (180°) at a time.

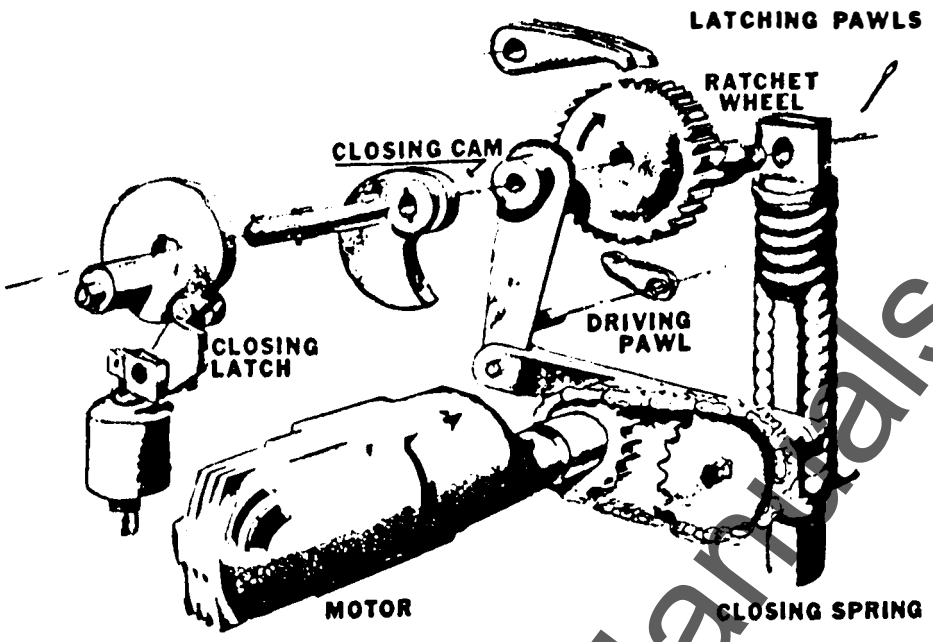


FIGURE 16 SCHEMATIC ML-13C MECHANISM

5.14 INSPECTION AND TEST

For ease in reviewing the adjustments, the following are summarized:

1. Trip Latch Wipe .187 to .250
2. Release Latch Wipe .187 to .250
3. Closing Prop Wipe .187 to .375
4. Latch Checking Switch Contacts make when the gap between the trip latch and the stop is .062 max.
5. Switches - clearance from support .015 to .032
6.

TYPE BKR	WIPE	GAP	OPENING SPRING LENGTH
4.16-250-0	.23 to .28	.56 to .62	7.31 to 7.44

7. Check all nuts, washers, bolts, cotter pins, and terminal connections for tightness.
8. Inspect all wiring to make sure that no damage has resulted during installation, and test for possible grounds or short circuits.
9. See that all bearing surfaces of the mechanism have been lubricated. Refer to the section on LUBRICATION.
10. 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.
11. See that any place where the surface of the paint has been damaged is repainted immediately.
12. Check the trip coil plunger and the release coil plunger to see that they move freely.
13. Check that there is no hardware missing.

6.0 ELECTRICAL CHECKS

6.1 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 close coil, trip coil, and motor terminals. For electrical operation of the mechanism, the control power may be either alternating or direct current. The operating ranges for the closing and tripping voltages are given on the breaker nameplate. The ranges, listed in the table below are standard.

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.

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 (5) Figure 1 or the manual close button (6).

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
AT RATED NORMAL VOLTAGE MAX. MOTOR CHARGING TIME IS 4 SECONDS				

6.2 HIGH POTENTIAL TEST

If high potential tests to check the integrity of the insulation are required, the AC high potential test described is STRONGLY recommended. DC high potential testing is not recommended except for the vacuum interrupter integrity test. The following procedure must be adhered to.

PRIMARY CIRCUIT

BEFORE HIPOTTING THE BREAKER, DISCONNECT THE CABLES (4) FIGURE 10 FROM THE SURGE SUPPRESSORS AT THE CONNECTION BLOCKS (2) AND FOLD THE CABLES AWAY FROM THE INTERRUPTERS AND SECURE WITH TAPE OR STRING.

An AC Hipot Test set capable of producing the test voltages shown below may be used to hipot the breaker.

BREAKER VOLTAGE RATING	TEST VOLTAGE 60 HZ (RMS)
4.16 KV	14 KV
7.2 KV	27 KV
13.8 KV	27 KV

With the breaker contacts open apply the test voltage to each bushing of the breaker individually with the other five bushings and the breaker frame grounded.

Then, with the breaker contacts closed, apply the test voltage to each phase with the other two phases and the breaker frame grounded.

The test set should be connected with its output potential at zero and the voltage increased to the test voltage and maintained for 60 seconds. The voltage should then be returned to zero and the hipot test set disconnected.
NOTE: DO NOT EXCEED THE TEST VOLTAGE INDICATED FOR THE APPLICABLE BREAKER VOLTAGE RATING.

SECONDARY CIRCUIT

To hipot the breaker secondary circuit, circuit, thread a wire through a (16) disconnect pins on the secondary coupler (1) Figure 4. Remove the two motor leads from the 2 point terminal block. Terminal block. Attach the threaded wire to the hihipot machine and increase the voltage to 1125 volts (RMS-60HZ) and maintain for 60 seconds. Reduce the voltage zero and remove all hipot wire and reconnect the motor leads.

6.3 VACUUM INTERRUPTER INTEGRITY TEST

FOR 4.16KV BREAKERS, THIS TEST CANNOT BE PERFORMED WHILE THE VACUUM INTERRUPTER IS ASSEMBLED IN THE BREAKER (REFER TO PARA. 9.1).

The breaker must be in the open position. 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.

CAUTION: DO NOT APPLY VOLTAGE THAT IS HIGHER THAN THE RECOMMENDED VALUE. CONTACT GAP MUST BE WITHIN LIMITS OF TABLE II AS DESCRIBED IN PARAGRAPH 5.5.

During a high potential or 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 specified gap.

Before applying high voltage to the vacuum interrupter disconnect the cables (4) Figure 10 from the surge suppressors at the connection block (2) fold the cables away from the interrupters and secure with tape or string.

This test of the vacuum interrupter will determine its vacuum integrity. With the breaker open individually check each interrupter by connecting the hipot test set "hot" lead to the rear bushing and the ground lead to the front bushing. If the test set has a center point ground, the connections may be made either way. Apply 36kV (rms) 60 Hz or 50KV DC and hold a minimum of five (5) seconds (maximum 10). 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 compare vacuum interrupters by measuring or DC leakage current. There is no significant correlation.

After the high potential voltage is removed, discharge any electrical charge that may be retained by touching both ends with a ground stick.

Reconnect the cables (4) Figure 10 from the surge suppressors at the connection block (2).

CAUTION: MANY DC HIGH POTENTIAL TEST SETS ARE HALFWAVE RECTIFIERS. THIS TYPE OF HIPOT TESTER MUST NOT BE USED TO TEST VACUUM INTERRUPTERS. THE CAPACITANCE OF THE VACUUM INTERRUPTERS 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 READING 40kV. IN THIS CASE, SOME PERFECTLY GOOD VACUUM INTERRUPTERS CAN SHOW A RELATIVELY HIGH LEAKAGE CURRENT SINCE IT IS THE PEAK VOLTAGE OF 120kV THAT IS PRODUCING ERRONEOUS VACUUM INTERRUPTER LEAKAGE CURRENT. IN ADDITION, ABNORMAL X-RADIATION MAY BE PRODUCED.

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

Hipotronics	Model 860PL
Hipotronics	Model 880PL
Hipotronics	Model 7BT60A
James G. Biddle	Catalog 222060

7.0 AUXILIARY DEVICES

7.1 LATCH CHECKING SWITCH

Refer to Figure 17. Charge the closing springs sufficiently to reset the mechanism linkage. Rotate the trip latch (4) by pressing the manual trip lever to open the latch checking switch (2). Allow the trip latch to reset slowly and determine the point at which the contacts are made by using a circuit continuity tester (light indicator, bell set, etc.). The contacts of the latch checking switch should just make when the gap between the trip latch (4) and the stop pin (5) located on the latch roller link (7) is 1/16". There should be a minimum of 1/64" between the switch arm (3) and the switch support (1). To obtain adjustment of the latch checking switch, bend the latch checking switch arm (3).

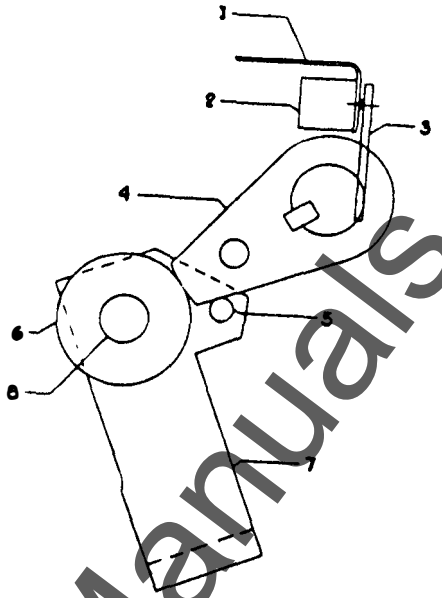


FIGURE 17 (0114C5320) LATCH CHECKING SWITCH

1	SWITCH SUPPORT	5	RESET PIN STOP
2	LATCH CHECKING SWITCH	6	LATCH ROLLER
3	SWITCH ARM	7	LATCH ROLLER LINK
4	TRIP LATCH	8	LATCH ROLLER PIN

7.2 PLUNGER INTERLOCK

Refer to Figure 18. With the breaker in the closed position, the vertical distance "A" from the top of the plunger bolt (1) to the bottom of the breaker lifting rail (3) should be 11- 7/32" to 11- 11/32". To change this adjustment, add or remove washers (2).

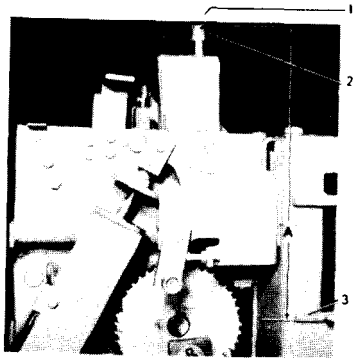


FIGURE 18 (8034464) PLUNGER INTERLOCK

1. PLUNGER BOLT
2. WASHER
3. BREAKER LIFTING RAIL

7.3 AUXILIARY FUSES

Refer to Figure 19. On breakers with "C" suffix, a set of protecting fuses (10) is mounted on the front of the breaker. These fuses are the primary protective devices for the closing control circuit on those breakers that are used in metal-clad units designed for solenoid operated breakers.

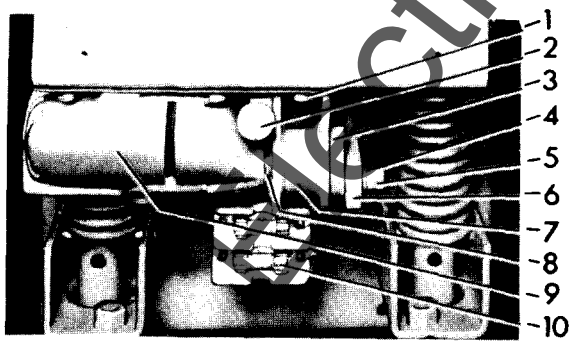


FIGURE 19 (8034471) DRIVING ELEMENTS

1. MOUNTING BOLTS
2. MANUAL CLOSE BUTTON
3. ECCENTRIC
4. RETAINING RING
5. HEX CHARGING STUD
6. DRIVING LINK
7. MOTOR SUPPORT
8. RETAINING RING
9. MOTOR
10. FUSE

7.4 SURGE SUPPRESSORS

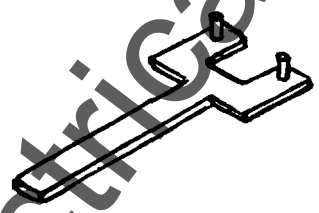
When required GE/Vac™ Vacuum Circuit Breakers have provisions for mounting surge suppressors within the breaker. They are located in the rear of the breaker as shown in Figure 10, Ref. (3).

Surge suppressors are required on circuits utilizing equipment with low BIL ratings such as motors and dry-type transformers. Given the interchangeability feature of GE/Vac™ breakers it is recommended that suppressors be used on all feeder applications.

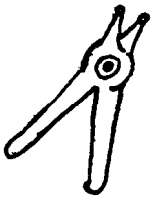
SURGE SUPPRESSORS SUPPLIED WITH GE/Vac™ BREAKERS WILL LIMIT THE PEAK MAGNITUDE OF TRANSIENT VOLTAGE ON THE LOAD TO THE VALUES GIVEN IN TABLE IV.

TABLE IV SURGE SUPPRESSOR PEAK "LET THROUGH" VOLTAGES

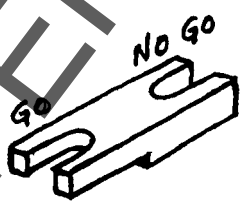
SYSTEM VOLTAGE (KV)	SWITCHGEAR BIL RATING (KV)	SUPPRESSOR "LET THROUGH" VOLTAGE (KV)	SURGE SUPPRESSOR CAT. NO.
4.76	60	9	0209B4555G003
8.25	95	18	0209B4555G002
15	95	30	0209B4555G001



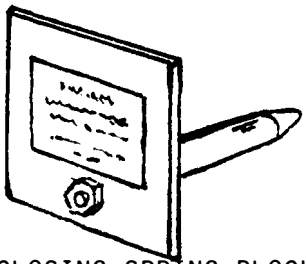
4. SPANNER WRENCH (0258C0630 P028)



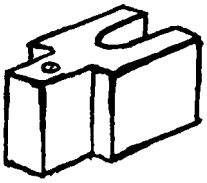
5. RETAINING RING PLIERS (006443282 P001)



1. WIPE GAGE (0138D3329 P007)



2. CLOSING SPRING BLOCK (0138D3329 G005)



3. OPENING SPRING BLOCK (0138D3329 P023)

FIGURE 20 MAINTENANCE TOOLS (0138D3329 G006)

8.0 MAINTENANCE

8.1 GENERAL

GE/Vac™ circuit breakers have been designed to be as maintenance free as practicable. They include features such as sealed vacuum interrupters and quality lubricants which contribute to many years of trouble free performance with a minimum amount of maintenance. When maintenance is required, the linkages and inspection points are readily accessible.

To obtain maximum reliability the breaker should be inspected and maintained on a regular schedule. The breakers are designed in accordance with applicable standards which require that they be capable of performing up to 5000 no load or normal load operations for 1200 ampere breakers and 3000 operations for 2000 ampere breakers before any replacement of parts should be necessary. This requirement is based on the breakers being inspected and serviced every 2000 operations or at least once a year whichever comes first.

The frequency of required maintenance depends on the severity of the service conditions of the switchgear application and should be determined by each operating company. Although it is recommended to inspect and maintain breakers at least once a year, service conditions may be such as to extend maintenance periods. Conditions which would dictate more frequent maintenance intervals are conditions of corrosive or salt atmosphere, conductive or abrasive dust, high relative humidity (>90%), temperature extremes (<-30°C, >40°C) or vibration or mechanical shock.

8.2 CONTACT EROSION

Interrupter contact erosion varies with interrupting current levels. Low level interruptions cause very low erosion rates. Fault current interruptions between 80% and 100% of rating result in maximum erosion rates. After 15 fault operations above 80% of rating the the following should be performed.

1. Contact erosion per paragraph 5.8.
2. Wipe and gap checks per paragraph 5.5.
3. Vacuum interrupter integrity test per paragraph 6.3.

WARNING

BEFORE ANY MAINTENANCE WORK IS PERFORMED, MAKE CERTAIN THAT ALL CONTROL CIRCUITS ARE DE-ENERGIZED AND THAT THE BREAKER IS REMOVED FROM THE METAL-CLAD UNIT.

DO NOT WORK ON EITHER BREAKERS OR MECHANISM UNLESS THE CLOSING SPRING AND THE OPENING SPRING HAVE BEEN DISCHARGED. THIS MEASURE IS REQUIRED TO PREVENT ACCIDENTAL CLOSING OR TRIPPING. DO NOT WORK ON ANY PART OF THE BREAKER OR MECHANISM WITH THE TEST COUPLER ENGAGED.

8.3 RECOMMENDED MAINTENANCE

The following operations should be performed at each maintenance period.

1. Perform a visual inspection of the breaker. Check for loose or damaged parts.
2. Check the contact erosion indicator and the wipe and gap measurements per paragraph 5.8 and 5.5.
3. Perform the vacuum interrupter integrity test per paragraph 6.3.
4. Check that all strikers for operating the interlock switches are adjusted to a clearance of 1/64 to 1/32" between the striker and the support.
5. Wipe all insulating surfaces clean with a lint free dry cloth or industrial wiper. Clean the barriers, primary bushing studs, porcelain insulators, operating rods and the vacuum interrupters.
6. Make a careful inspection of the mechanism 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 per paragraph 8.4 and perform a slow closing operation to verify that the mechanism operates freely throughout its stroke. Check all control wire terminal connections. Finally make all the mechanical checks described under Adjustments in paragraph 5.

8.4 LUBRICATION

In order to maintain reliable operations, 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 V require lubrication. These have 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 similiar 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 oxidation.

8.5 METHOD OF CLEANING BEARINGS

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

1. SLEEVE BEARINGS

The breaker sleeve bearings located in the driving element and the mechanism linkage and frame should be cleaned and relubricated with GE D50H15 lubricant at general overhaul periods. This includes the bearings in the driving pawl (3) Figure 5, latching pawls (2), cranks, and the bearings in the mechanism frame and interconnecting links. Bearings that are pressed into the frame or other mechanism members should not be removed. The main shaft bearings should be removed, cleaned, and lubricated with GE D50H15 lubricant at general overhaul periods.

2. ROLLER & NEEDLE BEARINGS

The cam follower roller (12) Figure 9 and latch roller bearing (16) should be first removed from the mechanism and the inner race disassembled. They should then be placed in a container of clean petroleum solvent or similiar cleaner. 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 inductive 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 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.

8.6 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.

TABLE V

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 coated 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 fingers.	Wipe clean and apply D50H47.	Wipe clean and apply D50H47.
Dashpot	Check oil level add oil if necessary. Fill to level of plug hole in side cylinder. Use Univis J-13 (D50H27) dashpot oil with the breaker in the closed position.	Check oil level add oil if necessary. Fill to level of plug hole in side of cylinder. Use Univis J-13 (D50H27) dashpot oil with the breaker in the closed position.

9.0 REPAIR AND REPLACEMENT

The following information covers the proper method of removing and replacing various elements of the breaker.

Upon completion of any kind of repair work the mechanical and electrical checks described under ADJUSTMENTS in Section 5 MUST BE MADE.

9.1 INTERRUPTERS

Refer to Figures 10 and 11. To replace the interrupter, it is first necessary to close the breaker contacts to "K" point (that point where the contacts first touch). This is done to take the load off the pins to allow easier removal. To close the breaker contacts to the "K" point, follow the slow-close procedure described in paragraph 3.3 but stop at the "K" point as indicated by a bell set or light set across the front and rear bushings (22) and (1) Figure 10.

1. Disconnect the cables (4) at the blocks (2) and remove the complete surge suppressor and support assembly.
2. Remove the (2) 1/2-13 bolts holding the connection block (2) Figure 10 to the rear bushing (1).
3. Remove pin (19) Figure 11 after noting the quantity and location of the washers.
4. Remove the 3/4-10 bolt holding the connection bar (34) Figure 11 to the front bushing (27).
5. Remove the (4) 3/8-16 bolts holding the casting (35) Figure 11 to the porcelain insulators (10). Be careful to keep the shims used between the casting and insulators in place.
6. Slide the interrupter and wipe cage assembly to the rear and remove to a bench where the assembly can be secured.
7. Remove the clamp (7) Figure 11.
8. Remove the (2) 3/8-16 bolts holding the guide (2) Figure 11 to the casting (35).
9. Remove the interrupter (1) Figure 11 with its guide (2) attached from the sliding contacts (5) held in the casting (35). Remove by pulling straight up with a minimum of rocking.
10. Disassemble the guide (2) Figure 11 from the interrupter (1) by removing the (3) 1/4-20 nuts.
11. Remove the (2) 3/8-16 clamping bolts holding the connections block (2) Figure 10 to the stationary end of the interrupter (6).
12. It may be necessary to spread the connection block (2) Figure 10 in order to reassemble it on the stationary end of the new interrupter and do not tighten the (2) 3/8-16 clamping bolts.
13. Reassemble in the reverse order.
    A. Connection block 2 Figure 10
    B. Interrupter guide 2 Figure 11
    C. Interrupter & guide 1 Figure 11
    D. Clamp 7 Figure 11
    E. Slide assembly into breaker
    F. Line connection bar 34 Figure 11 with contact surface
    G. Pin and washers 19 Figure 11
14. Tighten the hardware in the following order:
    A. 3/4-10 bolt at front bushing
    B. (2) 1/2-13 bolts holding connection block (2) Figure 10 to rear bushing (1).
    C. (4) 3/8-16 bolts holding casting (35) Figure 11 to insulators (10)
    D. (2) 3/8-16 bolts holding the guide (2) Figure 11 to the casting (35) checking that the original shims (3) and spacers (4) are in place.
    E. (2) 3/8-16 clamping bolts in the connection block (2) Figure 10.
15. Before putting the breaker into service operate it approximately 100 times and perform the vacuum interrupter integrity test and wipe and gap checks per paragraphs 6.3 & 5.5.
16. After 100 operations the contacts will be seated and the erosion indicator bolt can be reset. Refer to Figure 14. Loosen the locknut (5) and adjust the bolt (4) to line up with the top edge of the .125 groove in the coupling (3) with the breaker closed. Tighten the locknut (5).
17. Reassemble surge suppressor assembly and reconnect cables.

9.2 BUSHINGS

IMPORTANT: DO NOT REMOVE ALL SIX BUSHINGS AT ONCE. The bushings have been carefully alligned 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 metalclad 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 metalclad 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.

9.3 INTERLOCK SWITCH

To remove the two interlock switches (2) Figure 4, remove the two mounting screws and disconnect the wires. Reassemble in the reverse order and check the switch adjustment as explained under ADJUSTMENTS.

9.4 CLOSING LATCH MONITORING SWITCH

To remove the closing latch monitoring switch (13) Figure 8 remove the bolts and disconnect the wires. Reassemble in the reverse order and check the adjustments as explained under ADJUSTMENTS.

9.5 TRIPPING LATCH CHECKING SWITCH

To remove the tripping latch switch (1) Figure 8 remove the mounting screws and disconnect the wires. Reassemble in the reverse order and check the switch adjustments as explained under ADJUSTMENTS.

9.6 MOTOR, RELAY & LIGHT SWITCHES

To remove these switches (7) Figure 8, remove the mounting screws and disconnect the wires. Reassemble in the reverse ordr and check the switch adjustments as explained under ADJUSTMENTS.

9.7 SPRING RELEASE & TRIP COILS

The spring release coil (15) Figure 8 and the trip coil (6) Figure 4 can be replaced as follows:

1. Cut the wires close to the coil.

2. Remove two coil support mounting bolts.

3. When replacing the coil be sure to note the quantity and position of the fiber spacers on both ends before bolting supports in place.

4. Be certain the armature is centered in the coil and not binding.

5. Butt connect wires and check operation of solenoid electrically and mechanically.

9.8 CHARGING MOTOR

Refer to Figure 6. To replace the spring charging motor remove the four mounting bolts from the motor mount. Withdraw the motor from the eccentric. Reassemble in the reverse order and be careful to align the motor so that the motor shaft is free to turn.

10.0 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.

Table VI provides a list of recommended spare parts in the event that repairs to the breaker are needed.

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.

RENEWAL PARTS REFERENCES

NAME	TITLE	PHONE

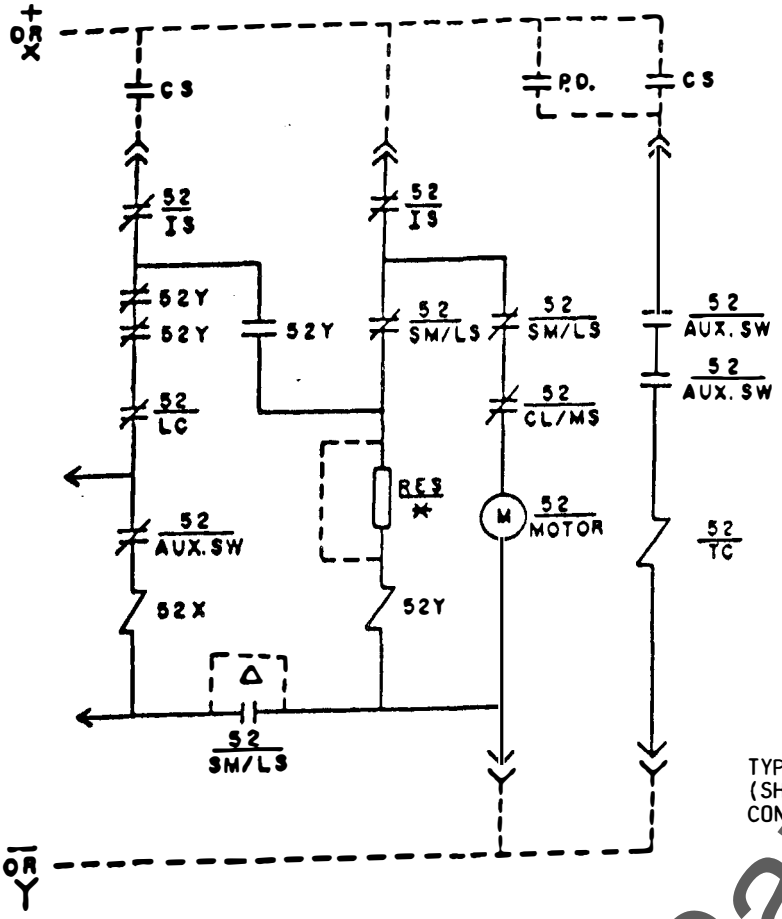
TYPE BREAKER	DASH NO.	SERIAL NO.	RATED VOLTAGE	CONT. CURRENT	CONTROL VOLTAGE	INTERRUPTER TYPE

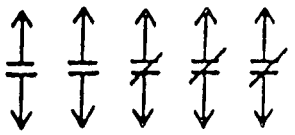
TABLE VI

RECOMMENDED RENEWAL PARTS FOR TYPE VVC VACUUM BREAKERS WITH ML-13C STORED ENERGY MECHANISM.

FIG. NO.	REF. NO.	NO. REQ'D.	DESCRIPTION	CATALOG NO. ◆	
6	6	1	SPRING CHARGING MOTOR -**		
			48 V-DC	018487360 G001	
			110 & 125 VDC & 115 VAC 60 HZ	018487360 G002	
			220 & 250 VDC & 230 VAC 60 HZ	018487360 G003	
8	17	1	RELAY -**		
			24 VDC	0137A7575 P006	
			48 VDC	0137A7575 P004	
			110 & 125 VDC	0137A7575 P001	
			220 & 250 VDC	010885565 G001	
			115 VAC 60 HZ	0137A7575 P005	
			230 VAC 60 HZ	0137A7575 P002	
4	6	1	POTENTIAL TRIP COIL -**		
			48 VDC	006174582 G034	
			110 - 125 VDC	006174582 G001	
			220 - 250 VDC	006174582 G002	
8	16	1	CLOSING COIL -**		
			48 VDC	006174582 G034	
			110 - 125 VDC	006174582 G001	
			220 - 250 VDC	006174582 G002	
			115 VAC 60 HZ	006174582 G010	
			230 VAC 60 HZ	006174582 G014	
6/8	5/1,7,13	5	SWITCH NORMALLY OPEN	0456A0866 P005	
8	7	1	SWITCH NORMALLY CLOSED	0456A0866 P006	
4	4	1	AUXILIARY SWITCH	0137A9192 G011	
5	3	1	DRIVING PAWL SPRING	0161A4241 P001	
3	2	2	LATCHING PAWL SPRING	0161A5909 P001	
			POWER/VAC* INTERRUPTERS	CATALOG NO.	TYPE
			4.16KV-250 - 1200/2000A-0	0186L0739 P054	PV52A
			7.2KV-500 - 1200/2000A-1		
			13.8KV-500 - 1200/2000A-1		
			13.8KV-500B - 1200/2000A-1		
			13.8KV-750 - 1200/2000A-1		

* REGISTERED TRADEMARK OF THE GENERAL ELECTRIC CO.
** REFER TO BREAKER NAMEPLATE OR SUMMARY FOR PROPER VOLTAGE.





SPARE CONTACTS ON $\frac{52}{\text{AUX. SW}}$

*· REQUIRED FOR 220 & 250V-dc OPERATION ONLY.

Δ CONTACTS FURNISHED AS REQUIRED.

TYPICAL ELEMENTARY WIRING FOR GEVAC VACUUM BREAKER (SHOWN WITH THE BREAKER CONTACTS OPEN AND THE CONTROL CIRCUIT DEENERGIZED).

	FIG. NO.	REF. NO.	DESCRIPTION
$\frac{52}{\text{AUX. SW}}$	4	4	AUXILIARY SWITCH
52X	8	16	CLOSING COIL (SPRG. REL. SOL'D)
52Y	8	17	CONTROL RELAY
$\frac{52}{\text{TC}}$	4	6	TRIP COIL
$\frac{52}{\text{IS}}$	6	5	INTERLOCK SWITCHES
$\frac{52}{\text{CL/MS}}$	8	13	CLOSING LATCH MONITORING SWITCH
$\frac{52}{\text{SM/LS}}$	8	7	POWER SWITCHES
$\frac{52}{\text{LC}}$	8	1	LATCH CHECKING SWITCH
$\frac{52}{\text{MOTOR}}$	7	1	SPRING CHARGING MOTOR