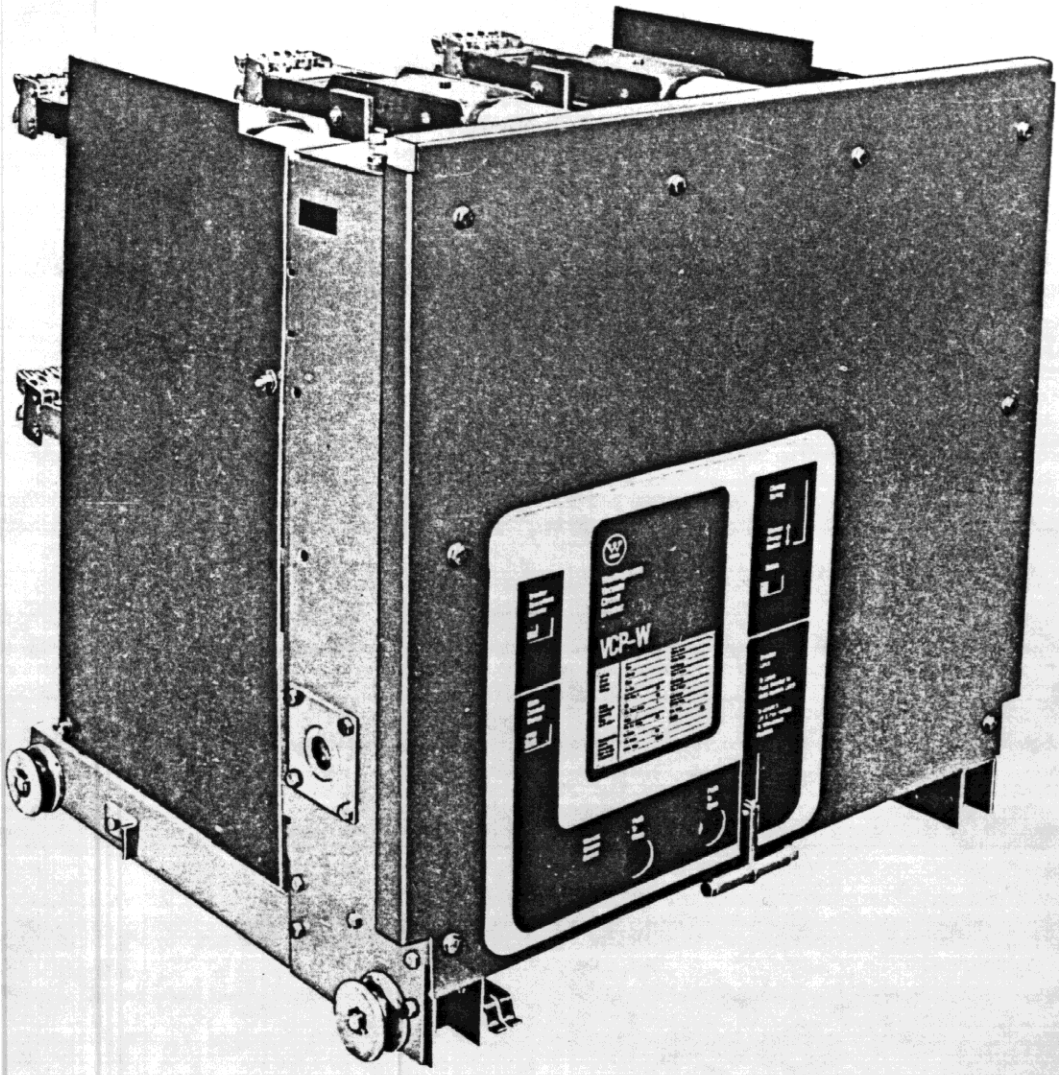
J. M. KOZLOVIC

Instructions for Installation, Operation, and Maintenance of Type VCP-W Vacuum Circuit Breakers

I.B. 32-255-1



READ AND UNDERSTAND THESE INSTRUCTIONS BEFORE ATTEMPTING ANY UNPACKING, ASSEMBLY, OPERATION OR MAINTENANCE OF THE CIRCUIT BREAKERS.

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

Westinghouse Electric Corporation
Distribution and Control Business Unit
I.B. 32-255-1 Effective June 1986

CAUTION

The circuit breakers described in this book are designed and tested to operate within their nameplate ratings. Operation outside of these ratings may cause the equipment to fail, resulting in bodily injury and property damage.

All Safety Codes, Safety Standards and/or Regulations as they may be applied to this type of equipment must be strictly adhered to.

TABLE OF CONTENTS

SECTION 1 - INTRODUCTION

The purpose of this book is to provide instructions for unpacking, storage, installation, operation and maintenance of Type VCP-W, Vacuum Circuit Breakers. They are horizontal drawout type removable interrupting elements for use in VC-W Metal-Clad Switchgear to provide reliable control and protection for medium voltage electrical equipment and circuits. VCP-W breakers are designed for ease of handling, reliable performance and ease of maintenance. Like ratings are interchangeable with each other.

Satisfactory performance of these breakers is contingent upon proper application, correct installation and adequate maintenance. It is strongly recommended this instruction book be carefully read and followed in order to obtain optimum performance for long useful life of the circuit breakers.

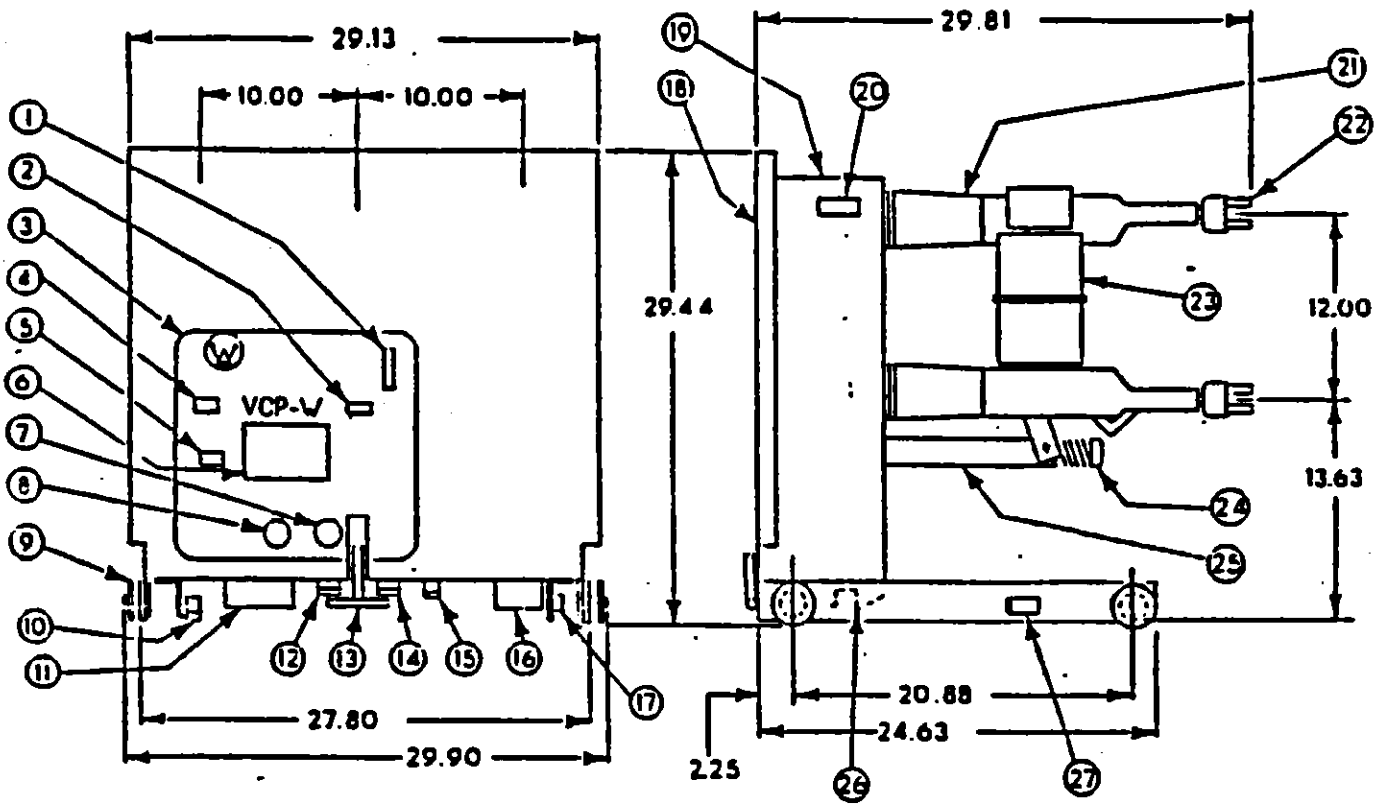
TYPE VCP-W BREAKERS ARE PROTECTIVE DEVICES. AS SUCH, THEY ARE MAXIMUM RATED DEVICES. THEREFORE, THEY SHOULD NOT UNDER ANY CIRCUMSTANCES BE APPLIED OUTSIDE THEIR NAMEPLATE RATINGS.

1.1 The available VCP-W breakers and their weights are listed in the table below:

Type of Breaker	Current Rating Amps	Lbs.	Type of Breaker	Current Rating Amps	Lbs.
50VCP-W250	1200	350	150VCP-W500	1200	350
	2000	410		2000	410
75VCP-W500	1200	375	150VCP-W750	1200	350
	2000	410		2000	410

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

OUTLINE AND DIMENSIONS



1	Emergency Charge Opening	15	MOC Operator
2	Spring Charge/Discharge Indicator	16	Code Plates
3	Escutcheon Plate	17	TOC Operator
4	Operation Counter Indicator	18	Front Panel
5	Breaker Contacts Indicator	19	Mechanism Enclosure
6	Breaker Nameplate	20	Lifter Slot
7	Push to Trip Button	21	Insulators
8	Push to Close Button	22	Primary Disconnect
9	Breaker Wheel	23	Vacuum Interrupter
10	Ground Contact	24	Contact Loading Springs
11	Secondary Disconnect	25	Operating Rod
12	Close Floor Tripper	26	Levering Latch
13	Pull Handle	27	Extension Rail Interlock
14	Trip Floor Tripper		

FIG. 1 OUTLINE AND DIMENSIONS

SECTION 2 - SAFE PRACTICES

Type VCP-W breakers are equipped with high speed, high energy operating mechanisms. They are designed with several built-in interlocks and safety features to provide safe and proper operating sequences. To ensure safety of personnel associated with installation, operation and maintenance of these breakers, the following recommendations should be considered:

Only qualified persons, as defined in the National Electric Safety Code, who are familiar with the installation and maintenance ance of medium voltage circuits and equipment should be permitted to work on these breakers.

Read these instructions carefully before attempting any installation, operation or maintenance of these circuit breakers.

- DO NOT work on an energized breaker.
- DO NOT work on a breaker with the secondary test coupler engaged.
- DO NOT work on a closed breaker or a breaker with closing springs charged.
- DO NOT USE a circuit breaker by itself as the sole means of isolating a high voltage circuit. For the safety of personnel performing maintenance operations on the breaker or connected equipment, all components should be disconnected by means of a visible break, and securely grounded.
- DO NOT leave breaker in an intermediate position in a cell. Always have the breaker either in the test or connected position.
- Always remove the spring charging handle from the breaker after charging the springs.
- Always use extreme care when rolling out and handling the breaker on extension rails.
- Breakers are equipped with safety interlocks, DO NOT defeat them. This may result in bodily injury or equipment damage.

SECTION 3 - RECEIVING, HANDLING AND STORING

Type VCP-W circuit breakers are subjected to complete factory production tests and inspection before being packed. They are shipped in packages designed to provide maximum protection to the equipment during shipment and storage and at the same time to provide convenient handling. Accessories such as the spring charging handle, levering crank, etc, are shipped separately with the switchgear assembly.

3.1 RECEIVING

Upon receipt of the equipment, inspect the crates for any signs of damage or rough handling. Open the crates carefully to avoid any damage to the contents. Use a nail puller rather than a crow bar.

When opening the crates, be careful that any loose items or hardware are not discarded with the packing material. Check the contents of each package against the packing list.

Examine the breaker for any signs of shipping damage such as broken, missing or loose hardware, damaged or deformed insulation and other components. File claims immediately with the carrier if damage or loss is detected and notify the nearest Westinghouse Sales Office.

Until the breaker is ready to be delivered to the switchgear site for installation, DO NOT remove the wooden crate. If the breaker is to be placed in storage, maximum protection can be attained by keeping it in its crate.

TOOLS AND ACCESSORIES

The following tools and accessories used with VCP-W breakers are shipped with VC-W switchgear - one per order. See Figure 3.2.

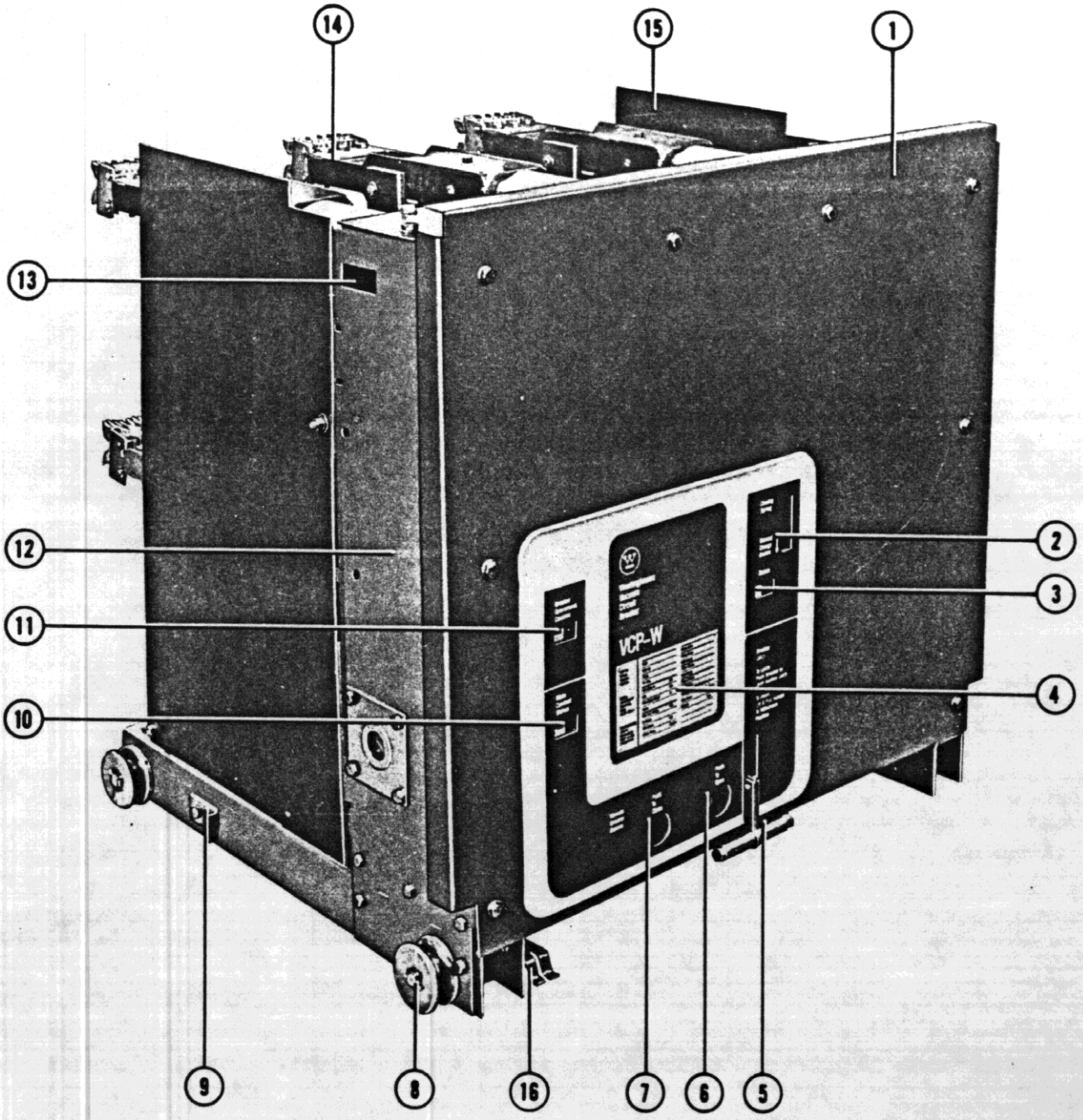
Maintenance Tool: Used to charge closing springs manually and lift the shutter in breaker compartment.

Lifting Yoke: Used to lift the breaker.

Levering Crank: Used to crank the breaker between Test and Connected positions.

Test Jumper: Used to operate the breaker electrically as it rests on the extended rails outside the breaker compartment or on the transport dolly. This jumper connects the breaker secondary disconnects to the compartment secondary disconnects.

Primary disconnect pliers. Used to install and remove primary disconnects.



1. Front Panel
2. Emergency Charge Handle Opening
3. Spring Charged/Discharged Indicator
4. Name Plate
5. Lift/Pull Handle
6. Manual Trip Button
7. Manual Close Button
8. Wheel
9. Extension Rail Interlock
10. Open-Closed Indicator (Red-Open – Green-Closed)
11. Operation Counter
12. Mechanism Enclosure
13. Lift Yoke Opening
14. Primary Disconnect
15. Phase Barrier
16. Ground Contact

Fig. 3.1 *External View of the VCP-W Breaker*

The following accessories are optional:

Test Cabinet: Used to provide power to operate the breaker outside its compartment.

Portable Lifter: Used to lift the breaker from or to the extended rails of the breaker compartment.

3.2 HANDLING

Type VCP-W breaker shipping containers are designed to be handled either by use of a rope sling and an overhead lifting device or by fork lift truck. If containers must be skidded for any distance it is preferable to use roller conveyors or individual pipe rollers.

Once the breakers have been inspected for shipping damage, it is best to return them to their original shipping crates until they are ready to be installed in the Metal-Clad Switchgear.

The breaker is secured to the crate by banding straps. When it is ready for installation, remove these straps. A lifting yoke is provided for each order. Position this lifting yoke on the top of the breaker and insert lifters into the breaker side openings with the lifting hole towards the interrupters. It is recommended that the portable lifter (optionally provided) be used to lift the breaker. The crate should be raised on 2 x 4 or 4 x 4 blocks to permit the breaker lifting device legs to run underneath the crate. If the portable lifter is not available, any lifter may be used provided that it is rated for at least 1000 lbs.

3.3 STORAGE

If the circuit breaker is to be placed in storage, maximum protection can be attained by keeping it in the original wooden crate. Before placing it in storage, checks should be made to make sure that the breaker is free from shipping damage and in satisfactory operating condition.

The breaker is shipped with its contacts open and closing springs discharged. The indicators on the front panel should confirm this. Insert the spring charging handle in the opening near center right. Charge the closing springs by pumping the handle up and down about 36 times until crisp metallic "click" is heard. This indicates that the closing springs are charged and is shown by the closing spring "charged" (yellow) indicator. Remove the spring operating handle. Operate the "push-to-close" button. The breaker will close as shown by the breaker contacts "closed" (red) indicator. Operate the "push-to-open" button. The breaker will trip as shown by the breaker contacts "open" (green) indicator. After completing this initial check, leave the closing springs "discharged" and breaker contacts "open".

Outdoor storage is not recommended. If unavoidable, the outdoor location must be well drained and a temporary shelter from sun, rain, snow, corrosive fumes, dust, dirt, falling objects, excessive moisture, etc. must be provided. Containers should be arranged to permit free circulation of air on all sides and temporary heaters should be

permit free circulation of air on all sides and temporary heaters should be used to minimize condensation. Moisture can cause rusting of metal parts and deterioration of high voltage insulation. A heat level of approximately 400 watts for each 100 cubic feet of volume is recommended with the heaters distributed uniformly throughout the structure near the floor. If the circuit breakers are stacked for storage, the stacks should be limited to two high.

Indoor storage should be in a building with sufficient heat and circulation to prevent condensation. If the building is not heated, the same general rule for heat as for outdoor storage should be applied.

SECTION 4 - INSTALLATION

4.1 INITIAL INSPECTION AND OPERATION

Before attempting to put the breaker in service, it should be carefully examined and operated manually and electrically.

Examine breaker for loose or obviously damaged parts.

4.2 Perform manual operations check. Place the the maintenance handle into the manual charging opening and charge the closing spring with about 36 up and down strokes of the handle. When charging is complete, the closing crank goes over center with with an audible "click" and the springs Charged/ Discharged indicator shows "charged".

Remove the maintenance handle.

Close and trip the breaker several times.

4.3 Check Vacuum Interrupter Integrity Using a dry lint-free cloth or a paper towel, clean all the insulating surfaces of the pole units. Conduct a vacuum interrupter integrity check as described in the maintenance Section, 6.4.

4.4 Check breaker primary and secondary insulation per Section 6.6.

4.5 Check Contact Erosion Indicator Manually charge the closing springs and close the breaker. View the vacuum interrupter moving stems from the rear of breaker. The erosion mark should be visible on each vacuum interrupter moving stem as described in Section 6.5.

4.6 Check Primary Circuit Resistance Check the primary circuit resistance as described in the Maintenace Section 6.8. The resistance should not exceed the values specified. Record the values obtained for future reference.

4.7 Compare the breaker nameplate information with switchgear drawings for compatibility. Breaker and compartment code plates do match power ratings. However, they do not match control voltages.

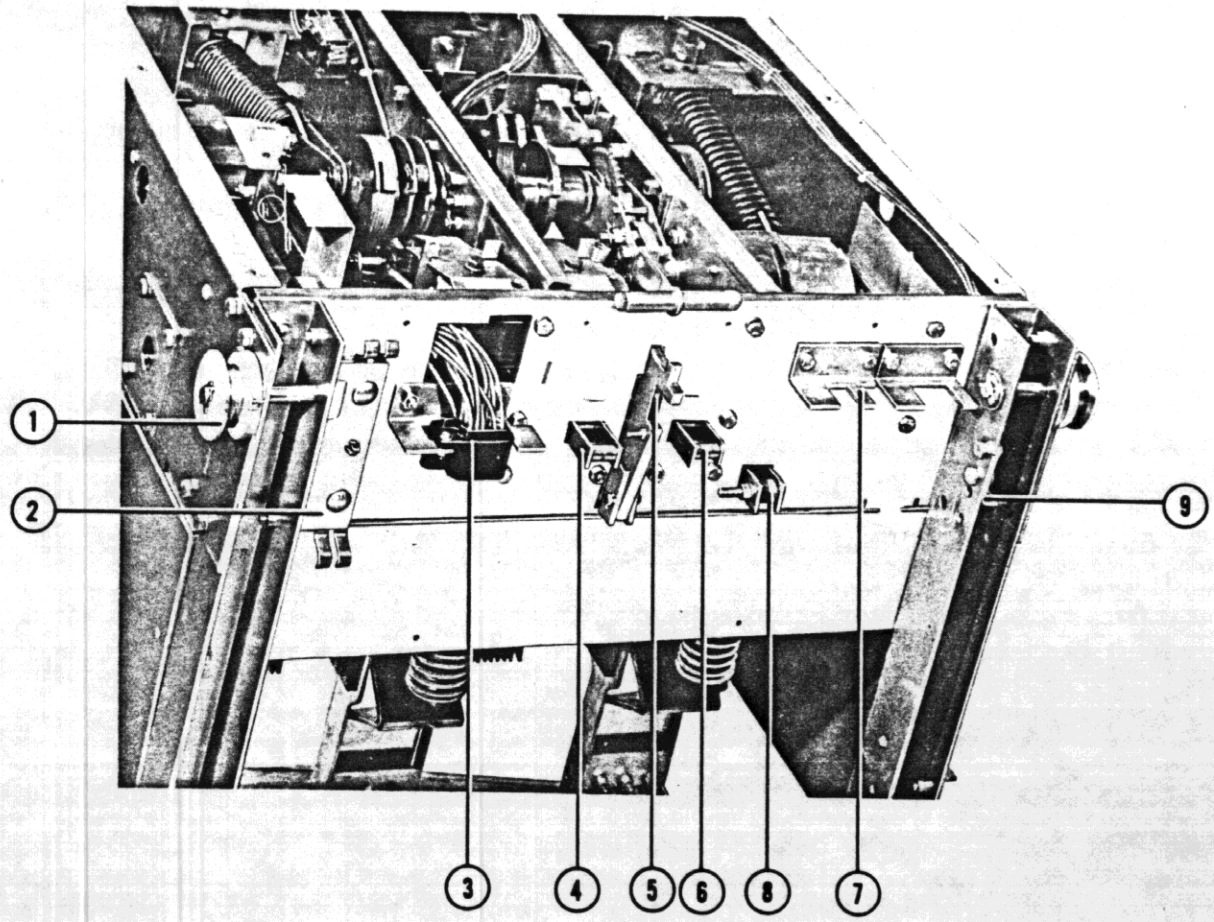
4.8 Perform electrical operations check.

After going through the above steps, the breaker is now ready to be operated electrically. It is preferred that this check be made in the test position of breaker compartment.

CAUTION

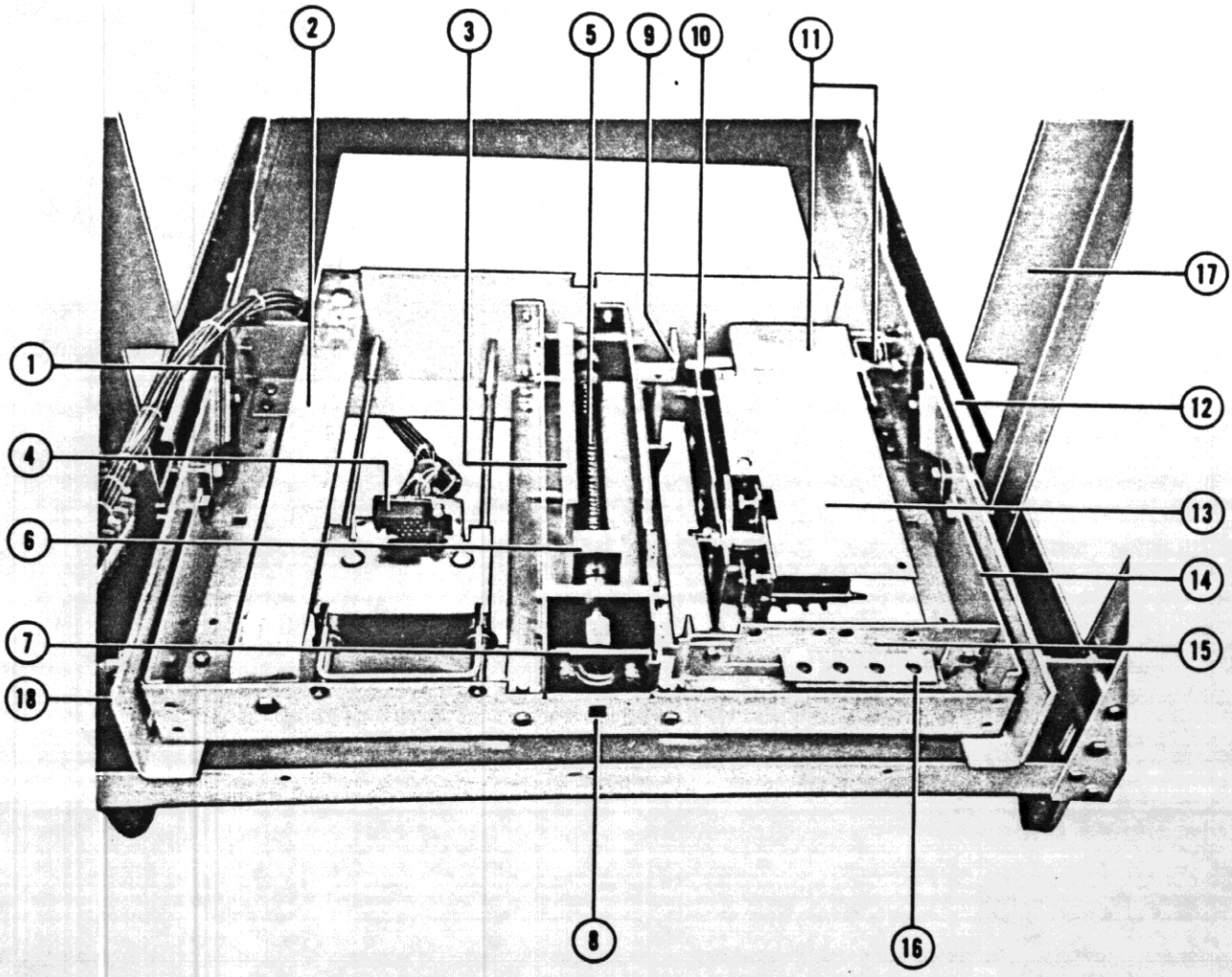
WHILE CHECKS ARE PERFORMED IN THE BREAKER COMPARTMENT, CARE MUST BE EXERCISED TO MAKE CERTAIN THAT PRIMARY CIRCUIT IS NOT ENERGIZED.

a. Make certain that levering nut is all the way up front into Test position



1. Breaker Wheel
2. Ground Contact
3. Secondary Disconnect
4. Close Floor Tripper
5. Levering Latch
6. Trip Floor Tripper
7. Code Plates
8. MOC Operator
9. TOC Operator

Fig. 4.1 *VCP-W Breaker Showing Interface Components*



1. Extension Rail Interlock
2. Ground Contact
3. Bkr. Position/Levering Interlock
4. Secondary Disconnect
5. Levering Screw
6. Levering Nut
7. Levering Socket Engagement Interlock (Slider)
8. Breaker Connected Position Indicator Opening
9. Breaker Contact Status Interlock
10. MOC Operator
11. TOC Operator & Switch
12. Shutter Operator (Manual)
13. MOC Switch Cover
14. Extension Rail Guide
15. Code Plate Mounting Bracket
16. Padlock Openings
17. Picture Frame
18. Left Fixed Rail

Fig. 4.2 *VC-W Switchgear Breaker Compartment*

b. Engage extension rails with the fixed rails.

c. Load the breaker on extension rails carefully.

d. Push the breaker into the compartment Test position as confirmed by a crisp metalic sound of the breaker levering latch engaging the levering nut. Remove the extension rails.

e. Pull secondary disconnect cage forward as far as possible to engage with breaker secondaries. As soon as control power is available, the motor will start charging the closing springs.

f. Close and trip the Breaker several times to verify crisp closing and tripping operations.

Note: If control power is not available in the Breaker compartment, electrical operations check may be performed outside on extension rails or on the floor with test cabinet or test jumper.

4.9 Breaker/Compartment Interface Check. Check for correct operation of the following interlocks.

(a) To trip the breaker (if it is closed) as levering crank is engaged to move the breaker to or from the Test position.

(b) To prevent engaging the levering crank and moving the breaker from Connected position unless the breaker is open.

(c) To trip, close, and trip the breaker if the breaker is closed and the springs are charged, as it is moved from Test position to extension rails or from extension rails to Test position.

(d) To prevent the breaker from latching into the Test position unless matching code plates are on the breaker and in the enclosure.

(e) To prevent breaker from being withdrawn from enclosure if the extension rails are not in position.

(f) To prevent the breaker from closing between the Connected and Test positions.

(g) To prevent the breaker from closing automatically when moved from Test to Connected position.

And correct operation of:

(h) The MOC switches in test and connected position as the mechanism operates to open and close the breaker.

(i) TOC switch by the movement of the breaker to Connected position.

(j) Primary Stabs Isolating Shutter without any interference.

As Below:

- Engage the levering-in handle. The breaker shall automatically trip and MOC switches shall operate. (If the breaker compartment is equipped with MOC switches that are required to operate in Test position.

- Lever the breaker towards Connected position. As it approaches Connected position, shutters shall open freely. Breaker's movement into Connected position is indicated by red flag in front of the levering device. TOC switch shall operate. Remove the levering crank.

- Close the breaker. MOC switches shall operate and the closing springs shall become charged.

- Attempt to engage the levering crank. The slider cannot be pushed far enough to be able to engage levering crank. Trip the breaker and lever it out approximately halfway towards Test position.

- Attempt to close the breaker by pushing the "push to close" button on the breaker. The breaker shall operate "trip free." Lever the breaker into Test position. Close the breaker and charge the closing springs.

- Remove the extension rails. Disengage the levering latch by lifting the handle on the breaker and try to pull the breaker out. The breaker shall not move out more than two inches beyond Test position. Push the breaker to Test position. Add extension rails. Disengage the levering latch again and pull the breaker out. The breaker shall trip, close, and trip as it comes out on the extention rails from Test position.

  Correct operation indicates that the breaker is ready for installation.

  CAUTION

  BEFORE ENERGIZING THE PRIMARY CIRCUIT MAKE CERTAIN THAT ALL DOORS ARE CLOSED.

SECTION 5 - DESCRIPTION AND OPERATION

Westinghouse type VCP-W breakers are horizontal draw out vacuum circuit breakers. They are designed for use in VC-W Metal-Clad switchgear compartments. Most ratings can be stacked two high in a vertical section which results in considerable savings in floor space. They use vacuum interrupters to close and open the primary circuit. The mechanism is front mounted spring stored energy type which not only aids personnel safety but also provides ease of inspection and accessibility for servicing. The same basic mechanism is used for all ratings. Thus a minimum investment in spare parts is required. Due to the inherent long life characteristics of the vacuum interrupters and a highly reliable spring stored energy type mechanism, type VCP-W circuit breakers provide long trouble free service with minimum maintenance.

5.1 INTERRUPTER ASSEMBLY

The vacuum interrupter is mounted vertically and is supported from the fixed stem clamped to the top conductor. Current transfer from the fixed and moving stems of the interrupter are through a unique Westinghouse patented clamped joint. This design not only eliminates any need for lubrication and maintenance as required in typical sliding joints but also assures a reliable low resistance joint. Multiple finger type primary disconnecting contacts at the ends of the top and bottom conductors provide means for connecting and disconnecting the breaker to the primary stabs in the switchgear compartment.

A vacuum interrupter erosion indicator is located on the moving stem of the interrupter. It is visible when breaker is withdrawn and viewed from the rear of the breaker.

5.1.1 VACUUM INTERRUPTER

The Type VCP-W breaker for VC-W Metal-Clad switchgear utilizes vacuum interrupters for interruption and switching functions. Vacuum interruption offers the advantages of enclosed interrupters, small size and weight, short interrupting time, long life, reduced maintenance and environmental compatibility (low noise, no arc by-products, and minimum mechanical shock).

Arc interruption is simple and fast. In the closed position, current flows thru the interrupter. When the contacts are opened, an arc is drawn between the contact surfaces. It is rapidly moved around the slotted contact surfaces by self-induced magnetic effects which prevent gross contact erosion and the formation of hot spots on the surfaces. The arc burns in an ionized metal vapor which continually leaves the contact area and condenses on the surrounding metal shield.

At current zero the arc extinguishes; vapor production ceases. Very rapid dispersion, cooling, recombination, and deionization of the metal vapor plasma together with the fast condensation of metal vapor products cause the vacuum to be quickly restored. Hence the opened contacts withstand the transient recovery voltage.

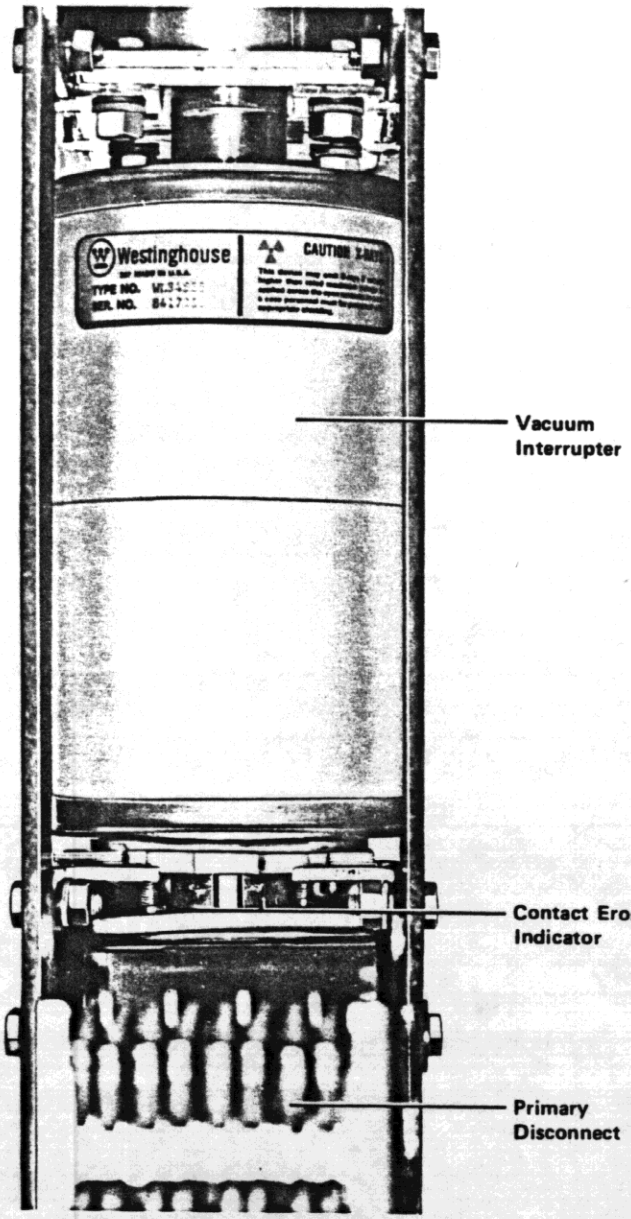


Fig. 5.1 *Vacuum Interrupter Showing Contact Erosion Indicator*

5.1.2 CONTACT EROSION INDICATOR

The purpose of the Contact Erosion Indicator is to determine the erosion of the contacts. When contact erosion reaches 1/8 inch, the interrupter assembly must be replaced. The contact erosion indicator is a mark located on the moving stem of the interrupter. See Fig. 5.1.

In order to determine if the contacts have eroded to the extent that the interrupter must be replaced, close the breaker and observe the erosion mark placed on each vacuum interrupter moving stem from the rear. If the mark on the vacuum interrupter stem is visible, the interrupter is ok. If the mark is no longer visible, the interrupter assembly must be replaced.

5.1.3 WIPE AND STROKE

Wipe is a measure of (1) force to hold vacuum interrupter contacts closed and (2) energy to hammer the contacts open with sufficient speed for safe and clean interruption.

Stroke is the gap between fixed and moving contacts of vacuum interrupter with the breaker open.

Circuit breaker mechanism provides fixed amount of motion to the operating rods. First portion of the motion is used to close the contacts (i.e. stroke) and the remainder is used to further compress preloaded spring. This additional compression is called wipe. Wipe and stroke are thus related to each other. As the stroke increases due to erosion of contacts, the wipe decreases. Great deal of effort and ingenuity has been spent in design of Type VCP-W breakers in order to eliminate any need for field adjustment of wipe or stroke. Thus, there is no provision for adjustments. Type VCP-W breakers are designed to operate satisfactorily with wipe and stroke ranges given in table below:

	OPERATING RANGE INCHES	
BREAKER RATING	WIPE	STROKE
150VCPW500/1200 Amp	15/16 to 1/2	11/32 to 9/16
50VCPW250/1200 Amp	11/16 to 1/4	"
150VCPW250/1200 Amp	"	"
All Remaining Ratings	11/16 to 1/4	7/16 to 11/16

5.1.4 PHASE BARRIERS

Interphase barriers on all VCP-W breakers are flat sheets of insulation attached to the breaker. See Figure 3.1. All VCP-W breakers have two barrier sheets; one on each side. Some breakers, depending on rating, have two additional barrier sheets between the pole units.

CAUTION: The breaker should not be placed in its compartment unless the interphase barrier sheets are in place.

5.2 STORED ENERGY MECHANISM

The spring stored energy operating mechanism is arranged vertically in the front of the breaker. It includes all the elements for storing the energy, closing and tripping of the breaker, manual and electrical controls, and interlocks. Manual controls are all in the front and readily accessible. The vacuum interrupter assemblies are mounted on insulators on the rear of the mechanism assembly. Motion to close and open the interrupter contacts is provided thru operating rods connecting the mechanism pole shaft to the bell cranks of the interrupter assemblies.

The mechanism is mechanically trip free. Normal operation is to charge the closing spring electrically by means of the spring charging motor and then to close the breaker electrically by energizing the spring release coil. Tripping is accomplished by energizing the trip coil. For maintenance purposes the closing springs can be charged manually and the breaker can be closed and tripped by pushing the Push to Close button and the Push to Open button on the front panel.

CAUTION: WHEN CONTROL POWER IS NOT AVAILABLE FOR CLOSING, IT MAY ALSO NOT BE AVAILABLE FOR TRIPPING. AN EVALUATION OF THE HAZARDS RELATED TO LACK OF TRIPPING POWER MUST BE MADE BY THE OPERATOR BEFORE CLOSING A CIRCUIT BREAKER UNDER THESE CONDITIONS. (PROTECTIVE RELAYS MAY OPERATE TO ENERGIZE THE TRIP CIRCUIT, BUT BREAKER WILL NOT TRIP DUE TO LACK OF TRIPPING POWER.)

5.2.1 OPERATION OF STORED ENERGY MECHANISM

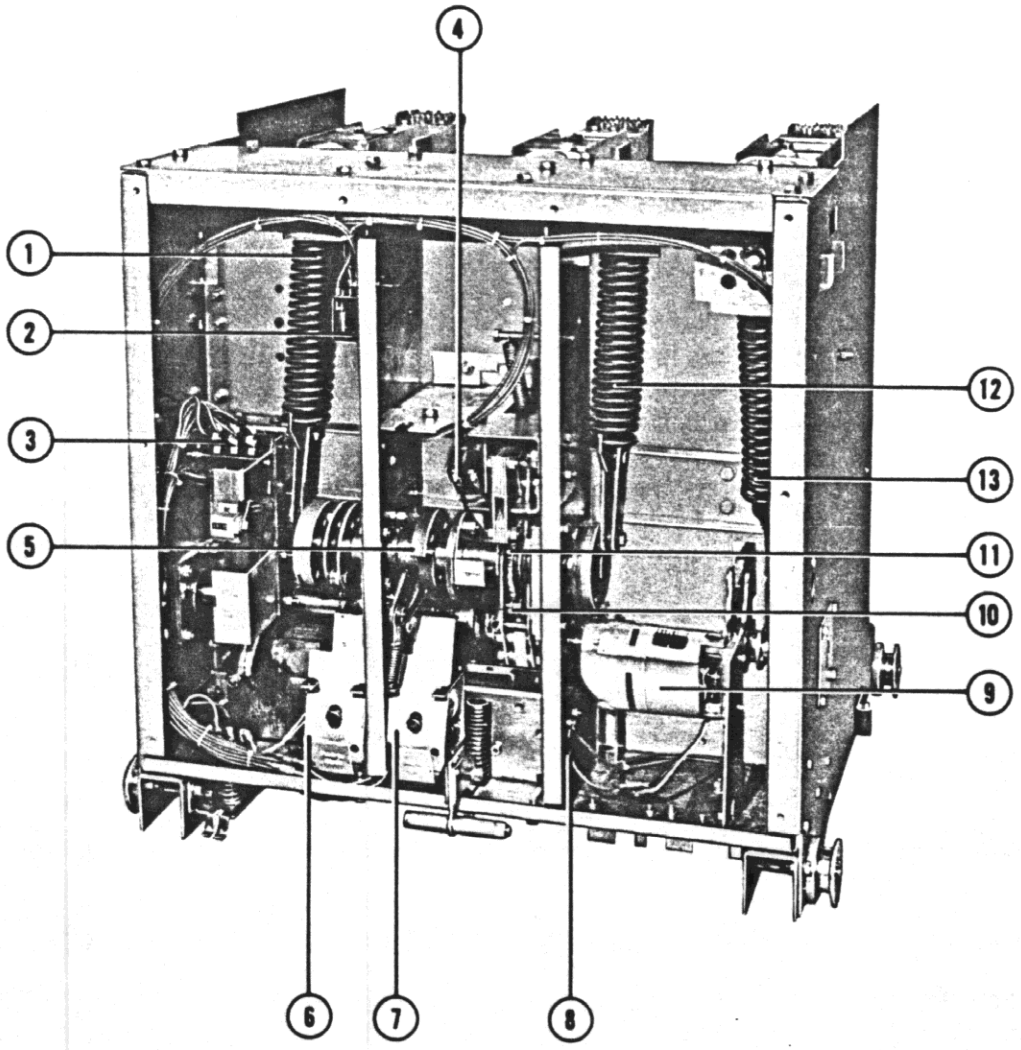
The mechanism stores the closing energy by charging the closing springs and applies the released energy to close the breaker, charge the contact loading springs and reset spring. The mechanism may rest in any one of the four positions shown in Figure 5.3 as follows:

a. Breaker open, closing springs discharged.

b. Breaker open, closing springs charged.

c. Breaker closed, closing springs discharged.

d. Breaker closed, closing springs charged.



1. L.H. Closing Spring
2. Anti-Pump Relay
3. Auxiliary Switch
4. Motor Cutoff Switch
5. Closing Cam
6. Spring Release (Close Coil) Assembly
7. Shunt Trip Assembly
8. Position Switch
9. Charging Motor
10. Charging Pawl
11. Ratchet Wheel
12. R.H. Closing Spring
13. Reset Opening Spring

Fig. 5.2 *VPC-W Breaker – Front Panel Removed*

1. Pole Shaft
2. Main Link
3. Banana Link
4. Trip Latch
5. Shunt Trip Lever
6. Shunt Trip Coil
7. Cam Shaft
8. Closing Cam
9. Operating Rod
10. Main Link Roller
11. Trip Bar "D" Shaft

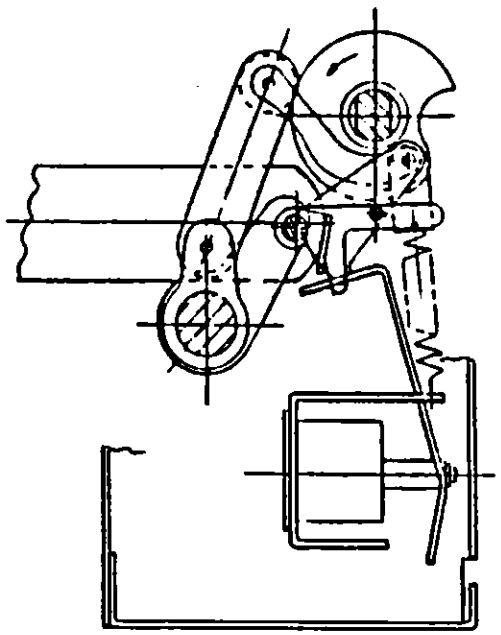


FIG. 5.3a Breaker Open & Closing Spring not Charged

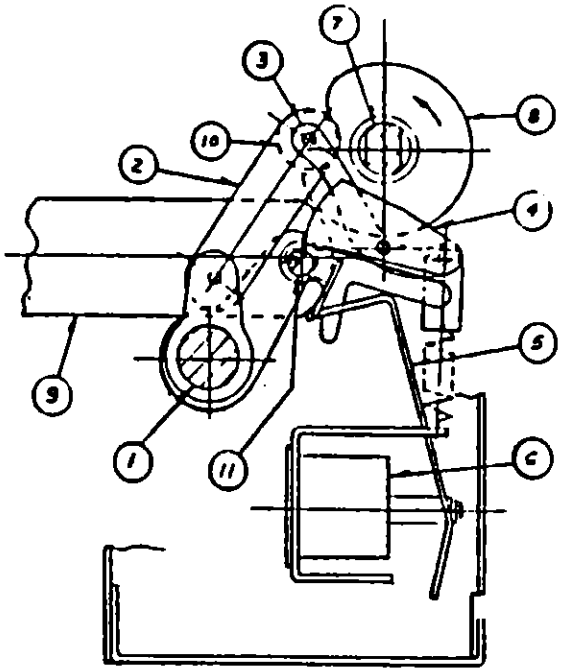


FIG. 5.3b Breaker Open & Closing Spring Charged

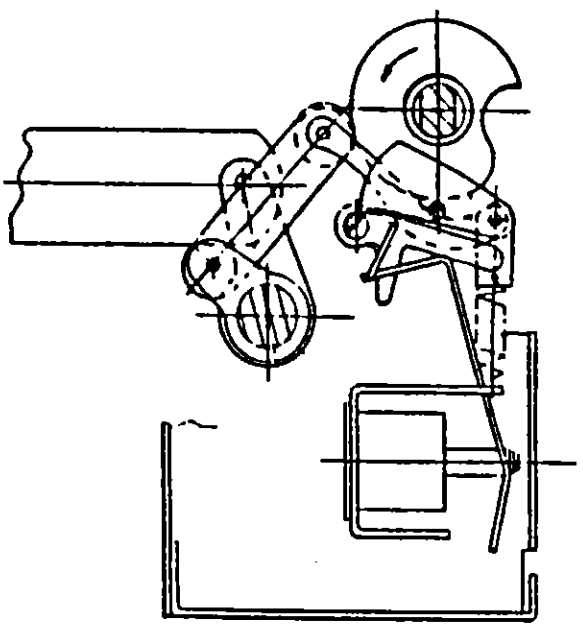


FIG. 5.3c Breaker Closed & Closing Spring not Charged

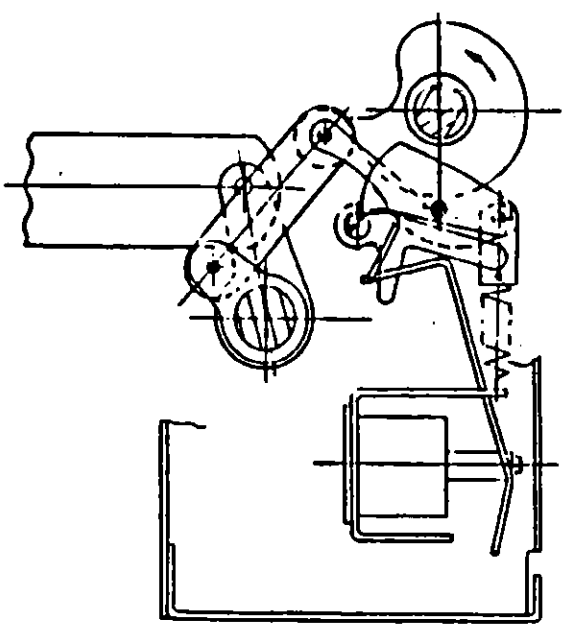
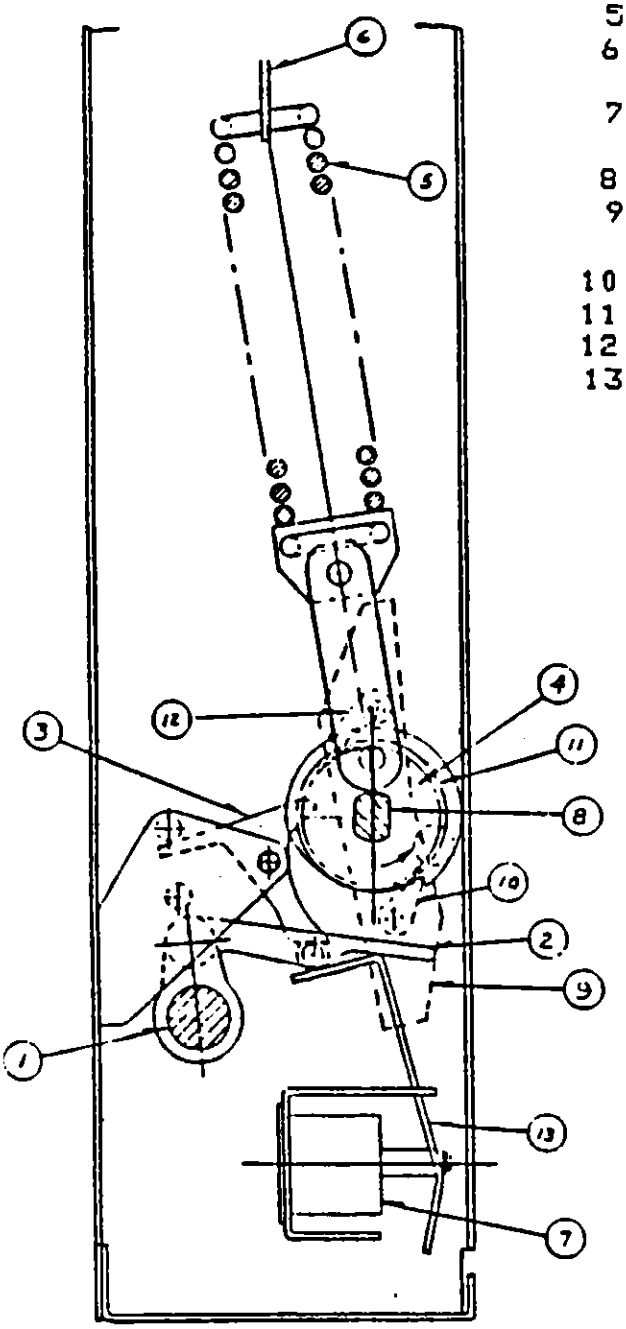
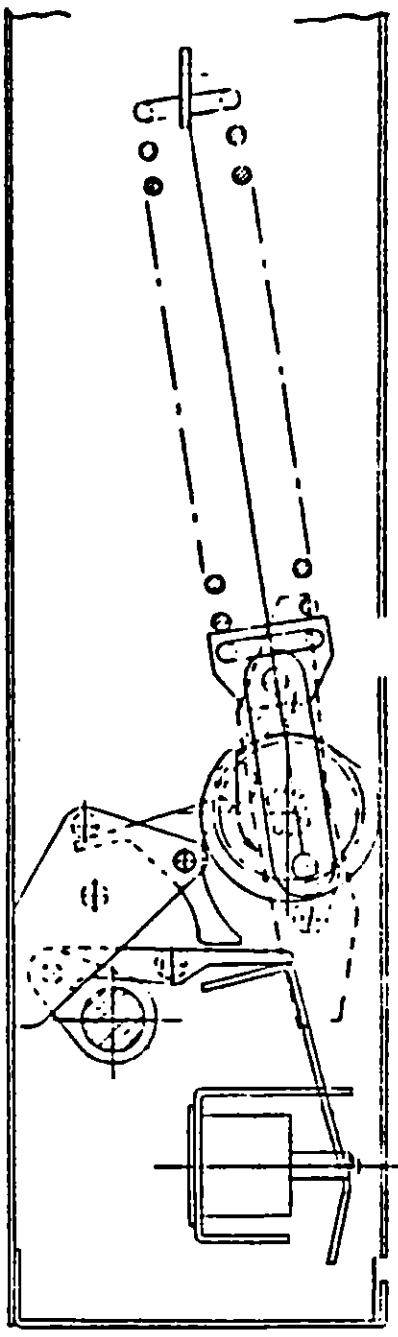


FIG.5.3d Breaker Closed & Closing Spring Charged

FIG. 5.3 Closing Cam & Trip Linkage

1. Pole Shaft
2. Anti Close Interlock
3. Spring Release (Close) Latch
4. Spring Crank
5. Closing Spring
6. Closing Spring Fixed End
7. Spring Release (Close) Coil
8. Cam Shaft
9. Motor Ratchet Lever
10. Drive Pawl
11. Ratchet Wheel
12. Holding Pawl
13. Spring Release (Close) Clapper





Breaker Open, Spring Discharged

Breaker Closed, Springs Charged

FIG. 5.4 Charging Schematic

5.2.2 CLOSING SPRING CHARGING

Figure 5.4 shows schematic views of the spring charging parts of the stored energy mechanism.

The major component of the mechanism is a cam shaft assembly which consists of a hex shaft to which are attached two closing spring cranks (one on each end) and the closing cam, drive plates and a free-wheeling ratchet wheel.

The ratchet wheel is actuated by an oscillating mechanism driven by an electric motor. As the ratchet wheel rotates, it pushes the drive plates which in turn rotate the closing spring cranks and the closing cam with it.

The closing spring cranks have spring ends connected to them which are in turn coupled to the closing springs. As the cranks rotate, the closing springs get charged.

When the closing springs are completely charged, the spring cranks go over dead center and the closing stop roller comes against the spring release latch. The closing springs are now held in fully charged position.

5.2.3 CLOSING OPERATION

Figure 5.3 shows the positions of the closing cam and tripping linkage. Note that in Fig. 5.3a in which the breaker is open and the closing springs are discharged, the trip "D" shaft and the trip latch are in the unlatched position. When the closing springs get fully charged, the trip latch snaps into the fully reset or latched position as in Fig. 5.3b.

The closing springs can be released to close the breaker by moving the spring release latch out of the way. This is done electrically or manually by depressing the spring release lever which turns the spring release latch out of the way of the closing stop roller. The force of the closing springs rotates the cam shaft thru the springs cranks. The closing cam being attached to the cam shaft also rotates causing the breaker to close.

In Figure 5.3c the linkage is shown with the breaker in the closed position before the closing springs have been recharged. Rotation of the closing cam pushes the main link roller so as to rotate the pole shaft of the breaker and close the contacts. This is made possible by the trip "D" shaft preventing the trip latch from turning and thus preventing collapse of main link and remaining link.

Figure 5.3d shows the breaker in the closed position after the closing springs have been recharged. Note that the spring charging rotates closing cam by one half turn with no change in other linkage. The cam for this position of the travel is cylindrical and causes no further movement on the main link roller.

5.2.4 TRIPPING OPERATION

When the trip "D" shaft is turned either by trip button or trip coil, all links return to the original "open" condition shown in Fig. 5.3a.

5.2.5 TRIP FREE OPERATION

When the trip "D" shaft is maintained upset manually, any attempt to close the breaker ends up in discharge of closing springs without any movement of pole shaft or vacuum interrupter stem.

5.3 CONTROL SCHEME

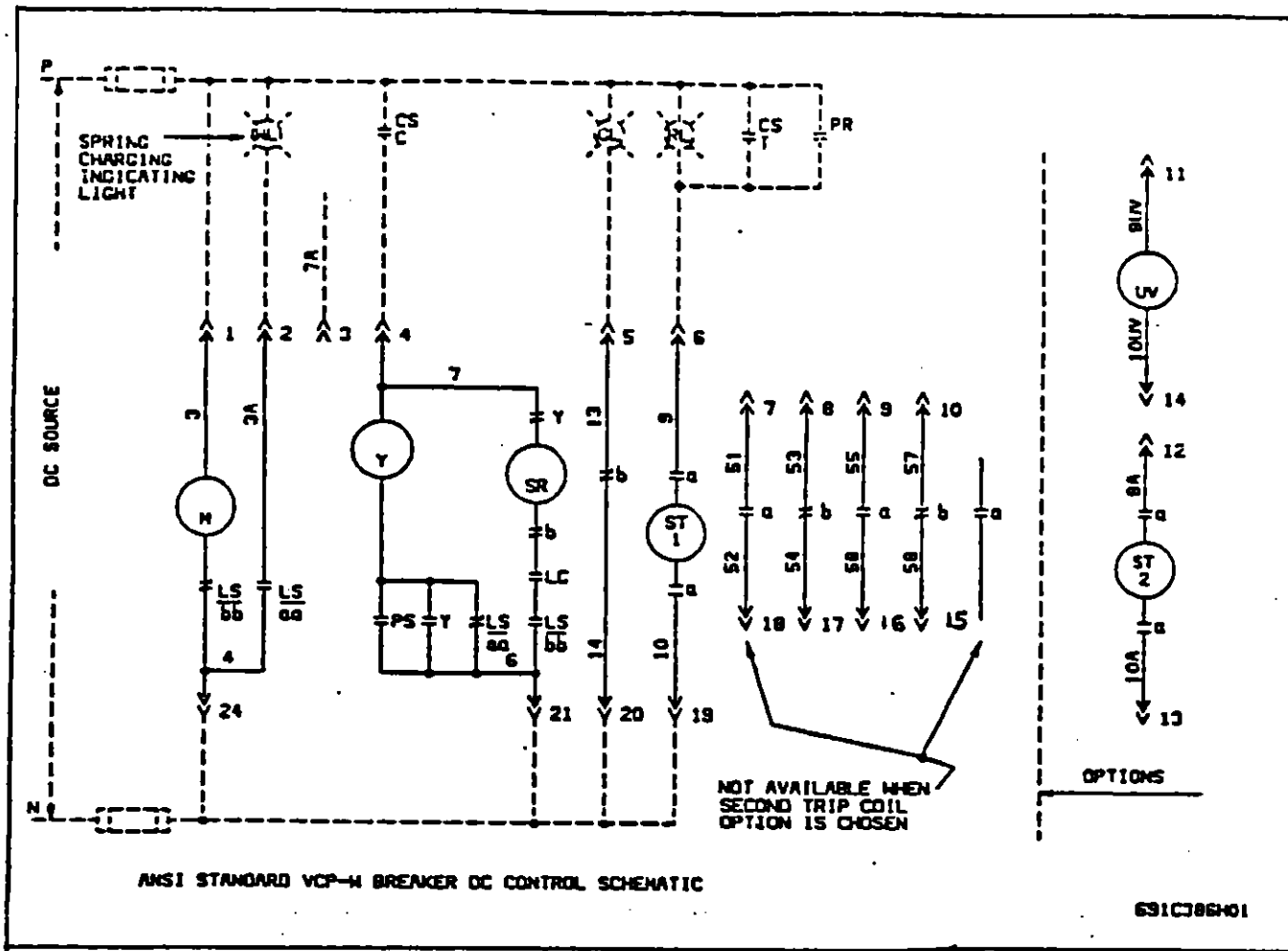
There are two basic control schemes for type VCP-W breakers - one for DC control and one for AC control. See Fig. 5.5. There may be different control voltages or more than one tripping element, but the principal mode of operation is as follows:

As soon as the secondary disconnects make up, the spring charging motor automatically starts charging the closing springs provided the control power is available. When the springs are charged, the motor cut off switch turns the motor off. The breaker may be closed by making up control switch close (CS/C) contact. Automatically upon closing of the breaker, the motor starts charging the closing springs. The breaker may be tripped any time by making up control switch trip (CS/T) contacts. Note the position switch contact in spring release circuit in the scheme. This contact remains made while the breaker is being levered between test and Connected position. Consequently it prevents the breaker from closing automatically even though control switch close contact may have been made while the breaker is levered to Connected position.

5.3.1 SECONDARY DISCONNECTS

The breaker control wiring is arranged for drawout connecting by a 25 point male plug arranged to connect to a corresponding female plug mounted in the switchgear compartment. The breaker plug is mounted on the left side under the bottom pan of the mechanism and it is fixed in that position. The female plug in the compartment is mounted on a movable carriage. See Figures 4.1 and 4.2. The secondary disconnects will engage automatically as the breaker is levered into the Connected position.

To engage the secondary contacts while the breaker is in Test position, pull the carriage all the way towards the front. This will latch the contacts. To disengage, simply push the carriage to the rear.



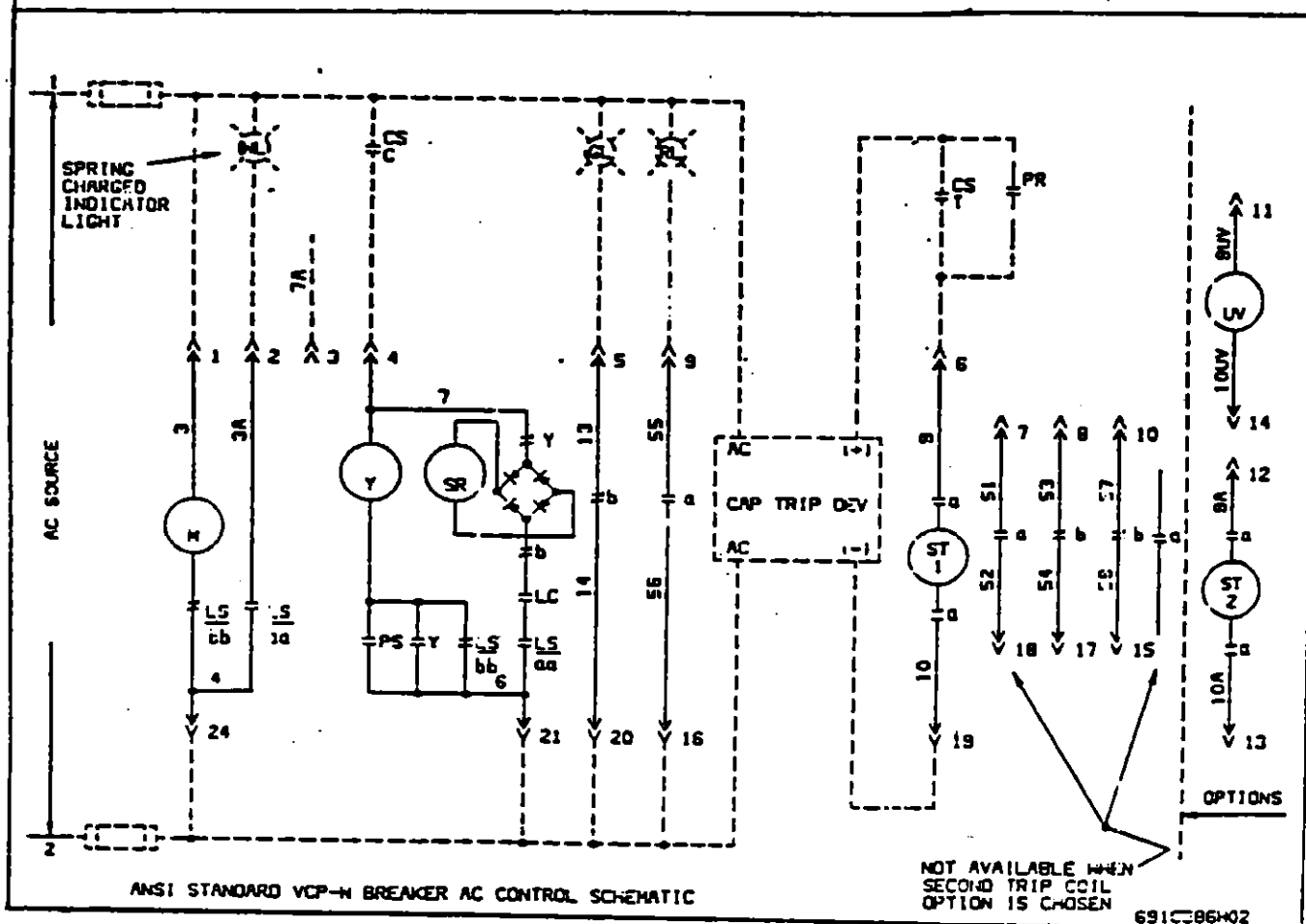


FIG. 5.5 TYPICAL "DC" AND "AC" CONTROL SCHEMES

5.4 INTERLOCKS

All VCP-W breakers are equipped with several interlocks. These interlocks permit proper and safe breaker operation.

CAUTION: CONDITIONS HAZARDOUS TO PERSONNEL, EQUIPMENT AND PROPERTY CAN BE CREATED SHOULD ANY OF THE INTERLOCKS BE BY-PASSED OR MADE INOPERATIVE.

5.4.1 BREAKER - COMPARTMENT CODE PLATES

A set of two code plates on the breaker and two in the compartment form this interlock. It is intended to prevent the insertion of a lower rated breaker into a higher rated compartment. The ratings are based on continuous current, interrupting current, close and latch current and maximum voltage. Breakers with the same or higher ratings in all of the above categories, can be inserted into compartments of equal or lower rating. If the ratings do not agree, the breaker cannot be inserted into the Test position. See Figure 4.1.

NOTE: Code plates do not block out control voltage or scheme in compatibility.

5.4.2 LEVERING INTERLOCK

The purpose of this interlock is to prevent engaging the levering crank when the breaker is closed in the Connected position. A tab on the right hand side of the levering slide cage interferes with the breaker MOC switch operator thus preventing the slide from moving far enough to permit engagement of the levering crank. See Figs. 4.1 and 4.2.

5.4.3 ANTI-CLOSE INTERLOCK

This interlock prevents releasing the closing springs electrically or manually if the breaker is already closed - see Figure 5.4. On a closed breaker, the interlock lever moves toward the rear. In this position, the movement of the spring release clapper does not lift the lever and thus the spring release latch cannot be moved.

5.4.4 FLOOR TRIPPING AND SPRING RELEASE INTERLOCKS

These interlocks are operated by the interaction between the floor tripper rollers Figure 4.1 on the bottom of the breaker and levering device rails. They perform several functions:

- Hold the breaker trip free between the test and connected positions. The latch check switch is also held open thus preventing any electrical close signal from closing the breaker.
- Permit the breaker to be withdrawn in safe mode (breaker open, springs discharged) when moved from the test to the withdrawn position or vice versa.
- Trip the breaker (if closed) before being levered from test position.

The above functions are accomplished by pushing up the trip rollers which in turn rotate the trip "D" shaft or spring release latch.

5.5 MISCELLANEOUS

5.5.1 GROUND CONTACT

The Ground Contact is an assembly of spring loaded fingers to provide a means for grounding the breaker chasis when it is inserted into the switchgear compartment. The ground contact is located on the left side of the breaker under the mechanism bottom pan. An extension of the switchgear ground bus is secured to the compartment floor in such a position to engage the ground contact when the breaker is pushed into the Test position and to remain engaged in all positions of the circuit breaker from the Test position to and including the Connected position. See Figures 4.1 and 4.2.

5.5.2 MOC AND TOC SWITCH OPERATORS

As shown in Figure 4.1, the MOC (Mechanism Operated Control) switch operator is coupled to the pole shaft. In the test and connected positions of the breaker, this operator aligns directly above the MOC switch bell crank lever in the compartment. As the breaker closes, the operator moves down and pushes the bell crank lever to change the MOC switch contact position. Thus, MOC switch contact position can be correlated with the breaker contact position in the same manner as the auxiliary switch mounted in the breaker. (Note that the MOC switch operator is provided on all breakers but MOC switches in the compartment are provided only when specified on the switchgear order).

As shown in Figure 4.1, the TOC (Truck Operated Control) switch operator is mounted in the right foot of the breaker. It operates the TOC switch as breaker moves to the connect position in the switchgear compartment.

5.6 LEVERING DEVICE

The purpose of the Levering Device is to move the circuit breaker between the Test and Connected positions. For VCP-W breakers, the device is a drive screw and drive nut. Although the device is mounted in the switchgear compartment, a brief description here will help understanding the operation. See Figure and Figure .

The levering device consists of a drive screw, a drive nut, two side rails and a sliding cage. In the Test position, the nut is all the way to the front. As the breaker is pushed in, the levering latch snaps on the nut. Turning the crank clockwise while pushing forward advances the breaker toward the Connected position. During this travel, the floor tripper "Trip" roller is lifted up holding the breaker trip free. When the breaker reaches the Connected position, the crank cannot be turned any further. A red flag shown in Figure 4.2 indicates that the breaker is fully engaged.

If the breaker is closed in the Connected position, the slider cannot be pushed forward to permit engagement of the levering crank. After tripping the breaker, the levering crank may be engaged and breaker withdrawn to the Test position by turning the crank counterclockwise. This position is indicated by no further motion of the crank.

The breaker levering latch may be disengaged when the breaker is in the Test position only by lifting the latch release. As the breaker is withdrawn, it comes out with the contacts open and the springs discharged because of the floor tripping and spring release interlocks.

SECTION 6 - MAINTENANCE AND INSPECTION

6.1 When performing any maintenance, be sure about the following:

- o Do not work on a breaker in "Connected" position.
- o Do not work on a breaker with secondary disconnects engaged.
- o Do not work on a breaker with springs charged or contacts closed.
- o Do not defeat any safety interlocks.
- o Do not leave spring charging handle in the socket after charging the closing springs.
- o Do not stand less than one meter away from the breaker when testing for vacuum integrity.

6.2 FREQUENCY OF INSPECTION

Preferably inspect the breaker once a year when operating in a clean, non corrosive environment. For a dusty and corrosive environment, inspection should be performed twice a year. Additionally, it is recommended to inspect the breaker every time it interrupts fault current.

Refer to the table on following page for maintenance and inspection check points.

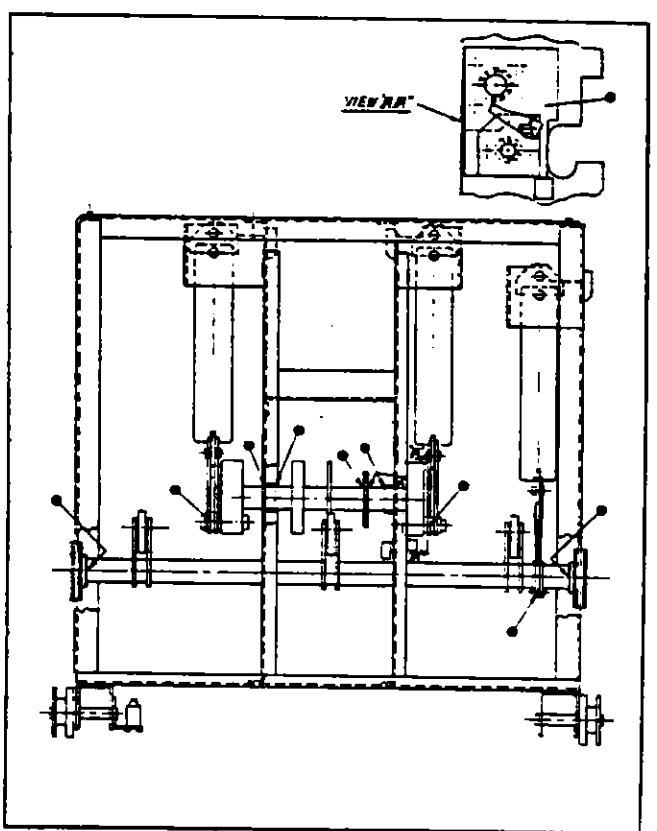


Fig. 6.1 Location Of Lubrication Points

6.3 INSPECTION AND MAINTENANCE

No.	Section	Inspection Item	Criteria	Inspection Method	Corrective Action if Necessary
1	Insulation	Stand off insulators, operating rods, tie-bars and barriers.	No dirt	Visual check	Clean with lint-free cloth.
			No cracking	Visual check	Replace if cracked.
	Insulation Integrity	Main Circuit to Ground.	Withstand 27 kv, 60 Hz for 1 minute.	Hipot Tester	Clean and retest or replace.
		Between Main Circuit Terminals.	Withstand 27 kv, 60 Hz for 1 minute.	Hipot Tester	Clean and retest or replace.
		Control Circuit to Ground.	Withstand 1200V for 1 minute.	Hipot Tester	Clean and retest or replace.
2	Power Elements	Vacuum Interrupters	Contact wear - visibility of mark.	Visual - Close the breaker and look for mark on moving stem.	If mark is not visible, replace interrupter assembly.
			Adequate Vacuum	See Section 6-4	Replace interrupter assembly if vacuum is not adequate.
			Dirt on ceramic body.	Visual check	Clean with dry lint-free cloth.
		Primary Disconnects	No burning or damage	Visual check	Replace if burned or damaged.
3	Control Circuit Parts	Closing and tripping devices including disconnects.	Smooth and correct operation by control power.	Test closing and tripping of the breaker twice.	Replace any defective device - identify per trouble shooting chart.
		Wiring	Securely tied in proper place.	Visual check	Repair or tie as necessary
		Terminals	Tight	Visual check	Tighten or replace if necessary.
		Motor	5000 Operations	Check Counter	Replace brushes.
4	Operating Mechanism	Tightness of hardware.	No loose or missing parts.	Visual and tightening with appropriate tools.	Tighten or reinstate if necessary.
		Dust or foreign matter.	No dust or foreign matter.	Visual check	Clean as necessary.
		Lubrication	Smooth operation and no excessive wear.	Sight and feel.	Lubricate very sparingly with light machine oil.
		Deformation or excessive wear.	No excessive deformation or wear.	Visual and operational.	Remove cause and replace parts.
		Manual operation.	Smooth and crisp operation.	Manual charging, closing and tripping.	Correct per trouble shooting chart if necessary.

6.4 VACUUM INTERRUPTER INTEGRITY TEST

Vacuum interrupters used in type VCP circuit breakers are highly reliable interrupting elements. Satisfactory performance of these devices is dependent upon the integrity of the vacuum in the interrupter and the internal dielectric strength. Both these parameters can be readily checked by a one minute 27 KV AC RMS high potential test. During this test, the following caution must be observed:

CAUTION

APPLYING ABNORMALLY HIGH VOLTAGE ACROSS A PAIR OF CONTACTS IN VACUUM MAY PRODUCE X-RADIATION. THE RADIATION MAY INCREASE WITH THE INCREASE IN VOLTAGE AND/OR DECREASE IN CONTACT SPACING. X-RADIATION PRODUCED DURING THIS TEST WITH RECOMMENDED VOLTAGE AND NORMAL CONTACT SPACING IS EXTREMELY LOW AND WELL BELOW MAXIMUM PERMITTED BY STANDARDS. HOWEVER, AS A PRECAUTIONARY MEASURE AGAINST POSSIBILITY OF APPLICATION OF HIGHER THAN RECOMMENDED VOLTAGE AND/OR BELOW NORMAL CONTACT SPACING, IT IS RECOMMENDED THAT ALL OPERATING PERSONNEL STAND AT LEAST ONE METER AWAY IN FRONT OF THE BREAKER.

With the breaker open and securely resting either on the extended rails or the transport dolly, connect all top primary studs (bars) together and to the high potential machine lead. Connect all bottom studs together and ground them along with the breaker frame and secondary contacts. Start the machine at zero potential, increase to 27 KV AC rms, 60 Hz and maintain for one minute. Successful withstand indicates that all interrupters are satisfactory. If there is a breakdown, the defective interrupter or interrupters should be identified by an individual test and replaced before placing the breaker in service.

After the high potential is removed, discharge any electrical charge that may be retained, particularly from the center shield of vacuum interrupters. To avoid any ambiguity in the AC high potential test due to leakage or displacement (capacitive) current, the test unit should have sufficient volt-ampere capacity. It is recommended that the equipment be capable of delivering 25 milliamperes for one minute.

Although an AC high potential test is recommended, a DC test may be performed if only a DC test unit is available. In this case, 40 kV DC should be applied for one minute, and the test equipment should be capable of delivering 5 milliamperes for one minute to avoid ambiguity due to field emission or leakage currents.

The current delivery capability of 25 mA AC and 5 mA DC apply when all three VI's are tested in parallel. If individual VI's are tested, current capability may be one third of these values.

Note that the indicated high-potential test voltages of 27 KV AC rms and 40 KV DC apply irrespective of whether the breaker voltage rating is 5 kV, 7.5 kV, or 15 kV.

CAUTION

Some DC high potential units, operating as unfiltered halfwave rectifiers, are not suitable for use to test vacuum interrupters because the peak voltage appearing across the interrupters can be substantially greater than the value read on the meter.

6.5 CONTACT EROSION

Since the contacts are contained inside the interrupter, they remain clean and require no maintenance. However, during high current interruptions there may be a minimal amount of erosion from the contact surfaces. Maximum permitted erosion is 1/8 inch. To determine contact erosion, close the breaker and observe the vacuum interrupter moving stem from the rear of the breaker. If mark on each stem is visible, erosion has not reached maximum value thus indicating good health of the interrupter. If the mark is not visible, vacuum interrupter assembly replacement is indicated.

It is extremely unlikely that the contact erosion will reach 1/8 inch during normal lifetime of the breaker. However, the vacuum interrupter assembly must be replaced if it does.

6.6 INSULATION

In VCP-W breakers, insulation maintenance primarily consists of keeping and insulating surfaces clean. This can be done by wiping off all insulating surfaces with a dry lint free cloth or dry paper towel. In case there is any tightly adhering dirt that will not come off by wiping, it can be removed with a mild solvent or distilled water. But be sure that the surfaces are dry before placing the breaker in service. If a solvent is required to cut dirt, use Stoddard's Solvent Westinghouse 5S812CA or commercial equivalent. Secondary control wiring requires inspection for tightness of all connections and damage to insulation.

6.7 INSULATION INTEGRITY CHECK

PRIMARY CIRCUIT:

The integrity of primary insultion may be checked by the AC high potential test. The test voltage depends upon the maximum rated voltge of the breaker. For the breakers rated 4.76 KV, 8.25 KV, and 15 KV, the test voltages are 15 KV, 27 KV and 27 KV RMS, 60 Hz respectively. Conduct the test as follows:

Close the breaker. Connect the high potential lead of the test machine to one of the poles of the breaker. Connect the remaining poles and breaker frame to ground. Start the machine with output potential at zero and increase to the test voltage. Maintain the test voltage for one minute. Repeat for the remaining poles. Successful withstand indicates satisfactory insulation strength of the primary circuit.

If the DC high potential machine is used, make certain that the peak voltage does not exceed the peak of the corresponding AC RMS test voltage.

SECONDARY CIRCUIT:

Remove the motor leads. Connect all points of the secondary disconnect pins with a shooting wire. Connect this wire to the high potential lead of the test machine. Ground the breaker frame. Starting with zero, increase the voltage to 1125 RMS, 60 Hz. Maintain the voltage for one minute. Successful withstand indicates satisfactory insulation strength of the secondary control circuit. Remove the shooting wire and and reconnect the motor leads.

6.8 PRIMARY CIRCUIT RESISTANCE CHECK

Since the main contcts are inside the vacuum chamber they remain clean and require no maintenance at any time. Unlike most typi- cal circuit breaker designs, VCP-W breakers do not have sliding contacts at the moving stem either. Instead they use a highly reliable and unique flexible clamp design that eliminates the need for lubrication and inspection for wear.

If desired, the DC resistnce of the primary circuit may be measured as follows; close the breaker, pass at lest 100 amps DC current through the breaker. With the low resistance instrument, measure resistance across the studs on the breaker side of the disconnects for each pole. The resistance should not exceed 60, 40, and 20 micro-ohms for 1200, 2000 and 3000 amp breakers respectively.

6.9 MECHANISM

Make a careful visual inspection of the mechanism for any loose parts such as bolts, nuts, pins, rings, etc. Check for excessive wear or damage to the breaker components. Operate the breaker several times manually and electrically to make certain the operation is crisp and without any sluggishness.

6.10 LUBRICATION

All parts that require lubrication have been lubricated during the assembly with molybdenum disulphide grease, Westinghouse M No. 53701QB. Over the period of time, this lubricant may be pushed out of the way or degrade. So, proper lubrication at regular intervals is essential for maintaining the reliable performance of the mechanism. Once a year or every 2000 operations (1000 operations for 3000 amp breaker) whichever comes first. The locations shown in figure 6.1 should be lubricated with a drop of light machine oil such as mobil 1.

After lubrication operate the breaker that opening and closing operations are crisp and snappy.

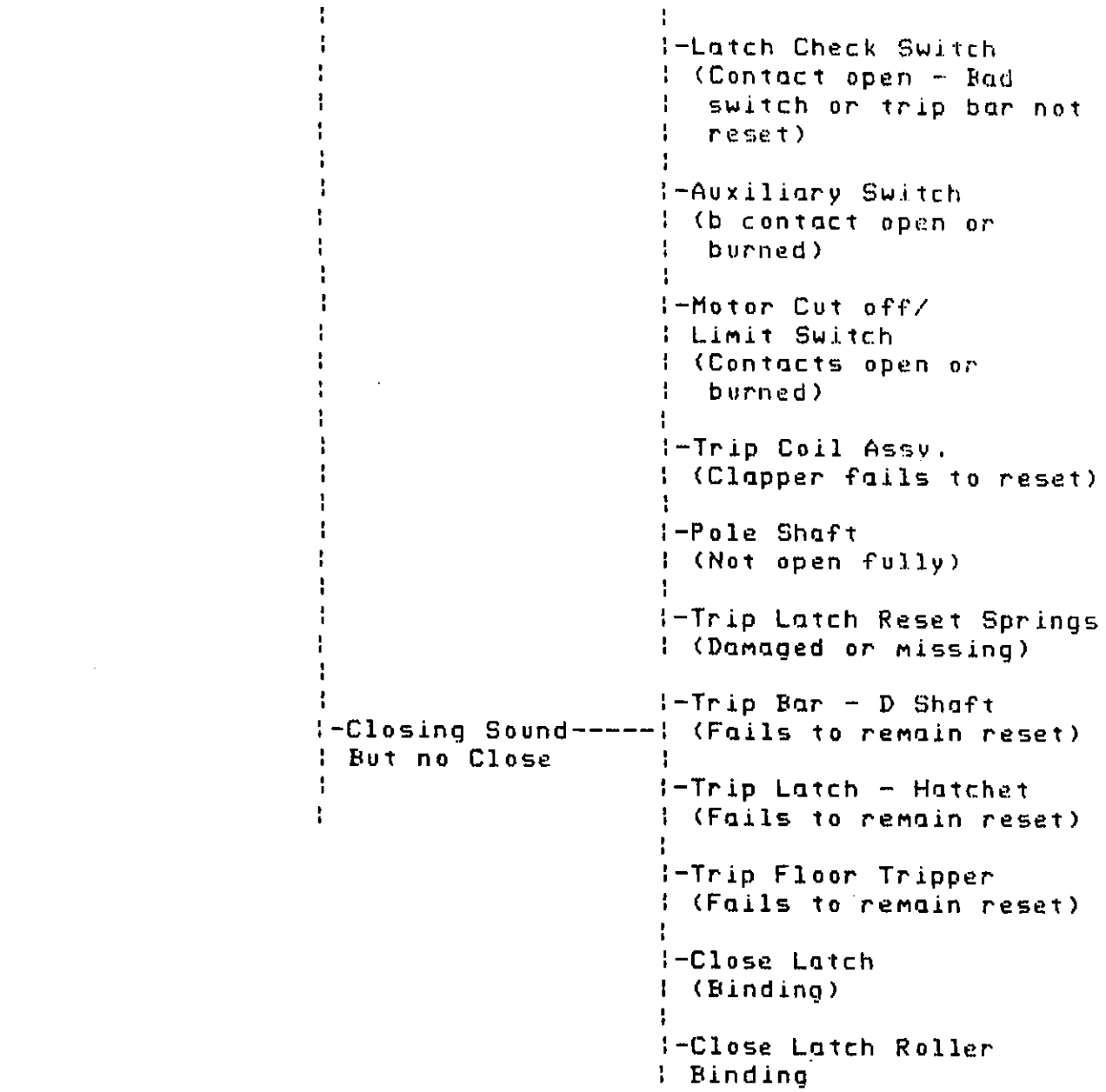
Roller bearings are used on the pole shaft, the cam shaft, the main link and the motor eccentric. These bearings are packed at the factory with a top grade slow oxidizing grease which normally should be effective for many years. They should not be disturbed unless there is definite evidence of sluggishness or dirt, or unless the parts are dismantled for some reason.

- If it becomes necessary to disassemble the mechanism, their bearings and related parts should be thoroughly cleaned off old grease in a good grease solvent. Do not use carbon tetrachloride. They should then be washed in light machine oil until the clean is removed. After the oil has been drawn off, the bearings should be packed with Westinghouse Grease 53701QB or equivalent.

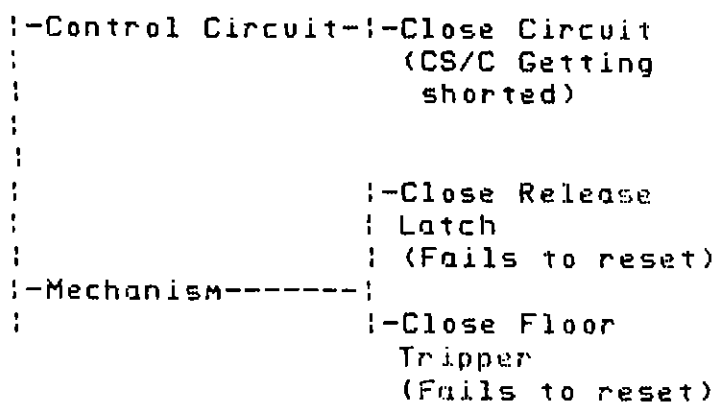
6.11 TROUBLE SHOOTING CHART

FAILS TO CLOSE

- Closing Springs not charged
  - Control Circuit
    - Control Power (Fuse Blown or Switch off)
    - Secondary Disconnects (Pins 1 and or 24 not engaging)
    - Motor Cut-off Switch (Poor or burned contacts. Lever not operational.)
    - Terminals and connectors (Poor or burned contacts)
    - Motor (Brushes worn or commutator segments open)
  - Mechanism
    - Pawls (Slipping or broken)
    - Ratchet Wheel (Teeth worn or broken)
    - Cam Shaft Assy. (Sluggish or jammed)
    - Oscillator - Reset spring off or broken
- Closing Springs Charged but breaker does not close
  - No Closing Sound (Close Coil, does not pick up)
    - Control Power (Fuse blown or switch off)
    - Secondary Disconnects (Pins 4 and or 24 not engaging)
    - Anti Pump Relay (Y relay N.C. contact open or burned)
    - Close Coil (Open or burned)



UNDESIRABLY CLOSES



FAILS TO TRIP

- -No Trip Sound
  - -Control Circuit
    - -Control Power (Fuse blown or switch off)
    - -Secondary Disconnects (Pins 6 and or 19 not engaging)
    - -Auxiliary Switch (a contacts not making poor or burned)
    - -Trip Coil (Burned or open)
    - -Terminals & Connections (Poor or burned or open)
  - -Trip Mechanism
    - -Trip Clapper (Jammed)
    - -Trip Bar, Trip Latch (Jammed)
- -Trip Sound But no trip
  - Trip Mechanism
    - -Pole Shaft (Jammed)
    - -Operating Rod Assembly (Broken or pins out)
  - -Vacuum Interrupter (One or more Welded)

UNDESIRABLY TRIPS

- -Control Circuit
  - -Control Power (CS/T Switch, remains made)
- -Mechanism
  - -Trip Coil Clapper (Not resetting)
  - -Trip Bar or Trip Latch (Poor engagement of mating or worn surfaces)
  - -Trip Bar Reset Spring (Loss of torque)

SECTION 7 - RENEWAL PARTS

GENERAL

In order to minimize production downtime, it is recommended that an adequate quantity of spare parts be carried in stock. The quantity will vary from customer to customer, depnding upon the service severity and continuity requirements. Each customer should develop his own stock level based on operating experience.

The following items in the quantity specified may be used as guide:

7.1 RECOMMENDED RENEWAL PARTS FOR VCP-W CIRCUIT BREAKERS

Description	Qty.
Interrupter Assemblies	
50VCP-W250-1200A - 58 kA	3
50VCP-W250-2000A - 58 kA	3
75VCP-W500-1200A - 66 kA	3
75VCP-W500-2000A - 66 kA	3
150VCP-W500-1200A - 37 kA	3
150VCP-W500-1200A - 58 kA	3
150VCP-W500-1200A - 37 kA	3
150VCP-W500-2000A - 58 kA	3
150VCP-W750-1200A - 58 kA	3
150VCP-W750-2000A - 58 kA	3
1200 Amp. Primary Disconnect	6
2000 Amp. Primary Disconnect	6
Spring Charging Motor	
48V DC	1
125V DC/120V AC	1
250V DC/240V AC	1
Spring Release (Close) Coil	
48V DC	1
125V DC	1
250V DC	1
120V AC	1
240V AC	1
Shunt Trip Coil	
48V DC	1
125V DC	1
250V DC	
Anti-Pump Y Relay	
48V DC	1
125V DC	1
250V DC	1

120V AC	1
240V AC	1
Motor Cut-off Switch Assembly	1
Latch Check Switch	1
Auxiliary Switch	1
Fastener Kit	1

7.2 ORDERING INSTRUCTIONS

- Always specify breaker rating information and shop order number.
- Describe the item, give style number and specify the quantity desired.
- For electrical components, specify voltage.
- State method of shipment desired.
- Send all orders or correspondence to the nearest Westinghouse sales office.

7.3 REPLACEMENT OF COMPONENTS

7.3.1 Location of Components

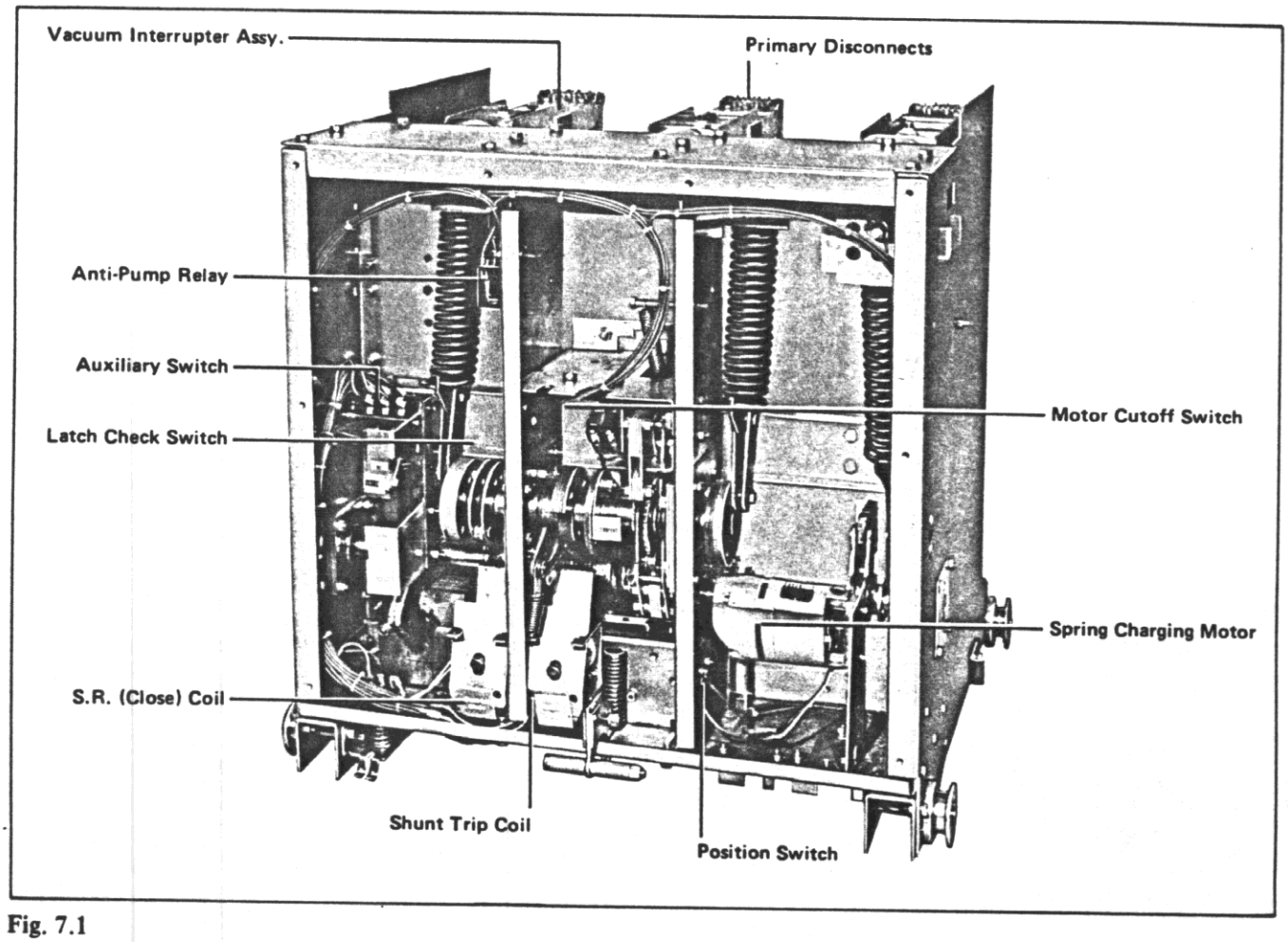


Fig. 7.1

CAUTION: BEFORE ATTEMPTING TO REPLACE ANY COMPONENT, MAKE CERTAIN THAT THE BREAKER IS OPEN, CLOSING SPRINGS DISCHARGED AND CONTROL POWER IS DISCONNECTED. DISASSEMBLY STEPS ARE SHOWN HERE. FOR ASSEMBLY, FOLLOW THE ORDER IN REVERSE.

7.3.2 Replacement of Vacuum Interrupter Assembly

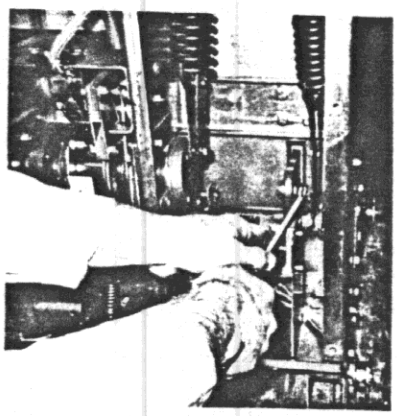


Fig. 7.2 *Remove Pin Clip*

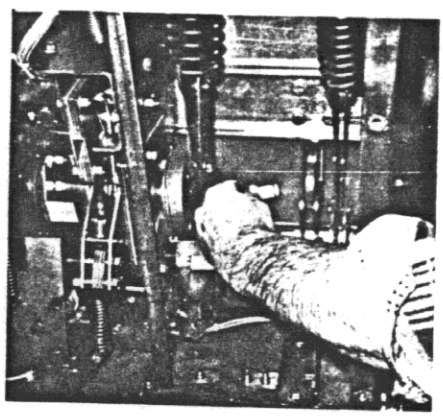


Fig. 7.3 *Remove Pin*

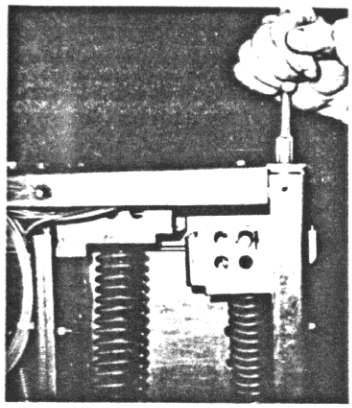


Fig. 7.4 *Remove Top Cover*

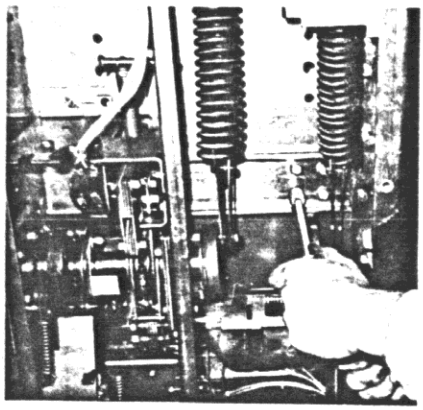


Fig. 7.5 *Remove Bottom Insulator Mounting Bolts*

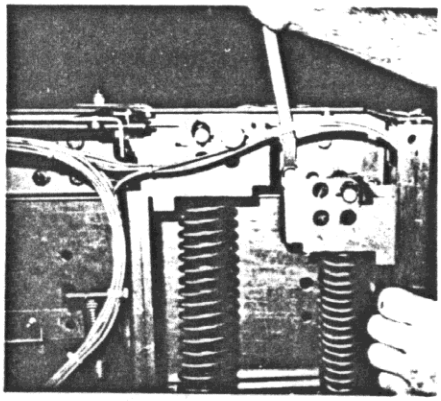


Fig. 7.6 *Support Vacuum Interrupter Assembly at the Insulator. Remove Top Mounting Bolts. Remove Pole Unit Assembly*

7.3.3 Replacement of Primary Disconnects

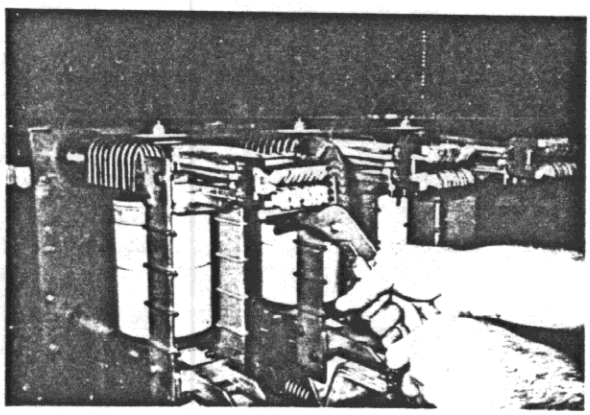


Fig. 7.7 *Remove With the Help of Special Pliers as Shown*

7.3.4 Replacement of Spring Charging Motor

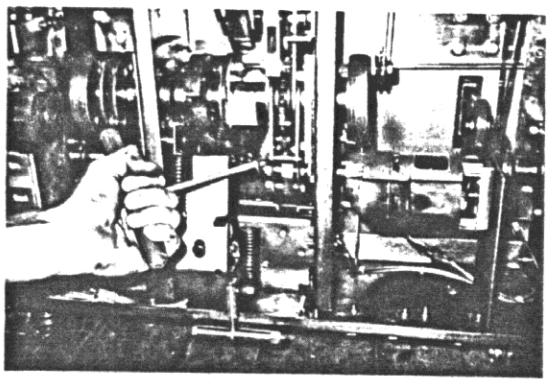


Fig. 7.8 *Remove One End of Oscillator Reset Spring*

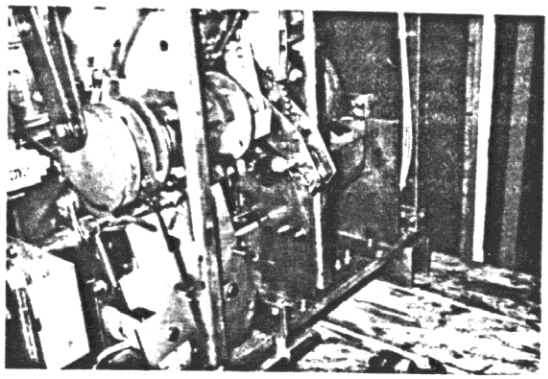


Fig. 7.9 *Lift Oscillator Assembly as Shown*

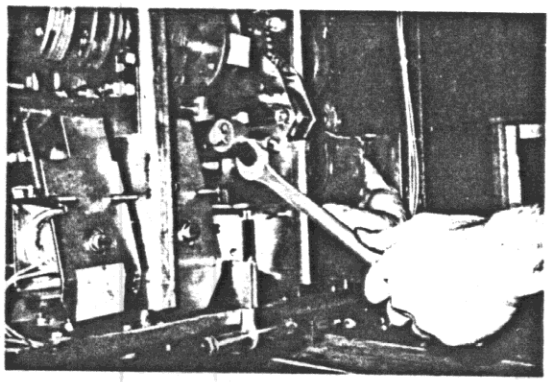


Fig. 7.10 *Turn Eccentric Counter Clockwise and Remove It*

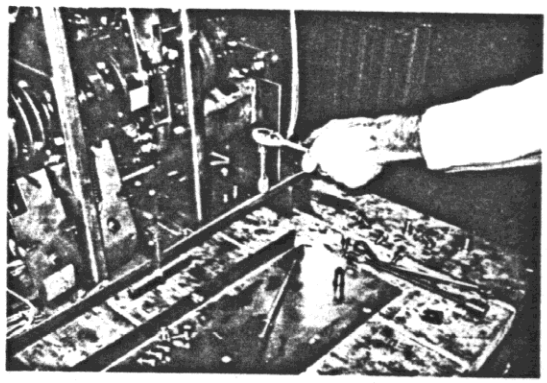


Fig. 7.11 *Disconnect Motor Lead Terminals. Remove Motor Mounting Bracket Bolts.*

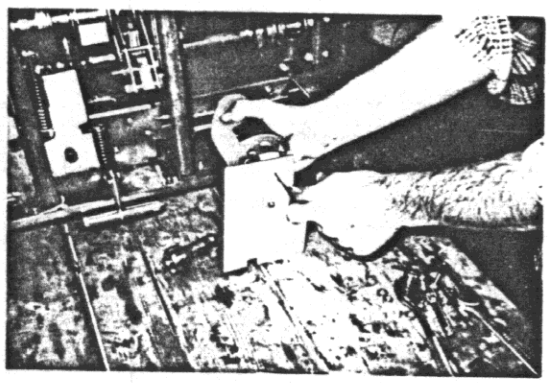


Fig. 7.12 *Remove Motor Mounting Screws*

7.3.5 Replacement of Auxiliary Switch

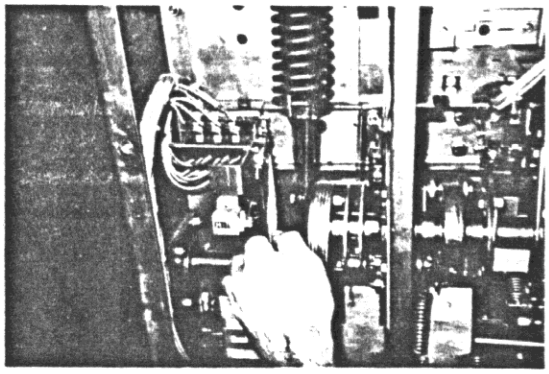


Fig. 7.13 *Remove E Ring Connecting Link to Switch Pin. Remove Wire Link to Operation Counter.*

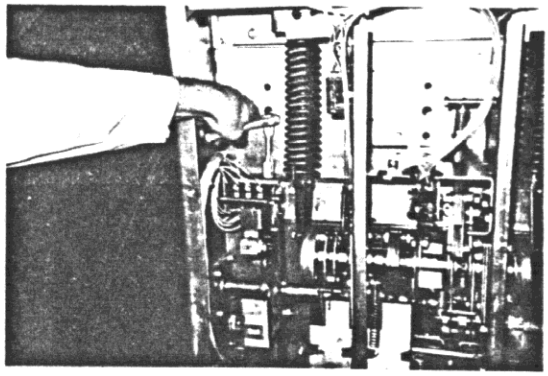


Fig. 7.14 *Remove Two Mounting Bolts for Switch Assembly. Remove Two Screws Fastening Switch to the Bracket.*

7.3.6 Replacement of Latch Check and Position Switches

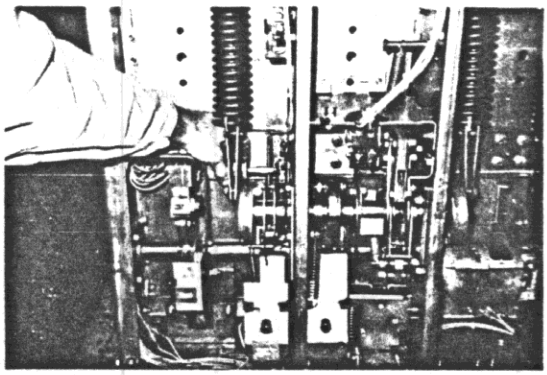


Fig. 7.15 *Remove Two Mounting Screws. Disconnect Terminals. For Position Switch Location See Fig. 7.1.*

7.3.7 Replacement of Shunt Trip and Spring Release (Close) Coils

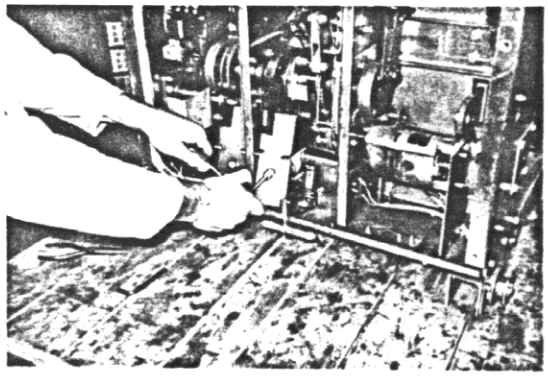


Fig. 7.16 *Remove Mounting Screw. Disconnect Coil Lead Terminals. Pull Out Shunt Trip Coil From Right Side, Spring Release (Close) Coil From Left Side.*

7.3.8 Replacement of Motor Cutoff Switch

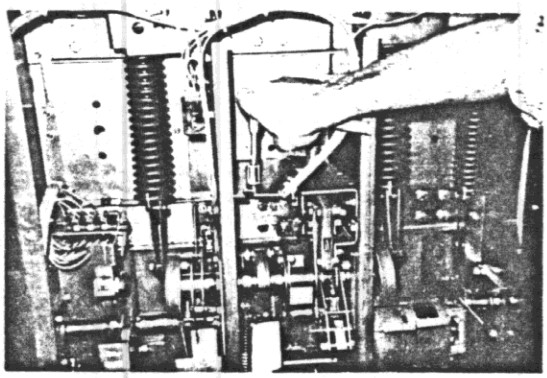


Fig. 7.17 *Remove Two Mounting Screws. Disconnect Leads.*

7.3.9 Replacement of Anti-Pump Relay

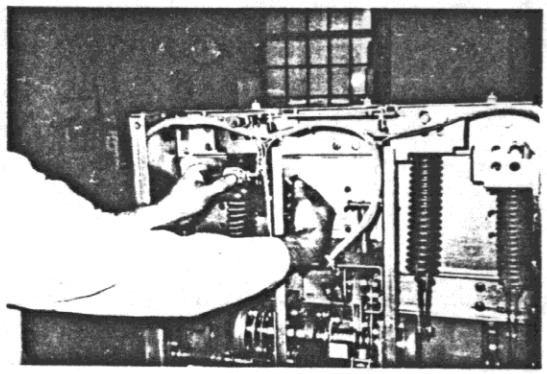


Fig. 7.18 *Disconnect Terminals. Remove Two Mounting Screws.*

Westinghouse Electric Corporation
Switchgear Division, East Pittsburgh, Pa. 15112

Printed in U.S.A.