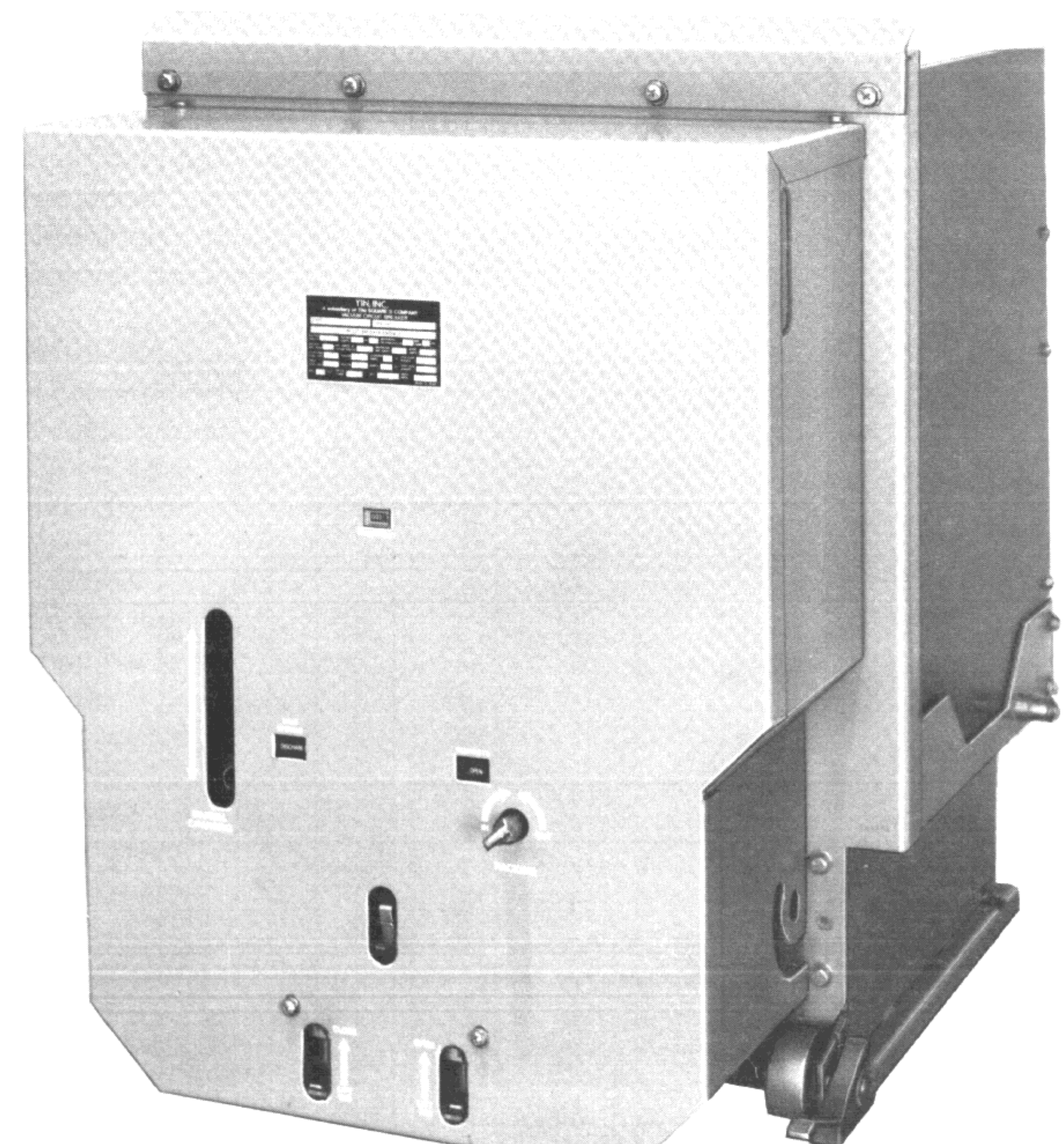
September, 1983

Manual 6080-1

Installation & Maintenance Manual

VACARC™
Vacuum Circuit Breaker
Type VAD

• INSTALLATION • OPERATION • MAINTENANCE



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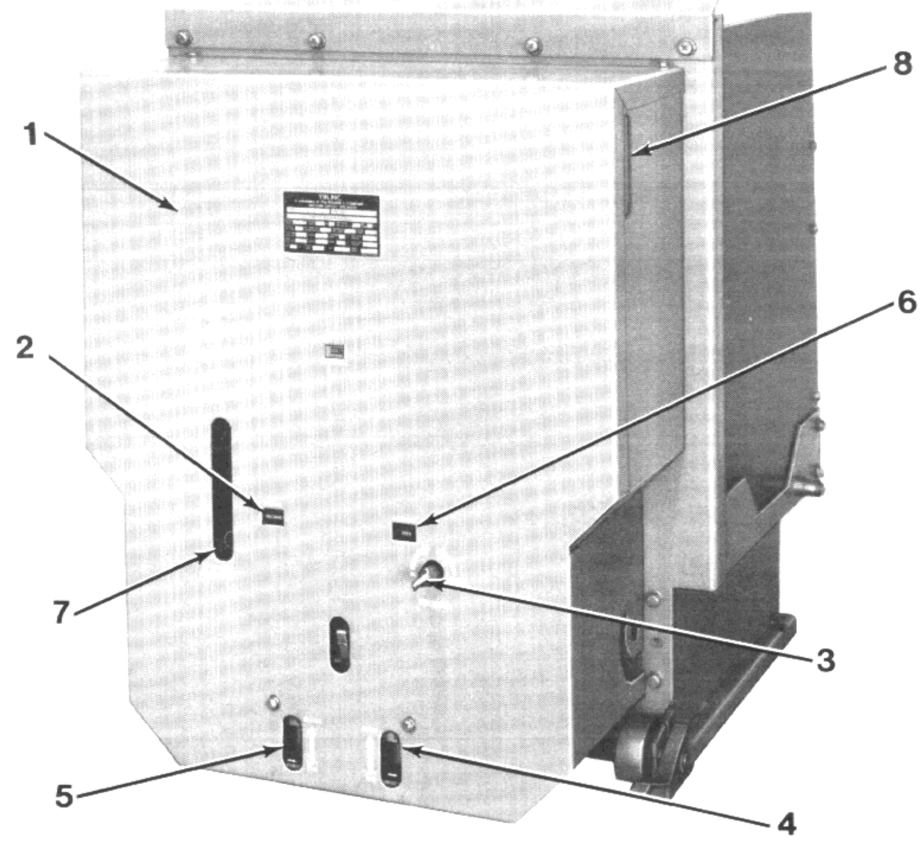
Type VAD Vacuum Circuit Breaker



1. FRONT MECHANISM COVER
2. CHARGE-DISCHARGE INDICATOR
3. RACKING SHAFT
4. OPEN LEVER
5. CLOSE LEVER
6. OPEN-CLOSE INDICATOR
7. MANUAL CHARGING ARM
8. HANDLE HOLES

Figure 1

1. INTRODUCTION

This manual provides installation, operation and maintenance instructions for all models of this series of horizontal drawout vacuum circuit breakers. Available in all standard ratings and meeting or exceeding all applicable industry standards, these breakers provide three-cycle interruption, long switching life ease of operation and maintenance.

1.1 Receiving

Upon receipt, by the customer, the entire breaker should be inspected for damage that may have occurred in transit. All items should be checked against the packing list provided. The transportation company and the manufacturer should be notified of damages or shortages.

1.2 Handling

Use care when uncrating and handling the breaker. NEVER USE THE PRIMARY DISCONNECTS AS HANDLES. Roll and maneuver the breaker by grasping the handle holes (Figure 1, 8) at the sides of the front mechanism cover (Figure 1, 1). When using a fork lift or hoist, lift the breaker by the strong points of the frame to prevent damage.

1.3 Storage

If the breaker must be stored before it is put into operation, keeping it in a place that is clean, dry and free of corrosive elements and mechanical abuse is absolutely necessary. Coat all bare metal surfaces with grease to prevent rusting.

The manufacturer recommends that the breaker be put in its permanent location as soon as possible. If the breaker is to function in outdoor switchgear, install it only when power is available and heaters are operating.

Breakers that must be stored for prolonged periods should be inspected regularly for rusting and overall condition. Greasing should be performed when necessary.

2. INITIAL BREAKER PREPARATION

The following describes the steps that are necessary to prepare the breaker for installation into its cubicle:

1. Examine the entire breaker.

2. Use a clean, dry cloth to remove dirt and moisture that may have collected on the outside of the vacuum interrupters (Figure 3, 8) and all insulating parts.

3. Cycle the breaker manually several times and check for proper operation. This is accomplished by using the handle end of the racking bar (supplied with the breaker) to move the manual charging arm (Figure 1, 7) up and down until the drive springs (Figure 2, 1) are fully charged. The drive springs are fully charged when the charge-discharge indicator (Figure 1, 2) reads "charged" and the manual charging arm can no longer be raised.

4. Electrically operate the breaker several times and check for proper operation.

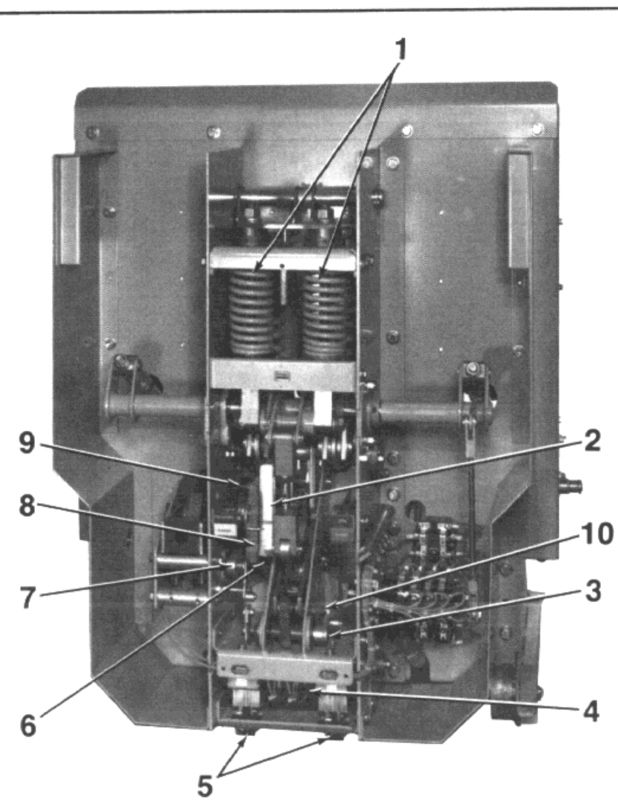
5. To assure that damage has not occurred during shipment, perform a hipot test on each vacuum interrupter while the breaker is in the open position. Gradually raise the voltage to the proper level. The hipot test voltage should be 19kV rms for a 4.16kV class breaker; 36kV rms for a 7.2kV or 13.8kV class breaker; or 60kV rms for a 23kV class breaker. The contact gap should sustain this potential for 1 minute. If the vacuum interrupter fails, it must be replaced. Observe the following instructions when performing the hipot test:

a) Do not exceed the preceding voltages.
b) Do not test interrupters with open gaps less than ½-inch.
c) All persons should stay at least 6 feet away from the vacuum interrupter under test.
d) Perform tests only when all insulating parts are installed.
e) Discharge to ground the primary disconnects (Figure 3, 5) and vacuum interrupter mid-band ring before handling. These areas can retain a static charge after a hipot test.

6. Insert the breaker into its cubicle by following any applicable directions provided by the cubicle manufacturer. The breaker is completely racked into its cell by using the racking handle, supplied with the breaker, to turn the racking shaft (Figure 1, 3) clockwise until the racking shaft turns freely and breaker motion has stopped.

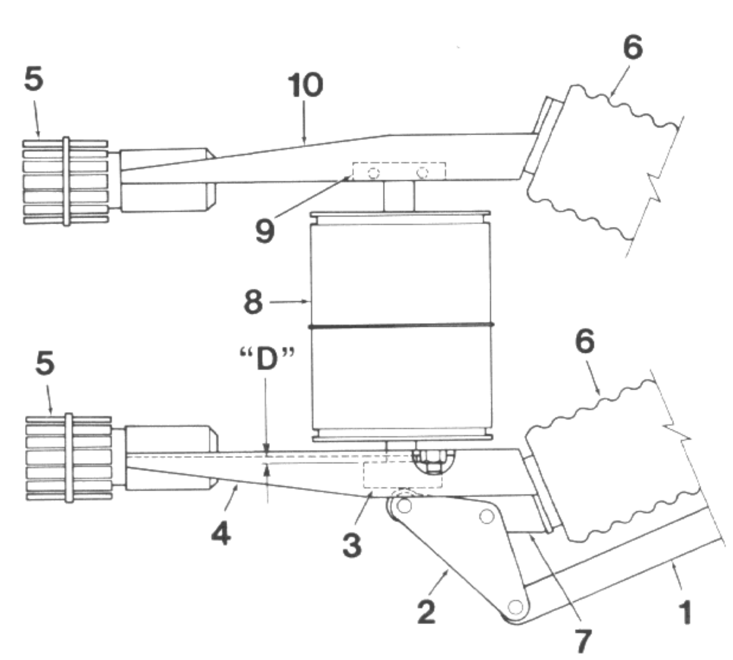
7. With the main power off, cycle the breaker several times and check for proper operation.

8. The breaker is now ready for normal operation.



1. DRIVE SPRINGS
2. LIFT ARM
3. TRIP OPENING ARM
4. CHARGING MOTOR
5. SPRING DISCHARGE INTERLOCKS
6. LIFTING ROLLER
7. TRIP CLOSING CAM
8. DRIVE LEVER
9. TRIP CLOSING ROLLER
10. LATCH CHECK SWITCH (OPTIONAL)

Figure 2



1. CONNECTING LINK
2. PIVOT WING
3. FRONT TERMINAL CLAMP
4. BOTTOM BUS BAR
5. PRIMARY DISCONNECT
6. STANDOFF INSULATOR
7. PIVOT BASE
8. VACUUM INTERRUPTER
9. REAR TERMINAL CLAMP
10. TOP BUS BAR

Figure 3

3. VACUUM CIRCUIT BREAKER — DESCRIPTION

3.1 Vacuum Interrupters

Interruption in the vacuum circuit breakers is performed by the vacuum interrupters (Figure 3, 8) mounted vertically within the breaker frame. Consisting of a pair of butt contacts, one movable and one fixed, hermetically sealed in a high vacuum, these interrupters require only a short contact gap for circuit interruption. The resulting high operating speed allows the entire operating sequence, from fault to clear, to be consistently performed in three cycles or less. The possibility of restriking is minimized because the dielectric strength of the vacuum gap recovers more rapidly than the rate of rise of the applied voltage.

3.2 Primary Disconnects

The primary connection to the associated switchgear are made through the six primary disconnects (Figure 3, 5) mounted horizontally at the rear of the breaker. Take care to insure that the primary disconnects do not receive rough treatment. NEVER USE THE PRIMARY DISCONNECTS AS HANDLES WHEN MANEUVERING THE BREAKER.

3.3 Operating Mechanism

The operating mechanism is of the stored energy type employing charged springs to perform breaker opening and closing functions. The operating mechanism contains all necessary controls and interlocks. It is mounted at the front of the breaker so that it can be easily accessed for inspection and servicing. Opening and closing can be performed electrically or manually.

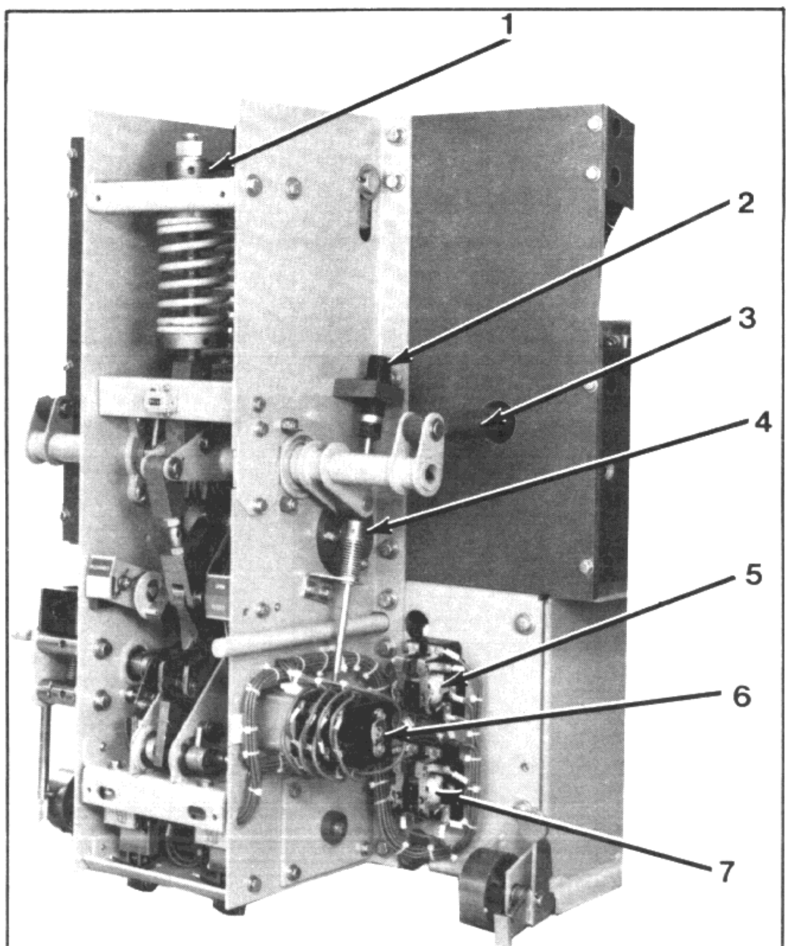
3.4 Control Circuitry

A typical schematic diagram for the control circuitry of the circuit breaker is presented in Figure 16. The following describes the operation of the various components of the control circuitry.

3.4.1 Auxiliary Switch

The auxiliary switch (Figure 4, 6) is a multi-stage switch used to operate those circuits which are dependent upon either the position of the breaker contacts or the position of the drive springs (Figure 2, 1). The schematic diagram of Figure 16 indicates how each of the auxiliary switch stages are interconnected with the breaker circuitry. The function of each stage is as follows:

a. Two a-type auxiliary contacts are connected in series with the trip solenoid (TC). (NOTE: For 250VDC control, three a-type contacts are employed.) Since these stages are open when the breaker is in the open position, the auxiliary contacts prevent the trip solenoid from being energized when the breaker is in the open position.
b. The b-type contact, connected in series with the closing solenoid, disables the closing solenoid when the breaker contacts are in the closed positon.
c. For user convenience in indicating the position (opened or closed) of the breaker contacts, Figure 16 indicates how a green light (contacts open) and a red light (contacts closed) can be connected to the breaker control circuitry.
d. Typically two b-type contacts and one a-type contact are connected to the secondary disconnect, as shown in Figure 16, for optional use. (In the case of ANSI DC close, DC trip circuitry an additional a-type contact is provided. Other variations can occur depending upon latch check switch and other optional requirements. Consult the cubicle manufacturer's diagrams where necessary.)



1. RETURN SPRING STOP
2. SHOCK ABSORBER
3. DRIVE CONNECTING LINK
4. SHOCK ABSORBER ROLLER
5. MOTOR RELAY
6. AUXILIARY SWITCH
7. ANTI-PUMP RELAY

Figure 4

3.4.2 Charging Motor Limit Switch

The charging motor limit switch (Figure 5, 4) energizes the motor relay (Figure 4, 5) when a drive spring charging operation is required and de-energizes the motor relay when the drive springs (Figure 6, 1) reach the fully charged positiion. As shown in the schematic diagram of Figure 16, the charging motor limit switch (LS) is connected in the normally open position. Whenever the drive springs are not in the fully charged position, the charging motor limit switch cam (Figure 5, 5) actuates the charging motor limit switch. The cam allows the switch to assume its normally open position once the drive springs are fully charged.

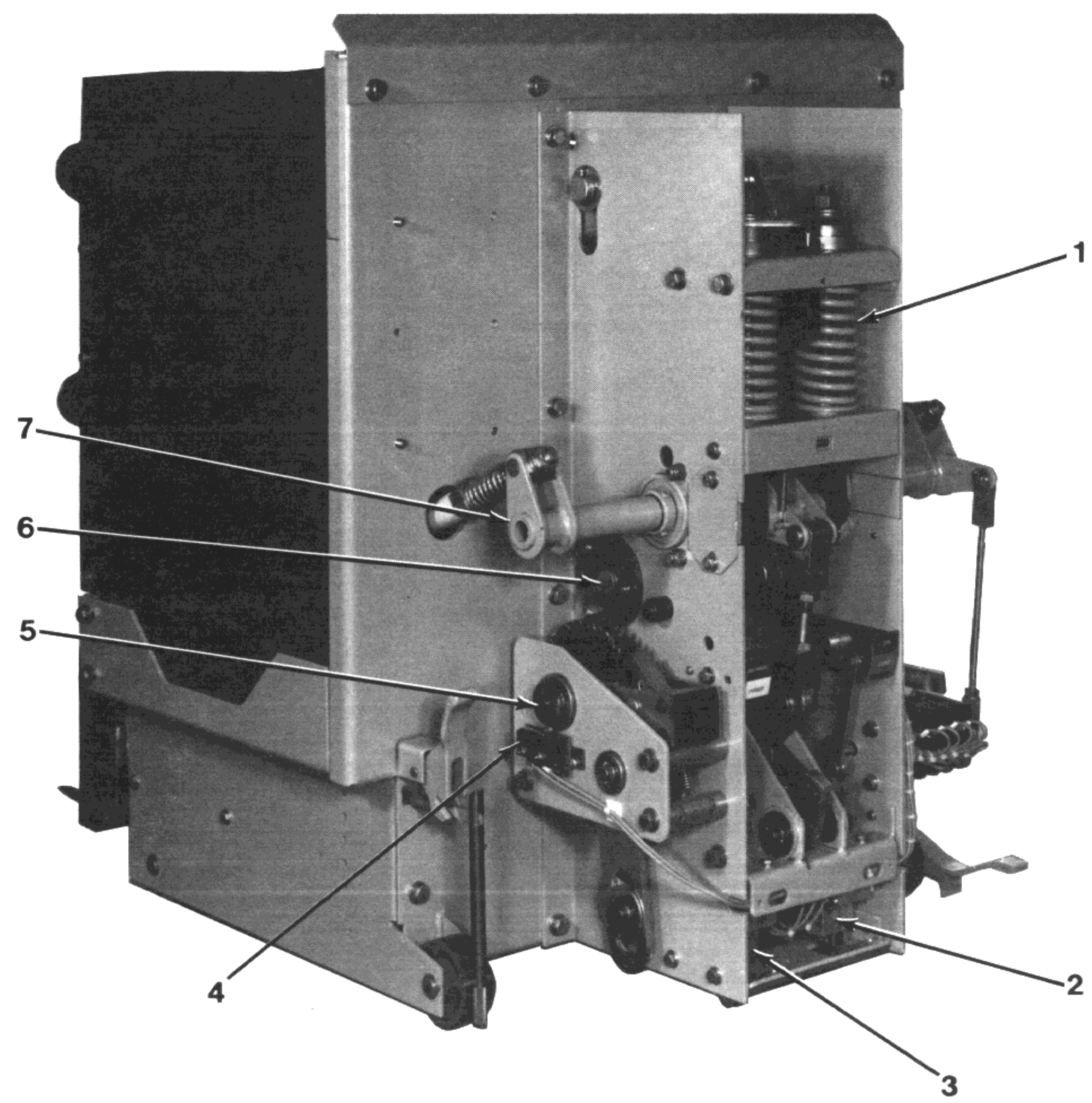
3.4.3 Motor Relay

When energized by the closing of the spring charging motor limit switch (LS), the motor relay (MR) energizes the spring charging motor (M) through a pair of normally open contacts and disables the closing solenoid (X) through a pair of normally closed contacts.

3.4.4 Anti-Pump Relay

The anti-pump relay insures that, should the control switch (CS/C), which energizes the closing solenoid, be continuously maintained in the closed position, the springs will not be continuously charged and discharged. The anti-pump relay performs this function by allowing the closing solenoid to be energized only if the control switch (CS/C) is closed after the drive springs have reached the fully charged position and the motor relay (MR) has been de-energized.

The anti-pump relay will be energized if the control switch (CS) is closed and the motor relay (MR) is energized. If the control switch is held continuously, the anti-pump relay will be latched in the energized position after the motor relay is de-energized by a pair of its own normally open contacts. When the anti-pump relay is energized, a pair of its normally closed contacts, in series with the closing solenoid, insure that the closing solenoid cannot be energized by the control switch. The closing solenoid cannot be energized unless the control switch is first opened (de-energizing the anti-pump relay), then closed again.



1. RETURN SPRING
2. OPENING SOLENOID
3. CLOSING SOLENOID
4. CHARGING MOTOR LIMIT SWITCH
5. CHARGING MOTOR LIMIT SWITCH CAM
6. DRIVE SHAFT
7. MAIN SHAFT

Figure 5

3.4.5 Latch Check Switch (Optional)

The latch check switch (LC) (Figure 6, 10) normally open contacts are in series with the closing solenoid coil to insure that in the event of either an electrical or mechanical malfunction of the trip mechanism, the closing circuit is rendered inoperative. (NOTE: In some cases an auxiliary LC contact (optional) is wired to the secondary disconnect).

3.5 Indicators

Two indicators are provided on the operating mechanism. The open-close indicator (Figure 9, 6) designates the position of the vacuum interrupter contacts. The charge-discharge indicator (Figure 9, 2) displays the state (charged or discharged) of the drive springs (Figure 6, 1).

3.6 Manual Charging Arm

The drive springs (Figure 6, 1) can be manually charged by using the handle end of the racking bar (supplied with the breaker) to move the manual charging arm (Figure 9, 7) up and down until the drive springs are fully charged. The drive springs are fully charged when the charge-discharge indicator (Figure 9, 2) reads charged and the manual charging arm can no longer be raised.

1. DRIVE SPRINGS
2. LIFT ARM
3. TRIP OPENING ARM
4. CHARGING MOTOR
5. SPRING DISCHARGE INTERLOCKS
6. LIFTING ROLLER
7. TRIP CLOSING CAM
8. DRIVE LEVER
9. TRIP CLOSING ROLLER
10. LATCH CHECK SWITCH (OPTIONAL)
11. CLOSING SOLENOID
12. OPENING SOLENOID

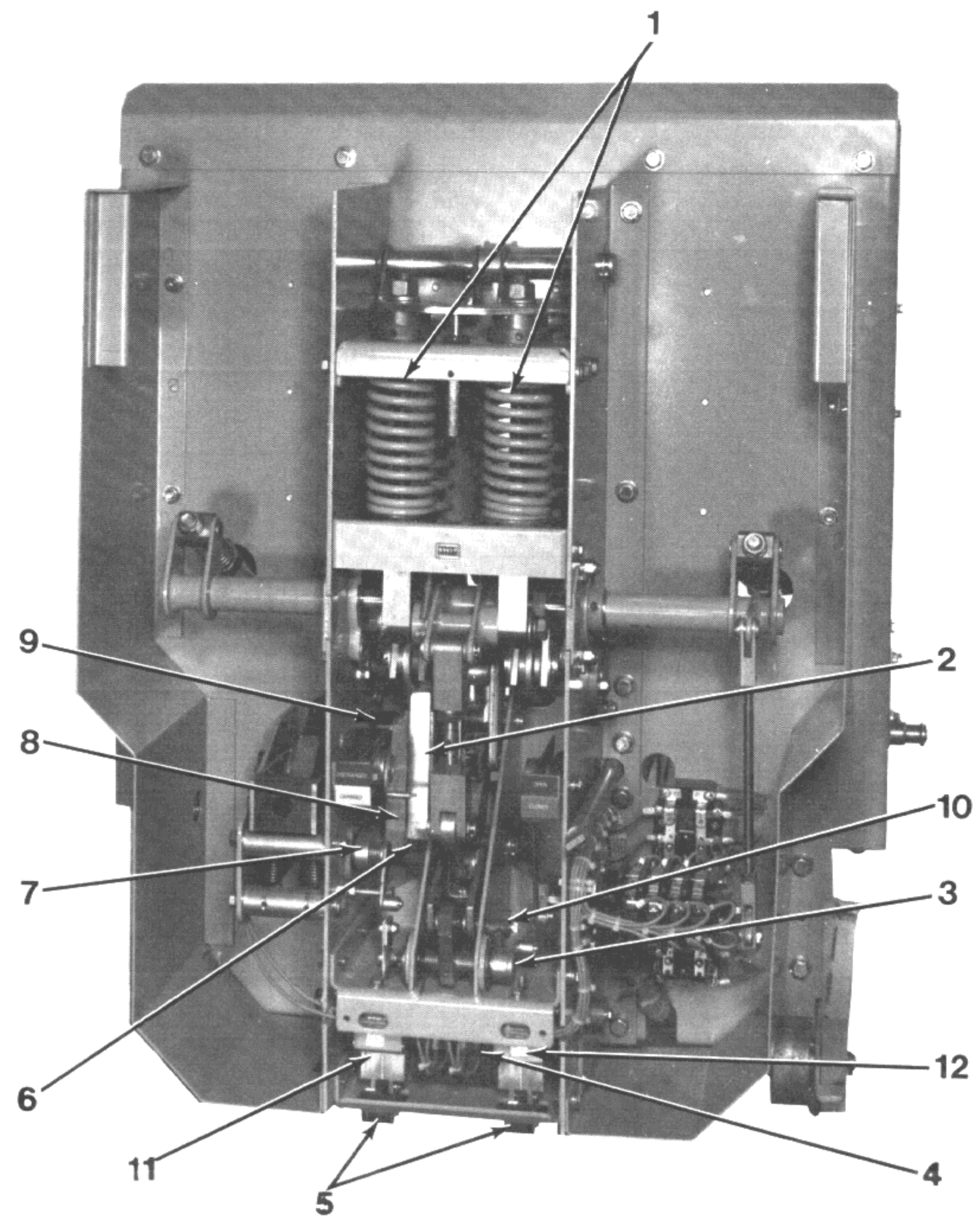


Figure 6

4. OPERATING MECHANISM — DESCRIPTION OF OPERATION

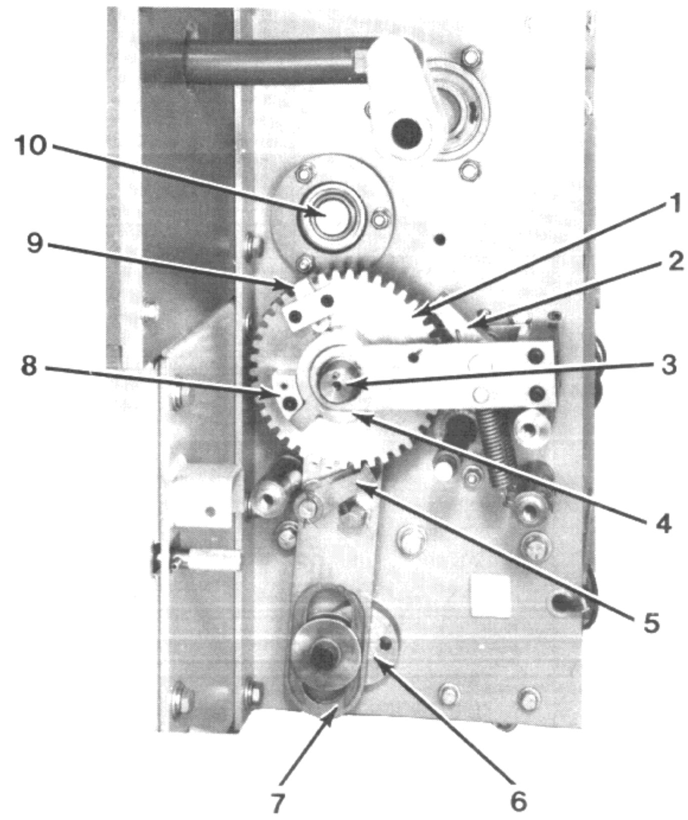
The following is a description of the operation of the operating mechanism. This manual will refer to the operating mechanism as the front of the breaker. The terms left and right will be used as if facing the operating mechanism. The terms clockwise and counterclockwise will be used as if facing the left side of the breaker.

4.1 Drive Spring Charging

Assume that the interrupter contacts are in the open position and that the drive springs (Figure 6, 1) and the return springs (Figure 5, 1) are discharged. When power is supplied to the breaker control circuitry (Figure 16), the charging motor (Figure 6, 4) is energized. The motor eccentric (Figure 7, 6), mounted on the charging motor shaft, drives the ratchet arm assembly (Figure 7, 7) backward and forward. With each forward stroke of the ratchet arm, the spring loaded drive pawl (Figure 7, 5), mounted on the ratchet arm, engages a tooth on the gear (Figure 7, 1) and advances the gear a few degrees counterclockwise. The holding pawl (Figure 7, 2) holds the gear in position while the drive pawl makes its reverse stroke to engage another tooth. The gear is free to rotate on the gear shaft (Figure 7, 3). As the gear is advanced, the drive block (Figure 7, 8), mounted on the outside face of the gear, engages the gear on the drive hub (Figure 7, 4) and rotates the drive hub. A roll pin connects the drive hub to the gear shaft (Figure 7, 3) and the drive lever (Figure 6, 8) assembly. The gear shaft and drive lever assembly thus rotates with the drive hub.

As the drive lever rotates, the lifting roller (Figure 6, 6) on the drive lever contacts the lift arm (Figure 6, 2) on the drive shaft (Figure 7, 10) and pushes the lift arm up rotating the drive shaft counterclockwise. The counterclockwise drive shaft rotation compresses the drive springs until the spring load against the drive lever passes dead center and attempts to discharge. At this point, the drive lever rotates a few degrees until the trip closing roller (Figure 6, 9) on the drive lever can rotate no further and the drive springs are held in this charged position until a closing operation is initiated.

When the drive springs reach the fully charged position, the charging motor limit switch cam (Figure 5, 5) allows the charging motor limit switch (Figure 5, 4) to open, de-energizing the charging motor. Simultaneously, the pawl lift slide (Figure 7, 9) is pushed forward by the cam lobe on the drive hub so that the drive pawl rides on the pawl lift slide and does not engage the gear. This arrangement allows the charging motor and ratchet assembly to coast smoothly to a stop.



1. GEAR
2. HOLDING PAWL
3. GEAR SHAFT
4. DRIVE HUB
5. DRIVE PAWL
6. MOTOR ECCENTRIC
7. RATCHET ARM ASSEMBLY
8. DRIVE BLOCK
9. PAWL LIFT SLIDE
10. DRIVE SHAFT

Figure 7

4.2 Closing Operation.

Once the drive springs (Figure 6, 1) have been charged, the breaker can be closed by lifting the close lever (Figure 9, 5) or by energizing the closing solenoid (Figure 6, 11). Either method disengages the trip closing cam (Figure 6, 7) from the trip closing roller (Figure 6, 9) and allows the drive springs to discharge. The discharging drive springs rotate the drive shaft (Figure 7, 10) clockwise. The clockwise rotation of the drive shaft gives the drive spring bearing (Figure 8, 3) a downward motion. The drive spring bearing engages the toggle cam (Figure 8, 1) rotating the front of the toggle cam up and the rear of toggle cam down under the catch (Figure 8, 2). The front of the toggle cam is connected to the main shaft (Figure 5, 7) by the drive linkage (Figure 8, 5). The upward motion of the front of the toggle cam thus rotates the main shaft counterclockwise and compresses the return springs (Figure 5, 1).

The drive connecting links (Figure 4, 3) transform the rotary motion of the main shaft into a linear motion which closes the vacuum interrupter contacts. The trip opening cam (Figure 8, 10) forces the entire toggle assembly (Figure 8) to remain latched in this position.

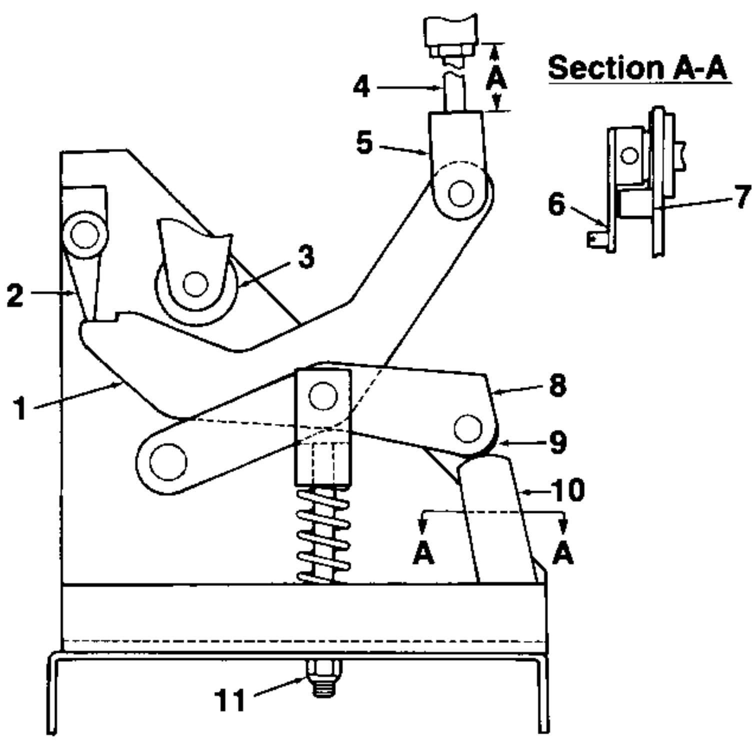
When the drive springs discharge, rotating the drive shaft in a counterclockwise direction, the descending lift arm rotates the drive lever such that the drive lever completes the remaining 360 degrees of rotation to its initial position where it can once again perform a drive spring charging operation. The gear shaft and drive hub rotate with the drive lever. The drive hub rotates out of contact with the drive block. Since the gear (Figure 7, 1) rotates freely on the gear shaft, the gear remains stationary. The rotation of the drive hub is such that the pawl lift slide (Figure 7, 9) follows the cammed surface of the drive hub until the pawl lift slide moves back below the gear teeth permitting the drive pawl (Figure 7, 5) to engage the gear. The charging motor limit switch cam (Figure 5, 5) rotates with the gear shaft and closes the charging motor limit switch (Figure 5, 4) energizing the charging motor (Figure 6, 4) which once again charges the drive springs.

4.3 Opening Operation

With the return springs (Figure 5, 1) charged, the operating mechanism is now ready to perform an opening operation. If the open lever (Figure 9, 4) is lifted or if the opening solenoid (Figure 6, 12) is energized, the trip opening cam (Figure 8, 10) will be rotated clockwise out from under the toggle bearing (Figure 8, 9). The force of the charged return springs pushing down on the toggle cam (Figure 8, 1) will cause the toggle sub-assembly (Figure 8, 8) to rotate clockwise. When the rear of the toggle cam clears the catch (Figure 8, 2) the return springs will completely discharge, rotating the main shaft (Figure 5, 7) and the toggle cam clockwise. The clockwise rotation of the main shaft is transformed to a linear motion by the drive connecting links (Figure 4, 3). The drive connecting links are connected to the vacuum interrupters (Figure 3, 8), and their motion opens the vacuum interrupter contacts.

4.4 Spring discharge Interlocks

The spring discharge interlocks (Figure 13, 5) are located directly below the opening and closing solenoids (Figure 13, 11) and (13, 12). Three cams, located on the floor of the skeleton cell, engage the spring discharge interlocks in such a manner that the primary disconnects (Figure 10, 1) cannot be engaged or disengaged with the interrupter contacts in the closed position and all springs are automatically discharged whenever a circuit breaker is inserted into or removed from its cell.



1. TOGGLE CAM
2. CATCH
3. DRIVE SPRING BEARING
4. DRIVE LINKAGE SHAFT
5. DRIVE LINKAGE
6. TRIP OPEN ARM
7. TRIP OPEN ECCENTRIC
8. TOGGLE SUB-ASSEMBLY
9. TOGGLE BEARING
10. TRIP OPENING CAM
11. TOGGLE SUB-ASSEMBLY RETAINER NUT

Figure 8

5. ADJUSTMENTS

All adjustments are factory set and need not be checked when placing a new breaker into operation.

During periodic inspections and when a breaker part is repaired or replaced, the following adjustments should be checked. To perform these adjustments, first remove the breaker from its cubicle, then remove the front mechanism cover (Figure 9, 1).

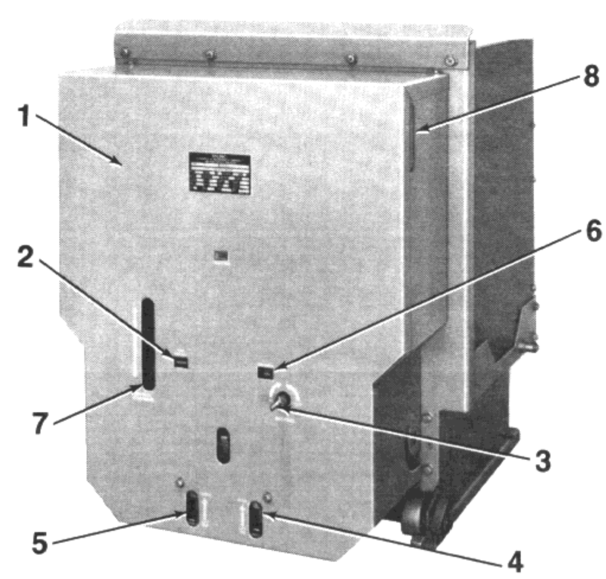
WARNING: WHENEVER AN ADJUSTMENT IS TO BE CHECKED OR PERFORMED WITH THE DRIVE SPRINGS IN THE CHARGED POSITION, IT IS ABSOLUTELY NECESSARY TO BLOCK THE DRIVE SPRINGS BY PLACING THE BLOCKING PINS IN THE HOLES AT THE UPPER END OF THE DRIVE SPRING CENTER SHAFTS. (THE BLOCKING PINS ARE SUPPLIED IN THE ENVELOPE CONTAINING THE INSTRUCTION MANUAL).

5.1 Trip Open Eccentric

With the breaker in the open position and the drive springs charged, the vertical free movement in the opening solenoid plunger (Figure 14, 2), before engaging the trip open arm (Figure 8, 6), should be 1/8" ± 1/16". Rotate the trip open eccentric (Figure 8, 7) to achieve the proper gap. (If a latch check switch (Figure 13, 10) is supplied, this adjustment is not required).

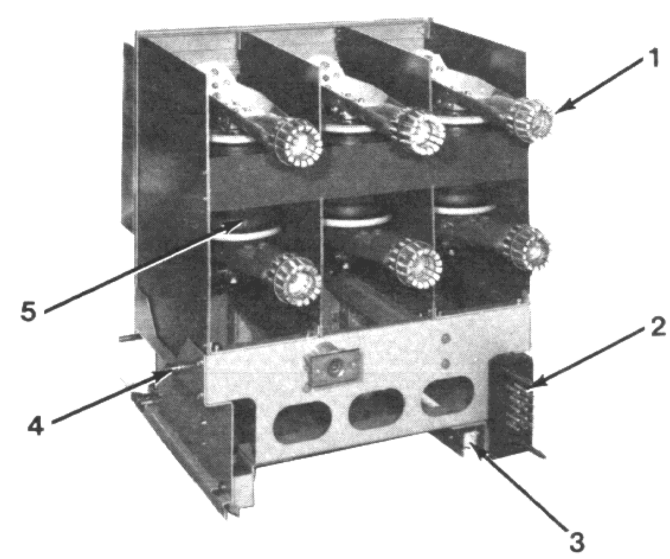
5.2 Toggle Bearing Clearance

With breaker in the open positiion and drive springs (Figure 13, 1) charged, the clearance between the toggle bearing (Figure 8, 9) and the trip opening cam (Figure 8, 10) should be 1/32" + 1/32" — O". If adjustment is necessary, the toggle sub-assembly retainer nut (Figure 8, 11) should be adjusted clockwise to increase clearance, counterclockwise to decrease clearance.



1. FRONT MECHANISM COVER
2. CHARGE-DISCHARGE INDICATOR
3. RACKING SHAFT
4. OPEN LEVER
5. CLOSE LEVER
6. OPEN-CLOSE INDICATOR
7. MANUAL CHARGING ARM
8. HANDLE HOLES

Figure 9



1. PRIMARY DISCONNECT
2. SECONDARY DISCONNECT
3. GROUND CONTACT
4. SHUTTER LIFT ROLLER
5. VACUUM INTERRUPTER

Figure 10

5.3 Charging Motor Limit Switch

Actuated by the charging motor limit switch cam (Figure 14, 5), the charging motor limit switch (Figure 14, 4) serves to energize the charging motor (Figure 13, 4) during a drive spring charging operation and de-energize the charging motor when the drive springs (Figure 13, 1) reach the fully charged position. The charging motor limit switch is properly adjusted if its contacts are open when the drive springs are in the fully charged position and closed when the drive springs are discharged. The position of the charging motor limit switch contacts can be determined by using a continuity tester. If adjustment is necessary, loosen the two screws which hold the charging motor limit switch in place and move the switch up or down as required. Tighten the two screws.

5.4 Adjustments Affecting the Vacuum Interrupters

The following adjustments need to be made only when a vacuum interrupter is replaced. These adjustments are listed in the order in which they should be performed.

5.4.1 Drive Linkage

Distance "A" (Figure 8) for the drive linkage should be 2 $^{3}/_{16}$" ± $^{1}/_{16}$". If adjustment is performed, be certain to tighten the jam nuts when completed.

5.4.2 Spring Overtravel

When the breaker is in the closed position, the spring overtravel (Distance "E", Figure 11) for a new vacuum interrupter assembly should be .188" + $^{1}/_{16}$"–0. Adjustment is performed as follows:

When the breaker is in the fully closed position, check the spring overtravel. If adjustment is necessary, remove the nut (Figure 11, 6) at the end of the drive connecting link. Insert the T-handle adjustment tool #T-1 into the slots in the end of the erosion indicator (Figure 11, 1) and turn the erosion indicator clockwise to shorten or counterclockwise to lengthen the overtravel. THIS ADJUSTMENT IS FACTORY SET AND SHOULD ONLY BE PERFORMED WHEN INSTALLING A NEW VACUUM INTERRUPTER AS DIMENSION "E" PROVIDES AN INDICATION OF CONTACT EROSION (SEE SECTION 6.1a). NOTE: Special tool #T-1 can be ordered from the factory.

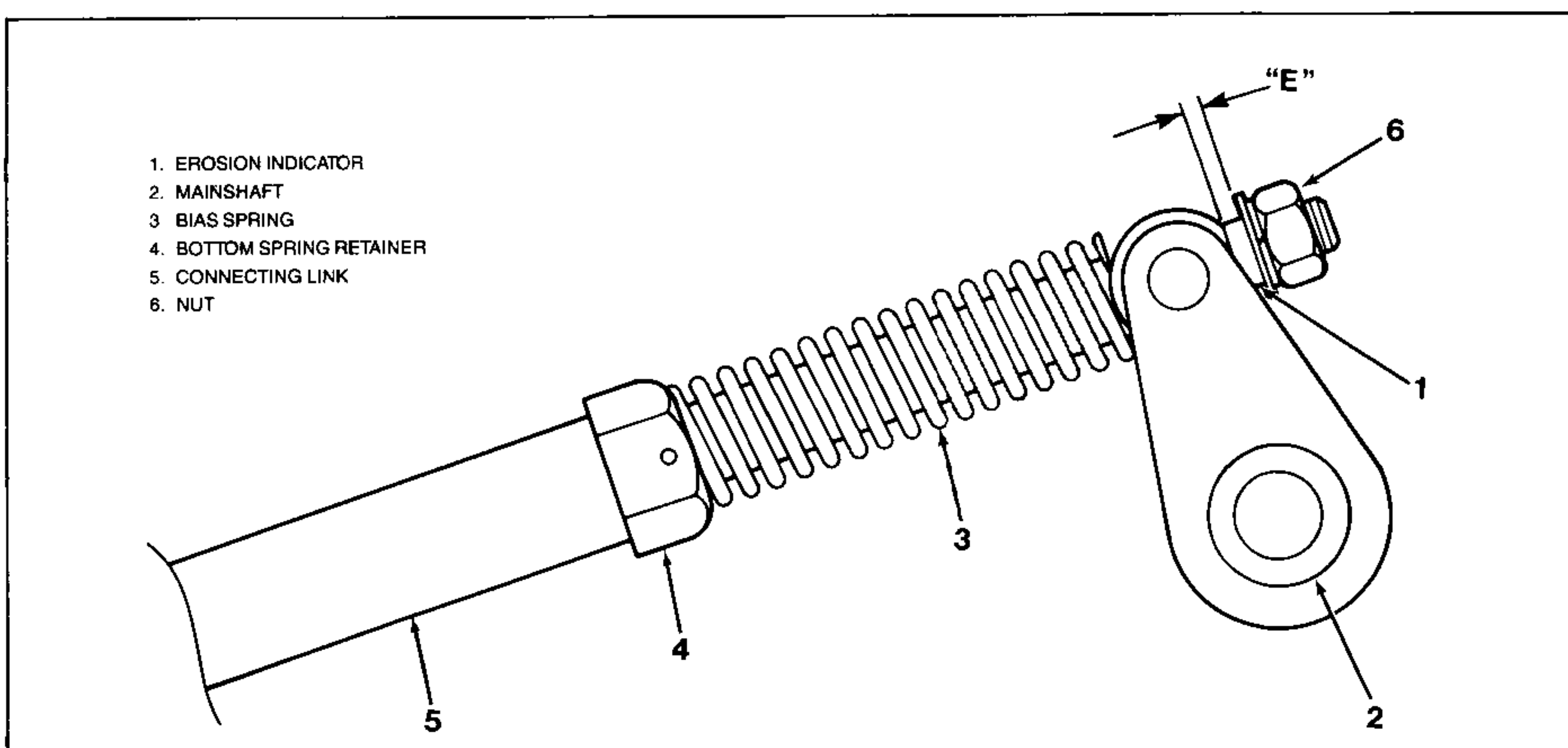


Figure 11

5.4.3 Primary Contact Gap

With the breaker in the open position, the primary contact gap should by .500" to .625" for breakers rated at maximum interrupting capabilities of 23KA and below or .625" to .800" for breakers rated at 36KA maximum interrupting capability. To determine the primary contact gap, measure distance "D" (Figure 15). with the breaker in the open position, then with the breaker in the closed position. The difference between these two measurements is the primary contact gap.

To adjust the primary contact gap, use the return spring stops (Figure 12, 7). Turn the stops clockwise (viewed from above) to decrease the primary contact gap. It should be noted that both stops must be adjusted simultaneously and equally. The return spring stops can be turned easily if the locking nuts are loosened and the breaker is in the closed position. Exercise caution since the return springs (Figure 14, 1) are in the charged position. After performing the adjustment, tighten the locking nuts against the stops. Open and close the breaker, then remeasure the primary contact gap. Repeat the procedure until the correct primary contact gap is obtained. (To facilitate this adjustment after return spring replacement has been performed, the initial setting distance "C" (Figure 12) should be approximately $9^5/_8$" when the breaker is in the open position).

5.4.4 Return Spring Pre-Loading Setting

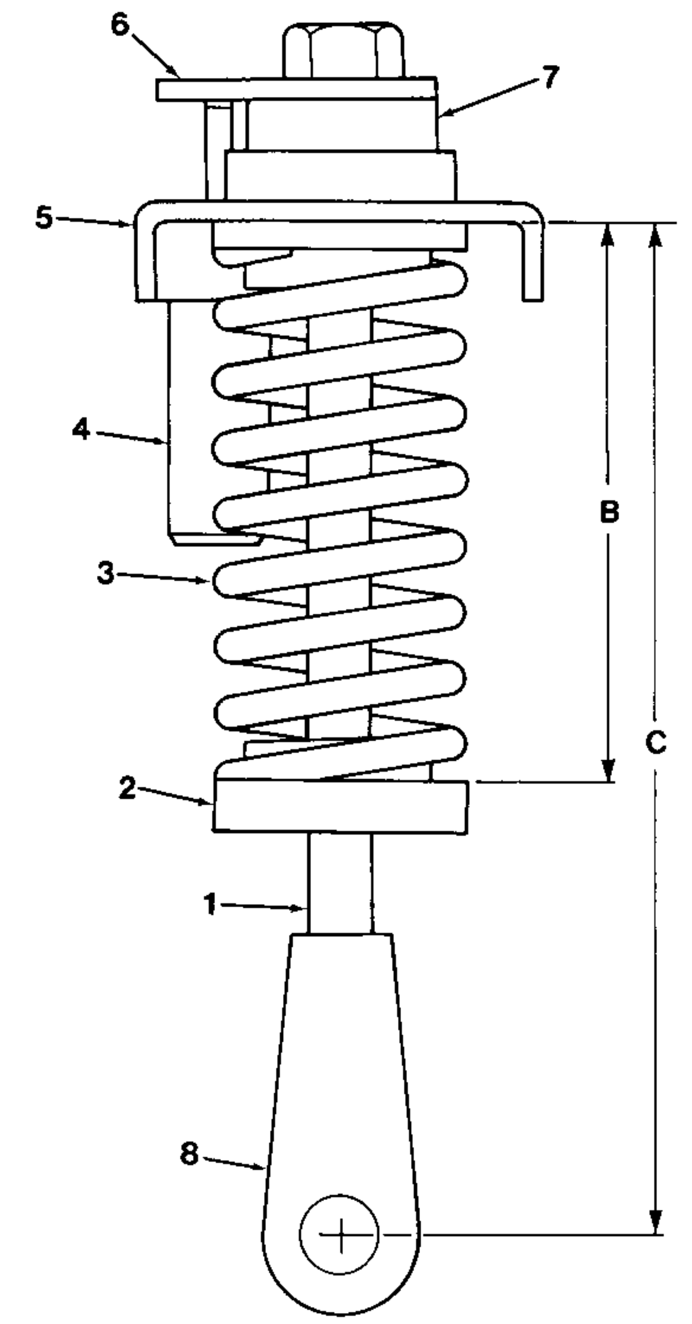
The return spring pre-load setting is determined by distance "B" shown in Figure 12. This adjustment is factory set to provide the correct contact velocities and should not be changed. If disassembly is ever required, note this setting and readjust to the same distance upon reassembly. To adjust distance "B", turn the adjustable retainer (Figure 12, 2) clockwise (viewed from above) to increase distance "B" and counterclockwise to decrease distance "B".

5.4.5 Shock Absorber

All shock absorber adjustments and settings have been made at the factory. No adjustments should be necessary. If, however, they are required, consult the factory.

5.4.6 Contact Compression

Once the above adjustments have been performed, cycle the breaker open and closed 25 times to compress the contacts of the new vacuum interrupter(s) which has been installed. After cycling the breaker, remeasure adjustments 5.4.2, 5.4.3 and 5.4.4. Perform these three adjustments again if required.



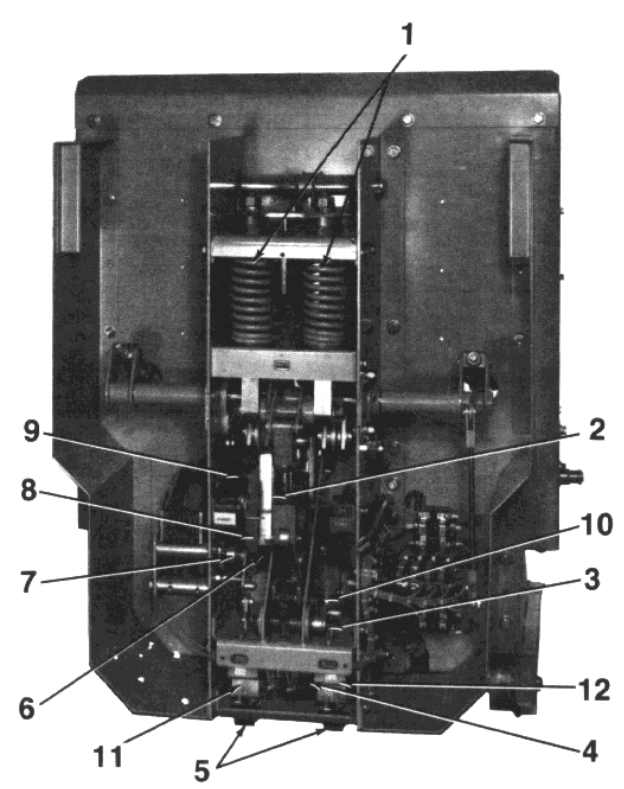
1. RETURN SPRING SHAFT
2. RETURN SPRING ADJUSTABLE RETAINER
3. RETURN SPRING
4. SHOCK ABSORBER
5. RETURN SPRING MOUNTING BOX
6. SHOCK ABSORBER PAD
7. RETURN SPRING STOP
8. RETURN SPRING CONNECTING BLOCK

Figure 12

6. MAINTENANCE

For safety, always remove the breaker from its cubicle and discharge or block the drive springs (Figure 13, 1) and the return springs (Figure 14, 1) before performing any maintenance or repair work.

Because of the wide variations in operating uses and environments, each operating company should develop a maintenance schedule, based on operating experience, which will provide assurance of proper breaker condition. Until such a schedule is determined, it is recommended that breakers be inspected after one year or every 2000 operations, whichever occurs first. It is also recommended that breakers be inspected after severe fault operations and notation of any contact erosion be recorded (See 6.1a).



1. DRIVE SPRINGS
2. LIFT ARM
3. TRIP OPENING ARM
4. CHARGING MOTOR
5. SPRING DISCHARGE INTERLOCKS
6. LIFTING ROLLER
7. TRIP CLOSING CAM
8. DRIVE LEVER
9. TRIP CLOSING ROLLER
10. LATCH CHECK SWITCH (OPTIONAL)
11. CLOSING SOLENOID
12. OPENING SOLENOID

Figure 13

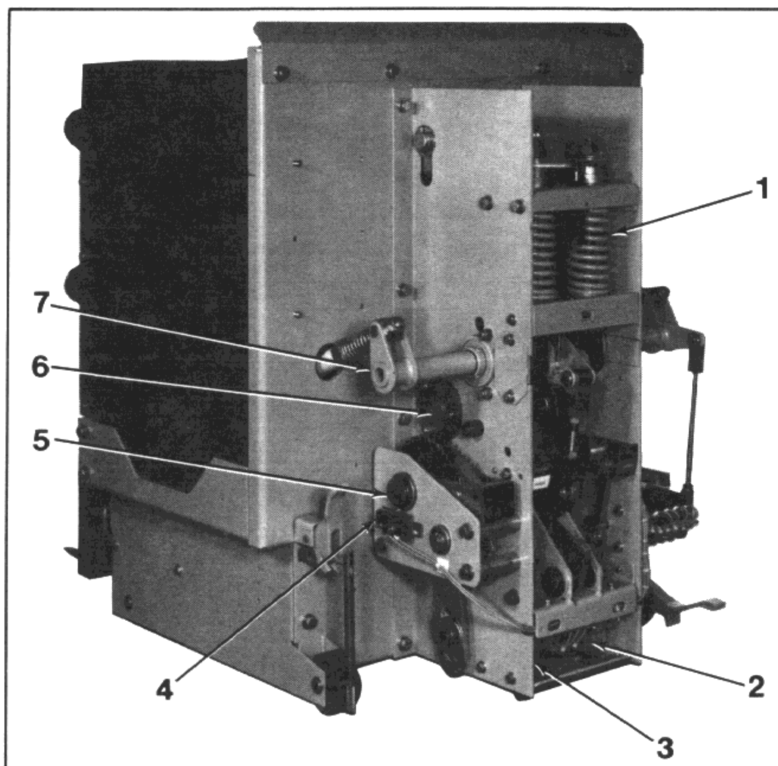
6.1 Vacuum Interrupters

To assure reliable interruption, perform the following two checks:

a) Contact Erosion: Any contact erosion will result in a reduction of the spring overtravel. (See Section 5.4.2). Contact erosion can therefore be determined by closing the breaker and measuring the spring overtravel. The difference between this measurement and the original spring overtravel measurement at the time the interrupter was put into service represents contact erosion. When the spring overtravel has been reduced by $^{3}/_{16}$" the primary contacts have eroded $^{1}/_{8}$" and the vacuum interrupter must be replaced.

NOTE: It is important to measure carefully and record the spring overtravel of each interrupter when a breaker is first put into service. This distance is normally factory set to $^{3}/_{16}$".

b) Hipot Tests: Hipot test each interrupter in accordance with the instructions provided in initial breaker preparation on pg 3, Part 5.



1. RETURN SPRING
2. OPENING SOLENOID
3. CLOSING SOLENOID
4. CHARGING MOTOR LIMIT SWITCH
5. CHARGING MOTOR LIMIT SWITCH CAM
6. DRIVE SHAFT
7. MAIN SHAFT

Figure 14

6.2 Insulating Surfaces

Using a clean, dry cloth, remove all dirt and moisture from the outside of the vacuum interrupters (Figure 15, 8) and from all insulating parts.

6.3 Mechanism

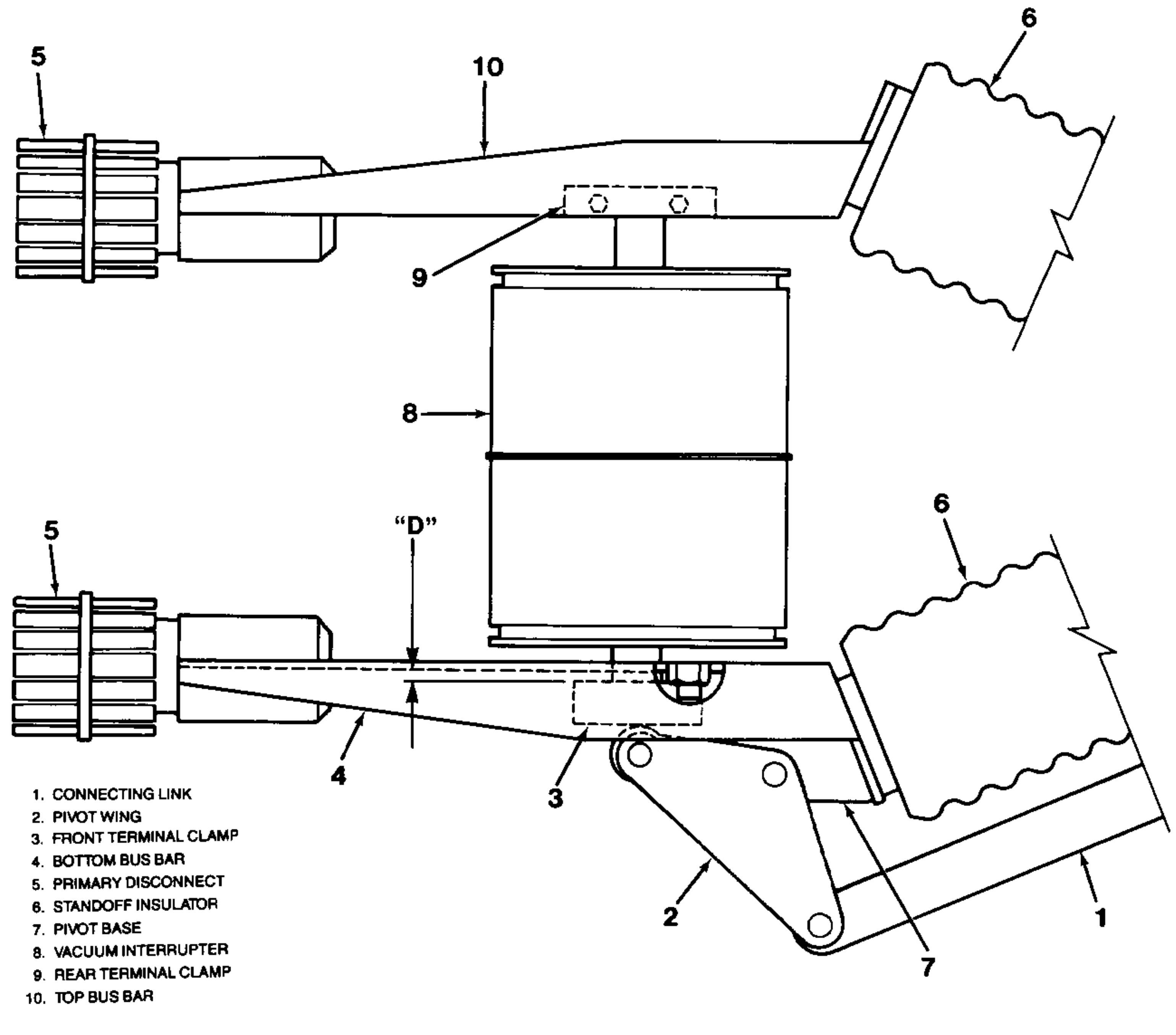
The entire breaker and operating mechanism should be inspected for loose hardware and worn or broken parts. All wiring should be checked for loose connections and damaged insulation. Inspect all bearings and contact surfaces for damage or excessive wear. Examine the shock absorber for evidence of leakage. Verify proper mechanism adjustments as specified in adjustments section beginning on page 9.

6.4 Electrical

Insure that all electrical connections are tight and clean. Using a high quality contact cleanser, clean the relay and auxiliary switch contacts.

6.5 Overhaul

After every 10,000 operations or every five years, whichever occurs first, it is recommended that the breaker be given a thorough overhaul and that all components which have been excessively worn be replaced. Overhaul may require disassembly of the operating mechanism. For breaker lubrication, follow Method II in the lubrication chart on Page 14. Check for proper adjustments and adjust if required.



1. CONNECTING LINK
2. PIVOT WING
3. FRONT TERMINAL CLAMP
4. BOTTOM BUS BAR
5. PRIMARY DISCONNECT
6. STANDOFF INSULATOR
7. PIVOT BASE
8. VACUUM INTERRUPTER
9. REAR TERMINAL CLAMP
10. TOP BUS BAR

Figure 15

6.6 Lubrication

It should be noted that all bearings used in this series of vacuum circuit breakers are sealed and do not require lubrication.

The lubrication chart below provides the location of all lubrication points, the type of lubrication required and the two methods of lubrication. Method I is the periodic lubrication required after 2000 operations or one year, whichever occurs first. Method II is the lubrication procedure to be used whenever the breaker is overhauled or disassembled. Severe operating conditions may warrant different lubrication intervals and procedures. Variations should be based on the experience of the operating company.

It is recommended that the breaker be manually operated several times after lubrication and observed for proper operation.

LUBRICATION CHART

LUBRICATION POINT	METHOD I Lubrication at Maintenance Period	METHOD II Lubrication at Overhaul
Ground surfaces, such as cams, gear teeth, rollers, pawls, etc.	Wipe clean and apply lubricant.*	Disassemble, wipe clean, and apply lubricant.*
Contact surfaces on lift arm (Figure 13, 2), toggle cam (Figure 8, 1), return spring connecting block (Figure 12, 8) catch (Figure 8, 2), etc.	Wipe clean and apply lubricant.	Disassemble, wipe clean, and apply lubricant.
Gear shaft (Figure 7, 3) and drive shaft (Figure 7, 10)	No lubrication required.	Disassemble, wipe clean, and apply lubricant to contact surfaces.
Ratchet arm (Figure 7, 7)	No lubrication required.	Disassemble, wipe clean, and apply lubricant to bronze bushing and all contact surfaces.
Contact and pivot points of all linkages.	Wipe clean and apply lubricant.	Disassemble, wipe clean, and apply lubricant.
Drive spring assembly.	No lubrication required.	Do not disassemble. Wipe clean and apply lubricant to center shaft.
Motor eccentric (Figure 7, 6) and eccentric roller.	Wipe clean and apply lubricant to slot in ratchet arm.	Disassemble, wipe clean, and apply lubricant.
All shafts, sleeves, spacers, and bushings.	No lubrication required.	Disassemble, wipe clean, and apply lubricant.
Silver plated primary disconnect (Figure 10, 1) contacts and grounding contact.	Wipe clean and apply a high quality conductive contact lubricant, such as G.E. #D50H47.	Wipe clean and apply a high quality conductive contact lubricant, such as G.E. #D50H47.

**It is recommended that a high grade, heavy duty lubricant, such as Texaco Multifac EP2 or Chevron SRI Grease, be used.*

7. RENEWAL PARTS

7.1 Minimum Requirements

Sufficient renewal parts should be maintained in stock to assure prompt replacement of worn, broken or damaged parts. A list of factory recommended renewal parts is provided below.

Because of the wide variation in operating uses and environments, the recommended renewal parts are presented only as a minimum requirement. Each operating company should develop its own renewal parts stock, based on operating experience, which will provide assurance of proper breaker condition.

Part No.	Description	Min. Qty.
1500D	Vacuum Interrupter Module	1
2021D	Trip Coil	1
2022D	Close Coil	1
1715D	Spring Charging Motor	1
2033D	Anti-Pump Relay	1
2013D	Motor Limit Switch	1
2029D	Auxiliary Switch	1
2032D	Motor Relay	1

7.2 Ordering Instructions

When ordering renewal parts:

1. Always specify the complete rating information and breaker serial number.

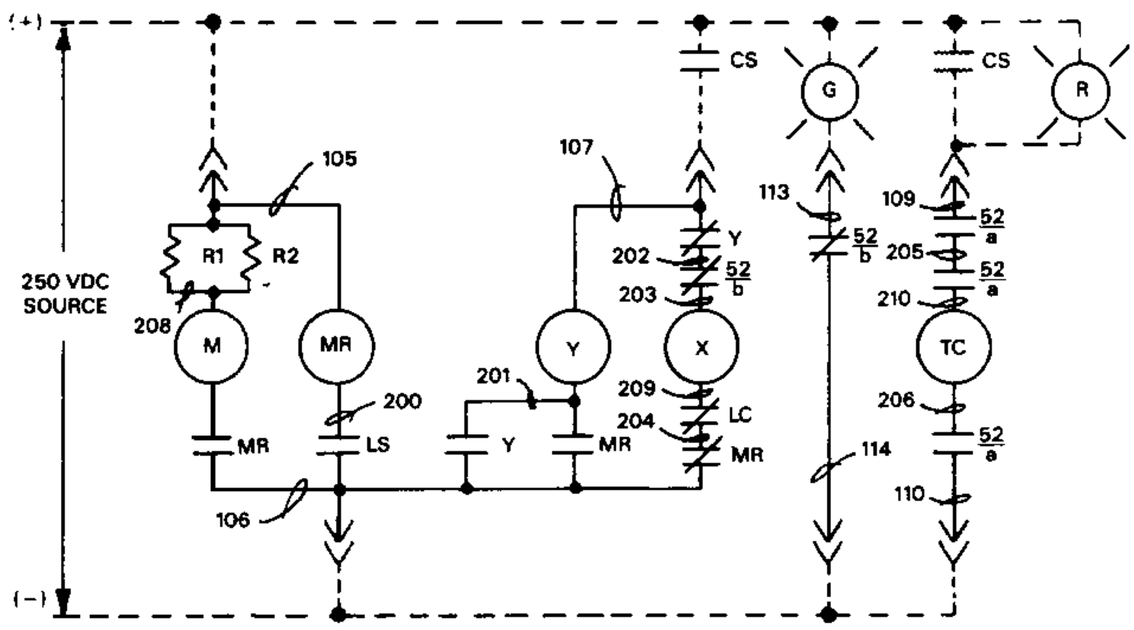
2. Specify part number, description of part, figure number (if provided) and the catalog from which this information is taken.

3. For electrical components, specify operating voltage.

4. Standard hardware components are not listed. These should be purchased locally.

8. CONTROL SCHEMATIC DIAGRAMS

250V DC, DC Trip, DC Close With Latch Check Switch
and Auxiliary LC Contact

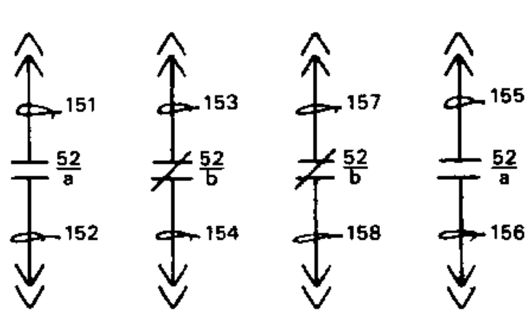


LEGEND

52 - VACUUM CIRCUIT BREAKER
M - SPRING CHARGING MOTOR
LS - SPRING CHARGING MOTOR LIMIT SWITCH
TC - TRIP COIL (OPENING COIL)
X - SPRING RELEASE COIL (CLOSING COIL)
Y - ANTI-PUMP RELAY
MR - MOTOR RELAY
G - GREEN INDICATING LIGHT
R - RED INDICATING LIGHT
CS - CONTROL SWITCH
LC - LATCH CHECK SWITCH
R1, R2 - CURRENT LIMITING RESISTOR, 56Ω, 250W
-<< - INDICATES SECONDARY DISCONNECT POINT

NOTE:

1.) 52/b OPEN WHEN BREAKER IS CLOSED.
2.) 52/a OPEN WHEN BREAKER IS OPEN.
3.) DASHED LINES INDICATE USER SUPPLIED CIRCUITRY AND COMPONENTS.



AUXILIARY CONTACTS

SECONDARY DISCONNECT WIRING

(CIRCUIT BREAKER SIDE CONNECTION VIEW)

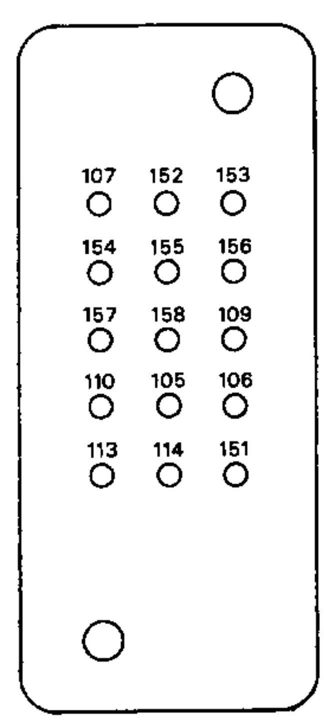
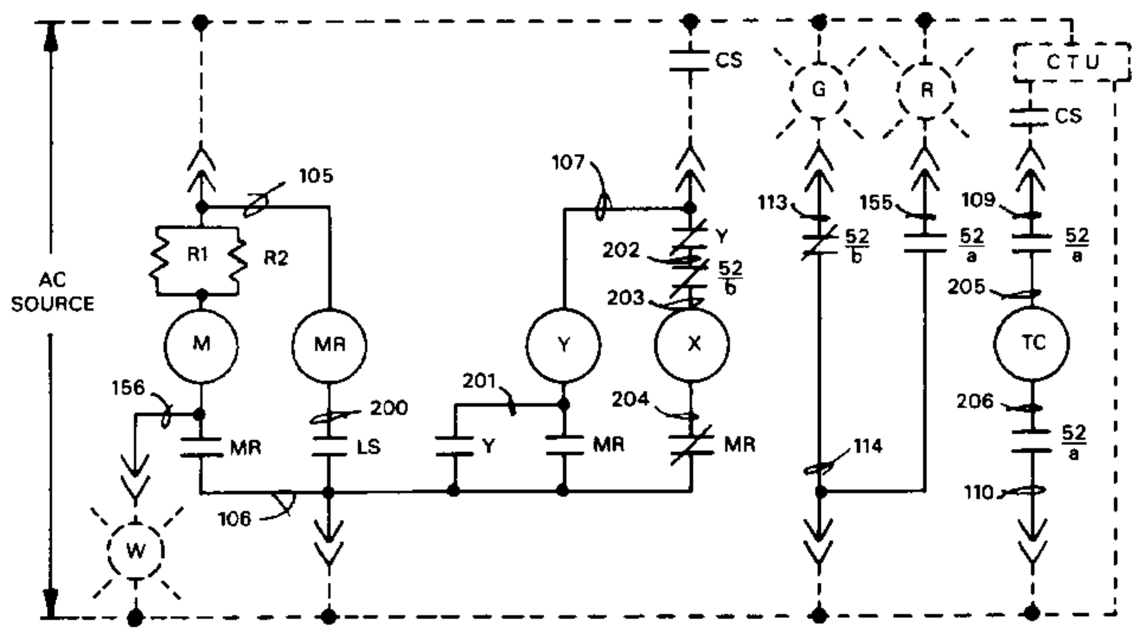


Figure 16

CONTROL SCHEMATIC DIAGRAM

Circuit Breaker AC Close, DC Trip

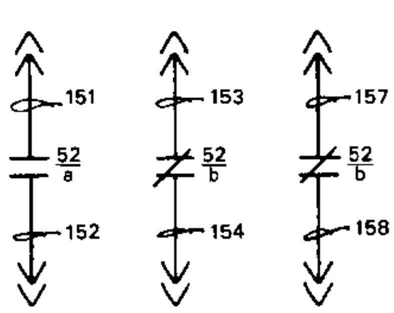


LEGEND

52 - VACUUM CIRCUIT BREAKER
M - SPRING CHARGING MOTOR
LS - SPRING CHARGING MOTOR LIMIT SWITCH
TC - TRIP COIL (OPENING COIL)
X - SPRING RELEASE COIL (CLOSING COIL)
Y - ANTI-PUMP RELAY
MR - MOTOR RELAY
G - GREEN INDICATING LIGHT
R - RED INDICATING LIGHT
W - WHITE INDICATING LIGHT
CS - CONTROL SWITCH
R1, R2 - 120V/250W HEATER (230 VAC ONLY)
-<<- - INDICATES SECONDARY DISCONNECT POINT
CTU - CAPACITOR TRIP UNIT

NOTE:

1.) 52/b OPEN WHEN BREAKER IS CLOSED.
2.) 52/a OPEN WHEN BREAKER IS OPEN.
3.) DASHED LINES INDICATE USER SUPPLIED CIRCUITRY AND COMPONENTS.



AUXILIARY CONTACTS

SECONDARY DISCONNECT WIRING

(CIRCUIT BREAKER SIDE CONNECTION VIEW)

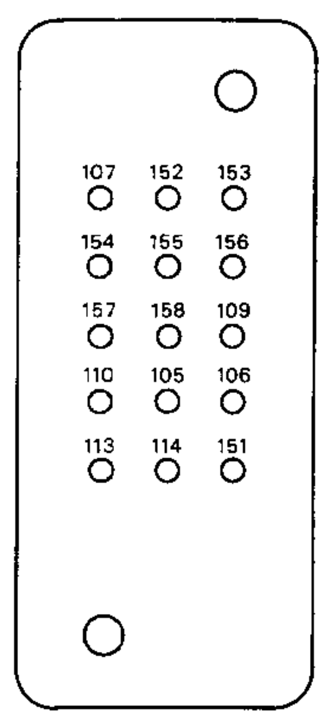
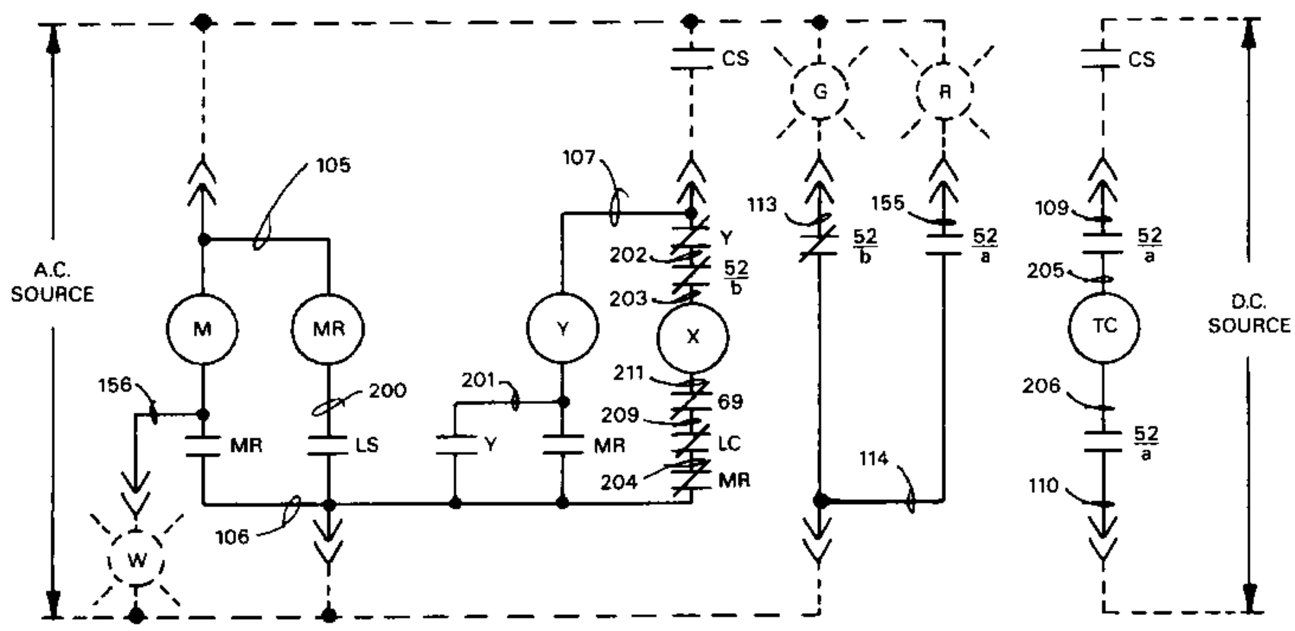


Figure 16

CONTROL SCHEMATIC DIAGRAM

Circuit Breaker AC Close, DC Trip, With Latch Check Switch and Permissive Trip Device

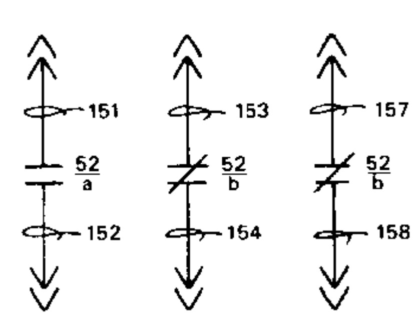


LEGEND

52 - VACUUM CIRCUIT BREAKER
M - SPRING CHARGING MOTOR
LS - SPRING CHARGING MOTOR LIMIT SWITCH
TC - TRIP COIL (OPENING COIL)
X - SPRING RELEASE COIL (CLOSING COIL)
Y - ANTI-PUMP RELAY
MR - MOTOR RELAY
G - GREEN INDICATING LIGHT
R - RED INDICATING LIGHT
W - WHITE INDICATING LIGHT
LC - LATCH CHECK SWITCH
69 - PERMISSIVE TRIP DEVICE
-<< - INDICATES SECONDARY DISCONNECT POINT

NOTE:

1.) 52/b OPEN WHEN BREAKER IS CLOSED.
2.) 52/a OPEN WHEN BREAKER IS OPEN.
3.) DASHED LINES INDICATE USER SUPPLIED CIRCUITRY AND COMPONENTS.



AUXILIARY CONTACTS

SECONDARY DISCONNECT WIRING

(CIRCUIT BREAKER SIDE CONNECTION VIEW)

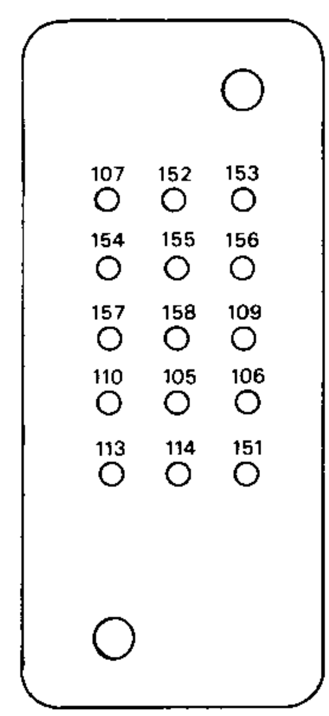
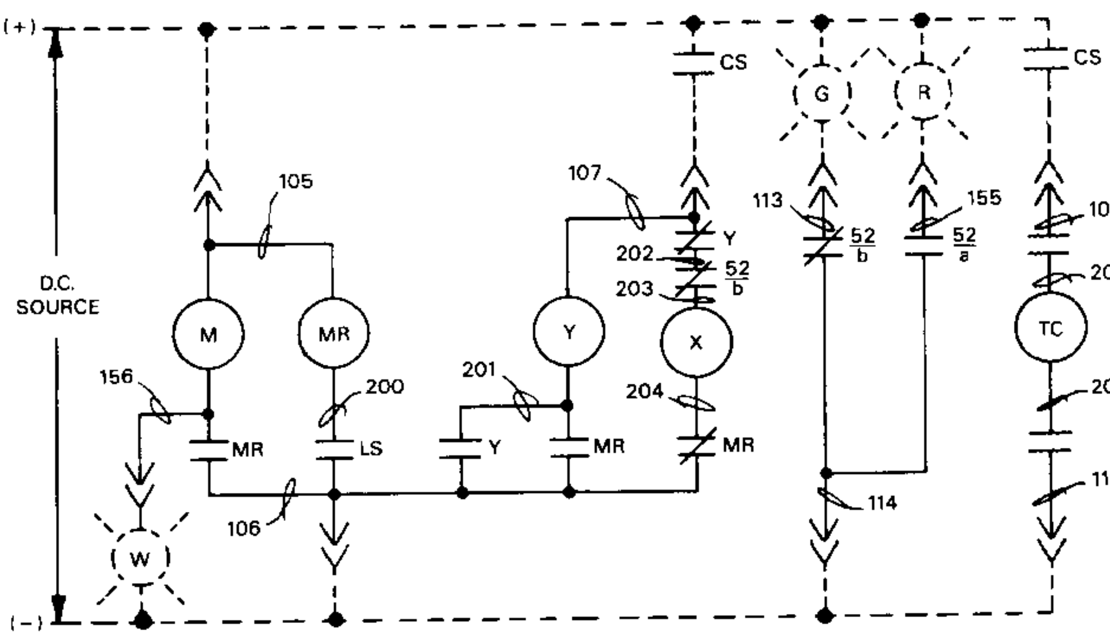


Figure 16

CONTROL SCHEMATIC DIAGRAM

Circuit Breaker DC Trip, DC Close

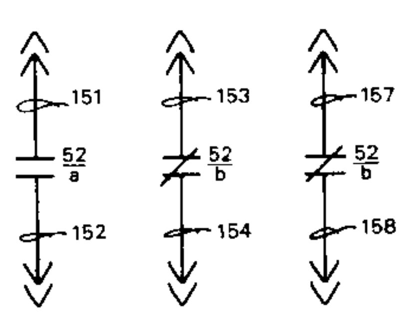


LEGEND

52 - VACUUM CIRCUIT BREAKER
M - SPRING CHARGING MOTOR
LS - SPRING CHARGING MOTOR LIMIT SWITCH
TC - TRIP COIL (OPENING COIL)
X - SPRING RELEASE COIL (CLOSING COIL)
Y - ANTI-PUMP RELAY
MR - MOTOR RELAY
G - GREEN INDICATING LIGHT
R - RED INDICATING LIGHT
W - WHITE INDICATING LIGHT
CS - CONTROL SWITCH
-<< - INDICATES SECONDARY DISCONNECT POINT.

NOTE:

1.) 52/b OPEN WHEN BREAKER IS CLOSED.
2.) 52/a OPEN WHEN BREAKER IS OPEN.
3.) DASHED LINES INDICATE USER SUPPLIED CIRCUITRY AND COMPONENTS.



AUXILIARY CONTACTS

SECONDARY DISCONNECT WIRING

(CIRCUIT BREAKER SIDE CONNECTION VIEW)

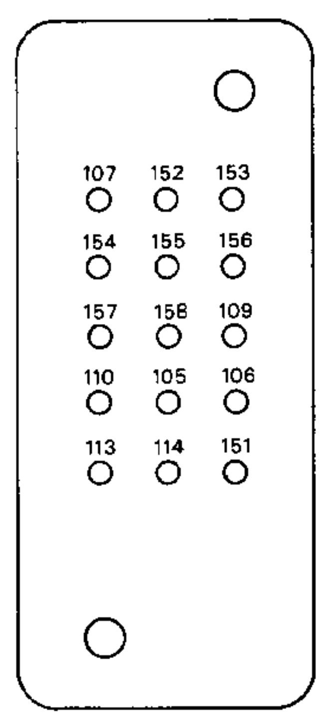
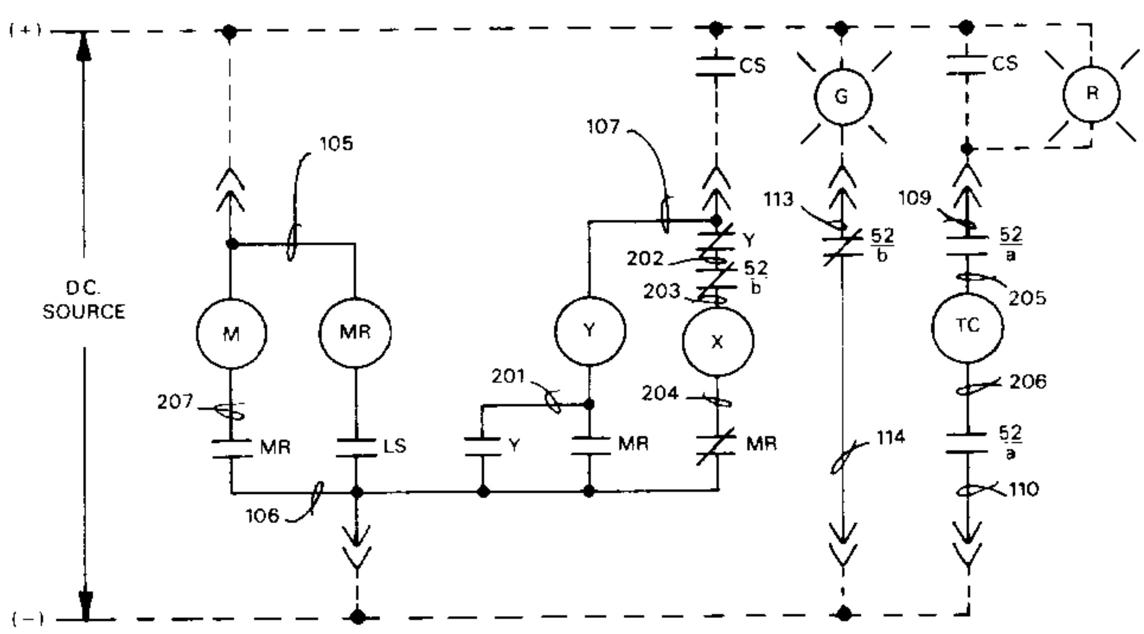


Figure 16

CONTROL SCHEMATIC DIAGRAM

Circuit Breaker DC Trip, DC Close, ANSI Standard

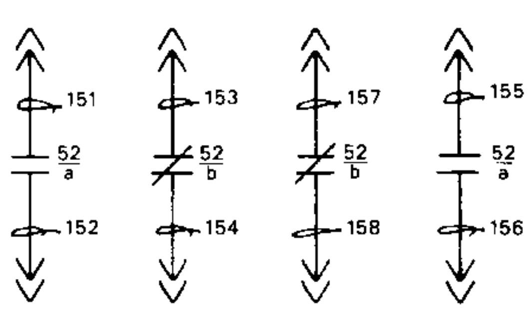


LEGEND

52 - VACUUM CIRCUIT BREAKER
M - SPRING CHARGING MOTOR
LS - SPRING CHARGING MOTOR LIMIT SWITCH
TC - TRIP COIL (OPENING COIL)
X - SPRING RELEASE COIL (CLOSING COIL)
Y - ANTI-PUMP RELAY
MR - MOTOR RELAY
G - GREEN INDICATING LIGHT
R - RED INDICATING LIGHT
CS - CONTROL SWITCH
—<< - INDICATES SECONDARY DISCONNECT POINT

NOTE:

1.) 52/b OPEN WHEN BREAKER IS CLOSED.
2.) 52/a OPEN WHEN BREAKER IS OPEN.
3.) DASHED LINES INDICATE USER SUPPLIED CIRCUITRY AND COMPONENTS.



AUXILIARY CONTACTS

SECONDARY DISCONNECT WIRING

(CIRCUIT BREAKER SIDE CONNECTION VIEW)

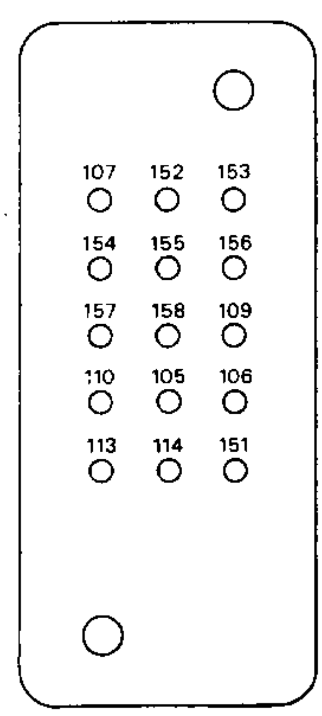


Figure 16

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